FOOD PROCESSING GUIDE

Steven C Seideman
Extension Food Processing Specialist
Institute of Food Science & Engineering
2650 North Young Avenue
University of Arkansas
Fayetteville, AR 72704

Last Updated; October 17, 2006
FOREWORD

This publication was prepared by Steve Seideman, Extension Food Processing Specialist of the Institute of Food Science & Engineering at the University of Arkansas. This guide is designed to provide fundamental information to entrepreneurs, small food processing businesses and individuals in large food companies who want to learn more about food processing. Included in this guide is information on basic business considerations, planning a marketing strategy, processing, food science, labeling, and regulations. Some of the materials for this guide were drawn from outside sources and the original authors are identified with this material. The author of this manual expresses his appreciation to these authors for allowing the use their material.

The Institute of Food Science & Engineering is part of the Division of Agriculture, University of Arkansas. It is composed of interactive technology centers that provide research and extension support for value-added processing of agricultural products in Arkansas. These centers provide an interdisciplinary focus for programs and an information pipeline to the food processing industries of Arkansas. Programs encompass harvesting, handling, processing, packaging and evaluation of food products.

The Institute's ultimate mission is to provide technical advances in food processing and packaging that foster safe, efficient, environmentally responsible processing systems. This mission relates to the public's need for safe, affordable nutritious food products and the need for economic growth in the state's agricultural and processing sector.

The information in this guide is designed as a starting point. Since new product development is both a science and an art and success of a new product is largely dependent upon timing, perseverance and luck, there is no guarantee that following the fundamental information contained in this guide will ultimately lead to success. However, by following the principles set forth in this guide, your probability of success will be greatly improved.

Further information on food processing can be obtained by going to the following websites:
http://www.uark.edu/ua/foodpro - This website has additional information on food processing and also lists the services that the Institute provides and sources of valuable information needed to enter the food processing business.
http://www.uark.edu/ua/foodedu - This website contains numerous modules of fundamental food processing lectures.

There are over 230 food processing plants in Arkansas. Food manufacturing in Arkansas is an $11b/year business representing 25% of all manufacturing in the state. Food manufacturing is strong in Arkansas for several reasons. The first is that the labor pool is good, hard-working and relatively inexpensive compared to some northern states. Second, Arkansas is a “Right to Work” state meaning that people who work in these processing facilities do not have to join a labor union. Third is the fact that there is an excellent interstate road system that crisscrosses the state. Fourth is the fact that there are plenty of commodities to process. And fifth is that Arkansas is centrally located in United States with easy access to any market in any direction.
ACKNOWLEDGMENTS

This guide was compiled from a variety of sources and I would like to express appreciation to the authors of these works for allowing me to use their materials. Appreciation is also expressed to those people who lent their expertise in reviewing the information presented.

This guide was started with material from the book entitled “Starting a Food Processing Business” by Luke Howard and Pam Brady. Some sections of that book have been used in this guide. In addition, some sections of this guide have been adapted from fact-sheets and other materials. Acknowledgements are given to the original authors at the beginning of these sections.

The purpose of this guide is to put information and contacts at the fingertips of Arkansas food processors and manufacturers. We hope you will use this as a guide in your efforts to promote quality and value-added food products in the state of Arkansas.

The names of companies, laboratories, government agencies and food processing companies have been compiled from several sources believed to be reliable. However, we assume no liability for errors or omissions. Nor do we endorse one company over another, or necessarily recommend the use of these companies. Please note that the companies and associations listed herein are for the convenience of the guide users. The University of Arkansas does not recommend any specific company and is not held liable for any company.

Links to commercial sites are provided for information and convenience only. Inclusion of sites does not imply University of Arkansas Division of Agriculture's approval of their product or service to the exclusion of others that may be similar, nor does it guarantee or warrant the standard of the products or service offered. The mention of any commercial product in this web site does not imply its endorsement by the University of Arkansas over other products not named, nor does the omission imply that they are not satisfactory.
<table>
<thead>
<tr>
<th>Chapter#</th>
<th>Chapter Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>1) Starting a Food Business – An Overview</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>B. The Product</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>C. The Business Plan</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>D. Manufacturing / Operations / Regulations</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>E. Label Design and Packaging</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>F. Going to Market</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>G. Assistance</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>H. Checklist for Entrepreneurs</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2) Developing Food Products for a Changing Marketplace</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>B. Getting market Share</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>C. Entrepreneurship</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>D. The Product</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>E. Understanding the Business</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>F. Food Channels / Distribution</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>G. Value Added Foods</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>H. Food Product Development</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>I. Innovation as a Competitive Strategy</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>3) Business Considerations/ Business Plans / Marketing</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>B. Business Blueprints</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>C. Business Planning/ Plans</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>D. Organizing Your Business</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>E. Marketing your Product</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>F. Guerrilla Marketing</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>G. Pricing your Product</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>H. New Product Presentations</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>4) Principles of Food Preservation and Processing/ Food Microbiology and Safety</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>B. Principles of Food Preservation and Processing</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>C. Microbiology</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>D. Food Preservation</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>E. Pathogens</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>F. Shelf Life and Stability</td>
<td>103</td>
<td></td>
</tr>
<tr>
<td>G. Code Dating</td>
<td>104</td>
<td></td>
</tr>
<tr>
<td>H. Recalls</td>
<td>104</td>
<td></td>
</tr>
<tr>
<td>5) Organization/ Operations/ Management</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>B. Organization of a Food Company</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>C. Operations of a Food Processing Plant</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>D. Copacking of Food Products</td>
<td>128</td>
<td></td>
</tr>
<tr>
<td>E. Crisis Management</td>
<td>131</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6) Food Processing and Equipment</th>
<th>141</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Introduction</td>
<td>141</td>
</tr>
<tr>
<td>B. Food Processing</td>
<td>141</td>
</tr>
<tr>
<td>C. Food Processing Equipment</td>
<td>145</td>
</tr>
<tr>
<td>D. Finding Food Equipment</td>
<td>147</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7) Food Product Labeling, Additives and Ingredients and Packaging</th>
<th>148</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Introduction</td>
<td>148</td>
</tr>
<tr>
<td>B. The Basics of Food Labeling</td>
<td>148</td>
</tr>
<tr>
<td>C. Nutritional Labeling</td>
<td>152</td>
</tr>
<tr>
<td>D. Other Label Components</td>
<td>154</td>
</tr>
<tr>
<td>E. Food Ingredients, Additives and GRAS</td>
<td>158</td>
</tr>
<tr>
<td>F. Food Packaging</td>
<td>165</td>
</tr>
<tr>
<td>G. Label Design and Packaging</td>
<td>172</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8) Food Processing Regulations</th>
<th>173</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Introduction</td>
<td>173</td>
</tr>
<tr>
<td>B. History of Food Regulations and Major Legislation</td>
<td>173</td>
</tr>
<tr>
<td>C. Food Processing Regulations- General</td>
<td>174</td>
</tr>
<tr>
<td>D. FDA Regulations</td>
<td>175</td>
</tr>
<tr>
<td>E. USDA Regulations</td>
<td>176</td>
</tr>
<tr>
<td>F. Ingredient Uses in Food Products</td>
<td>177</td>
</tr>
<tr>
<td>G. Local Contacts</td>
<td>177</td>
</tr>
</tbody>
</table>
1. Starting A Food Business- An Overview

A) Introduction:
This chapter is a general overview of the field of starting a food business. The road to developing a successful new food product can be somewhat confusing and long. This guide can be used to make the journey easier to understand. This first chapter goes through some of the key things one must do to start the journey and is written to help you understand the “big picture”. The details of the components of this first chapter are discussed in subsequent chapters in greater detail.

B) The Product:
The first step in starting a food processing business is to have a food product concept or idea. The concept or idea can be either a particular product or a new and innovative processing method. The idea or concept doesn’t have to be perfect to begin with. You just need to start on something. Your original idea or concept will probably change several times as you develop your business plan and get to know the business. So just start with any idea and move forward.
Your idea could put more people to work and you may be the kind of person this country needs to compete in world markets and maintain its standard of living. Your idea may be the cutting edge of the future. In general, food products with just a different flavor do not have a high success rate because they can be easily matched by spice companies. Anyone can go into a store, buy your product and match the flavor within a matter of weeks. On the other hand, the restaurant trade is always looking for food products that they can just heat and serve. They may have an interest in a new food item. Just start with a concept or idea knowing it does not have to be the ultimate idea. Remember that ideas are “a dime a dozen”. This means that your idea for a new product is not the key to success. I agree you have to have a good idea but companies with good ideas fail all the time. You have to have knowledge of the business, certain skills necessary to run the business, have family support for the first 3-5 years to get your business off the ground. Perseverance and some luck are also needed. All of these things will have to flow forward over the first few years of your business.
C) **The Business Plan:**

After you have come up with an idea for a new food product or processing method, the next step is to develop a business plan. Sample business plan outlines are available on the internet and are discussed in a later chapter. The writing of a business plan is the most important part of the whole process of developing a new food product or process but often neglected and is probably why most new food products fail in the marketplace. The concept of developing a business plan is to write down your thoughts and review them frequently with ever increasing detail. I could see a person working on a business plan for 5-6 months. The idea is to plan your new business in every detail so that you minimize the probability of wasting money. Once you have started writing the plan, you will realize that there are areas that you don’t know about. Try to find people who can help you in areas that you are unfamiliar with. Get assistance wherever you can. There are a number of sections of a business plan that I do not think are initially important but there are others that tend to be the central focus of the whole new product development scheme. The most important aspect of the business plan is how you plan to market your new food product. You must clearly define such elements as “defining your customer” and why should a potential customer pick up your product versus a competition”. Other important elements include “how you plan to manufacture the product and distribute it” but these are not as important as getting potential customers to pick up your product and try it. I often hear people say that my product tastes real good. That is good but how will potential customers know that it tastes good unless they pick it up and try it. If you cannot market and sell your product, you do not have a viable business.

D) **Manufacturing/ Operations/ Regulations:**

After you have a food product concept and have written a fairly extensive business plan, it is time to consider the manufacturing of the food product. It is highly recommended that an entrepreneur first use the copacking option. Copacking, also known as contract manufacturing, is when you go to an existing food processor and have them make the food product for you. Many food manufacturing facilities have excess capacity and these plants can offset some of their operating expenses by selling you that excess capacity. I recommend this option for several reasons; 1) It minimizes your financial risk. A small processing plant can cost over $100,000 and building a processing facility to support an untested food concept is a financial risk you don’t need. Your money and time is better spent selling and marketing the product. 2) Government regulations are very long and hard to understand for the new person to the business. There are many government regulations you must know about before getting into the business. There are regulations governing the facilities, processing, labeling (to include 5 parts of all labels, nutritional labeling and allergen labeling), food safety plans and naming of the product (standards of identity). For an entrepreneur, this is just too much to handle when the success of new products lie in the sales and marketing of your product. There is just not much money to be made in manufacturing.
E) Label Design and Packaging:

Food products must look good and in a package that consumers recognize. The label design and color can have a tremendous impact on how well a food product sells. I suggest that entrepreneurs find and utilize a graphic design company that understands visual literacy and how customers tend to shop with their eyes. In today’s world with computer graphics, it is so easy to do it yourself but you may not understand the customer as well as you think. Remember to include the nutritional label, UPC code and a product code for tracking your product. Maybe you should consider having the name of the product or logo trademarked. Aside from the government requirements and the buyer’s requirements, there are things you must be cognizant of to effectively “romanticize your product” and to entice potential customers to pick up and try your product. When it comes to the actual package of the product, remember to package it in a form that the customer can identify with. For example, customers are used to buying bread in plastic bags so don’t package it in a can.

F) Going to Market:

Once you have all the above mentioned items completed, you are ready to “go to market”. Get some samples made to take out and show buyers who represent stores or restaurants. Set up appointments with product buyers. Maybe hire a professional sales person to make the presentation. After you have the order, implement your business plan. You can never have enough customers. Continue to refine your business plan and make more sales calls. You can never have enough business.

E) Assistance:

As an entrepreneur, you have many places to go for assistance. The federal and state governments want you to be successful so you can pay more taxes so they have institutions that provide assistance at no or minimum costs. For food product technical assistance, contact the Institute of Food Science and Engineering at the University of Arkansas. For business plan development, contact the Arkansas Small Business Development Center. Remember the old adage “Success breeds success” and successful people want to help others become successful. There are many people out there in the world who have been successful and would like to help others. They will help you in ways you would never imagine. Successful people are always helping others. Seek out these people, take them to lunch and most of them will tell you everything they know. They can provide you with a lot of important tips. The information age is upon us. The internet makes information readily available delivered to our home. There is a tremendous amount of information that is available for your use if you know where to find it.

8) Checklist for Entrepreneurs:

On the following pages (Table 1.1) is a checklist that may be useful for entrepreneurs in new product development. Understand that new product development is not an exact science. There are always different ways of doing
things but this checklist covers some of what I consider the most important elements in the development and marketing of a new food product. Use of these elements should increase your odds of success. As previously mentioned, new product development is not an exact science but also a discipline that requires some personality traits such as passion, persistence etc. Therefore, we cannot guarantee success by the use of our suggestions. You still have to provide the personality and perseverance.
<table>
<thead>
<tr>
<th>STEP #</th>
<th>ITEM</th>
<th>COMMENT</th>
</tr>
</thead>
</table>
| 1     | Have an idea | 1) Just do it.  
2) Think of something to do. It doesn’t have to be great. You will probably change your mind many times before you get to one you feel really good about.  
3) Remember that entrepreneurs find a need, want or desire and fill it.  
4) Flavor concepts in themselves are not very good for the long haul. |
| 2     | Conduct a “Reality Check” | 1) Talk to some people in your area that are doing something similar.  
2) Conduct internet searches on the subject. Find out what has been going on in the area.  
3) Determine if you can apply some new technology to the processing. |
| 3     | Attend some “Arkansas Small Business Development” courses | 1) The ASBDC has numerous courses conduct throughout Arkansas. I highly recommend that you take the following courses 1) Starting a Business in Arkansas, 2) How to Write a Business Plan and 3) Guerrilla Marketing. There are other ones that may also be of interest to you. For more information on these workshops and many other resources, go to the ASBDC website at; [http://www.asbdc.ualr.edu/](http://www.asbdc.ualr.edu/).  
2) Review the booklet entitled “Business Blueprints; Is your Business Idea Feasible” available online at; [http://www.asbdc.ualr.edu/consulting/feasibility.pdf](http://www.asbdc.ualr.edu/consulting/feasibility.pdf). See if you have the personality and the abilities to start a small business.  
3) Review the booklet entitled “New Venture Guide” available online at; [http://www.asbdc.ualr.edu/start/](http://www.asbdc.ualr.edu/start/). The information contained in this booklet will help you to determine state regulations, understand marketing and how to write a business plan.  
4) There are many other resources available from the Arkansas Small Business Development Center. Use |
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| **2** | **Start developing a business plan** | 1) Write down your idea and think about who will buy your product and why. What need does it fill?  
2) Start writing a business plan with emphasis on describing your product (the product, sales channel, trend, who is the end user, etc), Who is the competition?, What does the market look like?, What is your cost to produce?, etc.  
3) The process of developing a business plan will increase your knowledge of the industry and your passion for the business will build.  
4) Work on it several times per week. Think big.  
5) Talk about your product to people in the industry. Go where food people hang out. Successful people have a habit of helping others.  
6) Use available assistance  
7) Learn the business  
8) Spend 3-6 months in this phase of writing a business plan. Call it “minimal risk taking”.  
9) Define your marketing strategy. This is very important. It is how you will “go to market”. What promotional tools will you use? Coupons, advertising mode (TV, newspaper,). How will people know about your product? Use guerrilla marketing. What is your pricing strategy? Develop sales information and “point of sale” material. Make a sales target list. Conduct market research. etc  
10) Learn more about federal, state and local regulations, permits needed, type of business, etc |
| **3** | **Decide on your packaging option** | You need to decide how your product will be packaged. This may be dependent upon whether a copacker can package it the way you want. |
| **4** | **Decide on a manufacturing mode** |   |
| **4A** | **Copacker Mode** | **CoPacker Mode:**  
1) Get confidentiality/ non-disclosure agreement signed  
2) Give formula to copacker and discuss product  
3) Get label and package designed. Get UPC code  
4) Write process specification (pack size, quality checks etc) |
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5) Get test batch made.</td>
<td></td>
</tr>
<tr>
<td><strong>4B</strong></td>
<td><strong>Self Manufacturing</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Self Manufacturing Mode:</strong> <strong>NOT RECOMMENDED</strong></td>
</tr>
<tr>
<td></td>
<td>1) Acquire facility</td>
</tr>
<tr>
<td></td>
<td>2) Get inspection for facility for either FDA or USDA.</td>
</tr>
<tr>
<td></td>
<td>3) Get equipment</td>
</tr>
<tr>
<td></td>
<td>4) Hire skilled people (sales, production, marketing, QA/QC, maintenance, finance etc)</td>
</tr>
<tr>
<td></td>
<td>5) Write process specifications, labeling, licenses, procurement of ingredients, packaging, etc, etc, etc.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Design package label</strong></td>
</tr>
<tr>
<td></td>
<td>1) Decide how you want your label to look for maximum consumer appeal.</td>
</tr>
<tr>
<td></td>
<td>2) Make sure to include the 5 mandatory parts required by federal regulations and any other that may be needed.</td>
</tr>
<tr>
<td></td>
<td>3) Get UPC code if needed or desired.</td>
</tr>
<tr>
<td></td>
<td>4) Do a pricing on your product</td>
</tr>
<tr>
<td>5</td>
<td><strong>Get Sales</strong></td>
</tr>
<tr>
<td></td>
<td>1) Try to sell your product. Go everywhere. Doors will be slammed in your face. Live with it.</td>
</tr>
<tr>
<td></td>
<td>2) Continue to refine marketing strategy the rest of your life.</td>
</tr>
<tr>
<td></td>
<td>3) Sell to everyone, everywhere. Never stop.</td>
</tr>
<tr>
<td></td>
<td>4) Everyday, try to call on at least one possible customer.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Get more Sales</strong></td>
</tr>
<tr>
<td></td>
<td>1) Refine marketing strategy</td>
</tr>
<tr>
<td></td>
<td>2) Continue selling</td>
</tr>
<tr>
<td></td>
<td>3) Remember – You are getting what you wanted. And you thought making money would allow you time for vacation? Ask Bill Gates about vacation. He took only 10 days over a 10 year period of time. Success is all about passion and goal accomplishment.</td>
</tr>
</tbody>
</table>
A) **Introduction:**

This chapter is for people who are interested in starting a food processing business or learning more about how to get a food product on the market. It will assist you in the process of getting started with helpful hints and suggestions to make your journey easier. Everyday people come up with ideas for food products that they think may have a market. Some of these ideas are simply an old family recipe for a salsa, barbeque sauce or something that friends have encouraged them to market. Some of these ideas involve totally new products that may have a market. Almost every major food company in existence today started with someone in your situation—an entrepreneur.

Before you get too excited about marketing a new product, you need to be aware of some statistics. There are over 15,000 new food products introduced to the marketplace each year. Only about 10% of them last more than one year and about 2% of them ever return the investment made to introduce them to the marketplace. As a future entrepreneur, you need to be aware of these statistics and make prudent, minimal-risk taking decisions that get you where you want to go.

There is a more positive view to product development. This positive viewpoint says that 4-5 food manufacturers make 80-90% of the food. That leaves somewhere between 10-20% of the market open to small businesses that cater to a specific customer base. This niche market is too small for major food companies to play in so it is wide open to small businesses and entrepreneurs. There has never been a better time to start your own business. Major consolidation continues by large corporations in many industries creating profitable niches for new businesses to fill. The advances being made in technology and the Internet have created entirely new industries for business products and services, which are still relatively untapped.

B) **Getting Market Share:**

The single most important success factor a new entrepreneur or any small business needs to focus on is getting market share or volume. If you cannot market and sell your product, you do not have a business but a hobby. Consumers tend to be “creatures of
habit”. This means they tend to eat the same foods over and over again. The daily menu will change but they tend to primarily eat certain foods with some frequency. They tend to eat what they are accustomed to and often choose brands they are familiar with. In any retail food store, there are literally thousands of types and brands of food. So how are you going to get a potential customer to pick up your product? Why should they pick up your product versus the competition? If you have great-tasting product, how will the potential customer ever know it until they pick it up, purchase it, take it home and try it? Your whole focus in working with a new product should be about what you are going to do to get a potential customer to pick up your product and try it.

Many would-be food entrepreneurs call me about a great recipe they have for a product and are eager to build a facility to start manufacturing it. This would be a mistake. You can get your product co-packed by someone else who already makes similar products sparing you the expense of building a facility costing a minimum of $100,000. The emphasis for an entrepreneur should be in the areas of marketing and selling the product. It is the hardest thing to do but also the most profitable. Let me reemphasize this one point. You can get your food product co-packed relatively cheap. Your time, money and energy are best spent on marketing and selling your product. You may have a great product, but it will not sell itself. Somehow, you have to let people know it is available and where to get it. If you cannot sell your product, you do not have a business. We will discuss this in more detail in Chapter 3 of this guide under the subject of marketing.

C) **Entrepreneurship:**

An **Entrepreneur** is a person who organizes, operates and assumes the risks for business ventures or more simply stated a person who owns an enterprise. Entrepreneurship is one of the most important engines that drive our country’s economy. Through entrepreneurship, new ideas are turned into new business products, new ways are discovered to provide services to people and entirely new industries are created. In recent years, the businesses of successful entrepreneurs have not only contributed to economic vitality, but have also created most of the new jobs that employ the people of this country. Drive down a city business street sometime and look at all the small businesses that exist in a community. Most people are of the belief that big companies employ the vast majority of Americans that work, but the converse is true. Most Americans work for smaller, locally or regionally owned companies. In almost every State of the Union speech, the President of the United States talks about encouraging “entrepreneurship”. The federal government and most states have numerous organizations to help people start businesses. You probably are asking why are federal and state agencies so interested in helping entrepreneurs? The answer is plain and simple. Entrepreneurs create jobs, and people that have jobs pay taxes. Taxes are what keep our government providing goods and services such as roads, schools, police, fire protection, etc. So by helping you become profitable, they increase the amount of taxes received from both you and your employees and make governments more financially able to provide services.
Entrepreneurial Personality

Entrepreneurs have a certain personality that drives them. Everyone encounters problems every day. Problems tend to frustrate, confuse and annoy most people, but to an entrepreneur, they view problems as opportunities and start to look for solutions. They are truly problem-solvers. There are always wants and desires in our advancing society and resourceful entrepreneurs will seek solutions for them. Entrepreneurs recognize opportunities and take action. Not everyone is meant to be an entrepreneur. It is hard work and takes courage but the rewards are usually commensurate with the effort. There are some signs of having an entrepreneurial spirit that have proven to be somewhat accurate over time.

Signs that you are an Entrepreneur
1) You come from a line of people (e.g. your parents) who didn’t like working for someone else.
2) You’re a lousy employee – a lot of people that start new businesses have been fired from or quit several jobs.
3) You have worked for someone else for years and have gone about as far up the ladder as you can go.
4) You are bored in most jobs and want to have some independence and action to your life and work.

So what is needed to become an entrepreneur?
So now you are thinking you would like to try to be an entrepreneur but want to know what is needed to proceed. Listed below are some personal characteristics that are required.

1. A passion for the business- you will go through some tough times and if you are looking for an easy job, this isn’t for you. As you go through the tough couple of years, you learn to see the business as a part of something bigger. As time goes, you develop a passion for the business where others things in life tend to bore you.
2. Some starting capital or money- It takes some money to get started. A ballpark estimate of at least $10,000 is needed. It usually takes a lot more than you think.
3. Family support- You are going to have to “give it your all” to get a new business off the ground, and without an understanding family, you probably won’t make it.
4. An idea – You have to have some idea of what you are going to make, sell or provide. It doesn’t have to be a big idea but it has to fill a need or desire.
5. Some skill sets- You will have to have or develop some skill sets such as how to sell your product or service, procurement of raw materials, marketing, production, accounting, hiring and firing – all these skill sets we call “management”. You don’t have to know them all since you can hire some people to manage those areas in which you are not skilled. It's better to have a fair new product and a great manager than the other way around. Management is the most important element for success of a product. Edison wasn't only an
inventing genius. He was also a promoting genius, a publicity genius, a capital-raising genius and a genius at seeing potential markets for inventions. Have you ever heard of Joseph Swan? A strong case could be made for saying he invented the electric light eight months before Edison. Who got the patents? Who got the bulb to the market? Edison. Who invented the electric light bulb? Edison. Few of us are Edisons. We may have brilliant product ideas, but we aren't usually knowledgeable, let alone brilliant, in all of the areas that need to be covered.

6 Assistance - There are many organizations that provide expertise or assistance to entrepreneurs. You have to know where to find and utilize them.

7 Personality traits such as:
   - Risk-taker
   - Adventurer
   - Courageous
   - Confident
   - Competitive
   - Visionary
   - High energy level

Let’s look at some big name entrepreneurs and what they did. Some of the most successful entrepreneurs include Wally Amos (cookies), Mary Kay Ash (cosmetics), Henry Block (income tax), Debra Fields (Mrs Fields Cookies), Henry Ford (cars), Bill Gates (Microsoft), Leon Gorman (L.L.Bean), Ray Krone (McDonalds), J. Willard Marriott (hotels), Don Tyson (meat processing), and Sam Walton (Walmart). There are literally thousands more but these are ones we encounter quite frequently.

These entrepreneurs had a certain philosophy. Most of them were not necessarily brilliant, but they did have a passion for the business. They found ways of delivering goods and/or services to people who wanted those services and were willing to pay for them. The next time you go into a food store, look at all the new products on the shelves. One hundred years ago, everything was sold as a commodity. Now, the word “value-added” is hot, whereby entrepreneurs have found ways to make products more convenient to the consumer. They have literally added value and the corresponding price is substantially higher than the commodity from which it was derived.

Where do ideas for new products come from? Ideas are “a dime a dozen”. Everyone has ideas on how to do something cheaper, easier, faster, etc. than what is on the market. The difference is that entrepreneurs make their ideas become realities. For example, take Famous Amos Cookies. Anyone can make cookies but he took his cookies to the marketplace where people who don’t have time to bake can buy them. Mary Kay Ash simply took upscale cosmetics, promoted parties and built a loyal sales staff. Leon Gorman of L.L. Bean fame took upscale outdoor clothing and built an excellent mail-order business. By now, you are thinking these were not technological break-through ideas but simply doing a concept and doing it well. Therefore, the concept or idea you come up with doesn’t have to be the big, break-through thing the world has been waiting for. You have to have a passion for the business. Without the
passion, the probability for success is very low. Most people want to think that if I have one big idea, I will become rich and famous. It is not the idea as much as the passion and other personality traits that are needed to drive down the road of success. I think we need to redefine the word genius in terms of success. Thomas Edison said "Genius is one percent inspiration and ninety-nine percent perspiration."

**Entrepreneurial Thinking**

Entrepreneurial thinking is about recognizing opportunities in the marketplace and understanding how and when to capitalize on them. Becoming an entrepreneur is not necessarily an inherent trait. It takes time to train oneself to use your talents and experience to see opportunities where others do not. Each individual possesses a different perspective on products they would find useful and services they would like to see perform differently. It can often be just as profitable to improve upon an existing business. The advantage here is that you can learn from the mistakes of competing companies while still borrowing the positive aspects of their business for your own. Whether starting a completely new type of business or expanding on current ideas already in the marketplace, the key is learning to use your unique perspective to produce a product or service that provides increased value to potential customers.

Entrepreneurial thinking is relatively easy to learn. It involves training your mind to look at products and services in a different way and understanding how to improve upon them. How would you change the way a company you are familiar with is currently conducting business? Are there complimentary products or services that you feel would be of value to the same target market? Train yourself to be continuously learning about and evaluating other types of businesses. This is how to create ideas of your own and gain valuable insight into an industry. Project your understanding of a given industry into the future to get an idea for what types of products and services will be desired down the road. The marketplace of every industry is continuously changing, and those that have the foresight, ingenuity, and desire have the potential to capitalize on the opportunities that develop.

Although starting a business is never a sure thing in terms of success and prosperity, entrepreneurial thinking teaches you to capitalize on opportunities in your current job and other areas of your life as well. All of this does not mean that you should quit your job today. However, you should begin trying to lay the seeds for a type of business that interests you. What is it that you enjoy doing or have experience with? What demands are currently not being met in the marketplace? Why are companies not already doing this? The marketplace is full of opportunities and those that choose to take on the challenge give themselves the chance to create a type of wealth, happiness, and security that can be achieved by starting your own business.

Companies such as Yahoo, Amazon.com, and eBay were founded only a few short years ago and have enjoyed enormous success in their industry by generating significant value for their customers. These companies and many others often start in someone’s basement, garage, or dormitory. Being an entrepreneur has nothing to do with age, gender, race or education. Everyone must start somewhere, and those that have the drive and ambition to build their idea into a reality give themselves the
chance for unparalleled success.

Starting a business is not something that happens overnight. However, it is probably not as difficult as you might imagine. The Internet has brought a wealth of information to your fingertips, if you know where to look for it. You can access information on almost every topic of interest to an entrepreneur by simply performing a search on any of the search engines. Speak with other individuals who have started their own business. They will provide you with a wealth of insight and possibly some useful contacts.

It is never too soon to begin contemplating starting your own business. This will only encourage your development as an entrepreneur and help open your eyes to opportunities in the marketplace that you never knew existed. The key is to believe in yourself, your idea and have the desire and passion to make it into a reality.

D) The Product;

The first step in starting a food business is to have a food product concept or idea. The concept or idea can be either a particular product or a new and innovative processing method. The idea or concept doesn’t have to be perfect to begin with, just get started on something. Your idea or concept will probably change several times as you develop your business plan and get to know the business. So just start with any idea and move forward.

Your idea could put more people to work and you may be the kind of person this country needs to compete in world markets and maintain its standard of living. Your idea may be the cutting edge of the future. In general, food products with just a different flavor do not have a high success rate because they can be easily matched by spice companies. Anyone can go into a store, buy your product and match the flavor within a matter of weeks. On the other hand, the restaurant trade is always looking for food products that they can just heat and serve. They may have an interest in a new food item. Just start with a concept or idea knowing it does not have to be the ultimate idea. Remember that ideas are “a dime a dozen”. This means that your idea for a new product is not the key to success. I agree you have to have a good idea but companies with good ideas fail all the time. You have to have knowledge of the business, certain skills necessary to run the business and have family support for the first 3-5 years to get your business off the ground. Perseverance and some luck are also needed. All of these things will have to flow forward over the first few years of your business.

Most people who are thinking about starting a food processing business are concerned about the big companies and how they cannot compete with them. It is true that they probably cannot compete with them on price. Big companies have high speed/high volume lines that can make products fairly inexpensively. As a general rule, no matter who the product whether it be car, computers etc, 4 to 5 manufacturing companies control 80-90% of the market. This means that somewhere between 10-20% of the market is open to small companies. We call this a “niche market” because we are catering to a particular kind of customer that has the money and the desire to pay more for something to get what they perceive as a better value. Your product idea should be one targeting these niche groups. The market is generally considered too
small for large companies to go after so you don’t have to compete on price. For example, suppose you created a tomato juice beverage and called it “Razorback Juice”. There would probably be a market for it in Arkansas but not in the surrounding states so big beverage processors would not even try to make such a beverage. In addition, there is a mood in America now to distrust the big companies and buy from the small processors. This explains the tremendous success of farmers markets and how they can charge twice the price of the major food stores.

The food idea or concept you come up with will need to be screened by one for what one might call a “reality check”. Listed below are the questions you need to ask yourself to do a reality check.

1) Is it original or has someone else already come up with it?
2) Can somebody produce and distribute it?
3) Will it really make money?
4) Will someone buy it?
5) Can you protect your idea?

Although a modest list, the problems arise from the dozens of underlying questions that must be answered before the major questions can be resolved. Here, for example are the 33 areas that the University of Oregon's Innovation Center runs each submitted idea through to determine if it has commercial merit:

<table>
<thead>
<tr>
<th>Legality</th>
<th>Functional Feasibility</th>
<th>Trend of Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>Production Feasibility</td>
<td>Product Line Potential</td>
</tr>
<tr>
<td>Environmental Impact</td>
<td>Stability of Demand</td>
<td>Need</td>
</tr>
<tr>
<td>Societal Impact</td>
<td>Consumer/User Compatibility</td>
<td>Promotion</td>
</tr>
<tr>
<td>Potential Market</td>
<td>Marketing Research</td>
<td>Appearance</td>
</tr>
<tr>
<td>Product Life Cycle</td>
<td>Distribution</td>
<td>Price</td>
</tr>
<tr>
<td>Usage Learning</td>
<td>Perceived Function</td>
<td>Protection</td>
</tr>
<tr>
<td>Product Visibility</td>
<td>Existing Competition</td>
<td>Payback Period</td>
</tr>
<tr>
<td>Service</td>
<td>Potential Sales</td>
<td>Profitability</td>
</tr>
<tr>
<td>Durability</td>
<td>Development Status</td>
<td>Product Interdependence</td>
</tr>
<tr>
<td>New Competition</td>
<td>Investment Cost</td>
<td>Research &amp; Development</td>
</tr>
</tbody>
</table>

Some entrepreneurs worry that they cannot compete with the big manufacturers. Understand that businesses, over time, will evolve. The big food companies of 50 years ago have gone by the wayside and the next generation of businesses have taken over their territory. Remember the big food retailers of the 1950s and 1960s- A&P and Kroger? They are not nearly as large as they once were due to other food retailers like Albertsons, Ralph’s, Walmart, Wegman’s that were entrepreneurs in the 1950s and 1960s. Bigger is not always better. The economies of production go up as a company gets bigger but big companies tend to lose sight of the customer, get sidetracked, lose their competitive edge or get tied up in big labor contracts etc.
Some people have suggested that they cannot compete in new food products because large companies have huge research and development staffs that have the power to be truly creative. This is a false assumption. For the most part, the best and most creative ideas seem to come from individuals. I have read lots of stories about projects that began in someone’s basement or what are called in industry “skunkworks projects”. In general, they are just too big a step for big companies to believe in. As the discoverer of penicillin, Sir Alexander Fleming, said, “It is the lone worker who makes the first advance in a subject: The details may be worked out by a team, but the prime idea is due to the enterprise, thought and perception of an individual.” Big companies also worry about their pride. There is a fear that exists of something new. Nobody wants to be first. Everybody wants to be second. So everyday, individuals are creating totally new products on their own.

E) Understanding the Business;

Over time, I have noticed that the people that understand the food business tend to be far more successful than people who just have an idea. In order to start a new business or maintain an existing business, one needs to truly understand the food processing business. My interpretation of understanding the business is shown in Figure 2.1.

FIGURE 2.1; Understanding the business

In this scenario, an entrepreneur comes up with an idea. By working hard (passion) on an initial idea, the entrepreneur develops an understanding of production, the customer and the market. After gaining all this knowledge of the business, the entrepreneur now comes up with another idea that is much better than the initial idea. I know we all would like to forego the initial work and go straight to the final idea but this is not possible. I call it “paying your dues”. You have to do the work to be a member of the “Entrepreneurs Club”. So what are the details involved in gaining knowledge of the business to include production, the customer and the market? Let us now go through the steps in understanding the business.
I have categorized the elements of this area as working knowledge of production, the customer and the market. The details of each of these are shown in Table 2-1. As an entrepreneur, you will need to know these to some extent. As a company grows in size, one needs to be more knowledgeable in the details and often hires specialists to manage them in greater detail.

The knowledge of production means you are knowledgeable in the various aspects of getting food products manufactured that include everything from the knowledge of raw material markets, government regulations, and distribution networks to processing equipment. (See Table 2-1).

The knowledge of the customer is about knowing who the potential customer is and what we call the “demographics of the customer”. The target customer is who we think will want to buy our products. We want to know everything about that target customer so we can focus our marketing efforts in an effective and efficient manner. When you buy a power tool or appliance, there is often a warranty card in the box. The idea is, you fill out the warranty card and they guarantee the product for a certain amount of time. Notice in the warranty card they ask for some seemingly unimportant details like yearly income, number of people in the household, age etc. What they are doing is accumulating demographic information to target their product better in the future. You also need to figure out initially who your customer is. Are you aiming your product to upper class career people who don’t have time to cook a meal or to children? The more you know about who you are targeting as a customer, the more you can design your product to their needs and desires. Overall, I would describe today’s consumer as being more demanding, more adventurous, having more disposable income and being starved for time and a “want it now” mentality compared to people 20 years ago. In addition, older consumers are sick of self-denial and younger consumers often lead a more decadent lifestyle. Just knowing these little pieces of customer knowledge can help you design products for whichever market group you want to target.

The next category is that of understanding the market. Some of the details in this category blend in with those of understanding the customer. In this area, you want to understand who your competition is, what they charge, how they package and promote their product, etc. To learn about this area, you may want to spend some time in a supermarket seeing how the potential competition promotes their products such as the use of coupons, recipe ideas, etc.
<table>
<thead>
<tr>
<th>KNOWLEDGE CATEGORY</th>
<th>THE DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding Production</td>
<td>This means you need to understand;</td>
</tr>
<tr>
<td></td>
<td>a) Government regulations</td>
</tr>
<tr>
<td></td>
<td>b) Processing equipment</td>
</tr>
<tr>
<td></td>
<td>b) Getting capital to start a business</td>
</tr>
<tr>
<td></td>
<td>c) Distribution networks</td>
</tr>
<tr>
<td></td>
<td>d) Raw material markets, packaging, labeling, shelf life, etc</td>
</tr>
<tr>
<td>Understanding the Customer</td>
<td>This means you need to understand the customer that you want to buy your product.</td>
</tr>
<tr>
<td></td>
<td>a) Does it fill a customer need?</td>
</tr>
<tr>
<td></td>
<td>b) Who is my target customer?</td>
</tr>
<tr>
<td></td>
<td>c) What are they willing to pay?</td>
</tr>
<tr>
<td></td>
<td>d) How customers evaluate products of this type?</td>
</tr>
<tr>
<td></td>
<td>e) How will I promote my product to reach the target customer.</td>
</tr>
<tr>
<td>Understanding the Market</td>
<td>a) Who is your competition?</td>
</tr>
<tr>
<td></td>
<td>b) How to label and package the product?</td>
</tr>
<tr>
<td></td>
<td>c) What is a fair price?</td>
</tr>
<tr>
<td></td>
<td>d) How will people know about your product and where to get it?</td>
</tr>
<tr>
<td></td>
<td>e) Sales strategies and marketing</td>
</tr>
<tr>
<td></td>
<td>f) Store markup</td>
</tr>
</tbody>
</table>

**F) Food Channels/ Distribution:**

There are basically 2 channels in food distribution which include retail and food service. In the retail market, the goal is to give the consumer what they want at a price they are willing to pay. Examples of products that retail customers are interested include primarily value-added foods that save them time in preparation. Go to a retail food store sometime and notice how few commodity products are available versus products that are partially or fully prepared. The other food channel is that of food service which are primarily restaurants but also includes school, and other institutions that service cooked foods. In food service, we are not selling directly to the general public but to a restaurant representative or a buyer. They have the ultimate customer’s
best interests in mind but are also interested in addressing restaurant concerns such as food safety and the shortage of good labor.

The retail channel represents food stores like Walmart, Kroger, Dillons, etc. They are very consumer oriented because they sell directly to the ultimate consumer. They tend to be very “heavy up” on marketing with competitors all trying to get customers to buy their product at the exclusion of the competition. It is a very crowded market and exceedingly competitive. Walk down the cereals section of a food store and notice the number of types and brands of breakfast cereals. The average food store carries 70 to 90 types and brands of breakfast cereal.

The food service channel includes restaurants from fast food establishments up to fine table clothe restaurants. This is, by far, the largest growing segment of the food industry. Over one-half of the meals served in the United States today are meals eaten away from home and this trend is not predicted to reverse anytime in the near future because the average older consumer is starved for time. In addition, younger people do not possess the cooking skills that their parents had. A survey was conducted recently to determine the attitudes toward cooking of several age groups. The results are shown in Table 2-2. As you can see, younger people are just not that astute about cooking.

<table>
<thead>
<tr>
<th>Generation</th>
<th>Attitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swing/WWII (55+)</td>
<td>“I’m glad I don’t need to cook anymore”</td>
</tr>
<tr>
<td>Baby Boomers (34-55)</td>
<td>“I wish I had time to cook”</td>
</tr>
<tr>
<td>Gen-Xers (25-34)</td>
<td>“What, me cook?”</td>
</tr>
<tr>
<td>Gen-Y (18-24)</td>
<td>“What’s cooking?”</td>
</tr>
</tbody>
</table>

The food service channel is fertile ground for entrepreneurs. The retail market is just too crowded and competitive. Most restaurants use food distributors to deliver foods on a daily basis. Some restaurants use full service distributors like Sysco and U.S. FoodService to get their food products delivered while others use independent brokers. Restaurants want items that reduce the probability of a food safety incident and items that reduce the labor “in the backroom”. (e.g. precooked, preportioned, premarinated, etc). In the food safety arena, restaurants are fearful of lawsuits from customers getting sick from E. Coli, Listeria, Salmonella and other harmful pathogens. An incident like that of “Jack in the Box” and other more recent episodes can ruin a restaurant. Restaurants are also experiencing labor problems. They often have up to 90% turnover of employees per year and the quality of the labor pool is down due to low wages and benefits. Correspondingly, restaurants want food items that are precooked and further processed to reduce labor in the kitchen.
G) Value-Added Foods:

“Value-added” food is defined as “Food items whose value has been increased through refinement, the addition of ingredients, processing or packaging that makes the whole more attractive to the buyer or readily usable by the consumer than the initial commodity”. We live in a “Value-Added” society. Many of our grandparents or great-grandparents raised their own hogs and chickens, grew produce in a garden, made their own furniture and probably made their own farm implements. In our current society and because of the industrial revolution, it is now cheaper and easier to buy pork, eggs, produce, furniture and farm implements than it is to make it yourself. Because of technology, mass production, strategic purchasing etc, Americans live in a value-added society. Americans have a love affair with value-added. They can get what they want, when they want it and at a cheaper price than doing it themselves. No matter how you look at it, “convenience sells”. Have you been to a food store lately? Look at all the choices there are of various products. Value-added products include anything that is further processed above the commodity itself. Let’s take the dairy field as an example of value added products. The dairy field is, by far, the most innovative food product area. They start with raw milk and make numerous products to include 1%, 2%, skim milk, ice cream, yogurt, and cheeses from cottage cheese to various flavors (cheddar, swiss, colby etc) and they slice it, dice it, shred it and even individually wrap slices. Don’t forget that milk is homogenized and pasteurized-things you don’t have to do. These are all examples of “value added” foods.

I have some observations on value added foods. Note that almost everything we buy is “value-added”. Note also that the price charged for adding value is substantially more than the price for the raw commodity.

So how does the entrepreneur cash in on value-added foods? High speed, efficient food processing equipment is expensive but saves on labor in the long run. As an individual, you will have to just get started preferably using a copacker who has some high speed equipment and slowly build your business focusing on a niche market. It may take several years. After you have some initial success, you may want to find some venture capitalists to invest in your business. Farmers have been known to form cooperatives to pool their raw commodities and control the processing aspect to their benefit. Examples of successful cooperatives include Ocean Spray, Welch’s, and Sunkist. At any rate, you will need to start somewhere and that is with an idea. Come up with an idea and find a way to do it better, cheaper or more efficiently than the competition. Technology and creativity are your keys to success. Technology is coming at us faster than ever before. Older, more established companies are more hesitant to adopt new technology. Creativity abounds in people without regard to education or income but can be substantially amplified via marketing.

