



E-ISSN: 2709-9385

P-ISSN: 2709-9377

JCRFS 2023; 4(1): 40-48

© 2023 JCRFS

[www.foodresearchjournal.com](http://www.foodresearchjournal.com)

Received: 15-10-2022

Accepted: 30-11-2022

**Awadhesh Kumar Yadav**

Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

**Suresh Chandra**

Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

**Tarun Kumar**

Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

**Puja**

Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

**Deepali Mudgal**

Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

**Vijai Kumar**

Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

**Correspondence****Awadhesh Kumar Yadav**

Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

## Status of vegetable processing and value addition

**Awadhesh Kumar Yadav, Suresh Chandra, Tarun Kumar, Puja, Deepali Mudgal and Vijai Kumar**

**Abstract**

The development of vegetable product is most important as it is improving shelf life of the vegetables and it also improves the quality of vegetable by the addition of value in it. These crops have high potential in maintaining sustainability in terms of economy country. Many of the vegetables are under estimate in terms of processing although they have high processing capacity. In India there are various types of vegetable are available because they are not utilizing properly although they have very high nutritive value. This review give information about processing of some of the major vegetable crops and it also cover processed product of vegetables.

**Keywords:** Value addition vegetable, processing, sustainability

**1. Introduction**

India is the one of the top vegetables producing country in the world. Vegetables are good source for dietary nutrients such as vitamins, fibers and minerals. In fresh vegetable the moisture content is more than 80% (Orsat *et al.*, 2006). Per capita consumption of vegetable in India is lower than daily requirement. It happens due to high post-harvest losses (20-40%) of fruits and vegetables in India. (Nagi *et al.*, 2020) <sup>[17]</sup> today, one of the major global challenges is to ensure food security to the ever-growing population whilst ensuring the sustainable development. According to FAO, 70% increase in food production is needed to make the food available to the world population which will reach 9 billion by 2050. Post-harvest losses are approximately 20-50% in developing countries and 10-15% in developed countries. India's climatic and soil condition provide an excellent platform for the cultivation of a wider variety of vegetables.

India is producing around 85 million tons of fruits and 170 million tons of vegetables every year. The present situation demands considering Agriculture as the major economic and commercial activity to enhance growth and national economy. The huge production base of fruits and vegetables provides excellent export opportunities for India. Despite this advantage, India's share in the global market is insignificant and accounts for only 1.7 per cent of the global trade in vegetables and 0.5 per cent in fruits (Thulasiram, 2020) <sup>[26]</sup>.

India loses about 35-45% of the harvested fruits and vegetables during handling, storage, transportation etc. leading to the loss of Rs. 40,000 crores per year. Estimated loss of Vegetables such as Onion 25-40%, Garlic 08- 22%, Potato 30-40%, Tomato 5-47%, Cabbage & cauliflower 7.08-25.0%, Chili 4-35%, Radish 3-5% and Carrot 5-9%. The losses of vegetables are a serious matter of concern for India's agricultural sector. The highly perishable commodities of vegetables are lost after harvest due to insufficient methods of harvest, decay, and over-ripening, mechanical injury, weight loss, trimming and sprouting. So that, these aspects are to be looked critically to see if any improvement in the present state of vegetable industry, especially in the context of processing and marketing are to be accomplished. (Bala *et al.*, 2020) <sup>[17]</sup>.

In India maximum vegetables are processed in order to prevent it from post-harvest losses. Since 2011 the global vegetable processing industry has grown and also expected to grow after 2020. In developing countries such as in India & Afghanistan due go increase in industrialization which leads them to attain a standard of leaving. But in some developed country, like China, USA the processing of vegetable is declining as they prefer fresh produce is being healthier than there processed product. Vegetables play a major role in the human diet as they are rich source of nutrients. They contain many phytochemicals which prevent many diseases such as hypertension, cancer, heart diseases etc. Hence consumption of vegetables is most important to lead a healthy life and achieve nutritional security.

As vegetables are seasonal they are not available throughout the year. Value addition is the process of converting vegetables to a more valuable form than its original form. Vegetables help in maintaining strong metabolism. Hence value addition is useful in achieving the food security (Saisupriya and Saidaiah 2021) [22].

Fresh vegetables are more nutritive than processed ones. Along with carrot are rich source for Beta carotene which is an important antioxidant. Beta carotene is the most important precursor of Vitamin A. Potato are a good source of fiber, which can help you lose weight, prevent heart disease by keeping cholesterol and blood sugar levels in check. As fresh vegetables are healthier than their processed product. Vegetables are important sources of many nutrients, including potassium, dietary fiber, folic acid, vitamin A, and vitamin C. Diets rich in potassium may help to maintain healthy blood pressure. Vegetable sources of potassium include sweet potatoes, white potatoes, cucumber tomato products (paste, sauce, and juice), beet greens, soybeans, lima beans, spinach, lentils, and kidney beans (Nagi *et al.*, 2020) [17].

Food processing industry including fruit and vegetable processing is the second largest generator of wastes into the environment only after the household sewage. A number of value added products such as essential oils, starch, pectin, dietary fibers, acids, wine, ethanol, vinegar, microbial pigments, flavors and gums, enzymes, single cell proteins, amino acids, vitamins, organic compounds, colors and animal feed can be made out of the waste from processing industries (Joshi *et al.*, 2020) [12].

A well developed food processing industry is expected to increase farm gate prices, reduce wastages, ensure value addition, promote crop diversification, generate employment opportunities as well as export earnings. Growth of food processing industries would provide expanding demand for farm produce, vegetables, fruits and other greens that would help improve agricultural incomes. The food processing industry has strong backward linkages with rural economy, as all the raw material is produced by rural people. Hence, any growth in food processing industry, positive or negative will have a direct impact on economy of rural India. Food processing industry would help in reducing rural urban disparity and ensuring household food and nutritional security for all at an affordable cost. The development of agro-based industries are easy to established and have the potential of providing steady and additional income to the rural people without making large initial investment. Thus, development of agro-based industries plays a significant role in the process of economic development in the country as a whole.

