Online Instructor's Manual
to accompany

Foods: Experimental Perspectives

Eighth Edition

Margaret McWilliams

Prentice Hall

Boston Columbus Indianapolis New York San Francisco Hoboken

Amsterdam Cape Town Dubai London Madrid Milan Munich Paris Montreal Toronto

Delhi Mexico City Sao Paulo Sydney Hong Kong Seoul Singapore Taipei Tokyo

10 9 8 7 6 5 4 3 2 1

PEARSON

ISBN-13: 978-0-13-420471-0
ISBN-10: 0-13-420471-9

Table of Contents

Experimental Foods Laboratory Manual (9th edition)

PREFACE

Food Science instructors, this Instructor's Manual to accompany *Foods: Experimental Perspectives*, 8th Edition, by Margaret McWilliams, is meant for you. I hope that you will find it useful as you teach Experimental Food Science. Each chapter in this manual includes a brief overview of the chapter, providing a guide to content on which to focus. Chapter objectives following the overview are written for the student and are presented in performance format. You will note that the overview and objectives do not cover every concept in the chapter. The time you have available and the specific needs of your students clearly will determine just how you will decide the content and emphasis you will present and use in your class.

Web sites in this Instructor's Manual were chosen to be the more "permanent" type. Most of the web sites have links to features both within and outside of their site. Please encourage the students to explore these sites. And if you have viewed them yourself, you can incorporate references to them in your lectures. And a big thanks goes to those food science instructors who have great web materials out there.

The test bank follows, with questions in a variety of formats. The essay/discussion questions are designed to be helpful in evaluating higher level thinking.

I welcome any input you might have on this Instructor's Manual and also on *Foods: Experimental Perspectives*.

Margaret McWilliams
MMcWRedondo@aol.com

CHAPTER 1: TODAY'S FOOD SCENE

OVERVIEW

Consumers, farmers and fishermen, and the food industry are constantly reshaping the food marketplace in response to increasing cultural diversity, environmental, economic, and lifestyles concerns. Among current key issues are food safety (including terrorism and environmental and microbiological risks) and health. Functional foods, designer foods, organic foods, phytochemicals, prebiotics, probiotics, genetically modified organisms, biotechnology, and nanotechnology are now in the vocabularies of consumers.

Careers related to food may involve the role of food and health, the feeding of people at home or away, or may be in the broad food industry (from basic food research to all aspects of bringing food products to the consumer, including governmental roles).

STUDENT OBJECTIVES

Upon completion of Chapter 1, Today's Food Scene, the student should be able to:

1. Discuss genetically modified organisms from the perspectives of both food producers and consumers.
2. Describe some of the problems farmers have to deal with in their profession.
3. Outline the issues fishermen and people running fish farms face. Discuss the significance of functional foods for consumers.
4. Discuss the roles of some federal agencies involved in the nation's food supply.
5. Describe various professional career opportunities that are centered on various aspects of the food industry.

CHAPTER OUTLINE

Issues in the Food Supply

Production Perspectives

Consumer Voices

Food for Thought: Ultragrain®

Food for Thought: World Farming Challenges and Nonprofits

Sustainability

The Trip to the Table

Security in the Food Supply

Food for Thought: Safety with Pressure

Challenges to the Food Industry

Functional Foods

Designer Foods

Nanotechnology

Careers in Food

Summary

Web Sites
A large number and variety of commercial sites and news releases exist under the terms "natural," "organic," biotechnology, and genetic engineering.

Biotechnology - http://www.fda.gov/Food/Biotechnology/default.htm. Many interesting links from the FDA Center for Food Safety and Applied Nutrition.

Dr. Duke's Phytochemical and Ethnobotanical Databases - http://www.ars-grin.gov/duke Compiled by the Agricultural Research Service with links to plant, chemical, activity, ethnobotany searches with other databases and documents available for browsing. Includes a warning statement.

The Linus Pauling Institute - http://www.orst.edu/dept/lpi Located at Oregon State University, the Linus Pauling Institute conducts research to determine the role of micronutrients, phytochemicals, and microconstituents of food in maintaining human health and preventing and treating disease.

The Institute of Food Technology - http://www.ift.org Check this link for information on careers in food science and technology.
Study Questions

Multiple Choice Questions:

1.Ultragrain flour is which of the following?

a. a rye mutation,
b. cellulose with gluten added, (
c. new strain of wheat milled to a fine texture
d. mixture of wheat and triticale flours
e. mixture of triticale and rye flours.

