# Losses of nutrients through food processing

A variety of things can happen during the growing, harvesting, storage and preparing of food that can affect its nutritional content. Processes that expose foods to high levels of heat, light or oxygen cause the greatest nutrient loss.

**1. Intentional losses due to cleaning and milling**

**Milling**

The milling or processing operations vary for different grains. In the case of rice, the purposes of milling are to remove the husk and bran layers of paddy to provide cleaned and whole white rice kernels for human consumption. The operation can be performed manually or using milling machines. Traditionally, in rural areas, milling is performed manually by repeated pounding. Milling yields are highly dependent on the milling method, skills of the operator, and crop conditions before the milling process. Milling of paddy containing foreign materials results in a high amount of cracked and broken kernels and can also damage machines. Inadequately maintained milling machines result in a high amount of broken kernels and low milling yields.

All cereals require some form of processing prior to consumption, thereby introducing potential sources of nutrient loss. **Milling**, involving the mechanical separation of the endosperm from the germ, seed coat and pericarp, results in changes to the micronutrient composition.

- Most of the B vitamins, iron and calcium are concentrated in the outer layers of grain, which are removed by milling.

- After milling, flour is largely composed of the endosperm, although the composition can be varied and regulated by altering the processing conditions. Flours can be produced to a range of different extraction rates, depending upon the amount of bran, germ and pericarp that are removed.
- the non-uniform distribution of nutrients throughout the grain, the nutrient loss due to processing is non-linear and is characteristic for each nutrient. Thiamine is most concentrated in the scutellum and the aleurone layer while riboflavin is more evenly spread throughout the grain, although it is predominantly concentrated in the germ. Commercial milling removes about 68% of thiamine, 58-65% of riboflavin and 85% of pyridoxine from whole wheat. Iron and zinc, which are located at the periphery of the kernel, are also considerably reduced by commercial extraction rates. It is impossible to add back everything that is taken out, especially the phytochemicals. The ‘fibre’ that is added back to

some products is often in the form of resistant starch, which may not be as beneficial as the fibre removed.

**Preparation of vegetables**

Most vegetables are peeled or trimmed before cooking to remove the tough skin or outer leaves. Washing and peeling result in the loss of much of the water soluble vitamins B and C since these nutrients are more concentrated in the peel and outer layers. Peeling is an essential stage of processing in most roots and tubers. To minimise losses of vitamins and minerals peeling must be minimised without affecting palatability.

**2. Inevitable losses due to processing and cooking.**

**Blanching**

Blanching is the plunging of a food item into boiling water for a very short time period before removing it andtransferring it to cold or icy water. The cold water stops the cooking process. Blanching can remove the bittertaste from some vegetables and can also enhance their colour, making them more appealing. The application ofvery high heat will kill many microorganisms and will also soften the tough fibres in vegetables.The water soluble vitamins, including Vitamin C and B-complex vitamins, are heat sensitive (heat-labile) andeasily destroyed by blanching so care must be taken not to blanch foods for too long and to quickly refreshfoods in cold water to prevent heat labile nutrients from being destroyed.

Blanching is used to inactivate enzymes as a pre-requisite to the preservation of vegetables. Blanching can be carried out by immersion in boiling water or by treatment with hot air or steam. Boiling water is the most common form of blanching used at the small scale. Nutrient retention during blanching differs according to the method used and the type and size of vegetable. Inevitably there is some loss of water-soluble nutrients such as mineral salts, protein, sugar and vitamins (C and B complex) during the blanching and subsequent water-cooling, but these can be kept to a minimum by attention to detail. Losses are greater from food with a large surface to volume ratio.

**Losing nutrients through cooking**

Some vitamins dissolve in water, so you lose your vitamins to the cooking water if you prefer to boil your vegetables. For example, boiling a potato can cause much of the potato's B and C vitamins to migrate into the boiling water.

It is still possible to benefit from these nutrients if you consume the liquid, for example, by turning the potato and the liquid into a soup. Alternative cooking methods such as grilling, roasting,

steaming, stir-frying or microwaving generally preserve a greater amount of vitamins and other nutrients.