Promoting food processing is seen as a way to enhance farm incomes in India as it raises the demand for agricultural products for further value addition (Ghosh, 2014) [29]. Value addition to food has assumed critical importance in the last decade due to socio-economic and industrial factors. Preservation and processing of food products has a prolonged history in human civilization. Organized food cultivation is believed to have taken place 10,000 to 15,000 years ago. By the middle of the nineteenth century, common agro processing industries included hand pounding units for rice, water power driven flour mills, bullock driven oil ghanies, bullock operated sugar cane crushers, paper making units, spinning wheels and handloom units for weaving. Large scale commercial food processing and retailing

originated in Western Europe and the United States and the two regions today account for 35 per cent of the world's largest food manufacturing firms.

Food processing is one of the largest global sectors at \$7 trillion annual production. According to NSDC's report on food processing the Global Processed Food Industry is valued at US \$ 3.2 trillion and accounts for over 3/4th of global food sales. Despite the large size of the industry, only 6% of the processed food is traded the world over as compared to bulk agricultural commodities where 16% of produce is traded. The USA is the single largest consumer of processed food and accounts for 31% of the global sales. This is because as countries develop, high quality and value added processed food is preferred over staple food. Indian food processing industry ranked fifth in terms of production, consumption, export and expected growth (Singh, 2012; Hussain & Yadav, 2016) [30, 31].

India's north-eastern region (NER) is endowed with various sorts of fruits, vegetables, and other agro-products, and has the potential to be a sunrise zone for food processing and other agri-businesses. It is observed that simple value addition like cleaning, sorting and packaging can increase income of farmers by 42.8% per kg. It is also observed that although Central Government and various other state governments have come out with various policies and schemes for the development of sector in the region, still that the development of food processing sector in NER is hindered due to lack of infrastructure facilities like poor connectivity with national and international market, inadequate supply chain and poor power supply (Rais *et al.*, 2014) [20].

The Indian food processing industry is still in its nascent stage, but it is poised for high growth in coming years. The total value of Indian food processing industry is expected to touch US\$ 194 billion by 2015 from a value of US\$ 121 billion in 2012, according to data released by Indian Council of Agricultural Research (ICAR). The industry registered a compound annual growth rate (CAGR) of 15.6 per cent during FY07-FY12 (MOFPI, 2012) [16]. In India, the industry is largely dominated by the ready-to-eat segment, which contributed nearly 90 per cent of the total sales of packaged foods in India FY12 (MOFPI, 2012) [16].

According to (Roy and Ojha, 2012) [32]. Development of fruit and vegetable processing is critically important to the expansion and diversification of the agricultural sector in India as well as Bengal. Such activities would reduce seasonality of consumption of a range of processed food; minimize post-harvest losses, and increase profitability and sustainability of production systems besides their impact on increasing farm income, rural employment and foreign exchange earnings and reduction in marketing risks

Vegetables offer a variety of benefits when consumed but they are not always well marketed, packaged or readily available to consumers, especially those living in urban areas. The vegetables have largely been ignored over the years, yet they are said to be highly nutritious crops that have potential to boost income of both women farmers and traders who usually produce and sell them. Poor infrastructure for transporting and handling indigenous vegetables is now a greater constraint than market demand or price in urban areas (Biodiversity for Food and Nutrition Project, 2012).

Fruits and Vegetables are highly valued in human diet mainly for their minerals and vitamins content (Grubben *et*

al., 2014) [33]. They are good sources of vitamin C, folate, β-carotene (pro-vitamin A), potassium, iron, zinc and calcium (van Jaarsveld *et al.*, 2014) [34]. Also, they are substantially high in antioxidants, bio-active compounds and fibers (Khandpur & Gogate, 2015; Wadhwa, Bakshi, & Makkar, 2015) [35, 36].

**Status of vegetables in India**

It is observed that the current status in availability of vegetables only meet half of the requirement of vitamins and minerals. Processing of vegetables by developing such techniques, which is easy to operate as well as can also produce economic quality product. In India less than 2% of the vegetables from total production is processed and in Brazil the 70% and in Malaysia around 83%. One of the most common methods for preservation of Vegetables is dehydration. Dehydrated forms of vegetables are consumed in several forms, without affecting its nutrient value. Due to post harvest losses of vegetables due to poor management, the losses of farm produce are very high. In studies it was recorded that 75,000-1, 00, 000 crore per year losses are cause due to post harvest management of food commodities (Nagi *et al.*, 2020) [17].

Demand for processed value added vegetables is growing and can be achieved through low cost processing techniques with the maintenance of nutritive and sensory quality. On average of 40% in developing countries and 70% in developed countries while in India only 2-2.5% processing is done. India is the second-largest producer of vegetables in the world next only to China and accounts for about 12 percent of the world production of vegetables. India ranks 1st in the world in terms of production ginger, okra and second-largest producer of potatoes, green peas, tomatoes, cabbage and cauliflower. During 2021-2022, the production

of horticulture crops was about 342.33 million tons from an area of 28.08 million hectares. As per National Horticulture Database published by National Horticulture Board, the total area under production of vegetable in India is nearly 11.2Mha with the production of 204.61 million tons during 2021-2022 (NHB, 2022 2nd estimate).The production volumes for major vegetables are given in table 1.

**Table 1:** Major vegetable production statics in India

S.N.	Commodity	Production (MT) (2019-2020)	Production (MT) (2020-2021)	Production (MT) (2021-2022)
1	Potato	48562	56173	53575
2	Onion	26091	26641	31703
3	Tomato	20550	20.10	20336
4	Brinjal	12682	12874	12982
5	Cabbage	9272	9560	9715
6	Cauliflower	8941	9225	9437
7	Sweet Potato	1141	1121	1159
8	Chilies (Green)	4119	4363	4272
9	Carrot	1828	1885	1867
10	Cucumber	1656	1652	1638
11	Pumpkin	2183	2205	2299
12	Radish	3184	3263	3304

Source: National Horticulture Board (NHB) 2021-2022

Presently less than 2% of fruits and vegetables are processed, even as our county ranks second in the world in terms of production. This is comparatively low when compared to other countries like Brazil (30 percent), USA (70 percent) and Malaysia (82 percent). In 2022 there is to be major production of vegetable in India according to the State of Agricultural and Processed Food Products Export Development Authority (APEDA) shown on table-2.

