Upon completion of this lesson, students will be able to:

1. Explain the factors that contribute to losses in food nutrients during processing and how to maintain maximum nutrient content.

In this Lesson

- Nutrient retention in preserved foods
- Factors contributing to nutrient loss
- Effects of home processing methods on nutrient content:
  - Canning
  - Drying
  - Freezing
- Handling and preparing food for serving
- Economics of home-preserved foods

Extension Bulletins

- Nutritive Value of Foods, PNW 357
  (does not include home preserved foods but is a good reference book)
- Storing food For Safety and Quality, PNW 612

Web Sites

National Center for Home Food Preservation (use the search feature to see a wide variety of articles on nutrient retention of home preserved foods) http://www.uga.edu/nchfp/

Searchable data base for articles on the nutritional value of home canned foods.
Nutrient Retention in Preserved Food

Research on the nutritive value of foods has been going on since the 1920s. A number of factors affect nutritive retention in home processed food, including variety, conditions of harvest, storage before processing, and methods used during processing. Some loss of vitamin content cannot be avoided in food preservation. Mineral, fat, carbohydrate, and protein content are relatively stable for all food-processing methods.

The results of one study (shown below) indicate that vitamin C retention in peas is similar for a variety of preservation methods.

**Percent Retention of Ascorbic Acid in Processed Peas**

Cooked garden fresh peas were highest in vitamin C, while frozen, canned, and freeze-dried peas were slightly lower. Air-dried peas were lowest.

Most of the fresh produce we purchase is market fresh. By the time it’s distributed to the point of purchase (bought, and prepared table ready) market fresh produce could be anywhere from one day to more than two months old.

Most commercially canned or frozen fruits and vegetables are processed within one to two days after harvest, and therefore are likely to be a more uniform source of nutrients than fresh produce purchased at the grocery store. If home-preserved foods are processed soon after harvesting and stored correctly, the nutrient content will be similar to commercially canned and frozen food.
Factors Contributing to Nutrient Loss

Some vitamins and minerals are water-soluble. Washing should be held to a minimum and soaking should be avoided, especially after fresh foods are trimmed and peeled. Water-soluble vitamins and minerals are leached out if blanched in water. Blanching with steam or a microwave oven does not require immersion in water; therefore, substantially reducing the leaching of nutrients.

Many nutrients, including ascorbic acid, niacin, thiamin, and riboflavin are gradually destroyed by heating. The presence of oxygen increases the losses of water-soluble vitamins, ascorbic acid, folic acid, riboflavin, and thiamin, especially while foods are being heated or if exposed to light. Fat-soluble vitamins, particularly A, D, and E, are also sensitive to oxygen, heat, and light.

The presence of heavy metals, such as copper and iron, further increases the loss of vitamins.

Home preservation methods try to minimize losses do to these factors, therefore it is necessary to follow recommended guidelines.

Effect of Home Processing Methods on Nutrient Content

Canning—Heat and the presence of oxygen are the two worst causes of vitamin loss in home-canned foods. Even though hot-packed foods are exposed to more heat, hot packing evacuates air from food tissue. So, once foods are processed, there is less oxygen left in the jar to cause nutrient losses.

Storage of canned foods should be in dry, moderately cool place (50°F is ideal). This means away from hot pipes, radiators, furnaces, water heaters, the hot attic, and the kitchen range. One-year storage at 70°F results in the same amount of vitamin C loss as does four months at 98°F. Jars should also be stored in subdued light since light promotes some reactions that reduce nutrient quality.

Freezing— Foods that are properly prepared, packaged, quick frozen, stored correctly, and consumed within a year have a nutrient value equal to or greater than food preserved by any other method. Vitamin C is frequently added to apples, cherries, peaches, and pears to prevent browning; it will add to the vitamin C content of the fruit. Packaging in airtight containers is vital to maintaining quality, texture, and optimal nutrient retention. The effect of storage temperature is also highly important. A food stored at 0°F or less will not undergo significant nutrient loss for up to one year. If stored at 15°F, it will lose 50 percent of its vitamin C in six months. Vitamin A, thiamin, and riboflavin are not affected.

Drying—Drying causes high vitamin losses. However, losses can be reduced by proper storage conditions after drying. Low temperatures, low moisture levels, and the absence of oxygen are the conditions most favorable for retaining vitamins A and C in dried food.
Handling and Preparing Food for Serving

Up to half of the vitamins can be lost by improper preparation, excessive cooking, or poor storage in the home. Water-soluble vitamins are lost if foods are cooked in excessive water and served drained, or when leftovers are repeatedly refrigerated and reheated for serving.

