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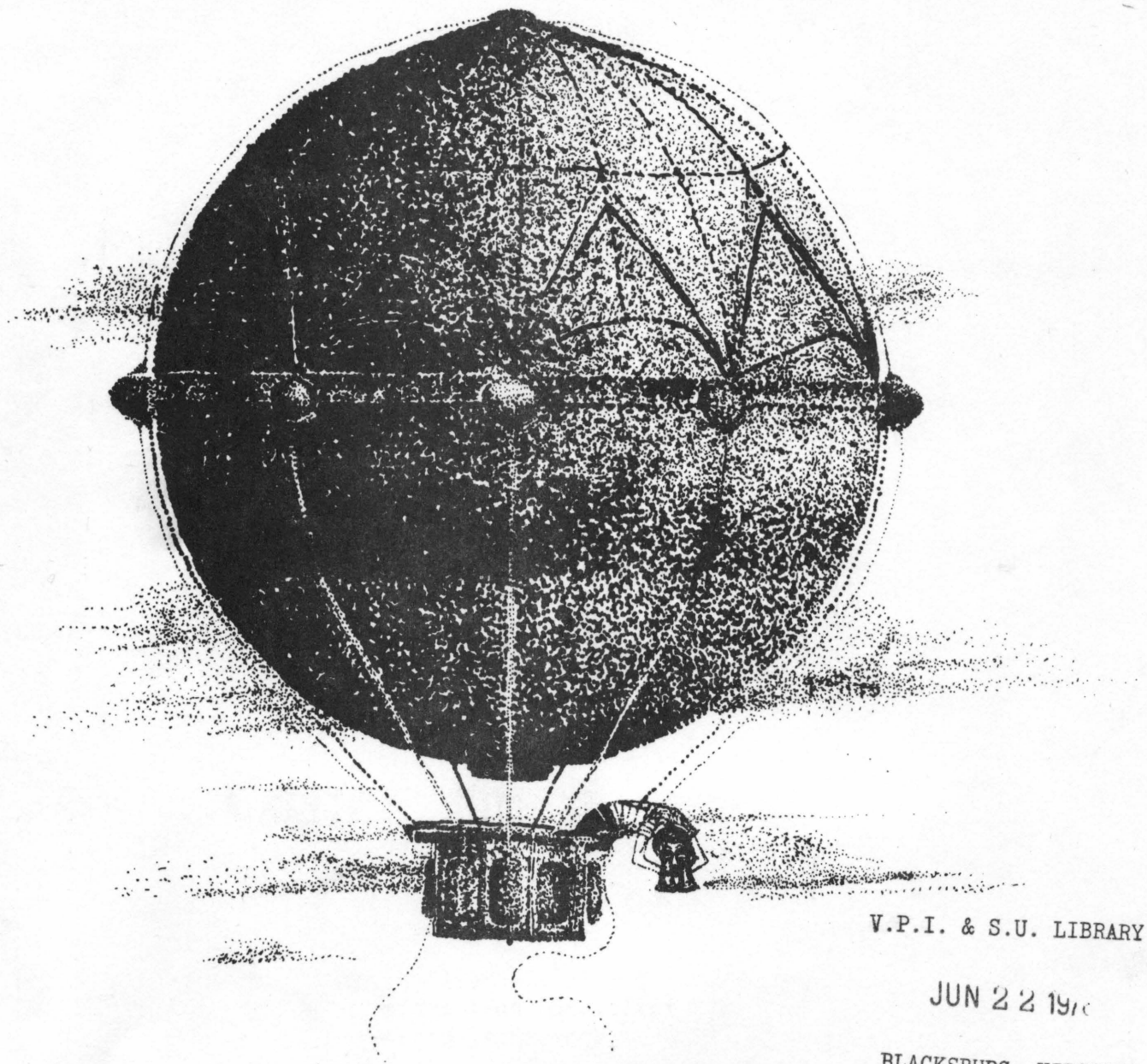

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LEADER'S MANUAL

4-H

FOOD INDUSTRY – DARE TO DISCOVER!

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FOOD INDUSTRY--DARE TO DISCOVER!

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To the Leaders:

The 4-H Project, "Food Industry--Dare to Discover!" is rather difficult to lead without the appropriate background and vocabulary. However this manual contains a wealth of information to help you provide necessary leadership to this project.

You, as a leader, need not be an expert in the field of food science & technology, because you will serve as a resource person to give directions to students as to the right place for information and assistance.

