Summer School

Cutting Edge Epitome of Processing, Value Addition and Waste Utilization of Horticultural Crops for Augmenting Farmers Income

October 01-21, 2019

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COMPENDIUM

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ICAR Sponsored Summer School

Cutting Edge Epitome of Processing, Value Addition and Waste Utilization of Horticultural Crops for Augmenting Farmers Income

October 01-21, 2019

CONTENTS

Processing and Value Addition of Vegetable Crops: Challenges and Opportunities

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Presently, 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. Huge amounts of food are lost every year worldwide due post-harvest damages caused due to physical factors (mechanical injuries), physiological factors (Wilting, shriveling, chilling injury) or some pathological factor(decay due to fungi or bacteria). These causes in many instances are interrelated i.e. mechanical injury may promote the chances of post-harvest decay in most of the cases. Post-harvest losses are approximately 20-50% in developing countries and 10-15% in developed countries. Vegetables are the most important supplement to human diet as they provide the essential minerals, vitamins and fibre required for a balanced diet. India's climatic and soil condition provide an excellent platform for the cultivation of a wider variety of vegetables.

Regular consumption of vegetables provides nutrition and health benefits – people who eat more vegetables as part of an overall healthy diet are likely to have a reduced risk of some chronic diseases. Vegetables provide vital nutrients for health and maintenance of our body. They are rich sources of many beneficial phytochemicals and nutrients. However, it generally advised to take good amount of fresh fruit and vegetables but it is not every time possible. This is possibly due to the high cost, throughout year availability and seasonal in nature. Therefore, processing is mandatory and many times it is desirable. The processed forms of vegetables may be complementary increase of total consumption as well as enabling regular intake throughout the year in place of fresh vegetable. Most vegetables are naturally low in fat and calories. Vegetables are important sources of many nutrients, including potassium, dietary fibre, 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, white beans, tomato products (paste, sauce, and juice), beet greens, soybeans, lima beans, spinach, lentils, and kidney beans. Dietary fibre from vegetables, as part of an overall healthy diet, helps reduce blood cholesterol levels and may lower risk of heart disease. Fibre is important for proper bowel function. It helps reduce constipation and diverticular disease. Fibre containing foods such as vegetables help provide a feeling of fullness with fewer calories. Folic acid helps the body form red blood cells (RBC). This reduces the risk of neural tube defects, spina bifida, and anencephaly during fetal development. Vitamin A keeps eyes and skin healthy and helps to protect against infections. Vitamin C helps heal cuts and wounds and keeps teeth and gums healthy. Vitamin C also helps to iron absorption in our body.

Value addition and processing of vegetables

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. Examples of value-added products are preserves, tomato purees, ketchup, pickles and dehydrated products. 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.

Current status of production, processing and market potential

India is the second-largest producer of vegetables in the world next only to China and accounts for about 15 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 2018-19, the production of horticulture crops was about 314.67 million tonnes from an area of 25.87 million hectares. As per National Horticulture Database published by National Horticulture Board, the total area under production of vegetable in India is nearly 10.44 Mha with the production of 195.88 million tonnes during 2018-19 (NHB, 2019 Ist estimate).The production volumes for major vegetables are given in table 1.

Table 1: Major vegetable production statistics in India

S.N.	Commodity	Production (MT)
1	Potato	52.59
2	Onion	23.61
3	Tomato	20.51
4	Brinjal	12.98
5	cabbage	9.19
6	cauliflower	9.17

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).

Table 2: Major vegetables producing states of India

State	Major Vegetables
Maharashtra	Onion, tomato, capsicum beans, brinjal,
Karnataka	Tomato, gherkin, chili, onion,
Himachal Pradesh	Cole crops, mushroom, pea
Andhra Pradesh	Chili, brinjal, tomato, okra, onion, tapioca
Gujarat	Potato, brinjal, okra, tomato, onion
Tamil Nadu	Tapioca, onion, tomato, cabbage, brinjal
Uttar Pradesh	Potato, brinjal, cabbage, cauliflower, pea, tomato
West Bengal	Brinjal, tomato, okra
Bihar	Potato, brinjal, onion, cauliflower
Madhya Pradesh	Onion, beans, potato, tomato, brinjal, cauliflower

