

Curing Techniques

Unit: Culinary Science

Problem Area: Food Science

Lesson: Curing Techniques

- **Student Learning Objectives.** Instruction in this lesson should result in students achieving the following objectives:

- 1 Summarize smoking techniques.**
- 2 Summarize salting techniques.**
- 3 Summarize sugaring techniques.**

- **Resources.** The following resources may be useful in teaching this lesson:

E-unit(s) corresponding to this lesson plan. CAERT, Inc. <http://www.mycart.com>.

"Barbecue and Food Safety," *USDA: Food Safety Information*. Accessed Nov. 13, 2014. http://www.fsis.usda.gov/shared/PDF/Barbecue_Food_Safety.pdf?redirecthttp=true.

"Botulism," *Centers for Disease Control and Prevention (CDC)*. Accessed Nov. 13, 2014. <http://www.cdc.gov/nczved/divisions/dfbmd/diseases/botulism/#what>.

"Curing and Smoking Meats for Home Food Preservation," *The National Center for Home Food Preservation Guide and Literature Review Series: Smoking & Curing*. Accessed Nov. 13, 2014. http://nchfp.uga.edu/publications/nchfp/lit_rev/cure_smoke_cure.html.

"Fundamentals of Meat Curing," *Texas A&M University: Meat Science*. Accessed Nov. 13, 2014. <http://meat.tamu.edu/ansc-307-honors/meat-curing/>.

"Meat Curing Methods," *Morton Salt*. Accessed Nov. 13, 2014. <http://www.mortonsalt.com/for-your-home/culinary-salts/meat-curing-methods>.

"Resources for Home Preserving Venison," *National Center for Home Food Preservation*. Accessed Nov. 13, 2014. <http://nchfp.uga.edu/tips/fall/venison.html>.



“Simple Techniques for Production of Dried Meat,” *Food and Agriculture Organization of the United Nations*. Accessed Nov. 13, 2014. <http://www.fao.org/docrep/003/x6932e/x6932e02.htm>.

■ **Equipment, Tools, Supplies, and Facilities**

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

■ **Key Terms.** The following terms are presented in this lesson (shown in bold italics):

- brine
- brining
- corning
- curing
- methemoglobinemia
- osmosis
- smoking
- sodium nitrate (NaNO_3)

■ **Interest Approach.** Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Curing meat or fish is a process to flavor and preserve meat using smoke, salt, nitrite, or sugar. Do you eat bacon, hotdogs, lunchmeat, pepperoni, smoked salmon, or ham? If you enjoy these meats, you are eating cured foods. Many curing techniques are used with pork products because pork is a bland meat that improves in flavor with curing or by adding spice rubs.

Have you noticed the difference in color between a pork roast and a ham? Have you eaten a pork steak baked in the oven? Have you eaten a pork steak cooked on the grill? What is the difference in the color of each type of pork? Smoking, nitrates, or other curing techniques cause meat to have a pink or red color. Use VM-A to introduce the curing lesson by displaying a variety of salami products and homemade smoked sausage, ham, and bacon.

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Summarize smoking techniques.

Anticipated Problem: What is curing? What are smoking techniques?

I. Smoking techniques

A. **Curing** is a process of using salt and sodium nitrite alone or together with other flavorings or sugars to preserve food. **Smoking** is a dry-heat cooking method that uses exposure to smoke from burning or smoldering plant materials (often wood) to cook, to flavor, or to preserve food. Smoking injects a characteristic smoky flavor (e.g., the distinctive mesquite wood flavor).

1. Some woods used for smoking are:
 - a. Hickory
 - b. Mesquite
 - c. Apple tree wood
2. Corncobs are used in smoke curing.
3. A smokehouse was the typical place where meat and fish were preserved before refrigeration. This stand-alone building is part of America's history with every home and farm having a smokehouse. Today, electric kilns are used.