I have some suggestions for value-added food products. Watch out for the old “cheaper is better” philosophy. Customers have money and they are willing to pay for quality. They tend to stay away from cheap foods with the idea that “You get what you pay for”. Watch for the reemergence of “Comfort Foods”. These are foods that wealthy people who now have the money can afford that takes them back to the foods served by their mothers. They include such products as whole muscle ham, meatloaf, pot roast and sandwiches. Flavor profiles of existing products are also constantly changing. Young people don’t identify with Italian. Grilled flavored products are in
style. Some health issues are fading as people go back to fat steaks, cigars and pizzas. There is a health market out there and it is growing but as with any trend, it may go back down at any time. If you are a smaller business, remember to reexamine your product lines every 2-3 years to make sure it is relevant to today’s dynamic consumer.

May I say a few words about the marketing value-added foods. Facts do not sell a product. Emotions sell products. Watch some TV commercials sometime and try to understand the message. They usually are not based on the facts of the product but on the emotion they want you to have when you buy their product. For example, brand X pants are not sold on the strength of the material or stitching but how well people who wear them entice members of the opposite sex. This may sound ridiculous but it works. I often hear this referred to as “Romanticizing the Product”. That is to say, make it emotionally appealing in some way to the customer. People do not buy products on quality as much as their perception of what the product will do for them. Wearing a famous brand of pants will make you fit into a certain group of people. A good dinner makes the housewife look good to her family. The three keys to successful value-added food products are;
1) Give the customer what they want and at a price they are willing to pay.
2) Do it cheaper, better or differently than the competition.
3) Market your product better than the competition.

8) Food Product Development;

There are many ways to develop new food products and there is no set method that has proven better than another. Big food companies have large Research & Development (R&D) organizations whose sole purpose is the development of new products. Their direction generally comes from the marketing department who provide the concept along with demographic information about the target customer.

As an entrepreneur, you will probably start with an idea and go from there. The entrepreneur starts with an idea and builds a company over time around the idea. But where do ideas come from? Some people have an understanding of the business and know what customers want or see a product that he/she thinks the customer will want and try via marketing information to lead the customer to the product. Some people just have the ability to look into what the customer wants and move from there. Still other people have been quite successful using focus groups or brain storming sessions as a source of ideas.

The research development organizations in large food processing companies utilize graphic images like that found in Figure 2-2 to develop new food products. It is essentially a list of all the things one must be aware of that effect the ultimate success of a new product. One cannot be an expert at all of them but know where to find the information or have organizations that are experts in them. Think of each one of these as links in a chain where a chain is as strong as its weakest link. Larger food companies are always determining their weakest link and strengthening it. This can be called “realignment” or “refocusing”.

25
Details of Product Development;

As you begin to develop a new food product, there are a series of basic steps you should follow which are shown in Figure 2-3. This sequence is not set in stone and should be tailored to your product and your person way of doing research.
Let’s go through each step of the elements in Figure 2-3.

**Step #1**: Start with an idea. It doesn’t have to be a great idea, just something to start on.

**Step #2**: Conduct your own reality check. A reality check is where you do some critical thinking about your initial idea. In this step, you ask yourself the following questions and seek answers before going to step #3. The series of questions can be divided in one of three categories (Marketing, Management and Money).

**Marketing**
1) Who will use your product?  
2) How will it be used?  
3) What preparation is necessary?  
4) How will the consumer benefit from it?  
5) Does it have any other uses?  
6) Who is the competition and what is the price and size available?  
7) How is your product different from the competition?  
8) Where will your product be available?  
9) How will people find out about your product?  
10) What will the price be?

**Management**
1) Regulatory –  
   a) What agency has jurisdiction over the products I plan to make (USDA or FDA)  
   b) What are the regulations in processing, labeling, etc  
   c) What are the local/ state regulations regarding business structure, zoning, etc.

2) Production- It is important that you identify the equipment, facilities, and processes needed to manufacture your product. Concentrate on the following areas:
   1) Ingredients: Are they readily available year around? How many suppliers can you find?  
   2) Processing: What kind of facility is needed? What type of equipment?  
   3) Facilities: You might want to consider private labeling your product at an existing facility as a first stage. How much room do you need? Are any buildings vacant in the community? What about the water supply and waste management?  
   4) Packaging: What type of material to use? How does it affect consumer appeal and product safety?  
   5) Distribution: Will special distribution channels be needed, especially if the product will be sold frozen or refrigerated?  
   6) Shelf life: How long will your product last? Is the shelf-life of the product enough to allow for shipping and distribution?
Money

Before a value-added food product is created for sale an understanding of all costs of production and marketing the product is required. You should have a detailed cost analysis made before the product is manufactured. There are two types of costs to consider: fixed costs and variable costs. Annual fixed costs are those that will not change in any one year regardless of the level of production. They include equipment, building, property taxes, manager's salary, insurance, and any other item that, once purchased, will not fluctuate due to changes in production levels.

Variable costs are expenditures that will vary with the volume of production, such as hired labor, raw ingredients, packaging materials, fuel, electricity, utilities, and all other items that are used during production.

Step #3: Write a business plan. This is discussed in greater detail in Chapter 3. Most of the elements you collected in Step #2 will be used in writing the business plan.

Step #4: Make prototype samples. It is suggested that you go to a copacker and have samples made up to use to do a small test market.

Step #5: Conduct a small test market. In this step, you want to get your prototype samples in the hands of people that will ultimately use the product. You can either give away free samples with a questionnaire, take the samples to a focus group or actually sell some of your product. You are interested in what these potential customers think of your product and work out any bugs. Your product may need some fine tuning or “tweaking”. Your market test will be much more useful if you plan it well in advance with the help of an expert in the field. Ask for assistance from the Small Business Development Center in your area to help plan and interpret the results of your test.

Step #6: Manufacture a small batch; If the test market stage went well, you need to have some more samples made up to take to customers.

Step #7: Get customers. In this step, we are defining customers as food store or restaurant buyers. You need to take in samples to these prospective buyers for a sales presentation. You may also need to present your marketing plan and other promotional programs such as coupons, advertising plan etc to potential buyers.

Step #8: Go into full scale commercialization; If you were successful in step #7, you should have an order to fill. This means you have to get product made and sent to the retail store or restaurant. You should then be interested in product maintenance. This should concentrate on 2 things.

a. Quality improvement
Look for any potential defects in the product as it is handled through distribution and display, and adjust your formula or processing procedures to remedy the problem. Also, solicit consumer response to help you identify alternative flavors or packaging.

b. Profit improvement
This will be achieved mainly by cutting your costs rather than raising the price of your product. Investigate ways to improve process efficiency, save on labor costs, and find alternate suppliers of ingredients.

**New Products;**

When a new food product is developed, the cost of development and marketing often result in a loss for the food company. Figure 2-4 shows the life span of a new food product from its development to its final senility. Notice that a new food product initially losses money, then become profitable for some time and eventually becomes less profitable primarily due to competition. Therefore, once you get a new product on the market, it is immediately time to start on another one.

![Figure 2-4; The Cost and Life Span of a New Food Product](image)

**1) Innovation as a Competitive Strategy;**

Thus far, we have discussed new products only as it relates to a food in general. New products can be a particular product such as a recipe but can also be an old product that consumers are familiar with but made in a more efficient manner by new technology or a new process. This is far more common than people think. The way food products are made today barely resembles the products made in the 1950s. The sum result of technological innovations in processing is value-added food products that are cheaper than we can make ourselves. Maybe your innovation doesn’t need to be a totally new product as much as the same product made a different way. You must be thinking of innovative processing techniques that can be patented. As Bill Gates of Microsoft once said ”Build a moat around your innovation where no one else can do it”. If you are an innovative type, you may wish to get grant money from the Small Business Administration group to test a new processing technique.
3. Business Considerations/ Business Plans/ Marketing

A) Introduction:
Most entrepreneurs fail not because of the product they are trying to introduce but because they run out of money before they become successful. This is usually the result of failure to plan their business or writing a business plan. This chapter deals with some of the business aspects of starting a new business including some of the parts of the important business plan. The Arkansas Small Business Development Centers should be on top of your list of organizations to go to for help. Most of their assistance is free or very low in cost. I strongly suggest that everyone take their seminars on 1) Start a Business in Arkansas, 2) Writing a Business Plan, and 3) Guerrilla Marketing. I also suggest you get their publications entitled “Business Blueprints; Is Your Business Idea Feasible?” and “New Venture Guide”. These are excellent reference books for entrepreneurs.

B. Business Blueprints:
To most people, the idea of a new food product or process is the only thing that matters. This is not true. I have seen and continue to see what I would consider bad ideas come forth and become successful. I also see great ideas of products and processes fail. In general, a successful business has three parts; Market, Management and Money.

The Arkansas Small Business Development Center
The Arkansas Small Business Development Center is headquartered in Little Rock (501/324-9043; www.asbdc.ualr.edu) but also has locations in Fort Smith, Harrison, Hot Springs, Magnolia, Osceola, Stuttgart, Arkadelphia, Fayetteville, Jonesboro and Dumas. They have a wealth of knowledge and materials to help you get started. In addition, they also provide free counseling in areas that you may have problems. They can provide the market research, feasibility analysis and business planning assistance necessary to make an innovation successful.
**Market:**
"Is there a market for my product or service?" You need to determine if you have a market for your product. Without customers that will buy your product or service in sufficient numbers and at a high enough price to provide a profit, the business will fail.

**Management:**
"Can I bring this product to market?" Products or services, however inherently attractive, do not sell themselves or manage businesses. You must be able to demonstrate to yourself and others that you have sufficient skill and experience to manage your business and bring the product to market profitably.

**Money:**
If the answers to the Market and Management questions are "Yes," then and only then should you think about money. Too many people ignore the market and management issues and focus only on money, but the survival of the business depends on the market and the management. To overlook those issues will assure business failure and an inability to secure financing.

The Arkansas Small Business Development Center has an excellent booklet entitled “Business Blueprints; Is Your Business Idea Feasible”. This booklet can be obtained via one of their business locations or online at: [http://www.asbdc.ualr.edu/consulting/feasibility.pdf](http://www.asbdc.ualr.edu/consulting/feasibility.pdf). This booklet is absolutely essential for anyone considering getting into the food processing business. The purpose of this workbook is to help you think about your business idea and perform an initial business feasibility analysis. It will guide you through consideration of market, management, and money questions. To analyze these areas adequately will take significant time and effort, but your work will pay off many times over. Guided by this workbook, you can collect information necessary for business success and the acquisition of financing. The booklet guides you through a series of questions that enable you to;

1) Identify your personal objectives, skills and resources
2) Describe your business idea and requirements
3) Evaluate your business feasibility focusing on the market, management and money.

The chart shown below (Figure 3-1) provides you a way to visualize some of the critical steps that need to be undertaken before starting your business. Following the step-by-step process pictured in this flow chart can help make sense out of what can be a detailed and sometimes confusing process. While completing these steps does not guarantee success in business, your detailed attention to them will improve your chances of success. They will help you evaluate your business idea before you or other people make a financial commitment. The sections of this business feasibility workbook provide details for completing each of the steps listed.
Figure 3-1: The Step by Step Feasibility Process

Step 1. Identify Your Personal Objectives

Step 2. Identify Your Personal Skills and Experience

Step 3. Identify Your Personal Financial Resources

IDENTIFY PERSONAL OBJECTIVES, SKILLS, AND RESOURCES

Step 4. Describe Your Product or Service

Step 5. Describe Your Competition

Step 6. Describe Your Sales and Distribution Process

DESCRIBE BUSINESS IDEA AND REQUIREMENTS

Step 7. Describe Your Sales and Distribution Process

Step 8. Describe Your Management Requirements

Step 9. Develop Your Sales Forecast

Step 10. Identify Your Start-up Expenses

Step 11. Estimate Your 12-Month Operating Budget

STEP 12. EVALUATE BUSINESS FEASIBILITY

Market Scoresheet

Management Scoresheet

Money Scoresheet
C) Business Planning/ Plans

The business details involved in starting and running a business is an area few entrepreneurs and small businesses understand and is usually the cause of business failure. After coming up with a food product idea, the next step is to come up with a business plan. A business plan is a written document that describes your business, the competition, cash flow, your marketing plan and other components that will justify the worthiness of your idea or concept.

There are several reasons to write a business plan;
1) To help you think through the venture and ensure that you have considered all your options and anticipated any potential difficulties. It is hard to plan the details of a business when all the major elements of the business are running around your head.
2) To convince lenders and potential investors that you are in control of the project and that their money will be safe with you.
3) To serve as an operating guide as you turn your idea into a viable business.

You may need a business plan to get a startup loan or get potential investors to buy into your business, but the best reason for developing a business plan is for you to solidify your whole plan for production, marketing and sales of your product. The vast majority of startup businesses that fail do not fail due to the product idea or concept but fail due to the lack of a good, solid business plan. As an entrepreneur, you need to learn how to manage risk. Life has inherent risks to it as just about everything we do. Starting a food business is no different. It has certain risks and you as an entrepreneur are taking a risk. However, you can minimize those risks by thinking, studying, researching and ultimately writing a business plan. I like to think of it as “prudent risk taking”. You know the risks involved but you are also aware of the financial and personal rewards before you ever open the business.

Not everyone enjoys the art of writing but writing a business plan should be fun and exciting. You are literally building a business in your mind. There is no risk, no real money spent- it sounds more like a game similar to Monopoly. Have fun with it like a game remembering there is no real risk until after you have the plan all developed and you have a good feeling about it. Then you have to decide if you want to spend your money. Start by downloading a copy of a business plan from the Arkansas Small Business Development Center or just type the business plan on the following page in a Microsoft Word document or similar product and start filling in the information. The main points to initially consider are #5 Description of the Business, #11 The Market and #12 The Competition. These are the most critical ones to consider upfront. Use the internet, talk to people in the business, go to libraries and the Arkansas Small Business Development Center to gather information. Spend several evening per week studying and gathering information to fill in the details you gather for your business plan. You can also customize a downloaded copy of a business plan to fit your needs. Include everything you want to in your plan. You can never have too much information. Just start writing the plan as to what you know at that time. Don’t worry about not knowing everything. At this point, you will probably realize how little you know. I suggest that you buy a laptop computer and a good
recliner chair and spend many nights per week just dreaming and adding everything you can to your business plan. The most important thing is to have fun with it.

There are a number of sources from which to obtain detailed business plan formats;
1) The United States Small Business Administration has a Business Plan form that can be downloaded from [www.sba.gov/starting_business/planning/basic.html](http://www.sba.gov/starting_business/planning/basic.html).
2) The Arkansas Small Business Development Center has an excellent booklet entitled “Start-Up Guide” that has a business plan in it. There is also a business plan outline in the New Venture Guide. Call 501/324-9043 for a free copy. You can also download a copy of a business form from; [http://www.asbdc.ualr.edu/bizfacts/1004.asp](http://www.asbdc.ualr.edu/bizfacts/1004.asp).

Listed below are the elements for a business plan from the Arkansas Small Business Development Center.

**Business Plan Outline**

1. **Cover Page**: Name, address, email, webpage if you have one and phone number of business. Give your plan a businesslike appearance by typing on high quality paper and putting it in a vinyl or cardstock binder or a three-ring binder. If you have a logo, use it to dress up this page.

2. **Title Page**: Repeat the business name, address and phone number, and add the name and addresses of the principal owners. Also show the dates of issue of the plan and type "copy number ___" so you can number and control the copies.

3. **Executive Summary**: A brief (one-page) statement of the business plan objectives. Address the following questions and add additional information that will help you achieve your goals. (You may choose to write this page last.). Although the executive summary is the first section of the business plan, it should be the last section you write. Until you have completed the rest of the plan, you simply will not have enough information to formulate a good executive summary. Topics included in the executive summary should include:
   A. The business name and description
   B. Product and service description and its advantages.
   C. Market summary.
   D. Financial projection summary
   For a financing proposal:
   E. Who is requesting the funds and how much is needed?
   F. What will the money be used for?
   G. How will the funds be repaid?
   H. What collateral will be offered to secure the loan?
   I. Why does a loan or an investment make sense? What is the impact on local economy, job creation, increased tax base, investment in the future of the community?
4. Table of Contents: A single page showing major topics and page references.

5. Description of the Business: Answer as many of the following questions as are appropriate:
   A. What business are you in? Type of business: primarily merchandising, manufacturing, or service?, what is the nature of the product(s) or service(s)?, what will be special about your business?
   B. What market do you intend to serve? What is the total market, and what is your expected share?
   C. How can you serve the market better than your competition?
   D. Present status of the business: start-up, expansion of a going concern, or take-over of an existing business?
   E. If you will be doing any contract work, what are the terms? Reference any firm contracts and include them as supporting documents.
   F. Do you have any letters of intent from prospective suppliers?
   For existing business:
   G. What is the history of the business?
   H. Why does the owner wish to sell at this time?
   I. If the business is going downhill, why? How can you turn it around?
   J. How will your management make the business profitable?
   K. What is the purchase price formula? Give breakdown for building, improvements, equipment, inventory and goodwill.
   Note: If yours will be a seasonal business, make sure seasonality is reflected in your narrative and financial projections with appropriate footnotes.

6. Business Location:
   A. What is your business address and why did you choose this location?
   B. Will the building be leased or owned?
   C. What are the terms and length of the lease contract?
   D. What renovations will be needed and at what cost?
   E. Describe the neighborhood (e.g., stable, changing, improving, deteriorating).
   F. What other kinds of businesses are in the neighborhood?
   G. How much can your business expand before you will be forced to move or add on to the present building?

7. Licenses and Permits:
   A. Is your business name registered with the secretary of state?
   B. State how you will be affected by local zoning regulations.
   C. What other licenses or permits will you be required to obtain?

8. Management:
   A. What is your business and management experience?
   B. What education have you had, including both formal and informal courses that contribute to your management abilities?
   C. Are you physically suited to the job?
D. Do you have direct operational and/or management experience in this type of business?
E. Describe your organizational structure and include a brief description of who does what. (Include an organizational chart if necessary.)
F. List proposed salaries and wages.
G. What other management resources will be available (accountant, lawyer, SBDC)?

9. Personnel: Write a paragraph or two about your personnel needs.
A. What are your anticipated personnel needs?
B. What skills must your employees have?
C. Can you use part-time help to meet changing business volume?
D. Will you have to train people and at what cost?

10. Insurance: Describe your potential business risks and tell what insurance coverage you will purchase to protect yourself.

11. The Market: Generally explain who needs your product or service and how you plan to reach them.
A. What is the present size and growth potential of the market?
B. What percent of the market will you have now and in the future?
C. Describe age, sex, occupation, lifestyle, income, etc. of your various market segments.
D. How will you attract and keep your segment of the market? (product quality, price, public relations, personal selling)
E. What features or services will you offer that will justify your price?
F. How will you handle credit sales? (extend your own credit, accept major credit cards).

12. Competition: Briefly describe your competition and tell how their operations are similar and dissimilar to yours. What is your unique selling proposition and how will you use it to control your market?

13. Financial Data:
A. Source and application of funds statement.
B. Capital equipment list.
C. Current balance sheet and income statement (less than 90 days old).
D. Break-even analysis.
E. Projected income statement, detail by month, first year, detail by quarter, second year, notes of explanation and assumptions
F. Cash flow projections; detail by month, first year, detail by quarter, second year, notes of explanation and assumptions
G. Projected balance sheet; Notes of explanation and assumptions
H. For an existing business, income statement, balance sheets and/or tax returns for past three years.
14. Supporting Documents:
A. Personal resumes for all principals.
B. Personal financial statements for all principals.
C. Letters of reference.
D. Letters of intent from prospective suppliers or customers.
E. Copies of all leases, contracts, or agreements, deeds, or other legal documents.
F. Any other information that might help your case or answer potential questions.

Final Comments;
The development and growth of a food company is hard work, but it can be rewarding in the long run. The business plan is just the beginning of the journey. The suggested format of a business plan is just a general outline. Your product may not need all the elements and possibly not the extent suggested but it is the best place to start. In general, it is suggested that entrepreneurs initially have their food product co-packed (have a manufacturer make it for you) so you can concentrate on marketing and sales. This can make the writing of the business plan much easier. I also suggest that you have a “notes section” or keep a journey of everything you hear people say, comments from seminars that you attend, ideas that come across your mind when you are day-dreaming- everything that you can think of.

You will never hit higher than you aim. Look at the business plan as monopoly and you are playing with play money. Write a book with the end in mind. Dare to dream big. Talk to lots of people. Work to get it right the first time. Start with an idea and then add technology.

D) Organizing your Business;
Many people considering going into business are not aware of all the necessary legal paperwork and permits needed to become a company. In the section below, I have outlined the business structures one must consider, record keeping and other legal requirements and concerns. Some of the information for this section was derived from the booklet “New Venture Guide” from the Arkansas Small business Development Center and can be obtained online at; http://www.asbdc.ualr.edu/consulting/NewVentureGuide.pdf.

I. Business Structures;
There are several kinds of business structures. The most common are sole proprietorship, partnership and corporation. The following discussion of the various types of business structures is presented solely as an overview. Choosing the best form of legal organization for your business is a highly personal matter which depends on your situation. No one form of organization is recommended. It is strongly recommended that you use the following discussion as a means of familiarizing yourself with the types of business organizations. After becoming familiar with these, discuss the
advantages and disadvantages of each form and your specific situation with a qualified tax accountant and/or your attorney before you make a final decision on the type of organization best for you.

**Sole Proprietorship**

A sole proprietorship is a business which is owned and operated by one person. To establish a sole proprietorship, you need only to obtain whatever licenses you need and begin operations. It is the easiest way to go into business.

**Advantages:** The advantages of a sole proprietorship are as follows.

- Little or no government approval is needed. And going into business this way will not be costly.
- The business can be terminated at any time the sole proprietor decides, or it will be terminated with his death. You do not have to share any profits and, likewise, you do not have anyone with whom to share losses. You can quickly respond to problems since you make all the decisions. You have relative freedom from government control and special taxes.

**Disadvantages:** The disadvantages of a sole proprietorship are:

- In a sole proprietorship you have unlimited liability. You, as the sole owner, are responsible for the full amount of business debts. You can lessen the problems of liability, such as physical loss or personal injury, with proper insurance. The business can be crippled if you get sick or terminated if you die. You have less access to capital.
- Getting long-term loans in a sole proprietorship is hard because your collateral is limited. You only have the viewpoint and experience of one person, which can be very limited.
- There are no special tax breaks. The financial results of your business are treated as your personal income or loss for tax purposes. Despite these disadvantages, most businesses start as a sole proprietorship and evolve into a partnership or corporation to increase the access to additional capital or for reasons of taxation.

**Partnerships**

A partnership is an association of two or more persons to carry on as co-owners of a business for profit. Like a marriage, partnerships are easy to get into and sometimes hard to get out of. It is a good idea in the beginning to develop a partnership agreement in writing outlining the responsibilities of the partners.

The two most important types of partnerships are general partnerships and limited partnerships. General partners may or may not participate in the management of the business, but they have joint and several liability. This means each partner is liable up to his/her percentage ownership, but each is also liable for liabilities not satisfied by the other partners. In a limited partnership, the general partner(s) manage the company and the limited partners who do not participate in the management and control of the enterprise have their liability limited to their investment in the business.

**Advantages:** The advantages of a partnership are as follows.

- The legal formalities and expenses can be much less than the required in the creation of a corporation.
- You can obtain more capital and more expertise than in a sole proprietorship just because there are more people to draw on.
- There is less flexibility in making decisions than in a sole proprietorship if decision making is shared. Taking a partner should increase your ability to obtain capital.
Disadvantages: The disadvantages of a partnership are as follows. a) As in a sole proprietorship, general partners have unlimited liability. You can lessen the problems of liability, such as physical loss or personal injury, with proper insurance. Elimination of any partner automatically dissolves the partnership, unless succession is specifically spelled out in the partnership agreement. If you want to buyout a partner, it may be difficult unless specifically arranged in the written agreement. b) The acts of one partner can bind the rest. One partner may agree to buy supplies that are not needed and not budgeted for, committing the others to the expenditures.

Corporations:
This is by far the most complex of the three business structures. A corporation is a distinct legal entity, distinct from the individuals who own it. In Arkansas, a corporation can be one or more people doing business. A corporation is formed by the authority of a state government. You may want to use the services of an attorney for assistance in completing and registering forms with the secretary of state's office (Do not compensate the attorney by allowing him to become a stock holder). You must have the forms completed when you take them there as they do not allow the people in the office to provide any assistance.
As a corporation, you are responsible for paying the corporate franchise tax. Even if you never do business as a corporation, you must file an annual report and pay the modest franchise tax. There are other requirements of being a corporation, e.g., stockholders meetings. If you are becoming a corporation to avoid unlimited liability and don't meet all the requirements, a case could be made against you that you were not acting as a corporation and your personal assets could be used to satisfy the debt. This is known as piercing the veil of the corporation.
It is strongly suggested to incorporate after you are in business making money. To dissolve a corporation, you pay $50 plus all back franchise taxes.
Advantages: The advantages of a corporation are as follows. a) The stockholders of a large corporation have limited liability at the fixed amount of their investment. However, if you are the sole or one of the largest stockholder(s) in your small corporation, creditors will often make you personally responsible for the debts as well. b) There is a stability and relative permanence of existence in a corporation. In case of death of one person, the business will continue. c) The ownership of a corporation is easily transferable as setup in the charter for the corporation. d) It is easier to secure additional capital. e) The ability of the corporation to draw on the expertise and skills of more than one owner is possible.
Disadvantages: The disadvantages of a corporation are as follows. a) The charter and various laws limit the activities of the corporation. b) Some additional government regulation and reporting requirements exist. Forming a corporation can be costly. c) Double taxation - you pay income tax on the corporation's net income and on dividends. To avoid this, forming a subchapter S corporation allows the shareholders to be taxed as if the corporation was a partnership.
Remember, no one is expected to know everything. It is extremely important for every business to identify someone in the fields of law, accounting, banking and insurance and use them when they don't have the knowledge to decide.
**S Corporation and Limited Liability**

Two other forms of business organizations are the S Corporation and Limited Liability Company.

**S Corporation**

An S Corporation makes a tax election filing with the IRS. The IRS treats the S Corporation as if it were a partnership or proprietorship for tax purposes, thus allowing the owner(s) to distribute earnings to themselves and pay taxes on an individual basis.

**Advantages:** Continuous existence; flow-through taxation; limited liability

**Disadvantages:** Expensive to organize; limited to one class of stock 35 owners, and no entity shareholders; has additional legal and tax rules that must be monitored to maintain the integrity of any possible tax advantages.

**Limited Liability Company**

The LLC is a hybrid form of business entity with one or more members, which offers the best of both corporations and partnerships (i.e. liability limited to investment in company and profit or loss flows to each member / partner).

**Advantages:** Limited liability; flow-through taxation; managers not required to be members.

**Disadvantages:** Expensive to organize; the last date the company will dissolve must be stated in the Articles of Organization; newly created entity so law is still developing.

**2) Record Keeping**

There is no particular way to keep books except that personal and business expenses must be kept separate and receipts must be kept. So why should you keep records? The first reason is for tax purposes. All expenses incurred in a business are at least partially tax deductible. Secondly, records make it possible to determine if you are making a profit. You may think your business is profitable, but that may not be true. Do you know how much it costs you to make your product? A small business person should not continue an activity that is not profitable. And finally, you keep records to be able to obtain bank loans. No one will loan you money without a complete set of records showing how the business is doing.

The records that are necessary are:

A) Sales and gross receipts (receipts should be given);
B) Purchases (receipts should be obtained); expenses (travel, overhead, etc.).

Most people start a business in hopes of becoming rich. Others have a business in addition to their primary source of income. Whatever category you are in you should know how the IRS views the situation. Briefly, you must claim any income you make in any business on your income tax. For purposes of reporting to IRS, you will need the following:

A) Well-documented and complete accounting records of expenses and income;
B) A separate checking account;
C) Proof, in as many ways as possible, that the efforts you made were toward making a profit. This proof may take the form of any of the following:
A) The amount of time and effort spent to carry on an activity, particularly if the activity does not have significant personal or recreational aspects, or if you quit another job to do this one.
B) Capital invested and expectations that the assets may appreciate in value;
C) Success of the producer in carrying on other similar or dissimilar activities;
D) Financial status of the taxpayer. Lack of other sources of income indicates to the IRS that the activity is engaged in for profit;
E) Elements of personal pleasure or recreation. The presence of such elements suggests that the activity is a hobby. Fortunately the courts long ago ruled that a business activity can be enjoyable.

3) Other Legal Requirements:

There are many other legal business requirements that you will need to be engaged in a business. Listed below are the most common.

Sales Tax Permits

There are many government requirements when setting up a business. One of the first things you will need to do, if you are selling retail, is to obtain a sales tax permit. Sales tax collection is important as it provides income to state, county and city governments.

Anyone selling within the state must have this license. Taxes must be collected for the particular city or county where goods or services are sold. On mail order items, sales tax must be charged on items delivered to areas inside the state but not on merchandise mailed outside the state. Possessing a sales tax permit exempts the holder from paying taxes on raw materials used in the business and is a prerequisite for buying raw materials wholesale. Forms are submitted monthly. If you are buying an existing business, make sure they do not have a current tax liability as you would be liable for it. Also ask for a statement stating that the business' sales taxes are paid. The permit requires a $50 non-refundable processing fee. Obtain the permit from the Arkansas Department of Finance and Administration, Sales and Use Division, Seventh and Wolfe, P. O. Box 3861, Little Rock, AR 72203; 501-682-7104.

Registering a Fictitious Name

In a sole proprietorship or a partnership, if you use a name other than your own, you must file that name as an assumed, or fictitious, name with the county clerk's office. This is also known as D/B/A (doing business as). It is not costly. The reason for doing this is so the public will know who owns the business. "Jane's Pickles" or "Ma Barker's BBQ Sauce" is not enough information to be able to contact you. Also by registering your name, you will prevent someone else from using the same name and ensure that the name is not already in use. Contact the county clerk's office in the county you are doing business to register a fictitious name. This will only protect your business name in your county. When operating as a sole proprietorship or a partnership, for protection on a state level, you can register your company name with the secretary of State's office. As a further measure of protection on a local, state and national level, a trademark is suggested (see next topic). If you incorporate, the name
will be part of the papers you file with the Secretary of State Office and you will not have to file them separately.

**Trademarks or Trade Name Registration**

You may also want to register your trademark or trade name. This provides the registration and protection of trademarks, service marks, and trade names. The term, "service mark," is a mark used in the sale and advertising of services to identify the service of one person from another. The term, "trademark," means any word, name, symbol, or device, or combination used by a person to identify the goods made or sold by that person. The term, "trade name," is a word, name, symbol, device or any combination used to identify a business, vocation or occupation from someone else's. To register a trademark with the federal government or learn more about trademarks, go to: [http://www.uspto.gov](http://www.uspto.gov). To register a service mark, trademark or trade name, contact the Secretary of State, State Capitol Building, Room 256, Little Rock, AR 72201, 501-682-1010. It costs $50 and is valid for five years.

**Patents**

A patent for an invention is the grant of a property right to the inventor, issued by the United States Patent and Trademark Office. Generally, the term of a new patent is 20 years from the date on which the application for the patent was filed in the United States or, in special cases, from the date an earlier related application was filed, subject to the payment of maintenance fees. U.S. patent grants are effective only within the United States, U.S. territories, and U.S. possessions. Under certain circumstances, patent term extensions or adjustments may be available.

The right conferred by the patent grant is, in the language of the statute and of the grant itself, “the right to exclude others from making, using, offering for sale, or selling” the invention in the United States or “importing” the invention into the United States. What is granted is not the right to make, use, offer for sale, sell or import, but the right to exclude others from making, using, offering for sale, selling or importing the invention. Once a patent is issued, the patentee must enforce the patent without aid of the USPTO.

There are three types of patents:

1) Utility patents may be granted to anyone who invents or discovers any new and useful process, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof;

2) Design patents may be granted to anyone who invents a new, original, and ornamental design for an article of manufacture; and

3) Plant patents may be granted to anyone who invents or discovers and asexually reproduces any distinct and new variety of plant.

To learn more about patents or register for a patent, go to: [http://www.uspto.gov/main/patents.htm](http://www.uspto.gov/main/patents.htm).
**UPC Code:**

There are a variety of different types of bar codes. However, the U.P.C. symbol is the most recognized bar code in the United States, since it appears on almost every retail product. The U.P.C. symbol is the bar code representation of the UCC-12. The Universal Product Code (UPC) number consists of twelve numeric characters that uniquely identify a company's individual product. Although, the initial U.P.C. usage was focused on retail point of sale (POS), many other industries have adopted this coding structure.

The first six to nine digits of a U.P.C. is referred to as the “Company Prefix”, and they are assigned by a non-profit organization (GS1 US formerly the Uniform Code Council). This number uniquely identifies a company and always remains constant on all of a company's products. The next set of digits is called the “product numbers”, and these numbers uniquely identify individual items. Unlike the UCC Company Prefix, product numbers are arbitrarily assigned by each company. The twelfth character in a U.P.C. is the “check digit”. This number is derived from a formula based upon the previous eleven numbers. The GS1 US is the only organization which could assign Company Prefixes. See the figure below for the assignment codes. To apply for a UPC or bar code, go to; [www.gs1-us.info](http://www.gs1-us.info).

A UPC is not a state or federal requirement but most retail stores require them.

![UPC Diagram](image)

**Food Service Permit**

If you are a restaurant owner, you will also need to obtain a food service permit. This permit, which costs a minimum of $50 to review your plans and $25 for a yearly license, ensures cleanliness and proper facilities for food preparation. The health department must inspect the kitchen where food is being prepared. If you are in a home-based food service, a different kitchen other than that used for family meals must be used. Also a separate restroom, other than that used by the family, must be provided whether or not food is served on the premises. Contact your local sanitarian, first. Then you may be required to contact the Department of Health, Sanitarian Services, 4815 West Markham Street, Little Rock, AR 72201; 501-661-2171.

**Self-Employment Tax**

If you are self-employed, you must pay self-employment taxes when filing your income tax form. Use schedule SE. Theses self-employment taxes pay for social
security and medicare benefits. Self-employed people do not pay unemployment taxes nor can they collect unemployment.

**Federal Tax Identification Number (TIN)**

If you plan to hire people to work in your company, you must comply with more government regulations. The federal TIN enables you, as an employer, to deposit various taxes. You must collect income tax and social security and medicare taxes from your employees. You must also pay social security and medicare taxes for your employees. Payroll tax deposits would most likely be made on a weekly or monthly basis. Payments (and deposits) of Federal unemployment taxes must also be made. When you apply you will receive a packet of information about withholding taxes as well as information about an IRS Small Business Tax Workshop offered quarterly in Little Rock. The workshop is free and will explain all the forms. Contact the Internal Revenue Service, 700 West Capitol, Room 100, Little Rock, AR 72201, 1-800-829-1040, for federal tax information.

**State Withholding**

After receiving your federal TIN, you must register with the state for state withholding taxes. The state withholding requirements are similar to federal requirements. Request the state employers guide for information and forms. Contact the Arkansas Department of Finance and Administration, Revenue Division, Seventh and Wolfe, P. O. Box 3861, Little Rock, AR 72203; 501-682-7290, for the state taxes.

**State Unemployment Insurance**

You need to register with the Arkansas Employment Security Department. They will assign you an identification number. The insurance rate is usually around 3.3% on the first $9,000 for each employee and is paid quarterly. Contact the Employment Security Department at 1-800-285-1121 for information about an office in your area.

**Arkansas Workers' Compensation**

This fund pays compensation and medical benefits to employees who are injured, or to dependents of employees who are killed or die in the course of their employment. You obtain this insurance through your insurance agent. Workman's Compensation Insurance is required by law if you have three or more employees. Proprietors and partners do not count as employees; however, all members of corporations do. Employers are required to post a sign in a conspicuous place informing employees of what procedures to follow in case of an injury. Employees are required to submit a written notification of injury no later than the close of the next business day. Contact the Arkansas Workers' Compensation, P. O. Box 950, Little Rock, AR 72203; 501/682-3930.

**Privilege License**

You obtain this license from the city where you do business. If your business is located outside a city, you may not need one. If you need one, you can obtain it from the city clerk's office. In Little Rock you pick it up at the zoning commission and take
it to the city clerk’s office. The fees vary depending on the type of business. In Little Rock it could be $100 - $200 for a small business with no inventory. It is renewable every year and takes about 45 minutes.

**Zoning**

If you are operating in any area not zoned for business, you will need to check with the zoning commission in your town. The zoning commission will tell you if your location is in compliance. Often, it is neighbors rather than a government official who report zoning violations. Zoning requirements vary among cities. For example, in the city of Little Rock you must strictly adhere to the following conditions: Only 49%, or a maximum of 500 square feet, of the principle residential structure can be used for the office operations of your business. This will include telephone and bookkeeping service.

No outside storage of equipment or materials is allowed except material or equipment kept on a truck. Only one service vehicle no larger than 3/4 ton can be parked, stored or maintained at a private residence. There can be no use of any accessory structure on residential property for storage or for conducting business. No present or future employees are permitted to report to this location for job assignment. No additional building or remodeling is allowed on this property to accommodate this business. Since the Arkansas Department of Health prohibits commercial food preparation from the family kitchen, these regulations essentially mean that foods for sale cannot be prepared in a residential area. You might also need to find out about sign ordinances while you are at the zoning commission. Some ordinances are strict about where and how far from the business signs can be placed.

**4) Other Concerns**

1) Getting your business into the yellow page ads may be all the advertising you need. Be aware of the dates when they are due. To be in the yellow pages, you have to have a business phone which costs more than a phone in your private residence.
2) Decide if you want your mail delivered to your physical address (not a good idea for a home-based business) or a post office box.
3) Be sure to sign up for a garbage service as residential service will not cover a business. Be sure it is included in your budget.
4) Be sure you have the space and help to off-load deliveries.
5) Be sure you have a source of supplies. If you need help finding them, check the Small Business Sourcebook or the Thomas Register.
6) Be sure to remember to budget for utility deposits. They may be as high as $1,000.
7) Do not sign your lease until you have the money to start your business. Paying for an unused building is unwise.
8) Set up a separate bank account for your business. No one should pay bills for the business out of their personal account. Having a separate account assists in your record keeping and documentation of tax deductible items.
9) Be sure you have the proper insurance to cover your needs, especially if you are using a business structure of a sole proprietor or partner. Some types of insurance you
might need are property/casualty; general liability; product liability; workers' compensation; and business interruption.

10) Insure that you can accept credit cards. Your business could be crippled without the ability to accept them. To obtain the necessary account, check with your local bank for a merchant's number.

11) However big a business you plan to start, you will be more successful if you obtain the support of your family. Set up a work schedule and follow it.

12) Plan your equipment needs. You might start with used, functional equipment and add more equipment as your business grows.

13) Keep contacts alive and well with colleagues. Join a service club. It is good for business to have a network of people you can call for help.

E) Marketing your Product:

Introduction;

To many people, “marketing” means either selling or advertising of your business. Jay Levinson in his book “Guerilla Marketing” defines marketing as “everything you do to promote your business from the moment you think of the idea until the customers buy and begin to do so on a regular basis”.

There are basically two theories on what the goal of business is;

1) The goal of business is profit and profit means the firm survives and has a chance to grow.
2) The goal of business is to get and keep a customer. Profit is implied because if you don’t make a profit, you will not be around to keep or service your customer. You choose which goal you want to accept. The bottom line is that a profit must be made.

You may be asking yourself, “What is the difference between selling and marketing?” Selling asks the question “How do I get the customer to buy my product?” Marketing takes a broader view and asks “What does the customer want to buy?” The business owner needs to attract new audiences, study the competition and develop his or her product or service so that it appeals to a highly discriminating or targeted audience.

One should view marketing as a process. The successful marketing process includes;
1) Determining what the customer needs and wants.
2) Developing a product or service to meet those needs or wants.
3) Understanding the competition and what they offer.
4) Linking with the customer as a source for fulfilling his or her needs and wants.
5) Doing all of this at a price that provides a profit so that the business can continue to grow.

Let’s go through each one of these in more detail.

1) Determining What the Customer Needs or Wants. A successful business owner analyzes the market. He or she defines the particular market segment most likely to purchase their product or service. The owner then determines the specific benefits desired by the customer.
2) Developing a Product or Service to Meet those Needs or Wants. Upon understanding what benefits are wanted, the owner develops a product or service, the features of which provide the customer with the requested benefits. Marketing is selling these benefits rather than the features. A feature is any prominent or distinctive aspect, quality or characteristic. A benefit is what that feature gives the customer. An example would be a reclosable package. The feature is reclosable: The benefit to the customer is that it can be reclosed and stored for later use.

3) Understanding the Competition and What They Offer. Customers face a large marketplace. A successful business owner is able to define a target market and distinguish his or her business from the competition. Walk down an aisle in any food store, look at all the different brands of a particular type of product and see how each brand tries to provide benefits to the customer.

4) Linking the Customer as a Source for Fulfilling His or Her Needs and Wants. The successful business owner must let the customer know he or she is in business. The owner must also tell the customer how they can meet their needs, a function known as advertising. Types of advertising include radio, TV, newspaper and magazines, flyers, billboards, web-advertising, etc. The business owner must figure out the most cost effective way of getting to the target audience.

5) Doing All of this at a Price that Provides a Profit so the Business can Continue. This implies a price of products or services that allows both the customer and the owner to feel good about the transaction. The business owner must make a profit so that he or she can stay in business to continue providing that product or service.

**Marketing Activities**

There are basically four major categories of marketing activities known as the 4 P’s:

1) Positioning
2) Production
3) Pricing
4) Promotion.

1) **Positioning** is defining the purpose of your product or service as it benefits a potential customer. Positioning is finding a market niche. It creates a perception of special value and benefits in your product or service. Developing one’s position is one of the major goals of the marketing process. An example of positioning is the fast food chain’s hamburger businesses positioning themselves as low cost versus another that features customer choice (“Have it your way”). Place (where the goods or services are marketed) and packaging (how the goods or services are displayed) are extremely important to positioning you product. If a product or service appeals to walk-in traffic, your location must be where such traffic occurs, not in a limited traffic area. If you are developing a product for an upscale market, the packaging must reflect the image you are trying to attain.

2) **Production:** Successful marketing achieves business growth. The owner must have anticipated and planned for this growth in the production process. The inability to fill orders can quickly strangle a firm’s growth and even cause the firm to go out of business.
3) Pricing: Pricing is a key factor to business success. Pricing can be done as a “wild guess”, based on what the competition charges or as a cost-buildup process. I strongly prefer the cost buildup model whereby you list all your costs (raw materials, processing costs, packaging, promotion, salaries, distribution, etc.) and then add a profit margin. Look at what the competition charges as compared to your cost. How can you do it cheaper or better than the competition? Are people willing to pay that price for your product or service? How about running promotions on your product or services so people will try it - buy one, get one free, coupons with a certain amount off?. Most new entrepreneurs tend to under-price their products and services.

4) Promotion: This addresses the question “How will people know about my product or service?” Promotions include paid advertising such as radio, TV, newspaper, etc, and unpaid publicity such as press releases, etc. Promotions may also include trade shows, mailings, internet, in-store demos, etc. Promotional efforts must occur in the media that your perspective customers use. Successful promotional efforts focus on the benefits of your product or service. Benefits can be convenience (precooked, reclosable packaging, etc), fun, good health, etc. Customers do not buy a product or service for its features. They buy it for what it can do for them. Learn to romanticize your product. Watch TV ads- wearing certain brands of trousers make you more appealing to the opposite sex. Laugh? It works. Watch some TV ads- what is the message they are sending? Understand the importance of brand loyalty to customer and that we live in a brand-conscious society. Develop sales literature- price list, catalog sheet, product information sheet, point of purchase brochure etc to entice customers to stop, look at your product and hopefully purchase it. The ultimate goal is to get customers to repeat purchase your product even if it isn’t “on-sale”.

