

IMPORTANCE OF OLERICULTURE

India is the second largest producer of vegetables in the world (surpassed only by China), accounting for about 10 per cent of the world's production. In 2002, India produced 78.2 million tons from 5.73 million ha of land. Indian farmers grow an amazing number that is 175 different vegetables but potato, tomato, onion, cabbage and cauliflower account for 60 per cent of total production.

It is projected that the domestic vegetable requirements will rise from current levels of 83-91 million tonnes to 151-193 million tonnes by 2030. Indian farmers today cannot meet the high domestic demand for vegetables, as India imports approximately \$678 million of vegetables annually.

To increase domestic vegetable production, improvements are first needed in the vegetable seed industry. There are now more than 50 seed companies developing new vegetable varieties, with increased emphasis on high-yielding hybrids. The Indian Council of Agricultural Research has three major institutes for conducting research on vegetables: Indian Institute of Horticultural Research (IIHR) in Bangalore, Indian Institute for Vegetable Research (IIVR) at Varanasi, and Indian Agriculture Research Institute (IARI) in New Delhi. Almost all agricultural universities and the State Department of Agriculture are involved in vegetable research and development. Among the 25,000 plant scientists in India, at least 1,000 are conducting research on vegetables. To increase year-round vegetable consumption, the seasonality of production must be reduced. Processing can make vegetables more accessible year-round, but less than 7 per cent of India's vegetable production is processed. Another factor that limits consumption is post-harvest damage. Currently 20-25 per cent of vegetables produced are lost due to poor post-harvest handling, and in the case of tomato and cabbage, Post-harvest losses are as high as 60 per cent. To remedy these losses, special cold storage vegetable markets and supermarkets are emerging in metropolitan areas. Specialized vegetable marketing centers are organized in strategic locations and vegetables farmers receive assistance to transport and systematically market their produce.

Vegetable exports under WTO regime

India is a major exporter of vegetables, exporting approximately \$246 million of vegetables annually. In the past, Indian vegetable exports were restricted to potatoes and fresh onions. But now the Government of India observes great opportunities for expanding exports of several more vegetables, including lettuce, fresh peppers, tomatoes, squash and gherkins. For example, the export of fresh tomatoes alone increased eight fold.

Export potential

The world trade organization (WTO) and General Agreement on Tariffs and Trade (GATT) has opened new opportunities for exporting fresh and processed vegetables. During 2001-02, Rs. 582.31 crore have been realised with the export of total fresh vegetables. In India, Agricultural and Processed Food Products Export Development Authority (APEDA) is the nodal organisation to access the market, guide and promote export of agricultural commodities. APEDA has identified traditional vegetables including okra, bitter gourd, chilli, onion, potato and non-traditional vegetables like asparagus, celery, sweet pepper, sweet corn, baby corn, green peas, french bean, cucumber, gherkins and cherry tomato having good export potential. Cultivation of new vegetable like gherkin, baby corn, sweet corn, broccoli, Brussels sprouts, Chinese cabbage, asparagus, celery and parsley is one the rise trends and provide better returns. The vegetables being exported include okra, tomato, baby corn, cucumber, gherkins, chillies, french bean, capsicum, bitter gourd, bottle gourd, onion and potato. Usually, nontraditional vegetables are exported to European countries and Australia, in addition to Gulf and South East Asian Countries. Whole pod edible garden pea is also in demand in European countries. However onion and traditional vegetables are being exported to Malaysia, Singapore, Gulf countries, Sri Lanka, Bangladesh, Pakistan and Nepal.

Export of processed vegetables

The Government of India while realising the global potential of processed fruits and vegetables, even in dried and dehydrated form. has classified the horticulture development as a thrust area. A national policy and programme has been formulated in this regard, there are a number of schemes facilitated at Centre/State Govt. levels for development of this industry. The Ministry of food Processing Industries has been offering appreciable economic incentives to promote food parks in the country, while APEDA/Ministry of Commerce encourages and supports the establishing of Agri Export Zones (AEZs). The installed capacity of food and vegetable processing industry in the country has increased from 1,108 million tonnes in 1993 to 2.328 million tonnes as on 1st April. 2004. The utilisation of fruits and vegetables for processing in the organised and unorganised sector is estimated to be around 2 per cent of the total production, over the last few years, there has been a positive growth in ready-to-serve beverages, dehydrated and frozen vegetables, tomato products, pickles, spices paste and curried vegetables. There are about 63 vegetables traded in the world market in dehydrated, canned and processed form. Dried and preserved vegetables are in demand in Egypt, Sri Lanka, UAE, USA and Turkey. The total quantity of dried and preserved vegetables exported during 2003-2004 is estimated to be 211.16 lakh tonnes valued at Rs, 520.49 crore. The export

of dehydrated vegetables from India is dominated by just five main products, which are onion flakes and powder, tamarind powder, dehydrated vegetables, garlic powder/flakes. The main product of export is dehydrated onion flakes/powder, which has been of the order of about 7224 MT valued at Rs.32.95 crores approximately in the year 2000-01.

