

# Value Addition in Vegetable Based Enterprise

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**Abstract**—Globally, India ranks second next to China in vegetable production with a producing 178.1 Mt of fresh produce. Although we have achieved self-sufficiency in vegetable production for feeding the countrymen, being a highly perishable in nature, about 25-30% of India's fresh vegetable gets wasted due to market glut lack during the peak production period and lack of adequate storage and processing units. Moreover, a large number of vegetables are not available round the year because of their seasonal nature, warranting the need of their preservation through storage and processing in order to ensure their availability in lean period. Thus there is an urgent need to strengthen the network of post-harvest management both at the areas of production as well as at the retail outlets which will in turn reduce the loss by uplifting domestic consumption and diversifying vegetable products for export. With the changes in the consumers' preferences, fluctuating market behavior and emergence of supermarkets, the demand of value-added products viz., "value-added", "ready-to-use" products of potato, pea, carrot, cauliflower, tomato have also increased. Apart from these traditional vegetables, there are several non-traditional vegetables, processing and value addition of which may take a vital role in doubling the farmers' income. Moreover, the demand of frozen vegetables, organic vegetables, minimally processed vegetables; consumer pack vegetables have increased many folds. The food processing industry ranks 5th in its contribution to value addition but tops the list in terms of employment opportunities. With every 1 billion rupees investment in vegetable production in the organized sectors generates 140 man-days per year, while, the same level of investment in Small Scale Investment (SSI) units creates 1050 man-days per year. Thus, processing and value-addition ensures better market acceptance, fetches remunerative price of vegetables and additionally creates entrepreneurship for unemployed youth.

**Keywords:** value addition, post-harvest management and entrepreneurship.

## 1. INTRODUCTION AND IMPORTANCE:

India has the advantage of diversified agro-climate which provides ample scope for producing large quantities of vegetable crops and due to the development of advanced production technology, vegetable production in India has been estimated to reach 181 million metric tonnes during 2018. Recent trend in human diet is towards the larger intake of vegetables but a large number of vegetables are not available throughout the year because of their seasonal nature, warranting the need of their preservation through storage and processing. Indian farmers get only about 30% share of the

price paid by the consumers. Moreover due to market glut and lack of storage facilities, a large quantity (30-35%) of fresh produce is lost. If we consider the global scenario, less than 2 per cent of fruits and vegetables are processed in India, as compared to 30 per cent in Thailand, 70 per cent in Brazil, 78 per cent in the Philippines and 80 per cent in Malaysia. These necessitate value addition of the fresh produce. Thus, there is an urgency to strengthen the network of post-harvest management for the purpose of

1. Table and raw consumption
2. Liquids, beverages (alcoholic and non-alcoholic)
3. Health drinks
4. Pulp and other semi-liquids
5. Culinary products
6. Pharmaceuticals, oleoresins, cosmetics, confectioneries etc.
7. Recycling of horticultural waste

## 2. ADVANTAGES OF FOOD PROCESSING IN INDIA:

- India is one of the largest food producers in the world
- India has diverse agro-climatic conditions and has a large and diverse raw material base suitable for food processing companies
- India is looking for investment in infrastructure, packaging and marketing
- India has huge scientific and research talent pool
- A largely untapped domestic market of 1000 million consumers
- 300 million upper and middle class consume processed food
- 200 million more consumers expected to shift to processed food by 2010
- Well developed infrastructure and distribution network

- Rapid urbanization, increased literacy, changing life style, increased number of women in workforce, rising per capita income- leading to rapid growth and new opportunities in food and beverages sector
- 50 per cent of household expenditure by Indians is on food items
- Strategic geographic location (proximity of India to markets in Europe and Far East, South East and West Asia)

### **Indian Vegetable Processing Industries– Road Map for Future:**

India is the second largest producer of vegetables in the world (ranks next to China) and accounts for 16% of the world's production of vegetables. Among vegetables, potato, tomato, onion, cabbage and cauliflower account for around 50% of the total vegetable production in the country. The domestic industry is yet to change its preference in favour of processed foods. Consumption of value added fruits and vegetables are low compared to the primary processed foods and fresh and vegetables. The inclination towards processed foods is mostly visible in urban centers.

