IJFANS
International Journal of Food And Nutritional Sciences

Volume 7, Issue 2, April 2018, www.ijfans.com e-ISSN: 2320-7876

INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

IMPACT FACTOR ~ 1.021

Official Journal of IIFANS

IJFANS International Journal of Food and Nutritional Science

e-ISSN 2320 -7876 www.ijfans.com
Vol. 7, No. 2, April 2018

Research Paper ***Open Access***

QUALITY CHARACTERISTICS OF DEVELOPED BEETROOT JUICE

Sri Vidhya N A C[1] and Radhai Sri S[1]*

*Corresponding Author: Radhai Sri S, ✉ radhaisris@yahoo.com

Received on: 17th October, 2017 Accepted on: 19th February, 2018

Beetroot has been considered as a nutritional food since early Roman and Greek times for reduction of fevers. Beetroot juice is useful in anaemia, enhances body's power of resistance, reduces blood pressure, for cardiovascular disease prevention, for healthy liver function, for cancer prevention among others. Hence, an effort has been taken to develop beetroot juice and to analyse for its Quality Characteristics. Physico-chemical characteristics such as Brix, TSS, titrable acidity, brix acid ratio, moisture, ash, total sugar; nutrient analysis including energy, carbohydrate, protein, fat, vitamin C, folic acid, sodium, potassium, magnesium, phosphorous were analysed by following standard procedures. Sensory attributes ranked higher for colour. The nutrient content of developed juice had 0.21% pointing the presence of wide variety of minerals, 0.98 µg of folic acid, higher level of potassium of 180 mg and 48 mg of sodium which can help to regulate fluid levels and blood pressure. Shelf life characteristics of beetroot juice were studied with intervals of 0, 15, 45, 60 days. On storage there was slight increase in Brix from 13° to 14°

Keywords: Nutrition, Physico chemical, Quality

INTRODUCTION

Beetroot *(Beta vulgaris L. ssp. culgaris,*) is a member of the chenopodiaceae family which include silver beet, sugar beet and fodder beet (Grubben and Denton, 2004). It is a crop of temperate region where cool weather and high humidity are available (Rehman and Ali, 2000). Beet is widely cultivated for the production of commercial sugar forage plants, natural dye and food for human consumption (Nilson, 1970; Mornement, 2002; and Rey *et al.*, 2005).

Beetroot should be obtained fresh and grated or juice for maximum benefits (Manfred Urs Koch, 2011). Beetroot generally called as garden beet, it is a juicy root vegetable in two colour-deep red and violet beetroot is a native of Europe, used by Greeks and Romans thousand years back. It is now cultivated for its nutritional foods. Beetroot juice is useful in anaemia as it forms blood owing to substantial iron. It triggers and activates the R.B.C., pusher fresh oxygen into the body and enhances lung function for normal breathing. The juice of the red beet enhances body's power of resistance (Syed Aziz Ahmad and Sharma, 2008).

Beetroot ranks among 10 most powerful vegetables with respect to its antioxidant capacity ascribed to a total phenolic content of 50-60 µmol/g dry weight (Vinson *et al.*, 1998; and Kahkonen *et al.*, 1999). Beetroot is a rich source of potent antioxidants and nutrients, it can be used for blood pressure, for cardiovascular disease prevention, for healthy liver function, for cancer prevention among others (Adam and Betine, 2002). Beetroot is a potential source of valuable water soluble nitrogenous pigments, called betalins (Pedreno and Escribano, 2001). Betalins have been extensively used in the modern food industry. They are one of the most important natural colourant (Francis, 1999; and Azeredo, 2009). Betalins have several application in food, such as desserts, confectionaries, dry mixes, dairy and meet products (Delegado *et al.*, 2000). Beetroot is mainly consumed as a pickled or canned preserve, a cooked

[1] Department of Nutrition and Dietetics, PSG College of Arts and Science, Coimbatore 641014, Tamil Nadu, India.

vegetable or sometime a juice (Kahkonen *et al.*, 1999; Pedreno and Escribano, 2000; and Kanner *et al.*, 2001). Considering the beneficial aspects of Beetroot, the study was conducted to Develop of Beetroot juice and to analyse for its Quality Characteristics.

MATERIALS AND METHODS

Development of Beetroot Juice

Selection of Raw Materials: The fully matured, fresh, firm, hard beetroot was procured from Pazha Mudhir Nilayam Peelamedu, Coimbatore. Beetroot purchased was smaller in size without blemishes.

Quality Testing of Vegetable: The quality of the beetroot was decided based on the size, colour, texture, free of pests and disease and internal damage.

Physical Characteristics of Beetroot: Physical characteristics of beetroot was determined by measuring the average weight of the vegetable, calculating the edible portion and non-edible portion.

Preparation of Beetroot Juice

Beetroots were washed with clean water to remove dust, dirt and outer material. The weight of beetroot was taken using electrical weighing balance (digital balance). Sorting and grading was done by manual methods. The beetroot was cut into slices of about of 2-3 mm thick and subjected to extraction using juice pulper (Ashurst, 1994). Optimum quantity of sugar and citric acid were added to juice and then mixture was filtered through muslin cloth, further pasteurized at 85 °C to destroy enzymes and reduce the microbial load and filled in 200 ml hot filling pet bottle.

Quality Analysis of Developed Beetroot Juice: Quality of food refers to a composite which differentiate individual units and enable determination of the degree of acceptability by the consumer. The overall quality may be broken down into component characteristics such as colour, texture, flavour, nutritional value, free from harmful microorganism and undesirable substances (Ranganna, 2008).

Response Measurement Techniques

Total Soluble Solids: Total Soluble Solids value is defined as the amount of sugar and soluble minerals. It is determined by the help of hand refractometer. This was carried in accordance with the method described by Ranganna (2003).

pH: pH is inversely proportional to the acidity of any medium. pH value of beetroot juice was measured by pH meter.

Titrable Acidity: Titrable acidity is directly proportional and is a measure of shelf life of the product and guard against attack of microorganisms. It also helps to ensure some 25 chemical changes during preparation (Swientek, 1998) and storage (Langthasa, 1999). It was determined according to AOAC method.

Brix Acid Ratio: The brix acid ratio is the ratio of °Brix to the grams of anhydrous citric acid in 100 g of citrus juice or concentrate. The ratio is determined by dividing the degree Brix of a sample by the percent titrable acidity of the sample. The ratio indicates the part of soluble solids present per part of acid (Ranganna, 2003).

$$Brix{:}Acid\ Ratio = \frac{Brix}{Acidity}$$

The ratio was calculated for the beetroot juice.

Juice Yield: The juice yield was determined considering the weight of before and after pressing in the hydraulic press and following the equation (Chander *et al.*, 2003).

$$Juice\ yield = \frac{Weight\ of\ the\ sample - Weight\ of\ the\ cake}{weight\ of\ sample} * 100$$

Physico Chemical Characteristics of Developed Beetroot Juice: Knowledge of the physico-chemical properties of food is fundamental in analysing the characteristics of food during its processing (Rao and Das, 2003). Physical properties such as moisture, ash and total sugar were determined.

Sensory Evaluation of Beetroot Juice: Sensory analysis is a scientific discipline in which man is a measure instruments. It is often defined as "a discipline used to evoke, measure, analyse and interpret reactions to the characteristics of foods and similar materials as they are perceived by the sense of sight, smell, taste, touch and hearing" (Mc llven and Armstrong, 1996; and Piggott *et al.*, 1998). For sensory evaluation of the juice, the product was evaluated by a panel of 20 semi trained panelists which comprised post graduate students of Food and Nutrition Departments of PSG CAS. Panelists were required to evaluate the colour, flavour, consistency, taste and overall acceptability using 5 point scale.