INTRODUCTION

The project "Food Industry--Dare to Discover" seems to offer unlimited opportunities for study and observation in an educational 4-H program for 4-H boys and girls at the senior level. It should be especially useful and fascinating for those in the early teens who want to learn about the world around them, especially about what's happening in the food processing industry.

Of course, there will be many questions to answer--young people are full of them. You can handle it.

Should any information or quick answers be desired, or required, they may be obtained by writing or calling one of the Extension Specialists in the Department of Food Science and Technology at VPI & SU.

Young workers may use this project to study the food industry from many different approaches. It will also be helpful for them in deciding whether or not the food industry offers good career opportunities. The food industry is a great industry, full of challenges and opportunities.

What is Food Science and Technology?

Food Science has been defined as the application of the physical, biological, and mathematical sciences to the understanding of the properties, preservation, and improvement of foods.

Food Science may be considered by some people to be a broad-term designation for the activities of those people who concern themselves with the scientific aspect of food processing. It is considered by some to be an "Allied Science" because it requires a knowledge, and use, of two or more of the following disciplines:

Chemistry - (Organic-Inorganic-Analytical-Physical)

Engineering - (Mechanical-Chemical-Sanitary-Industrial)

Biochemistry

Microbiology

Biology

Nutrition

Physics

Mathematics

Computer Science

Business Principles and Administration

There are numerous levels of responsibility within the industry and some descriptions may be of interest.

Food Technology may be defined as the application of Food Science to the production, processing, packaging, storage, distribution, and utilization of foods.

A Food Scientist performs at a highly technical level in food processing and usually holds advanced degrees from a College or University and may have spent years in research and development in areas of formulating, processing, and testing food products.

A Food Technologist usually has had formal training in one or more of the basic disciplines but has specialized in food processing. The food technologist may have acquired his status by long and devoted service to an industry and have earned his credentials at the laboratory bench rather than at the University.

Technicians may, or may not, have formal university training, but have acquired certain skills required for the job, or position, to which they are assigned. Usually they are working under the direction and supervision of a food scientist or food technologist.

Food Service involves preparing and serving meals. The term is used to cover the process of collecting, preparing, and serving foods for groups of people such as large cafeterias, hospitals, dining halls, military mess halls, and school lunch programs. The areas of study are related to cost accounting, nutrition levels, quantities, and efficiency of labor and equipment.

Q.C. is the abbreviation for Quality Control and includes proper testing, inspection, or analyses required to maintain a safe food product according to the specifications adopted by the manufacturer. The person(s) responsible for Q.C. programs must have considerable authority within the organization.

Q.A. is the abbreviation for Quality Assurance and it means much the same as Q.C. except it usually extends the specifications to cover overall quality of product from the beginning of the process and throughout the operation to the consumer; whereas, some Q.C. programs generally are designed to make sure the product meets certain specifications at the time it was packaged or shipped.

Historical Background of Food

This is an interesting subject because once man decided to remain in one area it was essential that he find a way to preserve food for the off-season or find some new foods which were available during those periods.

While it is not always easy to locate the references, there are numerous articles printed on food items of "bygone years." How our ancestors collected, preserved, and stored food before the advent of canning, refrigeration, and freezing is interesting.

Here in America there are some real stories of interest.

The first cows on the continent arrived at the Jamestown, Virginia, colony in 1611. The hand-cranked ice cream freezer is reported to have been invented by a woman, Nancy Johnson, in 1846. She failed to patent the invention and a similar type of freezer was patented by Mr. Young on May 30, 1848.

While the history of ice cream indicates that water ices (sweetened fruit drinks) were served during the reign of Alexander the Great, the first wholesale ice cream operation in the United States was started by Jacob Fussel in Baltimore, Maryland, in 1851. The business was so successful he opened plants in Washington, D. C. (1856), Boston, Massachusetts (1862), and New York City (1864).

In 1856 Gail Borden received the first patent on condensed milk.

In 1884 Dr. H. D. Thatcher invented the milk bottle. The plastic coated paper milk container was introduced in 1948 and the plastic container followed in 1964.

Our early settlers brought the art of cheese-making with them and utilized this method to conserve the valuable nutrients to provide food for off-season and extended trips west.

Some brought the art of sausage making and applied it to the meats available in this country.

Country cured and preserved hams are examples of a product which dates back to the early history of our country. Today the process is somewhat commercialized but varies only a little from the original.

The art of drying meats, fish, and fruits was practiced and played an important role in the conquest of the West.