To minimize nutrient losses during storage, processing, preparation, and serving of food, follow these guidelines:

- preserve only garden or farm fresh foods
- don't expose the food unnecessarily to oxygen
- don't expose food to excessive light
- don't expose food to extremes in pH—don't use strong alkali or acid to prepare food
- blanch foods where appropriate to inactivate enzymes that can destroy vitamins
- avoid excessive or unnecessary heating of foods
- avoid excessive trimming and over-chopping of vegetables
- cook foods in covered pans (to shorten cooking time and reduce water needed)
- cook foods with a minimum amount of water
- cook vegetables only until tender
- use steam cooking or stir frying instead of boiling or frying
- use a microwave oven for preparing foods when possible

The Economics of Home-Preserved Foods

The reasons for preserving fresh foods, whether from the garden, farm, produce stands, or store, often include saving money as well as satisfying personal preferences. There are many variables, however, which affect the cost of home-preserved foods. The true costs include the total inputs of supplies, equipment, fresh food, skill, human energy, and fuel energy to process and store food.

Cost of Fresh Food—The cost of fresh food is a major variable in determining the economy of home-preserved foods.

When calculating the cost of food, make allowance for discarded portions. From 5 to 70 percent of fresh food weight is waste. For example, the weight of cut kernel corn is only 30 to 35 percent the weight of ears with husks.
Cost of Equipment and Supplies—Capital costs for canners and freezers can be spread over an expected 20-year life span, while smaller equipment lasts about 10 years. Freezing is the only preservation method that requires continual energy input for food storage. Cost of electricity for operating a freezer varies as much as 50 percent, depending on the efficiency of the unit, usage habits of the owner, and local cost for electricity.

Energy consumption to operate a freezer is higher for:
- an old freezer
- automatic defrost systems
- poor habits in defrosting, cleaning, and filling the appliance

Costs attributed to preserving produce increase if the freezer is not filled to capacity at least once a year.

Cost of Electricity—Energy costs vary by processing method.

Canning. Based on studies done at Pennsylvania State University, the average energy used was 0.4 kwh per pound of canned peaches and 0.5 kwh per pound of canned corn.

Freezing. In general, about 0.05 kwh of electricity per pound of food is used for blanching food. Freezing a pound of food to 0°F uses another 0.03 kwh of electricity. Operating a new 15 cubic-foot freezer filled to its 525-pound capacity requires about 700 kwh of energy per year, or an additional 1 1/3 kwh per pound of food. The cost of electricity to operate freezers manufactured before 1978 is about 50 percent higher.

Canned, frozen and purchased foods should take into account all costs. In one detailed cost calculation, the cost for commercially canned peaches was three times more than homegrown and home-canned peaches, but only one and a half times more than the cost for home-canned peaches purchased in a farmer's market. The cost for home-frozen peaches (stored for one year) was about ten percent higher than for home-canned peaches.

Calculating the actual cost of home food preservation requires gathering a lot of detailed data. If you are interested in making your own cost comparisons, the lists on the next page can help you in identifying what to include.

A substantial amount of money can be saved by home preservation if fresh food is home produced or received as a gift. Also, canning is a slightly less expensive method to preserve food. Disregarding labor, it is generally cheaper to preserve home-produced fruits and vegetables than to purchase them canned or frozen. Savings are less when fresh produce must be purchased.
Cost of Canning*
- Cost of pressure canner (cost/expected 20-year life)
- Allowance for repairs and replacement
- Cost of water bath canner (cost/expected 10-year life)
- Small equipment (cost/expected life)
- Jars and screw bands (cost/expected 10-year life)
- New lids
- Water
- Energy for preparing and processing
- Food cost
- Added ingredient costs

Cost of Freezing*
- Fixed yearly overhead costs:
  - Cost of freezer (cost/expected life of 20 years if new)
  - Annual repair allowance
  - Electricity to maintain at 0°F per year
- Variable costs with amount for food frozen:
  - Electricity to freeze foods (0.1 kwh per pound)
  - Packaging costs
  - Water and fuel to prepare and blanch foods
  - Food cost
  - Added ingredients

Cost of Drying*
- Cost of dehydrator (cost/expected life)
- Cost of trays (cost/expected life)
- Water to prepare foods
- Energy to prepare food
- Food cost
- Added ingredient cost (anti-darkening agents, marinades, etc)
- Energy for drying
- Water and energy to rehydrate

* The value of labor is not included.

Notes: