UNIT I - PRINCIPLES OF FOOD PRESERVATION

Lesson 1: Introduction to Food Preservation

Objective

The student will be able to describe factors related to food preservation.

I. Study Questions

A. Why are foods preserved?

B. Why is food preservation important?

C. What techniques can be used to preserve food?

D. What are the causes of food deterioration?

E. How does time and the type of storage affect food quality?

II. References

A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit I.

B. Transparency Master

TM 1.1: Approximate Storage Life of Frozen Foods

C. Activity Sheets

1. AS 1.1: Effects of Packaging Material in Maintaining Meat Quality
2. AS 1.2: Effects of Light on Food Flavor

UNIT I - PRINCIPLES OF FOOD PRESERVATION

Lesson 1: Introduction to Food Preservation

TEACHING PROCEDURES

A. Introduction

Give an overview of this unit and a sample of the activities.

B. Motivation

1. Ask students to explain what they think the saying "You're not worth your salt" means. Salt has always been a very valuable commodity: used as a flavoring agent and as a preservative. Since it was so valuable, it was a source of payment for hired labor. If Jack Worker was lazy or inefficient, thus overpaid, he may have been called a worker not worth his salt.

2. Ask students if they know where the term "Uncle Sam" originated. The term "Uncle Sam" originated during the War of 1812. Pork was shipped in barrels that were stamped with the letters "U.S." and "Sam Wilson," the name of the meat packer. Soldiers referred to the meat as Uncle Sam's meat.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss with students why there is a science of food. Emphasize how food science and technology cover all phases of food production from production/handling to processing/preserving, packaging, distribution, marketing, and consumption. In the United States, an adequate food supply exists because of suitable natural resources, a favorable and diverse climate, educated producers/processors, and the application of science and technology. However, food is a perishable commodity and must be preserved.

Why are foods preserved?

a. To ensure an abundant and diverse food supply throughout the year
b. To prevent microbial growth
c. To maintain the taste and texture of food

d. To provide food products in a more convenient form

2. Discuss the historical significance of food preservation and how it will be useful in the future. Food has always been a basic necessity for life. From the beginning of time, humans have fished, gathered, hunted, cultivated the soil, and raised animals for food. An adequate food supply, or lack of one, has contributed to the rise and fall of many nations. Even today, starvation and malnutrition are major problems in many countries. How will your future be affected by an adequate food supply? What preservation techniques may be expanded or developed in the future?

Why is food preservation important?

a. Food preservation is necessary for life unless fresh food is gathered on a daily basis.
b. Historically
    1. Early civilizations developed in areas where food was plentiful.
    2. Before "sun-drying", fruits and vegetables were eaten seasonally.
    3. Before salt curing, meat was preserved only for a minimal length of time.
    4. Napoleon was successful largely because he provided a healthy diet for his soldiers. He suffered his greatest defeat when it became difficult to feed his troops.
    5. Early Asians preserved food with spices and sugar.
    6. American pioneers depended on salted, pickled and smoked meat and fish and dried beans.
        a. Meat was processed/preserved in winter months.
        b. Sausages were cooked and covered with melted lard.
        c. Milk, eggs, and butter were kept in springhouses.
        d. Fruits and vegetables were preserved in root cellars, by burying, or by drying.
    7. The railroads in the 1830's and the refrigeration car in the 1880's brought considerable changes.
c. Future
    1. World population continues to grow while productive acreage declines. Longer preservation techniques are needed.
    2. Convenience may dictate processing, so preservation technology will need to keep current.
    3. Energy expense of irradiation, refrigeration, and freezing may be reduced by new technology.
    4. Medical use of some types of chemotherapy alters the immune system, which requires that meals be sterilized by irradiation.

3. Discuss techniques that can be used to preserve food by controlling microbes and enzymes. Have students work in groups to begin complete AS 1.1. On day 30, the activity will be completed.

   What techniques can be used to preserve food?

   a. Heat
      1. Pasteurization
      2. Sterilization
   b. Cold
      1. Refrigeration
      2. Freezing
   c. Drying
      1. Dehydration
      2. Freeze-drying
   d. Irradiation
   e. Packaging
      1. Vacuum
      2. Modified atmosphere/controlled atmosphere
   f. Additives
      1. Salt
      2. Smoke
      3. Sugar
      4. Spices
      5. Others
      6. Acid
   g. Fermentation - 'natural' additives
      1. Acid
      2. Alcohol

4. Discuss the causes of food deterioration. Food is subject to physical, chemical, and biological deterioration. In practical terms, food is actually undergoing deterioration from the time it is harvested or slaughtered. The critical question is: How slow or how rapid is this process? Have students complete AS 1.2.