The American Indian had practiced similar techniques in preparation of meat and fish to ward off starvation during long winters.

Conservation - Preservation of Food

Most foods are highly perishable and do not exist long in the fresh state. Man has wrestled with this problem from his beginning and has developed several processes to extend the useful life of many food items.

Foods are treated or processed to preserve perishable products to provide safe, wholesome, nutritious foods for future consumption.

Most agricultural food crops reach maturity about the same time each year in any given region. Therefore it is necessary to process large quantities in relatively short periods.

Some products can be protected or conserved by proper refrigeration for limited periods. This will extend the period of normal processing. Some of these same foods can be sent to the marketplace under refrigeration and sold as "fresh" items.

Some products such as the cereal grains, beans, peas, can be stored in the dry state until time to further process to final food products like breakfast cereals, flours, pork & beans, etc.

While there may be only three basic methods of preserving food (physical - addition or removal of heat) chemical (addition - salt, sugar, or other additives) and biological (fermentation), we think of them in different terms. There are at least 10 ways to extend the useful life of food products. A brief mention of several might be of interest.

1. Refrigeration simply means "cooling," but not freezing. Examples of foods that are normally refrigerated at some stage prior to consumption include: milk, meat, fruits, and vegetables and some prepared items, like bakery goods.

2. Freezing protects foods for a longer time than does refrigeration; many foods will keep frozen up to one year or even longer. Most foods freeze a few degrees below 32°F. but will keep better at temperatures near zero Fahrenheit.
3. Canning goes back to Appert at the time of Napoleon. It means the heat processing of foods in hermetically sealed containers such as cans, jars, bottles, and pouches.
4. Drying is the oldest method of preserving foods known to man; probably 5,000 - 10,000 years.

   Sun or Atmospheric drying is nature's way. Examples of products dried in this manner are fruits, vegetables, meats, and fish. Dehydrating is reserved for the artificial heat processes.

   Heat induced drying is relatively modern from a historical viewpoint dating back to the middle 1800's. Examples of products include milk, soup bases, juices, etc.

   Freeze drying is the youngest of technological advances in drying of foods. In simple terms, freeze drying is defined as "sublimation." The frozen food is subjected to a vacuum which causes the frozen moisture to vaporize from the solid to the gaseous stage and thus be removed from the food.
5. Salting is a very old method going back 5,000 years or more. Meats and fish are among the most common foods preserved by salting.
6. Sugar solutions are shelf stable and will keep a long time if at proper concentration. Low available water content is the key to the stability of sugar solutions.

7. Fermentation is an old, traditional method of preserving food such as cabbage to sauerkraut, milk to yogurt or buttermilk, and pork to summer sausage. Microorganisms are responsible for fermentation in the natural process. Cultures are sometimes added to obtain the desired results. They produce certain acids to lower the pH and raise the acid level. Fermented foods can keep for long periods of time without refrigeration.
8. Pickling is similar to the fermenting method. Pickled herring is a good example. A salt solution with vinegar is necessary to start the pickling process, e.g., homemade pickles. Both the salt and acid from the vinegar give a preservative effect.
9. Smoking is a preservative technique in the historical sense; it was used by the American Indians in smoking fish and some meats. Smoke itself has several antimicrobial agents. However, we use smoke today more for flavor and color effects.
10. Concentrating is a method of reducing the moisture level below that level required for active microbial growth. Fruit, vegetable juices, and purees can be concentrated to lower the moisture content.

Many foods are preserved by reducing the water activity. Spoilage microorganisms cannot grow if the moisture content is too low. Products like dried fruit, dry-cured pork, syrups, and jellies have low water activity. Molds and yeasts have a limited tolerance to reduced water activity. Therefore, any process to lower water activity leads to preservation of food products. Microorganisms have four requirements for growth and reproduction: (1) favorable temperatures, (2) favorable moisture level, (3) favorable food source, and (4) favorable medium (pH).

Industry Vocabulary

Each industry, each profession, has its own vocabulary and it is necessary to understand the terms and expressions used.

Many foods are standardized by law and their composition will be fairly constant from one manufacturer to the next - processed cheese - cheese food, etc.

Some foods have counterparts in the "imitation" or synthetic class. For example, "Mellorine" is the class name applied to products made to resemble ice cream but which contain fats other than butter fat. "Coffee Whiteners" are products made to imitate light cream or half & half when used in coffee.

