International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(4): 2534-2538

Received: 10-05-2019
Accepted: 12-06-2019

Bharat Sidram Agarkar
Ph. D. Scholar (PAU) and Asstt. Prof. College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Poonam Aggarwal
Head, Department of Food Science and Technology, PAU, Ludhiana, Punjab, India

Correspondence
Bharat Sidram Agarkar
Ph. D. Scholar (PAU) and Asstt. Prof. College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Studies on extraction and preservation of juices of sugarcane, Kinnow, Aonla, lemon and ginger

Bharat Sidram Agarkar and Poonam Aggarwal

Abstract
The juices of sugarcane var. CoPb-91, kinnow, aonla, lemon and ginger were extracted using standard procedures, analysed for physicochemical parameters and optimized the processing parameters. The juices pasteurized at 82 ^{0}C temperature for 5 min, sodium benzoate was added at 120ppm level, hot filled in sterile glass bottles of 200ml capacity and further heat processed in boiling water for 30 min were found suitable. The processed and bottled juices of sugarcane (with addition of 3 per cent lemon juice), kinnow, aonla, lemon and ginger were found stable without microbial growth during storage of 6 months at room temperature.

Keywords: Sugarcane juice, Kinnow juice, aonla juice, lemon juice, ginger juice

Introduction
Sugarcane, kinnow, aonla, lemon and ginger are well known for their nutritional and medicinal properties. The extraction of juices make convenience for their end use in beverages and soft drinks while processing and preservation also makes their availability in off season. In India, the urban and rural population is habitual for thirst quenching and delicious drink made up from sugarcane juice with lemon, mint and ice. It contains water (75-85 per cent), reducing sugar (0.3-3.0 per cent), non-reducing sugar (10-21 per cent), minerals, enzyme and organic acids (Swaminathan 1995) [30]. The sugarcane juice strengthens the stomach, kidneys, heart, eyes, and brain and sex organs. It is very useful in scanty urination (Karthikeyan and Samipillai 2010) [14]. It is used to cure jaundice, sore throat, cold and flu. It has a low glycemic index and hydrates the body quickly (Subbannayya *et al.* 2007) [29]. Kinnow mandarin has attractive colour, distinctive flavour and being rich source of vitamin C, calcium and phosphorous and used in beverages, industrial and medicinal products (Sogi and Singh 2001) [27]. The fresh fruit of aonla is very rich source of ascorbic acid (454.40 mg/100ml) and appreciable source of total sugar, calcium, iron and phosphorus (7.53, 14.91, 0.62 and 11.81 mg/100ml, respectively) and also has great potential for processing (Dachiya and Dhawan 2001) [6]. Aonla is used in the treatment of haemorrhage, dysentery, diarrhoea, gastric disorders, constipation, headache, jaundice, diabetes, cough and enlargement of liver (Anand 1970, Parrotta 2001, Goyal *et al.* 2007) [1, 23, 11]. Ginger (*Zingiber officinale*) is important to cure gallstones, to decrease joint pain from arthritis. Ginger has blood thinning and cholesterol lowering properties hence useful for treating heart disease (Fahlberg 1969) [9]. The present study was undertaken by considering the importance of these juices and to understand the problem of juice extraction, packaging and preservation for their consistent use in the improvement of human health.

Materials and methods
Extraction of juices: Sugarcane The sugarcane var. CoPb-91 from Punjab Agricultural University Research Station Kapurtala, kinnow, aonla, lemon and ginger from local market were procured. Sugarcane was cleaned, cut into 2.5 feet length, washed by clean by mechanical washer, skin and nodes were scrapped with special curved blade stainless steel (SS) knife and again washed in mechanical washer for 2 min and surface dried in perforated SS trays using fans. The juice of sugarcane was extracted with double extraction using mechanical crusher (SS make). The extracted juice was first filtered through the SS screen and then filtered through the four fold clean muslin cloth. Kinnow were washed, peeled manually using hand gloves and SS knife. The juice was extracted through juice extractor and filtered

through the double folded muslin cloth. Fresh aonla fruits were sorted graded, washed and heat treated in hot water (95^0C) till the fruit colour changes to pale yellow. The seeds were removed and the juice was extracted using juice extractor with addition of equal quantity of water and filtered through the four fold muslin cloth. The lemon fruits were sorted, graded, washed, drained, halved and juice was extracted using manually operated machine and then filtered through the four fold muslin cloth. The fresh ginger was washed, peeled manually, cut into small pieces and grinded in mixer with double quantity of water. The slurry was then filtered through the double folded muslin cloth and kept for 2hr in cylindrical transparent plastic container to settle the sediment at bottom. Clear extract is then filtered through 4 fold muslin cloth.

Processing of juices: The juices were pasteurized at different temperatures viz. 78, 80, 82, 84 and 85 ^{0}C for different periods (2, 3, 4, 5 and 6 min.) with sodium benzoate (120ppm) as preservative were tested for optimization by using sensory evaluation and total plate count after 3 months of storage. The juices were then hot filled and processed in boiling water for 30 min, cooled to room temperature slowly in running tap water, let it for the surface dry and labelled. The bottles were stored at ambient temperature (30 ± 4^0C) for the further storage stability. The juices were analyzed for the proximate composition viz. moisture content, total solids, ash, content, titratable acidity and ascorbic acid (Ranganna 2015) [24]; pH using digital pH meter (Elico India) which was calibrated according to method of AOAC (2005) [3]; antioxidant activity by DPPH (Brand-William *et al.* 1995) [4]; total phenols by Folin-Ciocalteau method (Singleton and Rossi 1965) [26]; Total flavonoids (Marinova *et al.* 2005) [20]; total sugars (Dubois *et al.* 1956) [8]; reducing sugars (Nelson 1944 and Somogyi 1952) [22, 28]; viscosity using RV model viscometer, mineral content by Inductively Coupled Plasma-Atomic Emission Spectrophotometer (ICP-AES) and sensory evaluation by 9 point hedonic scale (Larmond 1970) [16] and total plate count for bacteria was counted by using method of AOAC (1995) [2].

Result and discussion

Optimization of processing conditions

The juices of sugarcane (with addition of 3 per cent lemon juice), kinnow, aonla, lemon and ginger pasteurized at 82 ^{0}C temperature for 5 min were found suitable on their sensory evaluation as score was superior over the other pasteurization temperatures and times. The products were found stable for 6 months but there was difference in sensory scores as shown in Table 1.

Table 1: Optimization of pasteurization temperature and time of juices of sugarcane, kinnow, aonla, lemon and ginger

Pasteurization		Overall acceptability					Total plate count (cfu/ml)				
Temperature (^{0}C)	Time (min)	SC	K	A	L	G	SC	K	A	L	G
78	2	7.5	7.4	7.3	7.3	7.5	-	-	-	-	-
	3	7.5	7.4	7.4	7.3	7.7	-	-	-	-	-
	4	7.5	7.4	7.4	7.5	7.7	-	-	-	-	-
	5	7.6	7.5	7.6	7.6	7.7	-	-	-	-	-
	6	7.7	7.6	7.8	7.7	7.7	-	-	-	-	-
80	2	7.5	7.5	7.5	7.4	7.6	-	-	-	-	-
	3	7.5	7.6	7.6	7.5	7.6	-	-	-	-	-
	4	7.5	7.6	7.6	7.6	7.8	-	-	-	-	-
	5	7.7	7.7	7.9	7.6	7.8	-	-	-	-	-
	6	7.6	7.6	7.9	7.6	7.6	-	-	-	-	-
82	2	7.6	7.7	7.6	7.6	7.6	-	-	-	-	-
	3	7.7	7.7	7.7	7.7	7.8	-	-	-	-	-
	4	7.8	7.8	7.9	7.9	7.8	-	-	-	-	-
	5	8.0	8.1	8.2	8.0	8.1	-	-	-	-	-
	6	7.6	7.8	7.9	7.7	7.7	-	-	-	-	-
84	2	7.5	7.5	7.6	7.5	7.3	-	-	-	-	-
	3	7.5	7.5	7.6	7.5	7.3	-	-	-	-	-
	4	7.6	7.6	7.6	7.6	7.2	-	-	-	-	-
	5	7.7	7.6	7.7	7.5	7.2	-	-	-	-	-
	6	7.7	7.6	7.5	7.6	7.1	-	-	-	-	-
86	2	7.4	7.2	7.5	7.4	7.4	-	-	-	-	-
	3	7.4	7.3	7.4	7.3	7.4	-	-	-	-	-
	4	7.3	7.3	7.3	7.2	7.3	-	-	-	-	-
	5	7.3	7.3	7.3	7.0	7.3	-	-	-	-	-
	6	7.1	7.1	7.1	7.0	7.1	-	-	-	-	-
CD at 5%	0.01	0.02	0.02	0.02	0.02	0.02	-	-	-	-	-

