

Role of vegetables in human diet

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There are hundreds of common vegetables eaten in different parts of the world. A regular supply of vegetables either fresh, frozen or canned should be an essential part of good living and good feeding as they add to the elegance and attractiveness of a meal. In developing countries, the consumption of vegetables for health reasons is all the more important.

PRODUCTION AND CONSUMPTION

In Pakistan, the wide range of agro-climatic conditions permits the production of a variety of vegetables. Since 1970, vegetable production has been growing at an average rate of 3.4 percent per year, reaching 3.1 million tons in 1983-84. Punjab is the major producer of vegetables, followed by Sind, NWFP and Baluchistan. During the current Sixth Five-year Plan (1983-88), the Government is continuing its efforts to accelerate the vegetable production through the adoption of

new technology and utilization of production inputs and services.

The excessively high proportion of wastage during the production, transportation and marketing of fresh vegetables is a problem of serious dimensions as it ultimately leads to lower net returns for the grower, increases the prices for the consumers and drastically reduces the availability of vegetables for local consumption and surplus for exports.

According to Micro-nutrient Survey (1976-77), the daily per capita intake of total vegetables (leafy, starchy roots and others) was 76 g as compared to 95 g in 1965-66. However, the consumption of green leafy vegetables was increased from 10.8 g in 1965-66 to 33.1 g per person per day in 1976-77. Green leafy vegetables alone provided 18.4 percent of the total iron intake in the average national diet and along with other vegetables, contributed 38.3 percent to pro-Vitamin A consumption. The rural people consumed more

vegetables than those living in urban areas. According to Nutrition Survey of Northern Areas of Pakistan (1980), the per capita consumption of total vegetables in these areas was 214 g per day.

NUTRITIVE VALUE

The chemical composition of green leafy vegetables (spinach, cabbage, lettuce, coriander, etc), roots and flowery (onion, turnip, carrot, radish, cauliflower, pumpkin, etc) and starchy roots (potato, sweet, potato, yam, etc) is given in Table 1.

In general, the value of vegetables as a source of energy is very small. The large bulk of vegetables helps to promote satiety and this, with other energy value, makes them useful in the prevention and treatment of obesity. Vegetables are also of insignificant value as a source of proteins and essential amino acids. All vegetables contain indigestible cellulose fibre. This increases the bulk of the faeces. In this way, vegetables, by increasing the size of the stool, have a mild laxative effect. People who eat a diet rich in vegetable fibre have a lower mortality from ischemic heart disease than those who eat a Western type diet. A marked decrease in the intake of dietary fibre may result diverticular disease of the colon, appendicitis, cancer of the large intestine, hiatus hernia, haemorrhoids and varicose veins. All of these diseases are rare in communities consuming plenty of vegetables in their diets. Some of the side-

Table 1. Chemical composition (as purchased) of vegetables

Component	Vegetables		
	Leafy (Range)	Roots and flowers (Range)	Starchy roots (Range)
Moisture, percent	75-80	70-90	65-80
Energy, Kcal/100 g	10-50	10-50	50-125
Carbohydrate, g/100 g	1-12	2-10	10-25
Protein, g/100 g	1-4	0.5-2.5	1.5-2.5
Fat, g/100 g	Trace	0-0.4	Trace
Calcium mg/100 g	25-500	20-100	10-30
Iron, mg/100 g	1-25	0.5-4.0	0.5-2.0
Carotene, μ g/100 g	600-6000	0-180	0
Ascorbic acid, mg /100g	10-200	5-100	5-25
Thiamin, mg/100 g	0.03-0.08	0.05-0.20	0.05-0.10
Riboflavin mg/100 g	0.03-0.25	0.01-0.20	0.03-0.08
Nicotinic acid mg/100g	0.2-1.0	0.1-1.0	0.5-1.5
Folic acid mg/100 g	20-100	2-30	—

effects of dietary fibre are the unavailability of dietary calcium, zinc and iron to the body in the presence of phytic acid present in the fibre. However, phytic acid has been reported to be destroyed by heat during cooking.

Consumption of green and yellow vegetables helps meet the body's needs for minerals and vitamins and in a small way, for protein. These vegetables are especially good source of iron and Vitamin A value. In general, the darker the colour of the vegetable, the larger the content of iron and vitamin A value found in them. All vegetables contain valuable amount of ascorbic acid (Vitamin C), but the quantities are variable and losses in cooking and preparation

may be big. However, a single helping of vegetables (90 g) daily even it has been badly treated by the cook, will usually provide at least 10 mg of Vitamin C, an amount known to prevent scurvy. All vegetables contain small amount of B Group of vitamins, but their contribution to the total intake is seldom big. Some vegetables such as garlic and pepper are bactericidal. In developing countries, it is possible to improve the nutritional status of population at risk of malnutrition by a small increase in the vegetable supply. A poor woman with insufficient iron, Vitamin A and ascorbic acid in her diet may find great improvement in her health as a result of taking one helping of good vegetables a day.