There is huge opportunity unexplored underlying in the vegetable processing in the country viz., primary processing (Cleaning, grading, sorting, Cutting,), secondary processing (Pulp, flakes, paste, frozen, diced, canned) and Tertiary processing (Jams, jellies, chips, ready to serve drinks, Indian ethnic products). Indian vegetable processing activity is still largely based on primary processing, which accounts for 80 percent of the value addition. India presently produces a very wide range of processed vegetables, i.e., dried/preserved and dehydrated vegetables such as vegetable sauces and juices, preserved onions, cucumbers and gherkins, mushrooms and truffles, green pepper in brine, dehydrated garlic powder and flakes, dried garlic, chutneys and pickles. India is the market leader in dehydrated onions and garlic in 2014, India's market share for dehydrated onions was 37 %. 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. 27,257.69 crores in 2017-18, which including the share of products like dried and preserved vegetable (Rs. 944.65 crores), other processed fruit and vegetable (Rs. 3404.70 crores). The major destinations for Indian vegetables are UAE, Bangladesh, Malaysia, Netherland, Sri Lanka, Nepal, UK, Saudi Arabia, Pakistan and Qatar. India exported fresh vegetables worth Rs 168 crore and fresh onions worth Rs 12.7 crore to the UK in 2017-18, and trade sources said about 30 tonnes to 50 tonnes of vegetables are shipped to London on a daily basis. These declined by about 20% in the summer season when Indian vegetables grown in southern Europe compete with vegetables exported from India. Indian exporters expect that after Britain leaves EU, they may not have to face competition from southern Europe. During 2014-15, India exported fresh fruits and vegetables worth USD 1.2 Bn. Onions, okra, bitter gourd, green chilles, mushrooms and potatoes contribute largely to the vegetable export basket.

Reason for increasing demand for processed vegetables in India

- Less price of fresh produce as prices in India is fixed based on demand and supply. In peak season, when there is a glut in market prices drop down drastically and farmers didn't even get the production cost incurred.
- An increasing trend of vegetable production every year as productivity is increasing due to cultivation of hybrid varieties. Hence, the surplus produce can be processed.
- Introduction of the corporate sector in vegetable marketing as well as in processing industry.
- Increasing demand for processed products in domestic market as well as global market.
- Processing industries employ the labour with minimum wages and also the overall production cost must be lower. Such requirements can be easily accomplished in India as compared to European and American countries.

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

	2016-17		2017-18		2018-19	
Product	**Qty**	**Rs. Lacs**	**Qty**	**Rs. Lacs**	**Qty**	**Rs. Lacs**
Fresh onions	2415739.06	310606.44	1588985.72	308882.22	2183766.42	346887.38
Other fresh vegetables	980977.94	258950.82	735198.84	184878.16	720559.58	195096.87
Cucumber and gherkins (Prepd. & preserved)	179660.96	93619.23	220939.2	128522.29	212819.85	143713.31
Processed vegetables	210582.41	228003.71	226483.9	221158.88	248122.33	247399.74

Qty in MT Value in Rs. Lacs

- Processable varieties introduced or developed indigenously which are specifically used for processing in a way to increase the recovery of final products.
- The advancement in processing techniques and machinery are now being adopted by the processors in India.
- Government is also promoting the farmers/rural youth to establish their own processing industry by providing financial support to promote establish the small scale industries.
- There has been a drastic change in the eating pattern/food habits of the countrymen as people are attracted towards consuming junky foods such as pizza, burgers, pasta, noodles, etc. As the food habit can't be changed, and hence in order to enhance the consumption of vegetables, the incorporation in the form of powder, flakes, paste can be done in products prepared using extrusion techniques. Many extruded products are prepared by the incorporation of powder forms of leafy vegetables like spinach, moringa, curry leaf and fenugreek, etc. by the researchers.
- People prefer ready to use (RTU), ready to eat (RTE) processed products like onion and garlic paste, chutney, pickles, dried and dehydrated vegetables.
- Minimally processed salads, vegetables and other vegetables that have 100% edible portion.
- Rural population is continuously reducing and urban population is drastically increasing.
- Smaller family size/single working men or women leads to more usage of processed vegetables as it will reduce the time involved in cooking.
- Processed vegetables have more shelf life and are less bulky in nature.
- More nutritional value per unit volume of produce.
- Prices of processed vegetable products are more stable as compared with fresh vegetables.

Challenges for vegetable processing in Indian conditions

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. Non-availability of suitable processing varieties is also a limiting factor. 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. Though these undesirable changes cannot be stopped, it can be slowed down by certain suitable methods. 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). 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-

- Lack of transport
- Lack of proper storage facilities
- Poor availability of suitable packaging materials at cheaper rate
- Lack of local cold storage to store the surplus

The food processing sector is critical to India's development. It establishes vital linkages between industry & agriculture, the main pillar of the Indian economy. The growth of food processing will bring immense benefits to the economy,

Table 4: 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)

creating employment and raising standard of life of people across the country, especially in rural areas. Interestingly, processing industry ranks fifth in the country and employs around 13 million people directly and 35 million people indirectly. It accounts for 14% of total industrial output of the GDP. Its turnover is estimated at Rs 1, 44, 000 crores, of which Rs 1, 11, 200 crores in the unorganized sector. The liberalization of the Indian economy and world trade and rising consumer prosperity have thrown up new opportunities for diversification in the food processing sector and opened up opportunity for food processing industry growth.