Nutrient Analysis: Beetroot is a rich source of potent antioxidants and nutrients including magnesium, sodium, potassium, vitamin C, which are important for cardiovascular health. Beetroot is high in folate which supports red blood cell growth and helps to prevent anaemia (USDA National

Nutrient Database for Standard Reference, 2009). Beetroot is a rich source of carbohydrate, a good source of protein and has high level of important vitamins, minerals and micronutrients. It is good source of dietary fibre and has practically no fat and cholesterol (Stephen Nottingham, 2004). Further the studies on analysis of nutrient content of beetroot juice were limited. Considering this the following nutrients were analysed in developed beetroot juice.

Energy: Beetroot is an instant source of energy since it is rich in carbohydrate. The energy value of beetroot juice was estimated by bomb calorimeter.

Carbohydrates: Carbohydrates are first hydrolysed into simple sugars using hydrochloric acid. In hot acidic medium glucose is dehydrated to hydroxyl methyl furfural. This compound forms green coloured product with anthrone method which has absorption maximum at 630 nm. The carbohydrate content was determined by using anthrone method.

Protein: Fruits and vegetable contribute only about 2% of protein content. Protein content of beetroot juice was estimated by micro Kjeldhal method.

Fat: Fat constitute only about 0.1% in beetroot in 100 gm edible part (Syed Aziz Ahmed and Sharma, 2008). Fat was determined by soxhlet method. Dietary fibre was determined.

Vitamin C: Vitamin C is the most important vitamin for human nutrition that is supplied by fruits and vegetables. L-Ascorbic acid is the main biologically active form of vitamin C. Ascorbic acid is reversibly oxidised to form L-dehydro ascorbic acid, which also exhibits biological activity.

Folic Acid: The high content of folic acid amounting to 15.8 mg dry matter is a nutritional feature of the beets (Wang and Goldman, 1997) and hence folic acid content in beetroot juice was determined.

Magnesium: Magnesium is an essential mineral for optimal metabolic function. Magnesium was determined by flame photometry method.

Phosphorous, Potassium and Sodium: One cup of beetroot provides the body with 64.60 mg of phosphorous. The high potassium and sodium content of beetroot provides a good solvent for calcium deposits particularly where inorganic calcium has to be accumulating in the system (Clinkard, 1960). The supply of organic sodium (72 mg) and potassium (325 mg) is one reason for blood cleansing abilities of beetroot and in particularly fresh beetroot juice (Manfred Urs Koch, 2011). Hence, potassium and sodium were determined using flame photometry.

Microbial load Contamination of food by mould and bacteria is common and their presence in the finished product is considered to be unfit for consumption (Ranganna, 1986; and Maitin, 2003). The total plate count method was adopted to test the bacterial load. Shelf life characteristics of developed beetroot juice. The shelf life characteristics of the developed beetroot Juice was tested initially and periodically. Response measurement techniques such TSS, Titrable acidity, Brix acid ratio, pH were tested at 0, 15, 45, 60 days. Microbial load was tested at 0 days and 45 days.

RESULTS AND DISCUSSION

Physical Characteristics of Beetroot

Beetroots were taken to measure the physical characteristics of vegetables. The physical characteristics like average weight of the vegetable, edible and non-edible portions, juice yield were measured separately. The values are presented in Table 1. About 40 numbers of beetroot of different sizes were weighed. The average weight of it was 74 ± 14 g. The weight of the edible portion and non-edible were 78 and 21% respectively. The edible index of beetroot was 88% and the waste index was 11%. The beetroot juice yield was estimated to be 40%.

Response Measurement Techniques of the Developed Beetroot Juice

TSS, Acidity, pH and Brix Acid Ratio

Response Measurement Techniques such as Total Soluble Solid (TSS), Titrable acidity, Brix acid ratio and pH were tested in the developed beetroot juice and presented in

Table 1: Physical Characteristics of Beetroot

Parameters	Obtained Value (Mean)
Average weight of each vegetable (g)	74 ± 14
Weight of edible portion (%)	78
Weight of Non edible portions (%)	21
Edible index (%)	88
Waste index (%)	11
Juice yield	40 Percent