Answer: C. a new strain of wheat milled to a fine texture.

2. Bt is a term meaning
a Beets,
b Beef,
c Biologically tainted
d Bacillus thuringiensis
e None of these.

Answer: D. Bacillus thuringiensis

3. GMO is a term meaning
a. Beets,
b. Beef,
c, Biologically tainted,
d. Genetically modified organism
e None of these.

Answer: D. GMO means Genetically Modified Organism

4. Phytochemicals include:
a. Beta glucan in oats
b. Catechins in green tea
c. Isoflavones in soy products
d. Lycopene in tomatoes
e. All of the above.

Answer: E. All of the above

5. What people choose to eat is defined by:
a. Jointly by what they see on TV and in the News
b. Jointly by consumers and the food industry
c. Jointly by their doctor and advertisement
d. Jointly by producers and farmers

Answer: B Jointly by consumers and the food industry

6. The waste from a herd of 1,000 cattle has to be managed carefully to avoid:
a. Methane contamination
b. Water rights litigation
c. Feedlot contamination
d. Microbiological contamination.

Answer: D. Microbiological contamination.

7. The legal definition of "Organic" is that the plant or animal food has been produced without ?
   a. Soil
   b. Growth hormones
   c. Compost
   d. Bone meal.

   Answer: B Growth hormones

8. The National Organic Program is administered by:
   a. FDA
   b. USDA
   c. USDC
   d. CDC

   Answer: B USDA

9. Functional food is sometime refered to as?
   a. Nutraceutical, '
   b. Natural
   c. Organic
   d. GMO.

   Answer: A. Nutraceutical

TRUE/FALSE

10.T or F. Phytochemicals are chemical compounds in plants needed for life and growth.
   Answer: False Chemical compounds in some plants that have biological activity that may contribute positively to human health

11.T or F. Genetically modified organisms (GMO) are not well accepted in the European Union because of consumer worries about safety.
   Answer: True

12. T or F. The Department of Homeland Security is the only federal agency charged with maintaining the security of the nation's food supply.
   Answer: False USDA, FDA,FBI and Homeland Security

13.T or F. Nanotechnology is based on genetically modifying microorganisms.
   Answer: False This technology develops, creates, and uses particles at the atomic, molecular, or macromolecular range.

14. T or F. Nanotechnology may be useful in some packaging materials.
   Answer: True

15. T or F. Regulations for labeling food "made with organic ingredients" are more restrictive than for foods "organic".
Answer: False

16. T or F. Probiotics are active in the small intestine.
Answer: True

17 T or F. NIH has approved some heart-health claims regarding nutrients and heart health for use on food labels.
Answer: False, answer is FDA

18. T or F. Designer foods are being promoted to help consumers lose enough weight to wear designer fashions.
Answer: False, designer foods developed to meet needs of improved health.

19. T or F. The food marketplace is undergoing limited changes because the U.S. population is quite constant in its demographics (e.g., age distribution and ethnicity).
Answer: True

20. T or F The American Humane Association and other organizations are providing Federally recognized certification.
Answer: False Certifications are through the industry with no government oversight.

Matching

21. Natural	A. Biotechnology
22. Nanotechnology	B. protect the nation's food and water supplies
23. Genetic engineering	C. Registered Dietitian Nutritionist
24. RDN	D. no artificial ingredient
25. Strategic Partnership Program	E. Working with matter including atoms or molecules

Answers:
21. D
22. E
23. A
24. C
25. B

ESSAY/SHORT DISCUSSION QUESTIONS

26. Forecast what you see happening in the food marketplace in the next 25 years. Take into account consumer trends and lifestyles in your discussion.

[In forecasting the food marketplace for the year 2025, one might see an increase in prevention and treatment of disease through nutrition. This would be in response to the increase in the 65 years and older population group. Consumers

will be interested in foods that have been linked to reducing the risk of obesity, heart disease and cancer. The current interest in cultural foods will increase in response to the increasing cultural diversity of the population. Expect more foods representing other cultures, including Mexican, soul, and Asian food products. With the continued acceleration in the pace of life, expect more convenience foods: frozen, refrigerated, and dried. Small portions of food for snacking and small meals will continue to grow. Consumers will also demand accountability in the food supply, both from food safety and environmental standpoints.]