Company Image:
Although not traditionally thought of as marketing, I am a believer in how customers perceive your company’s image. If your company conducts business in a sloppy manner, customers will pick up on this. Even if you conduct your business in a professional manner, you still need to promote your company by donating to organizations such as the United Way, the Salvation Army and other charitable organizations. This communicates that you have a community-mindedness philosophy. Go through your organization and see that things are done as you think your customers would identify with. Are your letters and correspondence done professionally? Are your telephones answered professionally? Are your salespersons ethical? Is your receptionist cheerful, optimistic, properly attired? What about your business facility-people like to work with professional organizations and your office and facilities tell them about your professionalism. Business owners must remain aware of the customer’s perception of the business and move quickly to correct any negative images. Do you contribute to the community or show proper concern for the environment? Do the people within your organization project the image of the company in a favorable way? What about service after the sale? Effective marketing must continue with the product or service after the final sale. This support includes service, assistance, warranties, returns and refunds. Advertising is expensive. It gets
the customer to try your product or service. It is a good start but remember, the goal is
to have customer’s repeat business. Over time, you will notice that 80% of your sales
will come from just 20% of your total customers.

MKT RESEARCH

Before one starts a business and even periodically while in business, one should
conduct market research. Market research is an organized process to gather, analyze,
interpret and utilize relevant information about the business environment for the
purposes of making accurate business decisions. Market research focuses on potential
customers, existing customers, the competition and the business environment. The
ultimate goal of market research is business success. The objectives of market research
are;
1) Identify potential target markets.
2) Identify customer needs and wants.
3) Determine if the product or service meets customer needs.
4) Determine the best promotion technique for each market.
5) Examine the competition.

The purpose of market research data is to help the business owner make better
decisions. Using market research, the business owner can develop an accurate
understanding of the potential customer. The goal of market research is to reveal
unfilled needs in the form of a market niche, customer’s needs, a competitor’s
weakness or an unused marketing strategy. The ultimate goal is to increase the
business’ sales and profits. Any one can do market research to some extent. Basically,
you want to gather information about;
1) Your customers or potential customers
2) Your competition
3) General market information
Let’s go through each in greater detail.

1) About your Customers or Potential Customers

In this area, we want to obtain general demographic information such as age,
where they live, where they work, race, gender, marital status, income, number of
children, education, home ownership, lifestyle, etc. You also want to know their needs,
wants and desired benefits. You may also wish to know about the customer’s past and
future purchases (what, when, why, where, how much). You should also know about
products and services that compliment or substitute for your product. You also want to
know the advertising media that your customers use (radio, TV, newspaper,
magazines, etc.). The more information we can obtain about current customers and
potential customers, the better the chances we have of keeping them coming back for
additional products. What about those warranty cards? Whenever you buy any
appliance and certain goods, you are requested to fill out a warranty card. If you fill
out the warranty card, the product you bought will be under warranty for some
specified period of time. Note how much the information on the warranty card
parallels the demographic information we mentioned above. Warranty cards serve as a
prime method of collecting marketing information.
About the Competition
You want to gather information about your competition. Who are they? What products and/or services do they offer? What is the price range of products and services? What are their policies on returns, credit, warranties, etc.? Are there any special services? If they are a store-type business, what is their staff like (experience, customer respect, customer focus)? What kinds of promotions/advertising do they do? What is their company image like to the average customer?

General Market Information
In this section, we want to know more about the market in general. What is the long term future of the market? Some industries are in decline while some are going full throttle. It would be good to know what direction the market is going. What about the raw material market? It would be a mistake to get into marketing a product based on wheat when the wheat market is headed up due to drought in the Midwest.

Analyzing Market Research Data
To do market research, you first have to go out and get some of the information previously mentioned. The Internet brings information to your finger tips. You may have to learn where to go but information is available. You should also plan to visit a food store and just look around not only in the area that you want to enter but other food groups (e.g. what are the dairy foods people doing that I can adopt?). Talk to people in the business from entrepreneurs to store owners, brokers, sales representatives, etc. Most people like to help others and will tell you more than you ever dreamed. Market research identifies the available market, discovers the best method to reach the target market and asks what the customer needs and wants. Market research is a simple, structured, objective way of learning about people- the people who will buy your product or service.

There also some books that I encourage you to read;
1) A book entitled “From Kitchen to Market” by Stephan F Hall. Sold via Amazon.com for about $20- A complete, easy to understand book on taking a food product to market.
2) The Arkansas Small Business Development Center in Little Rock (501/324-9043) has a resource library that contains many references.

Once you have collected as much data as you reasonably can, you need to organize it by the something called the SWOT grid as shown in the Table 3-1.
TABLE 3-1; SWOT GRID

<table>
<thead>
<tr>
<th>SWOT format</th>
<th>My Business</th>
<th>Its Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>S = Strengths</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W = Weaknesses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O = Opportunities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T = Threats</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the grid, you evaluate your business or business potentials on its strengths, weaknesses, opportunities and possible threats. When you evaluate the environment, where do you see chances for growth and what might slow your business. Once this grid is filled out, you will be able to see where your business is headed and what you can do to improve your situation.

6. GUERRILLA MARKETING

We have previously discussed marketing in broad, general terms. For the small business owner or entrepreneur, marketing is something to think about but often question how they can compete with the larger, more established food processing companies. Guerilla marketing takes its name from guerilla warfare meaning “no rules”. In the words of the Father of Guerrilla Marketing, Jay Conrad Levinson, in describing guerrilla marketing: "I'm referring to the soul and essence of guerrilla marketing which remain as always -- achieving conventional goals, such as profits and joy, with unconventional methods, such as investing energy instead of money".

Guerilla marketing is specifically for the small business that allows them an unfair advantage over the established big companies. Guerrilla marketing involves the use of unconventional and unorthodox marketing methods that allow small businesses to compete with minimal financial investment. It involves recognizing and exploiting all marketing opportunities.

Jay Conrad Levinson in his book entitled “Guerrilla Marketing” lists the following as to what guerrilla marketing is and is not;

1) Guerrilla marketing invests time, energy and imagination into marketing rather than money. Guerrilla marketing does not cost a lot of money. Spend about 50% of your marketing budget on people who already do business with you and the other 50% on prospective clients.

2) Guerrilla marketing uses psychology and the laws of human being in their marketing. Guerrilla marketing is committed to knowing the customers. Guerrilla marketing is obsessed with benefits of the product, not the features.

3) Guerrilla marketing uses profits as the yardstick by which they measure the effectiveness of their marketing programs.
4) Guerrilla marketing focuses on the devotion to the customer follow-up rather than ending the deal with the sale.
5) Guerrilla marketing is dedicated to making relationships rather than sales, for long term relationships are paramount.
6) Guerrilla marketing uses marketing combinations rather than single marketing tools like advertising. Guerrilla marketing focuses on impact of the message rather than the volume.
7) Guerrilla marketing suggests that you be sure to maintain your focus.
8) Guerrilla marketing strives to aim marketing messages to individuals, not to groups. Guerrilla marketing understands positioning and niche markets.
9) Instead of thinking about what you can take from a customer, guerrilla marketing suggests that you think of what you can give.
10) Guerrilla marketing suggests you embrace technology. Become a “technophile”.
11) All guerrilla marketing is intentional from how the phone is answered to the attire your employees wear.
12) Instead of talking about yourself and being “me” marketing, guerrilla marketing talks about the customer and “you” marketing. Guerrilla marketing is committed to knowing the customers.
13) Instead of going for the sale with marketing, guerrilla marketing goes for consent to receive marketing materials. Then only markets to those who have given their consent.

More information on Guerrilla Marketing can be found at;  
http://www.gmarketing.com/

Special Comments on Guerrilla Marketing;

Guerrilla marketers are strong on defining benefits versus features. Features are characteristics that physically describe your product or service. Benefits describe how the product or service will help the customer solve his/her problem. Be blatant is promoting your benefits. Your benefit statement could become the basis of your business slogan.

Guerrilla marketers are obsessed with positioning. First write down what product or service you will offer. Second, make a list of features that are different or better than your competitor’s. Third, write out the benefits of your product or service. Your benefits should be better than your competition, if not, how will you compel consumers to switch. Most entrepreneurs and small businesses tend to focus on the wrong things. They try to do the same thing their competitor does. Market your difference from competitors. You have to do something better than your competition.

In guerrilla marketing, you need to determine who your customer is and your niche market. Your marketing message stays the same but use a different theme each month. You should focus your marketing efforts more on relationship building, not always in dollars. This relationship usually equates to return customers. The relationships that you build bring customers which is something the big companies cannot do.
Guerrilla advertising is more focused, more personal and in the long run more effective than traditional advertising. Traditional advertising uses newspapers, magazines, television and radio all of which can be very expensive. The most important aspect of this advertising is repetition. It will take at least 27 times for your ad to be noticed by a consumer. Guerrilla advertising uses mini-media such as business cards, brochures, banners, newsletters, circulars, door hangers, gift certificates, etc. You can be creative in this approach. Guerrilla advertising receives a higher rate of response to their targeted media and builds a loyal following. Media quality becomes more important than quantity.

G. PRICING YOUR PRODUCT;

Introduction;

The price you charge for your product is a very difficult task for most entrepreneurs and small business owners. This is usually understandable in that not all the costs are known but as your business grows, you should make a reasonable attempt at determining the exact amount that it costs to manufacture and market your product.

The Economic Research Service of the USDA has obtained figures on what it costs to manufacture and distribute food. Figure 3-2 below shows these costs as a percentage of the food dollar. The figure essentially says for every dollar you spend on food, the farmer who grew the crop gets 19 cents, the labor required to process, distribute and serve the customer in a restaurant if food service or labor required to stock the retail shelf in a food store comes up to 38 cents. The costs associated with packaging, transportation, energy, profits, etc are also shown. I must point out that these numbers include both food service (restaurants) and retail food stores so they are hard to directly related to only retail or only food service.

Figure 3-2; Components of the Food Bill.
Pricing is vital to the success of any business. The best way to look at pricing is charging the “right price” maximizes long term profits. This means that you might not make any profits the first few years of opening a business. Most business owners set prices that maximize sales but not profits. At times they set prices that guarantee sales but these prices do not even cover costs. This will only guarantee business failure in the long run.

**Product Distribution:**

Before you get into calculating your food manufacturing costs, you must determine which system of distribution is best suited to you and your products. This has to do with the type of sales outlets that you will work in. Options include retail food stores, specialty shops, food service or convenience stores. This decision will effect the pack size, cost of sales personnel, distribution, sales promotion and advertising and so many other components.

**Pricing:**

There are three methods of pricing products;

1) The **costing method** uses actual information and determines the actual cost to manufacture, distribute and sell your product. Because this method requires detailed information, it is the most difficult to do. We will go through this method later in this chapter.

2) The **competitive pricing** scheme is where the owner establishes his/her selling price higher or lower than the competition. The advantage to competitive pricing is the control of a major factor on obtaining and retaining customers. The disadvantages are knowing who the competition is and the fact that the competitions price may be constantly moving. Another disadvantage to competitive pricing is that it does not guarantee that you are covering all the costs incurred.

3) **Value pricing** represents a pricing strategy that typically occurs within small niche markets such as farmer markets. In this strategy, the uniqueness of the product allows the owner to charge extra. It implies that the customer is able and willing to pay for a customized product or personalized service.

**Cost Buildup:**

We will now go through the cost buildup of a food product for use in the costing method. The major cost items can be categorized as either **direct costs** or **indirect costs**. **Direct costs** as the name implies, are the costs directly associated with the manufacture of the product. These include materials and supplies, salaries, wages and benefits paid to produce the product and waste generated during the process that does not meet acceptable standards or is lost in the manufacturing process. **Indirect costs**, often referred to as overhead, are the costs associated with running the business and can be categorized as either **fixed expenses** or **variable expenses**. Fixed expenses include such items as rent, utilities, labor costs for office employees, property insurance, taxes, licenses, dues and subscriptions. Variable expenses include such items as office supplies, business travel, advertising, sales commissions and marketing.
**Determining your Costs:**

We will now go through the steps in determining your costs of producing your product. The figures used are fictitious so do not use them but come up with your own. The first step is to determine your direct costs which are costs incurred directly from the manufacture of the product. Let’s assume the product is 1 lb jars of salsa packed 25 jars per case. These are shown in Table 3-2

<table>
<thead>
<tr>
<th>Cost Component</th>
<th>Price/ lb</th>
<th>Amount /100 lbs</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato Sauce</td>
<td>$0.40</td>
<td>90</td>
<td>$36.00</td>
</tr>
<tr>
<td>Sugar</td>
<td>$0.48</td>
<td>8</td>
<td>$3.84</td>
</tr>
<tr>
<td>Salt</td>
<td>$0.32</td>
<td>2</td>
<td>$0.64</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100 lbs</td>
<td>$40.48</td>
</tr>
</tbody>
</table>

Comment: Rarely do you get a 100% yield. We are always going to have some raw product spoilage or cooking loss. Let’s say in this example, we only got a 92% yield. So, $40.48 divided by 92 lbs + $0.44 /lb or $44.00 per 100 lbs of ingredients.

| Total Cost of ingredients | $44.00 |
| If we package it in 25 lbs cartons, the ingredient cost per case = | $11.00 |

2. Packaging

<table>
<thead>
<tr>
<th>Cost Component</th>
<th>Cost per unit</th>
<th>Cost per case (25 jars per case)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Jars (16 oz)</td>
<td>$0.16</td>
<td>$4.00</td>
<td></td>
</tr>
<tr>
<td>Lids</td>
<td>$0.08</td>
<td>$2.00</td>
<td></td>
</tr>
<tr>
<td>Labels</td>
<td>$0.10</td>
<td>$2.50</td>
<td></td>
</tr>
<tr>
<td>Master Box</td>
<td></td>
<td>$2.25</td>
<td></td>
</tr>
</tbody>
</table>

Comment: You must include all packaging supplies. We have calculated it on a per case basis.

| Total Packaging cost per case | $10.75 |

3. Labor

| 3 people X 15 minutes (or .25 hrs) x $11.20 per hour | $8.40 |

Comment: In this example, we figured 3 people could manufacture and package 1 case containing 25 lbs of finished product in 15 minutes. You then need to come up with a full salary figure. This figure needs to include total salary including tax withholding and social security, workman’s comp insurance, benefits such as medical and dental, etc. You also have to remember that even though people are on the assembly line or at work, they are not always in producing. You need to account for breaks, vacation, setup time, product change-overs and other times that people are at work but are not actively producing. Most companies figure workers work about 70-80% of the time. If you are estimating labor, it is best to figure total hourly salary ($8.00/hr) and multiple by 1.4.

$8.00/ hr X 1.4 = $11.20 per hour.

| Total cost per case = | $30.15 |
Some people add in freight to above table.

So we finally come up with a direct cost per case of 30.15 or $1.06 per 1 lb jar of salsa.

**Indirect costs**

Now we need to add our indirect costs. You start by figuring out the cost of your building and equipment depreciated out over time as shown in Table 3-3.

Table 3-3; Cost of Building and Equipment

<table>
<thead>
<tr>
<th>Asset</th>
<th>Total Cost</th>
<th>Years</th>
<th>Cost / year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building (rent or purchase)</td>
<td>$220,000</td>
<td>20</td>
<td>$11,000</td>
</tr>
<tr>
<td>Kettle- 30 gallon</td>
<td>$10,000</td>
<td>7</td>
<td>$1,428.60</td>
</tr>
<tr>
<td>Mixer</td>
<td>$4,000</td>
<td>10</td>
<td>$400.00</td>
</tr>
<tr>
<td>Filler</td>
<td>$8,000</td>
<td>10</td>
<td>$800.00</td>
</tr>
<tr>
<td>Capper</td>
<td>$12,000</td>
<td>7</td>
<td>$1,714.30</td>
</tr>
<tr>
<td>Carton former</td>
<td>$7,000</td>
<td>10</td>
<td>$700</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$16,000</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After we have determined our cost for the facility and equipment, we can figure these numbers into our total indirect costs as shown in Table 3-4. Indirect costs should be figured on 52 weeks per year x 5 days per week or 260 working days per year.

Table 3-4; Indirect costs

<table>
<thead>
<tr>
<th>Cost item</th>
<th>Total annual Cost</th>
<th>Cost per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIXED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building &amp; Equipment</td>
<td>$16,000</td>
<td>$61.54</td>
</tr>
<tr>
<td>Utilities</td>
<td>$ 4,000</td>
<td>$15.38</td>
</tr>
<tr>
<td>Maintenance</td>
<td>$20,000</td>
<td>$76.92</td>
</tr>
<tr>
<td>Office Labor</td>
<td>$15,000</td>
<td>$57.69</td>
</tr>
<tr>
<td>Insurance (property &amp; liability)</td>
<td>$ 3,600</td>
<td>$13.84</td>
</tr>
<tr>
<td>Property Taxes</td>
<td>$10,000</td>
<td>$38.46</td>
</tr>
<tr>
<td>Licenses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manager salary</td>
<td>$20,000</td>
<td>$76.92</td>
</tr>
<tr>
<td>Accountant</td>
<td>$ 3,000</td>
<td>$11.54</td>
</tr>
<tr>
<td>VARIABLE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Travel</td>
<td>$ 3,000</td>
<td>$11.54</td>
</tr>
<tr>
<td>Advertising</td>
<td>$ 5,000</td>
<td>$19.23</td>
</tr>
<tr>
<td>Sales Commission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marketing</td>
<td>$ 6,000</td>
<td>$23.07</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$105,600</strong></td>
<td><strong>$406.13</strong></td>
</tr>
</tbody>
</table>
So, up to now we have:
1) Direct cost of $30.15/case or $1.06/ 1 lb jar
2) Indirect cost; We figured our indirect costs at $406.13/ day. We then calculated based on an 8 hour day, our per hour indirect cost to be $50.77/ hour or $12.68 / 15 minute time of manufacture.
3) Profit at 10% ($30.15 + 12.69) x .10 = Wholesale price or cost to sales.
   
\[
\text{42.84} \times 0.10 = 4.28 = $47.12 \text{ per case or } $1.88 / 1 \text{ lb jar.}
\]

Table 3.5; Summary of Costs to Sales

<table>
<thead>
<tr>
<th>Source</th>
<th>Cost per case</th>
<th>Cost per 1 lb jar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct costs</td>
<td>Calculated above</td>
<td>$30.15</td>
</tr>
<tr>
<td>Calculation; Add up your raw ingredients, packaging and labor</td>
<td></td>
<td>1.06</td>
</tr>
<tr>
<td>Indirect Costs; Calculation; Add up all other costs that are not directly related.</td>
<td>Calculated above</td>
<td>12.68</td>
</tr>
<tr>
<td>Profit; Total direct and indirect costs and multiply by 10%</td>
<td>((30.15 + 12.68) \times 0.10 = )</td>
<td>$47.12 $1.88</td>
</tr>
<tr>
<td>Your cost to sales or Ex-warehouse cost</td>
<td></td>
<td>$47.12 $1.88</td>
</tr>
</tbody>
</table>

The above determination of your cost works well for large and medium-sized companies but will probably not work well for the entrepreneur or small business. As a small business begins, many of the indirect costs are not applicable to the small business owner such as manager’s salary, office labor and other things. The small business owner does these things himself/herself. But it is important to go through this to start to get some handle of your true costs. Most entrepreneurs under-price their products because they are not aware of all these indirect costs. I strongly suggest that you go through this exercise and start gathering the information so you don’t underestimate your costs.

As your business grows, you must find ways to manufacture and deliver your products more efficiently and become more profitable. There are two things you can do to become more profitable. First, you can increase your prices. Second, you can decrease your costs to produce the goods. An increase in prices can cause sales to drop. If product sales drop too far, you may not generate enough money to cover your fixed expenses. Price increases require a careful reading of inflation rates, competitive factors and basic supply and demand for the product you are producing. The other way of increasing your profit is to lower your production costs. This can be accomplished by decreasing material costs or making the product more efficiently. Volume discounts are a good way to reduce material costs. The more material you buy from a supplier, the
more likely they are to offer you discounts. You can also reduce your labor costs by using automation.

**Selling your product:**

Now that we have figured our cost, it is now time to get it to the consumer. This is where it is important to have your food channel (retail, food service, internet sales etc) identified. Find out if the distributor and/or retailed use markup or margin. Most will probably use margins. Before getting into the details of determining final product cost to the consumer, we need to discuss the concepts of “markup” and “margin”. Many people used markup and margin synonymously but they are different. Markup is figured as a percentage of the wholesale price whereas margin is figured as a percentage of the selling price. For example, if we took our cost to sales of salsa and used a 25% markup, the cost would be computed as follows;

\[
\text{Wholesale price} \times 25\% = 25\% \text{ markup} \\
$1.88 \times 1.25 = $2.35 \\
\text{Or} \\
\text{Selling price/ Wholesale price} = \% \text{ markup} \\
$2.35 / $1.88 = 25\% \text{ markup}
\]

If we use margins, our cost to sales of salsa and used a 25% margin, our cost would be computed as follows;

\[
\text{Wholesale price} / \text{the reciprocal of 1} = 25\% \text{ margin} \\
1.00 - .25 = .75 \\
$1.88 / 0.75 = $2.50 \\
\text{Or} \\
\text{Wholesale price/ selling price} = 25\% \text{ margin} \\
$1.88 / $2.50 = a 25\% \text{ margin}
\]

The different selling prices of $2.35 and $2.50 occur when you use a markup versus a margin. The markup is cost plus profit; whereas the margin is calculated on selling price less profit.

For the entrepreneur, it is best to use the margins method and start with the competitor’s price as a reference. Then deduct the retailers and distributors margins and this will tell you where you need to be relative to your cost to sales.

To determine your final cost to the consumer, determine the distributors and retailers margin or markups. Most distributors use about a 25% margin whereas retailers typically use a 50% markup. To some people, 25% margins and 50% markups seem fairly high but one must understand what they do and their costs. Distributor margins are used to pay for storage of products at warehouses and make deliveries to restaurants or retail stores. The cost of trucks, drivers and fuel are all part of their costs. Retail stores also have costs such as the cost of the store itself, air conditioning/ heating, stocking shelves, polishing floors, salaries for clerks etc. Restaurants margins include costs of the building, cooking equipment, cooks, cleaning etc.
Table 3-6: Cost Buildup including Margins and Markup

<table>
<thead>
<tr>
<th>Segment</th>
<th>Per case</th>
<th>Per 1 lb jar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost to sales or wholesale</td>
<td>$47.12</td>
<td>$1.88</td>
</tr>
<tr>
<td>cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distributor (25% margin)</td>
<td>$62.83</td>
<td>$2.51</td>
</tr>
<tr>
<td>Retailer (50% markup)</td>
<td>$94.24</td>
<td>$3.76</td>
</tr>
</tbody>
</table>

**H. New Product Presentation**

If your product is directed toward retail food stores, the key is acceptance of your product by a buyer for either a food store chain or an independent wholesaler. The decision to stock an item is made by the buyer, and part of the decision process is based on the so-called new product presentation. There are several basic items that buyers must know about the product prior to making the decision. Among them are:

1. Size of container
2. Containers per case
3. Case weight and cube
4. Palletizing arrangement (cases per layer and number of layers)
5. Case cost - both delivered and picked up at your plant
6. Payment terms (such as 2 percent cash discount if paid in 10 days - net due in 30 days)
7. Promotional allowance*
8. Introductory allowance*
9. Quantity discounts
10. Advertising allowance*
11. Minimum order quantity
12. Maximum order quantity
13. Slotting allowance*
14. Present distribution in the trade area
15. Amount of product liability insurance*
16. Delivery time in working days
17. Uniform Product Code number
18. Is sale guaranteed
19. Is product advertised - media - dates
20. Coupon program
21. Method of shipping
22. Swell allowance (damaged goods)
23. Price protection
24. Is product taxable
25. Vendor spoils policy
26. Pull date information (if applicable)
27. Suggested retail price

*(note: items marked with a * are discussed in the following paragraphs):
This list at first may seem a bit overwhelming. Closer inspection finds that most questions can be answered easily. Major factors that should be carefully scrutinized relate to introductory and/or promotional allowance, advertising allowance, slotting allowance and product liability.

Introductory and/or promotional allowances are expected of new products and may be formulated in different ways. The two most popular means are “free” goods or a “cents off” program. Free goods are most often in the form that for every x cases ordered, one case is given free. Cents off is a discount off the processor’s unit price on all products bought during the period. Most retailers require that these terms are presented in contract form.

Advertising allowances may take either of these forms or a lump sum payment. In return, the retailer features your product in its weekly newspaper ad or with a special in-store display.

Slotting allowances are fees that wholesalers charge per item to stock new items in their warehouse. Be prepared, for buyers to ask for all of these allowances on a new untested product.

Product liability insurance is a must. Buyers will not even consider a product unless a policy is presented. Most expect the policy to be no less than a million dollars.

Another important factor to a buyer is the product’s current distribution in retail stores. This is akin to the “chicken and egg” dilemma. If the product was in distribution you wouldn’t be in his office seeking shelf space. Nonetheless, there are some things you can do in order to show buyers your product has been accepted by consumers.

One method would be to seek out an independent retailer in your local market who is willing to allow you to put your product in their store. Permission will be enhanced if you give them the initial stock and guarantee that you will remove the product if it doesn’t meet sales expectations. Permission should be further enhanced by putting on in-store demonstrations. You, or a member of your staff, should put on the demonstration which consists of providing bite-sized samples to customers. Such demonstrations are usually done on Friday and Saturday and a promotional price is often made available. This promotion price could be a discount off regular price, or in many instances, it is in the form of buy one and get one free.

After the demonstrations, you should go into the store at least twice weekly to monitor sales and make sure the product display is in order. Sales should be accurately monitored so they may be related to your broker and prospective buyers. This test should last from four to six weeks.
A) Introduction:

This chapter deals with how foods are preserved, processed and about
microbiology and other aspects of food safety and control. It is brief when one
considers the amount of information available. It is important that developers of new
food products understand the principles discussed in this chapter.

B) Principles of Food Preservation and Processing:

[Some of the information in this section dealing with food preservation and processing was adapted from Downing
Agricultural Experiment Station, Cornell University, Geneva, NY.]

The history of food preservation predates man’s ability to write. We know
cavemen used fire to cook meat which is a method of pasteurization. The ancient
Egyptians used salt peter which contains nitrite to preserve meat. Hebrew laws also
provide us with some insight into the beliefs about food preservation. They knew that
rubbing meat with salt known as “begissing” extended the shelf life of meat. The
exploration of the world by such explorers as Christopher Columbus, Ferdinand
Magellan, Marco Polo etc were the result of the quest for spices. Columbus was
specifically looking for a shorter way to the far-east where spices were abundant.
Although this is not food preservation per se, it does show the importance that people
at that time put on food. The American Indians found that meat could be dried and
subsequently preserved and is presently known as jerky. The Europeans found that
certain bacteria could be used to ferment some foods known today as beer, cheese,
sausages, sour kraut etc. Although the mechanisms of action of these early
preservation techniques were unknown at the time of their use, they are still used today
but with advanced knowledge of the science behind the technique, we are better at
maximizing the techniques.
Human beings consume a wide variety of foods with a range of chemical compositions, and many different flavors, colors, textures, and levels of nutrients. The main food types may be classified as follows:

1. Cereals - wheat, corn, rice, barley, etc.
2. Vegetables - beans, carrots, cucumbers, cabbage, potatoes, etc.
3. Dairy - milk from cows, goats, and other animals and products derived from milk such as cheese, cream, butter, yogurt, ice cream, etc.
4. Fruits - apples, cherries, grapes, peaches, bananas, pineapples, etc.
5. Meats - beef, pork, lamb, goat, rabbit, etc.
6. Fish - tuna, haddock, lobster, shellfish, etc.
7. Poultry - chicken, turkey, duck, eggs, pigeons, etc.
8. Fats - vegetable oils, vegetable fats, animal oils, animal fats, and mixtures of these.
9. Sugars - crystalline sugar, corn syrup, candies, chocolate, etc.
10. Legumes and oil seeds - dry beans, lentils, some nuts, soybeans, etc.
12. Miscellaneous - spices, salt, MSG.

Preservation and processing technologies are largely determined by the chemical composition and the structure of the food. Because of the wide variety of chemical compositions of food, many methods are used to preserve and to process them.

To set the stage for the material that follows, it is necessary to ask the question, "What influences people to choose a food?" There are several answers to this question. The first answer is because they like it. This introduces the concept of quality. People will not purchase food unless it reaches the quality standards that they expect for that food. Quality can be broken down into three components:

a) Appearance which is size, shape, and color;
b) Flavor which is taste on the tongue and odor in the nose;
c) Texture which is how the product feels in the hand, how it feels in the mouth as it is chewed, or how it pours if it is a liquid.

The importance of quality can never be underestimated. People will not eat food unless it provides the pleasurable experiences that they expect from it. Another important factor in food selection is the assumption that the food is safe, that is, it is free from harmful ingredients, spoilage microorganisms of public health significance and will cause no damage to the consumer's health. The safety aspect of food is an important criterion that must always be addressed. Food also must be affordable. The selling price must be in a range that people can afford and are willing to pay. Finally food is chosen because it is nutritious. For the majority of people, nutrition comes last. Few people will eat food because it is good for them if it does not have the appearance, flavor and texture that they expect. Nutrition is, of course, essential. However, before food can be called nutritious it must be acceptable since the nutritional value is zero if people refuse to eat the food. No one class of food can supply all of the essential
nutrients; a diet consisting of a wide range of foods is needed to assure adequate nutrition.

It is well known that some foods keep longer than others. We refer to this by saying foods have varying levels of perishability. On this basis, foods can be classified into three groups depending on how long they keep without any treatment.

1. Highly perishable foods will keep for only hours or days before spoiling. Examples are milk, meat, fish, and some fruits and vegetables. In general, the most perishable foods are those that contain a high level of protein or have moisture carbohydrates in them.

2. Perishable foods will keep for several weeks or months without spoiling. Examples are most fruits and vegetables, fats and oils.

3. Staple foods will keep for months or years without spoiling. Examples are whole cereal grains, oil seeds, nuts and honey.

The perishability of food dictates to a considerable extent the preservation techniques that are used to keep that food. For stable foods, preservation techniques are devoted to keeping out insects, rodents and other pests and keeping the foods dry to prevent it from becoming moldy. Highly perishable and perishable foods depend heavily on the technologies of refrigeration, drying, freezing, canning and the use of chemical preservatives to give shelf stability. These treatments can make highly perishables and perishables keep for many months or years if they are performed properly.

A distinction needs to be made between food preservation and food processing.

**Food preservation** increases the stability of the food so that it can be stored for a longer time before spoiling. Foods are preserved by any of the following methods:

1) Cold - refrigeration, freezing
2) Heat - pasteurization, sterilization
3) Reduction of moisture content
4) pH control
5) Chemical preservatives
6) Combinations of the above

**Food Processing** converts edible food into another form with a higher degree of acceptability. For example, from the nutritional standpoint, there is no reason why wheat should not be consumed directly as a food; however, its texture is much too hard for most people to chew. Consequently, wheat is processed into other forms with higher acceptability such as bread, pasta, cakes and cookies. Some food processing techniques decrease the stability of the food. For example, barley grains will keep for years in good condition but beer is a highly perishable product. Dry pasta and dry
beans will keep for many months in good condition but after being cooked, they become moist and will spoil within a few hours unless refrigerated.

One overriding concern that must be kept in mind in all food preservation and food processing operations is the concept of health and safety. Various government agencies are empowered to see that food manufacturing establishments, food retailers and food service establishments serve only food that will not be dangerous for human consumption. The major cause for concern by health authorities is the growth of harmful bacteria on moist foods. Bacteria are always present in the environment and can multiply quickly in moist foods. Food production facilities must be constantly vigilant in terms of maintaining conditions where bacteria cannot grow or if they grow, can only grow very slowly.

**Food Preservation:**

Food technologists recognize that all foods deteriorate in storage. Generally, foods have their best quality at the time of harvest or processing and the quality deteriorates steadily during storage. Poor quality raw materials will never produce a good quality preserved product. High quality raw materials can produce a good quality preserved product or a low quality preserved product depending on how well the processing is conducted.

All food is biodegradable. This means the food breaks down and is returned to the earth in a form that can be reused for growth. This is Mother Nature’s way of recycling. There are basically three ways in which foods are decomposed. First is that of small living organisms called microbes. These can be classified as bacteria, yeast and molds. They break the food down to smaller particles. For example, bacteria can breakdown large protein molecules into smaller particles some of which contain sulfur containing amino acids. This is what gives rotten food its characteristic odor. The second mechanism is that of enzymes. All forms of living matter from meat to plant tissues contain enzymes that cause food to breakdown into smaller particles. The best example is that of vegetables. Vegetables must be blanched (heat treated) before going into a freezer. Even through the freezer temperatures slow down the rate of enzymatic activity, it does not stop it. Failure to blanch vegetables before freezing will result in an extremely soft, mushy texture. This is due to the enzymes in the raw foods products breaking down the internal structure of the food while in the freezer. The third method of degradation is that of oxidation. Oxidation is not so much about structural damage but has to do with fat becoming rancid by what is known as the free radical.

All food preservation techniques are based on one of four major categories as listed in Table 4-1.
Table 4-1; Major Categories of Food Preservation

<table>
<thead>
<tr>
<th>Category</th>
<th>Types</th>
<th>Sub-Types</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Controlled</td>
<td>Cold</td>
<td>Refrigeration</td>
<td>Milk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Freezing</td>
<td>Frozen Vegetables</td>
</tr>
<tr>
<td></td>
<td>Heat</td>
<td>Pasteurization</td>
<td>Milk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sterilization</td>
<td>Canned vegetables</td>
</tr>
<tr>
<td>Moisture Controlled</td>
<td>Drying</td>
<td></td>
<td>Jerky</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced Aw</td>
<td>Jelly</td>
</tr>
<tr>
<td>pH controlled</td>
<td>Add acid</td>
<td></td>
<td>Acidified Vegetables</td>
</tr>
<tr>
<td></td>
<td>Add bacteria</td>
<td></td>
<td>Sour kraut</td>
</tr>
<tr>
<td>Preservatives</td>
<td>Smoke</td>
<td></td>
<td>Smoked meats</td>
</tr>
<tr>
<td></td>
<td>Chemical</td>
<td></td>
<td>Sodium Nitrite</td>
</tr>
<tr>
<td></td>
<td>preservatives</td>
<td></td>
<td>Sodium benzoate</td>
</tr>
<tr>
<td>Combination of above</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Temperature Controlled:**

Temperature can be used quite effectively to preserve food and is used frequently. Temperature treatments for preservation can be divided into the use of cold temperatures such as refrigeration and freezing. Heat treatments can be divided into pasteurization and sterilization techniques. The idea behind using temperature as a preservation technique mainly lies in the control of bacteria and to some extent enzymes. Bacteria grow well at temperatures above 40F. Bacteria grow at temperatures below 40F but at a much slower rate. Some believe that bacteria and enzymatic activity are stopped at freezer temperatures. This is not exactly true. Bacteria live through frozen temperatures but are dormant or grow very slowly.

Refrigeration is the easiest and most convenient method of extending the shelf life of foods. It is also known as the" gentlest" method of preservation because it causes the least change in the original quality of the food. Refrigeration greatly slows the rate of growth of microorganisms that spoil the food. These include bacteria, mold and yeast. It does not prevent their growth, it only slows it. Table 4-2 shows the growth of bacteria held at various temperatures and over a period of time. Notice that the time required to reach a million plus bacteria is shorter as the temperature is increased.
Most food poisoning organisms grow slowly between 40-50°F and grow extremely slow at temperatures below 40°F. For this reason, it is desirable to maintain the temperature inside refrigerators below 40°F.

The rate of growth of microorganisms on refrigerated food depends upon the temperature of the food, not on the temperature in the refrigerator. When warm food is placed in a refrigerator, a period of time is required to cool the food down to refrigerator temperature. During this time, microorganisms may be growing even though the food is in a cold refrigerator. Food in large containers takes longer to cool to refrigerator temperature than food in small containers. Therefore, it is unwise to place large containers filled with warm food in a refrigerator. Since rapid cooling is desired, it is advisable to pack food in containers no deeper than four inches. Once the food comes to refrigerator temperature, it may then be transferred into larger containers for continued storage in the refrigerator. In some cases it is possible to precool warm food by placing the container under cold running water for a period of time before it is placed in the refrigerator.

### Refrigerated Foods

The popularity of refrigerated/ chilled foods is increasing at a surprising rate. Most of these products are convenient to use and have a "close to fresh" image. Some of these products are partially cooked or processed prior to chilling. This heat reduces the microbial population but does not render the food "commercially sterile." Because of this, refrigerated foods have a limited shelf-life that is affected by temperature and customer abuse. Refrigerated foods have been in our stores for many years. Products such as milk, cheese, yogurt and other dairy products, cookie and biscuit doughs, eggs, salads and processed meats are commonly found in the refrigerated section or deli. The optimum storage temperature is 33°F or as close to freezing as possible. However, most refrigerated cases hold food at or near 45°F. This higher holding temperature reduces shelf-life of the products, and can lead to a problem of public health significance.

Several important points on preparation, handling and distribution need to be considered when working with refrigerated foods. First of all, always assume pathogenic organisms are present in a food product. Secondly, refrigeration temperatures may slow or prevent replication of most pathogenic microorganisms, but some will continue to multiply. These are known as “psychrotrophic bacteria”.

<table>
<thead>
<tr>
<th>Temperature F</th>
<th>24 Hours</th>
<th>48 Hours</th>
<th>96 Hours</th>
<th>168 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>2,400</td>
<td>2,100</td>
<td>7,850</td>
<td>1,400</td>
</tr>
<tr>
<td>39</td>
<td>2,500</td>
<td>3,600</td>
<td>218,000</td>
<td>4,200,000</td>
</tr>
<tr>
<td>46</td>
<td>3,100</td>
<td>12,000</td>
<td>1,480,000</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>11,600</td>
<td>540,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>180,000</td>
<td>28,000,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>1,400,000,000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
there name implies, they endure or tolerate cold temperatures. Psychrotropic pathogens include Yersinia enterocolitica, Listeria monocytogenes, nonproteolytic strains of C. botulinum, some strains of enterotoxigenic E. coli and Aeromonas hydrophilia.

Several other foodborne disease organisms are capable of growth at slightly above 41°F and may be present in refrigerated foods. These include: Vibrio parahemolyticus; Bacillus cereus; Staphylococcus aureus and certain strains of Salmonella.

A third consideration when working with refrigerated foods is that a manufacturer should expect some temperature abuse of the foods during storage and distribution. This abuse often occurs during handling at the consumer level.

The last two points for consideration deal with labeling. A "Keep Under Refrigeration" statement must be prominent on the product label and outside carton. In addition, a "Sell By" or "Use By" date needs to be used on these products. This will help processors control their product, but it is not a guarantee against problems. If the stock is not rotated properly, the out of date product may still get to the consumer.

A processor of refrigerated foods needs to incorporate into product preparation as many treatments or barriers as possible to help reduce the microbial population and minimize their reproduction. Some of these treatments include: heat, acidification, preservatives, reduced water activity and modified atmosphere packaging. Even though modified atmosphere is included as a potential barrier to microbial growth, it must be noted that reduced oxygen atmospheres may actually favor anaerobic bacterial growth, some of which are pathogenic. For many products, modified atmosphere packaging is really an aid to enhance product quality or appearance rather than safety.

One example of a product which successfully employs the multiple barrier principle is pasteurized cheese spread. The product uses a combination of reduced water activity (added salt and phosphates) and mild heat treatment to eliminate non-spore forming pathogens and inhibit growth of spore forming pathogenic microorganisms.

Any manufacturer who considers marketing a refrigerated food should have extensive shelflife studies conducted by persons knowledgeable in the area of food microbiology.

2. Freezing

Freezing is one of the safest and most popular food preservation techniques. It is used for almost all foods including prepared products. The advantages of freezing foods are that it is easy to do, there is usually excellent retention of quality in terms of flavor, color and nutritive value and it is safe. No pathogenic or toxic organisms can grow under frozen conditions. The disadvantages of frozen foods are the energy costs for freezing the food and holding it frozen and the food usually has to be thawed before it is ready for eating.

For many foods such as milk, meat and fish the rate of freezing has little effect on quality. But for other foods such as ice cream, vegetables and fruits, slow freezing gives a poor texture; for these products it is necessary to freeze quickly in order to get a satisfactory texture in the product. Since water expands when it changes to ice, foods expand about 10% in volume when they are frozen. Therefore, in packaging frozen foods it is necessary to provide space for the expansion of the food as it goes through the freezing process. The slow freezing of foods causes some textural problems in that
when food is slowly frozen, ice crystals grow in size and rupture the structural tissues responsible for good texture. The result of slow freezing is a mushy texture.

The recommended temperature for storage of frozen products is usually 0°F. At this temperature, most foods can be stored for six months or longer. At 10°F, the storage life of frozen foods generally drops to about half. The normal storage life of some frozen foods is given in Table 4-3.

Table 4-3. Storage Life of Frozen Foods (At O°F or Below).

<table>
<thead>
<tr>
<th>FOOD</th>
<th>STORAGE LIFE (Months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>18</td>
</tr>
<tr>
<td>Beans, green</td>
<td>12</td>
</tr>
<tr>
<td>Beef, wholesale cuts</td>
<td>12</td>
</tr>
<tr>
<td>Beef, ground</td>
<td>9</td>
</tr>
<tr>
<td>Broccoli</td>
<td>14</td>
</tr>
<tr>
<td>Cakes</td>
<td>12</td>
</tr>
<tr>
<td>Carrots</td>
<td>24</td>
</tr>
<tr>
<td>Cheese, shredded for pizza</td>
<td>12</td>
</tr>
<tr>
<td>Chicken</td>
<td>10</td>
</tr>
<tr>
<td>Egg roll</td>
<td>6</td>
</tr>
<tr>
<td>Enchiladas</td>
<td>6</td>
</tr>
<tr>
<td>Fish, fatty, e.g. salmon</td>
<td>3</td>
</tr>
<tr>
<td>Fish, lean, e.g. haddock</td>
<td>11-12</td>
</tr>
<tr>
<td>Ice cream</td>
<td>9</td>
</tr>
<tr>
<td>Meals, precooked</td>
<td>6</td>
</tr>
<tr>
<td>Orange juice, concentrated</td>
<td>24</td>
</tr>
<tr>
<td>Peas, green</td>
<td>14</td>
</tr>
<tr>
<td>Pies, fruit</td>
<td>12</td>
</tr>
<tr>
<td>Pies, cream</td>
<td>6</td>
</tr>
<tr>
<td>Pizza</td>
<td>6</td>
</tr>
<tr>
<td>Pork, chops</td>
<td>8</td>
</tr>
<tr>
<td>Potatoes</td>
<td>12</td>
</tr>
<tr>
<td>Strawberries</td>
<td>15</td>
</tr>
<tr>
<td>Turkey, whole</td>
<td>9</td>
</tr>
<tr>
<td>Waffles</td>
<td>6</td>
</tr>
</tbody>
</table>

There is a tendency for water in frozen foods to evaporate from the surface of the food and condense on the colder surface of the cooling coils. This drying out leaves a tough, hard, low moisture, discolored portion which is called "freezer burn." Freezer burn can be prevented by:

a) Using packaging materials that are moisture vapor proof.
b) Avoiding puncturing packages because freezer burn will occur at the point of puncture.
c) Prechilling just to the freezing point in high humidity air to minimize the loss of water vapor during freezing.
d) Dipping the unpackaged food pieces in water which forms a glaze of ice over the surface. The ice will evaporate before moisture is removed from the food.

Vegetables contain enzymes that will develop unpleasant flavors and soft textures during frozen storage. For this reason, vegetables are blanched to inactivate these enzymes and prevent the formation of these off-flavors and off-textures. Blanching usually consists of immersing pieces of prepared vegetables in water at 190-210°F for 2-5 minutes and then chilling in cold water before putting them in the freezer.

Most starch pastes cannot withstand freezing and thawing. They break down giving a poor appearance and poor texture. For this reason, starch thickened sauces and gravies that are intended for freezing need to be prepared from special grades of starch that withstand the freezing and thawing process without breakdown. Companies that supply food grade starches can provide information on the kind of starch needed for specific applications.