Human body requires a wide range of nutrients like carbohydrates, protein, fat, vitamins and minerals for normal growth and sustenance of physiological activities. Protein, carbohydrates and fat, generally referred as proximate principles are required in large quantities and are oxidized in the body to yield energy. Protein is the major growth promoting or body building nutrient. Vitamins and minerals are required in small quantities for physiological processes and metabolic activities. Vegetables are rich and comparatively cheap sources of vitamins like β -carotene, folic acid, vitamin-B, vitamin-C, vitamin-E, minerals like iron, calcium, magnesium, phosphorus and dietary fibres. It also supplies fair amount of carbohydrates, protein (4%) and energy (10%).

Vitamin-A is essential for clear vision in dim light and its deficiency leads to night blindness and dry-eye or Xerophthalmia. Vitamin-A as β -carotene or pro-vitamin-A, which gets converted to vitamin-A in liver and intestine. Former is found only in foods of animal origin. The β -carotene is found in green leaf vegetables and yellow fruits / tubers like carrot, pumpkin, papaya and sweet potato. This fat-soluble vitamin is not soluble in water and is not easily lost while cutting, washing and cooking.

Prolonged deficiency of Thiamine (vitamin-B1) leads to beri beri disease Vitamin B 2 complex consisting of riboflavin and nicotinic acid (niacin), vitamin-B6 (pyridoxine), vitamin-B12 and folic acid (folacine) are all essential for metabolic activities and their deficiency lead to pellagra, anemia and other disorders. Leguminous vegetables, onion bulbs, green onion, sweet potato and cabbage contain a fair amount of vitamin-B group. Folic acid is abundant in spinach, other green leaf vegetables and beans.

Man requires about 50 mg of vitamin-C (Ascorbic acid) daily and is mainly met from fruits and vegetables. Its deficiency causes "scurvy" characterized by weakness, bleeding gums and defective bone growth. Vitamin-C is a strong reducing agent and is lost easily on exposure to air and on cooking. Vegetables like tomato, sweet pepper, chilli, immature bean seed and bean sprouts are good sources of vitamin-C.

Vitamin-E (α -tocopherol) prevents oxidation of β -carotene and vitamin-A in intestine. Green leaf vegetables are fairly good sources of this vitamin. Leaf vegetables like palak, fenugreek, drumstick etc. supply a fair amount of minerals like calcium, iron, phosphorus etc. Tender fruits of okra contain iodine, essential for prevention of goiter disease.

Root and tuber vegetables like potato, sweet potato, cassava, yams and elephant foot yam contain high amount of carbohydrates. Leguminous vegetables like peas, beans, cowpea and hyacinth bean are good sources of proteins (14%).

Vegetables are rich sources of dietary fibre consisting of cellulose, non-starch polysaccharides and lignin. Role of dietary fibre in protection against colon cancer, lowering of blood pressure and diabetes is realized now. It is recommended to include-40.0 g of dietary fibre in our daily diet. Most of leaf vegetables are rich sources of dietary fibre.

Recommended daily allowance (RDA) by the Indian Council of Medical Research in for an adult man is 300 g of vegetables. It includes 100 g roots and tubers, 125g of leaf vegetables and 75 g other vegetables. The RDA for a woman is 75 g roots and tubers, 125 g. leaf vegetables and 75 g other vegetables totaling to 275 g/day. However, it varies with age of people and nature of work.

Vegetables as protective food

Vegetables are protective foods as their consumption prevents many diseases. Almost all vegetables are finding important roles in traditional systems of medicine. Several chemicals having therapeutic value were identified from vegetables. Antioxidants and flavanoids are the most important among them.

Role of vegetables as a source of antioxidants in prevention of new generation diseases and delaying ageing is well recognized. Antioxidants like β -carotene, ascorbic acid (vitamin-C), α -tocopherol (vitamin-E), amino acids and flavanoids present in various vegetables act as scavengers of free radicals, which induce cancer development, brain disorders and arteriosclerosis. Free radicals are molecules or atoms with unpaired electrons and are unstable and highly reactive. These free radicals initiate chain reactions of destructive processes by removing electrons from stable compounds forming many unstable compounds, free radicals and reactive oxygen species (ROS). Inflammation, strenuous exercise, exposure to certain chemicals, radiation, UV light, alcohol, cigarette smoke, air pollutants and excess of free fat diets also produce free radicals. Ageing results in a decreased production of enzymes, which counter adverse effects of free radicals and ROS.

Antioxidants act as scavengers of free radicals and ROS, and prevent them from causing further damage. Actions of free radicals are prevented or inactivated by chain reaction antioxidants. Antioxidants have definite roles in prevention of certain cancer, age related eye diseases, coronary artery diseases and HIV. Certain minerals like selenium and flavanoids like quercetin, kaempferol, myricetin and luteolin have also been isolated from vegetables.

