

Review Article

<https://doi.org/10.20546/ijcmas.2020.911.270>

Processing and Value addition of Vegetable Crops-A Review

Amit Nagil and Themmeichon Chamroy*

Lovely Professional University, Phagwara, Jalandhar, Punjab, India

*Corresponding author

ABSTRACT

Keywords

Value addition,
Vegetable,
Sustainability

Article Info

Accepted:

17 October 2020

Available Online:

10 November 2020

The development of vegetable product is always important as it is help is mentioning long life of the vegetables and it also improve the quality of vegetable by the addition of value in it. This paper consists of processing and value addition of different vegetables. In India there are various types of under-utilized vegetable are available because they are not utilizing properly although they have very high nutritive value. These crops have high potential in maintaining sustainability in terms of economy of country. Many of the vegetables are under estimate in terms of processing although they have high processing capacity. This review give information about processing of some of the major vegetable crops and it also cover processed product of this vegetables.

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). Fresh vegetables are more nutritive than processed ones.

Vegetables whose roots and tubers are consume are best source of calories, natural vitamins and minerals. In green leafy vegetables like spinach (*Spinacia oleracea*), amaranthus (*Amaranthus viridis*), bathua (*Chenopodium album*), mint (*Mentha spicata*) etc. along with carrot are rich source for Beta

carotene which is an important antioxidant. Beta carotene is the most important precursor of Vitamin A. Vitamin A is essential for the normal growth. Deficiency of Vitamin A decrease levels in the blood and low level in serum.

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. It is observed that the current status in availability of vegetables only meet half of the requirement of vitamins and minerals. Therefore, it is necessary to processes the available vegetables so it is important to evolve the system of processing of vegetables by

developing such techniques, which is easy to operate as well as can also produce economic quality product. This will also ensure the availability of vegetable in offseason all over the year. 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. Hot air drying by conventional tray drier or vacuum drier and sun drying can be used for dehydration of vegetables. Dehydrated forms of vegetables are consumed in several forms, without affecting its nutrient value.

Today cultivation of fruits and vegetables are very important. As it helps in generating employment throughout the year, it also used as a medium for foreign exchange. Fruits and vegetables have high nutritive value, so they play important role to fight hunger. Fruits and vegetables are good source for essential minerals, vitamins, dietary fiber, supply complex carbohydrates and proteins.

Powdered vegetables such as tomato (*Solanum lycopersicum*), carrot (*Daucus carota subsp. Sativus*) and leaves of fenugreek (*Trigonella foenum-graecum*) required simple technology for preparation. And they are used in incorporated in traditional food preparations, in this way each value is added in the product and nutrient value also maintained. 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.

In case of vegetables and fruits such as mango (*Mangifera indica* L.) and amla (*Emblica officinalis* L.) pickling is done. Pickling of cucumber is made in Africa, Asia, Europe, and Latin America (Steinkraus 2002). Khalpi is a cucumber pickle popular during summer

months in Nepal (Dahal *et al.*, 2005). Number of methods is used for the purpose of pickling, but the most common method is placing the vegetable in 5% salt.

It can be seen that during the process of storage of goods in canned there is low loss of Ascorbic acid (<15%) compare to that of fresh and frozen products. In several study that there is no statistically significant losses of ascorbic acid occur during storage of canned green beans at room temperature, and one study showed a slight loss of 6% after 18 months of storage of canned green beans (Marchesini *et al.*, 1975), (Elkins 1979) and (Fadel and Miller 1983).

In India maximum vegetables are processed in order to prevent it from post-harvest losses. It also helps the vegetables to be prevented from not only physiological or chemical spoilage it also saves it from microbial spoilage. It is important to prevent vegetables from spoilage due to moisture, enzymes or packaging. Basically, value addition is the process to convert vegetable produce to a more valuable product from its original state. The value of changed product is termed as value addition. In today's world vegetable farming is important source of employment as it provides employment throughout the year. And adding value is also very important for employment. In term of nutrient vegetables are important source of nutrient and helps in maintaining strong metabolism.

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 living. Which include good food with good health. 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. As fresh vegetables are healthier than their processed product.

Following table shows the stability of Vitamins under different conditions. (Source: FAO, 2020).

Nutrient	Air	Light	Heat	Max. cooking losses (%)
Vitamin A	Unstable	Unstable	Stable	40
Vitamin C	Unstable	Unstable	Unstable	100
Biotin	Stable	Stable	Unstable	60
Vitamin D	Unstable	Unstable	Stable	40
Vitamin K	Stable	Unstable	Stable	5
Vitamin B6	Stable	Unstable	Unstable	40
Vitamin B2	Stable	Unstable	Unstable	75
Vitamin B1	Unstable	Unstable	Unstable	55+

Stable= no important destruction ; Unstable= Significant destruction

Processing and Value addition in deferent vegetables

Onion (*Allium cepa*)

According to study onion has 6% share within the overall production of vegetables in India and about 93% of the entire export of fresh vegetables from India (Singh *et al.*, 2006). It is the one of the most commonly used vegetable throughout the world. Although it is use for the addition of taste and flavor, it also hold some medicinal value which is effective for cataract, cardiovascular disease and cancer due to its hypocholesterolemia, thrombolytic and antioxidant effects (Block, 1985), (Block *et al.*, 1997), (Stavric, 1997), (Nuutila *et al.*, 2003) and (Vidyavati *et al.*, 2010). It consist of several antioxidant from which mainly there are polyphenols such as flavonoids and sulfur-containing compounds, which have also been described in onion and garlic (Kourounakis and Rezza, 1991), (Horie *et al.*, 1992), (Yamasaki *et al.*, 1994), (Prasad *et al.*, 1995), (Block *et al.*, 1997), (Suh *et al.*, 1999), (Banerjee *et al.*, 2002), (Nuutila *et al.*, 2003) and (Gorinstein *et al.*, 2005). Onion is prosed in to different into products and is mainly exported in the form of dehydrated and canned onion.