B. Types of smoking

1. Hot smoking is a method to conserve and/or preserve food. Burning woods or electric kilns are used to slow-cook food, usually with indirect heat: 150° to 160°F. This cooks the meat as it is smoked and shortens smoking time. As with any potentially hazardous food, hot smoked items are kept under refrigeration when the process is complete.
2. Cold smoking is drying meat with cooled smoke. Cold smoking simply eliminates moisture to inhibit the growth of bacteria. The process uses a technique that smothers woods (at a temperature of approximately 85°F) and takes 12 to 24 hours to smoke. Other than cold smoked salmon, many types of meat are salted or cured before they are cold smoked. Because this method allows the food to be in the temperature danger zone (40°F to 140°F), the FDA recommends cooking the meat to 160°F before eating.
3. Pit barbecuing is a dry-heat cooking method in which food is placed in a large, level hole in the earth. The pit is filled halfway with coals from wood that has burned down. Getting these coals ready may take up to 4 hours. Then cooking can take up to 12 hours, depending on the thickness of the meat. Meat thermometers are used to determine doneness—to ensure a safe internal temperature—as the exterior cooks at a different rate than the interior.

4. Liquid smoke is an additive that gives food a consistent smoky taste without using burning or smothering smoke.

Teaching Strategy: Many techniques can be used to help students master this objective. Use VM-B and VM-C to facilitate a discussion. Have students begin the egg osmosis experiment (Steps 1 through 3 and Step 4a) in LS-A.

Objective 2: Summarize salting techniques.

Anticipated Problem: What are salting techniques?

II. Salting techniques

A. Salting or dry curing

1. Salt is used to dehydrate the proteins in foods; this is a dry curing process. **Corning** is the process of dry salting a food. The name “corning” comes from the word “corns” or pellets of salt. Dry salting slows microbial growth by removing moisture from the meat by osmosis. **Osmosis** is the movement of a solvent (in this instance salt) through a semipermeable membrane to equalize the concentration. A semipermeable membrane is one that allows some, but not all, molecules to pass through.
2. Corning originated in Anglo-Saxon times when German tribes migrated to England beginning in the 5th century. Corned beef is an example of corning (dry salting) a beef brisket. Other meats may be corned.
3. When the dry salting process is complete, the meat is rinsed thoroughly to remove any excess salt crystals, especially if the meat is to be smoked. Excess salt crystals slow down the smoking process.

B. Brining or wet curing

1. **Brining** is wet curing or immersion curing; foods are submerged in brine. **Brine** is a salt solution at a typical ratio of one cup of salt to one gallon of water. Sugar or nitrite can be added to brine. The meat is completely immersed in the brine solution. The percentage of sodium in the brine and the thickness of the meat determine the amount of time the meat remains in the brine solution.
2. Brining uses osmosis to pull salt and moisture into the meat cells through the semipermeable membrane. Lean meat (e.g., turkey and pork loin) is often brined before cooking to increase the moisture.

C. Nitrate (NO_3) curing

1. **Sodium nitrate (NaNO_3)** is a white crystal-like soluble solid compound used as a curing salt for preserving bacon, ham, and cheeses. It often is added to salt-cured meats to provide a sufficient amount of salt. Sodium nitrate curing products are colored pink to distinguish them from sodium chloride (table salt). Nitrates provide the characteristic pink color in cured meat.

2. Nitrates (NO_3) prevent *Clostridium botulinum* from forming in meat. *Clostridium botulinum* is a rod-shaped bacterium that produces toxins (poisons) that can paralyze nerves and cause death. Currently, most cases of botulism in the United States are caused by improperly home-processed foods.
3. Nitrates and nitrites (NO_2)
 - a. Nitrates and nitrites by themselves are not carcinogenic (cancer-causing). Nitrates consumed by humans are converted into nitrites by digestion. Other reactions are dietary amines forming carcinogenic nitrosamines.
 - b. Nitrites are found naturally in vegetables, drinking water, and human saliva. Spinach contains 740 mg of nitrites per 100 g, and ham contains only 0.89 mg of nitrites per 100 g.
 - c. Nitrites may cause a life-threatening problem called methemoglobinemia for infants under the age of 6 months. According to the National Institutes of Health (NIH), **methemoglobinemia** is a “blood disorder in which an abnormal methemoglobin—a form of hemoglobin—is produced.” It causes oxygen-deficiency in the blood from excessive nitrites in drinking water. Opinions vary on nitrites causing cancer in humans. Studies show extremely high doses of nitrites are required to cause cancer in lab animals.
 - d. The use of nitrates as an additive is limited to 200 ppm or lower by the United States Department of Agriculture (USDA).