Table 2. Acidity is the measure of shelf life of the product. Titrable acidity studied to ensure physico-chemical changes during preparation (Sandhu *et al.*, 1985). The TSS of beetroot pulp was 10 °Brix. The TSS of the developed juice was made to 15 °Brix with the addition of sugar. Acid value was found to be 0.14% with the pH of 3.7 in the prepared juice. Brix acid ratio was found to be 107. Similarly, Nilugin and Mahendran (2010) reported that the titrable acidity of palmyrah RTS had ranged between 0.28-0.32% citric acid equivalent of beverage. The pH of prepared palmyrah RTS beverages was below 4. Singh (1998) reported that pH of plain carrot juice ranged from 6.18 to 6.24. Total acidity of freshly prepared carrot juices ranged between 0.05 and 0.06%. Sethi (1990) reported acidity of black carrot juice as 0.32% while Khan *et al.* (1998) mentioned the acidity of plain carrot juice blended with other fruit juices ranged from 0.296 to 0.394%. Grewal and Jain (1987) mentioned the acidity of the juice in a beverage as 0.43%. In the present study, the acidity of prepared beetroot juice was adjusted by adding citric acid.

Physico-Chemical Characteristics of Developed Beetroot Juice

Physico chemical properties of the juice such as moisture, ash, total sugar were analysed. Table 3 presents the moisture, ash and total sugar content of the juice. The moisture content of the juice was 81% and ash content was 0.21% g. The higher per cent of ash value represents the presence of wide variety of minerals in the beetroot juice which was supported by USDA National Nutrient Database for Standard Reference (2009) who mentioned that beetroot is a rich source of potent antioxidants and nutrients including magnesium, sodium, potassium, vitamin C. Sharma *et al.* (2000) reported the water content of the carrot juice as 89.66%. Total sugar content of beet juice was 6.8%.

Table 2: Response Measurement Techniques of Beetroot Juice

Characteristics	Values
TSS (°Brix)	15
Titrable acidity (%)	0.14
pH	3.7
Brix acid ratio	107

Table 3: Moisture, Ash and Total Sugar Content (% as Wet Base) of the Juice

Characteristics	Beet Juice
Moisture (g %)	81
Ash (g %)	0.21
Total sugar (%)	6.8

Nutrient Content of Developed Beetroot Juice

Beetroot is a rich source of carbohydrates, a good source of protein, and contains high levels of important vitamins, minerals and micronutrients. It is a good source of dietary fibre, has practically no fat, and no cholesterol. This makes beetroot relatively low in calories (kilojoules). Raw beetroot contains 7.0 g of total sugars, while boiled and pickled beetroot contain 8.8 g and 5.6 g respectively (Stephen Nottingham, 2004). Considering this, both macronutrients and micronutrients present in beetroot juice were analysed.

It is clear from the Table 4 that 100 ml of beetroot juice provided 52 Kcal of energy, 12 g of carbohydrates and 0.40 g of protein. Only trace amount of fat and dietary fibre were present. Atef *et al.* (2012) reported that carrot juice had a higher content of ash and lipids (0.70 and 0.25% respectively) while, orange and lemon juices had a higher content of carbohydrates (11.68 and 9.19% respectively) followed by carrot (8.48%) and least amount was identified in pumpkin juice (5.94%). Table 5 reveals Vitamin C content was 1.48 mg and folic acid content as 0.98% µg. Beet juice is rich in essential nutrients such as folate, potassium, and vitamin C and a very good source of the antioxidants manganese. It also contains small amounts of thiamine, riboflavin, niacin and vitamin A in the form of beta-carotene (Cathy Wong, 2012). Phosphorous and magnesium level in beetroot juice was 10.20 and 14.33% mg respectively. However, the raw beetroot contains 64 mg of phosphorous and 39 mg of magnesium per 100 g (Jennifer, 2009). Also beetroot juice is a rich source of calcium, magnesium, phosphorus, potassium, and sodium. In addition, smaller amounts of iron, zinc, copper, manganese, and selenium are present in it. Beetroot is a rich source of potassium. Potassium content was higher as 180 mg and sodium was less as about 48 mg per cent. Abby Roberts (2011) stated that beet juice is high in potassium which can help to regulate the fluid levels and maintain the electrolytes.

