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Processing and value addition of carrot: A review

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Abstract

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.

Keywords: Value addition, vegetable, sustainability

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) ^[60]. 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.

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In studies it was recorded that 75,000-1,00,000 crore per year losses are caused 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) [46]. Khalpi is a cucumber pickle popular during summer months in Nepal (Dahal *et al.*, 2005) [57]. 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%) compared to that of fresh and frozen products. In several studies that there is no statistically significant loss of ascorbic acid 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) [54], (Elkins 1979) [27] and (Fadel and Miller 1983) [2].

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 an important source of employment as it provides employment throughout the year. And adding value is also very important for employment. In terms of nutrient vegetables are an important source of nutrient and helps in maintaining strong metabolism.

Since 2011 the global vegetable processing industry has grown and is also expected to grow after 2020. In developing countries such as in India & Afghanistan due to an increase in industrialization which leads them to attain a standard of living. Which includes 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 their processed product. As fresh vegetables are healthier than their processed product.

Processing and Value addition in onion

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) [9]. Canned carrot Small carrots are usually used 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 an increase in the number of carotenoids in the products (De Sa and Rodriguez-Amaya, 2004) [23]. 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) [87] and (Puuponen-Pimia *et al.*, 2003) [68].

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) [58]. Prolonged drying time and overheating of the product resulted in brownish colour, loss of flavor and decrease in rehydration ability (Giri and Prasad, 2007) [34]. 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) [5]. 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) [72]. Combination of vacuum and microwave drying minimizes the shrinkage during drying with lower breakdown of physical structure and higher porosity (Bétega *et al.*, 2014) [16]. Drying through Ultrasonic technology is an energy efficient technology. The ultrasound assisted 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) [21].

Flow chart of dehydration of carrot

Selection of fresh carrots Washing and removal of peel (peeling) Cutting (0.3cm) Water blanching which contain 0.2% potassium metabisulphite, 2% starch and 1% salt at 92° C For 3 min Dehydration at 45-50 °C for 10-11 h.

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) [88].

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) [17]. 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) [74] 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) [3]. 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) [71].

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)^[38]. It was reported that the entire soluble solid content of the carrot candy should be 70-75°B (Beerh *et al.*, 1984)^[15]. 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)^[80].

Carrot jam

It is prepared by boiling the pulp with predetermined quantity of sugar and pectin till it become 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)^[38]. Now a days in the preparation of jam carrot juice is added with citrus juice which helps in prevention of carotene to be get oxidize.

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)^[70]. Black carrot juice has also been incorporated as a colouring agent in manufacturing of strawberry jam (Kirca *et al.*, 2007)^[49].

Conclusion

In this chapter we found processing of carrot very useful for marketing and stability of value addition on products

References

- Abuelgassim A, Al-Showayman. The Effect of pumpkin (*Cucurbita pepo* L.) seeds and L-arginine supplementation on serum lipid concentrations in atherogenic rats. AJTCAM. 2012;9(1):131.
- Abou-Fadel OS, Miller LT. Vitamin retention, color and texture in thermally processed green beans and Royal Ann cherries packed in pouches and cans. J Food Sci. 1983;48:920-923.
- Adiamo OQ, Ghafoor K, Al-Juhaimi F, Babiker EE, Ahmed IAM. Thermosonication process for optimal functional properties in carrot juice containing orange peel and pulp extracts. Food Chemistry. 2018;245:79-88.
- Akubugwo IE, Obsai NA, Chinyere GC, Ugbogu AE. Nutritional and chemical value of *Amaranthus hybridus* L. leaves from Afikpo, Nigeria, African Journal of Biotechnology. 2007;6(24):2833-2839.
- Alam MS, Gupta K, Khaira H, Javed M. Quality of dried pomace power as affected by pre-treatments and methods of drying. Agric Eng Int: CIGR J. 2013;15(4):236-243.
- Amelia Jeanroy, Karen Ward; c2019. <https://www.dummies.com/food-drink/canning/home-canning-recipes/preparing-canned-onions/>
- Amnah MA, Alsuhailani, Amal Al-Kuraieef N. Effect of Low-Calorie Pumpkin Jams Fortified with Soybean on Diabetic Rats: Study of Chemical and Sensory Properties. Journal of Food Quality; c2018. p. 1-7.
- Anju Dhiman K, Priyanka Thakur, Surekha Attri, Deepika Kathuria, Preethi Ramchandran. Utilization of Ripe Pumpkin (*Cucurbita moschata*) for the Development of Fruit Bar. Current Journal of Applied Science and Technology. 2020;39(6):63-73.
- Anonyms. FAO Production Year Book. 2004;634:168.
- Anonyms. Fermented Fruits and Vegetables - A Global SO Perspective". United Nations FAO; c1998.
- Anonymous. National Horticultural Board, Agricultural and Processed Food Products Export Development Authority (APEDA); c2016. http://apeda.in/agriexchange/india%Prodection/India_prodection.aspx?hscode=1073.
- Babar VD. Preparation of Tutti-Fruity from Bottle Gourd. M.Sc. Thesis, Mahatma Phule Agricultural University, Rahuri, India; c1996.
- Banerjee SK, Maulik M, Manchanda SC, Dinda AK, Gupta SK, Maulik SK. Dose-dependent induction of endogenous antioxidants in rat heart by chronic administration of garlic. Life Sci. 2002;70:1509-1518.
- Battcock M, Ali SA. Fermented fruits and vegetables: a global perspective. Food & Agriculture Org. Chapter 6; c2006.
- Beerh OP, Saxena AK, Manan JK. Improvement of the traditional method of manufacture of carrot murrabba. Indian Food Pack. 1984;38(4):59-63.
- Béttega R, Rosa JG, Corrêa RG, Freire JT. Comparison of carrot (*Daucus carota*) drying in microwave and in vacuum microwave. Brazilian J Chemical Eng. 2014;31(2):403-412.
- Bin-Lim S, Kyung-Jwa M. Effect of blanching conditions on the quality of carrot juice. J Korean Society Food Sci Nutri. 1996;25:680-686.
- Block E. The chemistry of garlic and onions. Sci Am. 1985;252:94-99.
- Block E, Calvey EM, Gillies JZ, Uden P. Peeling the onion. In: Johns T, Romeo JT (eds) Functionality of food phytochemicals. Plenum, New York; c1997. p. 1-30.
- Chadha KL. Vegetable Crops, In: Handbook of Horticulture, Chapter 3, ICAR Publ., New Delhi; c2006. p. 352-355.
- Chen ZG, Guo XY, Wu T. A novel dehydration technique for carrot slices implementing ultrasound and vacuum drying methods. Ultrasonic Sonochemistry. 2016;30:28-34.
- Choudhury B. Vegetables. National Book Trust, New Delhi; c2017.
- De Sa MC, Rodriguez-Amaya DB. Optimization of HPLC quantification of carotenoids in cooked green vegetables-comparison of analytical and calculated data. J Food Composition Analysis. 2004;17:37-51.
- Deore SL, Khadabadi SS, Patel QR. *In vitro* Antioxidant Activity and Quantitative Estimation of Phenolic Content of *Lagenaria siceraria*. Rasayan J Chem. 2009;2(1):129-132.
- Desai UT, Musmade AM. Pumpkins, Squashes and Gourds. Chapter-11. In Handbook of Vegetable Science and Technology: Production, Composition, Storage and Processing. Marcel Dekker Inc., New York; c1998, 282.
- Dhiman AK, Babu NG, Attri S, Ramchandran P. Preparation of pumpkin pulp and effect of different preservation methods on chemical and sensory properties during storage. J Pharmacogn Phytochem. 2018;(7):943-949.
- Elkins ER. Nutrient content of raw and canned green beans, peaches, and sweet potatoes. Food Technol. 1979;33:66-70.
- Farnworth, Edward R. Handbook of Fermented Functional Foods. CRC; c2003. ISBN 978-0-8493-1372-1.