   What are the causes of food deterioration?

   a. Microorganisms
   b. Natural food enzymes
   c. Pests
      1. Insects
      2. Rodents

3. Birds
4. Parasites

d. Other factors
   1. Temperature abuse (warm and cold)
   2. Light
   3. Moisture
   4. Oxygen

5. Discuss how the time and type of storage affect food quality. At best, the quality of fruits, vegetables, nuts, meat, grain, dairy products, and eggs is only maintained (not improved) in storage. In most cases, the quality actually suffers. There are several critical factors that determine time of storage. Use TM 1.1.

   How does time and the type of storage affect food quality?

   a. Quality of raw food product
   b. Food handling immediately after harvest - Was it cleaned and chilled rapidly? In the case of fruits and vegetables, were refrigeration units placed in the fields or was the produce transported to the units at a later time? Sweet corn will metabolize its own sugar following harvest. If cooled to 32°F, only 10 percent of its sugars will be converted to starch in one day. At 68°F, 25 percent may be converted in the same time period. Portable hydrocoolers can jet spray freshly picked fruits and vegetables with cold water that may contain a germicide to inactivate surface microbes. The products would then be placed in a refrigeration unit. The use of cold N_2 will facilitate evaporative cooling. Animal carcasses must be lowered to an internal temperature of 36°F within 24 hours of slaughter.
   c. Relative humidity - A critical factor in long-term food storage is air moisture, or relative humidity (RH) during storage and handling.
      1. Most microorganisms thrive in moist environments. Thus, to inhibit their growth and multiplication, RH levels must be controlled.
      2. Environments that are too dry will dehydrate the product unintentionally and lower its quality.
         a. Beef stored at less than 90 percent RH dries out. If RH is between 90-98 percent, the beef will mold. At higher levels bacteria cause spoilage.
         b. Cheeses are wrapped in film or coated to inhibit mold growth.
      3. Meat tissue may be covered with a film of plastic to decrease moisture loss.

4. Eggs may be coated with a thin film of mineral oil to maintain moisture level.

d. Storage temperature - Refrigeration, or cool storage, refers to temperatures in the range of 30°-61°F. Freezing refers to temperatures below 30°F.
   1. Pure water freezes at 32°F, while most foods will not begin to freeze until 30°F is achieved.
   2. Refrigeration may preserve food for days or weeks.
   3. Freezing can preserve food for months or years.
   4. Neither freezing nor refrigeration completely destroys all microbes. Once food is thawed, rapid multiplication is possible.
   5. Refrigeration is one of the gentlest methods of food storage in terms of maintaining taste, nutritional value, and texture.
   6. Refrigeration accelerates the staling of breads.

e. Additional processing - For long-term storage of food, heat, dehydration, irradiation, fermentation, or complete freezing is necessary.

F. Other activities

1. Salt/sugar cure a ham. See MU Agricultural Guide #2526, "Country Curing Hams." It is included as Appendix A.

2. Assign students to visit local grocery stores and report the type of light used in meat, fruit, vegetables, dairy, and egg counters. Determine which food products are packaged in transparent, translucent, and opaque containers. Investigate what temperature the grocery store maintains and if the relative humidity reading is monitored.

G. Conclusion

Foods are preserved for human safety, quality enhancement, convenience, and to provide a constant supply. Food preservation was important in the past, is important today, and will be important in the future. There are many techniques used to preserve food that control microbes and enzymatic activity. Without these techniques, physical, chemical, and biological deterioration are possible. Food quality is also influenced by the time and type of storage.

H. Competency

1. Describe factors related to food preservation.

2. Related Missouri Core Competencies and Key Skills:

9D-6: Identify the control, the dependent, and the independent variables in an experiment.

9D-5: Describe the relationship between technologies which improve our lives and the environmental problems that can result from them.

I. Answers to Evaluation

1. b
2. d
3. c
4. c
5. a
6. d

7. To insure an abundant, safe, diverse food supply. To enhance its taste and texture and for convenience.

8. Early American colonists would slaughter animals in the cold months. Their meat would be salted, pickled, or smoked. Sausage was cooked and covered with lard. Fruits and vegetables were dried, buried, or stored in root cellars. Fresh milk, butter, and eggs were kept cool in springhouses.

9. Heat denatures proteins, breaks emulsions, dries food and can destroy vitamins. Enzymatic and non-enzymatic reactions increase as heat is increased.

10. Too much moisture can cause lumping, crystallization, and stickiness. Too little moisture can cause dehydration and staleness.