Teaching Strategy: Many techniques can be used to help students master this objective. Use VM–D through VM–G to facilitate a discussion. Have students work on Step 4b in LS–A. The following day, have students complete Step 5.

Objective 3: Summarize sugaring techniques.

Anticipated Problem: What are sugaring techniques?

III. Sugaring techniques

- A. Sugaring adds flavor to cured foods.
 1. Sugar can be sucrose (table sugar), syrup, or honey.
 2. Sugar eliminates the harshness of salt in cured meats.
 3. Sugar often is added to dry salting and to brines for cured meats.
- B. Sugar provides energy for nitrates (NO_3) to convert to nitrites (NO_2).
 1. Nitrites provide the characteristic red or pink meat pigment.
 2. Have students view an explanation of the equation showing how sodium nitrates convert to sodium nitrites at <http://meat.tamu.edu/anisc-307-honors/meat-curing/>.

Teaching Strategy: Many techniques can be used to help students master this objective. Have students complete the LS–A experiment. Then ask students to complete the osmosis conclusions and create and populate a data table.

- **Review/Summary.** Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. If a textbook is being used, questions at the ends of chapters may be included in the Review/Summary.
- **Application.** Use the included visual master(s) and lab sheet(s) to apply the information presented in the lesson.
- **Evaluation.** Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

■ **Answers to Sample Test:**

Part One: Matching

1. e
2. h
3. f
4. c
5. h
6. b
7. a
8. d

Part Two: True/False

1. T
2. F
3. F
4. T
5. F
6. T
7. F
8. T
9. T
10. T

Part Three: Short Answer

1. Answers will vary but should include three of the following smoking techniques to cure foods.
 - a. Hot smoking is a method to conserve and/or preserve food. Burning woods or electric kilns are used to slow-cook the food, usually with indirect heat: 150° to 160°F. This cooks the meat as it is smoked and shortens smoking time. As with any potentially hazardous food, hot smoked items are kept under refrigeration when the process is complete.
 - b. Cold smoking is drying meat with cooled smoke. Cold smoking simply eliminates moisture and inhibits the growth of bacteria. The process uses a technique that smothers woods (at a temperature of approximately 85°F) and takes 12 to 24 hours to smoke. Other than cold smoked salmon, many types of meat are salted or cured before they are cold smoked. Because this allows the food to be in the temperature danger zone (40°F to 140°F), the FDA recommends cooking the meat to 160°F before eating it.
 - c. Pit barbequing is a dry-heat cooking method in which food is placed in a large, level hole in the earth. The pit is filled halfway with coals from wood that has burned down. Getting these coals ready may take up to 4 hours. Then cooking can take up to 12 hours, depending on the thickness of the meat. Meat thermometers are used to determine doneness—to ensure a safe internal temperature—as the exterior cooks at a different rate than the interior.
 - d. Liquid smoke is an additive that gives food a consistent smoky taste without using burning or smothering smoke.
2. Nitrates (NO_3) prevent *Clostridium botulinum* from forming in meat. *Clostridium botulinum* is a rod-shaped bacterium that produces toxins (poisons) that can paralyze nerves and cause death. Currently, most cases of botulism in the United States are caused by improperly home-processed foods.
3. Nitrites are found naturally in vegetables, drinking water, and human saliva. For example, spinach contains 740 mg of nitrites per 100 g, and ham contains only 0.89 mg of nitrites per 100 g.

Curing Techniques

► Part One: Matching

Instructions: Match the term with the correct definition.

- | | |
|----------------------|---------------------------------------|
| a. brining | e. sodium nitrate (NaNO_3) |
| b. corning | f. brine |
| c. curing | g. osmosis |
| d. methemoglobinemia | h. smoking |

- _____ 1. A white crystal-like soluble solid compound used as a curing salt for preserving bacon, ham, and cheeses
- _____ 2. A dry-heat cooking method that uses exposure to smoke from burning or smoldering plant materials (often wood) to cook, to flavor, or to preserve food
- _____ 3. A salt solution at a typical ratio of one cup of salt to one gallon of water
- _____ 4. A process of using salt and sodium nitrite alone or together with other flavorings or sugars to preserve food
- _____ 5. The movement of a solvent through a semipermeable membrane to equalize the concentration
- _____ 6. The process of dry salting a food
- _____ 7. Wet curing or immersion curing
- _____ 8. A blood disorder in which an abnormal form of hemoglobin is produced

► Part Two: True/False

Instructions: Write *T* for true or *F* for false.

