

## Lesson 1: Agriculture in the Food Chain

Energy is required to sustain all forms of life on this planet. Life-forms can range from a single-celled organism to the most complex animal. This lesson discusses food chains and how people, through agriculture, have learned to control them to produce more food.

### Nature's Food Chain

The food chain is a sequence in which living organisms obtain food. It shows how food energy from the initial source in plants is transferred through a series of organisms by repeated eating and being eaten. There are four main parts to a food chain (see Figure 1.1).

1. The sun provides energy for everything on the planet.
2. The producer is plants that capture energy from the sun. These plants make their own food through a process called photosynthesis.
3. The consumer is an organism that eats another organism (food). It cannot produce its own food, so it gets its energy from other plants and animals. Specific consumer names are carnivores (organisms that eat only animals), herbivores (organisms that eat only plants), parasites (organisms that live off of another living animal or plant, usually at its expense), and scavengers (organisms that eat other organisms that are dead).

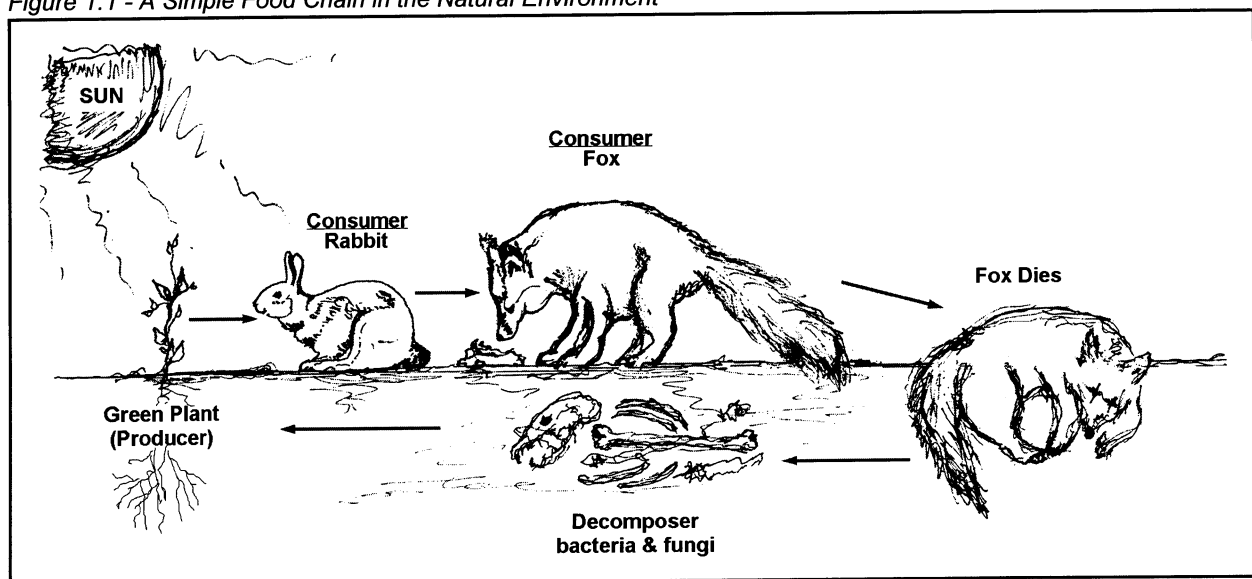
4. The decomposer is an organism, mainly bacteria and fungi, that breaks down dead matter and wastes into a form that can be used by other organisms. Without decomposers, the earth would be covered with trash.

A simple food chain occurring in the natural environment might be as follows: (1) caterpillars eat leaves, grass, and stems; (2) quail consume the caterpillars; and (3) foxes eat the quail. The sequence of one organism eating another happens continuously. Although quail eat caterpillars, they also feed on bugs and worms, so there are other organisms involved in this food chain.

There are also food chains in the aquatic environment. For example, algae are eaten by water insects (food energy flows from the algae to the insects), which in turn are eaten by minnows, which are eaten by larger fish. The larger fish may be caught and eaten by large herons or even predatory birds like eagles or ospreys (see Figure 1.2). Humans may enter into this food chain by catching and eating fish. Waste products from higher life-forms are in turn used by lower life-forms to begin the process again.