Dehydrated onion

The water (free water) is removed from the vegetable in the processes of drying due to which microbes are not able to survive and their population reduces. The processes of drying involve the application of heat to remove moisture in the form of vapor from dryer.

Dehydrated onions are considered as a potential product in trade. India is the 2 largest producers of dehydrated onion through out the planet. There is a large demand of dehydrated onion within the ecu countries only (Murthy and Subramanyam, 1999). A positive and significant rate of growth in onion export which is of 6.27% per year is recorded (Jyothi, 2003). Dehydrated onions in the form of powder are in extensive demand in several parts of the world, for instance UK, Japan, Russia, Germany, Netherlands, and Spain (Sarsavadia *et al.*, 1999).

Canned onion

As onion is the one of the important ingredients in preparation of many food product. For the processes of canning of low-acid foods like onion will require pressure canning which kill the harmful microbes.

Pressure canning at 240 degrees kills the botulism bacteria (Jeanroy and ward, 2019).

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 (Anon, 2016).

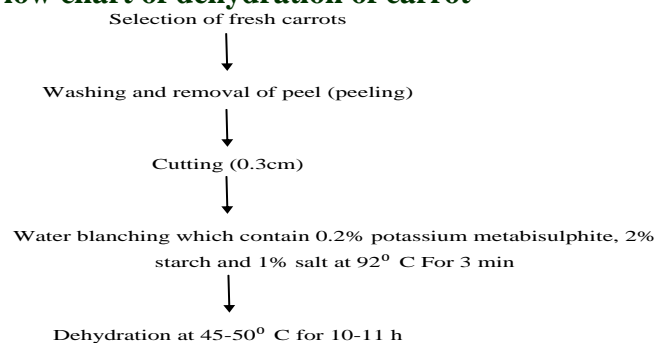
Canned carrot

Small carrots are usually use for the processes of canning. Canning can be done in many forms such as diced, halves, quartered or as a whole. The temperature requirement for blanching treatment is 71°C for 6 to 8 minutes results in better quality of canned product. To improve the colour and quality, carrots were treated thermally which caused increase in the number of carotenoids in the products (De Sa and Rodriguez-Amaya, 2004). Various studies reported that leaching of the soluble solids during blanching is the most responsible factor that causes the increase of carotenoids (Sulaeman *et al.*, 2001) and (Puuponen-Pimia *et al.*, 2003).

Dehydrated carrot: It was reported that blanched pre-treated dried carrot contains higher β -carotene with reduction of ascorbic

acid content in comparison to unblanched dried carrot. Blanching treatment also prevents the nonenzymatic browning of carrot (Negi and Roy, 2001). Prolonged drying time and overheating of the product resulted in brownish colour, loss of flavor and decrease in rehydration ability (Giri and Prasad, 2007). Pre-treatment of carrot with 5% sugar solution during blanching of shredded carrot prior to dehydration was reported to be better in retaining colour and flavor (Alam *et al.*, 2013) reported that convective drying at 65°C temperature of citric acid blanched carrot was best among solar drying, sun drying and convective drying methods. The freeze drying has been the excellent tool not only for the retention of carotenoids (96-98%) but also the flavor and colour of carrot (Rodriguez-Amaya, 1997). Combination of vacuum and microwave drying minimizes the shrinkage during drying with lower breakdown of physical structure and higher porosity (Béttega *et al.*, 2014). Drying through Ultrasonic technology is an energy efficient technology. The ultrasound assist vacuum drying of carrot will reduce the time of drying by three-fold (140 min) where as in vacuum drying it takes 340 min at same temperature of 75°C. Rehydration, colour and nutritional properties of dried carrot were more influenced by ultrasound assisted vacuum drying as compared to conventional drying methods (Chen *et al.*, 2016).

Flow chart of dehydration of carrot



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).

Carrot juice

Carrot juice are used to be mixed with other juices such as orange juice, pineapple juice and these juices are very popular in non-alcoholic beverages as it also uses in fermentation of yogurt. It was seen that the juice extract of blanched carrot is higher than the juice of cold squeezing and balanced carrot also have high number of carotenoids. Grinding of carrot in particle size from 6-2 mm increased yield by 0.7% per millimeter and also improved colour of juice for blanched and macerated carrots (Bin-Lim and Kyung-Jwa, 1996). Juice of carrot is a rich source of α and β carotene.

Carrot juice is used to reduce the bitterness of kinnow, mandarin juice. Salwa *et al.*, (2004) have incorporated carrot juice at the concentration of 5-20% in milk and prepared excellent quality carrot yogurt. To preserve the juice for extended time, some newer techniques like ozone processing, ultrasound treatment (US), high pressure (HP) and ultraviolet treatments are employed (Adiamo *et al.*, 2018). It was reported that shelf life of UV treated carrot juice was increased up to 12 days with no significant change in physicochemical and sensory characteristic of the juice stored at 4°C temperature (Riganakos *et al.*, 2017).

Carrot candy

It is a sweet food product prepared from carrot by immersing them in the sugar syrup followed by drying of excessive syrup and drying to the stable state (Haq Raees-ul and Prasad, 2015). It was reported that the entire soluble solid content of the carrot candy should be 70-75°B (Beerh *et al.*, 1984). The carrot candy which are stored in glass and LDPE material have better sensory attributes. The product stored at low temperature (1-3°C) stored in glass container retains β carotene up to 60% and can be served for 6 months (Sharma *et al.*, 2012).

Carrot jam

It is prepared by boiling the pulp with predetermined quantity of sugar and pectin till it becomes jelly in nature. Jam production is favored for fruits, researchers have made successful attempts to extend it to some vegetables like tomato, cucumber, pumpkin, sweet potato and carrot (Haq Raees-ul and Prasad, 2015). Now a days in the preparation of jam carrot juice is added with citrus juice which helps in prevention of carotene to be oxidized.

The prepared mixture is cooked with sugar and lemon juice with pectin for the formation of proper gel. The method is widely preferable as it retains most of the original compounds like phenolics, carotene, and potassium as well as colour attributes (Renna *et al.*, 2013). Black carrot juice has also been incorporated as a colouring agent in manufacturing of strawberry jam (Kirca *et al.*, 2007).

Cabbage (*Brassica oleracea var. capitata*)

It is one of the most important vegetables produced throughout the world. It belongs to the Cruciferae family. Different types of cabbage

have great variation regarding size, shape and color of leaves also because the feel of the highest (Singh *et al.*, 2006). It is measure that approx. 6.3 kg of brassica vegetables are consumed per person annually (Jordbruksverket, 2003). Cabbage usually consumed raw, but it also consumed in processed form such as Fermented cabbage also known as Sauerkraut.

Sauerkraut

It is small cut raw cabbage which is fermented with the help of lactic acid bacteria (Farnworth and Edward 2003) and (Anon. 2007). It increase the self-life of cabbage and also make its flavor sour which result from the lactic acid formed when the bacteria ferment the sugars in the cabbage leaves (Marks 2010) and (Mercola *et al.*, 2018). Basically, it is the by-product of pickling as like in case of other vegetable it simply refers to pickle but in cabbage it is known as Sauerkraut. In this processes cabbage is shredded and layered with salt and left for fermentation (Kaufmann and Klaus 2001).

Cucumber (*Cucumis sativus*)

It belongs to Cucurbitaceae family which also comprise of 118 genera and 825 species. This family vegetables are mainly found in tropical and subtropical regions throughout the world (Sebastian *et al.*, 2010). Cucumber is considered most important from them by the world (Khan *et al.*, 2015). The fruit of cucumber consist of 90% water (Uthpala *et al.*, 2018). 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.

Pickling

The pickle of cucumber is made from gherkin, which is popularly known as pickling cucumber. It has a high potential of export.

All gherkins produce is exported in processed form from country as due to processing self-life of vegetable increase. As in today's world the consumer preferences have shifted to high value vegetable product from cereals.

Pickling refers to fermented cucumber with the help of addition of salt, vinegar and spices etc. The immature fruits are used for the preparation of pickles (Purseglove 1969). The process of pickling not only extends shelf-life in vegetables but also impart desirable flavour attributes to the final product (Breidt *et al.*, 2007). The nutrient content also enhances from the processes of fermentation. The active stage of fermentation continues between 10 to 30 days, depending upon the temperature of the fermentation (Battcock *et al.*, 2006).

Ash gourd (*Benincasahispida*)

In subcontinent of India there is rich source of cucurbits are found, and it also consider as primary and secondary centre of origin of different gourds (Choudhury 2017). Ash gourd (*Benincasa hispida*) also belongs to the family Cucurbitaceae. It is also known with several names such as white gourd, Wax gourd, white pumpkin, Chinese preserving melon, tallow gourd and Chinese watermelon (Tindall 1986; Pandey *et al.*, 2015). It is very important vegetable, and it has very long storage life and it is used for the production of value added product such as Petha Badi sweet popularly known as pethamethai in India. It is a famous sweet in the world.

Petha Badi

Pethabadi is most popular sun-dried vegetable. This badi can be consumed either directly or it can be used in different dishes. Petha is very popular sweet from India. It has soft, chewy and candy like structure. It can be eaten dry or can be dipped in sugar syrup

known as Chashni. For the preparation of petha first the ash gourd fruit is peeled and seeds with fibrous portion are removed. Then the fruit is cut into large and thick pieces. Then addition of 1 tsp of lime water is used to cover the pieces then remove the pieces from them and wash it thoroughly then again put those pieces in lime water again for 2 hours. After that, the pieces washed and drained properly. Then the pieces cooked in boiling water until they become transparent and soft. Meanwhile the sugar syrup should be making. After that, the cooked pieces transfer to sugar syrup and let them cool for some time (Pandey *et al.*, 2009).

Bottle Gourd (*Lagenaria siceraria*)

Bottle gourd (*Lagenaria sicaria*) belongs to family Cucurbit. It also known as Calabash, Doodhi, and Lauki in different part of India (Deore *et al.*, 2009). In appearance it has yellowish green colour and have bottle like

shape with white pulp. In India gourd are grown in an area of 1.17 lakh hectare with the production of 1.43 lakh tonnes (Anon. 2004) and (Chadha. 2006). It has health promoting properties in it. The famous product produce from it is known as Tutti frutti (Babar.1996) and (Salunkhe *et al.*, 1998).

Tutti frutti

Tutti frutti is candy which is prepared from bottle gourd. Different methods are used for the preparation of tutti frutti as like slow syruing, single operation (boiling in sugar syrup) and slow syruing with 1% CaCl₂ (Babar. 1996). It was reported that slow syruing process are best for the preparation of tutti frutti. The prepared tutti frutii can be store in polyethylene bags for 3 months without compromising quality (Thamburaj and Singh, 2005) and (Desai and Musmade, 1998).

Preparation of Tutti Frutti from Bottle Gourd (Babar, 1996) and (Desai and Musmade 1998)

Bottle gourd (Washing, Peeling, Decoring)

↓

Cutting into cubes (0.3 to 0.4 cm³) and Blanching (3–4 min.)