- _____ 1. Sugaring eliminates the harshness of salt in cured meats.
- _____ 2. Sugar provides energy for nitrites to convert to nitrates.
- _____ 3. The USDA does not limit the use of nitrate additives.



- _____ 4. Most cases of botulism in the United States are caused by improperly home-processed foods.
- _____ 5. Sodium nitrate curing products are yellow in color to distinguish them from sodium chloride (table salt).
- _____ 6. The percentage of sodium in the brine and the thickness of the meat determine the amount of time in the brine solution.
- _____ 7. Dry salting inhibits microbial growth by removing moisture from the meat by methemoglobinemia.
- _____ 8. A smokehouse was the typical place where meat and fish were preserved before refrigeration.
- _____ 9. Hickory, mesquite, and apple tree wood are used for smoking foods.
- _____ 10. Lean meat (e.g., turkey and pork loin) is often brined before cooking to increase the moisture in the meat.

► **Part Three: Short Answer**

Instructions: Answer the following.

- 1. List and describe three types of the smoking techniques to cure food.

- 2. Describe the Clostridium botulism bacteria shape and the associated food safety issues.

- 3. List three sources of nitrites other than cured meats.

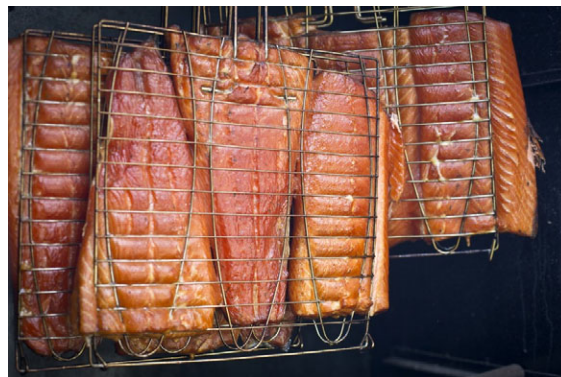
CURING TECHNIQUES

INTRODUCTION



Curing is a process of using salt and sodium nitrite alone or together with other flavorings or sugars to preserve food. How many of these cured meat varieties of salami, sausage, ham, and bacon can you name?

CURING TECHNIQUE—SMOKING



Smoking is a dry-heat cooking method that uses exposure to smoke from burning or smoldering plant materials (often wood) to cook, to flavor, or to preserve food. A typical English barrel-shaped smokehouse, a prosciutto ham, a variety of salamis, and smoked salmon are pictured here. Types of smoking include hot, cold, pit barbequing, and liquid smoke.

SOUTHERN-STYLE PIT BARBEQUE

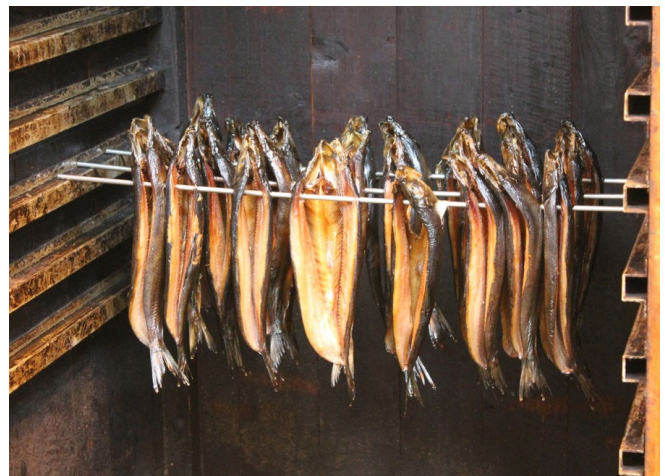


Pork is cured over hickory wood in this southern-style pit barbecue.