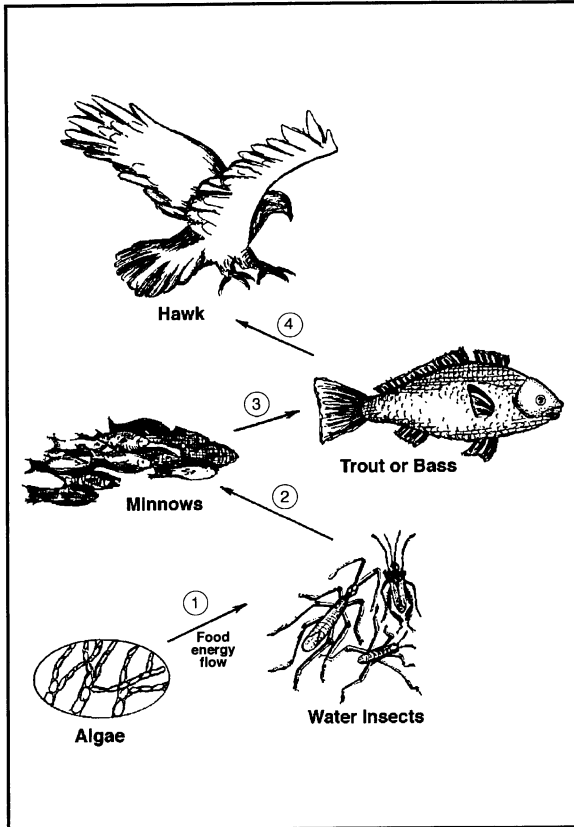
The food chain is not actually just one chain, but really a complex web much like a spider web. The differences among food chains are brought about by environmental differences. Each environment, or ecosystem, is home to specific organisms.

Figure 1.1 - A Simple Food Chain in the Natural Environment



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Figure 1.2 - A Simple Food Chain in the Aquatic Environment



### The Food Chain and People

The world population can no longer survive with food available from the natural food chain. The population is simply too large. Many countries have learned how to produce large amounts of food. Agricultural production in these countries provides enough food for humans, livestock, and exports to other countries. Countries that are not able to produce enough for their human population must purchase food from other countries.

In the agricultural food chain, the primary producers are plants. Food plants include crops like corn, wheat, barley, oats, and millet. Plants that produce vegetables and trees that produce fruits and nuts are considered primary producers. Crops such as grasses and forages used as livestock feed are also primary producers.

Some countries have the ability to produce enough to feed their human populations and their livestock. Food for humans can be obtained from both plant and animal sources. Nutritionally balanced diets for humans can be provided when both plant and

Figure 1.3 - All People Depend on the Food Chain



animal products are used. Unfortunately, many countries do not have enough to feed their human and animal populations adequately. This creates greater competition between humans and livestock for food crops. During periods of food shortages, livestock production is greatly decreased, and humans eat plant products of lower nutritional value.

### Agriculture and the Food Chain

Throughout history, humans have used the natural food chain to obtain food. Eating berries, catching fish, and hunting larger game animals provided food for individuals and communities. As the world population increased, the demand for more food prompted the controlled production of food also known as domestication. This involves the taming of wild animals, such as sheep and horses. Another example is raising plants such as tomatoes, cotton, beans, etc., in an organized arrangement rather than just letting the plants grow wild. Domestication of animals and plants is important in producing food and clothing for the world.

Agriculture and agricultural practices have enabled people to produce larger amounts of food than would be produced naturally in the food chain. Large-scale agricultural production has helped reduce food shortages in many parts of the world.

Although people have learned to manage the food chain, care must be taken to protect the environment and the natural food chain for wildlife.

## Summary

Natural food chains occur throughout the world in every environment. Agriculture and agricultural practices have enabled people to produce larger amounts of food than would be produced naturally in the food chain. Domestication of animals and plants has helped to produce food and clothing for humankind. Agricultural practices must protect the environment and the natural food chain for wildlife.

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## Lesson 2: Food Products from Plants

Plants supply food products such as grains, vegetables, fruits, and many other products in various forms. As consumers, it is important to understand the information listed on food labels.

### Food Products from Grain

Plants supply a large portion of the food in the human diet. Some foods from plants can be eaten fresh. Grains usually require some form of processing before being eaten. Grain crops grown in Missouri include corn, milo, rice, soybeans, and wheat.

Flour is a food product processed from wheat grain. Flour is used to make bread and other pastries. Cold and hot cereals are processed from grains. Cooking oil can be processed from corn, soybeans, and sunflowers. Pasta, including macaroni and noodles, is produced from wheat. Soybean products are used as a protein alternative to meat and may be added to many foods.

Starch processed from grain has many purposes. Dextrose is a corn product that is used as a major source of sweetener in human foods. Several snack foods are made from grains, including snack chips and crackers. Popcorn is a common snack food made from grain.

### Food Products from Vegetables

Many types of vegetables are grown in the Midwest. Vegetables are usually grown in home gardens or on farms that grow produce. Vegetables are used in a variety of ways. Fresh

vegetables can be eaten raw or cooked. They can be canned, frozen, juiced, or used in soups.

### Food Products from Fruits

In the Midwest, many types of fruits are grown including apples, cherries, grapes, peaches, plums, raspberries, and strawberries. They can be grown in home plots or in commercial orchards. Fruits can be processed and consumed in the following forms: fresh, canned, frozen, dried, juiced, and in jams and jellies.

### Food Products from Other Plants

Other plants are used to make food products such as maple syrup, herbs, chocolate, nuts, mustard, tea, coffee, and spices. Many of the plants that produce these products are not grown in Missouri. However, pecans are an important crop in the state.

## Understanding Food Labels

The Food and Drug Administration (FDA) food label provides valuable information that will help consumers make informed buying decisions. The key nutritional information found on a food label is listed below and illustrated in Figure 2.1.