27. Distinguish between the following:

Natural and organic foods - [A natural food is one made without chemical or artificial additives. An organic food is a food where no chemical fertilizers or pesticides were applied when the crops were being grown.]

Functional food and designer food - [A functional food contains useful amounts of chemical compounds that promote health beyond basic nutrition. A designer food is formulated to contain enhanced levels of phytochemicals.]

Biotechnology and genetic engineering - [Biotechnology is the development of new products by making a genetic modification in a living organism. Genetic engineering is biotechnology in which a genetic modification is achieved by removing, adding, or modifying genes.]

28. Enumerate the careers available to food professionals in health settings, feeding people away from home, and in basic food science. Relate this discussion to the skills needed to meet your personal career goal.

[Health - nutritionists and dietitians (R.D.) finding careers in clinical dietetics, food service administration, community nutrition, sports nutrition, consulting, nutrition counseling, and industries based on nutrition-related products. Food settings away from home - hospitality, hotels, and restaurant settings with emphasis placed on preparation and applied aspects of food and its service to groups of people. Entrepreneurs might operate their own restaurants; other fields include restaurant managers and catering. Food businesses provide a variety of careers in product development, quality assurance, food analysis, processing, packaging, microbiology and food safety, sensory evaluation, physical testing, labeling and governmental regulation, and marketing. Discussion of skills (writing, oral communication, scientific leaning, public relations, management, etc.) would relate to each student's personal career choice.]

29.. Based on the food science experiments that are performed, why is control critical?

[Control eliminates unintentional variables. This allows one to test for variations without having confounding, intervening variables. Unexplained or unintentional variables can influence the results. Control is needed in the formula, procedure, and also in the sensory and objective measurements, to ensure accuracy.]

CHAPTER 2: WATER

OVERVIEW

Water, is a key chapter to understanding future concepts in Experimental Food Science. Take time to review all the terminology in this chapter. Concentrate on the states of water and factors affecting freezing and boiling points. Review water activity and water's role in food preparation.

Water is a common constituent of foods and is used so frequently in food preparation that it is easy to take it for granted. However, the universality of its occurrence and its unique characteristics make water an important subject to study.

STUDENT OBJECTIVES

Upon completion of Chapter 2, Water, the student should be able to:

1. Describe the chemical character of water molecules and its influence on their behavior.
2. Interpret how the factors that determine the freezing and boiling points of water create their effects.
3. Describe bound water in foods.
4. Discuss the significance of water activity in foods.
5. Explain how the quality of water can influence food preparation.

CHAPTER OUTLINE

WEB SITES

http://www.landfood.ubc.ca/courses/fnh/301/water/wprin.htm#anchor-activity
Discussion of water activity.

http://www.bottledwater.org/ Information on the bottled water industry

STUDY QUESTIONS

MULTIPLE CHOICE

1. Which of the following agencies are responsible for the safety of our water supply at the federal level?

    a. FDA and USDA

    b. Department of Homeland Security and the Environmental Protection Agency

    c. Bureau of Land Management and the WPA

    d. Department of Health and Human Services only

    e. none of these.

    Answer: B

2. The energy required for the change in state between water and ice to occur is called ?

    a. Heat of vaporization

    b. Energy ratio

    c. Heat of fusion

    d. Water/ice ratio

    e. None of these.

    Answer: C

3. Altitude alters the boiling point because of a change in which of the followihg?

    a. Ionization

    b. Electrical repulsion

    c. Vapor pressure

    d. Atmospheric pressure

    e. None of these.

    Answer: D

4. Increasing the salt content in a boiling solution will cause?

    a. Foaming

    b. A decrease in boiling temperature

    c. An increase in boiling temperature

    d. Almost no change in boiling temperature

    e. Crystallization.

    Answer: C

5. Increasing oatmeal in boiling water will cause?

    a. Foaming

    b. A decrease in boiling temperature

    c. An increase in boiling temperature

    d. Almost no change in boiling temperature

    e. Crystallization.

    Answer: D

6. Sugar alters the boiling point because of a change in?

    a. Ionization

    b. Electrical repulsion

c. Vapor pressure

d. Atmospheric pressure

e. None of these.