11. Bacteria, mold, yeast.

12. Except for certain fruits and vegetables, the sooner a food product is cooled to 32°-40°F, the longer it can be stored. The conversion of sugars to starch is reduced by cooling.

13. Because microorganisms require moisture for survival, relative humidity levels are critical to food storage. Careful control of RH is vital. Too high = spoilage; too low = dehydration.

J. Answer to Activity Sheets

AS 1.1

1. They make a difference in food quality.
2. Class discretion
3. Light barrier; O_2 barrier
4. Class discretion
5. Tissue darkens and stiffens
6. Proper sealing and taping
7. Use packaging that is opaque and seals against O_2.

AS 1.2

1. Class discretion
2. Class discretion
3. Opaque containers reduces oxidation and rancidity.
4. Oxidation and rancidity
5. Class discretion; may include sealed bags, sealed tubes, foil bags
6. Class discretion
7. Class discretion

UNIT I - PRINCIPLES OF FOOD PRESERVATION Name _____

Lesson 1:Introduction to Food Preservation Date _____

EVALUATION

Circle the letter that corresponds to the best answer.

1. The removal of moisture in a food product is called:

   a. Freezing.
   b. Dehydrating.
   c. Irradiating.
   d. Sterilizing.

2. Removing all the oxygen from a food package is called:

   a. Sterilizing.
   b. Freeze drying.
   c. Heating.
   d. Vacuum packaging.

3. Sterilizing is applying a temperature of _____ and maintaining it for _____ minutes.

   a. 100°F, 15
   b. 180°F, 5
   c. 240°F, 15
   d. 420°F, 30

4. What are two preservation techniques that create a high osmotic pressure?

   a. Sweetening and sterilizing
   b. Salting and vacuum packaging
   c. Sweetening and salting
   d. Salting and fermenting

5. In fermentation, bacteria convert carbohydrates into:

    a. Acids and alcohol
    b. Sugars and acids
    c. Alcohol and salts
    d. Sugars and salts

6. What additives are used to preserve foods?

    a. Salt, flavorings, and oils
    b. Flavor enhancers and sugar
    c. Food coloring, sugar and flavorings
    d. Salt, spices, and sugar

Complete the following short answer questions.

7. Why is food preserved?

8. Describe the food preservation techniques used by early American colonists.

9. Describe how an increase in heat affects food preservation.

10. Compare and contrast too much moisture and too little moisture on food preservation.

11. Name three general types of microorganisms.

12. Why is refrigeration useful in food storage?

13. How does relative humidity affect food storage?

TM 1.1

Approximate Storage Life of Frozen Foods

Approximate Storage Life (in months unless indicated otherwise)

	-18°C (0°F)	-12°C (10°F)	-6.7°C (20°F)
Orange juice (heated)	27	10	4
Peaches	12	<2	6 days
Strawberries	12	2.4	10 days
Cauliflower	12	2.4	10 days
Green beans	11-12	3	1
Peas	11-12	3	1
Spinach	6-7	3	21 days
Chicken (raw)	27	15 1/2	<8
Fried chicken	<3	<1	18 days
Turkey pies	>30	9 1/2	2 1/2
Beef (raw)	13-14	5	<2
Pork (raw)	10	<4	<1 1/2
Lean fish (raw)	3	<2 1/2	<1 1/2
Fat fish (raw)	2	1 1/2	24 days

Courtesy U.S. Department of Agriculture

UNIT I - PRINCIPLES OF FOOD PRESERVATION AS 1.1

Lesson 1:Introduction to Food Preservation Name _____

Effects of Packaging Material in Maintaining Meat Quality

Objective: To examine the effects of packaging a food with a variety of common packaging materials.

Activity Length: Day 1 - 20 minutes
Day 30 - 30 minutes

Materials and Equipment:

Beef sirloin - 1/4 lb per group of students
Freezer space for about 30 days
Plastic wrap used to package beef in the store
Freezer foil
Freezer paper
Plastic freezer bags
Pyrex bowl (covered)
Plastic or freezer plate (to be used for the "no wrap" meat)
Microscope

Procedure:

1. Cut the beef into 6 equal pieces.

2. Wrap each piece of beef with one of the packaging materials. Label each piece of beef with the group's name and the kind of packaging and place it in the freezer.

    a. Plastic wrap used to package beef at store
    b. Freezer foil
    c. Freezer paper
    d. Plastic freezer bag
    e. Pyrex bowl (covered)
    f. No wrap" on plastic or freezer plate

3. Store the meat for 30 days and then thaw it.

4. Observe the meat as it thaws. Observe it under a microscope. The meat can be thawed in a microwave, except when foil is used.