**Table 2:** Major vegetables producing states in India

S. N	State	Major Vegetables
1	West Bengal	Brinjal, Cabbage, Cauliflower, Potato, Sweet Potato, Okra
2	Gujarat	Okra, Brinjal, Potato, Tomato, Cabbage, Cauliflower
3	Uttar Pradesh	Potato, Peas, Okra Sweet Potato
4	Orissa	Sweet Potato, Brinjal, Tomato, Cabbage, Cauliflower, Okra
5	Tamil Nadu	Tapioca, Okra, Tomato
6	Madhya Pradesh	Tomato, Brinjal, Cabbage, Cauliflower, Okra, Potato, Sweet Potato,

Source: National Horticulture Board (NHB) 2021-2022

India is the market leader in dehydrated onions and garlic in 2022, India’s market share for dehydrated onions was 70%. The government of India has set up a separate full-fledged ministry named ‘Ministry of Food Processing Industries’ for the development and promotion of food processing industries. To boost vegetable processing, the Ministry is extending financial support for setting up new units, modernization and up-gradation of existing units. Besides, the Agricultural and Processed Food Products Export Development Authority (APEDA) has been playing a major role in the export effort of processed vegetables by providing various services to the trade and industry such as identifying new markets, regular participation both in national and international trade fairs and also launch of promotional campaigns.

India’s exports of processed food were Rs. 41460.06 crores in 2021-2022, which including the share of products like Processed vegetable (Rs. 3986.45 crores), other processed fruit Juice and Nuts (Rs. 3626.08 crores). The country has exported 217521.38MT of cucumber & gherkin to the world for the worth of Rs. 1487.30 crores during the year 2021-2022. Major export Destination 2021-2022 the U.S.A, Russia, Canada, France, Spain, Belgium and Germany. India is also a prominent exporter of Processed Vegetables to the world. The country has exported 460621.02 MT of Processed Vegetables to the world for the worth of Rs.3986.47 during the year 2021-2022.Major export destinations 2021-2022 the U.S.A, U.K, Germany, Thailand, Nepal and Canada.

**Table 3:** Export statement of APEDA products (3 years)

Product	2019-2020		2020-2021		2021-2022	
	Qty	Rs. Lacks	Qty	Rs. Lacks	Qty	Rs. Lacks
Processed Vegetables	2532769.74	276053.17	4033553.79	371862.96	4606210.02	398645.32

Source: DGCIS (Annual export)

### Processing of Vegetable products

The establishment of the new Ministry of Food Processing Industries (MFPI) at the Centre is an indication of the Government's thinking. For the purpose of achieving growth of agro-processing industry in the country the Ministry of food processing was set up in July 1988 to give an impetus to development of food processing sector in the country.

According to (Ojha *et al.*, 2018) <sup>[19]</sup>. Producer of processed fruit and vegetable items like 'Fruit based ready to serve products', 'Chutney', 'Sauces' (other than tomato), 'Pickles', 'Tomato products', 'Non fruit syrup', 'Fruit pulp' and 'Preserved items'. Processed items like 'Mango Slice in Brine' (MSIB); 'Candied/ Crystallized Fruit', and 'Dehydrated Vegetable', in the entire eastern part of the country. However, the state itself contributes more than 62 per cent in production of processed fruit and vegetable items produced by the entire eastern part of the country comprising Bihar, Bengal, Orissa, Jharkhand, Andaman, and Nicobar Island.

The value addition is determined by calculating the difference between the raw product's value, cost, and other inputs and comparing it with the returns of the value-added products. It is important to determine the agricultural products that can be value-added which can support the market and enhance the income of the agricultural producers. In addition, there is a need to build up the technology and skills needed (technology transfer and capacity building) for product innovations On-farm value addition activity offers an alternative for diversification and rural development in the event of increasingly deregulated agricultural markets. In response to the global progress in agricultural production, many farmers have turned to participate in the value-added activities of agricultural crops to ensure their survival in the intense competition in the global markets. Value addition plays an important role in overcoming the postharvest losses. It has significant implications on the farmers, suppliers, processors, distributors, and retailers who target to improve the growth

rates, the market share, the customer satisfaction, and the sustainability issues in the business plans (Hinai *et al.*, 2022) <sup>[3]</sup>.

Processing and preservation is almost inexistent in the indigenous vegetables marketing chains, the high perishability of the indigenous vegetables poses major challenges in their marketing and distribution. About 20% of indigenous vegetables are dumped in the produce marketing process of the value chain. Yet, simple post-harvest handling practices such as simple bicarbonate wash can help minimize quantity and quality losses and enables availability during the periods when they are in short supply (Acedo and Weinberger, 2010) <sup>[37]</sup>. Value addition by applying appropriate production and postharvest techniques ensures that high quality produce reaches the market and satisfies consumer expectations.

The processing through which raw food materials are changed into more readily usable form is called food processing. The food processing industry includes companies that transform livestock and agricultural products into products used for intermediate or final consumption through techniques like grading, sorting, packaging etc. (Singh *et al.* 2012; Dharni & Sharma, 2008) <sup>[30, 38]</sup>. According to Food and Agricultural Organization (FAO), processed food can be of three types: primary, secondary and tertiary.

- Primary processing involves basic cleaning, grading and packaging of raw agricultural produce that is fit for human consumption, for example packed atta, packed milk, pulses, spices etc.
- Secondary and tertiary processing involves higher level of processing where new or modified products are manufactured, for example juices, pickles, dairy products, confectionary, bakery items, chocolates etc.