↓

Calcium chloride treatment (1% solution, 3–4 h)

↓

Syruping (70oBrix, 1–1.5 h)

↓

Shade drying, packaging and Storage

Pumpkin (*Cucurbita moschata* Duch ex Poir)

Pumpkin (*Cucurbita moschata* Duch ex Poir) is additional referred to as kashiphal or

lalkaddhu is one among the important Cucurbitaceous vegetables grown extensively in tropical and sub-tropical countries like Mexico, South America, South Asia, Central

Africa, etc. It is oval or round in shape with varying size and colour (Pandey *et al.*, 2003). It is a vegetable belongs to family Cucurbitaceae. The chemical found in this family are tetracyclic triterpenes, saponins, proteins, fibers, polysaccharides and minerals (iron, zinc, manganese, copper, etc.) (Abuelgassim *et al.*, 2012). Seeds are embedded in bright-yellow fibrous endocarp and are dark red in colour. Pumpkin seed oil has been implicated in providing many health benefits (Fu *et al.*, 2006). The most critical health benefit attributed to pumpkin seed oil is preventing the expansion and reducing the dimension of the prostate (Tsai *et al.*, 2002) and (Gossell *et al.*, 2006). Pumpkin is eaten as a fresh vegetable or as an ingredient in bar, jams and pickle (Escalada *et al.*, 2007).

Fruit bar

Bar or leather it is an intermediate food product form with the processes of dehydration of pulp or puree of pumpkin (FSSAI 2011). It is semi-moist in texture and appearance is shiny (Manimegalai *et al.*, 2001). It is very high in nutrient value, so it considers healthy product. The Pumpkin bar was prepared according to the method standardized by (Dhiman *et al.*, 2018). The pumpkin bar is obtained by using rotary vacuum evaporator by applying different temperature and time (N1= 60°C for 20 min, N2= 70°C for 15 min, and N3= 80°C for 10 min).

The Pumpkin pulp was mixed with granulated sugar so as to urge the specified TSS of 40°Brix. Different method of cooking are used for preparation of bar this are C1= Preparation of bar without cooking of ingredients, C2= Preparation of bar with cooking of ingredients, C3= Preparation of bar by using concentrated pulp and without cooking of ingredients, and C4= Preparation of bar by using concentrated pulp and with cooking of ingredients (Anju *et al.*, 2020).

Pumpkin Jam

Jams are produced mainly from fruit and sugar. Sugar is produced from sugar cane or from sugar beets is added in jam to make it sweet in taste. For preparation of jam pumpkin undergoes various processes first pumpkin were washed then peeled and cut into small cubes. 5 formulations of jam were prepared to select the best proportion of sweetener. Then cubes of pumpkin boiled. The boiling is done till proper desired concentration was appeared. Citric acid and sodium benzoate were added, and therefore the mixture was stirred for a further 1 min (Amnah *et al.*, 2018).

Pumpkin Pickle

Pickles are very important processes to preserve food for long term storage of pumpkin. Pumpkin pickle is very nutritive in nature as well as it has distinctive taste from any other pickles present in the market. For the preparation of pickle of pumpkin, first marinate the pumpkin pieces with salt and vinegar for half an hour then add the marinate to pan which consist of coconut oil with other substances such as seeds of mustard and fenugreek and it also have ginger and curry leaves with other spices such as turnip powder, coriander powder, Kashmiri chilli powder, green chillies and asafoetida mix everything first than add the pieces of pumpkin. Now add salt and vinegar and cook it for 1 min. then store in glass jar (Manorama, 2020).

Potato (*solanum tuberosum*)

Potato (*solanum tuberosum*) is a tuberous, starchy herbaceous annual vegetable belong to family Solanaceae. It is world fourth largest food crop followed after maize, wheat and rice. It is also known as king is vegetables. It is staple food in many parts of the world grown for its edible tubers and

contributes substantially to the world's caloric intake ("PotatoPro," 2017) contributing around 2% of the world's dietary energy supply. Agriculture Cooperation and Farmers Welfare, out of total vegetable production of 175008 million tonnes within the year 2016-17, potato accounts for around 27% i.e. 46546 million tonnes (Horticultural Statistics at a Glance 2017). Product of potato which is commercially use as popular food is potato chips.

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). 100g potato chips provide about 547 calories of energy with a fat content of 37.47g, total carbohydrate 49.74g, protein 6.56g alongside Sodium (525mg) and potassium (1642mg). As per ("Potato Chips - India | Statista Market Forecast," 2019). Preparation of potato chips include following steps:

Fresh potato free from any deformities are taken and peeled then washed.

Then the washed potatoes sliced in 1.5-2.0 mm into slices.

Then the surface starch is removed with water.

Then the sliced are blanched in predicament at 60-80°C for 2-3 min.

Then surface dry them.

Then fry the dried slices at 180°C till they become golden.

Obtained chips are salted or spiced and packed in bags within the presence of nitrogen gas (Singh *et al.*, 2016).

Canned potatoes

For the purpose of Canning of potatoes, the preferred potatoes are immature and small. In case of larger tuber, first they cut into small pieces then they canned (Thapa and Thapa, 2019). The processes of canning include following steps:

Fresh potato peeled and wash.

Then blanching is done for 4-5 min of potatoes.

The blanched potatoes then filled in can at the rate of 500g per A21/2 size can along with 2% brine leaving about 0.8 cm.

Now, the cans are expose to heat till the temperature reach 80°C which help in removal of air from it.

In final step the cans are sealed and sterilized at 10 psi for 45 minutes and cooled (Singh *et al.*, 2016).

Tomato (*Solanum lycopersicum*)

Tomato is ranked second among the vegetables in terms of production. Averagely about 10,800 tons of tomatoes are exported annually from India. Nearly 7.1 million tons of tomato is produced annually from 5.4 lakh hectares in India. Tomatoes are generally come under vegetable because of its low sugar content. It is good source of vitamins, minerals and other useful substances like fiber essential for good health.