1. Nutrition facts - This title indicates the FDA has approved the information on the label.
2. Serving size - The nutritional information found on the label is based on the indicated serving size. Serving sizes are standardized so that similar products can be compared. This part also indicates the number of servings per container.
3. Total calories and calories from fat - The total calories figure is the amount in one serving. As the amount of calories from fat approaches the total calories, more fat is contained in the food.
4. Percentage (%) daily value - This column lists the percent of key nutritional items (total fat, saturated fat, cholesterol, sodium, etc.) supplied by the food. This is based on a daily 2000-calorie diet.
5. Total fat - This figure is the total grams of fat.
6. Cholesterol - This figure is the total milligrams of cholesterol.

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Figure 2.1 - Key Parts of a Food Label

|   |                                  |           |        |   |
|---|----------------------------------|-----------|--------|---|
| <b>Nutrition Facts</b>  |                                  |           |        | ① |
| Serving Size 1 cup (30g)  |                                  |           |        | ② |
| Servings Per Container about 14   |                                  |           |        |   |
|   | Cereal with 1/2 cup Vitamins A&D |           |        |   |
| Amount Per Serving  | Cereal                           | Skim Milk |        |   |
| Calories  | 110                              | 150       |        |   |
| Calories from Fat   | 0                                | 0         |        | ③ |
| % Daily Value**   |                                  |           |        | ④ |
| Total Fat 0g*   | 0%                               | 0%        |        | ⑤ |
| Saturated Fat 0g  | 0%                               | 0%        |        | ⑥ |
| Cholesterol 0mg   | 0%                               | 0%        |        | ⑦ |
| Sodium 120mg  | 5%                               | 8%        |        | ⑧ |
| Potassium 35mg  | 1%                               | 7%        |        | ⑨ |
| Total Carbohydrate 26g  | 8%                               | 11%       |        |   |
| Dietary Fiber 2g  | 8%                               | 8%        |        |   |
| Sugars 15g  |                                  |           |        |   |
| Other Carbohydrate 9g   |                                  |           |        |   |
| Protein 2g  |                                  |           |        | ⑩ |
| Vitamin A   | 25%                              | 30%       |        | ⑪ |
| Vitamin C   | 25%                              | 25%       |        |   |
| Calcium   | 0%                               | 15%       |        |   |
| Iron  | 25%                              | 25%       |        |   |
| Vitamin D   | 10%                              | 25%       |        |   |
| Thiamin   | 25%                              | 30%       |        |   |
| Riboflavin  | 25%                              | 35%       |        |   |
| Niacin  | 25%                              | 25%       |        |   |
| Vitamin B6  | 25%                              | 25%       |        |   |
| Folate  | 25%                              | 25%       |        |   |
| Phosphorus  | 2%                               | 15%       |        |   |
| Magnesium   | 2%                               | 6%        |        |   |
| Zinc  | 25%                              | 30%       |        |   |
| *Amount in cereal. One-half cup skim milk contributes an additional 40 calories, 65mg sodium, 6g total carbohydrate (6g sugars), and 4g protein.  |                                  |           |        |   |
| **Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:   |                                  |           |        |   |
|   | Calories:                        | 2,000     | 2,500  |   |
| Total Fat   | Less than                        | 65g       | 80g    | ⑫ |
| Saturated Fat   | Less than                        | 20g       | 25g    |   |
| Cholesterol   | Less than                        | 300mg     | 300mg  |   |
| Sodium  | Less than                        | 2400mg    | 2400mg |   |
| Potassium   |                                  | 3500mg    | 3500mg |   |
| Total Carbohydrate  |                                  | 300g      | 375g   |   |
| Dietary Fiber   |                                  | 25g       | 30g    |   |
| Calories per gram:<br>Fat 9 • Carbohydrate 4 • Protein 4  |                                  |           |        | ⑬ |
| <b>INGREDIENTS:</b> OAT FLOUR, SUGAR, WHEAT STARCH, DRIED APPLE PIECES, BROWN SUGAR, CORN SYRUP, MALT, SALT, PARTIALLY HYDROGENATED VEGETABLE OIL (CONTAINS ONE OR MORE OF THE FOLLOWING OILS: CANOLA, SOY-BEAN), CINNAMON, CALCIUM CARBONATE, TRISODIUM PHOSPHATE, SODIUM ASCORBATE (VITAMIN C), ZINC OXIDE, NIACINAMIDE, REDUCED IRON, CALCIUM PANTOTHENATE, BHT (A PRESERVATIVE), VITAMIN A PALMITATE, THIAMIN MONONITRATE (VITAMIN B1), PYRIDOXINE HYDROCHLORIDE (VITAMIN B6), RIBOFLAVIN (VITAMIN B2), FOLIC ACID, VITAMIN B12, AND VITAMIN D. |                                  |           |        | ⑭ |

7. Sodium - This figure is the total milligrams of sodium.

8. Potassium - This figure is the total milligrams of potassium.

9. Carbohydrates - This figure is the total grams of carbohydrates

10. Protein - This figure is the total grams of protein. Due to individual needs, the food label does not specify a daily guideline for protein consumption.