5. Compare each of the pieces for general appearance: color, odor, the amount of drip (free water and juice coming from the meat), freezer burn, frost, and freshness. Evaluate each piece of beef on a scale of 1-5 with 5 being excellent and 1 being unacceptable. Record your answers on Table 1.1.

6. Evaluate the packaging methods between each of the groups.

Table 1.1

	Color	Odor	Amount of drip	Freezer burn	Frost	Freshness
Plastic wrap						
Freezer foil						
Freezer paper						
Plastic freezer bags						
Pyrex bowl						
No wrap						

(Rating Scale: 1 = unacceptable, 5 = excellent)

Key Questions:

1. What did you discover about packaging materials?

2. Which packaging materials are acceptable for freezing meat?

3. What qualities of the packaging materials allow them to preserve beef meat at an acceptable level?

4. What material would you <u>not</u> use to package beef in for freezer storage?

5. What does freezer burn look like?

6. What additional steps should you use to prepare beef to be frozen?

7. Based on your discoveries, what recommendations would you make for packing beef into freezer containers?

Adapted from: Frick, Marty. *Food Science, Safety and Nutrition*. The National Council for Agricultural Education, 1993.

UNIT I - PRINCIPLES OF FOOD PRESERVATION AS 1.2

Lesson 1:Introduction to Food Preservation Name _____

Effects of Light on Food Flavor

Objective: To observe and sample the effect light has on the flavor of corn chips stored in different ways for various periods of time.

Activity Length: 30 minutes to set up, 10 minutes each on days 3, 5, 7, and 9

Background Information:

Food is placed in packaging for a variety of reasons. This experiment will help you understand the effect light has on food quality. The packaging selected by the processor is determined by the protecting quality (from microorganisms), its ability to protect the food from damage, and its ability to preserve or maintain the food over time. As you are probably aware, fat oxidizes and becomes rancid (spoiled), causing undesirable flavors and odors. These flavors can develop in high fat foods, such as peanut butter, corn chips, or nuts. The method by which these foods are packaged can influence whether they become rancid or not. Light and oxygen can accelerate the process.

Materials and Equipment:

3 clear plastic jars and lids per group
aluminum foil
1-2 bags corn chips
graph paper
jar labels (masking tape)

Procedure:

1. Obtain three clear glass or plastic jars with lids (for each student or group of students). Label jars 1, 2, and 3. Wrap jar #1 with a light preventing layer (aluminum foil or construction paper). Place this protecting layer so that no light enters the jar.

2. Place equal amounts of corn chips (about 1/3 cup) in each jar. Smell and taste one chip from each jar. Record your opinion on Day 1 of Table 1.1. Place the lids on the jars.

3. Label the jars with your name, the date, and class period. Place the jars in a location that will not get extreme heat. Place jar #1 (the control) near jars #2 and #3. Place jar #2 near a window in order that it will receive sunlight. Place jar #3 under a continuous light source.

4. Observe, smell and taste corn chips from the jars every other day for 10 days (5 total samples). Rate the flavor of the chips on the following five-point scale. Rate the flavor based on how the chips originally tasted.

5. Make a graph of the data you collect as a result of this experiment. Chart the data on the flavor of the corn chips versus the storage time, for all three samples. The flavor should be on the side of the graph (y-axis) and the days should be on the bottom (x-axis). Use a different color pen or marker to show taste ratings and order ratings.

Scale:

1 = The Worst
2 = Bad Flavor
3 = OK (no opinion)
4 = Good Flavor
5 = The Best

Chart

Day	Rating of chips protected from light		Rating of chips exposed to sunlight		Rating of chips exposed to continuous light	
	taste	odor	taste	odor	taste	odor
1						
3						
5						
7						
9						

Key Questions:

1. When did the flavor of the corn chips begin to deteriorate?

2. When did you first detect a difference in the odor of the food?

3. What effect did wrapping the jar have on the quality of the chips?

4. What type of reactions occurred with the chips that caused them to deteriorate?

5. List three types of containers that food processors use to retain the quality of chips?

6. Do you see corn chips or potato chips or other types of high fat products being marketed which do not follow these rules? Why?

7. What types of precautions could chip processors use in the design of packages to better maintain the product over time?

Adapted from: Frick, Marty. *Food Science, Safety and Nutrition*. The National Council for Agricultural Education, 1993 and Mehas, Kay; Sharon Rodgers. *Food Science and You*. Peoria, IL: Glencoe, Publishing, 1989.