**Thawing** occurs at about one-half the rate of freezing under equivalent conditions. This means time for thawing can be an important consideration when working with frozen foods. Small items can be thawed in air. Large items should be thawed at a low temperature because the outside surfaces of the food may have considerable bacterial growth and possibly spoil before the center is thawed. Table 4-4 shows the change in microbial counts during thawing of a 30 lb. can of frozen whole eggs. The data clearly demonstrate that thawing conditions affect the rate of build up of microbes in the egg product.

<table>
<thead>
<tr>
<th>Thawing Method</th>
<th>Hours required to thaw out 30 lb can frozen whole egg</th>
<th>% increase in microbial count during thawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still air at 80 F</td>
<td>23</td>
<td>1,000</td>
</tr>
<tr>
<td>Still air at 45 F</td>
<td>63</td>
<td>225</td>
</tr>
<tr>
<td>Running water at 70 F</td>
<td>12</td>
<td>300</td>
</tr>
<tr>
<td>Running water at 60 F</td>
<td>15</td>
<td>250</td>
</tr>
<tr>
<td>Agitating water at 60 F</td>
<td>9</td>
<td>40</td>
</tr>
<tr>
<td>Dielectric heating</td>
<td>0.25</td>
<td>0</td>
</tr>
</tbody>
</table>

**Refreezing.** Occasionally frozen foods are partially or completely thawed before they are ready for use. Partial thawing and refreezing reduces the quality of the foods, particularly fruits, vegetables and prepared foods. Red meats are affected less than many other foods.

In general, you can safely refreeze foods that have thawed if they still contain ice crystals, or if they are still cold (40°F or less) and if they have not been held at this
temperature for longer than a day or two. Foods warmed to temperatures greater than 40°F are generally not appropriate for refreezing. Table 4-5 provides a guide for determining when foods may be refrozen.

Table 4-5. Guide to Safely Refreezing Thawed Food.

<table>
<thead>
<tr>
<th>Frozen Food</th>
<th>Thawed-but cold (40°F or colder)</th>
<th>Thawed – Warm (Above 40°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits</td>
<td>Yes</td>
<td>Probably safe – but may have fermented</td>
</tr>
<tr>
<td>Fruit Juice Concentrate</td>
<td>Yes – but flavor may be poor and reconstituted juice may separate</td>
<td>No – may have fermented</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Yes</td>
<td>Questionable – Safer not to refreeze- especially corn, peas, and beans discard</td>
</tr>
<tr>
<td>Meat</td>
<td>Yes- if odor is normal. If any odor- discard</td>
<td>Do not refreeze</td>
</tr>
<tr>
<td>Poultry</td>
<td>Yes- if odor is normal. If any odor- discard</td>
<td>No</td>
</tr>
<tr>
<td>Fish and Shellfish</td>
<td>Yes- if odor is normal. If any odor- discard</td>
<td>No</td>
</tr>
<tr>
<td>Cooked meat, Poultry and Fish</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Combination Dishes, Meat, Poultry, and Pot Pies, Casseroles, Whole Meals</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Soups</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Ice Cream and Sherbet</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Fruit Pies</td>
<td>Yes</td>
<td>Yes- but quality may be poor</td>
</tr>
<tr>
<td>Plain Cake and Cookies</td>
<td>Yes</td>
<td>Yes- but texture may be poor</td>
</tr>
<tr>
<td>Cream Filled Cake and Cookies</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

3. Heat Preservation

There are two methods of heat preservation of foods. They include pasteurization and heat sterilization.

A) Pasteurization. Pasteurization gives food a heat treatment of a short duration generally at temperatures below the boiling point. It is designed to kill most microorganisms in the food but it does not destroy all the living organisms. Most pasteurization heat treatments are designed to destroy all pathogenic organisms that may be in the food. (Pathogenic microorganisms are bacteria that cause food-borne illness). Therefore, pasteurized products are safe from the public health point of view since no disease producing organisms are present, but they have limited storage life
because of the possibility of growth of the non-pathogenic organisms that survive. For this reason, pasteurization is usually combined with refrigeration. The combination of pasteurization followed by refrigerated storage extends the shelf life of products considerably. For example, pasteurized milk stored at 35°F can keep for two weeks or longer.

Pasteurization is used for liquids such as milk, beer and juices, and many types of high acid sauces and condiments. An example of the time and temperature required for pasteurization can be found with raw milk. In batch pasteurization, milk is heated to 145°F and held at this temperature for 30 minutes then rapidly cooled. In high temperature-short time pasteurization (HTST) milk is heated to a temperature of at least 161°F and held for 15 seconds. In the ultra high temperature pasteurization (UHT) milk is heated to a temperature of 280°F for 2 seconds.

One advantage of pasteurization over sterilization (a more severe heat treatment to kill all bacteria present) is that a gentler heat treatment causes less damage to the flavor and color of the food than complete sterilization.

B) Heat Sterilization. The principle of sterilization is to close the food in a container that is totally impervious to microorganisms and then heat it until all the microorganisms inside the container are killed. With no live microorganisms present, the product will keep because there can be no microbial spoilage. This process is commonly called "canning" whether the product is packed in a can, a jar or a pouch. This process was invented by a French chef named Nicholas Appert who obtained a patent on the procedure in 1810.

In canning, it is especially important that all microorganisms that can spoil a food or cause a health hazard be destroyed. Yeasts and molds are destroyed relatively easily by heat. The vegetative cells of bacteria also are killed relatively easily by heat. However, many bacteria form spores, some of which are extremely resistant to heat. One organism in particular, Clostridium botulinum, can grow in inadequately canned food and cause poisoning. Therefore, processing to assure the destruction of this organism is critical.

Foods are commonly sealed in containers made of metal (tinplated steel or aluminum), or glass. In recent years some plastics, and plastic laminates (pouch pack) have been developed for food packaging that can withstand the heat and pressures of the retort.

The time and temperature required for sterilization depends on several factors known as critical factors. These include:
1. pH of the food
2. Physical nature of the food (a liquid or solid)
3. Nature of the container (metal can versus glass jar)
4. Size of the container (small can versus #10 can)

**Moisture Controlled:**

All foods contain water (moisture). Most foods contain considerable water when prepared and ready for eating. Fresh fruits and vegetables usually contain 85% to 95% water. Lean meat is about 55% to 70% water. Dry spaghetti contains about 10%
water, but after cooking it is 60% to 70% water. Most microorganisms require some available moisture to live and proliferate. There are two basic ways of controlling moisture to extend shelflife. They include drying and control of water activity (Aw).

**Dehydration:**

Dehydration is the oldest technology for preservation of foods. It has been used for thousands of years. Dehydration involves reducing the water content of the food to a level where it will not support the growth of spoilage organisms. Drying, the actual removal of water, is the most common form of dehydration. It is also the most widely used method of food preservation in terms of tonnage preserved. The most common dried foods are cereals and cereal products such as pasta and cookies, fruit, milk, fish, vegetables, instant coffee, coconut and eggs, in descending order of quantity.

In some foods, dehydration is accomplished by lowering the water activity, symbolized as Aw, of the food, not by actually removing the water. The addition of high levels of sugar accomplishes this in making sweet spreads, like jams, jellies and butters. Salt is also used as a dehydrating agent in making salt cured products like jerky.

**A) Drying.** This process consists of removing water naturally present in the food until the water activity is reduced from that of the fresh product to less than 0.7. At this low moisture content, the microorganisms that spoil food cannot grow. Dried foods are not sterile; the moisture content is too low to support microbes. However, good sanitation is needed to keep insects, rodents and other pests from the dried foods because these can spoil them. The safe moisture content for most dried fruits is usually 18-25%, for cereal products 10-12%, and most vegetables 4-12%.

The drying process consists of applying energy in the form of heat. This heat is absorbed by the food causing water vapor to leave the food. Because enzymes naturally present in vegetables may cause the development of unpleasant flavors and colors during storage, most vegetables need to be blanched (heated to about 200°F for about three minutes) before drying to destroy the enzymes. One exception is onions which are not blanched before drying because they would lose their flavor. Fruits are not usually blanched before drying.

**Water Activity**

Aw is a term used to describe the available moisture in a food product. Foods such as honey may contain an appreciable amount of moisture but if all the available moisture is bound by sugar, it is unavailable to microorganisms to grow. Table 4-5 shows the Aw range for various foods.
Table 4-5: Water Activity Values for Various Foods.

<table>
<thead>
<tr>
<th>FOOD PRODUCT</th>
<th>Aw RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dried fruits</td>
<td>0.60-0.75</td>
</tr>
<tr>
<td>Cake and pastry</td>
<td>0.60-0.90</td>
</tr>
<tr>
<td>Frozen foods</td>
<td>0.60-0.90</td>
</tr>
<tr>
<td>Sugars, syrups</td>
<td>0.60-0.75</td>
</tr>
<tr>
<td>Fruit cake</td>
<td>0.73-0.83</td>
</tr>
<tr>
<td>Honey</td>
<td>0.75</td>
</tr>
<tr>
<td>Fruit juice concentrates</td>
<td>0.79-0.84</td>
</tr>
<tr>
<td>Jams</td>
<td>0.80-0.91</td>
</tr>
<tr>
<td>Sweetened condensed milk</td>
<td>0.83</td>
</tr>
<tr>
<td>Fermented sausages (some)</td>
<td>0.83-0.87</td>
</tr>
<tr>
<td>Maple syrup</td>
<td>0.90</td>
</tr>
<tr>
<td>Ripened cheeses (some)</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Although the water activity increases as the water content increases, the relationship between Aw and percent water is complex. For example, raisins at 23% moisture, uncooked rice at 12% moisture and tea leaves at 4% moisture all have the same water activity of about 0.70.

Water activity is a more effective measurement than percent water in determining whether or not microorganisms can grow in a food. The minimum water activity for the growth of microorganisms is shown in Table 4-7.

Table 4-7. Minimum Water Activity for Microbial Growth.

<table>
<thead>
<tr>
<th>Type of Microorganism</th>
<th>Minimum Aw for Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td>0.90</td>
</tr>
<tr>
<td>Yeast</td>
<td>0.88</td>
</tr>
<tr>
<td>Molds</td>
<td>0.80</td>
</tr>
</tbody>
</table>
Adding sugar or salt, as in sweet spreads, candied fruits, salted fish or salted vegetables are means of reducing the water activity and preserving food. In meat, salt is usually supplemented with ingredients such as nitrites, which aid in spoilage prevention. In fish, various levels of salt may be combined with different storage temperatures to provide preservation.

In all of the above cases, salt is used to inhibit the growth of spore-forming bacteria such as C. botulinum and only enough heat is applied to kill the non-heat resistant types. Strains of C. botulinum are known to grow in a suitable food containing 7% salt, but their growth is inhibited at a concentration of 10 percent salt, which is equivalent to a water activity of 0.93. Although growth can occur at 7 percent, no toxin has yet been demonstrated at this concentration of salt.

Sweet spreads such as jams, jellies, and fruit butters rely on a high sugar content to lower the water activity of the fruit to a point where the available water will not support the growth of microorganisms.

Jams are prepared from practically all fruits and a few vegetables, but small fruits and berries are the most popular. All fruit must be carefully sorted and washed, and stems, skin and pits removed. If the fruit is too firm it should be boiled prior to pulping. Jams are prepared by boiling the whole fruit pulp with sugar to a moderately thick consistency without retaining the shape of the fruit.

Sugar in the form of sucrose (table sugar) or sucrose mixed with high fructose corn syrup (HFCS) is added following pulping. The proportion of sugar to fruit is dependent on the variety, ripeness and desired effect on the fruit. However, the most common proportion is 1:1, although some fruit require as little as 1/4:1. The fruit/sugar/water mixture is concentrated by boiling in a steam jacketed kettle. The average jam reaches a desired concentration at 219-221°F, but this end-point varies with processing conditions. A jelly thermometer and Abbe refractometer are used to determine end-point.

Pectin may or may not be added to the mixture based upon the natural pectin content of the fruit. However, many manufacturers add pectin to maintain consistent product quality. Jams sold in retail markets have a solids content of 69-70%, determined using a refractometer, a 27% invert sugar content, and a pH of 3.0-3.5. A solids content of 75% or greater may result in crystallization of the sugar and precipitation. After concentration, the jam is packed into a glass container, capped and pasteurized in boiling water.

**Jelly** is a gel produced by mixing fruit juice and sugar and concentrating to such a consistency that gelation occurs. A jelly should retain its shape, and not flow when it is removed from its container. The FDA strictly defines a jelly as a semi-solid food made from not less than 45 parts by weight fruit juice to 55 parts sugar. This substance is concentrated to not less than 65% soluble solids. Pectin and acid are typically added to overcome deficiencies in the fruit and to maintain consistent product quality.

Unit operations performed in jelly manufacturing include; boiling the fruit, extracting the juice, clearing the juice, concentrating the jelly, packaging and pasteurizing. Following pasteurization, the jars are cooled and dried prior to packaging. As with jams, the concentration (boiling) step is the most critical. The end-
point (69-70% solids and pH 3.0-3.5) should be reached as soon as possible, and should be monitored using a thermometer and refractometer.

**Fruit butters** are prepared from mixtures containing not less than five parts by weight fruit to two parts of sugar. These products should have a pH less than 4.6 and should receive a pasteurization process.

C) **Salt to lower Aw** - Salting of fish and meats results in preservation by drawing moisture out of the food. This lowers the water activity (Aw) of the food and prevents the growth of microorganisms. Many cured meats and fish have sodium nitrite/nitrate added in order to prevent the growth of Clostridium botulinum. Nitrites also are used to fix the color of cured meats and aid in flavor enhancement.

1. **pH Controlled**
   The pH scale runs from 0 to 14. The midpoint of the scale (pH=7) is the neutral point. All pH values less than 7.0 are acid. All pH values above 7.0 are alkaline. Since this is a logarithmic scale, a change of 1.0 pH unit indicates a ten-fold change in hydrogen ion concentration (what makes the food acid). For example, a food with a pH of 4.0 contains ten times as many hydrogen ions as a food at pH 5.0 and one hundred times that of a food with a pH of 6.0. The pH values of different foods are shown in Table 4-8.
Table 4.8. pH range of a Few Selected Fresh, Fermented, and Commercially Canned Food.

<table>
<thead>
<tr>
<th>Food</th>
<th>Approximate pH Range</th>
<th>Food</th>
<th>Approximate pH Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>2.9-3.5</td>
<td>Chicken with Noodles</td>
<td>6.2-6.7</td>
</tr>
<tr>
<td>Apple Juice</td>
<td>3.3-3.5</td>
<td>Chop Suey</td>
<td>5.4-5.6</td>
</tr>
<tr>
<td>Applesauce</td>
<td>3.2-3.5</td>
<td>Cider</td>
<td>2.9-3.3</td>
</tr>
<tr>
<td>Apricots</td>
<td>3.5-4.0</td>
<td>Clams</td>
<td>5.9-7.1</td>
</tr>
<tr>
<td>Asparagus</td>
<td>5.0-6.1</td>
<td>Cod (canned)</td>
<td>6.0-6.1</td>
</tr>
<tr>
<td>Bananas</td>
<td>4.5-5.2</td>
<td>Corn</td>
<td></td>
</tr>
<tr>
<td>Beans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baked</td>
<td>4.8-5.5</td>
<td>Cream Style</td>
<td>5.9-6.5</td>
</tr>
<tr>
<td>Green</td>
<td>4.9-5.5</td>
<td>Whole Grain</td>
<td></td>
</tr>
<tr>
<td>Lima</td>
<td>5.4-6.5</td>
<td>Brine Packed</td>
<td>5.8-6.5</td>
</tr>
<tr>
<td>Soy</td>
<td>6.0-6.6</td>
<td>Vacuum-Packed</td>
<td>6.0-6.4</td>
</tr>
<tr>
<td>Beans, with Pork</td>
<td>5.1-5.8</td>
<td>Crab</td>
<td>6.8-8.0</td>
</tr>
<tr>
<td>Beef</td>
<td>5.3-6.2</td>
<td>Crab Apples-Spiced</td>
<td>3.3-3.7</td>
</tr>
<tr>
<td>Beef, Corned, Hash</td>
<td>5.5-6.0</td>
<td>Cranberry</td>
<td></td>
</tr>
<tr>
<td>Beer</td>
<td>4.0-5.0</td>
<td>Juice</td>
<td>2.5-2.7</td>
</tr>
<tr>
<td>Beets, Whole</td>
<td>4.9-5.8</td>
<td>Sauce</td>
<td>2.3</td>
</tr>
<tr>
<td>Blackberries</td>
<td>3.0-4.2</td>
<td>Currant Juice</td>
<td>3.0</td>
</tr>
<tr>
<td>Blueberries</td>
<td>3.2-3.6</td>
<td>Date</td>
<td>6.2-6.4</td>
</tr>
<tr>
<td>Boysenberries</td>
<td>3.0-3.3</td>
<td>Duck</td>
<td>6.0-6.1</td>
</tr>
<tr>
<td>Bread</td>
<td></td>
<td>Dry Sausages</td>
<td>4.4-5.6</td>
</tr>
<tr>
<td>White</td>
<td>5.0-6.0</td>
<td>Egg Whites</td>
<td>7.6-9.5</td>
</tr>
<tr>
<td>Date and Nut</td>
<td>5.1-5.6</td>
<td>Fermented Vegetables</td>
<td>3.9-5.1</td>
</tr>
<tr>
<td>Broccoli</td>
<td>5.2-6.0</td>
<td>Figs</td>
<td>4.9-5.0</td>
</tr>
<tr>
<td>Brussel Sprouts</td>
<td>6.3-6.6</td>
<td>Frankfurters</td>
<td>6.2</td>
</tr>
<tr>
<td>Butter</td>
<td>6.1-6.4</td>
<td>Fruit Cocktail</td>
<td>3.6-4.0</td>
</tr>
<tr>
<td>Cabbage</td>
<td>5.2-6.3</td>
<td>Ginger Ale</td>
<td>2.0-4.0</td>
</tr>
<tr>
<td>Cantaloupe</td>
<td>6.2-6.5</td>
<td>Gooseberries</td>
<td>2.8-3.1</td>
</tr>
<tr>
<td>Carrots</td>
<td>4.9-6.3</td>
<td>Grapefruit</td>
<td></td>
</tr>
<tr>
<td>Catfish</td>
<td>6.6-7.0</td>
<td>Juice</td>
<td>2.9-3.4</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>6.0-6.7</td>
<td>Pulp</td>
<td>3.4</td>
</tr>
<tr>
<td>Celery</td>
<td>5.7-6.0</td>
<td>Sections</td>
<td>3.0-3.5</td>
</tr>
<tr>
<td>Cheese (most)</td>
<td>5.0-6.1</td>
<td>Grapes</td>
<td>3.3-4.5</td>
</tr>
<tr>
<td>Camembert</td>
<td>6.1-7.0</td>
<td>Haddock</td>
<td>6.2-6.7</td>
</tr>
<tr>
<td>Cottage</td>
<td>4.1-5.4</td>
<td>Halibut</td>
<td>5.5-5.8</td>
</tr>
<tr>
<td>Parmesan</td>
<td>5.2-5.3</td>
<td>Ham, Sliced</td>
<td>6.0-6.3</td>
</tr>
<tr>
<td>Roquefort</td>
<td>4.7-4.8</td>
<td>Hominy, Lye</td>
<td>6.9-7.9</td>
</tr>
<tr>
<td>Cherries</td>
<td>3.2-4.7</td>
<td>Honey</td>
<td>6.0-6.8</td>
</tr>
<tr>
<td>Chicken</td>
<td>5.5-6.4</td>
<td>Huckleberries</td>
<td>2.8-2.9</td>
</tr>
<tr>
<td>Food</td>
<td>Approximate pH Range</td>
<td>Food</td>
<td>Approximate pH Range</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------------</td>
<td>--------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Jam, Fruit</td>
<td>3.5-4.0</td>
<td>Sardines</td>
<td>5.7-6.6</td>
</tr>
<tr>
<td>Jellies, Fruit</td>
<td>3.0-3.5</td>
<td>Sauerkraut</td>
<td>3.1-3.7</td>
</tr>
<tr>
<td>Lemons</td>
<td>2.2-2.4</td>
<td>Juice</td>
<td>3.3-3.4</td>
</tr>
<tr>
<td>Juice</td>
<td>2.2-2.6</td>
<td>Scallops</td>
<td>6.8-7.1</td>
</tr>
<tr>
<td>Lettuce</td>
<td>6.0-6.4</td>
<td>Shrimp</td>
<td>6.8-8.2</td>
</tr>
<tr>
<td>Limes</td>
<td>1.8-2.0</td>
<td>Soda Crackers</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td>Juice</td>
<td>2.2-2.4</td>
<td>Soups</td>
<td></td>
</tr>
<tr>
<td>Loganberries</td>
<td>2.7-3.5</td>
<td>Bean</td>
<td>5.7-5.8</td>
</tr>
<tr>
<td>Mackerel</td>
<td>5.9-6.2</td>
<td>Beef Broth</td>
<td>6.0-6.2</td>
</tr>
<tr>
<td>Maple Syrup</td>
<td>6.5-7.0</td>
<td>Chicken Noodle</td>
<td>5.5-6.5</td>
</tr>
<tr>
<td>Mayonnaise</td>
<td>3.8-4.0</td>
<td>Clam Chowder</td>
<td>5.6-5.9</td>
</tr>
<tr>
<td>Milk</td>
<td></td>
<td>Duck</td>
<td>5.0-5.9</td>
</tr>
<tr>
<td>Evaporated</td>
<td>5.9-6.3</td>
<td>Noodle</td>
<td>5.6-5.8</td>
</tr>
<tr>
<td>Molasses</td>
<td>5.0-5.4</td>
<td>Oyster</td>
<td>6.5-6.9</td>
</tr>
<tr>
<td>Mushrooms</td>
<td>6.0-6.5</td>
<td>Pea</td>
<td>5.7-6.2</td>
</tr>
<tr>
<td>Olives, ripe</td>
<td>5.9-7.3</td>
<td>Tomato</td>
<td>4.2-5.2</td>
</tr>
<tr>
<td>Onions</td>
<td>5.3-5.8</td>
<td>Turtle</td>
<td>5.2-5.3</td>
</tr>
<tr>
<td>Oranges</td>
<td>2.8-4.0</td>
<td>Vegetable</td>
<td>4.7-5.6</td>
</tr>
<tr>
<td>Juice</td>
<td>3.0-4.0</td>
<td>Spinach</td>
<td>4.8-6.8</td>
</tr>
<tr>
<td>Oysters</td>
<td>5.9-6.7</td>
<td>Squash</td>
<td>5.0-5.3</td>
</tr>
<tr>
<td>Peaches</td>
<td>3.1-4.2</td>
<td>Strawberries</td>
<td>3.0-4.2</td>
</tr>
<tr>
<td>Pears</td>
<td>3.4-4.7</td>
<td>Tomatoes</td>
<td>3.7-4.9</td>
</tr>
<tr>
<td>Pickles</td>
<td></td>
<td>Juice</td>
<td>3.9-4.7</td>
</tr>
<tr>
<td>Dill</td>
<td>2.6-3.8</td>
<td>Tuna</td>
<td>5.9-6.1</td>
</tr>
<tr>
<td>Sour</td>
<td>3.0-3.5</td>
<td>Turkey</td>
<td>5.6-5.0</td>
</tr>
<tr>
<td>Sweet</td>
<td>2.5-3.0</td>
<td>Turnips</td>
<td>5.2-5.6</td>
</tr>
<tr>
<td>Pimentos</td>
<td>4.3-5.2</td>
<td>Turnip Greens</td>
<td>5.4-5.6</td>
</tr>
<tr>
<td>Pineapples</td>
<td></td>
<td>Vegetable</td>
<td></td>
</tr>
<tr>
<td>Crushed</td>
<td>3.2-4.0</td>
<td>Juice</td>
<td>3.9-4.3</td>
</tr>
<tr>
<td>Sliced</td>
<td>3.5-4.1</td>
<td>Mixed</td>
<td>5.4-5.6</td>
</tr>
<tr>
<td>Juice</td>
<td>3.4-3.7</td>
<td>Vinegar</td>
<td>2.4-3.4</td>
</tr>
<tr>
<td>Plums</td>
<td>2.8-4.6</td>
<td>Walnuts</td>
<td>5.4-5.5</td>
</tr>
<tr>
<td>Pork</td>
<td>5.3-6.4</td>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Potatoes</td>
<td></td>
<td>Distilled, CO2</td>
<td>6.8-7.0</td>
</tr>
<tr>
<td>White, Whole</td>
<td>5.4-6.3</td>
<td>Mineral</td>
<td>6.2-9.4</td>
</tr>
<tr>
<td>Sweet</td>
<td>5.3-5.6</td>
<td>Sea</td>
<td>8.0-8.4</td>
</tr>
<tr>
<td>Potato Salad</td>
<td>3.9-4.6</td>
<td>Whiting</td>
<td>6.2-7.1</td>
</tr>
<tr>
<td>Prune Juice</td>
<td>3.7-4.3</td>
<td>Wines</td>
<td>2.3-3.8</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>5.2-5.5</td>
<td>Yogurt</td>
<td>3.8-4.2</td>
</tr>
<tr>
<td>Raspberries</td>
<td>2.9-3.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhubarb</td>
<td>2.9-3.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
pH of the food is a critical factor in determining how much heat is needed. There are three pH ranges of interest:

a. Low acid food with pH greater than 4.6.

When food has a pH above 4.6 many kinds of microorganisms can grow, some of which form heat-resistant spores. These foods are called low acid and they require a sterilization temperature of 240°F (116°C) or higher. One organism in particular, Clostridium botulinum, forms heat resistant spores. If not killed, this organism can grow and form a deadly toxin which leads to death from botulism poisoning. Therefore, the time and temperature of heating must be strictly controlled to ensure that this microorganism has been completely destroyed. Vegetables (except tomatoes), meats, fish, and poultry have a pH above 4.6. Some tropical fruits such as banana, mango, papaya and fig also have a pH above 4.6 when ripe.

The Food and Drug Administration (FDA) requires all operators of sterilizing equipment for low acid foods and acidified foods as well as packaging inspectors, to pass an examination and become certified retort operators before sterilizing low acid foods.

b. Acid foods with a pH between 3.7 and 4.5. This includes most fruits and tomatoes, and tomato products such as ketchup and picante sauces. When the food has a pH below 4.5 (acid foods) the spore forming microorganisms cannot grow. Clostridium botulinum cannot grow below pH 4.6. These foods can be sterilized at 212°F (100°C) or less. For example, the following temperatures give commercial sterility for fluid foods that are filled at or above the specified temperature, sealed and held for three minutes before cooling:

<table>
<thead>
<tr>
<th>pH</th>
<th>Minimum fill temperature (degree F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9</td>
<td>185</td>
</tr>
<tr>
<td>4.1</td>
<td>190</td>
</tr>
<tr>
<td>4.2</td>
<td>195</td>
</tr>
<tr>
<td>4.3</td>
<td>205</td>
</tr>
</tbody>
</table>

c. High acid foods have a pH less than 3.7.

Sauerkraut and many pickles belong in this group. These products may be sterilized at temperatures as low as 165°F. The pH of foods is lowered by adding acid in some form. For example, cucumbers are a low acid food with a pH above 4.6, but pickled cucumbers have a pH less than 4.0 because of the acetic acid in the vinegar that is used to make the pickles.

Fermented and pickle foods are frequently referred to as acidified foods since they owe their stability to their high acid content. This acid may come from the microbial development of organic acids by lactic acid bacteria or the addition of acids (vinegar, etc.) to the foods, especially in the presence of a relatively high level of salt. Spoilage can occur either during the fermentation period or upon storage of the final product. Fermentation can fail if bacteriophage (viruses that cause diseases of bacteria) attack
the starter culture, if the temperature during fermentation is unsuitable, or if the
amount of fermentable carbohydrate is inadequate.

To prevent spoilage during the fermentation period:
1. Add lactic acid bacteria as a starter. Keep the starter in pure culture to help eliminate
bacteriophages.
2. Add fermentable carbohydrate or organic acid.
3. Maintain the salt level high enough to inhibit spoilage bacteria and to permit the
more salt-tolerant lactic acid bacteria to grow. This will vary from 2.5% - 5.0%.
4. Control the temperature to favor the lactic acid producing bacteria.

To reduce or eliminate spoilage during storage of the pickled or fermented food:
1. Add chemical preservatives, such as benzoates, sorbates or propionates suitable to
the product and acceptable to regulatory authorities.
2. Pasteurize the product, if practical, to destroy or inhibit spoilage organisms.
3. Store pickles fully covered with brine to inhibit molds and impede yeast
development.
4. Store and market product refrigerated.
5. The pH of the product must be less than 4.6. The lower the safer.

To produce products which have a pH of 4.6 or less, acidification must be properly
carried out. Here are some methods to obtain properly acidified foods.

1. Blanch the food ingredients in an acidified aqueous solution.
2. Immerse the blanched foods in an acid solution.
3. Direct batch acidification.
4. Directly add a predetermined amount of acid to individual containers during
production.
5. Add acid foods to low-acid foods in controlled portions.

These methods are acceptable and are used. However, each requires a certain
amount of control in order to acidify a particular product properly. No single means is
appropriate for all situations. A company may utilize more than one procedure
depending on the kind of products and the scheduled process which the processing
authority has designed from supporting data.

For proper production of an acidified shelf-stable product, there are some
components of the process which should be checked to ensure that the acidification
procedure is working as expected.

1. Every container of food must be acidified in the same proportions.
2. Monitor acidification by pH measurement before and, after equilibrium. The
finished product equilibrium pH should be less than 4.6. Finished product equilibrium
pH means the pH of the total product in the container. The pH measurements should
be recorded.
3. Monitor the scheduled thermal process.
The objective of the thermal process is to destroy vegetative cells of microorganisms of public health significance and those of non-health significance capable of reproducing in the food under normal conditions of storage and distribution. Processed containers should be handled in such a fashion as to prevent damage to the seals and/or product recontamination.

2. Physical Nature of the Product. When pieces of solid food are immersed in a mobile fluid (e.g. fruit in syrup, vegetable in brine) the fluid moves around by convection currents during heating and the contents heat rapidly. This is called convection heating. When the food is solid, with no mobile liquid (e.g. corned beef, cream style corn) the heat penetrates by conduction, which is slower than convection heating. Conduction heating of food requires a longer time to sterilize than convection heating.

3. Nature of the Container. Metal conducts heat rapidly while glass conducts heat slowly. Therefore, glass containers require a longer sterilization time than metal containers. Metal cans are usually sterilized in steam. Sometimes, acid foods in metal cans are sterilized in boiling water. Glass jars are always sterilized in boiling water. When a temperature above 212°F is needed, compressed air is used to produce the pressure needed to obtain the necessary temperature.

4. Size of Container. A large container requires more time to heat through than a small container.

Table 4-9 gives examples of the interaction between the physical nature or viscosity of the product, the pH of the product and the amount of heat that is needed to obtain commercial sterility in the product.

Table 4-9. Sterilization Process for 1 lb Tin Cans (Closing Temperature 140°F).

<table>
<thead>
<tr>
<th>Viscosity of Food</th>
<th>pH less than 4.6 (acid)</th>
<th>pH above 4.6 (low acid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Short time. Low temperature (e.g. fruits in syrup 15 min at 212°F)</td>
<td>Short time, high temperature (e.g. peas in brine 17 min at 250°F)</td>
</tr>
<tr>
<td>High</td>
<td>Long time, low temperature (e.g. solid pack tomatoes. 45 min at 212°F)</td>
<td>Long time, high temperature (e.g. cream style corn. 72 min at 250°F)</td>
</tr>
</tbody>
</table>

3. Preservatives;

Smoke
Smoke preserves food by several mechanisms. Smoke contains several chemical preservatives that inhibit the growth of microorganisms. Meats are typically smoked
over a fire, so heating and drying also contribute to preservation. If liquid smoke is
used for flavoring purposes, other methods of food preservation should be used to
inhibit the growth of microorganisms.

**Chemical Preservatives**

A preservative is defined as a chemical compound which is capable of retarding the
decomposition or spoilage of food to which it has been added. Preservatives play a
small but important, and legitimate role in food preservation. A century ago, many
chemicals were added to foods to preserve them or to conceal inferior quality. Many of
them were poisonous and were used in excessive amounts. The abuses of uncontrolled
additions of chemicals to food led to the first pure food laws in the U.S. in 1906. Some
of the objections to the preservatives in food today arise from the days when there was
no control of preservatives in food.

The advantages of chemical preservatives are that they are easy to use, it is simple
to add them to the food, they are cheap, no expensive equipment is needed, and no
complicated processing is needed. The disadvantages are that they can easily be used
in excess unless the amount added to the product is carefully measured, they may
allow careless and unsanitary processing practices, some of the public are fearful about
the presence of preservatives in the food they eat, and some people are allergic to
specific preservatives such as sulfur dioxide.

The Food and Drug Administration (FDA) closely regulates which chemical
substances may be used as preservatives, the foods to which they may be added, and
the level that can be added.

The most common preservatives are described in Table 4-10.
Table 4-10. Properties and Use Limits of Commonly Used Preservatives.

<table>
<thead>
<tr>
<th>Agent</th>
<th>Optimum pH Range</th>
<th>Targeted Organism</th>
<th>Use Limits</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium or Potassium Benzoate</td>
<td>2.5-4.0</td>
<td>yeasts and bacteria</td>
<td>do not exceed 0.1% by weight</td>
<td>Most often used in fruit juices, syrups, carbonated beverages and pickles.</td>
</tr>
<tr>
<td>Potassium Sorbate</td>
<td>6.0 or less</td>
<td>molds and yeasts</td>
<td>do not exceed 0.1% by weight</td>
<td></td>
</tr>
<tr>
<td>Sorbic Acid and Sodium Sorbate</td>
<td>6.5 or less</td>
<td>Molds, yeasts and some bacteria</td>
<td>0.05 to 0.2%</td>
<td>Used on cheeses, smoked fish, some syrups, pickles and meat products. Sorbic acid is metabolized by mammals like other fatty acids, therefore, an ideal preservative from human health standpoint</td>
</tr>
<tr>
<td>Propionates</td>
<td>5.0 or less</td>
<td>Molds</td>
<td>Do not exceed 0.03% by weight</td>
<td>Used in bread and some cheeses. Controls “rope” in bread.</td>
</tr>
<tr>
<td>Parabens (hydroxybenzoic acid)</td>
<td>7.0 or above</td>
<td>Yeasts and molds</td>
<td>Do not exceed 0.1% by weight</td>
<td></td>
</tr>
<tr>
<td>Sulfites and Sulfur Dioxide</td>
<td>4.5 or less</td>
<td>Yeasts, molds and bacteria</td>
<td>Depends on product, not a popular choice</td>
<td>Very effective in controlling molds in acid products. Used in dried fruits, dried vegetables, fruit juices, carbonated beverages, wines, and candied fruits. Sensitivities to sulfites by some humans has prompted FDA to phase out usage of this preservative on many products and to require warning labels on products when used.</td>
</tr>
<tr>
<td>Nitrates/ Nitrates</td>
<td>5.0 to 5.5</td>
<td>Clostridium botulinum spores</td>
<td>Nitrates do not exceed 200 ppm. Nitrates do not exceed 500 ppm</td>
<td>Mostly used in cured meat products.</td>
</tr>
</tbody>
</table>
Combinations:
Most highly perishable food products used combinations of preserving methods. Sausages typically contain high levels of salt, contain nitrites, are heat treated with they are cooked and may be smoked and distributed under refrigerated conditions. Jellies are heat treated to kill yeasts and molds but are also preserved by high sugar thereby reducing the Aw.

C) Microbiology
Introduction to Food Microbiology
This section covers the fundamental aspects of bacteria in food starting with the history, what they are and how they grow, classification systems and types of bacteria found in foods. It focuses primarily on bacteria responsible for food spoilage. Microbiology is the study of living forms so small that they can only be seen with the aid of a microscope. They have been referred to as germs, microbes, bacteria and microorganisms.

History
In the early 1700s Anton Van Leeuwenhoek, the inventor of the microscope, was first to observe these microscopic living forms. He referred to them as “wee beasties”. In 1810, Nicholas Appert, a French confectioner, place food in glass jars, sealed them and heated them in boiling water. He did not know at the time that he was killing spoilage bacteria but invented what is known today as “canning”. In the 1860s, Louis Pasteur showed that certain microorganisms were responsible for fermentation and decay of foods. He developed the application of heat to reduce the number of bacteria which now bears his name (e.g. Pasteurization). In 1895, the Massachusetts Institute of Technology determined that mysterious spoilage of some canned foods resulted from the failure to apply sufficient heat to destroy microorganisms.

Microorganisms
Food is “biodegradable” meaning it is degraded back into nature which is referred to as “spoilage”. Microorganisms cause this transition. The environment is filled with microorganisms-the air we breathe, the soil, it’s everywhere including in our food. It is the job of food professionals to control these microorganisms before they destroy our food. There are hundreds of types of microorganisms. Some cause food spoilage. Some do absolutely nothing. Some cause foodborne illness and are called pathogens. Some are beneficial and are used to make fermented foods and beverages such as beer, wine, sauerkraut, breads, cheeses, pepperoni and other fermented products. Antibiotics such as penicillin come from molds. Pathogens are those bacteria that cause foodborne illness. Although there are hundreds of species of pathogens, the vast majority of foodborne illnesses are caused by just four bacteria. (Salmonella sp, Campylobacter, Staphylococcus aureus, Clostridium perfringens). Although yeasts, molds and bacteria make up the category of microorganisms, we will
not be discussing yeasts and mold to any great extent in this section. We will focus primarily on bacteria since they are the main cause of food spoilage.

**Bacteria**

Bacteria are most important and troublesome for the food processor. Most bacteria are harmless in themselves but produce excretions and enzymes that result in food spoilage. They are single-celled living bodies that are 1/1,000 to 1/25,000 of an inch in length. The number of these tiny organisms that could be placed on the head of a pin would equal the population of New York City.

Bacterial growth refers with the way bacteria increase in number. They divide themselves such that 1 bacteria will produce 2 and 2 become 4 and 4 become 8. This doesn’t sound too drastic until you realize that there can be several thousand bacteria per gram of food and they double every so often depending on the environment they are in. Under optimum conditions, bacteria can double every 20-30 minutes.

Food is generally considered spoiled when the bacterial counts exceed $10^6$ or $10^7$. This is 1,000,000 to 10,000,000 bacteria per gram. Most spoilage is a surface phenomenon occurring only on the surface of food unless the food is ground or mixed such as sausage where spoilage occurs on the inside. Bacterial slime is generally on the order of $10^8$.

**Bacterial Classifications**

Bacteria can be classified in a number of ways.

A) **Shape**

- Round = cocci (round in shape)
- Elongated = rods

B) **Sporeforming**

Some rod-shaped bacteria are sporeformers. This is a dormant stage in their life cycle. These spores have the ability to survive a wide range of environmental extremes. They can survive heating up to 212°F and are resistant to most chemicals including sanitizing solutions. The most noteworthy sporeformer is Clostridium Botulinum.

C) **Oxygen requirements**

- Aerobic = Need oxygen to grow
- Anaerobic = Can grow only if oxygen is absent
- Facultative = Can grow with or without oxygen.

D) **Optimum temperature for growth**

Bacteria can be classified relative to the temperature in which they grow. The following are terms that are used to describe this relationship.

- Psychro = cold
- Meso = middle
- Thermo = warm
- Trophic = growing
- Duric = withstand
- Phil or philic = prefers
Using the above terms we can categorize bacteria based on their optimum temperature for growth.

1. Psychrotropic-grow best at 58-68°F but can grow slowly at refrigeration temperatures (32-50°F).
2. Mesophilic-Grows best at 86-98°F. Most food spoilage bacteria grow very well at these temperatures.
3. Thermophilic-Grow best at 100-150°F. Most sporeformers fit in this group.

**CONDITIONS AFFECTING BACTERIAL GROWTH**

There are 6 conditions affecting bacterial growth and can be remembered by the anagram FAT TOM. This stands for **Food**, **Acidity**, **Time**, **Temperature**, **Oxygen** and **Moisture**. Let's go through each of these.

1) **FOOD** - Bacteria, like any living organism, need food to live and reproduce. All food has bacteria on it but high protein and moist starchy foods are the ones most preferred by bacteria.

2) **ACIDITY** - pH is a measure of the acidity or alkalinity of foods. pH is on a 14 point scale with 7 being neutral. Foods with a pH of less than 7 are considered acid foods and pH values above 7 are considered alkaline. Most foods have pH values less than pH 7 so foods are considered acidic. Most bacteria prefer a pH range of 5.5 to 7.5. Most bacteria, especially pathogens, will not grow at a pH of 4.6 or less (acid). This is why fermented foods such as sauerkraut (fermented cabbage) and fermented sausages were historically used in Europe as a method of food preservation. Table 4-11 shows the pH ranges of some microorganisms. Table 4-12 shows the pH ranges of some foods.

**Table 4-11; pH RANGES OF BACTERIA**

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>pH Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molds</td>
<td>0.5-11</td>
</tr>
<tr>
<td>Yeasts</td>
<td>1.5-8.5</td>
</tr>
<tr>
<td>Salmonella</td>
<td>4.5-9.5</td>
</tr>
<tr>
<td>Clostridium Botulium</td>
<td>4.8-8.3</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>5.0-8.5</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>4.6-9.6</td>
</tr>
<tr>
<td>Campylobacter</td>
<td>5.0-9.0</td>
</tr>
</tbody>
</table>
Table 4-12; pH RANGES FOR FOODS

<table>
<thead>
<tr>
<th>Food</th>
<th>pH Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat</td>
<td>5.1-6.2</td>
</tr>
<tr>
<td>Chicken</td>
<td>6.2-6.4</td>
</tr>
<tr>
<td>Fish</td>
<td>6.6-6.8</td>
</tr>
<tr>
<td>Fruit</td>
<td>2.9-4.7</td>
</tr>
<tr>
<td>Apples</td>
<td>2.9-3.3</td>
</tr>
<tr>
<td>Grapes</td>
<td>3.4-4.5</td>
</tr>
<tr>
<td>Vegetables</td>
<td>4.8-6.0</td>
</tr>
<tr>
<td>Carrot</td>
<td>4.9-5.2</td>
</tr>
<tr>
<td>Corn</td>
<td>7.3</td>
</tr>
<tr>
<td>Dairy</td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td>6.5-6.6</td>
</tr>
<tr>
<td>Cheese</td>
<td>4.9-5.9</td>
</tr>
</tbody>
</table>

3) TIME - Bacteria proliferate over time. This proliferation is accelerated with higher temperature. Under optimal conditions, some bacteria can double every 20 minutes. The colder the storage temperature, the longer the potential shelflife of a food. Potentially hazardous foods should not remain in the danger zone (50-140°F) for more than 4 hours during the entire food handling process.

4) TEMPERATURE

Bacterial proliferation can be controlled by both heat and cold. Bacteria generally do not grow at freezer temperatures but they do survive in a dormant mode. Use of refrigeration temperatures (30-45°F) slows down the rate of bacterial proliferation. The colder the product, the slower the bacterial growth. At the other end of the temperature curve is the use of heat to control bacteria. There are two important words to define;

Pasteurization refers to the cooking of food where only a certain number of bacteria are killed and most pathogens. Pasteurization does not render the product sterile.

Sterilization refers to the total destruction of all living organisms and is only found in canned shelf-stable items.

Clostridium botulinum is a bacteria that can form a spore that is very resistant to heat. It produces a toxin that causes paralysis and is often fatal. It grows well in an anaerobic (no oxygen), warm (60-115°F) environment. Unless a food goes through the canning procedure (cook in a retort or pressure device of 240-250°F for several hours) it is assumed to have Clostridium spores present. Remember that Clostridium grow best at 60-115°F so you must cool all foods fast after heating. Remember to assume that all foods except shelf-stable canned foods and high acid foods contain Clostridium spores and treat them with the proper precautions.
Table 4-13 shows a bacterial thermometer that indicates how various temperatures effect bacteria. The most important temperature is that known as the “danger zone” where some bacteria can double every 20-30 minutes.