11. Vitamins and minerals - These figures are the percentage of each vitamin and mineral provided in the product. The FDA requires only Vitamin A, Vitamin C, iron, and calcium, although food companies can voluntarily list others. The daily recommendation is for 100% of each of the noted nutrients.

12. Daily values footnote - This chart is a summary of the key nutritional items that an individual should eat daily. The guidelines are based on a 2000-calorie diet.

13. Calories per gram footnote - This last section summarizes the amount of calories in each gram of fat, carbohydrate, and protein.

14. Ingredients - This part of the label lists the items that were processed to make the food product. The first item represents the greatest quantity in the product. The last item listed represents the least amount present in the product.

### Summary

Foods from plants make up a large portion of the human diet. Foods from grains, vegetables, fruits, and other plants may be eaten fresh or in a variety of processed forms. Food labels provide nutritional information to help consumers make informed buying decisions.

### Lesson 3: Food Products from Animals

Animals supply food products in the form of meat, seafood, eggs, dairy products, and in many other forms. As consumers, it is important to understand the information listed on meat labels.

## **Food from Meat Animals**

The primary source of food from meat animals comes from cattle, hogs, sheep, and poultry.

### ***Beef Cattle***

Beef comes from cattle and is often eaten as hamburger, steak, and roast. Veal is produced from young cattle and is a very lean meat.

### ***Hogs***

Pork is produced from hogs. Common products from hogs include pork chops, ham, and bacon.

### ***Sheep***

Lamb meat comes from young sheep. Meat from sheep of more than 1 year of age is called mutton. Common cuts from sheep are lamb chops and leg of lamb.

### ***Poultry***

Eggs are produced by several species of poultry. In most areas, only chicken eggs are eaten. Most chickens produce white eggs. However, some breeds of chickens produce brown eggs. Meat is also a major food product from poultry (chicken, turkey, duck, goose, etc.). Birds raised for egg production are usually not of the same breed as those produced for meat. Per capita consumption of chicken and turkey has increased in recent years.

Retail cuts for all the above types of meat are purchased by the consumer at the meat department in a grocery store. They are cut from the larger wholesale cuts that are shipped from the processing company to the grocery store.

## **Dairy Products**

Dairy products come from both dairy cattle and dairy goats. Most of the fluid milk consumed in the United States is produced by dairy cattle. Milk is the most common dairy product and is the base for other dairy products. Milk is generally pasteurized to kill germs and homogenized to keep the milk and cream particles mixed. Whole milk contains about 5% cream. Two percent milk has all but 2% of the cream removed before packaging. Skim milk has all the cream removed. Other dairy

products include assorted cheeses, ice cream, butter, yogurt, sour cream, and cottage cheese.

## **Fish and Seafood**

Freshwater fish include catfish, trout, and bass. Catfish and new hybrid fish are raised on fish farms. Catfish can also be raised in ponds and lakes. Some farmers have experimented with raising catfish in indoor tanks to control the environment.

Saltwater fish are harvested from the sea. Tuna, salmon, halibut, cod, and shark are examples of saltwater fish.

Besides fish, many types of seafood are available in markets and restaurants. Seafood includes lobster, scallops, clams, shrimp, oysters, and crabs. Even lobster's freshwater cousin, the crawdad (or crayfish), is eaten in some areas.

## **Processed Meats**

Processed meat products are popular today due to their long shelf life, convenience, low waste, and controlled portion size. Processed meats often combine beef, pork, and poultry. Processed meats such as luncheon meats and hot dogs may be produced with only one type of meat or by blending beef, pork, and poultry. Examples of processed meats include sausages, such as luncheon meats (bologna, etc.), hot dogs, and pepperoni. Other processed foods include chicken patties and nuggets. Food science researchers are striving to develop processing methods to create new products that would be acceptable to the public.

## **Meat Labels**

Information is provided on meat labels to help consumers make buying decisions. The key information found on a meat label is listed below and illustrated in Figure 3.1.


Species - The meat product is identified as beef, pork, or lamb.

Wholesale cut - The specific wholesale cut is identified.

Retail cut - The name of the retail cut is identified.

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Figure 3.1 - Key Information on a Meat Label

|   |                              |  |               |
|---|------------------------------|--|---------------|
|  |                              | <b>Greiman Angus Meats</b><br><b>FOOD GIANT STORES</b><br>Columbia, Missouri |               |
| Species →   | <b>BEEF</b>                  | <b>RIB</b>   | ← Retail cut  |
| Wholesale cut →   | <b>RIBEYE</b>                | <b>STEAK</b>   |               |
| "Sell by" date →  | <b>SELL BY</b><br>06-04-00   | <b>TOTAL PRICE</b><br>\$4.76   | ← Total price |
| Net weight →  | <b>NET WT/CT</b><br>0.75 lb. | <b>UNIT PRICE</b><br>\$6.35  | ← Price/lb.   |

Total price - This is the price paid at the checkout counter.

Price/lb. - This price is used to calculate the total price (price/lb. x net weight).