Onion and garlic contain several sulphur compounds like allicin and diallyl disulphide which are effective for control of blood cholesterol and preventing heart diseases. It also has antibacterial properties. The diphenylamine in onion is effective against diabetes.

Bitter melon contains a hypoglycemic ingredient 'cheratin' having effect against diabetes. Leguminous vegetables and brinjal also reduce blood cholesterol level indicating their role in preventing heart diseases. The 3-n-butyl pthalide isolated from celery is effective against hypertension. Certain species of yams contain diosgenin, used in manufacture of cortisone and contraceptive drugs.

Cole crops like Brussels sprouts, sprouting broccoli, knol khol and cabbage have anti-carcinogenic properties mainly due to hydrolysed glucosinolate derived products such as isothiocyanates and indoles. Presence of Indol-3 carbinol, offers protection against bowel cancer. Although, enzymatic hydrolytic products from glucosinolates are goitrogenic, some of the breakdown products induce enzymes responsible for detoxification of reactive carcinogens and eliminates carcinogens from mammalian tissue. The National Research Council Committee on Diet, Nutrition and Cancer, India and the American Cancer Society suggested inclusion of vegetables belonging to *Brassica* genus to reduce incidence of human cancer. In ancestral times, it was used against gout, diarrhea, stomach and celiac troubles. Cabbage juice is used as a remedy against poisonous mushrooms.

Toxic and anti-nutrient compounds

Plants produce toxins as a defense mechanism to protect from man and animals. During course of evolution and continuous cultivation, these undesirable qualities might have been eliminated by selection. Still a few harmful chemicals like trypsin inhibitors, phytates, oxalates and nitrates exist in cultivated vegetables.

Trypsin inhibitors are widely distributed in legumes, especially in raw soybeans. They inhibit activity of trypsin in the gut and interfere with digestibility of dietary proteins and reduce their utilization by affecting hydrolysis of proteins to amino acids.

Phytic acid (inositol hexaphosphoric acid) present in mature seeds of peas and beans binds iron, zinc, calcium and magnesium and reduces bio-availability of iron. On germination of grains, phytate content reduces due to enzymatic break down which improves iron availability.

Green leaf vegetables and legumes are rich source of oxalates and oxalic acid. Maximum oxalate concentration is noticed in amaranth (772 mg / 100 g). Oxalic acid converts calcium from the food consumed to insoluble calcium oxalates making it unavailable for absorption. Calcium oxalate crystals present in leaves and tubers of *Amorphophallus* and

Colocasia cause itching of skin, tongue and throat. Dietary oxalates contribute to increased excretion of oxalate in urine leading to urinary stones.

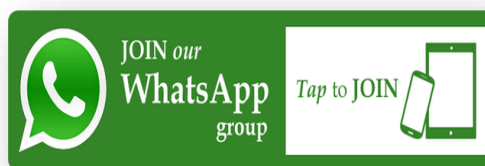
Vegetables are the single largest source of nitrate in human diet. Leaf vegetables have high concentration of nitrate. Nitrate accumulation results in serious deleterious effects. Within gastrointestinal tract, nitrate is reduced to nitrite, which is absorbed into blood stream where it binds with hemoglobin, oxidizing ferrous ion to ferric ion to form methaemoglobin. Methaemoglobin is incapable of oxygen transport and results in anoxia specifically referred to as “methaemoglobinaemia”. When nitrite ions combine with secondary or tertiary amines, N-nitroso compounds are formed, a few of which are potent carcinogens. On cooking, nitrate content gets reduced drastically.

Tapioca leaves contain glucosides, which liberate hydrocyanic acid by action of enzymes in stomach. *Dioscorea* species contain a toxic alkaloid, dioscorin that can be made harmless by boiling. Potato tubers when exposed to sunlight become green and produce an alkaloid called solanin, which is bitter in taste. A few brinjal varieties were also found bitter due to high solanin content.

All the brassicas contain glucosinolates (thioglucosides), which are sulphur containing compounds. Break down of glucosinolates with help of their associate enzymes produce the culinary flavour to cabbage, cauliflower and broccoli. The thioglucosides (sinigrin) are non-goitrogenic. But on enzymatic hydrolysis in the presence of an enzyme myrosinase, it produces allyl thiocynate-a goitrogen. At high intake levels, it causes enlargement of thyroid glands. Though cabbage contains goitrogen, its goitrogenic properties would be lost during cooking.

1. Vegetables rich in vitamin 'A'
2. Antinutritional compounds
 - a. oxalate
 - b. chlorophyll
 - c. lycopere
 - d. xanthophylls
3. Isothocynates presents in
 - a. cole crops
 - b. amaranthus
 - c. solanaceous vegetables
 - d. cucurbits
4. Temperate vegetables seed production done in
 - a. pusa
 - b. kullu valley
 - c. IHR
 - d. IIVR
5. RDA for adults
 - a. 250 g
 - b. 300 g
 - c. 410 g
 - d. 500 g

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