<table>
<thead>
<tr>
<th>Degrees F</th>
<th>Bacterial Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>Resistant spores killed</td>
</tr>
<tr>
<td>212</td>
<td>Boiling point of water</td>
</tr>
<tr>
<td>160</td>
<td>Resistant Salmonella kill</td>
</tr>
<tr>
<td>148</td>
<td>Vegetative cells killed</td>
</tr>
<tr>
<td>137</td>
<td>Trichina killed</td>
</tr>
<tr>
<td>140-50</td>
<td>DANGER ZONE</td>
</tr>
<tr>
<td>90</td>
<td>Bacteria double-20 min</td>
</tr>
<tr>
<td>70</td>
<td>Bacteria double-1 hour</td>
</tr>
<tr>
<td>60</td>
<td>Bacteria double-2 hours</td>
</tr>
<tr>
<td>40</td>
<td>Bacteria double –6 hours</td>
</tr>
<tr>
<td>32</td>
<td>Bacteria double-20 hours</td>
</tr>
<tr>
<td>28</td>
<td>Bacteria double –60 hours</td>
</tr>
<tr>
<td>14</td>
<td>Lower limit for bacterial growth</td>
</tr>
</tbody>
</table>

5) OXYGEN

Some bacteria require oxygen to grow (aerobic). Some bacteria will not grow in the presence of oxygen (anaerobic). Most bacteria responsible for food spoilage require oxygen. Most pathogenic bacteria are anaerobic.

6) MOISTURE

The amount of water available in food for chemical reactions and microbial growth is called water activity and is referred to as Aw. Water activity is measured from 0 (totally dry) to 1.0 (pure water). Most bacteria can only grow in foods that have a water activity higher than 0.90. The water activity available in foods can be reduced by freezing, dehydration or by adding salt or sugar or other water binders. Table 4-14
shows the Aw for various microorganisms and some typical Aw values for various foods.

Table 4- 14; Aw values for various microorganisms and typical Aw values for some foods.

<table>
<thead>
<tr>
<th>Aw/ Microorganism</th>
<th>Foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0-0.95</td>
<td>Bacteria</td>
</tr>
<tr>
<td></td>
<td>Meat, fish, sausage, milk</td>
</tr>
<tr>
<td>0.95-0.91</td>
<td>Bacteria</td>
</tr>
<tr>
<td></td>
<td>Moist cheeses, cured meat (ham), fruit</td>
</tr>
<tr>
<td></td>
<td>juice conc</td>
</tr>
<tr>
<td>0.91-0.87</td>
<td>Yeasts</td>
</tr>
<tr>
<td></td>
<td>Fermented sausages (salami), dry cheeses,</td>
</tr>
<tr>
<td></td>
<td>margarine</td>
</tr>
<tr>
<td>0.87-0.80</td>
<td>Molds</td>
</tr>
<tr>
<td></td>
<td>Juice conc, syrups, flour, fruit cakes,</td>
</tr>
<tr>
<td></td>
<td>honey, jellies, preserves</td>
</tr>
<tr>
<td>0.30-0.20</td>
<td>No microorganisms</td>
</tr>
<tr>
<td></td>
<td>proliferate</td>
</tr>
<tr>
<td></td>
<td>Cookies, crackers, bread crusts</td>
</tr>
</tbody>
</table>

Where do Bacteria come from?

Bacterial Origins

We have learned earlier that bacteria can double every so often depending on the environment. Most food microbiologists would agree that the single most important thing we can do to control bacteria spoilage in the finished product is to keep the bacterial counts as low as possible initially and along the food processing channel. Where do bacteria enter the food channel? Listed below are the areas of introduction of bacteria into the food channel.

#1; Environment from which originally obtained
- Were vegetables obtained where manure or compost were used?
- Were rodents such as mice, raccoons, etc allowed to frequent the field where these were harvested?
- Were some crops that were infected with disease co-mingled with uninfected product?
- Were animals destined to slaughter covered with manure?
- Were eggs and milk harvested from birds and cows in a sanitary manner?

#2; Microbiological quality of raw/unprocessed food
- Was the milk on the farm kept cold and obtained from cows in a sanitary manner?
-Was the harvesting equipment used and people harvesting the raw products clean and sanitary?

#3; Sanitary conditions of processing
- Was the food processing line properly cleaned and sanitized?
- Were the people instructed on sanitary operating procedures? (e.g. the wearing of hairnets, plastic gloves etc)
- Was attention given to proper cooking and cooling requirements?

#4; Adequacy of packaging, handling and storage
- Were refrigerated trucks and warehouses kept cold enough to prevent microbial proliferation?
- Was the product adequately packaged for the shelflife required?
- Was the product distributed, sold and eaten by the ultimate consumer within the allotted shelflife period specified?

Types of Bacteria on Foods
Certain foods contain different types of bacteria. Listed below are some of the most popular bacteria found on various food products.

Red Meat
- The muscle of livestock (beef and hogs) is considered fairly sterile while the animal is alive, however within several hours after the animal dies, the immune system ceases to function and bacteria from the gut begin to migrate through the intestinal walls toward the muscle itself.
- In addition, after slaughter, the hide is removed causing bacteria from the hide to be released into the air, some of which fall back onto the carcass surface.
- Bacteria from the intestinal tract include Enterobacter, Micrococcus and Proteus.
- Bacteria that are on the surface of carcasses include Pseudomonas, Micrococcus, Corynebacterium, Proteus, Aeromonas, Moraxella, Acinetobacter, Escherichia and Enterobacter.
- All of these are ubiquitous inhabitants of the common environment
  - Common Types of Spoilage of Fresh Meats include;
    - Sourcing (aerobic)-Chromobacterium, Pseudomonas, Lactobacillus.
    - Putrefaction-Clostridium, Pseudomonas, Chromobacterium, Proteus.

Ground Meat & Sausages
- By the act of grinding meat, any surface bacteria are further distributed into the interior of the meat.
- In addition, the grinding of the meat releases more juices improving the environmental conditions (increased Aw) that promote bacterial proliferation.
- Retail packages of sausages such as weiners and bologna often have a milky-looking juice inside. These are usually lactic-acid bacteria that ferment the sugar in the sausage to lactic acid.
- Common Types of Spoilage of Cured Meats include;
- **Souring**- Chromobacterium, Bacillus, Pseudomonas,
- **Greening**- Lactobacillus
- **Slimy**- Leuconostoc

**Poultry**
- Poultry are very similar to red meat in intestinal bacteria and surface bacteria to include Enterobacteriaceae, Pseudomonas, Bacillus, Micrococcus, Corynebacterium, Proteus, Chromobacterium, Escherichia and Enterobacter.
- Salmonella is quite common in poultry
- Common Types of Spoilage of Poultry include;
  - Odor & Slime-Chromobacterium, Pseudomonas, Alcaligenes

**Fish & Shellfish**
- Bacteria from the genera Pseudomonas, Chromobacterium, Micrococcus, Flavobacterium, Corynebacterium, Sarcina and Serratia have been associated with slimy coats on fish.
- Intestinal flora may include species of the genera Bacillus, Escherichia and Clostridium.
- Common Types of Spoilage of Fish include;
  - Discoloration-Pseudomonas
  - Putrefaction- Chromobacterium, Flavobacterium

**Fruits & Vegetables**
- The tissues of the internal parts of fruits and vegetables are like meat in that it is considered sterile.
- It is the exterior surface that harbors the bacteria.
- If manure is used as fertilizer, pathogens may be present.
- Vegetables growing in the soil such as root crops contain species of Bacillus, Pseudomonas and many others.
- Soils and plants harbor Lactobacillus, Leuconostoc and Pediococcus.

Common Types of Spoilage of Fruits and Vegetables include;
- **Bacterial soft rot**- Erwinia carotovora
- **Sliminess or souring**- Saprophytic bacteria

- Common Types of Spoilage of Fruit and Vegetable Juice
  - **Off-flavor**- Lactobacillus
  - **Souring**- Lactobacillus, Acinetobacter

- Common Spoilage of Sugar Products (Honey, Syrups)
  - **Ropy or stringy syrup**- Enterobacter aerogenes
  - **Green syrup**- Pseudomonas fluorescens
  - **Gassy or frothy molasses**- Clostridium
Fermented Foods
- Soil and plants harbor large numbers of Lactobacillus, Leuconostoc and Pediococcus. In fermented products such as pickles, sauerkraut and olives, we allow these natural occurring bacteria to convert carbohydrates to lactic acid thereby lowering the pH. The bacterial selection is conducted by using high salt solutions (called brines) that allow only certain types of bacteria to live.
  
  Common Types of Spoilage of Fermented Vegetables include;
  - Slimy kraut - Lactobacillus plantarum
  - Soft pickles - Bacillus
  - Black pickles - Bacillus nigrificans

Egg & Egg Products
- Eggs like meat are considered virtually sterile on the inside but the outside surface of the shell will have bacteria. Over time, these bacteria will invade the inside of the egg. Salmonella is a big concern with eggs and egg products. Egg products such as liquid eggs may contain the bacteria that were on the surface of the egg.
  
  Common Types of Spoilage of Eggs include;
  - Green rot - Pseudomonas fluorescens
  - Colorless rot - Pseudomonas, Chrombacterium
  - Black rot - Proteus

D. FOOD PRESERVATION

Food is designed by Mother Nature to spoil. This now has a term- “Biodegradable”. Eggs, milk and meat are perfect bacterial growth mediums. Food is extremely “biodegradable” and as food professionals, our job involves finding and implementing steps that keep food from spoiling and reduce or eliminate the pathogens that might be present.

Controlling Bacteria

Controlling bacteria in foods has been going on for centuries starting with the caveman discovering fire to cook meat, the use of saltpeter by Egyptians to cure meat through Europeans making fermented, dried sausages. Leviticus and Deuteronomy chapters of the Old Testament in the Bible have numerous references on what to eat and how food should be prepared. Most of the old methods of food preservation were probably discovered by accident with the theory of “let’s see if this works” or by long term observation. Over the last 100 years, mainly since the discovery of bacteria, great strides have been made at discovering how to preserve food mainly through the study of microbiology. Food preservation has gone from an art to a science.

Controlling Bacteria

There are basically 5 categories of things we know we can do to control bacteria.
* Control initial bacteria counts
* Control and use of temperature
Control Initial Bacteria Counts
The single most important control factor is that of keeping the initial bacteria counts on raw food as low as possible. Most other control methods only reduce bacterial counts by a percentage. Example; Cooking may reduce bacteria by 90%. What would you prefer? Having 10% of 100=10 bacteria or 10% of 1,000=100 bacteria? We can do this by working to keep raw material as clean as possible during harvest, proper cleaning of food processing facilities, use of sanitizing solutions such as chlorine in processing plants, the use of chlorinated water during processing and instruction of people in food processing of important hygiene issues.

Control and Use of Temperature
Bacterial proliferation can be controlled by both heat and cold. Bacteria generally do not grow at freezer temperatures but they can survive. Use of refrigeration temperatures (30-45F) slows down the rate of bacterial proliferation. The colder the better. Heat can also be used to control bacterial counts. Pasteurization is one technique. Most foods are pasteurized meaning that the bacterial population has been drastically reduced on the order of 90-95%. Most bacteria are very sensitive to heat and are easily killed. Milk is a good example. Milk is heated to a high temperature (161F) for a very short period of time (15 seconds) reducing the bacteria population but it will still spoil due to un killed bacteria after extended refrigerated storage. Milk pasteurized started in the early 1950s mainly to reduce the incidence of tuberculosis caused by Mycobacterium tuberculosis. Heat sterilization is another method of controlling bacterial counts through the use of heat. In this procedure, food in placed in containers and subjected to an extremely high degree of temperature usually in retorts or large pressure cookers. The high pressure allows the temperature to go above 212F without boiling. The use of heat sterilization produces shelf-stable foods requiring no refrigeration that is virtually free of bacteria.

Control Oxygen
There are a number of spoilage bacteria that require oxygen to grow (aerobics). By eliminating oxygen from the food, we can drastically slow down decomposition. Note the number of meat products sold in vacuum packages. Some foods can also be distributed in nitrogen-containing atmospheres which is a method of displacing oxygen.

Control Moisture
Drying of food products is certainly not new. The control of the water activity (Aw) is the key. High sugar items like honey, jellies and molasses do not generally spoil from bacteria because the sugar ties up the available moisture. Cereals and bakery items such as breads do not typically spoil from bacteria because their moisture content is so low.
Control Acidity
By keeping food products in an acidified condition, we can control bacteria. Clostridium botulinum will not grow below pH=4.6. Many soft drinks have low pHs to keep them from spoiling by bacteria. Pickles, olives, sauerkraut are preserved by their low pH. The old rule was that if you eat acid foods, you will never get food poisoning. We do find some exceptions to this age-old rule but it remains true for the most part.

E. Pathogens:
INTRODUCTION
Pathogens are bacteria that cause food poisoning. Foodborne illness or food poisoning is far more common than most people realize. People often say the family came down with the flu but in reality, the family ate the same food which had some pathogenic bacteria. Pathogens range in symptoms. Some cause only flu-like symptoms for a few days while some are fatal such as botulism. Although it may appear from the following information that there are numerous pathogenic microorganisms in foods, in actuality, our food supply is safer than any other country in the world and safer than any other time in the history of mankind. The number of cases of foodborne illnesses caused by pathogens can be drastically reduced through the use of certain food handling practices. The estimated illnesses from foodborne pathogens range from 6 million to 81 million people per year. Keep in mind that there are about 286 million people in the U.S. The estimated annual medical costs, productivity losses and costs of premature deaths due to the 5 major foodborne illnesses is estimated at $6.9 billion per year. The breakdown of the number of illnesses per year from various pathogens can be found in Table 4-15.

Table 4-15; Number of Illness resulting from various pathogens

<table>
<thead>
<tr>
<th>PATHOGEN</th>
<th>ILLNESSES PER YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td>4,420,000</td>
</tr>
<tr>
<td>Parasites</td>
<td>1,270,658</td>
</tr>
<tr>
<td>Viruses</td>
<td>9,278,500</td>
</tr>
</tbody>
</table>

It is hard to get an accurate number since most cases are not reported and many are never diagnosed. The CDC estimates that 78% of pathogen outbreaks occur as a result of poor food handling practices in commercial and institutional establishments while only 22% occur due to food handling practices in private residences. Very few pathogenic illnesses can be attributed to actual food processing facilities but has been estimated to be about 3%.

CLASSES OF PATHOGENS
Pathogens are defined as microorganisms that cause illness and possibly death. They can be classified as bacteria, molds, yeasts, parasites and viruses. The number of foodborne illnesses and deaths contributed to these pathogens can be found in tables 4-16, 4-17 and 4-18.
Table 4-16; Number of cases per year of bacteria, parasites and viruses.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Specie</th>
<th># Cases per year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bacteria</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Campylobacter spp</td>
<td>1,963,200</td>
<td></td>
</tr>
<tr>
<td>Salmonella</td>
<td>1,257,125</td>
<td></td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>248,000</td>
<td></td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>185,000</td>
<td></td>
</tr>
<tr>
<td>E Coli (non-0157H7)</td>
<td>120,000</td>
<td></td>
</tr>
<tr>
<td>Shigella</td>
<td>89,800</td>
<td></td>
</tr>
<tr>
<td>Yersinia enterocolitica</td>
<td>86,400</td>
<td></td>
</tr>
<tr>
<td>Streptococcus</td>
<td>51,000</td>
<td></td>
</tr>
<tr>
<td>E. Coli 0157:H7</td>
<td>62,475</td>
<td></td>
</tr>
<tr>
<td>Bacillus cereus</td>
<td>27,000</td>
<td></td>
</tr>
<tr>
<td>Vibrio spp</td>
<td>4,000</td>
<td></td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>2,500</td>
<td></td>
</tr>
<tr>
<td>Clostridium botulinum</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td><strong>Parasites</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Giardia lamblia</td>
<td>200,000</td>
<td></td>
</tr>
<tr>
<td>Toxoplasma gondi</td>
<td>112,000</td>
<td></td>
</tr>
<tr>
<td>Cryptosporidium parvum</td>
<td>30,000</td>
<td></td>
</tr>
<tr>
<td>Cyclospora cayetanensis</td>
<td>14,637</td>
<td></td>
</tr>
<tr>
<td>Trichinella spiralis</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td><strong>Viruses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norwalk-like viruses</td>
<td>9,200,000</td>
<td></td>
</tr>
<tr>
<td>Rotovirus</td>
<td>39,000</td>
<td></td>
</tr>
<tr>
<td>Astrovirus</td>
<td>39,000</td>
<td></td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>4,150</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-17; The Percentage of Deaths from Foodborne Pathogens

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>% Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td>72%</td>
</tr>
<tr>
<td>Parasites</td>
<td>21%</td>
</tr>
<tr>
<td>Viruses</td>
<td>7%</td>
</tr>
</tbody>
</table>
Table 4-18; The 5 Specific Pathogens that Account for 98% of Estimated Deaths

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>% Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmonella</td>
<td>31%</td>
</tr>
<tr>
<td>Listeria</td>
<td>28%</td>
</tr>
<tr>
<td>Toxoplasma</td>
<td>21%</td>
</tr>
<tr>
<td>Norwalk-like viruses</td>
<td>7%</td>
</tr>
<tr>
<td>Campylobacter</td>
<td>5%</td>
</tr>
<tr>
<td>E.Coli 0157;H7</td>
<td>3%</td>
</tr>
</tbody>
</table>

After looking at the numbers in the above tables, it would appear that viruses are a major problem but one has to remember that it is very hard to get an accurately identified source when working with viruses. Many viruses cannot live outside a host animal and are hard to quantitate. Parasites do not represent a major category of foodborne illness. Bacteria are the single largest concern for food processors in terms of both spoilage and pathogens.

**Potentially Hazardous Foods (PHF)**

Potentially hazardous foods (PHF) are defined as foods that are natural or synthetic and that require temperature control because it is in a form capable of supporting rapid microbial growth. PHF’s are most often responsible for outbreaks of foodborne illness. These include foods with high protein content such as meat, poultry, fish and dairy products. PHF’s also includes some low-protein foods, moist starchy foods as well as cooked rice, coleslaw, garlic in oil, and sliced watermelon. PHF’s generally have near-neutral pH levels (5.0 or higher) and a high moisture content (water activity higher than 0.91). Some of the more common potentially hazardous foods are listed in Table 4-19.
Table 4-19; Potentially Hazardous Foods

Meat & Meat products
Poultry
Fish
Shellfish
Raw eggs
Milk
Dairy products
Garlic-in-oil mixtures
Gravies
Creamed soups
Custards/Puddings
Protein salads
Sauces (esp cream sauces)
Cream-filled baked goods

THE MAIN PATHOGENS;
Pathogens are of key interest to food processors. Table 4-20 shows a list of the more common pathogens that can be found in foods. Of these pathogens, 80-90% of foodborne illnesses come from just 4 bacteria (Campylobacter, Salmonella, Clostridium perfringens and Staphylococcus aureus).

Table 4-20; Pathogens of Interest to Food Processors

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Pathogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmonella spp</td>
<td>Listeria monocytogenes</td>
</tr>
<tr>
<td>Shigella spp</td>
<td>Clostridium botulinum</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>Escherichia coli 0157:H7</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>Vibrio parahaemolyticus and vulnificus</td>
</tr>
<tr>
<td>Campylobacter jejuni</td>
<td>Yersinia enterocolitica</td>
</tr>
<tr>
<td>Bacillus cereus</td>
<td></td>
</tr>
</tbody>
</table>

There are some pathogens listed in Table 4-21 that cause some diseases that you might remember from history. Diseases like diphtheria, tuberculosis and cholera are rare in the U. S now because we understand how they grow and control them.

Table 4-21; Specific diseases caused by certain pathogens.

<table>
<thead>
<tr>
<th>DISEASE</th>
<th>PATHOGEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthrax</td>
<td>Bacillus anthrax</td>
</tr>
<tr>
<td>Diphtheria</td>
<td>Corynebacterium diphtheriae</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>Microbacterium tuberculosis</td>
</tr>
<tr>
<td>Scarlet/Rheumatic fever</td>
<td>Streptococcus pyogenes</td>
</tr>
<tr>
<td>Cholera</td>
<td>Vibrio cholerae</td>
</tr>
<tr>
<td>Gonorrhea</td>
<td>Neisseria gonorrhoea</td>
</tr>
<tr>
<td>Plaque</td>
<td>Yersinia pestis</td>
</tr>
</tbody>
</table>
There are basically three categories of foodborne diseases that can be carried or transmitted to humans by food. They include 1) Foodborne infection, 2) Foodborne intoxication or poisoning and 3) Foodborne toxico-infection. They are defined in Table 4-22.

<table>
<thead>
<tr>
<th>Type of Foodborne Illness</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foodborne infection</td>
<td>Foodborne infection results from eating food containing living harmful microorganisms. The microorganisms multiply in the body, invades and penetrates the intestinal walls causing illness.</td>
<td>Examples include Salmonella, Listeria monocytogenes, Campylobacter jejuni, Yersinia enterocolitica</td>
</tr>
<tr>
<td>Foodborne intoxication or poisoning</td>
<td>Foodborne intoxication or food poisoning resulting from eating food containing toxins or poisons produced by microorganisms that may not be present anymore.</td>
<td>Examples include Staphylococcus aureus, Bacillus cereus, Clostridium botulinum</td>
</tr>
<tr>
<td>Foodborne toxico-infection</td>
<td>Foodborne toxico-mediated infection results from eating a food containing a large amount of disease-causing microorganisms, which grow in the intestines and produce toxins</td>
<td>Examples include Clostridium perfringens, Bacillus cereus, E. Coli 0157:H7 and Shigella</td>
</tr>
</tbody>
</table>

Listed in Table 4-23 are various diseases and the pathogens that cause them along with characteristics, type of foodborne illness and symptoms.
<table>
<thead>
<tr>
<th>Disease</th>
<th>Pathogen</th>
<th>Characteristics</th>
<th>Type</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BACTERIA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>Salmonella..</td>
<td>non-spore forming, facultative and some strains can grow at pH range below 4.5</td>
<td>foodborne infection</td>
<td>abdominal cramps, headache, nausea, fever, diarrhea and sometimes vomiting. May cause severe dehydration in infants and elderly</td>
</tr>
<tr>
<td>SHIGELLOSIS</td>
<td>Shigella</td>
<td>do not produce spores, are facultative and some strains produce shiga toxin.</td>
<td>toxin-mediated infection</td>
<td>diarrhea (may be bloody), abdominal pain, fever, nausea, cramps, vomiting, chills, fatigue and dehydration. Infant day-care centers are a common source.</td>
</tr>
<tr>
<td>LISTERIOSIS</td>
<td>Listeria monocytogenes</td>
<td>does not form spores, is facultative, resists freezing, drying and heat and can grow at refrigeration temperatures</td>
<td>foodborne infection</td>
<td>nausea, vomiting, diarrhea, headache, persistent fever, chills, backache, meningitis, encephalitis and septicemia. Most often affects infants, pregnant women and their fetuses, immune-compromised and organ transplant patients. Foods associated with Listeria include; Unpasteurized milk and milk products. Raw vegetables Poultry, meat, seafood. Prepared and ready to eat foods. Pregnant women should avoid in-store sliced deli meats, soft cheeses and smoked salmon.</td>
</tr>
<tr>
<td>CLOSTRIDIUM PERFRINGENS</td>
<td>form spores and is anaerobic</td>
<td></td>
<td>toxin-mediated infection</td>
<td>abdominal pain, diarrhea, nausea, dehydration (fever, headache and vomiting are usually absent). Sources of contamination include human and animal intestinal tracts and soil (especially contaminated with feces). Foods associated with contamination include meat, meat products, poultry, stew, gravy and beans that have been improperly cooked.</td>
</tr>
<tr>
<td>Staphylococcal Food Poisoning</td>
<td>Staphylococcus aureas</td>
<td>does not form spores, is facultative and is very heat sensitive</td>
<td>foodborne intoxication or poisoning.</td>
<td>nausea, vomiting, abdominal cramps, and diarrhea. Sources of contamination include skin, hair, nose, throat, infected sores (boils &amp; whiteheads) and animals. Foods associated with contamination include meat, poultry, egg products, milk and dairy products, potato salad, custards and salad dressings</td>
</tr>
<tr>
<td></td>
<td>Bacillus cereus</td>
<td>forms spores and is facultative.</td>
<td>causes both toxin-mediated infections (causing diarrhea) and intoxication (causing vomiting).</td>
<td>Infection-watery diarrhea, abdominal cramps, pain, nausea. *Intoxication-nausea and vomiting; sometimes abdominal cramps and diarrhea. Sources of contamination include soil and dust, cereal crops, skin infection (whiteheads on skin). Cooking kills the vegetative cells but can cause spores to germinate, making reheated foods a problem. Foods involved; Infection-meat, milk, vegetables, fish. *Intoxication-rice products, starchy foods, sauces, puddings, soups.</td>
</tr>
<tr>
<td><strong>BOTULISM</strong></td>
<td>Clostridium botulinum</td>
<td>forms spores and is anaerobic</td>
<td>Causes food intoxication or poisoning.</td>
<td>vomiting and constipation or diarrhea initially with progressive fatigue, weakness, vertigo, blurred or double vision, breathing paralysis, dry mouth eventually leading to paralysis and death. Has been found in almost all foods but initially coming from soil and water.</td>
</tr>
<tr>
<td><strong>CAMPYLOBACTERIOSIS</strong></td>
<td>Campylobacter jejuni</td>
<td>does not form spores.</td>
<td>foodborne infection</td>
<td>bloody diarrhea, fever, nausea, vomiting, abdominal pain, headache and muscle pain. Sources of contamination include domestic and wild animals. Foods associated with contamination include unpasteurized milk and dairy products, raw poultry and non-chlorinated or fecal-contaminated water.</td>
</tr>
<tr>
<td><strong>Escherichia Coli 0157:H7</strong></td>
<td>does not form spores, is facultative and has survived freezing and low pH (below pH 4.0). Can grow at refrigeration temperatures</td>
<td>toxin-mediated infection</td>
<td>diarrhea (may become bloody), severe abdominal cramps, kidney failure and possibly death. Source of contamination is from the GI tract of animals and humans. Food associated include: Raw or undercooked meat and poultry. Unpasteurized milk and dairy products and fruit juices. Vegetables from manure fertilized fields. Non-chlorinated water.</td>
<td></td>
</tr>
<tr>
<td><strong>VIBRIO Spp</strong></td>
<td>Vibrio parahaemolyticus and Vibrio vulnificus</td>
<td>do not form spores; More common in warmer months.</td>
<td>foodborne infection</td>
<td>diarrhea, abdominal cramps, nausea, vomiting, headache and sometimes death in immuno-compromised individuals. Most commonly found in oysters and shellfish from the Gulf of Mexico. Foods involved are raw or partially cooked oysters and shellfish.</td>
</tr>
<tr>
<td><strong>YERSINIOSIS</strong></td>
<td>Yersinia enterocolitica</td>
<td>does not form spores, is facultative, can survive at a pH below 4.5 and can grow at refrigeration temperatures.</td>
<td>foodborne infection usually in young people (10-12 years old).</td>
<td>fever and severe abdominal pain (mimics appendicitis). Possibly diarrhea, headache, sore throat or vomiting. Source is soil, water, domestic and wild animals, rodents. Foods most commonly involved include meats, oysters and fish, unpasteurized milk and dairy products and non-chlorinated water.</td>
</tr>
<tr>
<td><strong>PARASITES</strong></td>
<td><strong>TRICHINOSIS</strong></td>
<td>Trichinella spiralis</td>
<td>a roundworm that burrows into the muscle of the host and causes infection.</td>
<td>Early symptoms include nausea, diarrhea, abdominal pain, occasional vomiting, swelling around the eyes and fever. Later symptoms include muscle soreness, thirst, extreme sweating, chills, bleeding and fatigue. Generally from meat animals that eat off the ground or in garbage dumps. Pork used to be the common vehicle to humans but proper cooking and the fact that hogs are now reared in confinement have reduced the incidence. Wild game such as bears and raccoons are the most common carriers.</td>
</tr>
<tr>
<td><strong>TOXOPLASMOSIS</strong></td>
<td>Toxoplasma gondii</td>
<td>Often there are no symptoms. When symptoms occur, they include enlarged lymph nodes in the head and neck, severe headaches, muscle pain and rash. Individuals with compromised immune systems such as HIV-infected people and pregnant women and their fetuses are at most risk. It is not passed by person to person contact. Cats are a common source. Pregnant women should avoid emptying cat litter box. Food sources include raw or undercooked meat especially pork, lamb, venison and raw vegetables.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VIRUSES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatitis A or Hepatovirus</td>
<td>infection of the liver</td>
<td>Symptoms include discomfort, fatigue, headache, nausea, loss of appetite, vomiting, abdominal pain and jaundice and may appear weeks/months after exposure. Transmitted to foods either by poor personal hygiene or contaminated water. Human feces is the main reservoir. Food sources that may be contaminated include water, ice, shellfish, cold cuts and sandwiches, milk or dairy products or any food that does not receive a further heat treatment. Also, fruits and vegetables that are washed with infected water or contaminated by infected humans or animals may contain Hepatitis A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norwalk Virus Gastroenteritis</td>
<td>Norwalk virus</td>
<td>causes an infection of the stomach and intestines</td>
<td>Symptoms include nausea, vomiting, diarrhea, abdominal cramps, headache and mild fever. May appear weeks/months after exposure. Transmitted to food by either poor personal hygiene or contaminated water. Food sources that may be contaminated include water, shellfish and raw fruits and vegetables that are washed with infected water or contaminated by infected humans or animals.</td>
<td></td>
</tr>
<tr>
<td><strong>HIV VIRUS</strong></td>
<td>The Human Immunodeficiency Virus is NOT a foodborne illness. HIV- infected people can work with food unless they have a secondary infection or communicable illness</td>
<td>symptoms including vomiting, diarrhea, fever, sore throat or jaundice.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MAD COW DISEASE</strong></td>
<td>caused by prions which are proteins thought to originate as</td>
<td>e. Mad cow is one of a group of diseases called Transmissible Spongiform Encephalopathies which include; - Creutzfeldt-Jacob disease in</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
regular components of neurological tissues in animals. When these proteins become abnormally shaped, they are able to transform molecules of normally shaped protein with which they come in contact to the abnormal prion configuration. This process is repeated numerous times until the number of abnormally-shaped molecules causes overt illness.

humans
- Scrapie in sheep and goats
- Chronic Wasting Disease in deer and elk in Wisconsin and Colorado.

A word about viruses. Viruses can only multiply in living cells (hosts) and are very hard to kill while in humans. They do not multiply in foods because of the temperature range that foods are kept in do not foster their growth. In addition, viruses are quite easily killed at fairly low temperatures when food is cooked however, food may become infected with viruses after cooking by human carriers or by contaminated water.
THE COMMON FOODBORNE ILLNESSES

As previously mentioned, 98% of food illnesses are caused by 4 pathogens. The next 3 tables show the sources, mode of transmission and symptoms of these 4 major pathogens.(Tables 4-24, 4-25 and 4-26)

Table 4-24; Sources of common Pathogens that cause Foodborne Illnesses

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campylobacter</td>
<td>GI tract of mammals, raw milk, untreated water, sewage</td>
</tr>
<tr>
<td>Salmonella</td>
<td>GI tract, eggs</td>
</tr>
<tr>
<td>C. Perfringens</td>
<td>Soil, dust, sewage, GI tract</td>
</tr>
<tr>
<td>Staph. Aureus</td>
<td>On humans esp nose, hair, face</td>
</tr>
</tbody>
</table>

Table 4-25; Transmission of Common Pathogens that cause Foodborne Illnesses

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campylobacter</td>
<td>Contaminated water, raw milk, undercooked meat, poultry or shellfish</td>
</tr>
<tr>
<td>Salmonella</td>
<td>Raw or undercooked milk, dairy products, eggs, meat, poultry, food handlers</td>
</tr>
<tr>
<td>C. Perfringens</td>
<td>“Cafeteria germ”; steam tables or room temp</td>
</tr>
<tr>
<td>Staph. Aureus</td>
<td>Person to person contact</td>
</tr>
</tbody>
</table>
Table 4-26; Symptoms of Common Pathogens that Cause Foodborne Illnesses

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campylobacter</td>
<td>Fever, headache and muscle pain, diarrhea, abdominal pain and nausea 2-5 days after eating</td>
</tr>
<tr>
<td>Salmonella</td>
<td>Stomach pain, diarrhea, nausea, chills, fever, and headache 8-72 hrs after eating</td>
</tr>
<tr>
<td>C. Perfringens</td>
<td>Diarrhea and gas pains 8-24 hrs after eating</td>
</tr>
<tr>
<td>Staph. Aureus</td>
<td>Nausea, abdominal cramps, vomiting and diarrhea 1-6 hours after eating</td>
</tr>
</tbody>
</table>

F) Shelflife and Stability

Shelflife or shelf stability are terms used to describe how long a food product will be safe or have suitable quality after the date of manufacture. It is up to the manufacturer to determine how long a product will be good for. These are usually expressed as a “Sell by___” date or “Best if used by___” date. In order to determine these dates, the manufacturer should put several units of product from each batch in a storage cabinet that is similar to the conditions the product will be distributed in. These samples should be evaluated at regular intervals to see if the product is still of acceptable quality. These end-point evaluations should be sensory (taste, smell, appearance) and bacteria counts. The most common quality attributes for food include flavor, texture and appearance or color. These quality indicators are how people will ultimately judge your product. Most deterioration of foods is caused by either bacteria damage or fat rancidity. Bacteria secrete enzymes that breakdown foods. They primarily attack the protein or carbohydrate portion of foods. When proteins are broken down, small aromatic particles are formed which cause a food to have a bad odor. The key to extending shelflife is temperature control since it limits the rate of proliferation of bacteria and slows their metabolic activity. The second component of food quality is fat rancidity. Fat goes rancid over time. Salt causes an increase in the rate of rancidity. Even though food is kept in a freezer, fat still goes rancid. If you have a food product high in fat, it is imperative that you consider this in shelf life determination. A person may choose to use an antioxidant such as BHA, BHT or vitamin C to extend the shelflife of high fat-containing foods. Another method is to package fat foods in atmospheres containing no oxygen. The fat used to fry potato chips can go rancid fairly quickly so most potato chips are packaged in nitrogen atmosphere packages.

Other less important product deterioration factors can be freezer burn caused
by the loss of moisture of the surface of foods in a freezer, ice crystal damage from slow freezing and color loss of some foods. A table of shelflife values for some frozen foods can be found in Table 4-3.

G) Code Dating:

Most foods are required to have a code date on them. The code provides a means for tracking product should there be complaints or if a recall is necessary. The code should consist of where the product is manufactured, the date and year it was manufactured, the product and batch number. In order to recall a product, the processor must be able to identify the product involved and determine the distribution of that product. A code-dating system needs to be part of the company's policy. Print production date code on all finished product packages and/or cases. This code can identify the production date, shift, or hour of production and/or lot or batch number, and production facility. Each processor may devise its own variation of coding. It is important that a meaningful product coding be established and a record-keeping system be adopted so individual lots of the product can be traced from the processing facility to the end user. Use the code date on all quality control records, production reports, and shipping forms.

Examples of code dating:

Julian Date Code of 2316A- This means the product was manufactured on the 231st day of a year. The “6” represents the year (1996) and “A” represents the hour period or production batch.

Gregorian Date Code of June 5, 1996 or 6/5/96A is the date the product was made. The “A” represents the hour period of production batch.

H) RECALLS:

This section on recalls is to be used as a guide for the teaching of the fundamentals involved in recalls but because of the seriousness, varying codes by various agencies (USDA vs FDA), type of product and method of processing, every food processing plant should have a recall policy that is developed after careful consideration of the regulations, product mix, customer base, method of processing and distribution etc. Recalls should be initiated by a company and are classified into one of three categories;

1) Market Withdrawal
2) Stock Recovery
3) Product Recall

MARKET WITHDRAWAL

A Market Withdrawal is the situation where no violation is involved or the violation is minor and not subject to seizure under current USDA or FDA policy and guidelines. An example would be a product with poor quality as defined by the manufacturing company.
STOCK RECOVERY

A Stock Recovery is a situation where none of the product has left the direct control of the manufacturer or primary distributor. This type of action would be a product recall or market withdrawal if the product were in the distribution channels.

PRODUCT RECALL

A true Product Recall is a voluntary action by a company that marketed the product and is defined as removing from the market and distribution channels those products that are adulterated or misbranded to the extent that it is subject to seizure under current FDA or USDA policy and guidelines. Product recalls are an efficient and effective means of removing sizable products from the marketplace. The alternative to recalls is the seizure or other legal actions by regulatory agencies. Recalls are classified as Class I, Class II or Class III depending on the severity of consequences.

Class I Recalls

Class I recalls represent emergency situations and involve the removal from the market of products in which the consequences may be either immediate or long-range, life threatening, and involve a direct cause-effect relationship such as the presence of *Clostridium botulinum* toxin in foods. When such circumstances occur, the FDA requires that the recall be made to the consumer level, that the product be placed on the public recall list and that a public warning be issued via the news media. The effectiveness check for Class I recalls must be such as to assure 100 percent removal of all known direct accounts and sub-accounts and, if necessary, product in possession of consumers.

Class II Recalls

Class II recalls represent priority situations (as opposed to emergency for Class I recalls) in which the consequence may be either immediate or long-range and with possible or potential life threatening or hazardous to health situation. These might include conditions such as: the presence of pathogenic microorganisms in food exclusive of *Clostridium botulinum*, improper calibration of thermometers, unnecessary exposure to radiation, etc. For a Class II recall, the FDA requires that the product be removed to the retail or dispensing level; that notice of the recall be placed on the public recall list; and when in the public interest there is a need that there be a press release announcing the recall. The effectiveness check for such a recall would be made on removal adequacy at levels reflecting the degree of consumer hazard associated with the violation.

Class III Recalls

Class III recalls represent routine situations in which the consequences to life are remote or nonexistent. These would involve recalls because of adulteration or misbranding not involving a health hazard. They might also include defects in food relating to esthetic qualities, label violations, etc. Removal in such cases would be made to the wholesale level and mention would be made of the recall on the public recall list. A press release ordinarily would not be issued but FDA would consider each case in the light of the particular circumstances. Effectiveness checks for a Class
III recall would be an exception rather than the rule. FDA may request the firm to submit a statement attesting to the amount of stocks returned and the disposition of them.

Why Should a Company have a Recall Policy?
Food processing companies should have a recall policy for such reasons as;
1) Protect customer and consumer safety
2) Protect the assets of the company
3) Comply with applicable laws and government regulations
4) Remove unacceptable or questionable products from the market at minimum cost and inconvenience to the customer and consumer.

The objectives of a recall policy are; 1) Locate the product, 2) Remove the product from the market and 3) Provide accurate information to government agencies and consumers/customers when appropriate.

HOW A RECALL WORKS:
Every day, a company has a constant stream of indicators from customers, quality control lab tests, government agencies and internally that something may be wrong. Managers are trained and experienced into what clues may be signs of a major problem. For example, if a customer complains about a product, they may just want coupons or free samples but if a doctor calls about a sick person who ate your product or if the USDA calls about something, it should be taken seriously.

When the plant manager or QA manager hears of something of significance, a recall team of a “Crisis Management Unit (CMU)” should be assembled. The recall team should consist as a minimum of the plant manager, quality control manager, sales, distribution, customer service etc. The recall team is called together to collect information about an incident such as 1) Is the source of information credible?, 2) What type of recall would this be?, 3) How widespread is the problem? 4) Any facts bearing on the incident that need to be discussed. If the information collected is decided to be of significance, the following actions need to be taken;

1) Suspected product in the warehouse should be put on “internal hold”.
2) If appropriate, government agencies should be notified.
3) Stores/ Customers should be notified of the situation telling them the product name and number, product size, bar codes numbers if used, code dates effected and estimated quantities etc
4) Initiate the pickup of suspected or recalled product from stores.
5) Keep accurate records of the amount of product recovered.
6) Dispose or rework recalled product.

This is obviously a very simplified version of what would happen. Anyone who has ever survived a recall can tell you, it is a gut-wrenching experience and one to be avoided at all costs. Because the numerous variables between products, manufacturing
methods, government regulations and other variables, one is best advised to have a recall policy and plan written up in detail.

I) HACCP

Introduction
This section discusses what HACCP is, the history of HACCP, what it does and how you can use it. Keep in mind that it is a very basic presentation of a complex subject. Although HACCP is required in some food companies, its methodology can also be used for quality improvements in the food processing arena.

What is HACCP?
HACCP is short for ‘Hazard Analysis Critical Control Point’. HACCP is a scientifically-based management system for food safety. HACCP uses a written plan which focuses on how potentially hazardous foods are handled in a food processing environment. HACCP is a state-of-the-art approach to consistent safe food production. HACCP is proactive and prevention-oriented focusing on preventing or controlling food safety hazards that fall into three main categories: biological, chemical and physical. HACCP is really all about prevention. Knowledge of the hazards and procedures to control the hazards will prevent foodborne illness in food processing plants. Identify a potential problem early and prevent it from becoming a real problem later.

The HACCP Concert
In maybe what is an over-simplification, under the HACCP concept, a “hazard analysis” is conducted to assess potential food safety hazards throughout the entire process for producing a given product. This is generally production people figuring out what can go wrong. Then they figure out critical control points (CCPs) on where to monitor hazards. Then a written plan is drafted to address various situations that might come up and how to handle them.

The History of HACCP
The HACCP system was originally developed for use in aerospace manufacturing under the name “Failure Mode Effect Analysis”. It was first adapted to food processing by the Pillsbury Company in 1959 in a project for the NASA space program. At that time, HACCP was used to guarantee that food used in the U.S. space program would be 100% free of viral and bacterial pathogens. By the late 1960s, Pillsbury was using a HACCP system to manufacture consumer goods. In late 1989, FSIS announced its intention to implement HACCP in meat and poultry inspection operations. FSIS embarked on a 3 year study to determine how best to implement HACCP.

The Seven Principles of HACCP.
1) Conduct a hazard analysis. Prepare a list of steps in the process where significant hazards could occur and describe the preventive measures.
2) Identify the Critical Control Points (CCPs) in the process.
3) Establish critical limits for preventive measurements associated with each identified CCP.

4) Establish CCP monitoring requirements. Establish procedures for using the results of monitoring to adjust the process and maintain the control.

The Seven Principles of HACCP

5) Establish corrective actions to be taken when monitoring indicates that there is a deviation from an established critical limit.

6) Establish effective record-keeping procedures that document the HACCP system.

7) Establish procedures for verification that the HACCP system is working correctly.

HACCP Definitions

Hazard - the capability of something to cause harm.

Risk - A condition or set of conditions that will lead to a hazard.

Critical Control Point - an operation, practice or procedure where unacceptable health risks might result if something goes wrong. Preventative measures at critical points will eliminate, prevent or minimize hazards.

Going Through the Steps of HACCP

We will now go through the steps involved in developing and implementing a HACCP system. Remember that this is only an introduction to HACCP.

Step #1; Evaluate Current Programs

Before implementing HACCP, it is important to see how the company is currently handling food safety issues. This includes a review of existing quality assurance programs, sanitation programs, recall procedures, and good manufacturing practices (GMPs). These programs, if effective, can become the foundation of HACCP plans.

Step #2; Gain Support from Management

Strong commitment from senior management is vital. It will cost money up front but will save money in the long run from lawsuits. Top management should understand the benefits associated with HACCP in regards to food safety. In addition, product quality should also improve.