Opportunities for vegetable processing in India

India is the fastest growing economy in the world. 4th largest economy in terms of purchasing power capacity. Proactive government policies with attractive fiscal incentives. Significant investments in world-class ports, logistics & supply chain infrastructure. Rich demographic dividend with high focus on skill development, availability of skilled manpower's. Good opportunity for world investors across the food processing supply chain which is currently lacking. India wastes fruit and vegetable than are consumed in United Kingdom. Frozen fruits and vegetable growth rate in India is nearly 121% while in dried and dehydrated products growth rate is 24% per annum. The other reasons owing to this quantum of post-harvest loss are higher respiration rate and higher moisture content (more than 85-90%) and poor harvesting practices. Over the last decade, the area under horticulture grew by about 3% per annum and annual production increased by 5.4%. Normally most of vegetables are consumed unprocessed but a very few are dried, canned or pickled or sometimes frozen. Vegetables are bulky in nature leading to low value per unit that's lead to costly transportation in their fresh form. So processing of produce reduces its volume that leads to less transportation cost. For achieving this, processing of vegetable should be done near its production areas. Some of the vegetables that can be processed commercially are given below:

India witnesses nearly 20-30% wastage in vegetables annually, due to lack of modern harvesting practices and inadequate cold chain infrastructure as most of vegetables are seasonal and highly perishable. Processing levels in F&V currently stand at close to 2%. Opportunity to invest in initiatives that help reduce wastage levels including adequate infrastructure (cold chain, processing infrastructure), R&D for processed food & packaging, innovative on farm preservation systems and skill development. India's location gives it the unique advantage of connectivity to Europe, the Middle East, Japan, Singapore, Thailand, Malaysia and Korea. The food processing sector ranks 1st in terms of employment & number of factories in operation and 3rd in terms of output. The industry has witnessed a growth of 7.1% during 2013-14, much higher than the growth in agriculture sector and at par with the manufacturing sector. Strategic geographic location and proximity to food-importing nations make India favorable for the export of processed foods. 100% foreign direct investment (FDI) permitted through automatic route in the food processing sector in India.

Estimated No. of Registered Food Processing Industries in India was 1133 during 2014-15 (Source: http://www.mofpi.nic.in). According to the Annual Survey of Industries (ASI), the total number of registered food processing factories in the country is 37,175. Andhra accounts for 25% of the total registered food processing units followed by Tamil Nadu (14%), Telangana (10%), Maharashtra (8%) and Punjab (7.5%).

Major Govt. financial support for setting up of new startup

Concessional rate of Customs Duty applicable to imported equipment under the project import benefits. 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 National Bank for Agriculture and Rural Development (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 Ministry of Food Processing Industries (MoFPI) was launched. Government of India through MoFPI is putting up 42 mega food parks (35 approved). The parks have around 1,200 developed plots (of approximately 1 acre each) with basic infrastructure enabled, that entrepreneurs can lease for the

Table 5: Status of vegetables having potential for commercial processing

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

Table 6: Expected opportunities in the vegetable processing sector

S.N.	Infrastructure & Technology	Processing
1	New technology in vegetable processing, cold storage, reefers, IQF, packhouses and ripening chambers	New products development- Fortified products, health food, tradition Indian food, convenience food
2	New Packaging technology for enhanced shelf life, retaining taste and texture, attractive, easy to handle and space-efficient	Processed organic vegetable especially mixed in baby food, confectionery and bakery items which have increased domestic and export demand.
3	Modern storage facilities & logistics	New product development in beverages viz. flavored muskmelon, watermelon juice drinks,
4	Energy efficient technologies	Seasonal available minimally processed muskmelon, watermelon and lauki juice etc.
5	Food testing labs	
6	R&D infrastructure	

setting up of food processing and ancillary units. Scheme for cold chain, value addition and preservation infrastructure by Ministry of Food Processing Industries.

Conclusion

Owing to the nutritional benefits of vegetables, its processing is a profitable venture in India. Government of India is also encouraging the farmers to convert themselves into farmer-cum-entrepreneur so that they can increase their standard of living and earn more money as compared to the direct sale of fresh produce. The government of India is having a target of increasing the level of processing of vegetables to >10% till 2025. There is also a definite scope of processed vegetables in different consumable forms for all groups of consumers.

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