**What about fat-soluble vitamins?**

Fat-soluble vitamins, including vitamins A, D, E, and K, can also be affected by food preparation methods. These vitamins are more stable than water-soluble vitamins but can still be impacted by certain cooking techniques. Here's how fat-soluble vitamins can be affected during food preparation:

1. Heat: Excessive heat can cause the breakdown of fat-soluble vitamins, particularly vitamin E. To minimize the loss of fat-soluble vitamins, consider using lower cooking temperatures and shorter cooking times.
2. Frying: When foods are fried, fat-soluble vitamins can leach into the cooking oil, leading to a loss of these nutrients. It's important to not only consider the cooking time but also the cooking method when trying to retain fat-soluble vitamins.
3. Storage: Improper storage of foods high in fat-soluble vitamins can result in nutrient degradation. Exposure to light and air can negatively impact the stability of these vitamins. It's important to store foods containing fat-soluble vitamins in airtight, opaque containers in a cool, dark place.
4. Processing: Certain processing methods, such as refining grains, can remove the fat-soluble vitamins naturally present in the food.

To retain fat-soluble vitamins during food preparation, consider incorporating sources of these vitamins into meals that require minimal cooking or use cooking methods that minimize nutrient loss, such as steaming or microwaving. Additionally, consuming a balanced diet that includes a variety of whole foods can help ensure an adequate intake of fat-soluble vitamins.

**Canning**

Food is heated inside the can to kill any dangerous microorganisms and extend the food’s shelf life. Some types of microorganisms require severe heat treatment and this may affect the taste and texture of the food, making it less appealing. Preservatives are generally not needed or used in canned foods.

Water-soluble vitamins are particularly sensitive to high temperatures. Many people believe that canned foods are not as nutritious as their fresh counterparts, but this is not always the case, as fresh food often deteriorates more rapidly than canned foods.

**Freezing**

Freezing will not improve inferior foods. If the food is fresh, of top quality, and frozen using proper procedures, the effect on quality will be minimized as long as the food remains solidly frozen at a constant temperature at or below 0 degrees. While freezing keeps many foods almost like fresh, certain changes occur.

**Baking**

Baking is a commonly used cooking technique that applies dry heat to a food along with an airflow. It avoids theproblems of nutrient loss due to leeching and is effective at breaking down starches. However, heat labilenutrients will be destroyed and the long cooking time will negatively affect nutrient value. Baked goods losemoisture and leech fats, tending to be dry. Loss of these fluids will invariably result in some loss of both watersoluble and fat soluble vitamins. The pH of the food may be altered by adding acidic cooking ingredients or, incakes, by adding baking soda (an alkaline ingredient).

**Any nutrient losses are due to the processing prior to freezing and the cooking once the frozen food is thawed.**

***I. Physical changes on frozen food***

The main physical changes of foods verified during freezing processes are related to the risk of freeze cracking, moisture migration, recrystallization of ice crystals and drip loss during thawing.

If frozen food is not stored in moisture-vapor-proof materials it may lose moisture and develop a dried surface condition, e.g. freezer burn.

***II. Chemical changes on frozen food***

During freezing, changes in temperature and concentration (due to ice formation) play an important role in enzymatic and nonenzymatic reactions rates. Ice crystals may release the enclosed contents of food tissues, such as enzymes and chemical substances, affecting the product quality during freezing and frozen storage. The main chemical changes verified during freezing and frozen storage are related with lipid oxidation, protein denaturation, enzymatic browning, and degradation of pigments and vitamins.

***III. Freezing food can lead to harmful microbial growth:***

Contrary to popular belief, freezing food does not destroy the harmful microorganisms present on fruits and vegetables. There is still a sufficient population of microorganisms present in freezers, which further accumulates on the food items stored and multiplies in numbers consequently. This will lead to spoilage of food product and cause a drastic reduction in the nutritional content.