Net weight - The actual weight of the meat product is identified.

"Sell by" date - The last date the meat should be sold. This is a freshness indicator for the meat department and consumers.

### Summary

There is a wide variety of food products produced from animals. Some foods are served fresh and others are processed. Meat contains protein needed to maintain good health. Protein can also be acquired from dairy and fish products. Information is provided on meat labels to help consumers make informed decisions.

## Lesson 4: Food Processing and Food Safety

Any food product intended for human consumption, whether plant or animal, requires careful handling. This unit covers reasons and methods used in the processing of food, describes how food progresses from the producer to the consumer, and addresses issues pertaining to food safety.

### Food Processing

Processing includes all the steps used to change raw agricultural products into consumable products. Raw products may go through one to several steps in processing. Raw products can be cleaned, dried, weighed, refrigerated, preserved, stored, and changed in form. The more processing steps a product goes through, the higher the marketing cost. Processing raw products can be as simple as picking a peach off a tree to as involved as changing the form of a product by changing its taste, color, shape, and packaging. Whether simple or involved, food is processed to maintain or improve its fitness for consumers.

### Reasons for Processing

Many foods are processed before they get to the consumer to make them more tasty. Some foods cannot be eaten raw. Processing is needed to change the raw product into a product that consumers can eat. Wheat is an example of a crop that is not very tasty in its raw form. Wheat is usually ground into flour. Flour is then made into breads, baked goods, or cereals.

Food processing also permits longer storage of food products by preserving them. Preservation maintains food quality and makes food safer for consumption. If food is not preserved properly, spoilage and contamination can occur, which can lead to health problems. Salmonella, dysentery, typhoid, and cholera are diseases that can be caused by eating unsafe food. Care should always be taken to ensure food is properly stored and prepared.

Transportation is an important step in food processing. Not all foods are produced in every state or country. Shipping food from centers of production to consumers is very important. Food that is not properly processed may spoil during transportation. This is a very costly problem for everyone involved.

Another reason for processing food is for the convenience of consumers. Most people are not willing to buy a live chicken to lay eggs. Also, few people would purchase a live animal when they want meat for their families.

### Methods for Processing

Foods may be processed in many different ways. The method used depends on the raw product, consumer demand, health, and safety. Following are several major processing methods.

**Freezing** - Freezing is achieved by reducing the temperature to 0°F, which virtually stops microbial growth and even kills some. Refrigeration (33°F-40°F) is useful to slow microbial growth.

**Heating** - Heating food products to a temperature greater than 180°F is a technique used to destroy harmful bacteria. This process, called pasteurization, is mainly used on dairy products.

**Fermentation** - Fermentation uses selected microorganisms to break down complex carbohydrates. Fermentation processes produce pickles, sour cream, yogurt, cottage cheese, and wine to name a few.

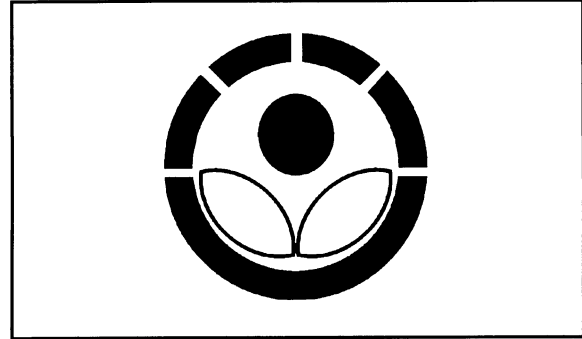
**Smoking and curing** - Smoking preserves foods by exposing them to smoke for a specified amount of time. Curing preserves by using salt, brine, or by aging the product. Ham, corned beef, and bacon are commonly preserved by curing.

**Vacuum packing** - Foods that have been vacuum packed have the air removed from the container to prevent microbial activity and increase their shelf life. For example, very few grocery stores purchase beef in the carcass form today. Instead, wholesale cuts are shipped as "boxed beef." These cuts are wrapped under a vacuum with a film that keeps out moisture and air.

**Irradiation** - This food processing method subjects food to radiant energy to kill microorganisms. Irradiation will kill *E. coli*, which can cause death. Several deaths and recalls of contaminated beef products in 1998 led to the use of irradiation as a food safety measure. It is a safe method of controlling harmful organisms, extending the shelf life of fruits and other foods, and killing unseen insects. In 2000, the FDA permitted beef, pork, and lamb to be irradiated. To allow consumers a choice, the international symbol of irradiation known as "radura" is required on meat products that have been irradiated (see Figure 4.1).

**Grinding** - The particle size of the raw product is reduced by grinding. For example, wheat is reduced to flour by using rollers to crush the larger

Figure 4.1 - International Irradiation Symbol



particles. Various wholesale cuts of beef, pork, or lamb are processed into ground beef (hamburger), ground pork (pork patties), or ground lamb (lamb patties).

**Homogenization** - Homogenizing food refers to a process forcing the food through a small valve under pressure to reduce the size of the globules of fat. When the large globules are reduced to a small size, the food's consistency remains constant. Milk is homogenized to keep the milk fat in suspension.