#### **Processing of Vegetables:**

Since vegetables are highly perishable commodities, they need to be preserved and processed in various forms rapidly after harvest. The vegetable are processed into more stable products that can be stored for extended period of time by canning, freezing or through chemical preservatives etc. Actually processing includes all the steps begins after harvest and end before consumption of food. Normally handling, transportation, reception, temporary storage, washing, sporting, peeling, size reduction i.e., slicing, blanching followed by either canning, freezing or drying.

**Canning:** Heat processing helps in destruction of microorganisms and hermetic sealing of cans prevent from further recontamination.

1. **Dehydration:** Removal of moisture by dehydration prevents the growth or reproduction of decay causing micro-organisms. It also brings substantial reduction in weight and volume, minimizing, packaging, storage and transportation cost.
2. **Freezing:** Freezing of vegetables results in substantial reduction of microbial activity as well as biochemical changes. Frozen products should be stored at  $-18^{\circ}$  C temperature till end-use.
3. **Chemical preservation:** Pickles, ketchups, sauce are made using chemical preservatives like potassium metabisulphite, sodium benzoate, acetic acid, salts etc.
4. **Freeze dehydrated vegetables :** The conventionally dried vegetables lose their structural integrity and have

poor rehydration characteristics while, freeze-dried or dehydrated ones retain their nascent texture and colour and reconstitute fairly rapidly even in cold water owing to their porous structure. Industrially freeze dehydration runs in two cycles - freezing and drying. A whole generation of vegetables can be freeze dried in particulate form or in puree or pulp/paste form. Vegetables and their products with initial moisture contents of 85-95% take about 24-30 hours to freeze dehydrated to a final moisture content of about 2%. As these products have very low moisture contents, there is no threat of residual microbial growth. The products remain shelf-stable under ambient conditions for more than a year without spoilage when adequately packed.

5. **Improved Dehydrated Vegetables:** Currently most of the dehydrated vegetables are produced by hot air dehydration which is the simplest and most economical; among the forced air drying techniques. However, conventionally, hot air dried products often lose their original shape and size at the alter thermo convective stresses, showed delayed and unsatisfactory rehydration and loose consumer appeal. It was found that treating blanched cauliflower with 3% salt and 6% sucrose for 12-16 hours at  $4^{\circ}$ C markedly reduced shrinkage and improved rehydration without affecting palatability besides increasing the shelf life of the dried products. Cabbage, brinjal and bitter gourd also showed improvements in their rehydration ratios and reconstitution times, when pretreated similarly with varying concentrations of sucrose and salt.
6. **IM Vegetables:** Intermediate Moisture (IM) foods technology offers a simple, inexpensive and excellent alternative to traditionally used dehydration and canning process for preserving vegetables. Moist infusion (desorption) of fresh vegetables in soak solution containing ingredients such as glycerol (humectant), sucrose, salt, potassium sorbate (antimycotic), potassium/sodium meta bisulphite , dextrose, pectin coupled with or without partial dehydration is intrinsic to IM technology in obtaining acceptable shelf-stable products through osmotic process. Recycling of residual infusion solution entailing filtration, decolourization, vacuum concentration and restoration of humectants, antimycotic and preservative concentration is also central to attaining economy in IM food manufacturing. This technology is indeed quite appropriate and suited to salvaging the current colossal post harvest losses in vegetables in cost effective manner. The IM carrot slices and cauliflower florets with moisture content of 47-49 and 0.80-0.83% having freshly cooked appearance have also been developed.
7. **HT Stabilized Vegetables:** Hurdle Technology (HT) stabilization is another paradigm shift in preserving vegetables, offering a value alternative to canning and

dehydration. The HT processing is a combination of processing technique in which several technological approaches and unit operations such as freezing, refrigeration, dehydration, irradiation, pulse electric fields, high pressure processing, use of chemical preservatives etc are used in unison in a synergistic fashion to bring about desired microbiological safety and sensory acceptability. This technology provides a simple process for preserving surplus and seasonal vegetables with value addition. The technique is also less energy intensive, requiring less capital investment. The products have fairly long shelf life and can be stored in flexi-polymeric packs without refrigeration. Convenience, safety, microbiological stability and fresh-like appearance are qualities of HT products.