It contains over 80 nutrients beneficial to human (Potty, 2009). It contains lycopene and beta-carotene pigment. Potty (2009) emphasized that lycopene is also linked to improve skin health by virtue of its ability to protect against undesirable UV ray exposure. Value addition to tomato with processing can be done by converting them in other product

through different processes these products are Tomato powder, Tomato juice, Tomato puree and Tomato ketchup.

Tomato powder

The variety which is used for the production of powder is Country tomato (Namdhaari). It is found in the selected area. Tomato is first washed then seeds of the fruit are removed then let them dry in sun. Then the dried tomatoes are powdered. Products of tomato are standardized using powder of tomato (Ramadas and Thilagvathi, 2011).

Tomato juice

For the preparation of tomato juice fully ripe well-developed colored tomatoes are used. They are washed thoroughly then they are trimmed then steamed then with the help of knives cut them in small pieces.

The pieces which are crushed are heated in the steam jacketed kettle till they become soft. Then the pulp is removed from the tomatoes. It will separate juice from seeds with the help of sieve. Then add sugar with salt @ 1% and heated to 85-90°C. Then bottle the hot juice and sealed immediately and processed sterilized in boiling water for about 30 minutes and cooled (Grandillo *et al.*, 1999).

Tomato puree

For the preparation of puree, the juice should be concentrated under vacuum to about 9-12% total solid to get tomato puree. Then the product is filled in bottles and put the bottles in boiling water for 30 min and then let them cool (Freeman *et al.*, 2011).

Tomato ketchup

For the preparation of ketchup, the juice of tomato is used. The juice concentrate with

salt, sugar, spices, etc. the spices which are used are cloves, cardamom, pepper, cinnamon and other ingredients etc. are tied loosely within a muslin cloth and placed in boiling juice in steam Jacketed Kettle.

Later sugar, salt and acetic acid are added. Then it is concentrated to 28 to 30% solids in which 12% are tomato solids. The final product is then preserved by the addition of sodium benzoate @ 750 ppm. Then ketchup is filled in hot clean dry bottles and processed in boiling water for 30 min then cooled at room temperature.

Green leafy vegetables (GLVs)

Green leafy vegetables (GLVs) are very important food crops. They provide adequate amount of vitamins and minerals for the body. They are rich source of carotenoids, ascorbic acid, riboflavin, folic acid and minerals like calcium, iron and phosphorus. They are tolerant to adverse climatic conditions. Low consumption of these vegetables in diet leads to deficiency of vitamin A and iron (Akubugwo *et al.*, 2007). The value addition for this vegetable can be achieved only by the process of dehydration.

Powder of GLVs

For the preparation of powder leaves of vegetables are first washed 2-3 times for the removal of adhering dust and impurities. Then they are sun dried properly for 6-7 days till they become crisp and their moisture level reduces to 6-7%. Then leaves are crushed in mortar and passed through sieve (Joshi *et al.*, 2015). Then the powder is stored in jars.

In conclusion the above study results clearly state that the vegetables are very important for gaining good health of human and the preservation and increasing their self-life is also an important factor as the process of

increasing self-life may result in the increment of taste and flavor. The processing of vegetable processing also helps in mentioning economy of the country as it holds export potential.