**Dehydration** - In dehydration, the moisture is removed from a food. Beef jerky and dried fruit, such as raisins, are common dehydrated foods.

**Emulsification** - Certain food products contain both water and oils/fats. Naturally, these two ingredients repel each other and separate. Emulsifiers are materials that keep this separation from occurring. Mayonnaise, margarine, salad dressing, sausage products, and ice cream are processed with emulsifiers.

**Extrusion** - Extrusion is a process where a formulated dough is forced through an extruder under high pressure. High pressure causes the starch molecules to expand. The steam generated by the heat of the process causes a puffing of the product, which forms a new shape. Breakfast cereals are commonly extruded.

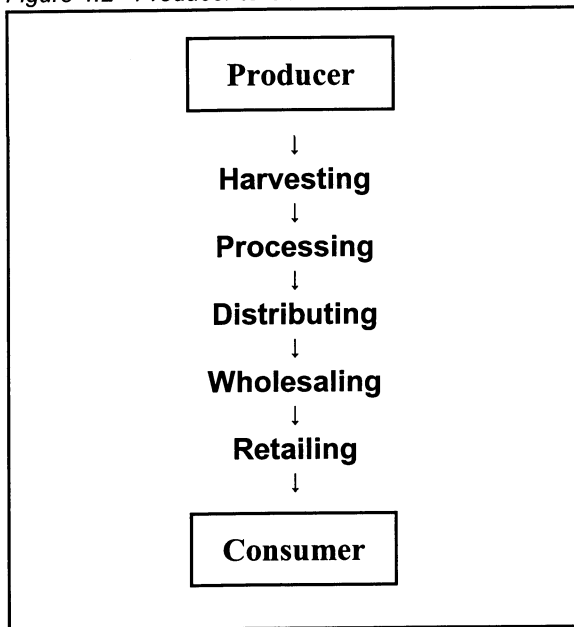
**Separation** - Bones and fat are removed from a product.

### Processing from Producer to Consumer

Raw products go through several steps to get from the producer to the consumer as illustrated in Figure 4.2. Producers grow plants and raise animals for the raw food products. Harvesting

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Figure 4.2 - Producer to Consumer



involves removing the edible portions from plants in the field. During processing, the raw product is cleaned, separated, handled, and prepared for distributing. Distributors store food until it is needed by wholesalers. Wholesaling involves selling fresh or processed foods to retailers. Retailers sell foods to consumers. Although consumers usually purchase food from retailers, in some cases they may purchase food from the producer or wholesaler. For example, farmers' markets allow producers to sell directly to consumers.

### Food Product Safety

Chemical preservatives may be used in food preservation to retain the color and fresh appearance desired in food products. Regulations affecting the use of preservatives have been established by the federal government. Consumers are ensured a safe food supply because food quality is monitored by government agencies. The Food and Drug Administration (FDA) sets guidelines and restricts chemicals used as preservatives. The U.S. Department of Agriculture (USDA) employs inspectors to monitor the use of chemicals in food processing. The Environmental Protection Agency (EPA) regulates the use of pesticides in crop and livestock production. Such regulations are enforced to ensure the nation's food supply is safe. Government inspectors also examine food

imported from other countries to ensure it is safe for human consumption.

During the past decade, the livestock industry has responded to the public's demand for safe food by implementing quality assurance programs. Beef and pork producers, for example, follow management plans that ensure the production of a safe and wholesome product. Producers' health plans and practices are reviewed by veterinarians.

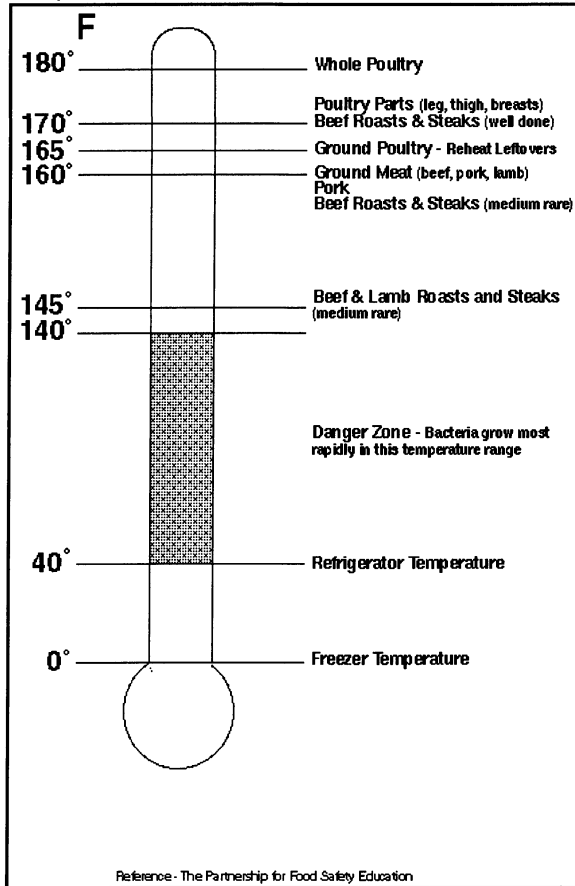
### Food Preparation, Quality, and Safety

The partnership for Food Safety Education recommends following these four steps to keep our food safe from harmful bacteria.