Organoleptic Characteristics of Developed Beetroot Juice

Organoleptic characteristics such as colour flavour, taste, consistency and overall acceptability of beetroot juice was

Table 4: Macronutrient Content (% as Wet Base) of Developed Beetroot Juice

Nutrients	Beet Juice
Energy (Kcal)	52
Carbohydrate (g)	12
Protein (g)	0.4
Fat (g)	Trace
Dietary fibre (g)	Trace

assessed by 20 semi trained panelists using a score card. The mean score secured for appearance was higher (4.5 ± 0.8) compared to scores recorded for other criteria. Minimum score of 3.3 ± 1.3 was recorded for flavour since the flavour of the beet juice was not preferred. However, the mean score attained for consistency, taste, overall acceptability was relatively higher as 4.4 ± 0.7, 4.3 ± 0.6, 4.3 ± 0.8 respectively.

Microbial Load of Developed Beetroot Juice and Stored Beetroot Juice

The freshly formulated beetroot juice had a minimum microbial load of 6×10^{-1}/cfu/ml which was less than permissible level. There was a slight increase in bacterial count of the beetroot juice. On storage, yet acceptable for consumption.

Shelf life Characteristics of Developed Beetroot Juice

The quality characteristics of the developed beetroot juice was analysed periodically on 0, 15, 45, 60 days to understand the suitability of beverage for consumption.

Physico-Chemical Characteristics of Stored Beetroot Juice

TSS, Titrable acidity, Brix acid ratio and pH of the stored juice were analysed and the values are presented in the Table 6.

The fresh beetroot juice had TSS of 13 °Brix and maintained till 15th day, however minimum increase (13 to 14 Brix) in TSS was recorded on 60th day of storage. This might be due to hydrolysis of polysaccharides into monosaccharaides and oligosaccharides. Similar results were also reported by Deka and Sethi (2001) and Jan and Masih (2012) who found an increase in total soluble solids during storage at ambient temperature in spiced RTS and pineapple juice blends respectively. There was a decrease in pH (3.9-3.6). This might be due to increase in titrable acidity as acidity and pH are inversely proportional to each other. Reduction of pH lead to increase in acidity from 0.12-0.16. A reduction in brix (108 to 87) was observed on storage.

Table 5: Micro Nutrients (Percent)

Nutrients	Beet Juice
Vitamin C (mg)	1.48
Folic acid (µg)	0.98
Phosphorous (mg)	10.2
Magnesium (mg)	14.33
Sodium (mg)	48
Potassium (mg)	180

Table 6: Physico-Chemical Characteristics of Stored Beetroot Juice

Sample	Total Soluble Solids (Brix°)	Titrable Acidity (%)	Brix: Acid Ratio	pH
0 Days	13	0.12	108	3.9
15 Days	13	0.12	108	3.9
45 Days	14	0.15	93	3.7
60 Days	14	0.16	87	3.6

CONCLUSION

The richness of beetroot with potassium has a higher role in reducing blood pressure and the other nutrients present in the Beetroot juice suggest the wide beneficial aspects.

Further studies are recommended to preserve the quality characteristics of Beetroot juice with longer shelf life.

REFERENCES

- Abby Roberts (2011), "Beet Juice and Athletes", Livestrong.com, http://www.livestrong.com/article/475637-beet-juice-athletes/
- Adam J and Betine (2002), "University of Maryland Medical Centre" [Online] http://www.umm.edu/altmed/conssuplements/betainecs.Html
- Ashurst P R (1994), "Fruit Juices", in P R Ashurst (Ed.), *Food Flavouring*, pp. 87-114, Blackie Academic and Sons Ltd., London.