References

- Abuelgassim A, Al-Showayman. 2012 The Effect of pumpkin (*Cucurbita pepo* L.) seeds and L-arginine supplementation on serum lipid concentrations in atherogenic rats. *AJTCAM*. 9(1):131.
- Abou-Fadel OS and Miller LT. 1983. Vitamin retention, color and texture in thermally processed green beans and Royal Ann cherries packed in pouches and cans. *J Food Sci* 48:920–923.
- Adiamo O Q; Ghafoor K; Al-Juhaimi F; Babiker E E; Ahmed I A M. 2018. Thermosonication process for optimal functional properties in carrot juice containing orange peel and pulp extracts. *Food Chemistry*. 245: 79–88.
- Akubugwo, I.E., Obsai, N.A., Chinyere, G.C. and Ugbogu, A.E. 2007. “Nutritional and chemical value of *Amaranthus hybridus* L. leaves from Afikpo, Nigeria”, *African Journal of Biotechnology*: 6 (24): 2833-2839.
- Alam M S; Gupta K; Khaira H; Javed M. 2013. Quality of dried pomace power as affected by pre-treatments and methods of drying. *Agric Eng Int: CIGR J*. 15(4): 236-243.
- Amelia Jeanroy, Karen Ward, 2019.<https://www.dummies.com/food-drink/canning/home-canning-recipes/preparing-canned-onions/>
- Amnah M. A. Alsuhaibani and Amal N. Al-Kuraieef. 2018. Effect of Low-Calorie Pumpkin Jams Fortified with Soybean on Diabetic Rats: Study of Chemical and Sensory Properties. *Journal of Food Quality*. 2018: 1-7.
- Anju K. Dhiman, Priyanka Thakur, Surekha Attri, Deepika Kathuria and Preethi Ramachandran. 2020. Utilization of Ripe Pumpkin (*Cucurbita moschata*) for the Development of Fruit Bar. *Current Journal of Applied Science and Technology*. 39(6): 63-73.
- Anonymous. 2004. *FAO Production Year Book*. 2004; 634: 168
- Anonymous. 2007. "Fermented Fruits and Vegetables - A Global SO Perspective". United Nations FAO. 1998.
- Anonymous. 2016. National Horticultural Board, Agricultural and Processed Food Products Export Development Authority (APEDA) http://apeda.in/agriexchange/india%Prodection/India_prodection.aspx?hscode=1073.
- Babar VD. 1996. Preparation of Tutti-Fruity from Bottle Gourd. M.Sc. Thesis, Mahatma Phule Agricultural University, Rahuri, India.
- Banerjee SK, Maulik M, Manchanda SC, Dinda AK, Gupta SK, Maulik SK. 2002. Dose-dependent induction of endogenous antioxidants in rat heart by chronic administration of garlic. *Life Sci* 70:1509–1518.
- Battcock M, Ali SA. 2006. Fermented fruits and vegetables: a global perspective. *Food & Agriculture Org*. Chapter 6.
- Beerh O P; Saxena A K; Manan J K. 1984. Improvement of the traditional method of manufacture of carrot murrabba. *Indian Food Pack* 38(4): 59–63.
- Béttega R; Rosa J G; Corrêa R G; Freire J T. 2014. Comparison of carrot (*Daucus carota*) drying in microwave and in vacuum microwave. *Brazilian J Chemical Eng*. 31 (2): 403-412.
- Bin-Lim S; Kyung-Jwa M. 1996. Effect of blanching conditions on the quality of carrot juice. *J Korean Society Food Sci Nutri*. 25: 680-686.
- Block E. 1985. The chemistry of garlic and onions. *Sci Am* 252: 94–99
- Block E, Calvey EM, Gillies JZ, Uden P. 1997. Peeling the onion. In: Johns T, Romeo JT (eds) *Functionality of food phytochemicals*. Plenum, New York: 1–30.
- Chadha KL. 2006. Vegetable Crops, In: “Handbook of Horticulture”, Chapter 3, ICAR Publ., New Delhi. 2006; 352–355.
- Chen Z G; GuoX Y; Wu T. 2016. A novel dehydration technique for carrot slices implementing ultrasound and vacuum drying methods. *Ultrasonic Sonochemistry*. 30: 28-34.
- Choudhury B. 2017. *Vegetables*. National Book Trust, New Delhi.
- De Sa M C; Rodriguez-Amaya D B. 2004. Optimization of HPLC quantification of carotenoids in cooked green vegetables-comparison of analytical and calculated data. *J Food Composition Analysis*. 17: 37–51.
- Deore SL, Khadabadi SS, Patel QR. 2009. In vitro Antioxidant Activity and Quantitative Estimation of Phenolic Content of *Lagenaria siceraria*. *Rasayan J. Chem*. 2(1): 129–132.
- Desai UT, Musmade AM. 1998. Pumpkins, Squashes and Gourds. Chapter-11. In *Handbook*

- of Vegetable Science and Technology: Production, Composition, Storage and Processing. Marcel Dekker Inc., New York. 1998: 282.
- Dhiman AK, Babu NG, Attri S, Ramachandran P. 2018. Preparation of pumpkin pulp and effect of different preservation methods on chemical and sensory properties during storage. *J PharmacognPhytochem*. 2018(7): 943-949.
- Elkins ER. 1979. Nutrient content of raw and canned green beans, peaches, and sweet potatoes. *Food Technol* 33:66-70.
- Farnworth, Edward R. 2003. Handbook of Fermented Functional Foods. CRC. ISBN 978-0-8493-1372-1.
- Fernads M. 2000. Role of salt, oil and acidity in the preservation of mango pickles against microbial spoilage. *J Food Sci Technol*. 261(13): 532-536.
- Freeman. B. B and K. Reimers. 2011. "Tomato consumption and health: emerging benefits," *American Journal of Lifestyle Medicine*. 5 (2): 182-191.
- FSSAI. 2011. Food safety standard (Food products standards and food additives). Ministry of Health and Family Welfare.
- Fu, C, Shi H, Li Q. 2006 A review on pharmacological activities and utilization technologies of pumpkin. *Plant Foods Hum. Nutr*: 61(2):73-80.
- Gil Marks. 2010. Encyclopedia of Jewish Food. p. 1052.
- Giri S K; Prasad S. 2007. Drying kinetics and rehydration characteristics of microwave-vacuum and convective hot-air dried mushrooms. *J Food Eng*.78: 512-521.
- Gorinstein S, Drzewiecki J, Leontowicz H, Leontowicz M, Najman K, Jastrzebski Z. 2005. Comparison of the bioactive compounds and antioxidant potentials of fresh and cooked Polish, Ukrainian, and Israeli garlic. *J Agric Food Chem*. 53:2726-2732.
- Gossell-Williams M, Davis A, O'Connor N. 2006. Inhibition of testosterone-induced hyperplasia of the prostate of Sprague- Dawley rats by pumpkin seed oil. *J. Med. Food*. 9(2):284-286.
- Grandillo, D. Zamir, and S. D. Tanksley. 1999. "Genetic improvement of processing tomatoes: a 20 years perspective," *Euphytica*. 110(2):85-97.
- Haq Raees-ul; Prasad K. 2015. Nutritional and processing aspects of carrot (*Daucus carota*) – A review. *South Asian Journal of Food Technology and Environment*. 1(1):1- 14.
- Horie T, Awazu S, Itakura Y, Fuwa T. 1992. Identified diallyl polysulfides from an aged garlic extract which protects the membranes from lipid peroxidation. *Planta Med* 58:468-469.
- Horticultural Statistics at a Glance 2017. (n.d.). Retrieved from www.agricoop.nic.in.
- Hyma Jyothi S. 2003. Export performance of onion and potato from India – an economic analysis. *Indian J Agric Mark*. 17(3):131-141.
- Jordbruksverket. 2003. Consumption of foodstuffs. Year book of agricultural statistics. Orebro, Sweden: SCB-Tryck. 2003: 259-72.
- Joseph Mercola, Brian Vasziy, Kendra Pearsall, Nancy Lee Bentley. 2018. Dr. Mercola's Total Health Cookbook & Program: 227.
- Joshi, Pallavi and Mathur, Beena. 2015. Development of value added products from the leaf powders of dehydrated less utilized green leafy vegetables. *Nutrition & Food Science*. 45. 302-309.
- Joy C Rickman, Diane M Barrett and Christine M Bruhn, 2007. "Nutritional comparison of fresh, frozen and canned fruits and vegetables. Part 1. Vitamins C and B and phenolic compounds" *J Sci Food Agric*. 87:930-944.
- K. H. Steinkraus. 2002. "Fermentations in world food processing," *Comprehensive Reviews in Food Science and Food Safety*. 1 (1):23-32.
- Kaufmann, Klaus. 2001. Making Sauerkraut and Pickled Vegetables at Home. *Book Publishing Company*. ISBN 978-1-55312-037-7.
- Khan Z, Shah AH, Gul R, Majid A, Khan U, Ahmad H. 2015. Morpho-agronomic characterization of cucumber germplasm for yield and yield associated traits. 6(1):1-6.
- Kirca A; Ozkan M; Cemeroglu B. 2007. Storage stability of strawberry jam color enhanced with black carrot juice concentrate. *J Food Processing Preservation*. 31: 531-545.
- Kourounakis PN, Rekka EA. 1991. Effect on active oxygen species of alliin and *Allium sativum* (garlic) powder. *Res Comm Chem Path Pharm* 74:249-252.
- M. F. de EscaladaPla, N. M. Ponce, C. A. Stortz, L. N. Gerschenson, and A. M. Rojas. 2007. "Composition and functional properties of enriched fiber products obtained from pumpkin (*Cucurbita moschata* Duchesne ex Poiret)," *Food Science and Technology*. 40 (7): 1176-1185.
- Manimegalai G, Krishnaveni A, Kumar RS. 2001. Processing and preservation of jack fruit