29. Fernads M. Role of salt, oil and acidity in the preservation of mango pickles against microbial spoilage. *J Food Sci Technol.* 2000;261(13):532-536.
30. Freeman BB, Reimers K. Tomato consumption and health: emerging benefits, *American Journal of Lifestyle Medicine.* 2011;5(2):182-191.
31. FSSAI. Food safety standard (Food products standards and food additives). Ministry of Health and Family Welfare; c2011.
32. Fu C, Shi H, Li Q. A review on pharmacological activities and utilization technologies of pumpkin. *Plant Foods Hum. Nutr.* 2006;61(2):73-80.
33. Gil Marks. *Encyclopedia of Jewish Food*; c2010, 1052.
34. Giri SK, Prasad S. Drying kinetics and rehydration characteristics of microwave-vacuum and convective hot-air dried mushrooms. *J Food Eng.* 2007;78(2):512-521.
35. Gorinstein S, Drzewiecki J, Leontowicz H, Leontowicz M, Najman K, Jastrzebski Z. Comparison of the bioactive compounds and antioxidant potentials of fresh and cooked Polish, Ukrainian, and Israeli garlic. *J Agric Food Chem.* 2005;53(7):2726-2732.
36. Gossell-Williams M, Davis A, O'Connor N. Inhibition of testosterone-induced hyperplasia of the prostate of Sprague-Dawley rats by pumpkin seed oil. *J Med. Food.* 2006;9(2):284-286.
37. Grandillo Zamir D, Tanksley SD. Genetic improvement of processing tomatoes: a 20 years perspective, *Euphytica.* 1999;110(2):85-97.
38. Haq Raees-ul, Prasad K. Nutritional and processing aspects of carrot (*Daucus carota*) - A review. *South Asian Journal of Food Technology and Environment.* 2015;1(1):1-14.
39. Horie T, Awazu S, Itakura Y, Fuwa T. Identified diallyl polysulfides from an aged garlic extract which protects the membranes from lipid peroxidation. *Planta Med.* 1992;58(5):468-469.
40. Horticultural Statistics at a Glance. (n.d.); c2017. Retrieved from www.agricoop.nic.in.
41. Hyma Jyothi S. Export performance of onion and potato from India – an economic analysis. *Indian J Agric Mark.* 2003;17(3):131-141.
42. Jordbruksverket. Consumption of foodstuffs. Year book of agricultural statistics. Orebro, Sweden: SCB-Tryck; c2003. p. 259-72.
43. Joseph Mercola, Brian Vaszily, Kendra Pearsall, Nancy Lee Bentley. Dr. Mercola's Total Health Cookbook & Program; c2018, 227.
44. Joshi Pallavi, Mathur Beena. Development of value added products from the leaf powders of dehydrated less utilized green leafy vegetables. *Nutrition & Food Science.* 2015;45(2):302-309.
45. Joy Rickman C, Diane Barrett M, Christine Bruhn M. Nutritional comparison of fresh, frozen and canned fruits and vegetables. Part 1. Vitamins C and B and phenolic compounds. *J Sci Food Agric.* 2007;87(6):930-944.
46. Steinkraus KH. Fermentations in world food processing,” *Comprehensive Reviews in Food Science and Food Safety.* 2002;1(1):23-32.
47. Kaufmann, Klaus. Making Sauerkraut and Pickled Vegetables at Home. Book Publishing Company; c2001. ISBN 978-1-55312-037-7.
48. Khan Z, Shah AH, Gul R, Majid A, Khan U, Ahmad H. Morpho-agronomic characterization of cucumber germplasm for yield and yield associated traits. 2015;6(1):1-6.