The Ministry of Food Processing, Government of India indicates the following six segments within the Food Processing industry.

**Table 4:** Segments of food processing industry and products produced in India

Sector	Products
Dairy	Whole milk powder, skimmed milk powder, condensed milk, ice cream, Butter and ghee, cheese
Fruits & Vegetables	Beverages, juices, concentrates, pulps slices frozen & dehydrated products, potato wafers/chips, etc
Grains & Cereals	Flour, bakeries, starch glucose, cornflakes, malted foods vermicelli, beer and malt extracts, grain based alcohol
Fisheries	Frozen canned products mainly in fresh form
Meat & Poultry	Frozen and packed-mainly in fresh from egg powder
Consumer Foods	Snack food, namkeens, biscuits, ready to eat food, alcoholic and non-alcoholic beverages

Source: Ministry of food processing India, Annual report, 2017

There are several fruit and vegetable processing industries of cottage and small scale which manufacture jams, jellies, squash, candies, fruit juices, dried fruit/ vegetable products etc. most of the processing equipment like bottle sealers, pulpers, juice extractor, are imported from India and China Besides some modern equipment such as Tetra pack is from Sweden. While some modern fruit processing industries import mango and citrus pulps and juice concentrates from India, (Acharya *et al.*, 2015) <sup>[39]</sup>.

The primary meaning of "postharvest loss" was defined as to measure quantitative and qualitative food loss in the postharvest system (de Lucia and Assennato, 1994) <sup>[40]</sup>. It is necessary to employ modern methods to extend storage life for better distribution and also processing techniques to preserve them for utilization in the offseason in both large and small scale.

Food processing/ preservation, in the broad sense, refer to all the measures taken against any kind of spoilage in food.

It is the process of treating and handling food in such a way so as to stop or greatly slow down spoilage to prevent food borne diseases while maintaining nutritional value, texture and organoleptic quality as well as increasing shelf life. There is great scope for processing and value addition to the underutilized fruits into various products like jam, jelly, preserve, candy, confectionery, pickle, fruit drinks, dried products etc. The medicines, like ayurvedic and unani for treating ailments like common cold, gastric troubles, chronic diarrhea and dysentery, headache, constipation, enlarged liver, diabetes, bronchitis, jaundice and fever, etc. (Chadha, 2003; Agarwal and Chopra, 2004) <sup>[41, 42]</sup>.

Food processing is a series of operations by which unprocessed foods are converted into foodstuffs to prolong their duration, i.e. shelf life, enable storage, and reduce time or effort spent in culinary procedures required for it (Monteiro *et al.*, 2012) <sup>[43]</sup>. Food processing is any method used to turn fresh foods into food products. This can involve one or a combination of various processes including washing, chopping, pasteurizing, freezing, fermenting, packaging, cooking and many more.

**Table 5:** Postharvest losses of major vegetable crops

Sr. No.	Crop	Average Loss (%)
1	Onion	8.20
2	Tomato	12.44
3	Cabbage	9.37
4	Cauliflower	9.56
5	Green pea	7.45
6	Potato	7.32
7	Tapioca	4.58

Source: (Jha *et al.*, 2015)

### Value added products of vegetables

In India, the value addition is only 8-10% compared to 23% in China, 45% in Philippines or 188% in UK. Irregular accessibility of good quality raw material from a reliable source for processing units is main challenge. In India, the processing is an ancient traditional method used for processing of fruits and vegetables in the form of pickles, chutneys, jams, jellies or juices, vinegar, etc. It is in practice at various levels i.e., domestic level (43%), cottage scale (18%), small scale (17%), large scale (9%) and relabeling scale (14%). vegetables undergo a number of changes after harvesting and these may not be necessarily desirable ones. These post-harvest treatments not only minimize the chances of decay but also extend their storage and market life. Commonly employed post-harvest treatments include washing with chlorine, treatment with calcium chloride or calcium nitrate to reduce post-harvest decay as well as enhancing the shelf life by controlling certain undesirable physiological changes. This also maintains nutritional quality and firmness of the produce. Among the different vegetable wax gourd, tomato and pea are processed more than 5% of their total fresh produce. Fresh vegetables are similar to living organisms and as such undergo normal life processes even after harvest. Loss in postharvest quality of vegetables is also affected by storage temperature, relative humidity and other factors (Kader, A.A., 2002) <sup>[44]</sup>.

The value of changed product is termed as value addition. Value addition is a process of increasing the economic value and consumer appeal of an agricultural commodity. It is a production/marketing strategy driven by customer needs and preferences. "Value-added" is used to characterize food

products converted from raw materials through processes that give the resulting product an "incremental value" in the market place either through higher price or expanded market.

Value addition to vegetables has assumed vital importance as it prevents deterioration provides better taste and nutrition. Value addition is the process of changing or transforming a product from its original form to a more valuable state. It is done by changing form, color or using methods which helps in increasing the shelf life of vegetables. Value addition activities are concerned with the changes of utility. It is a process of increasing the value and consumer appeal of vegetables. Value added vegetables is growing and can be achieved through low cost processing techniques with the maintenance of nutritive and sensory quality. Value addition can be achieved by processing vegetables into various forms. Different types of value added products of vegetables include dehydrated vegetables, beverages, jams, purees, sauces, pickles, chutneys, juices, flour, canned vegetables, minimally processed products and vegetable powders. (Saisupriya and Saidaiah 2021) <sup>[22]</sup>.