1. **Clean** - Always wash hands in hot, soapy water for at least 20 seconds before preparing or eating food. Use disinfectant cleaners to clean kitchen counters and other surfaces that come in contact with food. Hot water and soap do a good job too but may not kill all strains of bacteria. Be sure to always rinse vegetables and fruit in cold water (no soap) before eating or preparing them.
2. **Separate** - Bacteria can spread from one food to another through cross-contamination. To decrease this risk, keep raw meat, poultry, seafood and their juices away from ready-to-eat foods. If possible, use one cutting board for raw meat products and another for salads and other ready-to-eat foods. Never place cooked food on a plate that previously held raw meat, poultry, or seafood.
3. **Cook** - Foods are properly cooked when they are heated for a long enough time and at a high enough temperature to kill harmful bacteria that can cause foodborne illness. Always use a clean food thermometer to check the internal temperature of cooked foods as noted in Figure 4.3.
4. **Chill** - Refrigerate or freeze leftovers within 2 hours or less. Set your refrigerator no higher than 40° F and set the freezer at zero. Check these temperatures occasionally with an appliance thermometer. Never defrost food at room temperature. Thaw food in the refrigerator or in the microwave if it will be cooked immediately.



Figure 4.3 - Recommended Safe Cooking Temperatures for Consumers



## Summary

Food safety and processing affects everyone because of the need for safe, wholesome food. Processing involves all the steps of going from a raw agricultural product to a consumable product. We process food to improve taste, maintain quality, prevent spoilage, and to provide a safe and convenient product for consumers. Many different methods and steps can be used to process food. U.S. government inspectors monitor the food processing industry to ensure safe food for consumers. Keeping food safe from harmful bacteria is an important food safety principle.

## Lesson 5: Fiber Products from Agriculture

In this lesson, you will learn about several sources of fiber products: plants, animals, and synthetic sources.

## Fiber Products from Plants

Most of the fibers produced in agriculture are made into clothes or material. Cotton is the most common fiber. For many years in the southern part of the United States, cotton was the most dominant crop.

Figure 5.1 shows the Seal of Cotton (top) that identifies products made from 100% Upland Cotton (a common type grown in the United States). The Natural Blend (bottom) indicates fiber products containing at least 60% Upland Cotton.

Figure 5.1 - Seal of Cotton and Natural Blend Symbols



Flax is the plant used to produce linen cloth.

The hemp plant was used for many years to produce high-quality rope, burlap, and twine. Smoother nylon materials have been replacing hemp in rope production.

Products have also been developed using cellulose from tree fibers. Acetate and rayon are both materials that are manufactured from cellulose fibers.

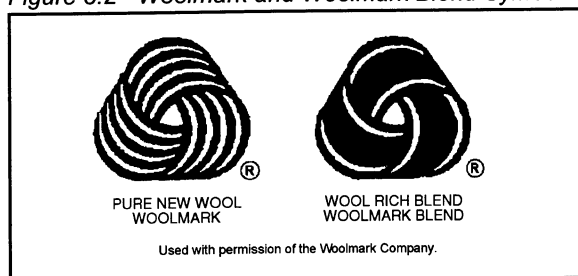
## Fiber Products from Animals

Animals produce some fiber products. Wool is the most common fiber produced by animals. Figure

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5.2 shows certification trademarks owned by The Woolmark Company. The Woolmark trademark (left) can be used on products made of 100% wool. The Woolmark Blend trademark (right) can be used on products that contain a minimum of 50% wool. Angora goats produce mohair. Silk is the product of silkworms. The fibers used to spin the silkworms' cocoon can be unwound to make silk and rewoven to produce silk cloth. Paint brushes, violin strings, feathers, and surgical sutures are other items made from animal products.

Figure 5.2 - Woolmark and Woolmark Blend Symbols



### Synthetic Fibers

Most of the fibers described above are produced from natural sources. Synthetic fibers are manufactured from raw materials such as coal, petroleum, and natural gas. Common synthetic fibers include acrylic, nylon, and polyester.

### Natural Fibers vs. Synthetic Fibers

Natural fibers come from inexhaustible resources, such as plants and animals, which reproduce over and over. Synthetic fibers come from exhaustible resources. Once the source of synthetic fibers is depleted, no more can be produced. Table 5.1 lists examples of natural and synthetic fibers.

Table 5.1 - Natural Fibers vs. Synthetic Fibers

| Natural Fibers   |   | Synthetic Fibers              |
|--|---|-------------------------------|
| Plant origin   | Animal origin   |                               |
| Cotton<br>Rope (hemp)<br>Rayon<br>Linen (flax)<br>Acetate<br>Burlap (hemp)<br>Twine (hemp) | Wool<br>Silk<br>Mohair<br>Paint brushes<br>Violin strings<br>Feathers<br>Surgical sutures | Acrylic<br>Polyester<br>Nylon |

### Summary

Many fiber materials are processed from agricultural products. Cotton and wool are produced in the United States to help meet the demand for quality fabric. Cotton is grown in southern states. Wool is from sheep that are raised throughout the United States. Many other fiber products are by-products of agricultural production. Fiber products produced from agricultural sources are inexhaustible whereas synthetic fibers are produced from raw materials that are limited in supply.