**8. Minimally Processed Vegetables:** Minimal processing falls in the realm of an art by which trimmed and cut vegetables preserved without causing significant changes in the fresh like properties of the produce. Such products are quite suitable for salads, curries and custard like preparations. Chopping, cutting, slicing and peeling, all injures the plant materials and lead to higher respiration activity and ethylene production and enhanced senescence besides providing extra sites for pathogen entry and substrates for their growth. Minimal processing cut vegetables entails certain additive pretreatments, infusion treatments and ionizing radiations that control the spoilage microorganisms and check the onset of deteriorative physio-chemical reactions when stored at refrigeration temperatures. In minimal processing, the trimmed, peeled, cut pieces and shreds of vegetables are non-thermally treated by dipping them in a soak solution, generally, consisting of potassium meta bisulphite (0.01 – 0.09%), sodium benzoate (0.03 – 0.08%), citric acid (0.5 – 1.2%), ascorbic acid (200-300 ppm) and salt (3.0 – 6.0 %) at 25-30°C for a few hours or, at 5 ±1°C for several hours. Sweet potato, yam, bottle gourd, ridge gourd, cabbage and carrot could be stored for up to 40- 60 days depending on the nature of the produce under refrigeration without spoilage retaining their fresh-like characteristics. However, cowpea, bitter gourd, cluster bean seeds showed shelf life of only 20-25 days at the same temperature. Above all, minimal processing encompassing various non-thermal soak pretreatments including ionizing radiations offer a promising technology that can be used to improve the safety of ready-to-eat cut fresh vegetables.

#### Post-harvest value addition includes

- Primary, secondary and tertiary processing
- Operations performed on farm produce
- To provide longer shelf life
- To maintain/ improve quality

- To enhance form, space and time utility of the produce for food, feed, fibre, fuel and industrial purposes
- Farm produce includes food crops, horticultural produce, sugarcane, plantation crops, spices and condiments, medicinal and aromatic produce, livestock and fish produce, fibre, fuel crops and others
- The post harvest operations include on-farm handling, cleaning, grading, moisture conditioning, milling, extraction, cooling, freezing, roasting, puffing, flaking, retort processing, packaging, transport and storage

#### Employment generation in vegetable based enterprise:

1. The food processing industry ranks fifth in its contribution to value addition but tops the list in terms of employment opportunities with approximately 15 lakhs employed consisting of 19 percent of the total investment in the industrial sector but contributes 18 percent to the GDP.
2. Employment potential in post-harvest and value addition sector is considered to be very high. Every Rs. 1 crore invested in fruits and vegetable processing in the organized sector generates 140 persons per year of employment.
3. The same level of investment in Small Scale Investment (SSI) units creates 1050 person day of employment per year. The SSI unit in food industry employs 4, 80,000 persons, which accounts for 13% of all SSI units employed

#### Processed Vegetable Products:

Vegetables	Value added products
Tomato	Canned whole or in form of pulp, puree, paste or juice, sauce or ketchup
Onion	Dehydrated (flakes, granules, powder), paste
Peas	Canned, frozen, dehydrated
Okra	Canned, frozen, dehydrated
Watermelon	Ready to serve beverage
Cauliflower	Frozen, dehydrated
Carrot	Frozen, dehydrated, juice
Beans	Canned, frozen, dehydrated
Pickles	Mixed vegetables like cucumber, cauliflower, carrot, peas etc.