GREEN LEAFY VEGETABLES

An immense variety of dark green leafy vegetables exists, many of which are known to be edible. In general, edible green leafy vegetables appear to be under-utilized throughout the world and may in some areas even be diminished in use. These are inexpensive, high yielding, already part of the local diet and often easily available, but these have a low status frequently.

Nutritionally, many edible leafy vegetables are excellent sources of carotene, folate, niacin, iron, Vitamin C and calcium. These are of special importance in the prevention of avitaminosis A, a major cause of blindness in young children. Leafy vegetables are best considered as vitamin and mineral supplements. They contain 1-4 percent protein in the fresh state and between 20 and 40 percent when dried. Moreover, protein is usually high in lysine and tryptophan, so that these are valuable in supplementing the amino acid deficiencies of cereals and improving the protein quality of cereal-based diets in much the same way as do legumes. The young tender leaves are more digestible and contain less fibrous material. These vegetables may be eaten as fresh leaves or in a powdered form obtained by sun-drying and or smoking.

In the prevention of blindness, it has been shown in India that children between two to five years of age may eat, digest and

benefit from 30 g of leafy vegetable each day. Leaf protein concentrate (LPC) has been found capable of replacing 50-74 percent of milk protein in the children recovering from protein malnutrition with only a slight reduction in nitrogen retention and absorption. However, in the dry processed form, the unfamiliar green colour might render them unattractive as human food.

The nutrient content of green leafy vegetables is known to be modified by storage and cooking procedures. Cooking does not alter the calcium and iron contents, but significantly lowers the concentration of vitamins. Losses in carotene are not marked but ascorbic acid is lost to a great extent. As much as 50-70 percent of ascorbic acid originally present may be destroyed by conventional cooking methods and cooking under pressure cookers does not seem to modify these losses. Consumption of raw green leafy vegetables has obvious advantages. However, one of the important considerations of their use in the raw state, particularly in rural areas, is the risk of introducing bacterial infections and parasitic infestations.

ROOT VEGETABLES

The nutritive value of these vegetables is almost similar to leafy vegetables except having low contents of calcium and iron. Carrot is the main source of carotene (Vitamin A). In contrast, turnip is good source of

Vitamin C but it contains no carotene. A recent study in Canada has established that "a carrot a day may keep the doctor away". According to this study, men and women having lip and mouth cancer were treated by beta-carotene (Vitamin A). Similarly, British scientists have discovered that people with high content of Vitamin A in their bloodstream have a 40 percent lower cancer risk than most normal people. Both carotene and Vitamin A are stable to most methods of cooking although there is some loss on frying.

Vegetables lose a large part of their carotene when they are air-dried as in old-fashioned methods, but much less when they are dried rapidly at a low temperature as in modern factory processing. Boiled or cooked carrots have better digestibility and available carotene than raw carrots. Both Vitamin A and carotene can be absorbed only in the presence of fat and there are some parts of the world where Vitamin A deficiency is caused not so much by a shortage of the vitamin as by a shortage of fat in the diet. To keep the skin and eyes healthy and to prevent blindness and cancer, an amount of 400 g of carrot would be sufficient to fulfil the requirements for one week. The Pakistan Agricultural Research Council (PARC) is giving high priority to increase vegetable production in the country. It has been planned in collaboration with USDA to introduce high-carotene carrots

having three to five times more carotene (Provitamin A) than the traditional varieties.

STARCHY ROOTS

The nutritive value of starchy root is shown in Table 1. Potato is the most important food of this class. It has two remarkable properties. Firstly, it is the cheap food that can best support life when fed as the sole item of diet. Secondly, potato yields more energy per acre than any cereal crop. About half an acre of land can produce enough potatoes to meet the total energy needs of a family of five persons for one year.

Over the years, potato has been the subject of many extraordinary misconceptions. Many Europeans once believed that it caused leprosy; the Scottish and Russians believed that eating potato was sinful since it was not mentioned in the Bible, and to the Irish potatoes were an aphrodisiac and tend to increase the production of offsprings. In America, even now it is believed that potato fattens the human body.