Step #3; Select a HACCP Coordinator

Management should select a HACCP coordinator who will ultimately be responsible for the entire HACCP plan. This person should have extensive knowledge of and experience with HACCP systems.

Step #4; Assemble a HACCP Team

A multidisciplinary team should be established to develop, implement and review HACCP plans. Members of the team should understand the basic principles of the processing operation and be familiar with the HACCP concepts. The team should include microbiologists and engineers as well as representatives from quality control staff, product development, maintenance, sanitation and processing.
Step #5; Describe the Food and its Intended Use

The HACCP team should do a complete description of each food product as shown in Table 2.1. The team should gather information on how the product is formulated including ingredients and the processing procedures used.

Step #6; Develop a Flow Diagram

A flow diagram must be developed for each product as shown in figure 2.1. A flow diagram lays out in great detail how a product is created from raw material production to processing and packaging to distribution to consumer use.

Step #7; Verify the Flow Diagram

Upon completing the flow diagram, the HACCP team should complete an on-site inspection to verify the completeness and accuracy of the diagram. Maintaining an accurate, up-to-date flow diagram for each product is critical to setting up and monitoring a HACCP system.

Step #8; Conduct a Hazard Analysis.

To control biological, chemical and physical hazards, a hazard analysis must be conducted to determine where the hazards are located and what can be done to prevent the hazards from occurring. The HACCP team should use both the product description and the flow diagram to determine where the hazards are and what can be done to control them. Additional factors such as hygienic design of equipment, employee hygiene and sanitation procedures should also be considered. When assessing the food product, the HACCP team should;

1) Identify potentially hazardous raw materials and foods that may contain pathogens and/or support microbial growth.
2) Identify the potential sources and specific points of contamination by analysis of each step in the food chain.
3) Determine the potential for microorganisms to survive or multiply during production, processing, distribution and preparation for consumption.
4) Assess the risks and the severity of hazards identified.

Step #9; Identifying Critical Control Points (CCPs)

After identifying and assessing the potential hazards associated with a product, a system of control to address those hazards must be developed. To do this, critical control points (CCPs) in the process that will prevent, eliminate or reduce the food safety hazards to acceptable levels must be identified. Once the CCP have been identified, mark them directly on the HACCP flow diagram. Examples of Critical Control Points include;

1) An example of a CCPs in meat slaughter and processing operations would include receiving live animals, scalding, evisceration, receiving the meat, product formulation, cooking, chilling and packaging.
2) An example of a biological CCP is the minimum internal cooking temperature for ground beef to ensure that pathogens in the raw product have been destroyed.
Step #10; Set Critical Limits

Once a CCP is identified, critical limits are established and monitored to indicate whether the CCP is “in control” - the state when correct procedures are being followed and criteria are being met. A critical limit (CL) is set for each CCP to determine whether a preventive measure must be taken. Critical Limits should be:

* Designed to indicate whether a CCP is in or out of control.
* Simple, specific and clear.
* Based on scientifically determined parameters and quantifiable.

Critical limits are associated with preventative measures that have been identified for each critical control point such as temperature, time, humidity, moisture level, water activity, pH and salt concentration. If the CCPs are monitored and immediate corrective actions initiated when appropriate, hazards will be prevented, eliminated or reduced to acceptable levels.

Step #11; Establishing Monitoring Procedures

Monitoring procedures are planned observations or measurements that assess whether a CCP is in control, determine whether a trend is occurring towards loss of control and provide written documentation for use in verification of the HACCP plan. Monitoring procedures must be effective because if the process is not controlled and a deviation occurs, the end result may be unsafe food. The best monitoring procedures are ones that are continuous. If it is not feasible, a specified monitoring interval should be established. An example would be continuous or periodic checking the temperature of a continuous apparatus to ensure the internal temperature of the product reaches 160F at the CCP.

Step #12: Prescribe Corrective Action

If specific critical limits are not met, a deviation will occur that requires corrective action procedures. Deviation procedures or corrective actions will remedy the deviation and ensure the product safety. An example is failure of a product to reach a desired internal temperature. A corrective action would be to check to ensure that the equipment is operating correctly and then continuing to heat the product until it reaches the desired temperature.

Step #13: Keep Accurate Records

The HACCP records are plant records that are completed at each CCP and contain information to ensure the HACCP plan has been correctly followed. A record may be in any form (processing chart, written record, computerized record) that shows the historical record of the process, the monitoring, the deviations and the corrective actions that occurred at the identified CCP.

Step #14: Verifying that the HACCP Process is Working.

Verification activities are methods, procedures and tests that are used to determine if the HACCP plan for the establishment is valid and is operating properly. Verification activities also help companies determine if hazards were overlooked or whether new unexpected hazards exist.
Conclusions

HACCP is a scientifically based management system for food safety based on prevention. HACCP is based on identifying potential problems early and preventing them from becoming a real problem later. This series presented the 7 principles and 14 steps involved in HACCP as an introduction to the subject. In actuality, the implementation and advancement of HACCP in the food processing business is a continuous, scientifically based program requiring professionals with years of experience and knowledge.

J) BIOTERRORISM

Security of our Food Supply

The security of our food supply is of paramount importance. This section deals with tampering or other malicious, criminal or terrorists actions to our food supply. For the purpose of brevity, let’s consider these as acts of terrorism and that terrorism refers to acts by persons or organizations of either national or international origins.

Prior to and during the great depression, 95% of Americans lived on farms and could raise their own food. Now, less than 1% of the population lives on farms. This means that 99% of Americans depend on agriculture and food manufacturers and distributors for their food supply. Not only do Americans depend on rural agriculture, food manufacturers and distributors for their food supply but they trust that it will be safe, nutritious, abundant and an economical value. Since the vast majority of Americans are dependent of our food supply, it makes our food supply an excellent target for certain groups to promote their agenda by terrorism. Terrorism can be defined as “The use of terror, violence and intimidation to achieve an end”. There are certain groups both domestic and international who believe so strongly in their cause that they use unscrupulous methods to instill fear in their opponents making them more agreeable to their way of thinking.

Why Bioterrorism?

The use of biological agents on humans, livestock and plants to instill terror in their opponents is not new. Most discussions on terrorism to date have centered on humans but using livestock and plants and the food produced from them is not only possible but has been used in the past. Bioterrorism has been referred to as “the poor man’s nuclear arsenal”.

History of Biological Warfare

Ancient Scythians dipped arrows in manure. Assyrians used ergot of rye in enemy wells. In 1346, (Siege of Kaffa) the Tartar army hurled corpses of soldiers who died of plague into the city. In the 15th century, Pizzaro used Vaiola contaminated
clothing to kill South American Indians. During the French and Indian War, smallpox-contaminated blankets were given to the Indians by the English. Recent Bioterrorism. During WW I, German secret agents introduced glanders to horse populations in New York and Virginia. They also attempted to introduce anthrax to horses and mules in Maryland. In addition, they used a combination of glanders and anthrax on horses, mules, cattle, sheep and reindeer in Norway, Romania, France, Spain and Argentina. During WW II, the Germans continued to develop biological agents for use against livestock as well as humans. The British made anthrax cakes to drop on German cattle. The US and Canada developed feather bombs laced with hog cholera and Newcastle virus for poultry for use on German livestock.

**Recent Bioterrorism**

In 1992, a year after the collapse of the Soviet Union, Russia admitted to a program code-named “Ecology” that produced biological agents aimed specifically at livestock, poultry and plants that employed tens of thousands of people in at least 8 separate production plants. Animal weapons included foot and mouth disease, rinderpest, classical swine fever (hog cholera), African swine fever and sheep and goat pox viruses. After the fall of the Soviet Union, some scientists went to the United States, Great Britain and other European countries. But others ended up in Iraq and other decidedly “unfriendly” countries. American Life Changes Forever With the bombings at Kenya, Tanzania, and other terrorist’s acts ultimately leading up to the World Trade Center and Pentagon attacks of September 11, 2001, the free life style we enjoy came to an end. Although we cannot allow terrorism to totally control our lives, we must become vigilant of the possibilities that exist.

**A Real Bioterrorist Attack**

What would happen if there was a real bioterrorist attack on our food supply?
1) The export market would collapse.
2) Food processing plants would close.
3) Growers wouldn’t be able to sell their produce.
4) Food companies would institute massive layoffs
5) Numerous retail grocery stores would close
6) Stocks would fall

**Terrorist’s Attack**

Those things could “theoretically” happen but if we proactively think and plan for the possibility that it will, the effects will be minimized. Remember that the goal of terrorism is to instill fear. The actual effects of a terrorists’ act are usually far less than the paralyzing effects of fear itself. The producers of all livestock, poultry and crops should be aware of what to do if a disease breaks out whether it be a natural case or one initiated by an act of terrorism. The key words of action are;

* PREVENT
* RESPOND
* MINIMIZE THE ADVERSE EFFECTS
PREVENT
Always do what you can to prevent a natural disease from occurring and note any suspicious activity in your area by unknown people. In the past, agricultural producers have been extremely good at this.

RESPOND TO
If a disease breaks out, respond to it quickly and methodically. The faster a producer responds to a crisis, the lesser the effects will be. Contact your local Cooperative Extension agent. They have a list of veterinarians and crop specialists who can diagnose the problem and can mobilize all the necessary agencies necessary to contain the spread.

MINIMIZE THE ADVERSE EFFECTS
Once the disease has been diagnosed, the Cooperative Extension Service agent should let you know what to do to prevent the spread of the disease. We have all recently seen diseases such as mad-cow in Great Britain, various forms of poultry diseases and hoof and mouth in other countries and how they contained/eliminated the disease to minimize the spread.

Our Food Supply Channel
Up to this point, we have covered the importance of guarding our food supply chain, the history of bioterrorism and what the agricultural producer community can do to respond to a biological crisis, either instigated by nature or bioterrorists. The FDA has recently issued guidelines for various elements of the food supply chain. These guidelines are available on-line at the following websites.

Food Processors
Food Producers, Processors and Transporters; Food Security Preventative Measures Guidance;

Food Importers

Retail Food Stores & Restaurants
Retail Food Stores and Food Service Establishments; Food Security Preventative Measures Guidance;
Depending on your business, we suggest that someone from every company have one designated person obtain a copy of the appropriate guidance document, study it and make recommendations to implement the suggestions that are pertinent to their business.

The FDA only published these as “guidelines” to help the food industry. They are only for guidance and are not legally binding.

The Bioterrorism Act and Food

The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 also known as the Bioterrorism Act requires domestic and foreign facilities that manufacture, process, pack and hold food for human or animal consumption in the United States to register with the FDA. USDA/FSIS (red meat and poultry facilities) are not required to register since FSIS has continuous inspection of these facilities.

Examples of FDA-Regulated Foods
- Food and food additives for humans and animals.
- Dietary supplements and dietary ingredients
- Infant formulas
- Beverages to include alcoholic and bottled water.
- Bakery goods, snack food and candy
- Fruits and vegetables
- Fish and Seafood
- Dairy products and shell eggs
- Raw agricultural commodities for use as food or components of food.
- Canned Foods
- Live food animals

Exempt from registration are farms, retail food establishments, restaurants, non-profit establishments that prepare food for or serve food directly to consumers, fishing vessels not engaged in processing and facilities regulated exclusively by the USDA/FSIS.

Information Needed to Register
- Name, physical address, phone number of the facility.
- All trade names the facility uses.
- Food product categories produced
- Name and contact information of the person submitting the certification statement
- Emergency contact information

How to Register
- Go to the following website for more information and how to register.
  [http://www.cfsan.fda.gov/~furls/ovffreg.html](http://www.cfsan.fda.gov/~furls/ovffreg.html)
- You can register online or by mail.
5. Organization /Operations/ Management

A) Introduction;
   This chapter is for people who are either in the food processing business or who are writing business plans to start a food processing business and want to know the operation of a food company and the operations side of the business. In addition, copacking or co-manufacturing and the development of a crisis management plan are also discussed.

B) Organization of a Food Company;
   The purpose of this section is to explain the basic organization of a typical food company and how they operate internally to give you the foods you enjoy everyday. Although we will present an organizational structure that is very formal, companies differ greatly in structure but all are designed to cover the basic functions. In a highly specialized culture, many departments have to work together to perform in a unified manner to procure raw materials, manufacture, market, sell and distribute their products. Each of the above functions (procurement, manufacturing etc) along with other functions, must each be good at what they do and are managed independently but serve the company’s overall mission. Let me say something about the purpose of a company. According to the Harvard School of Business, “The purpose of a company is to get and keep a customer”. The purpose is not to make a profit although it is implied that if you lose money, you will not be in business very long and will not be able to keep the customer. A number of people think that companies make a lot of profit, which in general is not always true. They believe this because they hear or see the gross sales numbers. This is not profit but the value of the products that they sell. If you believe companies make a lot of profit, buy their stock because profit is generally returned to the stockholders in the form of dividends or it is reinvested in the company, which means the stock price should go up.

Organizational Structure
   The purpose of an organizational structure is to organize the outcome of the major functions of a company. It is generally believed that a manager can only effectively manage 4-7 people depending on what is being managed and how good the manager is. Therefore, a President of a company cannot effectively manager all functions of a food company. To understand the idea behind organizational
structures, let’s first go through a basic Army organizational structure. The Army organizational structure is shown in Figure 5-1.

Figure 5-1; The Basic Army Organizational Structure.

Note that any basic Army unit whether it is a battalion or brigade has this same basic organizational structure. It has a leader (Commander) and his backup (Executive Officer). It covers the basic functions needed to carry out the mission (Personnel, Intelligence, Operations, Logistics and Civil Affairs). What if a food company was organized like the Army? The short answer is it is but varies slightly because the mission is different. A typical organization of a food company is shown in Figure 5-2. Note that the functions would line up fairly well. BUT the major functions of a food company are not the same in real life because the mission is different. The mission of the Army is to impose their will upon the enemy. In food companies, the mission is to get and keep a customer.

The Theoretical Structure of a Food Company

The next chart shows a basic theoretical structure of a food company. Since food companies differ widely in size, products and ways in which they go to market, the organizational structures will differ greatly but this structure does point out the major functions common to almost all food companies.
The Basic Structure of Food Companies:

Note that finance, marketing, sales and manufacturing are all covered and are considered a company’s major functions. These are the cornerstones of any food company and are essential for the company to function. Let’s now discuss each of these major functions in greater detail and then go through the less major but important other functions. These are called minor functions and include Product Management, Customer Service, Research & Development, Quality Control, Human Resources and Purchasing or procurement.

MAJOR FUNCTIONS

Finance & Accounting

Finance & Accounting is very important. Its functions include tracking sales, issuing reports on sales, control production costs, control capital for expansion etc. Most company presidents came out of finance and accounting. In most companies, the Vice President of Finance & Accounting is the successor to the President. Finance & Accounting people understand the financial community, the principles of accounting and how the stock market works, which is what the owners or share-holders are most concerned about.

Marketing

Most major food companies spend millions per year on marketing. Marketing works on how to increase sales. Food companies can be marketing-driven or sales driven. In marketing driven companies, marketing decides what to sell and the sales department sells it. In sales driven companies, marketing supports the sales staff. Marketing people work on advertising, coupons, fact sheets, promotions etc. Marketing people tend to be very creative. In some companies, marketing people are product managers. Product managers are people who manage a category of products and have profit and loss responsibility.
Sales

Sales people are the “front line troops” of any company. Their job is to get increased sales of what production can make. Sales can be organized within a company to sell along a sales channel such as retail, food service, national accounts or international sales. Sales personnel can work as sales representatives assisting retailers or national account chains to increase sales. Large account representatives work with major retailers, brokers and restaurants to increase sales.

Manufacturing/ Production

Manufacturing or production is the function that makes the food product. They make finished products from raw materials in the quantity specified by sales. They make products according to specifications. Many food manufacturing plants may have 25-500 SKUs (Stock keeping units or actual products). Manufacturing often spends capital to decrease production costs through automation. Food processing plants are very expensive to operate. Therefore, most food processing plants try to run 2 shifts per day and run on weekends if possible. They are often referred to as the “hidden heroes” of most food companies. They often contain some of the important minor functions or departments such as human resources, maintenance, quality control or quality assurance, distribution and warehousing, etc.

Minor Functions

Product Managers

Some companies have product managers who are responsible to manage a product line. Some companies use marketing to perform this function. They are also responsible for inventory control, and setting the sales price.

Customer Service

Customer service agents are the people who talk to customers and handle complaints. In some companies, they may receive product orders from food stores or restaurants when sales personnel are true sales representatives. Customer service can report to either the vice president of sales or the vice president of marketing.

Research & Development

Research and development people work with sales and/or marketing on new products and line extensions. They may also work with manufacturing on new equipment and technology transfer. They usually report to marketing, manufacturing or sales. In the past few years, the role of R&D people or technologists to has increased to work more directly with customers. In higher technology industries such as computers, R&D personal may be higher in the organizational structure.

Quality Control

Quality control or sometimes called quality assurance personnel usually report to the plant manager in manufacturing. Their job includes such routine practices as
inspection of incoming raw materials, conducting inspections while products are being made such as temperature measurements and operational sanitation and inspection of finished products. The current manufacturing philosophy is that quality cannot be inspected into products but must be manufactured into them. Correspondingly, QC/QA works to help manufacturing to build quality into finished products. Over the past decade, the emphasis on food safety has required an increased role of QA/QC people such that some companies now have separated QA/QC into two groups, one involved with food safety and one involved in quality. QA/QC people generally have the responsibility of running chemical and microbiological laboratories.

Human Resources
Human resources is the department that provide for the human resources needed to run manufacturing. They usually report to the plant manager. Their job is to recruit, interview perspective employees, do payroll, set up educational classes, file and audit evaluations, work in matters of human resources policies such as equal opportunity issues, sexual harassment, lawsuits etc.

Purchasing/ Procurement
Purchasing /procurement personnel buy raw materials and ingredients for production. They must coordinate purchasing of these raw materials and packaging with production plans to manufacture. They are usually part of the manufacturing group. New practices in purchasing and procurement include “just in time delivery” and strategic purchasing. Just in time delivery is when raw materials arrive at the manufacturing plant at the very time production is starting thereby minimizing the need for warehousing. Strategic purchasing is seen in larger companies where one supplier of raw materials may provide supplies to several manufacturing plants.

Food Companies Differ
Food companies differ widely in size, product line and personality or culture. No set organizational structure fits all companies but the functions described above are all there in some form or another. Some companies, especially smaller ones are privately held (owned by individuals) but most large food processing companies are publicly traded (on the stock market). This can have a profound influence on their organizational structure.

Personality/Culture
Like people, companies have personalities. These personalities are the culture adapted by upper management as to what they value and believe in. The President usually dictates culture. They can be sales, marketing, technology or production driven/ oriented depending on the product line and how management wants to “go to market”. Part of the personality/culture of a company is understanding it’s priorities. The overall goals of most food companies are 1)” to get and keep a customer” followed by 2) “building shareholder wealth”. Building shareholder wealth means that the company is increasing in dividends paid out to shareholders or the increase in the
value of the stock on the stock market. To increase shareholder wealth, we have to prioritize what we think will improve the companies performance.

Performance Criteria

Imagine yourself as a president of a small food processing company. What are the things you should do to increase the value of your company. Listed below are what I think are important in priority order that will increase the value of your company.

1) Increase Market Share – These are the things you do to increase sales volume. It is usually done through new products, advertising, etc. This is the single most important thing you need to do.
2) Food Safety- Although food safety may not directly increase shareholder wealth, any recall or negative publicity can kill you company in short order.
3) Quality- Quality can mean different things to different people but I like to think of quality as adherence to a specification. Manufacturing must make products to a specification.
4) Yield- The yield from manufacturing often surprises people not familiar with product. It seems like a trivial factor but can add up to a large number when you are producing thousands of pounds of product in a single day. Yield is real important in companies that utilize expensive raw materials such as meat and least important to the baking industry due to the inexpensive price of wheat.
5) Labor- As a company gets larger, the cost of labor begins to become more important. No matter what field you are in, you can generally figure labor will be 55-70% of your operating costs. It may even be higher when you figure in benefits such as medical, retirement plans, etc. As companies get larger, they realize the importance of automation and cost savings projects.

C) Operations of a Food Processing Plant:

This section was adapted from an article by Al Wagner (Wagner, A.B. Food Processors Handbook: Guidelines for Getting Started, Texas Agricultural Extension Service, Texas A&M University System, College Station, TX.) and describes the operations of a food processing plant.

RAW INGREDIENTS;

Ordering and Receiving - It stands to reason that good quality ingredients are needed in order to produce a good quality processed food. It is impossible to produce good quality products from inferior quality raw materials. However, a poor quality product can be manufactured from good quality ingredients. For this reason, food processors should have specifications for the quality of the ingredients that they use for manufacturing purposes.

Processors that are large enough to have a quality control laboratory will have detailed specifications for all their ingredients. These specifications usually include:

1) Chemical composition (for example, moisture, acidity, fat, protein, pH, etc.)
2) Microbiological counts for potential spoilage or disease organisms
3) Physical characteristics (color, size, shape, freedom from blemishes, etc.)
4) Sensory quality (odor, taste, texture) functionality (a requirement that the ingredient perform in a specified manner)
5) Container type and size for delivering the ingredients.

Small scale processors that do not have a quality control laboratory to check all the incoming ingredients should still check their ingredients relying primarily on sensory tests. Does the product look normal, smell normal, taste and feel normal?

Reliable suppliers may charge a little more. But, if it is known that the products they provide are always wholesome, safe and functional, it will probably be worth the extra cost involved for reliable ingredients.

Everybody hopes that there will never be a bad batch of raw materials but this does happen occasionally and it can cost a lot of money to discard unsatisfactory products. Therefore, even the smallest processor should check the incoming ingredients at least by sensory methods to ensure that they comply with specifications.

Handling and Storage - Raw materials should be received into a storage area which is separated from the manufacturing zone. This area should be kept clean. Good housekeeping should always be maintained in order to prevent infestation with insects, rodents, and other pests that may damage the raw materials. For some products refrigerated or frozen storage is needed. These too should always be kept clean. They need to be defrosted at regular intervals and the equipment needs to be functioning properly.

Raw ingredients should be taken from the warehouse on a first-in first-out basis into the manufacturing area. After conversion to a finished product materials should be taken to another storage area.

PRE-PRESERVATION STEPS;

The steps that are performed before preservation are determined by the nature of the product that is being manufactured. Small scale operations usually use the batch system; that is, sufficient material is weighed out to make one batch which is prepared and sent off to the filling line and then the next batch is weighed out and prepared. Large scale manufacturing operations prefer to use continuous high volume processing lines whenever possible, but this requires a major investment in sophisticated equipment.

In batch operations each ingredient needs to be measured out in the correct amount. There are two methods for measuring:

a) By weight. This is suitable for both dry and liquid materials. Scales need to be checked for accuracy periodically.
b) By volume. The containers used to measure liquid foods should be quickly rinsed after each use before the next batch is prepared. Volume measures for dry ingredients should be kept dry. The measuring equipment should match the amount of material that needs to be measured. For example, for a dry mix a large capacity scale is needed to weigh out the major ingredients such as salt and sugar and a
smaller set of scales is needed to weigh out minor ingredients such as spices and preservatives.

A check list should be established for each batch to ensure that every ingredient is added in the correct amount, none is left out, and no ingredient is put in twice. If this is not done, there will be an occasional batch in which the formula will be out of balance because the formulation has not been performed correctly. For example, salt often represents 1 to 2% by weight of a mixture; if it is left out, the product tastes unusual but it is difficult to identify exactly why it does not taste normal.

Frozen ingredients may need to be thawed. As discussed in the section on freezing, large quantities of frozen materials need to be thawed under refrigerated conditions to prevent undesirable growth of microorganisms during the thawing process.

Fruits and vegetables need to be washed and some of them need to be peeled. Depending on the product they may need to be cut or pureed; specialized equipment is available for these purposes.

Animal products (meat, poultry, fish, eggs) need to be kept refrigerated as long as possible to prevent microbial growth in the pre-preservation step. If these products are to be cut or ground, it is essential to maintain good sanitation of the equipment and good hygiene of the operators who are handling the equipment and the material.

Dry powders such as flour and confectioner’s sugar need to be handled in such a way that dust is minimized.

The operator needs to be alert at all times and carefully watch the product to make sure that everything is normal as the process proceeds from one step to the next.

Heating

Heating generally causes damage to the color, flavor and texture of the product, but it is often essential for the sake of processing. The longer the product is heated the more damage is done to the quality. Therefore, it is advisable to both heat the product to the required temperature then cool it as quickly as possible so that the desirable effects of heat are achieved with a minimum abuse to the color, flavor, and texture.

Many vegetables and some fruit are blanched prior to processing. Blanching involves immersion of the fruit or vegetable in hot water or steam (typically 2-5 min at 194-203°F). Blanching has many functions including: inactivation of enzymes responsible for loss of quality, partial cooking and softening to allow easier packing, washing of cut surfaces, removal of air from tissues, and shrinkage of tissues to facilitate container fill.

If water needs to be evaporated from the product (as for preserves), it is advisable to turn the heat up as high as possible so that evaporation will occur as quickly as possible.

Large scale processors prefer to use continuous heating and cooling equipment rather than batch processing. This requires a large investment. Batch processing is satisfactory if the batch size is small enough so that the heating can be accomplished in a reasonably short time. Small batches of food may be processed in an approved kitchen. Restaurant-sized sauce pans are often used for this purpose. These pans
should have a thick metal bottom to minimize burning. Gas or electric heat may be
used but most small processors seem to prefer gas heat.

For larger processing operations a steam jacketed kettle is ideal for heating or
for evaporation of liquids because it heats the product quickly. However, this requires
the installation of a steam boiler which increases the capital cost substantially over
large pots on a kitchen stove.

Finish Point

A test is needed to determine when the product that is being processed is
finished and ready to be packed into containers. For this purpose, simple rapid tests
that cause minimum delay in the packing and filling operation are preferred.
Depending on the product that is being manufactured, the test of the finishing point
might be one or more of the following:

1) Temperature (thermometer)
2) Brix (refractometer)
3) Consistency (viscometer or consistometer)
4) Acidity (titration)
5) pH (pH meter)
6) Color (colorimeter)

The test or tests that are used to establish the finish point need to be performed
carefully every time a batch is prepared in order to obtain a uniform quality product
from batch to batch.

The capacity of the pre-preservation steps should match the capacity of the
filling and closing equipment. The quality of the product will deteriorate if the
finished product is delayed for long periods of time waiting to be filled.

PACKAGING

The finished product needs to be filled into packages that allow the customer to
purchase a convenient amount at one time. Empty packages should be clean and
sanitary before filling.

There are a wide variety of packaging materials available. Selection of a
suitable package for your product is a combination of science, art, and legal
requirements. Some of the factors that need to be considered in selecting a suitable
package are:

1) Physical nature of the product. Liquid products need a very tight seal to prevent
leaks. Moist solids with water activity above 0.85 need to be sealed reasonably
tight to minimize drying of the product in storage. For dry solids the quality of the
seal may not be a critical matter.
2) The package needs to be convenient in size and easy for the customer to open
3) The cost of the package needs to be reasonable in relation to the cost of the product.
4) It is desirable for the outside of the package to accept attractive printing or tight
adherence of a label.
5) Tamper-evident packages will help prevent contamination and deliberate, illegal adulteration of your product after it leaves your custody.

6) Depending on the product, resistance of the package to the transmission of water vapor, gases, such as oxygen and carbon dioxide, and light may be needed.

The above requirements apply to foods stored at room temperature, in the refrigerator or in the freezer.

For foods stored at room temperature there are additional legal requirements depending on the chemical nature of the product:

1) If the water activity of the product is less than 0.85, the food is classed as a dry or intermediate moisture food. The potential for public health problems because of microbial growth on these foods is small. The Code of Federal Regulations Part 110 “Current good manufacturing practices in manufacturing, processing, packaging and holding human food” applies to these foods.

2) If the water activity of a food is higher than 0.85, there is a greater potential for public health problems and, therefore, there are more strict regulations governing these foods. Foods with a water activity above 0.85 are further subdivided into two groups depending on the pH.

A) **Water activity greater than 0.85 and pH less than 4.6.** This group of foods is comprised of acid foods, acidified foods, and fermented foods. The Code of Federal Regulation Part 110 cited above applies to these foods. For acidified foods the Code of Federal Regulations Part 114 is also required.

B) **Water activity greater than 0.85 and pH greater than 4.6.** These are classed as low acid canned foods and they require the most rigorous federal regulations. The Code of Federal Regulations Part 108, 110, and 113 are applied to this group of foods.

A process approved by a processing authority must be filed with FDA on each low-acid and acidified food sold in the U.S.

**FILLING, CLOSING AND STORING**

After preparation is completed the product needs to be filled into suitable size containers. The degree of integrity of the closure of the container needed depends on the water activity and the pH of the product. Dry products have the fewest regulations in this regard. Containers holding moist foods or liquid foods should be washed after the filling and closing operation. There are Federal regulations that apply to low acid moist foods in terms of container integrity. The book entitled “Principles of Thermal Process Control, Acidification and Container Closure Evaluation” published by the Food Processors Institute in Washington, D.C. spells out in detail the requirements for the evaluation of container closures and the keeping of records of closures for metal and glass containers containing low acid moist foods. The book can is available from the Food Processors Institute, 1401 New York Avenue NW, Suite 400, Washington, DC 20005.
**Cooling**

If the product has been heated or filled hot, there will be heat damage to the color and flavor after closing unless the product is cooled promptly. For glass and metal containers it is desirable to cool in water until the temperature reaches about 100-110°F.

The water used to cool cans may be at any temperature. Glass containers are likely to crack if the temperature of the cooling water is more than 60°F lower than the temperature of the product inside the glass container. Therefore, with glass containers it is customary to begin cooling in warm water and lower the temperature of the water as cooling progresses.

When large quantities of warm food are stacked solid, it may take days for the stack to cool to room temperature. During this period of time the product is likely to become dark in color and burned in flavor. The trade calls this “stack burn.” Therefore, large quantities of food should always be cooled before stacking. Small quantities of food (such as several dozen jars of homemade preserves) can be cooled in air because the amount is small. However, it is desirable to stack the containers in a single layer with spaces to allow air to move between the containers and accelerate cooling. A fan directed at the cooling material will speed up the cooling process.

**Coding**

A code should be placed on each container to identify the product, the batch number and day on which it was manufactured. The reason for this is that, should problems appear after the product left your control, the defective material can be identified and recalled. This avoids recalling everything that has been manufactured and is still on the shelves.

For low acid canned foods the law requires that each container have a code attached to the container that identifies the establishments where it was packed, the product, the year, day, and period it was packed. Records of the codes and tests done to assure safety and quality must be kept for three years.

**Storage**

The finished product should be stored in a clean, dry location that is conveniently located for loading into trucks that will start the product on its way to the market. It is preferable not to stack cartons of finished products on the floor. They should be stacked off the floor on pallets.

The storage areas should be kept clean and sanitary. It should be swept at regular intervals. Litter and trash that can harbor rats and insects must not be allowed to accumulate. Biodegradable waste material should not be stored in this area.

It is desirable to keep the temperature of the storage area cool because prolonged high temperature can damage the quality of the product over a period of time. It also is advisable to keep the humidity low because high humidity may cause condensation which will rust cans and weaken paper and cardboard cartons so they become moldy or break easily when handled.
QUALITY CONTROL

Quality may be defined as the degree of excellence of the product. It consists of two major elements:
1) Sensory quality, which might be considered the “visible” part of quality. This includes the appearance of the food, its odor, taste and texture.
2) Safety, which is the “invisible” part of quality. This means that the food is not harmful, adulterated, or in any way injurious to health.

Quality control needs to be applied to the complete manufacturing and distribution processes of the product. Some of the specific responsibilities of a quality control program are:
1) Inspection and testing of ingredients, packaging materials, and finished product;
2) Preparation of specifications for quality of raw materials preferably in a written form.
3) Regular inspections of the manufacturing plant to ensure that good sanitation is maintained at all times
4) Compliance to all government regulations at the local, state, and federal levels
5) Disposal of waste products from the manufacturing operations
6) Recording and reporting all appropriate tests made on the product at all steps of the manufacture.

A critical quality of a food is one which may constitute a health hazard to the consumer. An example of such a quality would be the presence of harmful bacteria or toxic substances. Tests to ensure that the product is safe and wholesome are defined as critical control points.

The U.S. Government’s Centers for Disease Control keeps good records of diseases caused by foods. Table 5-1 lists the factors that were responsible for foodborne diseases in the United States over a 21-year period.

TABLE 5.1; FACTORS CAUSING FOODBORNE DISEASE IN THE U.S.*
(1,435 food poisonings between 1988-1992)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percent of Outbreaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improper holding temperature</td>
<td>59.1</td>
</tr>
<tr>
<td>Poor hygiene of person handling food</td>
<td>35.8</td>
</tr>
<tr>
<td>Contaminated ingredients/unsafe food sources</td>
<td>11.2</td>
</tr>
<tr>
<td>Inadequate heat process</td>
<td>27.9</td>
</tr>
<tr>
<td>Contaminated equipment</td>
<td>16.0</td>
</tr>
</tbody>
</table>
*Note: Percentages greater than 100 because some outbreaks associated with more than one factor

The Centers for Disease Control found that 75% of foodborne disease outbreaks were caused by bacteria, parasites or viruses. Although the highest proportions of these outbreaks occurred in restaurants and other food service establishments, too many of them occur in home and food processing plants. The high incidence of bacteria-induced diseases underlines the need to always maintain good sanitation in the processing area.

The U.S. Food and Drug Administration have a regulation known as “Current Good Manufacturing Practice” which is usually abbreviated to GMP. This regulation can be found in appendix 1. The umbrella GMP regulation (Section 21 of the Code of Federal Regulations Paragraph 110) covers general regulations for all foods. In addition there are some specialized GMP’s for specific food groups. The FDA considers food to be adulterated if it has been prepared, packed, or held under unsanitary conditions whereby it may have become contaminated with filth, or whereby it may have been rendered injurious to health.

SANITATION

There are two important reasons for establishing and maintaining a good sanitation program in every food processing plant:

1) Economic: Poor sanitation often leads to spoilage of the food which renders it unusable.
2) Legal: The Food and Drug Administration has the power to seize and destroy products that have been manufactured or stored under unsanitary conditions. They also have the power to criminally prosecute any individual or company that is operating a food processing plant in an unsanitary manner. Sanitation standards include physical, chemical, and microbiological cleanliness standards for the manufacturing area, the buildings, equipment in the plant, personnel, water supply, waste disposal, raw product quality and finished product. Constant supervision of all aspects of the operation is needed to comply with these requirements.

Although it is not possible to cover all the sanitary standards here, the major standards apply to the following:
1) People with communicable diseases cannot work in a food processing plant.
2) Employees should wash their hands before going to work and after every visit to the bathroom.
3) Hair nets or caps must be worn.
4) All floors, walls, ceilings, and equipment must be maintained in a sanitary condition.
5) Animals and vermin such as rodents must be excluded from the area.
6) All food contact surfaces should be inert, wear resistant, smooth and easily cleaned.

Cleaning

The processing area must be thoroughly cleaned at the end of each working day. For many operations it is necessary to also clean periodically during the working day. Floors need to be swept clean every day. In wet food processing operations such
as fruits, vegetables, meats, and fish, the floors may need to be hosed down and scrubbed.

The food handling equipment must also be cleaned thoroughly every day. The steps in cleaning are as follows:

1. Rinse with water. This usually removes a large part of the soil on the equipment.
2. Clean with a suitable detergent. Scrubbing or high pressure spraying may be necessary to remove all visible food residues and any soil; A good detergent is needed here.
3. The equipment then needs to be rinsed again with water to wash off the detergent residue.
4. Equipment that handles moist foods is now required to be sanitized. The most common sanitizer used is chlorine. The most readily accessible and easily used source of chlorine is regular household bleach used at a suitable dilution.

The above steps should be effective in removing food residues and microorganisms which might grow and spoil the next batch of food that is passed through this equipment. In addition, the plant itself needs a sanitation program to ensure that rodents, birds and insects are eliminated from the plant.

There should be a regular inspection program for rodents. If any evidence of rodents occurs, trapping and baiting should be used to exterminate these pests. The building should be constructed so that rodents cannot enter the building. Suitable building construction should be such that birds cannot enter the building.

Insects are another problem. Cockroaches, moths, silverfish, beetles, and mites not only spoil the food but make it liable to be seized by the Food and Drug Administration. Although seldom harmful to health most consumers find the presence of insects in their food highly offensive.

Insects are controlled by keeping the premises well cleaned and swept and giving the insects no place to breed, to find water, or to find scraps of food. With serious infestations, insecticides or fumigation may be needed. In these instances a professional exterminator should be consulted.

D) Copacking of Food Products

Introduction:

Co-packing, contract manufacturing or private-label packing all refer to having someone else manufacture your product for you. This allows the entrepreneur the time and energy to market a food item without having to own a production facility. There are food companies in operation that either have excess capacity or are specifically in the business of manufacturing other people’s products. The complexities of moving a product from conception to market can be overwhelming even to experienced entrepreneurs. Developing networking relationships with reliable co-packers will permit the small business person to achieve maximum utilization of physical and financial resources and save time. About 70% of businesses fail in the first year or two of operation because they do not have the operating capital to keep the business going before they start seeing the cash coming in. Don’t waste your limited capital on
manufacturing the product. Listed below are some of the advantages and disadvantages of using a copacker.

**Advantages of Using a Co-packer**
1) Reduced startup costs- capital costs of equipment and facilities can be enormous.
2) Reduced lead-time in getting to market.
3) A co-packer may have experience with similar products that is transferable to your product.
4) Federal and state regulations on manufacturing, labeling and food safety are difficult and lengthy. A co-packer already knows them and can be a great help in getting your product to market.
5) Experienced co-packers have lines of credit for purchasing supplies and ingredients, insurance, food industry contacts and sources to get the job done efficiently.
6) Co-packers have the proper facilities for receiving and storing ingredients and can arrange storage of finished products.
7) Co-packers usually offer the advantage of buying supplies and ingredients in bulk, thereby reducing formulation costs.
8) Some co-packers will offer other services to entrepreneurs such as product stability testing, nutritional labeling, formulation assistance, ingredient substitution and other product development issues.
9) Co-packers can also offer suggestions on packaging and labeling which is usually based on the types of fillers, cappers and labeling equipment in their facility.
10) Co-packers can direct you to professionals who can help in the design and marketing of your product.

**Disadvantages to Using a Co-packer**
1) The obvious disadvantage is the loss of control over the product.
2) An entrepreneur is at the mercy of the co-packer’s production schedule, fixed costs and methods of doing business. The product must conform to the co-packer’s equipment and facilities’ limitations.
3) Using a co-packer can be expensive. A co-packer must recover direct and indirect overhead costs. In addition, the co-packer must make some profit.
4) Confidentiality may be a problem as formulations, ingredients and product specifications must be shared with the co-packer. In addition, it is often necessary to share customer and sales information. Co-packers also have access to other information such as sales volume and price. This information can be protected to some degree with agreements, but confidentiality can never be assured.

Once you have considered the advantages and disadvantages of using a copacker, and if you decide to go the route of copacking, there are several things you must do before you meet with a copacker that will make your visit more eventful.
1) Before you choose and meet with a co-packer, you must do your homework.
2) You should have your business and marketing plans in place which outline your product needs in terms of size and type of container, number of units per given period, buyer’s price and sales price.
3) Once you have established the product information, write preparation and process instructions. Write specifications for ingredients, packaging materials, regulatory compliance and finished product.

After you have accomplished the above, it is time to schedule an appointment with a copacker. When you meet with a copacker, the following things should be discussed.

1) First determine if a co-packer has the capacity to make the product you are wanting made. This can be done by telephone.

2) Go visit the co-packer and look over the production facility.

3) Go over all your preparation and process instructions and specifications. Does the co-packer have the right equipment to make your product. Consider what you are willing to change to accommodate the co-packer (e.g. 12 oz jars instead of 16 oz).

4) There are many details to work out with the co-packer. Listed below are some that may apply:
   a) Ask the co-packer if he has a standardized “Confidentiality Agreement” for your attorney to look over.
   b) Go over your preparation and process instructions and specifications with the co-packer. Work out every detail. Understand the cost associated with the manufacture of your product.
   c) How much product can the co-packer make- weekly, monthly, etc., and how much inventory will need to be on hand?

5) Arrange for a small test batch to be run, if applicable. This will insure that your kitchen batch preparation and processing give the same quality that the co-packer will make on large scale production equipment. It is also the source of your initial selling inventory which you will need as you go out and start making sales presentations.

6) Discuss who will carry the needed liability insurance.

7) Tell the co-packer if your potential buyers require that the food be manufactured under particular quality, safety or certification systems such as HACCP, ISO 9000, Kosher or Halal? Is a third party audit required?

**Contract:**

It is suggested that you use a contract with a co-packer and have your attorney view it. Listed below are some items that you may wish to cover in a contract;

1) Exactly what services are you contracting for?

2) What ingredients and supplies are you responsible for and what is the co-packer responsible for? Who will provide product liability insurance?

3) What are the critical factors that must be met during production as stated in the specifications?

4) Will the co-packer sign a non compete clause in the contract? Usually not, because it would limit his production to only you.

5) What are the production run limitations (size, amount of lead-time required, etc.)?
6) What are the payment terms? The usual terms are 10% down and the remainder on delivery.
7) What finished product testing will be provided?

While there may be other points to be covered in a contract, the above represent some points that should be covered. While it is recommended that an attorney advise you on contracts, the small entrepreneur may find the cost prohibitive.

**Make the Co-packer Relationship Work**

A good working relationship with a co-packer and an agreement which covers what the co-packer is expected to provide will make your venture more pleasant and hopefully profitable. Get the co-packer on your team. Give the co-packer a chance to be properly reimbursed for his services, so you can concentrate on selling your product.

**Where to Find Co-packers**

It is not easy finding co-packers, but since the advantages for using one are so great, an entrepreneur may have to alter some details of their specifications to accommodate the need. For entrepreneurs, the best source of information about co-packers, their abilities and how they work with entrepreneurs is often from other entrepreneurs. Meet with other entrepreneurs and small food processors at state association meetings, food shows and trade shows. Specialized co-packers often advertised in food industry trade periodicals and directories. State directories of manufacturers, University Extension Service and Federal/State Food Inspection agencies are places one can look for co-packers.

**E) Crisis Management**

**Introduction**

Crises has become a reality in today’s world and the importance of early planning has been shown with recent problems with hurricanes and other crisis’ that are happening around the world. Crises also happen in food processing companies ranging from microbiological food poisoning to product tampering. These crisis situations lead to loses of markets, legal lawsuits and can virtually ruin a food company. Even through food related crises cannot be prevented, they can be MANAGED. A “Crisis” can be defined as those unexpected events, whether of human or a natural catastrophe, that can cause a food plant to close or otherwise interfere with the normal course of business, or that can cause the public to lose its trust in an entire company. This section is designed to help food processing companies develop and implement a Crisis Management Plan that addresses all possible crises that can arise. The suggestions contained herein are very general. Each food processing company should design a crisis management plan that addresses its particular products and overall organization.
If you don’t think crises happen in the food processing industry, think again. The news is constantly filled with food related crises and there effects can be very bad. Several years ago, some glass particles were found in some glass jars of baby food. When one considers the number of jars of baby food produced daily, a few glass particles in the actual food will eventually happen. But the media is unforgiving and can portray the incident as inhumane – glass in baby food can kill babies- how horrible. There are constantly food recalls on the news about meat contaminated with pathogens such as E Coli 0157:H7 and Listeria Monocytogenes. Most of these end up as mere recalls but there have been times when food processing companies such as Jack in the Box and Sara Lee processed meats resulted in people dying from these pathogens. People also sue companies for things other than pathogens. Think about the “hot coffee in the lap” lawsuit and the more recent lawsuits alleging that fast food restaurants caused obesity in adolescents who ate there. The point of mentioning these sad events is that crisis are inevitable but the effects can be minimized if food processing companies have a crisis management plan that anticipates the problems and has a plan of action when things go bad. Although none of these crises were intentional and usually not even known to the parent food company when it happened, they still can have deleterious effects on the future of the business. By anticipating and detailed planning for a crisis before it happens can drastically minimize its ultimate effects on the company. “Failing to plan is like planning to fail”. “The best defense is a strong offense”

Situation

Suppose you are the President of XYZ Food Company and you are walking to your car at the end of the day. A news reporter comes up to you and says “Several people in Wayne AR have just become seriously ill and have implicated your food product. Would you care to comment?” How would you respond?