Baby back ribs, loin roast, and chicken are prepared on an offset smoker.

DRY CURING TECHNIQUE— SALTING



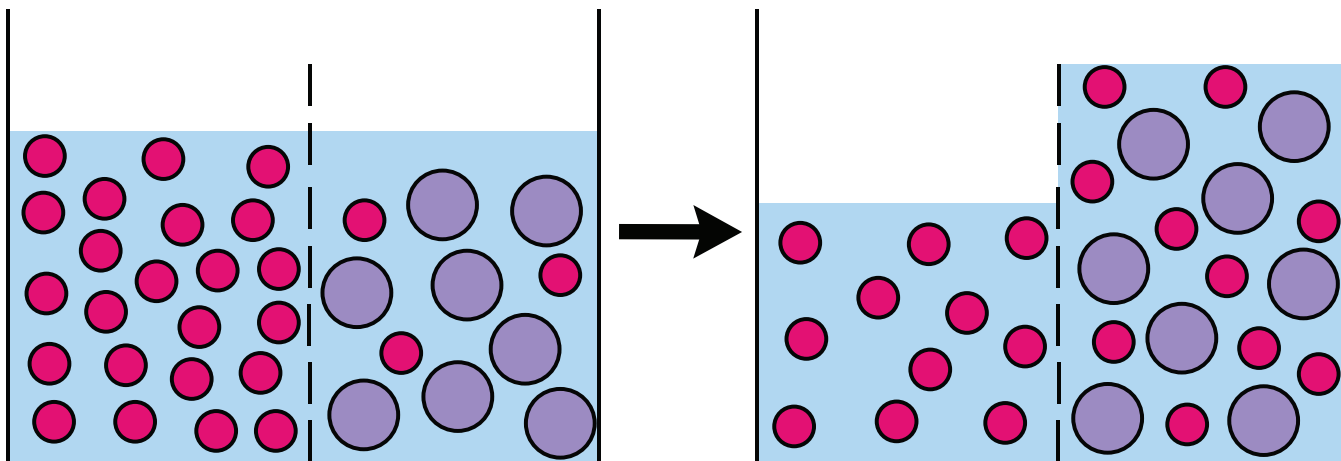
This beef jerky, cured bacon and ham, and kippers use the dry curing technique of salting. The kippers were dry cured before being smoked in this cabinet.

DRY CURING TECHNIQUE— CORNING



Corning is the process of dry salting a food. Dry salting slows microbial growth by removing moisture from the meat by osmosis. The raw beef brisket is “corned” with salts and spices and then is cooked and sliced.

OSMOSIS



Osmosis is the movement of a solvent through a semipermeable membrane—a membrane that allows some, but not all, molecules to pass through to equalize the concentration.

WET CURING TECHNIQUE— BRINING



Brining is wet curing or immersion curing; foods are submerged in brine. Lean meat (e.g., turkey and pork loin) often is brined before cooking to increase the moisture in the meat. These pictures are of an uncooked brined and seasoned turkey and a cooked brined and seasoned turkey.

The Science of Brining and Sugaring: What Is Osmosis?

Purpose

The purpose of this activity is to observe and document how osmosis works and to apply that knowledge to the process of curing meats.

Objectives

1. Read and rewrite experiment directions.
2. Follow and observe the steps in an egg osmosis experiment.
3. Compare and contrast the results of the mini-experiment and the variations of solutions in the egg osmosis experiment. Then relate them to cured meat techniques.
4. Create and populate a data table with experiment observations and measurements.

Materials

- ◆ computer
- ◆ printer
- ◆ cucumber
- ◆ vegetable peeler
- ◆ salt shaker
- ◆ raw eggs
- ◆ white vinegar
- ◆ glasses or beakers
- ◆ 100 ml graduated cylinder or $\frac{1}{2}$ cup measuring cup



- ◆ solutions (e.g., salt water, soda, or distilled water)
- ◆ grease pencils or masking tape
- ◆ metric or standard ruler
- ◆ paper and pencil or computer and printer (data table preparation)

Procedure

1. Day 1: Mini-Experiment and Egg Osmosis Experiment Preparation

- a. As a demonstration or in small groups, slice a cucumber very thin with a peeler, and place it on a plate. Sprinkle the cucumber with salt. Let stand 30 minutes or longer.
- b. During the standing time, read the experiment at <http://everydaylife.globalpost.com/egg-osmosis-experiments-distilled-water-salt-water-32546.html>. In your own words, analyze, simplify, and rewrite the experiment steps.
- c. Assemble the supplies and equipment needed to complete the experiment.