49. Kirca A, Ozkan M, Cemeroglu B. Storage stability of strawberry jam color enhanced with black carrot juice concentrate. *J Food Processing Preservation.* 2007;31(5):531-545.
50. Kourounakis PN, Rekka EA. Effect on active oxygen species of alliin and *Allium sativum* (garlic) powder. *Res Comm Chem Path Pharm.* 1991;74(2):249-252.
51. De EscaladaPla MF, Ponce NM, Stortz CA, Gerschenson LN, Rojas AM. Composition and functional properties of enriched fiber products obtained from pumpkin (*Cucurbita moschata* Duchesne ex Poiret). *Food Science and Technology.* 2007;40(7):1176-1185.
52. Manimegalai G, Krishnaveni A, Kumar RS. Processing and preservation of jack fruit (*Artocarpus heterophyllus* L.) bar (Thandra). *J Food Sci Technol.* 2001;38(5):529-531.
53. Manorama; c2020. <https://www.onmanorama.com/food/kerala-kitchen/2020/03/15/easy-pumpkin-pickle-matanga-achar.html>.
54. Marchesini A, Majorino G, Montuori F, Cagna D. Changes in the ascorbic and dehydroascorbic acid contents of fresh and canned beans. *J Food Sci.* 1975;40(4):665-668.
55. Merriam-Webster. Potato – Definition of potato; c2019. <http://www.merriamwebster.com/dictionary/potato>
56. Jayeeta M, Lal SS, Pavuluri R. Onion dehydration: A review. *Journal of Food Science and Technology.* 2012;49:267-77.
57. Dahal NR, Karki TB, Swamylingappa B, Li Q, Gu G. Traditional foods and beverages of Nepal-a review, *Food Reviews International.* 2005;21(1):1-25.
58. Negi PS, Roy SK. The effect of blanching on quality attributes of dehydrated carrots during long term storage. *European J Food Res Technol.* 2001;212:445-448.
59. Nuutila AM, Puupponen-Pimiä R, Aarni M, Oksman-Caldentey KM. Comparison of antioxidant activity of onion and garlic extracts by inhibition of lipid peroxidation and radical scavenging activity. *Food Chem.* 2003;81(4):485-493.
60. Orsat V, Changrue V, Raghavan GSV. Microwave drying of fruits and vegetables. *Stewart Post-Harvest Rev.* 2006;6:4-9.
61. Pandey S, Jha A, Rai M. Screening of advance breeding lines/cultivars for shelf-life and biochemical changes during storage of ash gourd (*Benincasa hispida*). *Acta Hort.* 2009;806:249-255.
62. Pandey SJ, Singh AK, Upadhyay DR, Mathura R. Ascorbate and carotenoid content in an Indian collection of pumpkin (*Cucurbita moschata* Duch. ex Poir.). *Cucurbit Genetics Cooperative Report.* 2003;(26):51-53.
63. Potato Chips - India | Statista Market Forecast. 2019. <https://www.statista.com/outlook/40110200/119/potatochips/India>.
64. Potato Stats of India | PotatoPro. (n.d.); c2019. from <https://www.potatopro.com/india/potatostatistics>.
65. Potty V. By-products utilization can improve the economics of tomato industry. *Processed Food Industry, CFTRI, Mysore*; c2009. (<http://vhpotty.blogspot.com>).
66. Prasad K, Axdal VA, Yu M, Raney BL. Antioxidant activity of allicin, an active principle in garlic. *Mol Cell Biochem.* 1995;148:183-189.
67. Purseglove JW. *Tropical Crops Dicotyledons-1*. Longmans Green and Co. Ltd; c1969. p. 109-110.