You have several options.
A) Tell the reporter “Sounds like a personal problem to me”.
B) Tell him you don’t have time to talk to him now because you are tired.
C) Tell him “No comment”
D) Tell him you are sorry about the whole incident and you will launch a full investigation.
E) Tell him that you think the liberal media probably staged the whole thing to get a good story.

The correct answer is D. Answer C is the second best answer but most people think you are covering up something if you say “No comment”. After any major problem, all the public expects to hear is concern for the victims and that the company is doing something (investigating, making restitution, cleaning up the mess etc).

The point of this story is that by preparing for a wide range of crises, a company will know how to respond to it. The President of XYZ Foods may not have been aware of the crisis but he had been trained to know what people expect. It has
been repeatedly shown that all the general public expects for the first few days after a crisis is concern for the victims and to state that some action will be taken.

**Crisis Management**

This section will help you get started into crisis management training and through a crisis management unit, anticipate and plan details on how to respond to any possible situation that arises. Although every crisis will be disruptive and unpredictable in various aspects and degrees, it is possible to anticipate many of the decisions that will have to be made during a corporate crisis. By outlining in advance the precise steps that corporate management and other personnel are to address in identified crisis situations (who is to do what and how they are to do it) the ability of a company to respond efficiently and effectively is greatly enhanced. Data suggests that the more potential crises an organization can think of beforehand and prepare for (whether it can completely prevent them or not), the more quickly and successfully it will recover from any crisis that happens. Many potential crises can be prepared for in advance since many crises send out a repeated and persistent trail of early warning signals. If one can identify the potential problems and plan for them, the probability of a successful recovery will be greater.

**THE STEPS IN CRISIS MANAGEMENT:**

Listed below are the steps to take in planning for Crisis Management.

**Step #1:** Form a Crisis Management Unit.

**Step #2:** Make a list of all possible crises one can think of.

**Step #3:** Write out an action plan for each of the possible crises listed in #2.

**Step #4:** Publish and distribute a Crisis Management booklet to all responsible parties.

Now let’s discuss each of these steps in greater detail.

**Step #1: Form a Crisis Management Unit.** This is referred to as the CMU (Crisis Management Unit). This unit is composed of key management personnel who direct a crisis. The CMU is a group of managers that serve to direct a crisis into a more favorable situation or minimize its deleterious effects. The group is made up of members from various departments who can rapidly respond to a situation, communicate with individuals, internal and external to the company, be responsible for determining the details of a crisis, identifying needs and ultimately controlling the situation. The president or plant manager will ultimately have to appoint a CMU committee since every plant and peoples personality vary greatly. Listed in table 5-2 are some suggested people to have on the CMU.
Table 5-2; The CMU Team

<table>
<thead>
<tr>
<th>Title</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Manager or VP Operations</td>
<td>Director of the CMU</td>
</tr>
<tr>
<td>HR Manager</td>
<td>Spokesperson</td>
</tr>
<tr>
<td>QA Manager</td>
<td>Assist in recalls</td>
</tr>
<tr>
<td>R&amp;D Person</td>
<td>Assist in technical issues</td>
</tr>
<tr>
<td>Maintenance Manager</td>
<td>Assist with engineering problems</td>
</tr>
<tr>
<td>Shipping Supervisor</td>
<td>Assist with recalls</td>
</tr>
</tbody>
</table>

The CMU Team

Since every company varies in its products and personalities, teams must be constructed of the right people and assigned responsibilities commensurate with their talents. Additional members may be sales, the safety director, marketing, HAZMAT team leader, First Responders team leader etc. I think there are all food processing plants should have. Every food processing plant should have a HAZMAT team and a First Responders team. The HAZMAT team usually consists of maintenance people who are trained to handle HAZARDOUS MATERIAL in the plant such as ammonia, chemical spills, etc. First Responders are the plants “first aid “people who are volunteers and trained to respond to emergency situations. Although I have never been on either of these teams, I have personally witnessed both groups save people’s lives .If you have ever seen these teams in action that are well trained, disciplined and cool in a crisis, you will never forget their importance.

CMU Responsibilities

Each team must have a director and alternate director. Each team needs to have a spokes-person for communicating with TV, radio and the press. This person has to determine when and the amount of media coverage and when and how to keep the employees informed of a crisis. No other person at the plant or any member of the CMU should ever discuss any matters with members of the media no matter what happens. This can be real important. The technical person and QA Manager may be one in the same. They are on the team for purposes of advising in technical matters, recalls, laboratory analysis and other food safety issues. Maintenance and shipping supervisors are on the team to handle matters concerning their respective department’s area of expertise.
CRISIS EVENTS

No matter what the crisis, there are a series of characteristics/events that take place. The CMU must realize these characteristics exist and control the situation. The characteristics and events involved in a crisis are presented in Table 5-3.

Table 5-3; Crisis Events

<table>
<thead>
<tr>
<th>Characteristic/Event</th>
<th>CMU Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Surprise</td>
<td>Collect the CMU and assign task</td>
</tr>
<tr>
<td>2) Insufficient information</td>
<td>Collect factual data. Make necessary comment to the media</td>
</tr>
<tr>
<td>3) Escalating flow of events</td>
<td>CMU should have control by now. Facts about the crisis should be known</td>
</tr>
<tr>
<td>4) Loss of Control</td>
<td></td>
</tr>
<tr>
<td>5) Intense scrutiny from outside.</td>
<td>Work through the media to keep a good company image.</td>
</tr>
<tr>
<td>6) Siege mentality</td>
<td></td>
</tr>
<tr>
<td>7) Panic</td>
<td></td>
</tr>
<tr>
<td>8) Short term focus</td>
<td>Keep CMU on the right track of fixing the original problem</td>
</tr>
</tbody>
</table>

The previous 8 steps will happen no matter what the crisis and will proceed in that order unless the CMU can stop it at any of the 8 steps. All 8 of these steps usually happen in the first 3-5 days of a crisis.

Step #2: Make a list of all possible crisis one can think of:

Before we start on a list of possible crisis it is probably a good idea to decide of some of the classifications of crisis. Crisis can be divided into two general types; 1) Those crises that occur at a plant or local in nature and 2) those crises that require corporate input. Examples of both types can be found in Table 5-4. If you are a small company, these are one in the same. These plant and local Crises are those types of crises that are local in nature and involve an expanded CMU structure, are local in media coverage and only require corporate knowledge of the crisis. Crisis requiring corporate input are those crises that affect the corporation because of potential media
coverage. They are also characterized as ones where the product has physically left the production facility.

Table 5-4; TYPES OF CRISIS;

<table>
<thead>
<tr>
<th>Local</th>
<th>Corporate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia leaks</td>
<td>Adulteration/Tampering</td>
</tr>
<tr>
<td>Bomb threats</td>
<td>Food Poisoning</td>
</tr>
<tr>
<td>Fires</td>
<td>Bioterrorism</td>
</tr>
<tr>
<td>Explosions</td>
<td>Recalls</td>
</tr>
<tr>
<td>Power Outages</td>
<td></td>
</tr>
<tr>
<td>Tornadoes</td>
<td></td>
</tr>
</tbody>
</table>

**Step #3: Write out an action plan for each possible crisis.**

This may seem overly simple as you do it but it is real important to detail it while you are calm and thinking. When a real crisis comes along, you will probably be surprised, in shock and extremely distracted so your thinking will be powered by emotion rather than logic. I suggest that you have some fun with this one. Take one possible crisis at a time and think of every possible way to handle it using brainstorming and creativity techniques. Remember that it is always better to be “proactive” to a crisis where the CMU has thought it through rather than being “reactive” where you are acting out of emotion. In planning for a crisis, attention to detail is the central theme. “The success to which one achieves in direct proportion to their dedication to excellence”. You must be dedicated to the excellence of planning for the Crisis. We will now go through each of the general crises with some thoughts on them. The following are not action plans by a few comments about the crisis that should be considered as the CMU writes the action plan. It is up to the CMU to write out a detailed action plan on each of these that can be distributed throughout the company.

**Ammonia Leaks**

When an ammonia leak is detected by sensors or smell, the HAZMAT team and First Responders should be summoned. All other employees should be evacuated from the area. After the HAZMAT team has collected information as to where the leak is and the how it happened, the CMU can be briefed on the situation and decide what steps to take.

**Bomb Threats**

All bomb threats should initially be treated as if they were real, although most turn out to be a hoax. Most bomb threats are made via the telephone. Therefore, switchboard operators must be trained on how to respond. It may be good to have
some simulated bomb threat calls with switchboard operators so that when a real call comes in, their reaction will be one of careful thought versus panic.
The person receiving a bomb threat should;
1) Remain calm and advise the caller that many innocent people might be hurt.
2) Keep the caller on the line as long as possible and attempt to get such information as
time remaining until detonation and location and type of device. If at all possible, the
operator should try to get someone to call the police while the caller is on the line.
3) Take careful notes of EVERYTHING that the caller tells the switchboard operator.
   Also try to collect any additional information you can such as background sounds. Is
the call from the outside or inside the plant? Is it an operator assisted call? Is the
caller a male or female?; Any particular speech or words that sound unusual?
4) Ask “Who is calling?” several times. You might catch the caller off-guard.
5) As soon as the caller terminates the conversation, the operator should
   IMMEDIATELY notify the plant manager or senior member of management on
duty. It is up to the plant manager to evaluate the threat and determine the
appropriate action to be taken.

Explosions & Fires
Explosions and fires can be covered in a Crisis Management booklet under the
same heading because most of the time they happen together or one may cause the
other to happen. Anyone discovering a fire should immediately contact the central
operator (or however you write your plan) and then immediately evacuate the area.
Pull any alarms in the area. While exiting, every employee should be notifying other
co-workers to evacuate the building. Maintenance or whoever is designated in the
CMU booklet should be in front of the plant to direct the fire department to the area
involved. Your CMU booklet should have a map of the evacuation routes in the plant.
These evacuation routes should be posted throughout the plant and new employees
should be made aware of them. During the initial stages of a fire, the plant manager
will determine what areas, if any, need to be evacuated. If the decision is made to
evacuate the plant, the members of the First Responders, HAZMAT team and
maintenance may be used to aid in the evacuation.

Power Outages.
The loss of electrical power is not a major problem for most plants unless it is
for an extended period of time. It could be assumed that this problem may occur in
conjunction with other emergency type situations. This would mean that those
situations would then become more difficult to handle. The loss of electrical power
causes;
1) A loss of regular lighting
2) A loss of regular phone service
3) A loss of refrigeration
The CMU should anticipate what precautions should be taken to;
1) How to evacuate people in remote areas of the plant.
2) Where to go for refrigeration.
**Tornadoes**

Most tornadoes occur in the Midwest and south central states between March and September. Tornadoes are usually preceded by thunderstorms and clouds that have a greenish-black color. Plants should have a designated person to monitor the radio when conditions are right for a tornado. There are two types of tornado alerts. A “Tornado Watch” means that conditions are right for a tornado but none have yet been spotted.

A “Tornado Warning” means that someone has actually confirmed the presence of a tornado. This is where management must be readily available to decide if and when emergency plans begin. Prior planning by the CMU should decide where employees are to go when a tornado is heading for the plant. A simple plant map similar to the one used for evacuation routes should be developed to show employees where to seek shelter. Your local police or fire departments can help you determine the safest places to seek shelter in your facility (e.g. along north walls; away from windows etc). Do not allow employees to leave the facility if a tornado is approaching. Flying debris in a tornado can injure people.

**MAJOR CRISIS SITUATIONS**

We have previously covered smaller, localized crisis situations. We will now cover major crisis situations that are more difficult to handle and can have devastating effects on the future of the organization. These include adulteration/tampering, food poisonings, bioterrorism and recalls. In general, these are more difficult to handle because of geographic distances—the food has left the plant and detailed information is harder to obtain. They are also more difficult to handle and more devastating because the media coverage has now become regional or even national. They may also be more difficult to handle because if you are part of a larger corporation, additional people are now involved.

**Major Crisis Situations**

Because of the expanded media coverage, the members of the CMU are the only plant personnel that need to be involved. The 8 steps of Crisis Events still happen as previously mentioned. If you have ever been through a recall or any of the major crisis situations, you know the need for forward planning in detail.

**Action Plan for Major Crisis Situations**

1) The CMU is assembled and discusses what is known. An action plan is developed based on what is known and tasks assigned to CMU members based on crisis templates in the CMU booklet.
2) If part of a larger corporation, the corporate office needs to be notified along with any relevant government agencies such as FSIS, FDA, FBI etc.
3) Expand the CMU if necessary.
4) Develop a press release, if necessary.
5) Notify employees and affected customers, if necessary.
6) Refine initial action plan and initiate;
   * Keep daily log of occurrences
   * Send samples to laboratories if needed.
   * Decide if a recall is needed, to what extent and who will facilitate the recall.
7) Continue meeting of CMU until crisis is over.
   * Marketing/ sales should be gathering statistics as to how the crisis hurt the company
     and develop a plan to counter negative publicity.
   * No CMU member should talk to anyone outside the CMU except the
     spokesperson.
   * Continue to work with investigative agencies (FSIS, FDA, FBI) if needed,

Product Adulteration / Tampering

   This section deals with tampering of food products. Remember the Tylenol case that happened over 13 years ago when someone added poison to bottles of Tylenol while it was on the store shelves? This case almost single-handedly lead to tampering-resistant packaging. The President of Tylenol went on television and expressed concern for the victims and said how bad it was for this to happen to a company whose purpose it was to help people suffering from illness. This was the perfect response and prevented Tylenol from losing any market-share. Could something like this happen to your product? How should the CMU respond? Bioterrorists could tamper with your product in the processing plant, during distribution and on store shelves. How should the CMU respond?

Food Poisoning:

   False claims are made all the time by consumers who ate your product and got sick. Some are just looking for free coupons or some type of monetary compensation. Some claims may be very real and it is best to respond quickly and proactively before it gets blown out of proportion.

Steps to be taken in cases of Food Poisoning
1) Assemble the CMU to discuss the situation and appoint a group to visit the patient, the doctor and any health officials involved. Notify any government agencies (FSIS, FDA, FBI etc) if appropriate. Send out samples to an outside laboratory, if appropriate.
2) The laboratory analysis should determine the type of bacteria involved. The CMU will meet to determine if the problem is due to the processing facility, consumer neglect or a false claim on the part of the consumer.
3) In these types of cases, it is important to suppress media coverage.

One final word on food poisoning cases. Each plant and company must determine how they will handle reported food poisoning cases. If the CMU response to a food poisoning case is too slow and if the problem is real, many people may become sick before you initiate a recall. However, if you initiate a recall when no real problem exists, you risk possible negative publicity when it wasn’t warranted.
Bioterrorism

We have all heard of the threat that bioterrorists could possibly get into the United State’s food supply channel although no specific attacks have actually taken place. Terrorists could conceivably poison the incoming raw materials in our food plants, poison the finished product in the plant or poison it while on the retail shelves which would fall under the topic of tampering/adulteration.

The FDA has recently published guidelines for bioterrorism in our food supply and can be found on the following websites;
* Food Producers, Processors and Transporters; Food Security Preventive Measures Guidance- can be found at [www.cfsan.fda.gov/~dms.secguid6.html](http://www.cfsan.fda.gov/~dms.secguid6.html).
* Retail Food Store and Food Service Establishments; Food Security Preventative Guidance-can be found at [www.cfsan.fda.gov/~dms/secguid5.html](http://www.cfsan.fda.gov/~dms/secguid5.html).

Every food processing plant should get these publications, study them and develop an action plan for food security. These guidelines should also be reviewed by the CMU and action plans developed to counteract the effects if something were to happen. After reviewing these guidelines, the CMU may possibly alter the way they approach crisis management.

**STEP #4; Develop and Distribute a Crisis Management Booklet to all Responsible Parties:**

The crisis management booklet should include the CMU members and their responsibilities, action plans for various crisis situations from local crisis to recalls with appendices as templates for every conceivable crisis and every possible telephone number needed. Get this booklet into the hands of every person in the plant who could use it. The appendices are good places to have a number of things so they are all in one place and easily obtained. These include detailed templates for every possible crisis that could happen along with telephone numbers. When you are in the mist of a crisis, you don’t want to be going through your file cabinet looking for some document or fumbling around looking for a telephone number. It is a good idea to have several pages of relevant telephone numbers in the appendix. Some necessary numbers include CMU work and home numbers, FDA, USDA, FBI, fire department, police department, local emergency preparedness group, hospital, ambulance service, a local chemical spill organization, natural gas company, water company, etc. Your CMU committee can brainstorm other organizations that needed to be included.
6. Food Processing and Equipment

A) Introduction:

The advent of the industrial revolution certainly changed many manufacturing industries but the food processing industry changed dramatically following WWII. WWII changed the food processing industry primarily by a better understanding on metal alloys and how to use them and the infusion of refrigerators into mainstream America. In addition, during the early 1900s, 80-90% of Americans lived in rural areas and derived a majority of their food supply from home gardens selling their excess to people living in the cities. Since the early 1900s, there has been a mass exodus from rural areas to cities. Less than 1% of America’s population now produce food for the remaining 99% of the population. In order for this to happen, the shelf life of foods had to be increased to accommodate the time from harvest to production and distribution. The technology of food processing has grown out of this need to extend the shelf life of foods. The number one reason for food processing has been to reduce spoilage however, along with this these changes has come improved nutrition and better eating quality of foods. In the 1950s and 1960s, labor was relatively inexpensive and processing equipment was expensive. Since that time, labor has become expensive and food processing equipment has become relatively inexpensive. Food processing equipment has become highly automated and mainly used to reduce labor costs. If you have a home garden you realize that you cannot produce and process your garden produce at nearly the cost of what you can buy it in a store. Whether you grow your own chickens for egg production, raise, feed and slaughter your own cattle for meat, you cannot begin to even compete with what you can buy the finished products in a store. Food in America is a real value mainly due to the automation and processing that has taken place in the last 50 years. In this chapter we will discuss food processing in general and some of the equipment needed to process food.

B) Food Processing

Food processing begins with raw products as listed in table 6.1. In this table, we have organized foods into one of twelve agricultural commodities. We have then listed some of the raw materials that make up each category and then listed some of the finished products that are made from the raw products. Go to a food store some time and notice how small the raw produce area is compared to the rows of finished, value-added products. At first you might think of the raw produce as being unprocessed but there is food processing used in these products. First of all, the varieties of produce bought in stores may be different that the varieties you plant in your home garden. In the case of tomatoes, certain varieties have been developed that have a thicker, tougher skin in order to withstand the rigors of transportation. Second
is the fact that most raw produces are transported to stores in modified gas atmospheres. Some raw food products will only last 2 to 3 days if picked at the ripened stage. With the use of modified gas atmospheres, raw produce can be picked just before ripening and allowed to ripen on the way to the store. Although one might argue that fresh, garden produce tastes better than artificially ripened produce, one cannot deny that having fresh produce available year round has to be more nutritious than eating only produce that is “in season”. As you shop the fresh produce area, notice on the label where that produce comes from. Some stores sell locally produced produce during the summer but in December, may have asparagus from Argentina, strawberries from Brazil etc. All of this has come about due to our understanding of the ripening process and how to control it. It has resulted in better year round selection of food and virtually eliminated most of the nutritional diseases that occurred in the past.

Table 6.1; Raw and Finished Food Products.

<table>
<thead>
<tr>
<th>Agricultural Category</th>
<th>Raw Products</th>
<th>Finished products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>Wheat, corn, rice, barley, etc</td>
<td>Cereal, beer, bread, cookies, canned corn</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Beans, carrots, cucumbers, cabbage, potatoes, etc</td>
<td>Canned vegetables, pickles, raw vegetables</td>
</tr>
<tr>
<td>Dairy</td>
<td>Milk from cows, goats and other animals.</td>
<td>Milk of numerous types, cheese, butter, ice cream, cream, yogurt,</td>
</tr>
<tr>
<td>Fruits</td>
<td>Apples, cherries, grapes, peaches, pineapples, berries, etc</td>
<td>Canned and fresh fruit</td>
</tr>
<tr>
<td>Meats</td>
<td>Beef, pork, lamb, goat, rabbit and skeletal meat and by products removed from such animals such as sausages, liver, selected meat cuts, heart,</td>
<td>Steaks, chops, roasts, sausages, etc</td>
</tr>
<tr>
<td>Fish</td>
<td>Tuna, haddock, lobster, shellfish, etc.</td>
<td>Fresh and frozen fish fillets, battered and breaded items</td>
</tr>
<tr>
<td>Poultry</td>
<td>Chicken, turkey, duck, eggs, pigeons, etc</td>
<td>Fresh and frozen birds and products and some further processed items</td>
</tr>
<tr>
<td>Fats</td>
<td>Vegetable oils, animal fats, various mixtures</td>
<td></td>
</tr>
<tr>
<td>Sugars</td>
<td>Crystalline sugar, corn syrup, candies,</td>
<td></td>
</tr>
<tr>
<td>Legumes and oil seeds</td>
<td>Dry beans, lentils, some nuts, soybeans</td>
<td></td>
</tr>
<tr>
<td>Beverages</td>
<td>Coffee, tea, juices, carbonated beverages, beer, wines</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Spice, salt, MSG</td>
<td></td>
</tr>
</tbody>
</table>
As an entrepreneur or small food processor, you need to continually look at newer faster equipment to be competitive. To stay in business, you always have to find a way to make food products, cheaper, better and differently than the competition. This competitive attitude has driven food processors to produce some of the best food in the world at a cheaper price than people can do it themselves. In order to understand or improve your processing line, the first step is to draw a flow chart like the one in Table 6.2. In this flow chart, we have drawn the process flow in the left column along with a written narrative of the procedure in the middle column. We then add a comment to the right column as to whether it can be automated or not.

Table 6.2. Flow Chart of a frankfurter line.

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>PROCEDURE</th>
<th>Automation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live Animals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slaughter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hide Removal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evisceration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carcass Splitting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carcass washing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chilling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carcass Fabrication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle Reduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixing/ Blending</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stuffing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casing Removal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cartonizing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retailing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This flow chart is very specific to a single product. You cannot make grape jelly following this frankfurter flow chart however the beginning and the end of flow charts tend to be similar. Every flow chart should start with your raw material. If you are fully integrated (meaning you grow your own raw material and, process it and take it all the way to the store), you probably grow varieties of produce that give you the exact starting material you want. If you are just processing food, your purchase specification should be written to buy a certain type of produce. This can be based on size, color, grade etc. Once you have your starting material, you should perform some sort of raw material inspection to sort out the raw products that are spoiled or blemished beyond what can be used as starting materials.

The end of the flow chart is usually quite similar across food products. This is usually some sort of packaging, cartonizing (where retail units are placed in a master box) followed by distribution and retailing.

After you have developed a flow chart for your production line, it is now time to find those procedures that can be automated. You can use the far right column for the flow chart like that in Table 6.2 to determine the number of people required to perform the procedure. You should also calculate the capacity needed. Your capacity
should be based on the amount of finished product you expect to sell over a given period of time. This step can be fairly difficult if you are not experienced at it but you will get better at it as you experience it. If you expect to sell 1,000 lbs of product per week, your total capacity to produce or manufacture should equal 1,000 lbs per week. You need to figure the number of people it takes to perform each step in the flow chart to produce that required amount of finished product. Then figure out if a piece of equipment will save you by not having to have as many people. When buying food processing equipment, you should also plan for more capacity that you are currently selling thus allowing for expansion. Some food processing equipment must be purchased to perform a procedure and is not based on automation. For example, if you are making low acid canned vegetables, you will need a retort (large pressure cooker). You cannot do this with labor savings in mind because no amount of labor can pressure cook a food product but the type of retort should be considered since some retorts are continuous while others are batch type.

As long as you are in the food processing business, you must be vigilant to changes in technology. What is breakthrough technology today can become obsolete within several years. The technology is constantly changing in many areas. For example, new methods of cooking are being developed such as radio-frequency cooking and induction cooking will replace older methods in several years. This can be viewed as a competitive strategy for small businesses because the big food processors of today will rarely have the money to totally update their system periodically whereas smaller businesses can afford to upgrade and modernize more frequently. Correspondingly, the big food processors of today may succumb to the smaller processor.

C) Food Processing Equipment:

The area of food processing equipment is large and complex. There both new and used equipment available but choosing the right piece of equipment is not so much a matter of the “right piece of equipment” but shades of gray as to what piece of equipment will get me where I want to go.

Dr Tim Bowser at Oklahoma State University has an online article that can be retrieved at [http://www.fapc.okstate.edu/factsheets/fapc102.pdf](http://www.fapc.okstate.edu/factsheets/fapc102.pdf). In his article entitled “Selecting and Purchasing Food Processing Equipment”, Dr Bowser describes his 5 step method for selecting and purchasing food processing equipment which includes 1) Identify need, 2) Define requirement, 3) Evaluate alternatives, 4) Acquire and install and 5) Examine results. If you are considering purchasing a piece of food processing equipment, I suggest you download and read this paper.

Drs Kent Rausch and Donald Erickson at Kansas State University has an article online entitled “Selection and Purchase of Used Food Processing Equipment” at; [http://www.fapc.okstate.edu/factsheets/fapc102.pdf](http://www.fapc.okstate.edu/factsheets/fapc102.pdf). In this article, Drs Rausch and Erickson summarize the basic steps in selection and purchase of food-processing equipment as 1) Determine the equipment needs, 2) determine the size of investment that is feasible, 3) locate the equipment possibilities, 4) evaluate these possibilities and 5) modify the selection, if needed, as new information becomes available. This article is also worth downloading and reading if you are looking into buying used food-processing equipment.
As a food processor, you need to determine whether you should buy new, used or refurbished food processing equipment. Food processing equipment can be categorized as listed in table 6.3.

Table 6.3. Categories of food-processing equipment.

Cleaners
  Washers
  Peelers
  Separators
Particles Reduction Equipment
  Dicers
  Grinders
  Choppers
Mixing
  Blenders
  Mixers
  Stirrers
Formers
Scales
Metal detectors.
Boilers
Cooking
  Steam jacketed kettles, Blentech
  Retorts all types from BPCS
  Heat exchanges
  Smokehouses
  Ovens
Conveyers
Fillers
  Stuffers
  Fillers
  Cappers
Labelers
Packaging
  Canning equipment
  Bags
  Boxes
  Overwrap trays
  Form fill and seal
  Vacuum
  Films
D) Finding Food Equipment:

The job of finding food-processing equipment can be complex by the internet has certainly made it easier. If you are an entrepreneur or small food processor, it may be worthwhile to check into using used food processing equipment. Most small scale food processing equipment is fairly expensive because hunters and small processors are always wanting this small equipment and the law of supply and demand certainly rules this market. Larger scale, used equipment may be a better value since it is larger and not many people are interested in a piece of equipment with a large “footprint”.

The best place to start looking for food-processing equipment is to do a Google search with the key word “Food Processing Equipment”. Listed below are some websites that may make the search for food-processing equipment less stressful.

http://www.fpsa.org
7. Food Product Labeling, Additives and Ingredients and Packaging

A) Introduction
Food packaging is primarily a method for protecting food during distribution and adding substantially to the shelflife. It also is used to promote the product in a positive light to the consumer. The label of food products must conform to government regulations. This chapter discusses the important aspects of the food labeling, packaging and also discusses some of the important ingredients used in foods.

B) The Basics of Food Labeling;

Introduction
A FOOD LABEL has 2 important functions. It tells the customer about the product in a positive manner and it must comply with federal or state regulations to add uniformity to food labeling and prevent consumer deception.

Display Panels
Food packaging has three types of display panels as defined by the regulations;
1) The Principle Display Panel (PDP) is the package panel that faces the purchaser and communicates what is in the box, can or jar.
2) The Alternative Principle Panel is the same as the PDP but allows more than one way to position the package on the shelf.
3) The Information Panel is directly to the right of the PDP or on the back of the package.
Table 7-1; Display Panels on a Food Package

<table>
<thead>
<tr>
<th>Information</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identity of Contents</td>
<td>•PDP</td>
</tr>
<tr>
<td>Ingredient Listing</td>
<td>•PDP or IP</td>
</tr>
<tr>
<td>Name and address of manufacturer, packer or distributor</td>
<td>•PDP or IP</td>
</tr>
<tr>
<td>Quantity of Contents</td>
<td>•PDP</td>
</tr>
<tr>
<td>Nutritional Label</td>
<td>•PDP or IP</td>
</tr>
</tbody>
</table>

**Parts of a Food Label**

There are basically 5 to 6 parts to an acceptable food label depending on whether the product is under control of the FDA or USDA. These parts include:

1) Name of the Product
2) Quantity of Product
3) Name of the Manufacturer or Distributor
4) List of Ingredients
5) Nutritional Label
6) If USDA inspected, must have inspection seal.

Figure 7-1 shows the location of the principle display panel and the information panels on a fictitious food product. Note that the principle display panel is the one that faces the customer when displayed and the information panel is immediately to the right of the principle display panel or on the back of the package.

Figure 7-1; Location of food label panels
The two required components that must be on the principle display panel include the identity of contents and the net weight statement (See Figure 7-2)

Figure 7-2; Components of the principle display panel

The three essential components of the information panel include the ingredient statement, the name and address of the manufacturer, packer or distributor and the nutritional label. The information panel can be immediately to the right of the principle display panel or on the back of the package. Figure 7-3 shows the layout of the components of the information panel.

Figure 7-3. Components of an Information Panel
We will now go into more detail on the required components of a food label.

**Name of the Product**

The name of the product is the common or usual name of the product shown in bold letters and is a statement of identity. Some foods are specifically defined in the regulations through “standards of identity” and must be identified by a standard name. The name of the product must appear on the principle display panel. Foods not covered under the standards of identity or a common and usual name are called non-standardized foods. A descriptive name should be used for a non-standardized product to accurately identify or describe the product. Most food products have a description known as a standard of identity. It is a legal description of what the food must be in order to call it that particular name. For example, ketchup has a certain consistency as measured by a viscosimeter in order to be called ketchup. If it is too thin in viscosity, it would be a tomato juice. The word “barbecue” also has a standard of identity. According to the standard of identity, the meat must be smoked over the coals of hardwood and must have a 30% weight loss during cooking. For meat to be called “Barbecue”, it must have the 2 requirements or it is not barbecue. You can call it “Beef with BBQ sauce” which means the meat portion is not BBQ. These standards of identity can be found on-line as described in chapter 8.

**Qualifying Statement**

Some food products, mainly USDA inspected products, may contain a “Qualifying Statement” immediately below the name of the product to explain how the product differs from the standard of identity. For Example; Smoked Sausage; Made with Turkey. In this case, the product name is “Smoked Sausage” but smoked sausage is traditionally made with beef and pork, so a qualifying statement is added (Made with Turkey).

**Quantity or Contents Statement**

This is an accurate statement of how much is inside the package or container. This declaration must appear in the lower one-third of the principle display panel. It is generally stated as “Net Contents” or “Net Weight”. The weights should be in the traditional manner (e.g. lbs, oz, etc.) followed by the metric unit (grams, liters, kilograms). For example” Net Wt 1 lb (454 g)”.

**Name of the Manufacturer**

The name of the manufacturer, packer or a statement indicating “Distributed by_____” is the declaration of responsibility. The company name, city, state and zip code must all be in this section. It is not required to have an address as long as your company name is in the telephone directory. This information is usually in the information panel but can also be present on the principle display panel.
**List of Ingredients**

The list of ingredients in the product appears in descending order of predominance by weight. The ingredient statement may be on either the principle display panel or an information panel. Foods using other standardized foods such as ketchup, mustard, mayonnaise, etc. as an ingredient must disclose the contents of the standardized food in the ingredient statement within parentheses. For example

**BARBECUE SAUCE**

Ingredients: water, tomatoes, ketchup (tomato concentrate, high fructose corn syrup, distilled vinegar, garlic powder), salt, sugar. Note that the ingredients that make up ketchup are in parentheses.

**Ingredient Declarations**

There are many regulations governing how and what is declared in the ingredient list that is beyond the scope of this guide. It is best to review the regulations for each ingredient used in your product. Some General Ingredient Declaration Rules include the following:

1) With the exception of onions, garlic and celery, the term “spices” can be used in the ingredient statement without listing all the spices used.
2) Flavorings and colorings should distinguish between those which are natural versus artificial.
3) Certified colors and protein hydrolysates must be declared by their common or usual name.
4) Food characterized by a particular flavor may require a qualifying name along with the product name (i.e. “Artificially Flavored”).
5) When chemical preservatives are used, a declaration of the chemical by its common or usual name and its function can be required. Typical functional qualifications include “preservative”, “to retard spoilage”, “a mold inhibitor”, “to help protect flavor”, and “to promote color retention”.

**Allergen Warning**

As of January 2006, an allergen warning must be under the ingredient statement to warn people with allergens that the product may contain one of the 9 potential allergens. The 9 major allergens are soy, milk, wheat, peanuts, tree nuts, eggs, fish, crustaceans and mollusks. If a food has any of these ingredients even in minute quantities, the word “Contains” must be at the end of the ingredient statement with the names of the allergens present in the food.

**C) Nutritional Labeling:**

The Nutritional Labeling and Education Act (NLEA) of 1990 provided for a mandate for the food industry to provide food nutrient data on food packages. Detailed information on the NLEA regulations can be found in ”A Food Labeling Guide” at the following URL: [http://vm.cfsan.fda.gov/~dms/flg-toctoc.html](http://vm.cfsan.fda.gov/~dms/flg-toctoc.html).
A nutritional label is provided to give consumers information they need to make food purchasing decisions for health reasons. Figure 7-4 shows a typical nutritional label.

Figure 7-4; A Typical Nutritional Label

**Parts of a Nutritional Label**

**Serving Size** - Serving size is based on a reference amount which is defined in the regulations. For example, all Barbeque sauces, hollandaise sauce, tartar sauce and dipping sauces use 2 tablespoons as a reference amount. This is so you can compare the various sauces with each other for nutritional data. There are many other rules and exemptions in the calculation of a serving size.

**Number of Servings per container** - This is the net weight divided by the serving size. It tells the consumer the number of serving in the container if used at the reference amount.

**Required nutrients** - There are fourteen (15) nutrients or nutrient facts that must be specified on nutritional labels. They include calories, calories from fat, total fat, saturated fat, trans fat, cholesterol, sodium, dietary fiber, total carbohydrates, sugar,
protein, vitamin A, vitamin C, calcium and iron. Consult the regulations as to which ones you need for your specific product.

D) Other Label Components

Depending on the product and how it is processed there are other label components which may apply to your product.

a) Safe Handling Instructions
Perishable products must give handling instructions such as “Keep Refrigerated” or Keep Frozen”. Meat, meat products and poultry or poultry products that are not further processed according to USDA-FSIS time/temperature requirements for all ready-to-eat products must carry “Safe Handling Instructions” as shown in the following slide. See figure 7-5.

Figure 7-5; A Safe Handling Instructions Message

b) Statement of “Imitation”
If the product is an imitation of the real thing, it must be stated on the label. An example would be cottage cheese-like food made from soybeans or other imitation dairy products where milk is absent or is used only as a minor ingredient.

c) Sulfites
Sulfides used in foods and beverages such as wines, if permitted to contain sulfites, must declare the presence of this additive if the level is greater than 10ppm. The declaration must be on the principle display panel “Contains sulfites”.

154
d) **Percentage Juice**
Any fruit or vegetable beverage or one purporting to be a fruit or vegetable beverage must declare the percentage juice content on the information panel or principle display panel. Examples are:
- “Contains 10% Apple Juice”
- “Contains no Apple Juice”

e) **Grades and Inspection**
Many people get grading and inspection confused. The two terms (grades and inspection) are totally different. An “Inspection Logo” is found on meat and poultry products means that the product was processed and packaged under continuous inspection by the U.S. Department of Agriculture (USDA/FSIS). They are inspected to guarantee the customer that the food product is safe and wholesome. A “Grade” is a designate for quality such as the beef grades of Prime, Choice, Select, etc. Grades can be company grades such as Fancy Grade, Grade A and are known as house grades.

A company may voluntarily have the USDA grade their product using USDA standards. If this is done, the grades will have a “U.S.” in front of them. For example “U.S. Grade 1” or “USDA Grade A”. As a rule of thumb, the lower the letter grade or number, the more nearly perfect is a product. Let’s talk about eggs as an example; Grade A Jumbo eggs. The “Grade A” means that the eggs will contain fewer spots, be less dirty or have less stained shells and be more uniform in shape than Grade B eggs. Jumbo refers to the size of the eggs.

Another example would be the insignia shown below. The “Inspected” round symbol means that the chicken was inspected for wholesomeness (e.g. it was inspected) and the letter “A” means the chicken is a high quality frying chicken. One symbol guarantees safety/wholesomeness and the other designates quality. Figure 7 shows a symbol that represents both an inspection logo and a grade identity.

Figure 7-6; A symbol representing both an inspection logo and a grade identity.
f) **UPC Code**

UPC stands for Universal Product Code. It is a bar code that distinguishes one product from another. The UPC code consists of 10 digits and vertical lines. The first five digits name the manufacturer and the last five digits name the product (peas, ketchup, etc.). It is not a government requirement to have a UPC code, but most retailers demand them for use in pricing a product and for inventory control purposes.

![UPC Code](image)

---

g) **Generic Foods**

Foods without fancy labels (no pictures, no recipes and usually black lettering on a white background) are termed “generic foods”. As a general rule, these products are overruns and are a way for the manufacturer to turn overstock merchandise into cash. Sometimes as much as 50% savings can be realized by purchasing these products since they have no “marketing” funds involved.

---

h) **Irradiated Foods**

Food products that are irradiated, must bear the irradiation logo and the term “Treated with Radiation” or similar statement. Foods are irradiated to improve shelf-life. Irradiation controls sprouting in potatoes as well as microorganisms, particularly pathogens. Spices that are irradiated do not have to bear the label. Most spices are either irradiated or treated with ethylene dioxide to reduce the bacterial load.
i) Descriptive Terminology and Health Claims

The terminology of nutrition and health claims is specifically defined under the NLEA (Nutritional Labeling Education Act) of 1990. The words “lite”, ”lean”, “No cholesterol”, “low sodium”, “fresh” or ”reduced salt” all have descriptions specifically spelled out for them by the USDA or FDA. Before using such claims, consult the regulations.

j) Health Claims

Health claims can sometimes be very desirable on a label. Foods having a scientifically proven and regulatory approved relationship to cancer, heart disease, hypertension or other health condition can be labeled as such. Most people have opinions about how foods can benefit them however, nutritional claims must be substantiated on hard scientific facts.

k) Code Dates

These are codes used on perishable foods that explain their shelf-life.
- PACK DATE- Date the product was packaged
- SELL BY DATE- Last day the product should be sold
- USE BY DATE- Last day the product is expected to maintain top quality
- EXPIRATION DATE- Last day the product should be consumed

Product codes can be very useful to food manufacturers if a recall is necessary.
E) Food Ingredients/ Additives and GRAS

Food Additives
This section will take you through the history, definition, legal/regulatory, categories and some specific food additives. Understand that this is a very broad topic yet a very important aspect of the overall food industry.

History
The use of salt peter in meat by the ancient Egyptians was probably the first recorded account of using food ingredients. Much world history and early exploration were an indirect result of man’s quest for spices and other flavorings. (e.g Marco Polo’s travels to the Orient for spices; Christopher Columbus’s voyage to find a shorter route to the Far East for spices).

General Definitions
A FOOD ADDITIVE is defined as “a substance or mixture of substances, other than the basic foodstuff, which is present in a food as a result of any aspect of production, processing, storage or packaging”. They are also defined as “Substances added to foods in smaller quantities for a specific purpose, those purposes being color, preservation, nutrition, texture, flavor or cost reduction ”.

FDA Definition
The FDA uses the term “food additive” to mean any substance, the intended use of which results or may reasonably be expected to result, directly or indirectly, in its becoming a component or otherwise affecting the characteristics of any food (including any substances intended for use in producing, manufacturing, packaging, processing, preparing, treating, transporting or holding food ), if such substance is generally recognized among experts qualified by scientific training and experience to evaluate its safety as having been adequately shown through scientific procedures to be safe under the conditions of its intended use.

Intentional Additives- Those which are added to perform a specific function. They are measured and added in exact amounts.
Incidental Additives-Substances present in foods in trace quantities as a result of some phase of production, processing, storage or packaging. These are unavoidable from the practical viewpoint.

Reasons for using Food Additives
The rapidly expanding population and migration of population from rural to urban areas requires that foods have increased shelflife. With less than 1% of the population growing food for the remaining 99% of the population, much of the food would never reach consumers in edible condition without food additives. Additives help the food supply to be more palatable, convenient, nutritious and safe with a long shelf-life and pleasing flavor.
Labeling
All food additives must be on the ingredient statement on the package label as required by law. All food ingredients must be listed in decreasing order of amount or can be just listed on the label if less than 2% of the total formula. Food ingredients must be approved for use as either listed as GRAS (Generally Recognized (or Regarded) As Safe) substances, prior sanctioned or be petitioned as a food additive.

CONCERN OVER SAFETY?
Although some people are concerned over the safety of food additives, the use of food additives have increased the overall nutrition, safety, shelf-life and quality of our food supply. A food additive has to be proven safe before it is used (GRAS Approved). Have you noticed that the children of every generation are 1” taller than the previous generation and are better off nutritionally? Obesity is now the problem—too much good food.

Natural
Most food ingredients are “natural”. They may be derived from plants or animals but are sometimes extracted and/or purified by artificial means. For example, Gelatin is derived from the hair follicles of hog skins and beef hides. Nitrites used to cure sausage are also natural occurring in water, celery and beer.

Categories of Food Ingredients
There are literally hundreds of food ingredients. Listed below is my method of classifying food additives by function. By classifying food ingredients based on function, it allows for a more thorough understanding of food ingredients, even those not specifically listed. Hopefully, this method will help you to learn more about food ingredients and their use.

Categories of Food Additives
- Preservatives-Antimicrobial
- Preservative-antioxidant & chemical changes
- Flavoring Agents
- Coloring Agents
- Acidulants
- Stabilizers & Thickeners
- Emulsifiers and Surface Active Agents
- Nutritional Supplements
- Firming Agents
- Anticaking Agents
- Leavening Agents
- Maturing & bleaching agents
- Humectants
- Curing agents & Adjuncts
Phosphates
Starter Cultures
Fats & Oils
Cost Reduction /Binders
Spices- natural and man-made.

