

EFFECT OF COOKING ON NUTRITIONAL STATUS OF VEGETABLES

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Nutritional importance of vegetables cannot be neglected in our daily meals. Vegetables are the major source of vitamins and minerals, but vegetable, protein is poor in quality. Vitamins and minerals are the chief regulators in human metabolism. Some of the vegetables are used in raw form as salad, but most of them require cooking for the improvement of digestibility and palatability. Some other vegetables require peeling to decrease their useless fibre. Minerals and other nutrients are affected by both peeling (*i.e.*, removal of outer coarse covering) and cooking. Methods, temperature and duration of cooking may also effect significantly the nutritive values of vegetables. Some of the important nutrients such as ascorbic acid and folic acid which are susceptible to oxidation are readily oxidized by brisk cooking. Minerals are also affected by high temperature, in some other cases flavor may be lost by brisk cooking. Excessive cooking may also cause an adverse affect on the digestibility of the vegetables.

Different cooking methods affecting the nutrients in vegetables are as under:

Boiling: Boiling is the cooking method that causes the greatest loss of nutrients in vegetables. Many of the water-soluble vitamins as well as other nutrients are transferred into the water and lost if the vegetables are drained and the water is thrown away rather than reserved and consumed as soup or broth. The amount of nutrients lost into the water depends on how long the vegetables are boiled, as well as the surface-to-volume ratio. Cutting the vegetables into large pieces or cooking them whole will aid in retaining nutrients, while mincing them into small pieces before cooking will result in the greatest nutrient loss. It is best to cook root vegetables including sweet potatoes, carrots, and potatoes whole and unpeeled. Boiling and draining vegetables results in a loss of 75% of the vitamin C and Folate, 70% of the thiamine and potassium, 65% of the vitamin B₆, 55% of the niacin and sodium, 50% of the vitamin B₁₂, 45% of the riboflavin and copper, 40% of the iron and magnesium, and 35% of the vitamin A and phosphorus.

Baking : Dry heat from baking destroys certain vitamins

and other nutrients, including vitamins C, B₁ and lysine. The effect is worse if the heat is too high or the vegetables are baked for longer than necessary.

Blanching: It is recommended to blanch vegetables before freezing them. Blanching is the process of scalding the vegetables by placing them in boiling water for a short period of time, usually about 2-3 minutes. This process kills bacteria and inactivates certain enzymes that can impair the color, flavor and texture of vegetables when they are frozen. However, blanching even for a short period of time still causes the loss of some nutrients. To minimize nutrient loss, vegetables should be placed into ice water immediately after blanching.

Steaming: Steaming is generally considered to be the best method to cook vegetables in order to preserve their nutritional content. Steaming uses a minimal amount of water and the vegetables are not submerged. In addition, steaming is a relatively quick method of cooking, so the vegetables are only exposed to heat for a short time.

Microwaving: Since microwaving is fast and only requires a small amount

of water, it is often recommended as a preferred method to prepare vegetables to avoid nutrient loss. However, it has been found that microwaving drastically reduces the amount of antioxidants in broccoli. Flavonoids in broccoli were decreased by 97% after microwaving, compared to 66% after boiling and only 11% when the broccoli was steamed. On the other hand, it has been seen that more flavonoids were retained in potatoes and tomatoes by microwaving than by boiling.

When vegetables are cooked by boiling or steaming, the changes in quantitative composition seems to be the resultant of three actions, the relative importance of which may vary widely:

- Shrinkage due to collapse of the cell walls and extrusion of the juices
- Leaching by the boiling water or condensed steam
- Hydration

Many vegetables, when steamed, suffer little or no loss, whether of total weight or of water soluble



Table 1 : Impact of various cooking and preparation methods on different nutrient contents of vegetables

Food	Nutrient	Method	% Nutrient loss
Broccoli	Vitamin C	Blanching	47%
Carrots	Folate	Boiling	79%
Carrots	Beta-carotene	Canning	27%
Cauliflower	Folate	Boiling	69%
Mixed vegetables	Vitamin C	Blanching (3-5 minutes)	25%
Mixed vegetables	Vitamin C	Boiling (10-20 minutes)	55%
Mixed vegetables	Vitamin C	Canning	67%
Mixed vegetables	Pantothenic acid	Canning	20-35%
Mixed vegetables	Vitamin B ₆	Canning	40-60%
Navy beans	Calcium	Cooking	49%
Navy beans	Copper	Cooking	59%
Navy beans	Iron	Cooking	51%
Navy beans	Magnesium	Cooking	65%
Navy beans	Manganese	Cooking	60%
Navy beans	Phosphorus	Cooking	65%
Navy beans	Potassium	Cooking	64%
Navy beans	Selenium	Cooking	50%
Navy beans	Zinc	Cooking	50%
Onions	Flavonoids	Boiling	30%
Spinach	Calcium	Blanching	0%
Spinach	Flavonoids	Boiling	50%
Spinach	Magnesium	Blanching	36%
Spinach	Phosphorus	Blanching	36%
Spinach	Potassium	Blanching	56%
Tomato juice	Folate	Canning	70%

constituents and it is note worthy potatoes are included among these. There is, in these cases, no extrusion of juices, the amount of condensation is insufficient for appreciable leaching or hydration and in saturated water vapour, as in boiling, there is naturally no evaporation. Other vegetables, including root vegetables such as carrots, Swedes and parsnips lose upto 30% of their water, the amount depending on the temperature of the steam and the time of cooking, with an approximately equal percentage loss of their water soluble constituents. In these, shrinkage with extrusion of juices seems to be the main factor. In still others, e.g., Brussels sprouts and cabbage, the losses appear to be small, but cannot readily be evaluated since the anatomical structure is such that extruded juices remain trapped in the spaces between the leaves.