The value addition for fresh produce is sorting, washing, cleaning, drying and packaging and value added products can be ginger powder, ginger oil, ginger candy, ginger extract and ginger garlic paste. Other than ginger, other crops of NEER also have a demand for themselves in the market, and value addition to the crops will generate more employment, increase income of self-employed people. Therefore, it is needed that state governments recognize those crops and strive towards the development of those produce. Of the fruit crops, banana, pineapple and orange are the most important, covering about 60% of the area and accounting for 66% of the production. Other important crops include litchi in Tripura and Assam, apple in Arunachal Pradesh, passion fruit in Nagaland, Mizoram and Manipur, cashew nut in Assam and Tripura and coconut in Assam, Tripura and Nagaland. In most cases, these states have missed the opportunity of processing these crops even though there is surplus production in each case. (Rais *et al.*, 2014) <sup>[20]</sup>.

**Carrot (*Daucus carota* L.):** It is one of the most important root crops of the world. It is consumed throughout the world in many forms such as fresh, as shredded, sliced, sticks or in the form of processed products. India has 88 thousand ha area under cultivation of carrot with annual carrot production of 1379 thousand MT out of which Haryana shares 27.80% followed by U P, Punjab and Tamil Nadu. Value added products of carrot include Jam, juice, candy, pickle, dehydrated and canned carrot. Carrots are also well known as a source of vitamin A because they have higher levels of carotene and processed carrots such as carrot juice is good for health (Potter *et al.*, 2011) <sup>[45]</sup>.

**Carrot pickle:** NaCl (sodium chloride) brine or potassium metabisulfite is used for the commercial production of pickle. It prevents the softening of the carrot also because it acts as a preservative (Fernads, 2000). The use of lactic acid helps in the processes of fermentation of the pickle of carrot. It has been reported that pickles are good appetizer and add the palatability of meal (Sultana *et al.*, 2014) <sup>[46]</sup>.

**Cucumber (*Cucumis sativus*):** It belongs to Cucurbitaceae family which also comprise of 118 genera and 825 species.

These family vegetables are mainly found in tropical and subtropical regions throughout the world (Sebastian *et al.*, 2010)<sup>[7]</sup>. Cucumbers considered most important from them by the world (Khan *et al.*, 2015)<sup>[48]</sup>. The fruit of cucumber consist of 90% water (Uthpala *et al.*, 2018)<sup>[49]</sup>. And they are very rich in nutrients. Although cucumber is very popular to consume raw in fresh form it is also famous in fermented form as pickles.

**Potato chips:** The most preferred variety of potato for the preparation of chips are Kufri Chipsona-1 and Kufri Chipsona-2. This variety is ideal for the preparation of potato chips. Potato chips are thin, fried, baked popular able to eat snacks used both in domestic also as in nutriment at restaurants (Wadagavi *et al.*, 2017)<sup>[50]</sup>. 100g potato chips provide about 547 calories of energy with a fat content of 37.47g, total carbohydrate 49.74 g, protein 6.56 g alongside Sodium (525mg) and potassium (1642 mg). As per ("Potato Chips - India Statista Market Forecast," 2019).

**Tomato:** Tomato processing industry is huge and processed tomato has big market. Value added products of tomato are

- Tomato paste,
- Tomato powder,
- Tomato juice,
- Tomato puree,
- Tomato sauce and ketchup (Saisupriya and Saidaiah 2021)<sup>[22]</sup>.

**Chili:** Value added products are Red chili powder, Green chili paste, Red chili paste, Red and Green chili pickle, Chili sauces, (Saisupriya and Saidaiah 2021)<sup>[22]</sup>.

**Green leafy vegetables:** Value addition in green leafy vegetables can be achieved by dehydration. They are washed, dried and powdered. Dehydrated leafy vegetables are concentrate source of micronutrients and can be used in product formulation (Joshi and Mathur, 2015)<sup>[1]</sup>.

**Pumpkin:** Seeds can be used as salty snacks after drying, roasting and salt dressing. Other products include jam and pickles. It is also a major component of vegetable sauce.

Pumpkin is grown throughout tropical and subtropical countries. This fruits is mainly consumed as vegetable, though it is used in traditional medicines in countries like in China, India, Brazil, Argentina, Mexico, America, and Yugoslavia. In Austria the pumpkin seeds have been used as source of oil (Caili *et al.*, 2007)<sup>[52]</sup>. Both pumpkin flesh as well as seeds is rich in nutritive components (Longe *et al.*, 1983; Lazos, 1986; Asiegbu, 1987; El-Adawy and Taha, 2001; Al-Khalifa, 1996)<sup>[53, 54, 55, 56, 57]</sup>. Pumpkins are cheaper as compared to carrots in cost and are abundantly available in market. Carotene content of some Spanish pumpkin varieties was found to be higher than that of carrots.

**Onion and garlic:** Different value-added products include powder, pickle, dehydrated flakes and oil. Although onion and garlic are semi-perishable crops, dehydration in to flakes would decrease bulk to store and transport besides increasing shelf life. Powders are used in preparation of pizza, bread and soups (Saisupriya and Saidaiah 2021)<sup>[22]</sup>.

Vegetables have to be improved by different value addition

activities like upgrading the packaging, Processing, handling, grading and transportation system. These kind of activities added value among to the vegetable producers, suppliers and exporters. Export expansion and demand from super market is constrained by poor quality of produces and imposition of different sanitary and phyto-sanitary criteria by the importing countries.

Value addition is a process of increasing the economic value and consumer appeal of a Commodity. It is a production/marketing strategy driven by customer needs and preferences. Produce is changed from its original form to more desirable form e.g. apple pie, jams, jellies and pickles etc. The simplest form of value addition is undoubtedly drying vegetable. For e.g. making sandarac and chana (dried radish slices). Anaerobic fermentation and drying of vegetable parts (gundruk or mountain soup) is another twist in value addition and marketing of such produce got increasing scope (Acharya *et al.*, 2015)<sup>[39]</sup>.