Gum to many people is chewing gum; however, to the food technologist, gum may be any one of several substances used to increase viscosity, reduce ice crystal formation (ice cream),contribute to body (gum tragacanth in salad dressing),improve mouth feel (gum arabic in soft drinks). The gums are a class of colloidal substances derived from some plants and certain sea weeds (alginates and carrageenan). Recently some products like Xanthan Gum are being prepared by a process employing fermentation of a suitable substrate with a pure culture of XANTHOMONAS campestris.

Emulsifiers in the food industry are edible products which tend to improve the stability of oil-in-water emulsions such as mono-and di-glycerides in some fluid salad dressings or in frozen desserts. Emulsifiers may also be used to stabilize water-in-oil emulsions as in margarine.

Sweetening agents may be nutritive, e.g., sucrose (sugar), corn syrup, honey; or they may be non-nutritive, such as saccharin, aspartame, or the cyclamates.

There are many sugars in nature and some are sweeter than others on the basis of the weight used. Sucrose is cane, or beet sugar, and is considered the standard

with a sweetness factor of 100. Lactose is milk sugar and has a sweetening factor of 16. Fructose is a much sweeter compound and has a factor of 130.

Normally, when we refer to sugar we are indicating sucrose. Other sugars must be further identified.

Antioxidants are a class of products added to other products to prevent, or retard oxidation; a type of spoilage usually related to fats and oils. Citric acid and ascorbic acid act as an antioxidant when used to prevent the browning of fresh apple slices.

G.R.A.S. - the term applies to a group of food additives GENERALLY RECOGNIZED AS SAFE by sanction of prior use.

There are many items which have been used for years and there is no indication they present a hazard to health of the consumers. Most condiments fall in this category.

Food Additives

It is imperative this term be fully understood if one is to have a true picture of the situation.

Unfortunately, the term food additive is an all-inclusive term and has been intermingled with less appealing designations such as "chemicals," "synthetics," and "preservatives."

Some of the activist groups have rallied around "words" to make a point and many people have lost confidence in the food processing industry.

Frankly, there are few foods we would want to eat without an additive of some kind. Actually, salt, sugar, vinegar, and the spices are food additives.

The propionates are classified as chemicals but they are also mold inhibitors. The proper addition of sodium propionate to baked goods extends the shelf life of the products to permit distribution through stores over a wide area. Propionates are natural products of fermentation and can be metabolized by the body as a food.

BHA (Butylated hydroxyanisole) and BHT (Butylated hydroxytoluene) are also safe chemical compounds and they act as antioxidants in edible fats to retard oxidation and development of rancid flavors in shortening and cooking oils. Here again is a product which extends the useful shelf life of a food product and helps keep costs at reasonable levels. They prevent the natural formation of organic peroxides during oxidation.

Color compounds are additives--some are natural products--some are synthetics --both are chemical compounds. They are used to make a food product have a desirable eye appeal. These additives are not to be used to deceive the consumer. That is the intent of the Food, Drug, and Cosmetic Act or U.S. food laws. Most

butter is colored during the winter months to standardize the color to the level normally present in the springtime when milkfat has the most yellow color. Nearly all margarine products are colored in recent years.

Flavoring materials may be either natural or synthetic, but both are chemical compounds. We must become accustomed to the use of added flavor which is labeled "artificial" because there is not enough natural product to do the job. For example, there are not enough strawberries grown to supply the world with fresh fruit and still supply the ice cream, candy, bakery, and other industries with natural flavors.

Food additives are generally safe and serve a useful purpose. Some people may not agree on the necessity, or advisability, of their use but most are not ready to accept the consequences if all are banned.

Enzyme Activity is Important

Practically all natural foods contain enzyme systems which are protein in nature. These enzymes are complex compounds found both in the plant and animal kingdoms, and exert their influence by forcing a reaction to proceed quickly to the desired endpoint, thus eliminating side reactions.

Enzymes play their roles in many ways and are active in developing the texture, tenderness, and other fine qualities, we expect in foods. While enzymes are essential in the growth and development of both plant and animal food items, they are also part of the "self destruct" system built into nature. When plants reach maturity, the process seems to reverse and deterioration starts; likewise, animal tissues start to deteriorate at death.

The enzymes can be destroyed, or inactivated, by heat; thus, it is necessary to pasteurize some products or blanch others before freezing or prolonged refrigeration.

Enzyme activity is also inhibited by reducing temperatures below their optimum range of performance.

Microorganisms can be regarded as miniature bags of enzymes, some of which break down various products so they can be utilized as food by the microorganisms.