- (*Artocarpus heterophyllus* L.) bar (Thandra). *J Food Sci Technol.* 38:529-531.
- Manorama (2020) <https://www.onmanorama.com/food/kerala-kitchen/2020/03/15/easy-pumpkin-pickle-matanga-achar.html>.
- Marchesini A, Majorino G, Montuori F and Cagna D. 1975. Changes in the ascorbic and dehydroascorbic acid contents of fresh and canned beans. *J Food Sci* 40:665–668.
- Merriam-Webster. 2019. Potato – Definition of potato. <http://www.merriamwebster.com/dictionary/potato>
- Mitra, Jayeeta & Shrivastava, Shanker Lal & Rao, Pavuluri. 2012. Onion dehydration: A review. *Journal of food science and technology.* 49: 267-77.
- N. R. Dahal, T. B. Karki, B. Swamylingappa, Q. Li, and G. Gu. 2005. “Traditional foods and beverages of Nepal-a review,” *Food Reviews International.* 21 (1): 1–25.
- Negi P S; Roy S K. 2001. The effect of blanching on quality attributes of dehydrated carrots during long term storage. *European J Food Res Technol.* 212: 445-448.
- Nuutila AM, Puupponen-Pimiä R, Aarni M, Oksman-Caldentey KM. 2003. Comparison of antioxidant activity of onion and garlic extracts by inhibition of lipid peroxidation and radical scavenging activity. *Food Chem* 81:485–493.
- Orsat V, Changrue V, Raghavan GSV. 2006. Microwave drying of fruits and vegetables. *Stewart Post-Harvest Rev.* 6:4-9.
- Pandey S, Jha A, Rai M. 2009. Screening of advance breeding lines/cultivars for shelf-life and biochemical changes during storage of ash gourd (*Benincasa hispida*). *Acta Horti* 806:249-255.
- Pandey SJ, Singh AK, Upadhyay DR, Mathura R. 2003. Ascorbate and carotenoid content in an Indian collection of pumpkin (*Cucurbita moschata* Duch. ex Poir.). *Cucurbit Genetics Cooperative Report.* 2003 (26):51-53.
- Potato Chips - India | Statista Market Forecast. 2019. <https://www.statista.com/outlook/40110200/119/potatochips/India>.
- Potato Stats of India | PotatoPro. (n.d.). 2019. from <https://www.potatopro.com/india/potatostatistics>.
- Potty V. 2009. By-products utilization can improve the economics of tomato industry. *Processed Food Industry, CFTRI, Mysore.* (<http://vhpotty.blogspot.com>).
- Prasad K, Axdal VA, Yu M, Raney BL. 1995. Antioxidant activity of allicin, an active principle in garlic. *Mol Cell Biochem.* 148:183–189.
- Purseglove, JW. 1969. *Tropiocal Crops Dicotyledons-1.* Longmans Green and Co.Ltd. 1969; 109-110.
- Puupponen-Pimia R; Hakkinen S T; Aarni M.; Suortti T; Lampi A M; Euroala M; Piironen V; Nuutila A M; Oksman-Caldentey K M. 2003. Blanching and long-term freezing affect various bioactive compounds of vegetables in different ways. *J Sci Food Agric.* 83: 1389-1402.
- Raes-ul H; Prasad K. 2015. Nutritional and processing aspects of carrot (*Daucus carota*) – A review. *South Asian Journal of Food Technology and Environment.* 1(1): 1- 14.
- Renna M; Pace B; Cefola M; Santamaria P; Serio F; Gonnella M. 2013. Comparison of two jam making methods to preserve the quality of coloured carrots. *LWT-Food Sci Technol.* 53: 547-554.
- Riganakos K A; Karabagias I K; Gertzou I; Stah I M. 2017. Comparison of UV-C and thermal treatments for the preservation of carrot juice. *Innovative Food Sci Emerging Technol.* 42: 165–172.
- Rodriguez-Amaya D B. 1997. Carotenoids and food preparation: The retention of provitamin A, carotenoids in prepared, processed and stored foods. *OMNI project, US Agency for International development office of Health and Nutrition, John Snow Inc.* 1997: 22-23.
- Salunkhe DK, Kadam SS. 1998. *Handbook of Vegetable Science and Technology: Production, Composition, Storage and Processing.* Marcel Dekker Inc., New York. 1998: 279.
- Salwa A A; Galal E A; Neimat A; Elewa. 2004. Carrot yoghurt: sensory, chemical, microbiological properties and consumer acceptance. *Pakistan J Nutri.* 3: 322–330.
- Sami Rokayya, Chun-Juan Li, Yan Zhao, Ying Li, Chang-Hao Sun. 2013. Cabbage (*Brassica oleracea* L. var. capitata) Phytochemicals with Antioxidant and Anti-inflammatory Potential *Asian Pac J Cancer Prev.* 14 (11), 6657-6662.
- Sareedha, P; Anburani A. and Samruban. J. 2006. Influence of integrated nutrient management on growth of gherkin (*Cucumis sativus* L.) Cv. Ajax hybrid. *Vegetable Sci.* 2006; Vol. 33(2), 196-197.
- Sarma, Paresh. 2019. Value Chain Analysis of