Value addition, such as processing (e.g., drying, blanching, and fermenting), can help address scarcity during lean seasons and mitigate the problem of high spoilage. Traditional food processing aims to maintain the supply of healthy, nutritious food throughout the year, especially in times of scarcity. Commercial food processing also seeks to generate income for the producer and seller. While most people in rural areas still rely on traditional foods for their basic needs, people in urban centers tend to buy processed and packaged foods for convenience. Today, the increasing number of women working outside the home adds to the pressure for such changes. Even people with healthy traditional diets demand external products, either as occasional delicacies, such as gas-laden drinks or as staples. Value addition as the process of transforming any agricultural commodities from a lower quality to a superior one, thereby attracting economic value. In India, value addition is limited to pickles, chutneys, preserves and candies at cottage level, which is highly decentralized and large units are located at small scale with unskilled labors. India is a global leader in production of fruits and vegetables. Fruits and vegetable processing sector is very important for overall growth in India as this sector ensures employment to skilled and unskilled labors.

#### Vegetables processing some challenges in Indian

The losses in leafy vegetables and fruit vegetables are much more than in root and tuber vegetable crops. Postharvest losses in vegetables during the storage may be least if they are stored properly under controlled conditions of temperature and humidity. In India this type of storage facility is available only in cities at higher rent. Hence a small grower cannot use it for harvested vegetables for storage. Therefore, it could be advantageous if cold storages facilities are constructed by government agencies or by private sectors near production areas for storing the produce, which can be further used by processing industries.

During a peak season, there is a local glut of produce, due to these postharvest losses in terms of quality and quantity occurs due to-

- Facilities of transportation.
- Storage facilities
- Availability of packaging material and rates
- Local cold storage facilities

### Vegetable processing in India there are some Opportunities

- India level witness 4.58%-15.88% wastage of fruits and vegetables so that there is some opportunities to investing in initiatives that including infrastructure (cold storage, processing).

- New technology for fruits and vegetables processing.
- Cold chain and pack houses uses for farm level, storage products, and end of retailers.
- Packaging technology.
- Food testing labs with latest technology.

**Table 6:** Status of vegetables having potential for commercial processing

S. No.	Product	Processed	Can be processed
1	Canned	Tomato, potato, chines cabbage, sweet potato	Okra, asparagus, carrot, snap bean and sweat pea
2	Pickled	Cauliflower, radish, turnip, ginger & pepper	Cucumber, bitter gourd, onion
3	Dehydrated	Tomato, brinjal, cabbage, cauliflower, potato, sweet potato, ginger & Chinese cabbage	Onion, carrot, garlic, capsicum etc.
4	Fermented, fried and other products	Radish, cucumber, potato, carrot, wax gourd, carrot, pumpkin	Carrot, cabbage, Chines cabbage, ratalu tapioca, etc.

### Govt. Financial support for new startup of processing of vegetables

Income Tax deductions on capital expenditure allowed at the rate of 150% for setting up and operating cold chain or warehouse for storage of agriculture produce. 100% income tax exemption available to new food processing, preservation and packaging units for the first 5 years of operation, and at the rate of 25%-30% thereafter. A fund of 20 billion created with (NABARD) for extending affordable credit to designated Food Parks and their units. Loans to food & agro-based processing units and Cold Chain covered under Priority Sector Lending (PSL) by banks. Schemes of Ministry of Food Processing Industries. Scheme for Mega Food Parks by (MOFPI) was launched. Government of India through MOFPI is putting up 42 mega food parks so for 22 mega food parks are operational. The basic infrastructure enabled, that entrepreneurs can lease for the setting up of food processing and ancillary units. Scheme for cold chain, value addition and preservation infrastructure by (Ministry of Food Processing Industries 2022).

### Conclusion

In India, value addition that supports food processing is essential to raising farm incomes since it increases consumer demand for agricultural products. The government's goal to establish India as a global food factory and market opens up a wealth of prospects for the food processing industry. India is a major global producer of several agricultural products, but its contribution to the world food trade is a pitiful 1.5%. Processing levels for agricultural products are quite low as compared to other nations, which results in significant perishable food loss. Despite having a substantial raw material base, India hasn't been able to fully realize its processing potential because of a number of issues that are impeding the expansion of this industry.

Value addition promoting food processing is a key to enhance farm incomes in India, as it raises the demand for agricultural produce. Government's initiative to make India Global Food Factory and Global Food Market brings immense opportunities for food processing sector. India is a leading producer of many agricultural commodities in the world; however, its share in the global food trade is meager 1.5 percent. Processing level of agro commodities is very low compared to other countries leading to high wastage of perishables. Though India has a strong raw material base, it has been unable to tap the real potential for processing because of certain challenges that hinders the growth of this

sector. To advance this industry, these difficulties must be resolved.

Value added products can be useful to increase nutritional value, to modify a product from its initial stage to its final stage, to maintain quality and sensory evaluation, and to increase demand in the local market. When compared to fresh veggies, processed products with value added have a huge market demand and higher market value, which can increase a farmer's revenue by doubling it. The availability of high-quality and acceptable raw materials is one of the main problems. By increasing investment in the food processing industry, this scenario can be improved. The processing industry and consumer preference for these goods are being hampered by persistent misconceptions about health-related issues including obesity and diabetes, which need for more understanding of myths about the nutritional value of vegetables. Vegetable processing is a lucrative industry in India because of the crops' nutritional value. In order to improve their level of life and generate more income than they would from the direct sale of fresh food, the Indian government is also pushing farmers to become farmer-entrepreneurs. The Indian government wants to increase the percentage of vegetables processed to over 10% by 2025. Additionally, there is a clear market for processed veggies in various consumable forms for all customer demographics.