68. Puuponen-Pimia R, Hakkinen ST, Aarni M, Suortti T, Lampi AM, Euroala M, *et al.* Blanching and long-term freezing affect various bioactive compounds of vegetables in different ways. *J Sci Food Agric.* 2003;83(14):1389-1402.
69. Raees-ul H, Prasad K. Nutritional and processing aspects of carrot (*Daucus carota*) - A review. *South Asian Journal of Food Technology and Environment.* 2015;1(1):1-14.
70. Renna M, Pace B, Cefola M, Santamaria P, Serio F, Gonnella M. Comparison of two jam making methods to preserve the quality of coloured carrots. *LWT-Food Sci Technol.* 2013;53:547-554.
71. Riganakos KA, Karabagias IK, Gertzou I, Stah IM. Comparison of UV-C and thermal treatments for the preservation of carrot juice. *Innovative Food Sci Emerging Technol.* 2017;42:165-172.
72. Rodriguez-Amaya DB. 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; c1997. p. 22-23.
73. Salunkhe DK, Kadam SS. *Handbook of Vegetable Science and Technology: Production, Composition, Storage and Processing.* Marcel Dekker Inc., New York; c1998, 279.
74. Salwa AA, Galal EA, Neimat A, Elewa. Carrot yoghurt: sensory, chemical, microbiological properties and consumer acceptance. *Pakistan J Nutri.* 2004;3(6):322-330.
75. Rokayya S, Chun-Juan Li, Yan Zhao, Ying Li, Chang-Hao Sun. Cabbage (*Brassica oleracea* L. var. capitata) Phytochemicals with Antioxidant and Anti-inflammatory Potential *Asian Pac J Cancer Prev.* 2013;14(11):6657-6662.
76. Sareedha, P, Anburani A, Samruban J. Influence of integrated nutrient management on growth of gherkin (*Cucumis sativus* L.) Cv. Ajax hybrid. *Vegetable Sci.* 2006;33(2):196-197.
77. Pares S. Value Chain Analysis of Tomato: A Case Study in Jessore District of Bangladesh. *International Journal of Science and Research (IJSR).* 2019;8:924-932.
78. Sebastian P, Schaefer H, Telford IRH, Renner SS. Cucumber (*Cucumis sativus*) and melon (*C. melo*) have numerous wild relatives in Asia and Australia, and the sister species of melon is from Australia; c2010.
79. Shafiq Md, Prasad C, Rohit S. Post Harvest Value Chain of Carrot-A Review; c2018, 1.
80. Sharma K, Karki S, Thakur N, Attri S. Chemical composition, functional properties and processing of carrot- A review. *J Food Sci Technol.* 2012;49:22-32.
81. Singh B, Raigond P, Ashiv AJ, Bir M, Singh P. A manual on potato processing in India; c2016. Retrieved from https://cpri.icar.gov.in/tech_bulletin/Technical_Bulletin4_8.pdf.
82. Singh J, Upadhyay AK, Bahadur A, *et al.* Antioxidant phytochemicals in cabbage (*Brassica oleracea* L. var. capitata). *Sci Hort.* 2006;108:233-7.
83. Singh S, Singh J, Rai M. Post harvest processing and value addition in vegetables: current perspectives. *Indian Food Ind.* 2006;25(4):54-58.
84. Srinivasa Murthy D, Subramanyam KV. Onion export markets and their stability for increasing India's exports: Markov chain approach. *Agric Econ Res Rev.* 1999;12(2):118-128.
85. Stavric B. Chemopreventive agents in foods. In: Johns T, Romeo JT (eds) *Functionality of food phytochemicals.* Plenum, New York; c1997. p. 53-87.
86. Suh HJ, Lee JM, Cho JS, Kim YS, Chung SH. Radical scavenging compounds in onion skin. *Food Res Int.* 1999;32(10):659-664.
87. Sulaeman A, Keeler L, Giraud DW, Taylor SL, Wehling RL, Driskell JA. Carotenoids content and physicochemical and sensory characteristics of carrot chips deep-fried in different oils at several temperatures. *J Food Sci.* 2001;66(9):1257-1264.
88. Sultana S, Iqbal A, Islam MN. Preservation of carrot, green chilli and brinjal by fermentation and pickling. *Int Food Res J.* 2014;21(6):2405-2412.
89. Thamburaj S, Singh N. *Cucurbitaceous Vegetables, In: Textbook of Vegetables, Tuber Crops and Spices.* ICAR Publication, New Delhi; c2005. p. 271-274.
90. Sittal T, Subash T. Scope of Value- addition in Potato. *International journal of Horticulture, Agriculture and Food science.* 2019;3:132-146.
91. Tindall HD. *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.* 1986;77(3):269-274.
92. Uthpala TGG, Marapana Upul. 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.* 2018;5:61-63.
93. Saradha Ramadas V, Thilagavathi T. Value added products of tomato and its quality characteristics. *International Journal of Current Research and Review.* 2011;3(6):211-218.
94. Vidyavati HG, Manjunatha H, Hemavathy J, Srinivasan K. Hypolipidemic and antioxidant efficacy of dehydrated onion in experimental rats. *J Food Sci Technol.* 2010;47(1):55-60.
95. Wadagavi V, Kallihal B, Dadanwale S, Choukimath MC. *Automatic Potato Chips Making Machine;* 2017.
96. Yamasaki T, Li L, Lau BHS. Garlic compounds protect vascular endothelial cells from hydrogen peroxide-induced oxidant injury. *Phytother Res.* 1994;8:408-412.