Answer: C. Vapor pressure

7. A pressure cooker can be used to?

a. Increase atmospheric pressure and raise the temperature of boiling wate

b. Decrease atmospheric pressure and raise the temperature of boiling water

c. Increase vapor pressure and raise the temperature of boiling water

d. Decrease vapor pressure and raise the temperature of boiling water

e. None of these.

Answer: A

8. What happens when some water is added to plain gelatin?

a. Flows freely

b. Melts the gelatin

c. Boils

d. Becomes bound and loses its flow properties

e. None of these.

Answer: D

9. When food absorbs some water from the surrounding air, the process is called?

a. Dehydration

b. Humidifying

c. Leaching

d. Resorption

e. None of these.

Answer: D

10. During the process of transforming ice into water and finally to steam, the largest amount of energy is required do which of the following?

    a. Melt ice

    b. Heat water to 4°C

    c. Heat water to 100°C

    d. Form steam

    e. None of these.

    Answer: D

TRUE OR FALSE

11. T or F. For water to be transformed into ice, energy (approximately 80 calories per gram of water) must be absorbed.

    Answer: False In freezing, heat dissipates, is not absorbed

12. T or F. Water contracts as it cools to 4°C and then expands a little as it is cooled to 0°C.

    Answer: True

13. T or F. The energy required to heat water from 0°C to 100°C is less than the energy needed to transform ice to water at 0°C.

Answer: False: For a gram of water to change into gas, 540 calories (actually, 539.4) are required

14. T or F. Ice cream with a high sugar content will melt more quickly than one with less sugar.

    Answer: True

15. T or F. Sugar and salt have the same impact on the temperature of boiling.

    Answer: False Salt as twice the effect that sugar does on temperature because it ionizes and sugar does not

16. T or F. Boiled potatoes cook more quickly in the mountains than at sea level because of a change in vapor pressure.

    Answer: False Lower atmospheric pressure means that it takes longer to boil potatoes.

17. T or F. Boiled potatoes cook more slowly in the mountains than at sea level because of a change in vapor pressure.

    Answer: False Lower atmospheric pressure

.

18. T or F. Boiled potatoes cook more slowly in the mountains than at sea level because of a decrease in atmospheric pressure.

    Answer: True

19. T or F. Boiled potatoes cook more slowly in the mountains than at sea level because of an increase in atmospheric pressure.

    Answer: False Lower atmospheric pressure

20. T or F. Water activity in all foods is lower than that of free water.

    Answer: True

21. T or F. The highest energy state of water is found in the solid state.

    Answer: False: Gaseous state

22. T or F. As elevation increases, the boiling point of water increases.

    Answer: False: Decreases due to a lack of atmospheric pressure

23. T or F. Bound water functions as a solvent and is easily frozen.

    Answer: False: only free water can act as a solvent

24. T or F. Water activity of cookies will be altered when a fat replacer is added as an ingredient.

    Answer: True

FILL IN THE BLANKS

25.. Water consists of two hydrogen atoms and one ____[oxygen]____. Each water molecule can be connected to four adjacent water molecules by weak ____[hydrogen]____ bonding. Water can exist in three states: solid, liquid, and gas. In the solid state, the molecules slow down and associate in precise arrangements called ____[crystals]___. In the [gaseous]___ state, molecules have kinetic energy and escape from the surface as [steam/water vapor]___.

26. The additional input of energy with no rise in ____[temperature]____ to change solid to http://www.bottledwater.org/or liquid to gas is called ____[latent heat]____. Examples are the heat of ___[fusion]___ when ice is formed, and the heat of vaporization, when water is converted to ___[steam/gas]___. The energy required for vaporization is much [greater]___ than that given off during fusion.

Essay/Short Discussion

27. Describe the water molecule, explaining hydrogen bonding.

[A water molecule is made up of two hydrogen atoms and one oxygen atom joined at an angle of 105^{o}. Thus the oxygen electrons are concentrated on one side of the molecule, while the hydrogen electrons are on the other side. This makes water a dipole, with the negative charges from the oxygen atom on one side and the positive charges contributed by the hydrogen atoms on the other side. Thus one water molecule easily hydrogen bonds to another water molecule to form clusters.]