### References

- Acharya UK, Karki TB, Gurung HP. Importance of Value addition in horticulture; c2014.
- Agricultural and processed food products export development authority, APEDA, 2022. <http://agriexchange.apeda.gov.in/indexp/reportlist.aspx>
- Alaa Al Hinai, Hemantha Jayasuriya, Pankaj B. Pathare Talal Al Shukaili. Present status and prospects of value addition industry for agricultural produce. 2022;7(1):207-216. <https://doi.org/10.1515/opag-2022-0084>
- Armachius James, Vumilia Zikankuba. Postharvest management of fruits and vegetable: A potential for reducing poverty, hidden hunger and malnutrition in sub-Saharan Africa, Cogent Food & Agriculture. 2017;3(1):1312052. DOI: 10.1080/23311932.2017.1312052
- Arya C, Joshi J. Status of Potato Production and its Future Prospects in Kumaun region of Uttarakhand. 2019 Jan-March;6(1). <http://ijrar.com/>

6. Reddy BJ, *et al.* A review on potato (*Solanum tuberosum* L.) and its genetic diversity. International Journal of Genetics, ISSN. 2018, 0975-2862. DOI: <http://dx.doi.org/10.9735/0975-2862.10.2.360-364>
7. Bala Gautam S, KK, Sahu M. A review of Post Harvest Management and value addition of horticultural crops. International Journal of Creative Research Thoughts (JCRT). 2020 July;8(7). ISSN: 2320-2882. [www.ijcrt.org](http://www.ijcrt.org)
8. Bokelmann W, Huyskens-Keil S, Ferenczi Z, Stöber S. The Role of Indigenous Vegetables to Improve Food and Nutrition Security: Experiences from the Project HORTINLEA in Kenya (2014-2018). Front. Sustain. Food Syst. 2022;6:806420. DOI: 10.3389/fsufs.2022.806420
9. Food and Agriculture Organization (FAO) database. <http://www.fao.org/home/en>.
10. Hoq MS, Raha SK, Sultana N. Value addition in vegetables production, processing and export from Bangladesh. Bangladesh J. Agril. Res. 2012;37(3):377-388. ISSN 0258-7122.
11. John Mang Muan Lian Zou, Dr. GP Prasain. A study on food processing industries for improvement of rural income in India. A study on food processing industries for improvement of rural income in India. Journal of Emerging Technologies and Innovative Research (JETIR). 2019;6(6). [www.jetir.org](http://www.jetir.org) (ISSN-2349-5162)
12. Joshi VK. Value addition to Fruit and Vegetable Processing Waste- An Appraisal. Int. J Food Ferment. Technol. 2020;10(2):35-58.
13. Kannaujia PK, Guru PN, Kale S, Dukare A, Mahawar M, Kumar R. Processing and Value Addition of Vegetable Crops: Challenges and Opportunities. ICAR-Central Institute of Post Harvest Engineering and Technology, Abohar (Punjab) 152116, India; c2019.
14. Makda Sakina. The food processing industry in India challenges and prospects. An International Peer-Reviewed Open Access Journal of Interdisciplinary Studies. 2019;12(3). ISSN: 2581-5628.
15. McGill CR, Kurilich AC, Davignon J. The role of potatoes and Potato components in cardiometabolic health: A Review; c2013. DOI: 10.3109/07853890.2013.813633
16. Ministry of food processing industries, government of India. <http://www.mofpi.nic.in>.
17. Nagil A, Chamroy T. Processing and Value addition of Vegetable Crops-A Review. Int. J Curr. Microbiol. App. Sci. 2020;9(11):2247-2260. Journal homepage: <http://www.ijcmas.com>.
18. National horticulture board database -2022, Ministry of agriculture, Government of India, [www.nhb.gov](http://www.nhb.gov).
19. Ojha Sabyasachi. Fruit and Vegetable Processing Sector in Bengal: Opportunities, Status and Challenges. Economic Affairs. 2018;63(3):641-652. DOI: 10.30954/0424-2513.3.2018.8
20. Rais M, Acharya S, Vanloon GW. Food Processing Industry: Opportunities in North East Region of India. The NEHU Journal. 2014 January-June;12(1):37-51
21. Ram Pha L. Present status and future prospectus of vegetable research and development in India; c2000.
22. Saisupriya P, Saidaiah P. Value Addition of Vegetables. Vigyan Varta. 2021;2(12):19-22. [www.vigyanvarta.com](http://www.vigyanvarta.com)
23. Shimira F, Afloukou F, Maniriho F. A Review on Challenges and prospects of potato (*Solanum tuberosum*) Production systems in Rawanda. Journal of Horticulture and post harvest research. 2020;3:97-112. [www.jhpr.birjand.ac.ir](http://www.jhpr.birjand.ac.ir)
24. Srivastava A, Sarkar PK, Bishnoi SK. Value addition in under-exploited fruits of Karonda (*Carissa carandus* L.): an earning opportunity for rural communities in India. 2017;12(2):161-163.
25. Thapa S, Thapa S. Scope of Value- addition in Potato. International journal of Horticulture, Agriculture and Food science (IJHAF). 2019 May-Jun;3(3). <https://dx.doi.org/10.22161/ijhaf.3.3.4>
26. Thulasiram R. Status and Constraints in Indian Fruits and Vegetable Export. 2020;1(4). [www.aiasa.org.in](http://www.aiasa.org.in)
27. Vasantha HP, Yu Li J. Value-Added Fruit Processing for Human Health. <http://dx.doi.org/10.5772/53161> Vegetables are the most important supplement to human diet as they provide the essential minerals, vitamins and fiber required for a balanced diet; c2013.
28. Zaheer K, Akhtar MH. Potato production, usage, and nutrition—a review. Critical reviews in food science and nutrition. 2016 Apr 3;56(5):711-21. DOI: 10.1080/10408398.2012.724479
29. Ghosh A, Thomas TA, Cudak MC, Ratasuk R, Moorut P, Vook FW, Rappaport TS, MacCartney GR, Sun S, Nie S. Millimeter-wave enhanced local area systems: A high-data-rate approach for future wireless networks. IEEE Journal on Selected Areas in Communications. 2014 Jun 3;32(6):1152-63.
30. Singh JA, Furst DE, Bharat A, Curtis JR, Kavanaugh AF, Kremer JM, *et al.* update of the 2008 American College of Rheumatology recommendations for the use of disease-modifying antirheumatic drugs and biologic agents in the treatment of rheumatoid arthritis. Arthritis care & research. 2012 May;64(5):625-39.
31. Hussain A, Yadav MK, Bose S, Wang JH, Lim D, Song YK, Ko SG, Kim H. Daesiho-Tang is an effective herbal formulation in attenuation of obesity in mice through alteration of gene expression and modulation of intestinal microbiota. PLoS One. 2016 Nov 3;11(11):e0165483.
32. Roy K, Mitra I, Ojha PK, Kar S, Das RN, Kabir H. Introduction of  $rm^2$  (rank) metric incorporating rank-order predictions as an additional tool for validation of QSAR/QSPR models. Chemometrics and Intelligent Laboratory Systems. 2012 Aug 15;118:200-10.
33. Grubben G, Klaver W, Nono-Womdim R, Everaarts A, Fondio L, Nugteren JA, Corrado M. Vegetables to combat the hidden hunger in Africa. Chronica Horticulturae. 2014;54(1):24-32.
34. Van Jaarsveld P, Faber M, Van Heerden I, Wenhold F, van Rensburg WJ, Van Averbek W. Nutrient content of eight African leafy vegetables and their potential contribution to dietary reference intakes. Journal of food composition and analysis. 2014 Feb 1;33(1):77-84.
35. Khandpur P, Gogate PR. Effect of novel ultrasound based processing on the nutrition quality of different fruit and vegetable juices. Ultrasonics Sonochemistry. 2015 Nov 1;27:125-36.
36. Manju Wadhwa MW, Bakshi MP, Makkar HP. Waste to worth: fruit wastes and by-products as animal feed. CABI Reviews; c2015 Oct 14. p. 1-26.