- Tomato: A Case Study in Jessore District of Bangladesh. *International Journal of Science and Research (IJSR)*. 8. 924-932.
- Sebastian P, Schaefer H, Telford IRH, Renner SS. 2010. Cucumber (*Cucumis sativus*) and melon (*C. melo*) have numerous wild relatives in Asia and Australia, and the sister species of melon is from Australia. 2010.
- Shafiq, Md & Chavan, Prasad & Sharma, Rohit. (2018). Post Harvest Value Chain of Carrot-A Review: 1.
- Sharma K; Karki S; Thakur N; Attri S. 2012. Chemical composition, functional properties and processing of carrot- A review. *J Food Sci Technol*. 49: 22-32.
- Singh, B., Raigond, P., Ashiy, A. J., Bir, M., & Singh, P. 2016. A MANUAL ON POTATO PROCESSING IN INDIA. Retrieved from https://cpri.icar.gov.in/tech_bulletin/Technical_Bulletin48.pdf.
- Singh J, Upadhyay AK, Bahadur A, et al 2006. Antioxidant phytochemicals in cabbage (*Brassica oleracea* L. var. capitata). *Sci Hort*. 108: 233-7.
- Singh S, Singh J, Rai M. 2006. Post harvest processing and value addition in vegetables: current perspectives. *Indian Food Ind* 25(4):54–58.
- Srinivasa Murthy D, Subramanyam KV. 1999. Onion export markets and their stability for increasing India's exports: Markov chain approach. *Agric Econ Res Rev*. 12(2):118–128.
- Stavric B. 1997. Chemopreventive agents in foods. In: Johns T, Romeo JT (eds) *Functionality of food phytochemicals*. Plenum, New York: 53–87.
- Suh HJ, Lee JM, Cho JS, Kim YS, Chung SH. 1999. Radical scavenging compounds in onion skin. *Food Res Int*. 32:659–664.
- Sulaeman A; Keeler L; Giraud D W; Taylor S L; Wehling R L; Driskell J A. 2001. Carotenoids content and physiochemical and sensory characteristics of carrot chips deep-fried in different oils at several temperatures. *J Food Sci*. 66: 1257-1264.
- Sultana S; Iqbal A; Islam M N. 2014. Preservation of carrot, green chilli and brinjal by fermentation and pickling. *Int Food Res J*. 21 (6): 2405-2412.
- Thamburaj S, Singh N. 2005. Cucurbitaceous Vegetables, In: *Textbook of Vegetables, Tuber Crops and Spices*. ICAR Publication, New Delhi. 2005: 271–274.
- Thapa, Sittal & Thapa, Subash. 2019. Scope of Value- addition in Potato. *International journal of Horticulture, Agriculture and Food science*. 3: 132-146.
- Tindall HD. 1986. *Vegetables in the Tropics*. Macmillan Education Ltd, Basingstake, Hampshire.
- Tsai YS, Tong YC, Cheng JT, Lee CH, Yang FS, Lee HY. 2002. Pumpkin seed oil and phytosterol-F can block testosterone/prazosin-induced prostate growth in rats. *Urol. Int*. 77(3):269-274.
- Uthpala, T. G. G. and Marapana, Upul. 2018. Study on Nutritional Composition on Firmness of Two Gherkin (*Cucumis sativus* L.) Varieties (Ajax & Vlasset) on Brine Fermentation. *American Journal of Food Science and Technology*. 5: 61-63.
- V.SaradhaRamadas, T.Thilagavathi. 2011. VALUE ADDED PRODUCTS OF TOMATO AND ITS QUALITY CHARACTERISTICS. *International Journal of Current Research and Review*. 3 (6): 211-218.
- Vidyavati HG, Manjunatha H, Hemavathy J, Srinivasan K. 2010. Hypolipidemic and antioxidant efficacy of dehydrated onion in experimental rats. *J Food Sci Technol*. 47(1):55–60.
- Wadagavi, V., Kallihal, B., Dadanwale, S., and Choukimath, M. C. 2017. Automatic Potato Chips Making Machine.
- Yamasaki T, Li L, Lau BHS. 1994. Garlic compounds protect vascular endothelial cells from hydrogen peroxide-induced oxidant injury. *Phytother Res*. 8:408–412.

How to cite this article:

Amit Nagil and Themmeichon Chamroy. 2020. Processing and Value addition of Vegetable Crops a Review. *Int.J.Curr.Microbiol.App.Sci*. 9(11): 2247-2260.
doi: <https://doi.org/10.20546/ijcmas.2020.911.270>