- Atef A M Abou-Zaid, Nadir A S and Mostafa T Ramadan (2012), "Studies on Sheets Properties made from Juice and Puree of Pumpkin and Some Other Fruit Blends", *Journal of Applied Sciences Research*, Vol. 8, No. 5, pp. 2632-2639.
- Awsi Jan and Dorcus Masih Er. (2012), "Development and Quality Evaluation of Pineapple Juice Blend with Carrot and Orange Juice", *Journal of Scientific and Research Publications*, Vol. 2, No. 8, pp. 1-8.
- Azeredo H M (2009), "Betalains: Properties, Sources, Applications, and Stability—A Review", *International Journal Food Science and Technology*, Vol. 44, pp. 2365-2376.
- Cathy Wong Beetjuice (2012), http:// altmedicine.about.com/od/juicefasting/a/beetroot-juice.html
- Chander P (2003), "Carrot Pulp Waste Contains Useful Carotenoids", *Food Digest*, Vol. 26, No. 3, p. 11.
- Clinkard C E (1960), *Use of Juice*, p. 15.
- Deka B C and Sethi V (2001), "Preparation of Mixed Fruit Spiced RTS Beverages", *Ind Id. Packer*, Vol. 42, No. 3, pp. 58-61.
- Delegado V F, Jimenez A R and Paredes-Lopez O (2000), "Natural Pigments: Carotenoids, Anthocyanins, and Betalains-Characteristics, Biosynthesis, Processing, and Stability", *Critical Rev, Food Sci. Nut.*, Vol. 40, pp. 173-289.
- Francis F J (1991), "Colorants", pp. 55-66, Eagan Press, St. Paul.
- Grewal K S and Jain S C (1987), "Preparation and Chemical Analysis Preserved Carrot Juice", *Beverage and Food World*, p. 63.
- Grubben G J H and Denton O A (2004), "Plant Resources of Tropical Africa Z", in: Vegetables P (Ed.), ROTA Foundation, Wageningen, Backhugs, Leiden, CTA, Wageningen.
- Jennifer Kirkman (2009), http://voices.yahoo.com/the health-benefits-eating-beetroot-3960166.html? Eat=22
- Kahkonen M P, Hopia A I, Vuorela H J, Rauha J P, Pihlaja K, Kujala T S and Heinonen M (1991), "Antioxidant Activity of Plant Extracts Containing Phenolic Compounds", *Journal of Agricultural and Food Chemistry*, Vol. 47, pp. 3954-3962.
- Kanner J, Harel S and Granit R (2001), "Betalains—A New Class of Dietary Cationized Antioxidants", *J Agric Food Chem*, Vol. 49, pp. 5178-5185.
- Kuhn M E (1998), "Functional Food Overdose", *Food Proc, Mag*, Vol. 59, No. 5, pp. 21-48.
- Langthasa S (1999), "Processing and Preservation of Apple Pulp", Ph.D. Thesis, IARI, New Delhi.
- Maitin K B (2003), "Current from in Rapid Methods for Detection of Pathogen's in Food and Beverages; Technical Lecture", 5th International Food Convection, pp. 54-55, Mysore, India.
- Manfred Urs Koch (1981), "Laugh with Health", p. 63, Exisle Publishing Limited, New Zealand.
- Mc Ilvenn H and Armstrong G (1996), "Sensory Analysis and the Food Industry: Can Computers Improve Credibility?", *Nutrition & Food Science*, Vol. 96, No. 1, pp. 36-40, ISSN: 0034-6659 (Sensory Document).
- Menrad M B, Husing K, Menrad T, Reib S, Beer-Borst and Zenger C S, "Functional Food", TA 37/2000, Bern: Schweizerischer Wissenschafts und-Technologierat.
- Mornement J (2002), "Just Beet", *Fresh Produce Journal*, Vol. 5, pp. 24-25.
- Nilson T (1970), "Studies into the Pigments in Beetroot (*Beta vulgaris* L. ssp. *Vulgaris var. rubra* L.)", *Lantbrukhogskolans Annaler*, Vol. 36, No. 1, pp. 179-219.
- Nilugin S E and Mahendran T (2010), "Preparation of Ready-to-Serve (RTS) Beverage from Palmyrah (*borassus flabellifer l.*) Fruit Pulp", *The Journal of Agricultural Sciences*, Vol. 5, No. 2, pp. 80-88.
- Pedreno M A and Escribano J (2001), "Correlation Between Antiradical Activity and Stability of Betanine from *Beta vulgaris* L Roots Under Different pH, Temperature and Light Condition", *Journal of the Science of Food and Agriculture*, Vol. 81, pp. 627-631.
- Pedreno M A and Escribano J (2002), "Studying the Oxidation and the Antiradical Activity of Betalain from Beetroot", *J Biol Educ*, Vol. 35, pp. 49-51.
- Piggott J R, Simpson S J and Williams S A R (1998), "Sensory Analysis", *International Journal of Food Science and Technology*, Vol. 33, No. 1, pp. 7-18, ISSN: 1365-2621.