#### Enterprises for Processed Vegetable Products:

1. Dehydrated Vegetables: Vegetables are seasonal and perishable. Dehydration is one of the methods to preserve them and make available throughout the year in hygienic conditions at reasonable cost. The dehydrated vegetables are easy to transport and cater to the needs of large catering establishments. They can be used in various preparations at any season of the year. Traditional sun drying is time consuming, less hygienic and climate dependent. The process for controlled dehydration of

vegetables consists of grading/ sorting, washing, peeling/ trimming, size reduction, blanching, Chemical treatment, dehydration and packing in unit can be established.

2. **Prepackaging of Vegetables:** This simple technique involves cleaning, trimming, cutting of the fresh produce and packing the same in unit packages in polyethylene bags. Bean, carrot, brinjal, green chilli, root crops, leafy vegetables, can be prepackaged to obtain 1 to 2 times extension in shelf life in polyethylene bags under normal conditions without any refrigeration. The prepacked produce presents better consumer appeal, longer shelf life and has considerable handling advantages in transport and marketing. The major facility required at the farm level or in orchards is a packing shed.
3. **Wax Emulsion for Vegetables:** A large number of units in tiny sector can be set up for improving the shelf life of fresh vegetables in villages where they are grown for marketing in the urban areas. The wax emulsion is diluted with cold water and used for dipping fruits and vegetables. It enhances the shelf life, protects vegetables from fungal attack, and reduces desiccation and weight loss during storage. The emulsion is harmless and imparts a gloss to fruits and vegetables. The process is quite simple and economical.
4. **Evaporative Cool Stores:** Evaporative cooling system is a simple and cheap method for short term storage of vegetables. It does not depend on conventional energy sources. A 170 liter capacity EC chamber has been designed and tested. The special features are dripping system for water, compactness, easy loading and unloading through door and recycling of water. During summer months the system maintained a 20-25°C temperature and 90-95 % RH as compared to ambient conditions of 23 –38°C and 30-75 % RH. The shelf life of commodities is extended up to 20% in EC storage. The freshness is well maintained due to the high humidity environment. EC stored tomatoes develop better colour and uniform ripening. This system can also be used for various other purposes like horticulture, plant propagation, mushroom cultivation, fermentation, sericulture, etc.
5. **Pickles and Chutneys:** Pickles and chutney have a great important in the Indian menu and have now become essential items in any feast and lunch. Pickling of vegetables is an old art. A large variety of these items are method of preparation varies. The basic method is salt curing of fruits and vegetables, acidifying, addition of vinegar / oil and the spices.
6. **Instant Pickles:** The traditional pickle making involves elaborate and time consuming process. A new concept has been worked out for making an instant pickle mix of lime and mango, which can easily be reconstituted, into a tasty pickle by the simple addition of oil and water. The dry mix has the features of convenience, better keeping quality, relatively low cost of production, reduced packaging and transportation cost. The ever expanding market for pickles, both in domestic and export sectors can be exploited by adopting suitable market strategies. The process is simple and consists of the selection of fully matured commodities for picking, washing, and cutting matured commodities for pickling, washing and cutting, brine curing at optimal conditions, drying, addition of dry spice mixes and packing in unit packages.
7. **Potato Flour:** Many ready –to –eat products are prepared from potato. Units based on potato products can easily be established in rural areas and the market can be exploited in urban and semi urban centres. Potato flour, granules and mash are used in the preparation of instant foods, soups etc. as binding materials and also for preparing kheer, tikki, chops, pakoda, cutlets, stuffed paratha, kofta and other products. Production of potato flour can be taken up easily using indigenous equipment's. The process involves peeling of potato, cutting, pre-treatment with salt and permitted preservatives, soaking, granulating and drying. The dried product is ground and packed. The flour obtained by this process can be easily reconstituted with boiling water to get the mashed potato and used for making a variety of products.
8. **Potato Chips:** Potatoes are grown extensively in the northern region of India. During the glut season, growers do not get remunerative prices. Therefore it is advisable to utilize the surplus produce by preparing potato chips under hygienic conditions. The product based on developed sun drying technology is superior to the conventional one both in colour and quality. The process is simple and can be easily adopted at rural areas
9. **Potato Wafer:** Potatoes are grown extensively in the northern eastern region of India. During the glut season, growers do not get remunerating prices. Therefore it is advisable to utilize the surplus produce by preparing potato chips under hygienic conditions. The product based on developed sun drying technology is superior to the conventional one both in colour and quality. The process is simple and can be easily adopted at rural level.
10. **Tomato Products:** Tomato is extensive grown in India and used for the preparation of puree, paste, ketchup, sauce and ready- to- eat products. There is a good domestic and export market. Since the fast food sector is expanding rapidly the demand, particularly for tomato ketchup and sauces, is also increasing.