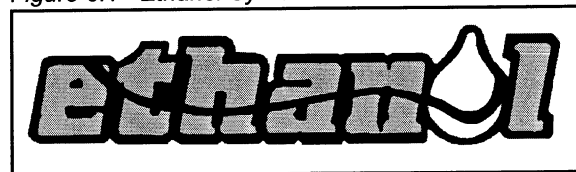
### Lesson 6: Nonfood Products from Agriculture

In this unit, nonfood products supplied from grain, trees, other plants, and livestock are discussed.

### Products from Grain

The most common nonfood use of grain is for livestock feed. However, many other nonfood products are now produced from grains. In fact, there are more than 3,500 different uses for corn products, and more uses are being found each day. One of the most well-known products is ethanol (see Figure 6.1). Produced from the fermentation of starchy materials such as corn, this alcohol product is blended with gasoline to make gasohol. The first blends in the 1970s were 10% ethanol by volume (E-10) and are still available at gas stations. In 2000, Missouri's first ethanol plant was opened near Macon.

Figure 6.1 - Ethanol Symbol



Corn is refined into starch, syrup, and dextrose. These items can be found in many products such as adhesives, dyes, mouthwash, paints, paper products, plastics, soaps, shoe polish, and toothpaste. Some recent examples of industrial uses of corn are the following:

- Corn-derived citric acid (a substitute for phosphate) increases the cleaning

- power of detergent and decreases the volume needed.
- Packing peanuts, a loose fill for shipping products in boxes and other containers, are replacing Styrofoam. The peanuts are made of approximately 95% cornstarch.
- Noncorrosive road deicer made from corn is an environmentally safe alternative to chloride salts.
- Starch-based superabsorbent polymers absorb up to 2,000 times their weight in water. They are used in some baby diapers, automobile fuel filters, and in the horticultural industry to hold moisture near the roots of plants during planting.
- Golf tees are manufactured from cornstarch. They begin degrading within 20 days and save over 50,000 trees per year.
- Biodegradable plastics are processed from corn.

Soybeans are processed for their meal and oil. The meal is used in animal feeds as a protein source. Thousands of other products are processed from soybeans including industrial products such as adhesives, caulks, cements, and fabric softeners. One of the most well-known nonfood uses of soybeans is soy printing ink. Many inks used by newspapers and magazines are processed from soybeans instead of oil. Soybean oil sprays have virtually eliminated the risk of deadly dust explosions at grain elevators. New construction materials such as plywood and countertops that contain soybeans are being used by builders. Even crayons are now being made from soybean oil rather than petroleum-based paraffin wax.

More recently, soybeans are being used in a biodiesel called soy diesel. When added to diesel fuel, the soybeans increase the fuel's lubricating properties, which in turn reduces engine wear. Soy diesel also helps reduce exhaust emissions.

### Products from Trees

Many nonfood products are produced from trees including lumber, paper, and cardboard. Wood pulp (very fine wood fibers) is processed into various paper products. Some varieties of evergreen trees are also raised for Christmas trees. Charcoal, a timber product, is produced by partially burning the wood. Bark chips and mulch

are also by-products of the lumber and paper industry and are used in landscaping. In addition, turpentine, varnish, and paints are by-products of the forest industry.

### Products from Other Plants

Some plants are grown for special purposes. Trees, shrubs, ground covers, and grasses are all grown for ornamental purposes. Such plants are used for landscaping, erosion control, and producing shade. Flowers are grown in landscapes and used in floral arrangements.

Plants can also produce things such as natural insecticides and medicines. Aloe vera is a plant that produces an oil used to ease the pain of minor burns. Perfumes are also made from plant parts.

### Products from Livestock

Very little is wasted in the processing of livestock. It has been said that the only thing not used in the processing of hogs is the "oink." The excess fat from animal carcasses is made into detergent. Products from hogs are also helpful in saving lives. Hogs help save human lives by providing insulin needed by diabetics and replacement heart valves for heart patients. Animal fats are also used to make soaps, glues, and candles.

Feathers from chickens and ducks are used to fill pillows. The hides of cattle and hogs can be used to make a wide variety of leather products. Leather is used to make clothing, upholstery, luggage, and book covers, just to name a few. Lanolin is an oil product extracted from sheep wool. Lanolin is used as a skin protector in hand lotion.

Many high-protein meal products are produced during meat processing. Bones, feathers, blood, and fish by-products can be crushed, dried, and ground into meal products, fertilizers, or animal feeds.

### Summary

Many nonfood products are processed from animals and plants. Some plants and animals are raised specifically for the special products they provide. Other products are by-products of plant or animal production.

## ***EXPLORING AGRICULTURE IN AMERICA***

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