37. Acedo Jr AL, Weinberger K. VEGETABLES POSTHARVEST Simple techniques for increased income and market. AVRDC-The World Vegetable Center. Taiwan and GTZ-Regional Economic Development Program. Cambodia (KH). Hal; c2010 Jun. p. 37.
38. Dharni K, Sharma S. Food processing in India: opportunities and constraints. The IUP Journal of Agricultural Economics. 2008;3:30-8.
39. Acharya VV, Steffen S. The greatest carry trade ever? Understanding eurozone bank risks. Journal of Financial Economics. 2015 Feb 1;115(2):215-36.
40. De Lucia M, Assennato D. Agricultural engineering in development. Postharvest Operations and Management of Food Grains; c1994.
41. Chadha ML, Oluoch MO. Home-based vegetable gardens and other strategies to overcome micronutrient malnutrition in developing countries. Food Nutrition and Agriculture. 2003(32):17-23.
42. Agarwal A, Chopra S, Sehgal AD. Choroid plexus papilloma associated with developmental delay. The Indian Journal of Pediatrics. 2004 Aug;71:763-6.
43. Monteiro F, Genin S, van Dijk I, Valls M. A luminescent reporter evidences active expression of *Ralstonia solanacearum* type III secretion system genes throughout plant infection. Microbiology. 2012 Aug;158(8):2107-16.
44. Kader AA. Postharvest technology of horticultural crops. University of California Agriculture and Natural Resources; c2002.
45. Pötter R, Georg P, Dimopoulos JC, Grimm M, Berger D, Nesvacil N, *et al.* Clinical outcome of protocol based image (MRI) guided adaptive brachytherapy combined with 3D conformal radiotherapy with or without chemotherapy in patients with locally advanced cervical cancer. Radiotherapy and Oncology. 2011 Jul 1;100(1):116-23.
46. Sultana S, Roy PK. Optimal capacitor placement in radial distribution systems using teaching learning based optimization. International Journal of Electrical Power & Energy Systems. 2014 Jan 1;54:387-98.
47. Sebastian C, Viding E, Williams KD, Blakemore SJ. Social brain development and the affective consequences of ostracism in adolescence. Brain and cognition. 2010 Feb 1;72(1):134-45.
48. Khan A, Khan S, Khan MA, Qamar Z, Waqas M. The uptake and bioaccumulation of heavy metals by food plants, their effects on plants nutrients, and associated health risk: A review. Environmental science and pollution research. 2015 Sep;22:13772-99.
49. Uthpala TG, Marapana RA, Jayawardana SA. Sensory quality and physicochemical evaluation of two brine pickled cucumber (*Cucumis sativus* L.) varieties. International Journal of Advanced Engineering Research and Science. 2018;5(3):237393.
50. Wadagavi V, Arpita SA, Kallihal B, Siddhalingeswar B, Dadanwale S, Choukimath MC. Automatic potato chips making machine. International Journal of Science and Research (IJSR), ISSN (Online); c2017. p. 2319-7064.
51. Joshi P, Mathur B. Development of value added products from the leaf powders of dehydrated less utilized green leafy vegetables. Nutrition & Food Science. 2015 Mar 9;45(2):302-9.
52. Caili F, Haijun T, Tongyi C, Yi L, Quanhong L. Some properties of an acidic protein-bound polysaccharide from the fruit of pumpkin. Food chemistry. 2007 Jan 1;100(3):944-7.
53. Longe OG, Farinu GO, Fetuga BL. Nutritional value of the fluted pumpkin (*Telfaria occidentalis*). Journal of Agricultural and Food chemistry. 1983 Sep;31(5):989-92.
54. Lazos ES. Nutritional, fatty acid, and oil characteristics of pumpkin and melon seeds. Journal of food science. 1986 Sep;51(5):1382-3.
55. Asiegbe JE. Some biochemical evaluation of fluted pumpkin seed. Journal of the Science of Food and Agriculture. 1987;40(2):151-5.
56. El-Adawy TA, Taha KM. Characteristics and composition of different seed oils and flours. Food chemistry. 2001 Jul 1;74(1):47-54.
57. Al-Khalifa AS. Physicochemical characteristics, fatty acid composition, and lipoxygenase activity of crude pumpkin and melon seed oils. Journal of Agricultural and Food Chemistry. 1996 Apr 18;44(4):964-6.