We will now go through each category of food additives

a) Preservatives-Antimicrobial
Those which act to control or prevent growth of bacteria, yeasts and molds. Examples are sorbates, parabens, benzoates, propionates, sulfur dioxide and lactate. Some food additives listed in other categories also act as antimicrobial agents such as salt, sugar, acids etc.
Calcium Propionate-mold inhibitor in bread.
Potassium Sorbate-Mold inhibitor in cheeses, syrups, jams, mayonnaise and pickles.
Sodium Benzoate-mold inhibitor in high acid foods, fruit drinks and carbonated beverages.
Sodium Lactate –used in meat to control some pathogenic bacteria
Sodium Nitrite-used in cured meat to control botulism, add the characteristic pink, cured color and contributes to flavor.

b) Preservatives-Antioxidants and Chemical Changes
Some preservatives are used in food to prevent oxidation of fat (rancidity) and act to inhibit detrimental chemical changes. Prevention of rancidity in fatty foods can be accomplished with BHA, BHT and propyl gallate. Citric acid, phosphoric acid and ascorbic acid are often added to enhance the effectiveness of BHA and BHT.
Chelating or sequestering agents (EDTA and SHMP) are added to foods to bind trace metals which can act as catalysts in fat rancidity. These agents are used to prevent or reduce discoloration, cloudiness and rancidity. They are used in products such as soft drinks, cream style corn, shrimp and beer.

c) Flavoring Agents
Sugar and salt are the most widely used additives. Sugar not only contributes to sweetness but also adds body to beverages, tenderness to baked goods and color when caramelized. Salt and sugar may also be used as preservatives at high concentrations. Honey (fructose) does not spoil at room temperatures because the sugar is at such a high level that it binds all the moisture making it unavailable for bacteria. Salt can come in many forms such as table salt (Sodium Chloride) or lite salt (Potassium Chloride). Sugars or sweeteners can include sucrose (table sugar), fructose, dextrose, corn syrup and corn syrup solids, brown sugar, maple syrup. Non-nutritive sweeteners such as saccharin and aspartame are used to impart a sweet flavor but not the caloric content of sucrose. Also, some polyhedral alcohols such as sorbitol and mannitol add a
sweet sensation to the taste buds. MSG or monosodium glutamate combines with a protein to enhance the flavor of high protein foods but does not have a flavor of its own. “Chinese Restaurant Syndrome” is one problem with MSG where persons susceptible to MSG become “gitty” after being exposed to it. Nucleotides such as disodium inosinate and disodium guanylate are flavor potentiators meaning they enhance the basic flavor already present in the food.

Polyhydric Alcohols are sweetners that perform other functions such as 1) Control Viscosity and body in soft drinks (glycerol), 2) Crystalline retardation in candy (propylene glycol), 3) Preservative in soft drinks (glycerol), 4) Sweetner in diet gums and candies (sorbitol), and 5) Dusting Agent in marshmallows (mannitol).

d) Coloring Agents
Coloring Agents come in synthetic and natural. Examples of approved synthetic colors include FD&C yellow #5, #6 and FD&C red #4. Some examples of natural coloring are:

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>COLOR</th>
<th>USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carotene</td>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td>Paprika</td>
<td>Red</td>
<td>Pepperoni</td>
</tr>
<tr>
<td>Saffron</td>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td>Tumeric</td>
<td>Yellow/Green</td>
<td></td>
</tr>
<tr>
<td>Caramel</td>
<td>Brown</td>
<td>Cola</td>
</tr>
<tr>
<td>Grape Skin</td>
<td>Purple</td>
<td></td>
</tr>
<tr>
<td>Beet Powder</td>
<td>Red</td>
<td></td>
</tr>
</tbody>
</table>

The soft drink industry is the single largest industry to use coloring agents mainly in cola beverages.

e) Acidulants
Acidulants are acids used for purposes of flavor (soft drinks), buffers, preservatives (work by lowering the pH) and work synergistically with antioxidants. Examples of acidulants include acetic acid, sorbic acid, succinic acid, adipic acid, malic acid, citric acid, phosphoric acid, lactic acid, tartaric acid and fumeric acid.

f) Stabilizers & Thickeners
These compounds are usually polysaccharides derived from natural plant extracts, chemically modified natural products or may be completely synthetic products. Stabilizers are added to chocolate milk to prevent chocolate particles from settling out or added to ice cream to bind excess water thus preventing ice crystals and a grainy texture. Thickeners are added to icings, cheese spreads, salad dressings, pie fillings, soups and gravies to provide the desired consistency. Examples include alginates, methyl cellulose, and gums from agar, xanthan, carrageenan, tragos, guar and Arabic.
Stabilizers & Thickeners include gelling agent used in puddings, thickening agent used in jams and pie fillings, whipping agent used in toppings and icings, coating agents used in confectionary, emulsifying agent used in salad dressing and foam agents used in whipped toppings.

g) Emulsifiers and Surface Active Agents
Emulsifiers permit the dispersion of tiny particles or globules of one liquid into another.
An oil and vinegar salad dressing illustrates one use of emulsifiers—an aqueous and oil in solution. Emulsifiers such as mono-glycerides play an important role in the baking industry by helping to increase volume, uniformity, fineness of grain and shelf-life. Lecithin (PAM) is one of the most widely used emulsifiers and is a natural substance found in both plants and animals. Surface active agents (surfactants) of which emulsifiers are one type are used to lubricate foods. Applications would include prevention of stickiness in peanut butter and caramel products.

Examples of Emulsifiers and Surface Active Agents include glycerol monostearate, diglycerol monostearate, sodium stearoyl-2-lactylate, sorbitan monostearate, sorbitan monooleate, propylene glycol monostearate and polyoxyethylene sorbitan monostearate.

h) Nutritional Supplements
Historically such nutritional diseases such as goiter, pellagra, rickets, and scurvy were not usual. It is now rare to encounter these problems due to foods being imported, being fortified or other means have been found to reduce the incidence of nutritional diseases. Salt is now iodized to prevent goiter. Breads are fortified with B-vitamins to prevent pellagra. Milk is fortified with vitamin D to prevent rickets and fresh juices are more economical and served year round as a source of vitamin C to prevent scurvy.

i) Firming Agents
Firming agents are used to improve the texture of processed fruits and vegetables. Calcium chloride, calcium lactate and aluminum sulfate (alum) are used to improve the texture of pickles, maraschino cherries and canned peas, tomatoes, potatoes and apples.

j) Anti-Caking Agents
Anti-caking agents are important in the salt industry where sodium silico aluminate is used to prevent particle clumping. Calcium phosphate performs the same function in “Tang”-type drinks. Corn starch has been added to powdered sugar to keep it free-flowing. Calcium stearate in garlic salt is another example of the use of an anti-caking agent.
k) Leavening Agents
A leavening agent is any chemical or biological substance that can produce bubbles or gas (usually CO₂) in dough. These gas bubbles expand, causing the dough to rise, thus yielding foods which are light in texture. Yeast is sometimes used but is not a reliable source of CO₂ gas. Baking powders have replaced yeast as the preferred leavening agent. These powders are generally composed of sodium bicarbonate, an acid salt such as calcium monophosphate and starch. The phosphate and the bicarbonate readily react in the presence of water to produce carbon dioxide gas. The starch helps keep these ingredients dry and non-reactive so that a given volume of baking powder will create a given amount of gas.

l) Maturing and Bleaching Agents
The bleaching process of milled flour is accelerated by the addition of certain chemicals such as chlorine or chloride dioxide in the form of a gas. These compounds make it possible to produce consistently high quality flour and avoid the problems created by prolonged storage with little loss of nutritive quality.

m) Humectants
These are substances such as propylene glycol, sorbitol, glycerine and mannitol which are added to foods to help keep them moist. Propylene glycol is added to shredded coconut and marshmallows, dried garlic and garlic flavored croutons to perform this function. Sorbitol helps maintain the smooth consistency of candies and fudges.

n) Curing Agents and Adjuncts
Curing agents such as sodium nitrite are added to meat products for purposes of preservation (mainly against botulism), cured meat color (pink), flavor and retardation of rancidity of fat. The amount added is carefully controlled by the USDA to usually equal a finished amount of 156 ppm in ham and sausages and 120 ppm in bacon. Curing adjuncts such as sodium erythorbate and sodium ascorbate are added to the initial process to speed the conversion of nitrite to nitric oxide.

o) Phosphates
Phosphates are normally used to hold moisture, decrease the pH and subsequently assist antioxidants retard fat rancidity. The most common phosphates include sodium tripolyphosphate, sodium hexametaphosphate, disodium phosphate and monosodium phosphate.

p) Starter Cultures
Starter cultures are live bacteria that are non-pathogenic and perform functions such as flavor development and protein texturization. Typical bacteria used include Streptococcus, Lactobacillus, Micrococcus, and Pediococcus. Starter cultures are used in beer for fermentation, in pepperoni and other sausages for flavor development and preservation and in yogurt and cheeses for texture and flavor development.
a) **Fats and Oils**
Various types of fats and oils are used in a wide variety of products for purposes of flavor, texture and as a cooking media. Fats are generally from animal sources which are hard at room temperature and more saturated (more hydrogens along the carbon backbone) than oils which are from plant sources and are liquid at room temperature and are more unsaturated. Fats are generally derived from beef (tallow) and pork fat (lard). Oils are generally derived from soybeans, peanuts, cottonseed, corn, olive, safflower, sunflower, palm and coconut. They can be added as mono, di or triglycerides to foods. The word “hydrogenated” means that oils are treated to add more hydrogens to the carbon backbone of unsaturated fatty acids to make them solid.

b) **Cost Reduction/Binders**
These are generally proteins or starches added to foods for purposes of texturizers and thickeners but mostly for purposes of cost reduction. They can be made from plant, animal or fermentation derived origins.
Plant Derived Proteins are usually made from soybeans. They can be purchased as “textured” to resemble meat particles such as textured soy protein. They are categorized based on protein content. Flours are free flowing and generally 50% or less protein. Concentrates are usually about 70% protein and are usually purchased as texturized soy protein. Isolates are usually 90% or more in protein.

Animal Derived Proteins include proteins of animal origin. Sodium caseinate is a protein derived from milk used as an artificial creamer for coffee. Non-fat dry milk is basically milk that has been dried to be in the form of a powder. Whey is a by-product of the cheese industry. Plasma is dried blood. Albumin is egg protein. Gelatin is protein derived from the hair follicle of hogs and cattle. It is the active ingredient in Jello. Mechanically separated meat is meat particles that have been mechanically removed from the bones of poultry and livestock.

Fermentation Derived Proteins are proteins that are made from yeasts. Examples include torula yeast and autolyzed yeast extract. Autolyzed yeast extract is single cell yeast grown in lignin, molasses or sawdust.

Cereal Grain Derived are proteins from cereal grains such as oats, wheat, barley, corn, rye and potatoes and is often referred to as gluten. Some products used for cost reduction purposes use the starch component of these products.

c) **Spices**
Spices can be truly natural, extracts of spices or artificial. Natural spices are made from ground, cracked or rubbed roots, leaves or seeds of plant origin. They have a long lasting flavor but often contain large numbers of bacteria and give the resulting food product a poor color. They are also hard to use in this form since the concentration of the flavor component varies by region of the world. Flavor extracts are derived from
the solvent or steam distillation procedure used to remove the spice flavor components in concentrated form. Essential oils are another product of steam distillation of a natural spice.

The advantages of extracts and essential oils are that they are very low in bacteria counts, do not present the color problems of natural spices and the concentration of active ingredients is very controlled. The disadvantage of extracts and essential oils is that the flavor components are in a more volatile state and can dissipate faster than natural spices.

**Artificial flavoring** also known as hydrolyzed vegetable proteins or HVPs are the result of cleaving protein peptides from long vegetable proteins such as soy protein that give a particular flavor note. This technology is used can give a wide range of flavors such as shrimp, chicken, beef and the list goes on. This is an active flavor component in Ramen-type noodles.

**WORKING WITH SPICE COMPANIES**

There are many spice companies available that can help you with spices. Many natural spices are either irradiated or treated with ethylene dioxide gas to reduce the microbial load. When working with spice extractives are often “plated” on dextrose or salt as a carrier.

There are several large spice suppliers that can assist in duplicating a flavor match to any product you have. They have highly trained people who can taste a food and tell what spices are in it and how much. On ingredient labels, the exact spices used do not have to be labeled. This is considered proprietary information. The spices used can be listed as just “Spice” or “Spice Extractives”.

A list of approved food additives and substances generally recognized as safe (GRAS) can be found at [http://www.access.gpo.gov/nara/cfr/waisidx_o2/21cfrv3_02.html](http://www.access.gpo.gov/nara/cfr/waisidx_o2/21cfrv3_02.html)

**F) Food Packaging:**

This section is a brief overview of the area of food packaging. It is intended to give the reader an understanding of a broad, highly technical area. Just go to a food store and look at all the types of packaging used for food items.

**The functions of food packaging**

There are basically four functions of food packaging. These include 1) the major role of preservation, 2) aid the customer in the use of the product, 3) used to unitize or group product together and 4) used to communicate and educate the consumer.

The major role of food packaging is that of preservation. In the early 1900s, most Americans lived on the farm where fresh food was quite plentiful and could be eaten soon after harvest. As more people moved into cities and the distance between the raw food and the consumer increased, so did the amount of time needed to get to market. I would say that without packaging, most foods would spoil within one week. In today’s world with adequate packaging, foods last one to two months without spoiling primarily due to improvements in packaging. Therefore, the major role of
Packaging is preservation. Packaging offers other advantages also that relate to food protection and quality. Packaging is used to protect the product from physical damage. An example would be the injection of nitrogen into bags of potato chips to keep them from being crushed. Another example would be the use of fiberboard for eggs which keeps them from damage does distribution and storage. Packaging also protects the product from the environmental contamination from dirt, insects and air. The use of simple plastic bags for the packaging of breads, rolls, fruits and vegetables are examples. We often refer to this type of packaging as “dust covers”. Packaging can also be used to limit the amount of oxygen present around the product. Oxygen is the main cause of rancidity of fat and fosters the growth of many bacteria. By using an oxygen impermeable material around food and eliminating oxygen, we can dramatically increase the shelf-life of food. Examples are vacuum packaging and modified atmosphere packaging (MAP) whereby oxygen is excluded from the food. Packaging also plays a role in limiting the loss of moisture in food products thereby preventing the surface dehydration of foods.

Food packaging is also used to aid the customer in the use of the product. Food packaging should have features which make the product easier to use and add convenience. This includes zip-lock / recloseable features, microwaveable products like popcorn, screw caps like on milk containers, dual ovenable trays, presliced cheeses etc.

Food packaging is often used to unitize or group product together. Most food products are shipped to stores in master cartons or cases that contain a number of retail units. When retail stores or restaurants order product, they usually order cases. Some retail foods are sold in individually packaged units such soft drinks, small bags of chips and puddings for school children etc.

And the last function of food packaging is that of communicating and educating the consumer. It is the package that identifies the product to the consumer. It tells them via the label what they are buying and the amount. In addition to convincing customers to buy the product, the package must inform consumers about how to prepare or use the product, contents or amount of product contained, ingredients, nutritional content, and other pertinent information found on a label on the package.

The Cost of Packaging

As a whole, the packaging industry is one of the largest in the United States and food packaging represents about half of the overall packaging industry. Food packaging is not cheap. Food packaging can amount to one-third to two-thirds of the cost of food products purchased at retail. The cost of packaging in many cases is greater than the cost of the raw ingredients used to make the food. Just think about the cost of bottled water. The water is fairly inexpensive. Most of the cost is that of the plastic containers. This may sound depressing but the good news is that packaging does pay for itself in preventing food from spoilage.
The Requirements for Food Packaging

Food packaging has several requirements that must be met. It is not necessary to meet all the following requirements and is dependent upon the product being packaged. These are:
1) Be non-toxic
2) Protect against contamination and growth of microorganisms.
3) Act as a barrier to moisture and oxygen.
4) Filter out harmful UV light
5) Provide resistance to physical damage
6) Be transparent
7) Protect against the ingress of odors and environmental toxicants.
8) Be tamper-resistant or tamper evident.
9) Be easy to open
10) Have dispensing and resealing features
11) Be readily disposable
12) Meet size, shape and weight requirements.
13) Have appearance, printability features
14) Be low cost
15) Be compatible with the food

Types of Food Containers

Food containers can be divided into three categories which include primary, secondary and tertiary packages. A primary container is the one that comes in direct contact with the food, for example, a jar or a can. It is the retail unit that you normally buy. The packaging must be nontoxic, and compatible with the food and cause no odor, flavor or other foreign chemical reactions. A secondary container is an outer box, case or wrapper that holds or unitizes several cans, jars, or other retail units together but does not contact the food directly. It is often referred to as the master container. It would not be possible to distribute products in glass jars, for example, without the corrugated secondary carton to protect against breakage. The function of the secondary container is to protect the primary from physical damage during shipment and storage. Corrugated fiberboard (cardboard) is the most commonly used to make secondary containers. A tertiary container groups several secondary cartons together into pallet loads or shipping units. The objective of tertiary packaging is to aid in the automated handling of larger amounts of products. Typically, a forklift or pallet jack is used to move and transport tertiary containers.

FOOD PACKAGING MATERIALS

There are relatively few materials used in food packaging (metal, glass, paper and paperboard, plastics) but within each of these categories, many types of packaging materials or combinations of materials are available. For example, within the category of plastics, there are literally hundreds of types of films and laminates varying in moisture permeability, gas permeability, flexibility, bursting strength and so on. Listed below are the main types of packaging materials used for food products along with their characteristics, advantages and disadvantages.
Metal
- Most cans are made of either steel or aluminum.
- The majority of canned products are in steel. Up until a few years ago, most steel cans were coated with tin, hence the term “tin can”. The tin has been replaced with thin coatings of chromium and chromium oxide and some food compatible organic coating.
- The strength of the can is very important with the canning of fruits and vegetable since it must be able to withstand the pressure of retorting.
- Steel cans are common for retorted fruits and vegetables because of the strength needed to withstand the external pressure exerted from retorting.
- Aluminum is used primarily in the beverage industry (soft drinks and beer) since aluminum is structurally weak and the internal pressure from the carbon dioxide in the drink adds the necessary strength to the container.

Glass
- Glass is chemically inert and an absolute barrier to the permeation of oxygen and water vapor.
- The principle limitations to glass are its susceptibility to breakage, which may come from internal pressure, impact and thermal shock, its weight which increases shipping costs and the large amounts of energy required for forming into containers.
- Glass is primarily formed from oxides of metals, with the most common being silicon dioxide which is common sand.
- Many glass containers are being phased out of use to plastics. For example, milk and coffee used to be sold in glass jars but now come in plastic containers.
- Breakage, liability issues, shipping weight are all reasons that glass is slowly being replaced by plastic.

Paper, Paperboard and Fiberboard
- The principle differences between these three are thickness and ultimate use.
- Papers are thin, flexible and used for bags and wraps.
- Paperboard is thicker, more rigid and used to construct single-layer cartons.
- Fiberboard is made by combining layers of strong papers and used to construct secondary shipping containers and is often referred to as “corrugated paperboard”.
- When used in primary containers, most paper products are treated, coated or laminated to improve their protective properties.
- Paper from wood pulp and reprocessed waste paper is bleached and coated or impregnated with waxes, resins, lacquers, plastics and laminations of aluminum to improve its strength.
- Other additives can be used to increase flexibility, tear resistance, burst strength, wet strength, grease resistance, sealability, appearance, printability and barrier properties

Plastics
- The term “plastics” refers to a broad range of materials that have the common property of being composed of very large long-chain molecules and are made
by connecting small repeating molecules called “monomers” together in a head-to-tail fashion, hence their name “polymers”.

- Scientists came up with the concept of polymers from studying some natural occurring polymers such as starches, proteins and natural rubber.
- There are only about 20 polymers that are used in food packaging but when they are combined in a variety of ways, they give rise to hundreds of different plastic-containing structures. These polymers vary widely in strength, oxygen and moisture permeability, sealability etc

<table>
<thead>
<tr>
<th>Polymer</th>
<th>Common name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose Acetate</td>
<td>Cellophane</td>
</tr>
<tr>
<td>Polyamide</td>
<td>Nylon</td>
</tr>
<tr>
<td>Polyesters</td>
<td>PET, Mylar</td>
</tr>
<tr>
<td>Polyethylene</td>
<td></td>
</tr>
<tr>
<td>Polypropylene</td>
<td></td>
</tr>
<tr>
<td>Polystyrene</td>
<td></td>
</tr>
<tr>
<td>Polyvinylidene chloride</td>
<td>Saran-oxygen impermeable</td>
</tr>
<tr>
<td>Polyvinyl chloride</td>
<td>PVC – meat overwrap</td>
</tr>
</tbody>
</table>

Copolymers
- One can use a combination of the previous mentioned polymers to make what is called copolymers that combine the strengths of various polymers.
- For example, we can combine ethylene with vinyl acetate, we get the plastic polyethylene-vinyl acetate copolymer known as ethylene-vinyl acetate

Laminates
- One can fuse together various types of paper, plastics and aluminum foil to create a class of films called laminates.
- The advantage of laminates is that they combine the advantages of certain materials to improve the resulting film.
- Some commercial laminates may contain up to 8 layers.
Coextrusion
- Coextrusion is the process where two or more molten plastics are layered upon each other in a flat manner and ultimately produces a multilayer film on cooling.

Edible Films
- Edible films have been around for centuries. Sausage casings are one example.
- Food materials can be protected from loss of volatiles or reaction from other food ingredients by being encapsulated in protective edible materials.
- This can be accomplished by spraying a thin film of gelatin, gum arabic or other edible material onto a food product.
- The coating of raisins with starches to prevent them from moistening the packaged breakfast cereal is one example.
- Edible films are also used to coat fresh fruits and vegetables to reduce moisture loss and provide increased resistance to the growth of surface molds.
- The most common and oldest edible film is wax.
- A wide range of products such as apples are waxed for appearance and improved keeping quality.

HOW DIFFERENT FOODS ARE PACKAGED
Since different foods spoil or deteriorate differently than others, there are certain ways that foods are packaged to give them the longest shelf life possible. In general, food packaging has evolved over time to give the consumer the cheapest packaging needed to achieve the desired shelf-life. For example, you can buy fresh fruits that you place in plastic bags that merely work as a “dust cover”. The expected shelf-life would be about one week. If you would like longer shelf-life and be able to store in a non-refrigerated shelf, you need to buy canned fruit at a cost substantially higher than fresh, unprotected fruit. You get to make the choice of the type of packaging that affords you the storage conditions you desire. Listed below are some of the most common methods of which different foods are generally packaged. Some people have become used to the type of packaging and will only buy food packaged in those types of containers. This can be important if you are introducing a new food product in an unfamiliar package. An example would be eggs. Most people are going to look for eggs in the traditional paperboard or styrofoam egg carton. So if you introduce eggs already shell-less in a plastic jug, most people would not recognize the package.

Meat Packaging
- Fresh red meats such as beef and pork have traditionally been overwrapped in a styrofoam tray with PVC film- oxygen permeability for red color. More
recently, meats are being packaged in modified gas atmospheres such as a mixture of oxygen, carbon dioxide and nitrogen.

Table 7-3; MEAT PACKAGING

<table>
<thead>
<tr>
<th>Type of Meat</th>
<th>Type of Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh red meat</td>
<td>• PVC overwrap (oxygen permeable)</td>
</tr>
<tr>
<td></td>
<td>• Gas flushed in a tray</td>
</tr>
<tr>
<td>Sausages</td>
<td>• Vacuum packaged</td>
</tr>
<tr>
<td>Poultry</td>
<td>• Frozen turkeys</td>
</tr>
<tr>
<td></td>
<td>• In a O2 impermeable bag</td>
</tr>
<tr>
<td></td>
<td>• Gas atmosphere in a tray</td>
</tr>
<tr>
<td></td>
<td>Frozen as precooked chicken</td>
</tr>
<tr>
<td>Seafood</td>
<td>• Frozen</td>
</tr>
<tr>
<td></td>
<td>• Gas flushed</td>
</tr>
</tbody>
</table>

Fruits and Vegetables
- Canned- shelf stable
- Jars- especially baby food
- Frozen -in bags in a box
- Netted fruits
- Edible coated
- Gas flushed plastic bags, especially salads

Cereals and Cereal Products
- Oat Meal in paperboard
- Most breakfast cereals in waxed or plastic bags inside a paperboard box.
- Bread and bakery items are packaged in a plastic bag.
- Crackers are packaged in waxed or plastic bags within a paperboard box.

Chips
- Most chips in a gas filled bag
- Some chips in paper bags

Dairy Products
- Originally in glass jugs
- Later came wax coated paperboard
- Now, still some wax paperboard but changing over to plastic jugs
- Cheese, yogurt, cottage cheese etc in plastic containers.
- Ice cream, butter come in wax coated paperboard or plastic containers.

Beverages
• Most soft drinks in aluminum cans
• Some juices sold in plastic jugs
• Coffee sold in glass jars, plastic jars and metal cans

Eggs
• The egg shell is mother nature’s most perfect package. Enzymes under surface prevent microbial invasion
• Usually sold in paperboard container that protects the eggs against shock

Popcorn
• Packaged with outer plastic wrap to prevent moisture migration.
• Inner paper package contains a susceptor than focuses the microwaves energy to pop the popcorn.

G) Label Design and Packaging:
The food package serves mainly as a form of food protection but can also be used to communicate and educate the consumer. This is the purpose of the label. The label must contain the government required items such as name of the product, net weight, nutritional facts panel, ingredient statement, responsible company and any other required label statements such as percent juice, keep frozen, refrigerate after opening etc. It should also contain those items that are not government required but are useful to the consumer. These can include cooking instructions, UPC code, trademarked logo, a photo of what the product looks like, serving suggestions, sell by or use by date and other items. All the above mentioned items and even others one can think of must be assembled in such a way that invites the consumer to pick up your food product at the exclusion of similar items. The colors used and the theme must work together to “romantize” your product. What we are trying to do here is to appeal to the consumer in some emotional way. Pay attention sometime when watching TV ads. They do not sell their products based on their strengths as much as what the product will do for you. That is what we are trying to do when we assemble the label components, color and theme. We are building our product packaging for eye appeal and keeping it through emotional appeal. Most current food labels have an “old fashioned” theme to them under the thought that the food grandma used to make tastes better than the food of today. We often call these “comfort foods” because they take you back in time when there were no problems, at least from your perspective. Bill Walker has a rule for label design. He calls the 3-3-3 rule. The customer must be able to read your label from 3 feet away, in 3 seconds with a 3rd grade reading level.

I encourage you to go to a food store and spend some time looking at labels. Notice the color, font type, and all the things food companies do to try to get you to pick up and try their product. It is both an art and a science..
A) **Introduction**

The federal government uses two agencies, the Food & Drug Administration (FDA) and the U.S. Department of Agriculture /Food Safety & Inspection Agency (USDA/FSIS) to regulate the safety and standards of food products. The role of food regulations is to ensure that foods are 1) safe, 2) pure, 3) wholesome, 4) sanitary and 5) honestly labeled. All regulations have these roles in mind. As a general rule, if your product contains more than 3% raw meat or poultry or more than 2% cooked meat or poultry, it is under the jurisdiction of the USDA/FSIS. Foods containing lesser amounts of meat and poultry and all other foods not containing meat and poultry are under the jurisdiction of the FDA.

B) **History of Food Regulations and Major Legislation**

Food laws can be traced back to Egyptian and Hebrews cultures. You can read some of the Hebrew or “Kosher” laws in the Old Testament of the Bible. Most of the Hebrew food laws can be found in Leviticus 11 and 22 and Deuteronomy 12 and 14. Some of the laws include:

1. Eat only cloven-hooved, cud-chewing animals (Leviticus 11:2).
2. Do not eat or touch pork (Leviticus 11:7)
3. Do not eat an animal which died of a disease (Leviticus 11:39)
4. Do not eat blood (Deuteronomy 12:15 & 22)
5. Do not eat animals that died a natural death (Deuteronomy 14:21)
6. Do not eat meat cooked with milk (Deuteronomy 14:21)
7. Do not eat the sciatic nerve (Genesis 32:32).

With an increase in science, we can now understand some of these laws and why they made sense at the time they were written. For example, the law that states one should not eat or touch pork was at that time very important since trichina was quite prevalent and could be transmitted to humans. With the advent of improved cooking methods and farming practices that minimize trichina, we now can eat pork with little worry. Christians believe in Peter’s vision in Acts 10 to negate many of the Old Testament food laws.
Major food legislation;
The English and even early colonists had food laws but most were of minor consequence. The first major food law in the United States was the Pure Food and Drug Act of 1906 which was the first federal food act developed by Dr Harvey Wiley who is considered the father of the FDA. The second law was the Federal Meat Inspection Act of 1906. This act was in response to a book called The Jungle by Upton Sinclair which exposed the horrible sanitary and dangerous practices in meat packing houses. The act resulted in mandatory inspection of animals, slaughtering conditions and processing facilities. The Federal Food, Drug and Cosmetic Act of 1938 authorized the creation of the Food and Drug Administration (FDA) that we know today. In addition, the Federal Trade Commission was also established in 1938 for the purpose of preventing false advertising. The Federal Poultry Products Act of 1957 was the first poultry regulations to be enacted. The Nutritional Labeling and Education Act of 1990 was developed to provide for uniform and consistent nutritional labels.

C) Food Processing Regulations – General
If you are new to the field of food processing, the regulations can be very intimidating. In the remainder of this chapter, we will try to simplify your understanding of where to find the regulations you are looking for.
In actuality, the federal regulations in the USDA and FDA are very similar in content but differ in implementation. In USDA/FSIS facilities, inspectors are always on site during processing versus FDA which makes annual or semi-annual inspections. In addition, USDA/FSIS does pre-label approvals and FDA does not.
There are many regulations but to begin your understanding, you only need to be knowledgeable of a few but know them well. The three main areas we will focus on is 1) Facilities and Operations, 2) Standards of Identity and 3) Labeling.

A. Facilities and Operations;
Both the FDA and USDA/FSIS regulations contain regulations on the construction, plants and grounds, operations, personnel and equipment in food processing plants. These can be found in the FDA regulations in Part 110 referred to as “Current Good Manufacturing Practices in Manufacturing, Packing or Holding Human Food” often referred to as GMP’s. The USDA/FSIS version is referred to as “Sanitation” and found in Part 416 of the USDA/FSIS regulations.

B) Standards of Identity
Standards of identity specify in detail what foods can and cannot be packaged under a given name. Before you decide what product you are going to make, check on the standard of identity of what you think it is. The purpose of standards of identity is to inform consumers what the product is since they have a right to know what they are purchasing. For example, for a product to be called Catsup, it must meet the standard
of identity – Which includes many criteria such as containing tomatoes and “The consistency of the finished food is such that its flow is not more than 14 centimeters in 30 seconds at 20 deg.C when tested in a Bostwick Consistometer”. It can flow slower than 14 centimeters in 30 seconds which would mean it is very thick but it cannot flow any faster which would be more of a tomato juice. You probably didn’t know that standards were so specific.

Another example is that of barbecued pork or beef. The standard of identity for barbecue states that it “shall be cooked by the direct action of dry heat resulting from the burning of hard wood or the hot coals there from for a sufficient period to assume the usual characteristics of a barbecued article, which include the formation of a brown crust on the surface and the rendering of surface fat. The product may be basted with a sauce during the cooking process. The weight of barbecued meat shall not exceed 70 percent of the weight of the fresh uncooked meat”. If your product does not fit this description, you cannot legally call it barbecue. You can call it “Barbecue-Flavored” or “Barbecue-style” but it is not barbecue. I strongly suggest that as you develop a new food product, we check the standards of identity for that product. I have seen people develop what that thought was barbecue because it was smoked meat only to later find out it had to have a 30% weight loss.

Standards of identity for FDA regulated products can be found in Parts 130-169 in the FDA regulations. The USDA/FSIS standards of identity can be found in Part 319. Some products don’t have standards of identity. For FDA regulated products, see Part 102. For USDA/FSIS regulated products, see Part 319.

**Labeling:**

Both the FDA and USDA /FSIS have regulations that are very similar in the area of labeling of food products and nutritional labeling. These are found in the FDA regulation Parts 101 and 104. The USDA/FSIS regulations are in Parts 317. The discussion of labeling and nutritional labeling in this notebook can be found in Chapter 7.

**D) FDA Regulations:**

To view the FDA regulations, go to; [http://www.access.gpo.gov/nara/cfr/waisidx_02/21cfrv2_02.html](http://www.access.gpo.gov/nara/cfr/waisidx_02/21cfrv2_02.html).

A drop down menu will appear as seen in Table 3:1. We will now go into some of the major parts of the regulations that one needs to be familiar with.

- **Part 101/104** – Discusses the mandatory parts of the label and nutritional labeling.
- **Part 102** – Lists the common of usual name for food products that do not have a standard of identity.
- **Part 110** – Entitled “Current Good Manufacturing Practice for Manufacturing, Packing and Holding Human Food”. This regulation is the main one if you are involved in food
manufacturing. The sections within this regulation include:

<table>
<thead>
<tr>
<th>Section</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>110.3</td>
<td>Definitions</td>
</tr>
<tr>
<td>110.5</td>
<td>Current good manufacturing practices</td>
</tr>
<tr>
<td>110.10</td>
<td>Personnel</td>
</tr>
<tr>
<td>10.19</td>
<td>Exclusions</td>
</tr>
<tr>
<td>Subpart B</td>
<td>Buildings and Facilities</td>
</tr>
<tr>
<td>110.30</td>
<td>Plant and grounds</td>
</tr>
<tr>
<td>110.35</td>
<td>Sanitary Operations</td>
</tr>
<tr>
<td>110.36</td>
<td>Sanitary facilities and controls</td>
</tr>
<tr>
<td>Subpart C</td>
<td>Equipment</td>
</tr>
<tr>
<td>110.40</td>
<td>Equipment and utensils</td>
</tr>
<tr>
<td>Subpart E</td>
<td>Production and Process Controls</td>
</tr>
<tr>
<td>110.80</td>
<td>Processes and Controls</td>
</tr>
<tr>
<td>110.93</td>
<td>Warehousing and distribution</td>
</tr>
<tr>
<td>Subpart G</td>
<td>Defect Action Levels</td>
</tr>
<tr>
<td>110.110</td>
<td>Natural or unavoidable defects in food for human use that present no health risk.</td>
</tr>
</tbody>
</table>

Part 113 - Thermal processed low-acid foods packaged in hermetically sealed containers – discusses the regulations for canning food products with a pH above 4.6.

Part 114 – Acidified foods – discusses the regulations for acidified foods (pH less than 4.6).

Parts 130-169 - Categories of food products with standards of identity.

**E) USDA Regulations:**

To view the USDA/ FSIS regulations on meat and poultry product, go to; [http://www.access.gpo.gov/nara/cfr/waisidx_03/9cfv2_03.html](http://www.access.gpo.gov/nara/cfr/waisidx_03/9cfv2_03.html). A drop down menu like that seen in Table 3.2 will appear. We will now go through some of the major parts;

Part 317 – Entitled “Labeling Marking Devices and Containers” covers the regulations regarding general labeling, nutritional labeling, packaging materials and weights.

Part 319 – Definitions of Standards of Identity or Composition covers the standards of identify of various meat products.

Part 416 – Sanitation covers the regulations on operational sanitation.

Part 417 – HACCP regulations.
F) **Ingredient Uses in Food Products:**

The FDA lists food additives permitted in foods for both FDA and USDA/FSIS products in Part 172 and Substances Generally Recognized as Safe (GRAS) in Part 182 of the Title 21 regulations. One should consult these lists before using an ingredient in food. They can be found at the following URL.

http://www.access.gpo.gov/nara/cfr/waisidx_05/21cfrv3_05.html.

G) **Local Contacts:**

If you live in Arkansas, the following contacts offices are contacts for both food inspection services;

1) **FDA-** Arkansas Department of Health – Randy Carter- 4812 West Markham, Little Rock, AR 72205-3867 (800/482-5400 ext 2809)

2) **USDA/FSIS-** FSIS Inspection District Office; 4700 S. Thompson, Springdale, AR 72764 (479/751-8412)
Table 8-1; Index of FDA Regulations

<table>
<thead>
<tr>
<th>Part</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>General</td>
<td>General</td>
</tr>
<tr>
<td>101</td>
<td>Food labeling</td>
<td>Food labeling</td>
</tr>
<tr>
<td>102</td>
<td>Common or usual name for non-standardized foods</td>
<td>Common or usual name for non-standardized foods</td>
</tr>
<tr>
<td>104</td>
<td>Nutritional quality guidelines for foods</td>
<td>Nutritional quality guidelines for foods</td>
</tr>
<tr>
<td>105</td>
<td>Foods for special dietary use</td>
<td>Foods for special dietary use</td>
</tr>
<tr>
<td>106</td>
<td>Infant formula quality control procedures</td>
<td>Infant formula quality control procedures</td>
</tr>
<tr>
<td>107</td>
<td>Infant formula</td>
<td>Infant formula</td>
</tr>
<tr>
<td>108</td>
<td>Emergency permit control</td>
<td>Emergency permit control</td>
</tr>
<tr>
<td>109</td>
<td>Unavoidable contaminants in food for human consumption and food-packaging material</td>
<td>Unavoidable contaminants in food for human consumption and food-packaging material</td>
</tr>
<tr>
<td>110</td>
<td>Current good manufacturing practice in manufacturing, packing, or holding human food</td>
<td>Current good manufacturing practice in manufacturing, packing, or holding human food</td>
</tr>
<tr>
<td>111</td>
<td>Current good manufacturing practice for dietary supplements</td>
<td>Current good manufacturing practice for dietary supplements</td>
</tr>
<tr>
<td>113</td>
<td>Thermally processed low-acid foods packaged in hermetically sealed containers</td>
<td>Thermally processed low-acid foods packaged in hermetically sealed containers</td>
</tr>
<tr>
<td>114</td>
<td>Acidified foods</td>
<td>Acidified foods</td>
</tr>
<tr>
<td>115</td>
<td>Shell eggs</td>
<td>Shell eggs</td>
</tr>
<tr>
<td>120</td>
<td>Hazard Analysis and Critical Control Point (HACCP) systems</td>
<td>Hazard Analysis and Critical Control Point (HACCP) systems</td>
</tr>
<tr>
<td>123</td>
<td>Fish and fishery products</td>
<td>Fish and fishery products</td>
</tr>
<tr>
<td>129</td>
<td>Processing and bottling of bottled drinking water</td>
<td>Processing and bottling of bottled drinking water</td>
</tr>
<tr>
<td>130</td>
<td>Food standards: General</td>
<td>Food standards: General</td>
</tr>
<tr>
<td>131</td>
<td>Milk and cream</td>
<td>Milk and cream</td>
</tr>
<tr>
<td>133</td>
<td>Cheeses and related cheese products</td>
<td>Cheeses and related cheese products</td>
</tr>
<tr>
<td>135</td>
<td>Frozen desserts</td>
<td>Frozen desserts</td>
</tr>
<tr>
<td>136</td>
<td>Bakery products</td>
<td>Bakery products</td>
</tr>
<tr>
<td>137</td>
<td>Cereal flours and related products</td>
<td>Cereal flours and related products</td>
</tr>
<tr>
<td>139</td>
<td>Macaroni and noodle products</td>
<td>Macaroni and noodle products</td>
</tr>
<tr>
<td>145</td>
<td>Canned fruits</td>
<td>Canned fruits</td>
</tr>
<tr>
<td>146</td>
<td>Canned fruit juices</td>
<td>Canned fruit juices</td>
</tr>
<tr>
<td>150</td>
<td>Fruit butters, jellies, preserves, and related products</td>
<td>Fruit butters, jellies, preserves, and related products</td>
</tr>
<tr>
<td>152</td>
<td>Fruit pies</td>
<td>Fruit pies</td>
</tr>
<tr>
<td>155</td>
<td>Canned vegetables</td>
<td>Canned vegetables</td>
</tr>
<tr>
<td>156</td>
<td>Vegetable juices</td>
<td>Vegetable juices</td>
</tr>
<tr>
<td>158</td>
<td>Frozen vegetables</td>
<td>Frozen vegetables</td>
</tr>
<tr>
<td>160</td>
<td>Eggs and egg products</td>
<td>Eggs and egg products</td>
</tr>
<tr>
<td>161</td>
<td>Fish and shellfish</td>
<td>Fish and shellfish</td>
</tr>
<tr>
<td>163</td>
<td>Cacao products</td>
<td>Cacao products</td>
</tr>
<tr>
<td>164</td>
<td>Tree nut and peanut products</td>
<td>Tree nut and peanut products</td>
</tr>
<tr>
<td>165</td>
<td>Beverages</td>
<td>Beverages</td>
</tr>
</tbody>
</table>
Table 8-2; Index of USDA/FSIS Regulations

<table>
<thead>
<tr>
<th>Part</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>Agency mission and organization</td>
</tr>
<tr>
<td>301</td>
<td>Definitions</td>
</tr>
<tr>
<td>302</td>
<td>Application of inspection and other requirements</td>
</tr>
<tr>
<td>303</td>
<td>Exemptions</td>
</tr>
<tr>
<td>304</td>
<td>Application for inspection: grant of inspection</td>
</tr>
<tr>
<td>305</td>
<td>Official numbers; inauguration of inspection; withdrawal of inspection; reports of violation</td>
</tr>
<tr>
<td>306</td>
<td>Assignment and authorities of program employees</td>
</tr>
<tr>
<td>307</td>
<td>Facilities for inspection</td>
</tr>
<tr>
<td>308</td>
<td>[Reserved]</td>
</tr>
<tr>
<td>309</td>
<td>Ante-mortem inspection</td>
</tr>
<tr>
<td>310</td>
<td>Post-mortem inspection</td>
</tr>
<tr>
<td>311</td>
<td>Disposal of diseased or otherwise adulterated carcasses and parts</td>
</tr>
<tr>
<td>312</td>
<td>Official marks, devices and certificates</td>
</tr>
<tr>
<td>313</td>
<td>Humane slaughter of livestock</td>
</tr>
<tr>
<td>314</td>
<td>Handling and disposal of condemned or other inedible products at official establishments</td>
</tr>
<tr>
<td>315</td>
<td>Rendering or other disposal of carcasses and parts passed for cooking</td>
</tr>
<tr>
<td>316</td>
<td>Marking products and their containers</td>
</tr>
<tr>
<td>317</td>
<td>Labeling, marking devices, and containers</td>
</tr>
<tr>
<td>318</td>
<td>Entry into official establishments; reinspection and preparation of products</td>
</tr>
<tr>
<td>319</td>
<td>Definitions and standards of identity or composition</td>
</tr>
<tr>
<td>320</td>
<td>Records, registration, and reports</td>
</tr>
<tr>
<td>321</td>
<td>Cooperation with States and territories</td>
</tr>
<tr>
<td>322</td>
<td>Exports</td>
</tr>
<tr>
<td>325</td>
<td>Transportation</td>
</tr>
<tr>
<td>327</td>
<td>Imported products</td>
</tr>
<tr>
<td>329</td>
<td>Detention; seizure and condemnation; criminal offenses</td>
</tr>
<tr>
<td>331</td>
<td>Special provisions for designated States and Territories; and for designation of establishments which endanger public health and for such designated establishments</td>
</tr>
<tr>
<td>335</td>
<td>Rules of practice governing proceedings under the Federal Meat Inspection Act Special services relating to meat and other products</td>
</tr>
<tr>
<td>351</td>
<td>Certification of technical animal fats for export</td>
</tr>
<tr>
<td>352</td>
<td>Exotic animals: voluntary inspection</td>
</tr>
<tr>
<td>354</td>
<td>Voluntary inspection of rabbits and edible products thereof</td>
</tr>
<tr>
<td>355</td>
<td>Certified products for dogs, cats, and other carnivora: inspection, certification, and identification as to class, quality, quantity, and condition</td>
</tr>
<tr>
<td>362</td>
<td>Voluntary poultry inspection regulations</td>
</tr>
<tr>
<td>381</td>
<td>Poultry products inspection regulations</td>
</tr>
<tr>
<td>390</td>
<td>Freedom of information and public information</td>
</tr>
<tr>
<td>391</td>
<td>Fees and charges for inspection services and laboratory accreditation</td>
</tr>
<tr>
<td>416</td>
<td>Sanitation</td>
</tr>
<tr>
<td>417</td>
<td>Hazard Analysis and Critical Control Point (HACCP) Systems</td>
</tr>
<tr>
<td>424</td>
<td>Preparation and Processing Operations</td>
</tr>
<tr>
<td>441</td>
<td>Consumer Protection Standards: Raw Products</td>
</tr>
<tr>
<td>500</td>
<td>Rules of Practice</td>
</tr>
</tbody>
</table>
590 Inspection of eggs and egg products (Egg Products Inspection Act) Voluntary inspection of egg products
592 Voluntary inspection of egg products