

UNIT III - THE BIOCHEMISTRY OF FOODS

Lesson 4: Processing Influences Nutritional Value

Objective

The student will be able to describe how processing techniques influence the nutritional value of food.

I. Study Questions

- A. How does temperature affect nutrient availability in foods?
- B. How does light affect nutrient availability in foods?
- C. How does water content affect nutrient availability in foods?
- D. How does oxidation affect nutrient availability in foods?
- E. What process can be used to maintain or enhance the nutritional value of foods?

II. References

- A. Martin, Phillip R. *Food Science and Technology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Unit III.
- B. Activity Sheet
AS 4.1: How Processing Affects Vitamin C

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TEACHING PROCEDURES

A. Review

Review the six classes of nutrients and their functions in the human body.

B. Motivation

Compare nutritional values of fresh (posted at the grocery store), frozen (on the container), and canned (on the container) fruits and vegetables. Check the list of ingredients to see if Vitamin C (Ascorbic Acid) was added.

C. Assignment

D. Supervised study

E. Discussion

1. Discuss how temperature affects nutrient availability in foods.

How does temperature affect nutrient availability in foods?

- a. Room or elevated temperatures allow enzymes to degrade tissue and break down vitamins.
 - b. Blanching stops enzyme activity.
 - c. Proteins toughen when exposed to high cooking temperatures.
 - d. High cooking temperatures and long cooking times destroy vitamins.
2. Discuss how light affects nutrient availability.

How does light affect nutrient availability in foods?

- a. Fluorescent and ultraviolet light can destroy riboflavin.
 - b. Vitamins, in general, break down in the presence of light.
3. Discuss how water content affects nutrient availability in foods.

How does water content affect nutrient availability in foods?

Water-soluble vitamins are a part of a food's juice and are easily lost.

4. Discuss how oxidation affects nutrient availability. Oxidation is the breakdown of nutrients in the presence of oxygen. BHA and BHT are antioxidants.

How does oxidation affect nutrient availability in foods?

- a. Overcooked or burned foods have been partially oxidized to carbon and oxygen gas and are not useful to the body.
 - b. Protein molecules release their nitrogen as nitrous oxide.
5. Discuss what processes are used to enhance the nutritional value of foods.

What processes can be used to maintain or enhance the nutritional value of foods?

- a. Enrichment - nutrient levels are increased
- b. Fortification - add nutrients that may not have originally been found in foodstuff
- c. Supplements - nutrients added to a level in excess of 50 percent RDA
- d. Cooking method and length
- e. Quick cooling post harvest
- f. Waxing/packaging

F. Other activities

Have students bring food labels from home that indicate enriched or fortified foods. Compare the labels.

G. Conclusion

Processing does influence the nutritional value of foods. Critical aspects are: temperature, light, water content, and exposure to the air or oxidation. There are several processes that are used to maintain or even enhance a foods nutritional value.

H. Competency

Describe how processing techniques influence the nutritional value of food.

Related Missouri Core Competencies and Key Skills: None

I. Answers to Evaluation

1. d
2. d

3. a
4. b
5. b
6. c
7. a

J. Answers to Activity Sheet

AS 4.1

1. Vitamin C is lost when foods are heated.
2. There is a time dependant relationship between heating and Vitamin C destruction.
3. Answers will vary but should indicate that most of the Vitamin C will

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Date _____

EVALUATION

Circle the letter that corresponds to the best answer.

1. Which of the following can cause nutrient loss in foods?
 - a. Light
 - b. Heat
 - c. Boiling in a water bath
 - d. All of the above

2. Light, especially fluorescent and ultraviolet, promotes the breakdown of:
 - a. Vitamin C
 - b. Water
 - c. Carbohydrates
 - d. Riboflavin

3. Cooking food in a water bath would increase the loss of:
 - a. Water-soluble vitamins
 - b. Fat-soluble vitamins
 - c. Minerals
 - d. Proteins

4. Oxidation is defined as:
 - a. The binding of protein molecules in the presence of O₂
 - b. The chemical reaction in the presence of O₂
 - c. The addition of a carbon atom
 - d. Inhaling oxygen

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Match the word on the right with the definition of the left.