2. Observe the release of moisture from the semipermeable membranes of the cucumber. Look up the definition of a semipermeable membrane. Write a conclusion for the mini-experiment.

- a. Semipermeable membrane is:
- b. Mini-experiment conclusion:

3. Egg osmosis experiment preparation:

- a. Begin the **naked** egg process by placing at least six unbroken raw eggs per class into six separate clear drinking glasses or six beakers and covering with white vinegar.
- b. Let stand 24 hours. (The use of additional eggs allows for more solutions to be tested.)

4. Day 2: Naked Eggs

- a. Check eggs, replace vinegar, and let stand another 24 hours. Write a summary of the acid-base reaction discussed on the experiment Web site. Research acid-base reactions and include other reactions in your summary.

5. Day 3: Osmosis Experiment

- a. Hold the egg in your hand and gently run cold water over the remaining shell. Gently rub any remaining eggshell off.
 - b. Place the egg in a clean glass, and cover with 100 ml or $\frac{1}{2}$ cup of solution* described below in Step 7. Use a grease pencil or a small piece of masking tape to indicate the top line of the solution.
 - c. Initial observations discussed in the article can be used. However, the eggs are very delicate and are likely to break when handled in the manner described.
6. *Vary the solutions added to each egg. If the number of naked eggs is limited, be sure to do a water solution (a, b, c), the salt solution (d), and the corn syrup solution (f). Let naked eggs remain at least 24 hours in the solutions. Circle the solutions your group selects. Solution options:
- a. Distilled water
 - b. Tap water
 - c. Tap water with food coloring
 - d. 20% salt solution
 - e. Soda
 - f. Corn syrup
 - g. White vinegar
 - h. Pickle juice
 - i. Other solutions of your choice: _____

7. Day 4: Osmosis Conclusions

- a. Observe the initial solution line and compare it to the final (current) solution line. Observe the appearance of the naked egg.
- b. Make a data table—sample shown below—comparing the change in solution amount, solution description, and naked egg description. Add all the solutions used in the class into the data table.
- c. Write a conclusion for the experiment. After observing the effect of salt and sugar on the naked egg (high protein), discuss how salting and sugaring would affect cured meats (high protein).

Sample data table to record observations:

Osmosis Experiment

Name: _____

Name: _____

Name: _____

Solution Type	Initial Height of Solution	Final Height of Solution	Initial Appearance of Naked Egg	Final Appearance of Naked Egg
20% salt solution				
Corn syrup				
Water				

The Science of Brining and Sugaring: What Is Osmosis?

1. This experiment takes up to four days to complete. Discussions about cured meats could be included on days of the experiment by dividing the class period into discussion and lab work segments. This experiment is an excellent way for students to understand osmosis and how it works in our body as well as in curing meats. [The lesson plan describes a procedure to provide short bits of information and then a portion of the lab experiment. See the Teaching Strategy section of each objective.]
2. Reading for understanding/information is part of this lab. Students read the article about the experiment and rewrite the experiment steps in their own words. Direct the students to complete Steps 1 and 2 of this experiment before handing out the lab sheet.
3. The experiment works well having one egg per student. If this is not possible, have one egg per group of two to four lab partners.
4. Cautions:
 - a. Eggs will break during handling unless the students use gentle movements. You may need to soak extra eggs in vinegar to allow for any breakage.
 - b. Making the initial measurements with a tape measure or string may break some eggs. This lab sheet includes another way to obtain the initial measurement by calculating liquid displacement. This alternative method uses the initial measurement of the height of the solution instead of measuring the egg circumference.
5. Eggs can be refrigerated or left at room temperature during the acid-base reaction to remove the eggshell. Expect a vinegar smell. NOTE: The eggs *cannot* be used for human consumption following the experiment.