(Technology Source: CFTRI)

**Vegetable varieties suitable for processing:** The various vegetable varieties suitable for value addition in the processing industries are presented in the following table-

Crop	Varieties/hybrids
Tomato	Pusa Gaurav, Pusa Uphar, Roma, Punjab Chhuara, Arka Saurav, Pusa Hybrid 2, Pusa Hybrid 4
Carrot	Pusa Keshar, Pusa Meghalli
Onion	Pusa Red, Pusa White Round, Pusa White Flat
Bitter gourd	Pusa Vishesh, Pusa Hybrid 1
Pumpkin	Pusa Vikas
Ash gourd	Pusa Shakti, Co 1
Vegetable Amaranth	Pusa Lal Chauli
Garden pea	Pusa Pragati, Arkel
Chilli	Pusa Sadabahar, Punjab Lal, Pant C1
Cauliflower	Pusa Snowball KT1, Pusa Snowball KT25
Cabbage	Hari Rani
French bean	Pusa Parvati, Contender
Potato	Kufri Chipsona 1, Kufri Chisona 2

### Problems Post Harvest Value Addition of Vegetables in India:

The sector has been facing the problems of

1. Erratic supply of quality raw materials
2. Inadequate infrastructure
3. Inadequate investment in organized sector, fragmented Research and Development (R&D)
4. Lack of adequately trained human resource
5. Lack of quality testing and certification laboratories
6. Long chain of intermediaries contributing to high costs and inefficiencies
7. High costs of carrying inventories, working capital, and taxation
8. Overshadowing of consumption patterns by cultural practices
9. Very heavy and multiple taxation for processing industry
10. No arrangements for processing waste utilization
11. The local entrepreneurs have to compete with multinationals in terms of quality, hygiene, appearance and standards
12. The bulk handling facilities are not available in all ports
13. Refrigerated warehousing and transportation facilities are also inadequate and costly.

### Strategies for value addition to vegetable at farmers' level:

A vegetable producer can increase the market value of his produce by adopting various measures such as

1. Pre-cooling
2. Washing
3. Grading

4. Post harvest treatment (hot water treatment with or without fungicides)
5. Waxing
6. Packaging
7. Proper transportation

### 3. CONCLUSION:

Because of the liberal government and other developmental measures being taken, the future of the vegetable processing industry looks very bright. With the new hybrids and/or varieties being added the production season is also being extended. These developments shall result in the greater availability of quality raw materials to the industry thus resulting in better capacity utilization and producing a wider range of products and of international quality. The multinationals now entering the food industry have an international marketing network and have their brand loyalties all over the world. This will enable the Indian products reaching all over the world in the form and packing required. With the rise in the per capita income particularly of the middle class a drastic change in the food habits has been noticed. This will lead to an increased domestic consumption of processed foodstuffs. A strong and dynamic food processing sector could play a vital role in diversifying agricultural activities, improving value addition opportunities and creating surplus for exports of agro-food products. The desired growth of horticulture sector in general and economic prosperity of rural farmer in particular is achievable only with the effective integration and synergy between horticulture and agro based industries. Value addition ensures better market and remunerative price of the horticultural produce by making it more marketable, creating better entrepreneurship for the unemployed youth.

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