Potato contains 75-80 percent of water and yield 70-90 kcal per 100 g. The protein content is low, about 2 g/100 g, but it has a high biological value. Potato is a useful source of protein and Vitamin C, especially if large amounts are eaten. A diet based on potatoes as a sole source of nutrients, provides all of the riboflavin, 1½ times the iron, 3-4 times the thiamin and niacin and more than 10 times

Vitamin C the body needs. Potato also contains magnesium, potassium, phosphorus, calcium, copper and other important mineral elements, 27 or more amino acids and more than 1000 different enzymes. In fact, a diet of whole milk and potato would supply almost all the food elements necessary for the maintenance of the human body. Potatoes are easily digested and well absorbed, thus a good food for invalids. Most people think that potato fattens human body because of its starch content. But, starch and other nutrients make up only 20 percent of potato, the remaining 80 percent is water. They, of course, like other foods form fat if eaten in amount sufficient to make the energy value of the diet greater than the daily energy consumption. The consumption of potatoes in Pakistanis' diet is very low. The average consumption is 26 g/head/day as compared to 140 g/head/day in America. Potato contributes 0.4 percent of the total calories in our diet. It is interesting to note that the consumption of sugar is increasing in our diet. Sugar provides empty calories and its excessive use may cause health problem. The contribution of sugar is 13 percent of the total calories which is higher than Japan (8.8 percent) and New Zealand (12.1 percent). There is an urgent need to educate people to eat more potato and reduce the sugar content in the diet. The quality of potato should be improved by increas-

ing the total solid contents and it may be bred genetically so that it may not blacken during storage or darken before or after cooking.

SOCIAL CONSTRAINTS

One of the major problems of including green leafy vegetables in the diet is the strong food beliefs and prejudices held by many rural communities. These are believed to be unsuitable foods for infants, children and even for pregnant and lactating women. Vegetables are considered to be "cold food" and predispose gastro-intestinal upset.

The presence of harmful or antinutritive substances in vegetables is known to have adverse effects on man.

A number of fatal incidents among infants in European countries following the use of processed preparations containing spinach led to the observation that the nitrate in these preparations was responsible for the toxicity. When nitrate fertilizers are used to grow vegetables the nitrate content shows a 3-12 fold increase. The ingestion of such vegetables may cause toxicity to infants and if severe, can lead to coma and death. This problem seems to be of importance in developed countries where the practice of feeding young infants on canned spinach is prevalent.

Other substances such as goitrogens in turnips and cabbage, thiocyanate in cabbage

and cauliflower, glycosides in mustard leaves, serotonin and tyramine in tomatoes, protease inhibitors in potatoes, cholinesterase inhibitors in potato, pepper cabbage, carrot and tomato and anti-vitamin factors such as ascorbic acid oxidase in cabbage, cucumber, pumpkin, carrots, potatoes and tomatoes and thiaminase in mushrooms. Among these inhibitors, it is possible to find compounds that are non-toxic to man and that could be synthesized and used as insecticide — a part of the plants defence against insects. Most of the anti-nutritive substances are inhibited by heat during cooking.

Phytate present in fibre can reduce the absorption of calcium, iron and zinc. However, phytate content can be reduced during processing.

Oxalic acid content in spinach, potato and tomatoes may interfere with the absorption of minerals. It causes calcium deficiency in man and higher doses of 1 to 2 g of body weight is toxic to kidney. The boiling of vegetable and discarding the water in which the vegetable has been cooked promote the elimination in part of the oxalic acid contained in vegetables.

Industrial contamination of the environment may increase the level of toxic mineral elements (lead, cadmium, mercury etc) in vegetables. In the long run such pollution may change not only the characteristic of foods and their health related properties but may also

influence the agronomic conditions of their production.

A single vegetable may cause different disorder in different people. Some people are allergic to tomatoes and much more rarely to peas and spinach and more rarely still to potatoes.

The human body possesses efficient defence mechanism and a great ability to adjust to circumstances which enable to counteract such substances that are of moderate or medium toxicity. The populations that are or could be endangered by eating natural food that are liable to contain harmful substances should be educated and informed about nutrition. Equally, it would be worth educating the general public about the benefits of progress made in agriculture.

POINTS TO PONDER

- o The nutritional importance of vegetables in diet should be emphasized and regular consumption should be encouraged by adopting intensive educational measures.
- o All available information on nutritional quality and

dietary uses of vegetables should be collected and made available to those engaged in field nutrition work.

- o Research is needed into the metabolic response regarding availability and utilization of vitamins and minerals by young children and adults to different amounts of various species of vegetables.
- o Systematic study of the nutritional composition and toxic factors should be made.
- o Studies on yield, cooking quality, disease resistance, resistance to insects, nematodes etc. are also important for increasing production of vegetables.
- o To avoid vitamin C losses during the preparation of vegetable, the following recommendations may be considered:
 - o Soak the vegetable in water for only a short period
 - o Cook it in the minimum amount of water in

a closed pan. Always put the vegetable in boiling water.

- o Pressure cooking is a good method of cooking without much loss of vitamins.
- o Losses are reduced by avoiding water i.e. cooking in fat.
- o Eat the cooked vegetables as soon as possible after cooking.
- o Use plastic vessels for storage and preparation of vegetables.
- o Copper cooking pots will lead to rapid destruction of vitamins.
- o Protect the raw vegetables from frost and do not allow them to become frozen in the refrigerator; keep them in the cool rather than the cold part.
- o Quick freezing at temperature -10°C or -27°C prevents the formation of large ice crystal and the plant tissues are undamaged so Vitamin C is not lost.