- Ranganna S (1986), *Sensory Evaluation General Instruction for Microbiological Examination*, 2nd Edition, pp. 670-686, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Ranganna S (2003), "Analysis of Fruits and Vegetables", pp. 86-92, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Ranganna S (2008), *Sensory Evaluation General Instruction for Microbiological Examination*, 4th Edition, p. 869, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
- Rao P K and Das H (2003), "Fuzzy Logic Based Optimization of Ingredients from Production of Mango Bar and its Properties", *Ind. J.Food Science. Technology*, Vol. 40, pp. 576-581.
- Rehman H and Ali J O (2000), "Plant Spacing and Sowing Time Effect on Yield in Turnip Crop", *Sarhad, J. Agri*., Vol. 16, pp. 575-577.
- Rey A I *et al.* (2005), "Use of Natural Food/Plant Extracts: Cloudberry (*Rubus Chamaemorus*), Beetroot (*Beta vulgaris* "Vulgaris") or Willow Herb (*Epilobium angustifolium*) to Reduce Oxidation of Cooked Pork Patties", *Food Science and Technology*, Vol. 38, pp. 363-370.
- Sandhu K S, Bhatia K S and Shukla F G (1985), "Physico Chemical Changes During Storage of Kinnow Mandarian, Orange and Pineapple Juice Concentrates", *Journal of Food Sci.Technology*, Vol. 22, pp. 342-345.
- Sethi V (1990), "Lactic Fermentation of Black Carrot Juice for Spiced Beverages", *Indian Food Packer*, Vol. 44, p. 12.
- Shahidi F (2004), "Functional Foods: Their Role in Health Promotion and Disease Prevention", *J. Food Sci*, Vol. 69, No. 5, pp. 146-149.
- Sharma G K, Semwal A D and Arya S S (2000), " Effects of Processing Treatments on the Carotenoids Composition of Dehydrated Carrots", *Journal of Food Science Technology*, Vol. 37, No. 2, pp. 196-200.
- Singh S, Shivare U S and Ahmed (1998), "Development of a Process to Manufacture Carrot Preserve", 4th International Food Convention, R153, Mysore.
- Stephen Nottingham Beetroot (2004), http://wiki.answers.com/q/what-ar-the-nutrition
- Swientek B (1998), "Toasts of the Town", *Prep. Foods*, pp. 21-26.
- Syed Aziz Ahmad and Sharma S C (2008), "Fruit and Vegetable Juice Therapy: Curative and Preventive Properties of Fruit and Vegetable in Ensuring a Healthy", p. 149, Publisher Pustak Mahal.
- USDA National Nutrient Database, Release No 24, Accessed on 20-10-2011, http://www.nal.usda.gov/fnic/foodscomp/cgi-bin/list-nut-edit-pl
- Vinson J A, Hao Y, Su X and Zubik L (1998), "Phenol Antioxidant Quantity and Quality in Foods: Vegetables", *Journal of Agricultural and Food Chemistry*, Vol. 46, pp. 3630-3634.
- Wang M and Goldman I L (1997), "Transgressive Segregation and Reciprocal Effect for Free Folic Acid Content in a Red Beet (*Beta vulgaris* L.) Population", *Euphytica*, Vol. 96, pp. 317-321.


IJFANS
International Journal of Food
And Nutritional Sciences