28. Distinguish between:

Heat of fusion and heat of vaporization - [Both are examples of latent heat. Latent heat is the change in the state of matter without a change in temperature. Heat of fusion is the heat released when water is frozen. Water changes from a liquid state of matter to a solid one. The removal of heat equivalent to 80 calories per gram of water is necessary for heat of fusion. This occurs at 0^{o}C. Heat of vaporization is the heat energy absorbed when water converts from a liquid to a gas. This action requires 540 calories per gram of water. It occurs at 100^{o}C.]

Bound and free water - [Bound and free water are two different forms in which water is held. The bound water has bonded to become an integral part of the food product. It has reduced mobility, does not exhibit colligative properties, does not support microbial growth nor crystallize. Free water can be expressed from the food product. It exhibits colligative properties and behaves like pure water.]

29.. Explain why a steam burn is so painful.

[A steam burn occurs when water in the form of gas hits the skin and is converted to a liquid. This is heat of vaporization and releases 540 calories per gram of water. This calorie production causes a steam burn.]

30.. In lab this week, you will be conducting an experiment on the effect of the form of sweetener on fruit texture with the objective measurement of cooking time. The heavy syrup variation is expected to cook in the shortest time, followed by the thin syrup variation and then the control (no sugar). Using the terms nonvolatile, non-ionizing solute, explain these results. Then imagine that salt was substituted for sugar, and, using the term nonvolatile, ionizing solute, explain these results.

[Sugar is a nonvolatile (does not form a gas), non-ionizing (because it is a molecular structure) solute (small particle dissolved in the solvent of water). A nonvolatile, non-ionizing solute will raise the boiling point of a liter of water by 0.52^{o} C. Thus the addition of sugar to cooking water in boiling apples will raise the boiling point and result in the apples cooking in a shorter time than those cooked in plain water.

Salt is a nonvolatile (does not form a gas), ionizing (because it is made up of two ions, sodium and chloride), solute (small particle dissolved in the solvent of water). A nonvolatile, ionizing solute will raise the boiling point of a liter of water by 0.52^{o}C per ion formed. Thus salt, which is composed of two ions, will raise the boiling point of a liter of water by 1.04^{o}C. Salt will have double the effect of sugar and result in the apples cooking even more quickly than in the sugar mixture (although they would taste too salty to eat if a comparable amount of salt is added to the cooking wter).]

31.. Explain the process of freezing homemade ice cream using the principles of freezing point and nonvolatile, non-ionizing solutes and nonvolatile, ionizing solutes.

[Homemade ice cream mixtures contain sugar. The sugar, a nonvolatile, non-ionizing solute, lowers the freezing point of the mixture; therefore, it will not freeze at 0^{o}C. The temperature must be lower than that for freezing to take place. In order to lower that temperature, rock salt is used. Salt is a nonvolatile, ionizing solute. It has double the effect on the freezing point as sugar, because the salt ionizes into two ions, sodium and chloride. Therefore, the salt will produce a brine as the ice melts. This brine has a freezing point low enough to freeze the ice cream mixture.]

32.. A soft drink machine is outside. One winter day, two students buy soft drinks. One buys a Coke, which is fine. The other student buys a Diet Coke. It is partially frozen. Explain why this occurred.

[The Coke was full of sugar, which lowered the freezing point enough that it was below that of the outside temperature. But the Diet Coke was sweetened with saccharin. Therefore, the lack of sugar meant that the freezing point was not lowered. When the outside temperature became cold, it froze the Diet Coke.]

33. . In Johnson City, Tennessee, the elevation is 1700 feet. Explain that altitude's effect on the boiling point of water.

[At sea level, water boils at 100^{o}C. The boiling point is the temperature at which the vapor pressure just exceeds the atmospheric pressure. Since atmospheric pressure decreases with an increase in altitude, at 1700 feet it will take less vapor pressure to overcome this atmospheric pressure. For every 960 feet in elevation, the boiling point of water is decreased by 1^{o}C. Thus, in Johnson City, Tennessee, water would boil at approximately 98^{o}C.]

34.. Compare the water activity of lettuce to that of dried apricots.

[Water activity is the ratio of the vapor pressure of a food sample to that of pure water. It is measured between 0 and 1.0. Many foods, including lettuce, have a water activity of 0.95 and higher. These foods are subject to microbial spoilage. Drying foods is a method of preservation by which the water activity is lowered.

Bacterial contamination is decreased, as the microorganisms need water to survive.]