The enzyme, diastase, will hydrolyze, or split, starch into its component parts, down to glucose which is the basic unit--a sugar. This is one of the processes employed to make sweeteners from corn products. The glucose may be used by certain microorganisms to produce alcohol.

Another example of enzyme is that of rennin--the enzyme found in the calf's stomach--which is used to coagulate (form a gel-like mass) milk protein in cheese manufacturing. Many are familiar with the JUNKET brand, rennet tablets in making

milk puddings and homemade ice cream recipes. This active ingredient in JUNKET is rennin.

Another example of enzyme activity with which many are familiar is that of lipase on milk fat to yield the rancid flavor. The lipase enzyme attacks the fats to break them down to basic units of fatty acid and some of these are characterized by strong flavors and aromas.

A shellfish removed from its natural habitat will soon die and almost immediately the enzymes start to work, and by a process known as "autolysis" will practically liquify the soft parts and soon only the hard shell remains.

Plant Tours

An organized tour of a food processing plant, bakery, dairy, etc., is an ideal way to learn about the operation from beginning to end. The purpose of the tour should be fully explained to the company contact prior to the trip. In this manner, the designated tour guide will have cleared with the necessary authorities and will be able to provide most of the information desired.

Check list of items to consider in tour request.

1. Contact manager (owner) for permission.
2. Determine size of group that can be accommodated in the tour.
3. Will group be allowed to walk through actual processing areas when in operation?
4. Will special clothes, or other protective gear be necessary? Will it be supplied?
5. Will the plant be in operation at time of visit?
6. Request a tour guide who knows the operation and purpose of the visit.
7. Agree upon the time required for tour.
8. Do not be late.
9. Do not overstay allotted time.
10. If it is too noisy or congested in processing areas determine whether or not they have movies of operation and a room to discuss process and answer questions before and after tour.
11. Before the tour it is desirable to discuss the tour and advise the group what to expect. It will save time and improve results. It is essential for safety.
12. Provide note pads so that the proper notes may be taken for reports and questions. Do not plan to carry large notebooks and other items while on tour.

13. If conference is held after tour, this is a good time to discuss the steps in operation and make initial preparations for flow diagram.
14. If products are to be sampled, be sure the group understands rules of cleanliness and good housekeeping in plant, conference room, and grounds.
15. Leader should express appreciation to company representative.
16. Designate some member of group to write a note of thanks to the manager and mention guide by name.

NOTE: Plant tours are an expense for the company involved. Some managers consider them a nuisance. Some managers may tell you tours cannot be arranged because of rules on safety, health, or insurance; sometimes this may be the case. However, it is often an excuse. Remember, you are the leaders of the group and they are the consumers and the leaders of tomorrow. Be a good salesman and win the point.

Flow Diagrams or Charts

This is usually a diagram in pictorial and/or chart form to depict the flow or route, of product through a processing operation. A very simple diagram may be shown as follows:

Cow ⟶ Milk ⟶ Can ⟶ Creamery ⟶ Bottle ⟶ Home

It could be expanded by including information on milking operations, transportation, testing, pasteurization, packaging, storage (refrigerated), and any other operation employed.

The operation can be identified by picture, or name, or other forms of art.

A flow diagram for wheat from the field to the table might be by different routes after it is received at the elevator, or mill. It could go the flour route, the cereal route, and wheat germ for natural food, etc.

A similar diagram for corn might show canned corn, corn meal, corn oil, cornstarch, dextrins, corn sweeteners, and corn syrup solids on to alcohol production. A check of food labels will help determine how such products are employed in formulating and processing food.

The identification of the steps and the processes involved offer an opportunity to learn more about the industry and to expand on one's power to use the printed word to "paint a picture."

Displays

In some cases a display can be used to show the operation. A good display will follow along with the flow diagram.

For perishable foods it will be necessary to use pictures or art work for intermediate steps; however, this is ideal because it offers opportunities to gain experience in other areas.

A good display might include a number of other products used in preparation such as the seasonings used in sausage, or the fact that applesauce is good with pork or that soy products may be used to extend hamburger, etc. Where such information is available, sample or typical formulations may be provided. A copy of government regulations will add to the dimensions.

Some Thoughts

The story of molasses as made in this country is most interesting especially when we consider the "bee" which was so much fun.

There is a good story in the production of sauerkraut and how this fermentation process preserved food for future use.

What is saleratus, sal soda, porridge, gruel, pemmican, jerky, blancmange, mush, or citron, souse, head cheese, white meat, salt pork, kefir, koumiss, leben, yogurt?