Boiling vegetables in water obviously increases the chances of hydration overcoming the tendency to shrinkage by extrusion or diffusion from the dead cells and infact, boiling results in little or no change in weight. The opportunity for leaching is, however much greater than in steaming and accordingly, the losses of water soluble constituents are considerable and increase with the duration of cooking as well as to some extent with the volume of water.

The loss of Ca during the boiling of vegetables is generally much less than that of K, and may be nil, because Ca so readily forms insoluble salts which are not removed by leaching. Instead, substantial increase in the Ca content of green vegetables has been observed to occur in practice and to be reproducible by using hard water. Similar increases in the Fe content of vegetables have also been found, probably when weak acids liberated during the cooking have dissolved Fe or Fe salts from the cooking vessels.

Ca salts have been shown to delay the “Cooking” (*i.e.*, the softening) of vegetables and the softening of hard water may be one course of the accelerating effect of sodium bicarbonate. Sodium bicarbonate, by raising the pH of the water, seems to increase somewhat the loss of water soluble salts, but this effect is not great and is almost compensated by the shortening of the cooking time and by way of precipitating Ca salts and hence immobilizing them, it tends to decrease rather than increase the loss of this element.

Baking and frying, so far at least as potatoes are concerned, appear to result only in loss of water, the process being one of evaporation. It is evident that cooking in air or fat must be regarded as the most conservative method of cooking vegetables so far as the inorganic constituents are concerned followed by steaming. As boiling results in considerable losses of all water soluble constituents, therefore boiling should be done with a very small volume of water which is partly “boiling” and partly “steaming”.

Though the losses of minerals, as well as of carbohydrate and protein, during the cooking of vegetables appear to be of little nutritional importance that is merely because these foods are very minor sources of those substances of which the percentage losses are or may be considerable. A survey of the scattered literature suggests that vitamin losses during the cooking of vegetables are due to the same causes as losses of salts, *i.e.*, they are largely due to leaching. Some of the vitamins, however, are chemically unstable and subject to destruction under the conditions of cooking, so that in these cases some part of the vitamin is actually destroyed.

The water insoluble vitamin or pro-vitamins appear

Table 2 : Loss of certain constituents in the boiling of vegetables compared with the daily intake of these constituents

Vegetables	Amount g	Loss mg.					
		Na	K	Ca	Fe	P	Carbohydrates
Potatoes	150	--	144	1.0	0.27	4.50	0.14
Carrots	50	30	40	3.4	0.10	2.00	0.95
Green peas	50	--	76	0.75	0.20	10.50	1.15
	Total	30	260	5.15	0.57	17.00	2.24
Dialy intake	--	mg.	mg.	mg.	mg.	mg.	g
		4600	3400	700	14	1400	300

Table 3 : The following table shows which nutrients are sensitive to these influences

Nutrient	Heat	Air	Water	Fat
Vitamin A	X			X
Vitamin D				X
Vitamin E	X	X		X
Vitamin C	X	X	X	
Thiamin	X		X	
Riboflavin			X	
Vitamin B ₆	X	X	X	
Folate	X	X		
Vitamin B ₁₂	X		X	
Biotin			X	
Pantothenic acid	X			
Potassium			X	

to be little affected by cooking especially in case of carotene. Water soluble vitamins appear to be lost by soaking out and the loss of these is affected by the same factors which affect the loss of minerals, but because of the destructive effects of cooking on the less stable members of this group, losses are much more variable than in the case of salts and are affected by factors which have little effect on salt losses. There is ample evidence that the volume of cooking water has a great effect on the losses of ascorbic acid and other water soluble vitamins. Losses are least, other things being equal, when the volume of water is kept at a minimum and therefore when steaming is substituted for boiling. For potatoes, cooking without water *i.e.*, roasting, baking or frying gives the greatest retention of vitamin C and when boiling is used, retention of the skin affords considerable protection against leaching. Vitamin B₁ and ascorbic acid are both

subject to destruction, the former being heat labile especially at high pH, the latter subject to oxidation catalyzed by Cu and by certain enzymes, this also being more rapid at pH above 6. Accordingly, the losses are greater if cooking is slow and especially by the initial raising of the temperature before enzymes have been destroyed. The destruction of ascorbic acid and Vitamin B₁ appears to continue after cooking is complete and the vegetables exposed to air, await serving.

Cooked or raw food has the same amount of Calcium, Phosphorous, Magnesium, Iron, Zinc, Iodine, Selenium, Copper, Manganese, Chromium and Sodium. The single exception to this rule is Potassium, which although not affected by heat or air escapes from foods into the cooking liquid. With the exception of vitamin K and the B vitamin niacin, which are very stable in food, many vitamins are sensitive and are easily destroyed when exposed to heat, air, and water or fats (cooking oils).

Cooking tips to preserve nutrients: No matter what cooking method is used, the most nutrients can be preserved by following the below mentioned guidelines:

- Cut vegetables into large pieces or cook whole.
- Put a lid on the pot to retain the steam.
- Minimize the amount of water used.
- Have the water boiling before adding the vegetables.
- Minimize the cooking time.
- Use the cooking water for soups and gravies.
- Root vegetables including sweet potatoes, carrots and potatoes should be cooked whole and unpeeled.
- Place vegetables into ice water immediately after blanching.
- Serve cooked vegetables quickly.

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