- | | |
|--|---------------|
| ____5. Nutrients added to a level that exceeds
50 percent of the RDA | a. Enrich |
| ____6 .Nutrient levels returned to levels present
before processing | b. Fortify |
| ____7. Nutrients are added to a food that may or
may not have been there originally | c. Supplement |

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AS 4.1

Lesson 4: Processing Influences Nutritional Value

Name _____

How Processing Affects Vitamin C

Objective: The student will be able to identify how processing affects Vitamin C retention in vegetables.

Activity Length: One class period

Materials and Equipment:

Blender

Knife

Scale

Cheesecloth or filter paper (a coffee filter will work, but may be a little slow)

Hot plate or stove

Microwave

1 - 200-ml beaker or other heat-resistant container (1 cup Pyrex measuring cup will work in the microwave)

6 - 150-ml beakers (clear disposable plastic drink cups work well)

60 grams of 2 different kinds of fresh vegetables (green beans, broccoli, potato, tomato, etc.)

Water

6 test tubes

Eyedropper

Indolphenol blue dye

Test tube rack

Labels (masking tape will work)

Hotpads

Procedure:

1. Cut the vegetables into uniform pieces, no larger than 3 cm in any dimension.
2. Weigh out 3 portions of each vegetable (total of 6 portions). A portion should weigh about 20 grams.
3. Label the 150-ml beakers with A, B, C (control first vegetable), D, E, and F (control second vegetable).
4. Place 20 grams of one vegetable in beakers A, B, and C.
5. Place 20 grams of the other vegetable in beakers D, E, and F.
6. Add 100 ml water to each beaker.

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7. Pour the contents of beaker A into the 200-ml beaker. Heat in the microwave until the water boils. Pour the contents back into beaker A.
CAUTION: Use hotpads when handling the hot beakers.
8. Wash the 200-ml beaker. Then repeat step 7 with beaker D.
9. Heat beaker B on stove or hot plate for about 30 minutes.
10. Heat beaker E on stove or hot plate for about 30 minutes.
11. Allow beakers to cool.
12. Transfer the contents of beaker A to the blender. Process at high speed until the sample is well blended.
13. Pour the contents of the blender through cheesecloth or filter paper to filter out the liquid. (If you have access to a centrifuge, centrifuge sample for 10-15 minutes.) The sample does not have to be clear. (With some vegetables this step can be eliminated, as long as the sample is liquid enough to pour easily into a test tube.)
14. Measure 60 ml of the filtrate back into beaker A.
15. Rinse the blender thoroughly after filtering the liquid.
16. Repeat Steps 12 -15 for the contents of beakers B, C, D, E, and F.
17. Using the eyedropper, measure 10 drops of indophenol blue dye into 6 test tubes. Label test tubes A, B, C, D, E, and F. Clean eyedropper.
18. Using the eyedropper, carefully add contents of beaker A into test tube A one drop at a time, counting the number of drops needed to make the blue color disappear. Stop adding drops when the color disappears. Record the number of drops added to the test tube.
19. Clean eyedropper before moving to next beaker.
20. Repeat steps 18 and 19, using beaker B with test tube B, so on, with beakers C, D, E, and F.
21. Vitamin C bleaches the blue color out of indophenol blue. This lab will make qualitative distinctions between the different processing techniques based on the amount of vitamin C they possess. The fewer the number of drops needed to make the blue color disappear, the greater the percentage of vitamin C in that sample. If the blue color does not disappear, the beverage is said to contain no vitamin C.

Key Questions:

1. What is the effect of heating on the vitamin C content of vegetables?
2. Why is there a difference between the microwaved vegetables and the vegetables cooked for 30 minutes on the stove.

3. What would you predict would happen if the vegetables were roasted at 350 F for 3 hours (like being cooked in a pot roast)?

Variations:

All kinds of processing treatments could be evaluated using this procedure. For example:

- What is the effect of peeling on vitamin C levels?

- What about adding salt or vinegar to the liquid?

- Freeze the vegetables

- Store vegetables for a week at different temperatures

This procedure would also work using fruits, but the amount of material titrated in step seven may have to be adjusted (vitamin C levels in fresh fruit is much higher than in processed juices.)