SC-sugarcane, K-kinnow, A-aonla, L-lemon, G-ginger, S-stable

Physicochemical and phytochemical characteristics of fresh juices of sugarcane, kinnow, aonla, lemon and ginger

The Physicochemical and phytochemical characteristics of pasteurized juices of sugarcane, kinnow, aonla, lemon and ginger are depicted in the Table 2.

Table 2: Physicochemical and phytochemical constituents of juices of sugarcane, kinnow, aonla, lemon and ginger

Parameters	Fresh juices					CD at 5%
	Sugarcane	Kinnow	Aonla	Lemon	Ginger	
Juice yield (%)	54.61	47.15	129.46	40.7	182	NS
Moisture content (%)	79.26	88.20	90.90	90.22	97.30	0.71
Total solids (%)	20.73	11.80	9.10	9.77	2.70	0.04
TSS (^{0}Brix)	20.54	10.30	8.60	9.16	2.10	3.10
Ash (%)	0.29	0.35	0.23	0.33	0.27	0.01
Acidity (%)	0.21	1.16	1.38	4.95	0.27	0.03
pH	5.35	3.24	2.77	2.44	5.68	0.11
Ascorbic acid (mg/100ml)	3.65	23.60	253.42	28.86	5.60	3.41
Antioxidant activity (% inhibition)	43.23	69.30	88.32	67.41	78.20	0.57
Total polyphenols (mg GAE/100ml)	487.3	1266.61	1536.6	1021.3	505	0.99
Total flavonoids (mg QE/100ml)	2.56	16.42	16.73	17.63	150	0.87
Total sugars (%)	18.57	9.59	1.48	4.39	1.75	0.77
Reducing sugars (%))	0.42	2.13	0.93	1.16	0.06	0.13
Viscosity (cp at 25^{0}C)	3.66	5.90	4.80	3.33	3.20	0.36

Sugarcane juice

The average value for per cent juice yields of sugarcane was found 54.61. The juice yields for different varieties of sugarcane were found different and values reported by Chauhan *et al.* (2002) [5] for sugarcane juice yield were in accordance (48 to 56.4 %). The moisture content of sugarcane juice was observed as 79.26 per cent. The values reported by Chauhan *et al.* (2002) [5] for the moisture content in sugarcane juices of different varieties were slightly higher those ranged between 80 to 81.7 per cent. The values for total solids (%), ash content (%) and total soluble solids (^{0}B) recorded were 20.73, 0.29 and 20.54, respectively. The total sugar and reducing sugar content values in per cent reported in sugarcane juice were 18.57 and 0.42, respectively. The above results are in agreement with result reported by Chauhan *et al.* (2002) [5]. The acidity (%) and pH values recorded as 0.21 and 5.35 which showed less value for acidity and more in case of pH than reported by Chauhan *et al.* (2002) [5]. The viscosity values (cp) observed as was 3.66. The ascorbic acid (mg/100ml), antioxidant activity (% inhibition of DPPH), total phenolic content (mg GAE/100ml) and total flavonoids (mg QE/100ml) values were reported as 3.65, 43.23, 487.3 and 2.56, respectively. Duarte-Almeida *et al.* (2011) [7] reported the same value for antioxidant activity of sugarcane juice.

Kinnow juice

The data depicted in the Table 2 showed that, the average value for the juice yield was observed 47.15 per cent. The average values for physicochemical parameters such as moisture content, total solids, ash content, acidity, total sugars and reducing sugars were found 88.20, 11.80, 0.35, 1.16, 9.59 and 2.13 per cent, respectively. The average values for TSS (^{0}Brix), ascorbic acid (mg/100ml), antioxidant activity (% inhibition), total phenolics (mg GAE/100ml) and total flavonoids (mg QE/100ml) in kinnow juice were reported as 23.6, 69.3, 1266.61 and 16.42, respectively. The values for phenolic content were at par with the value reported by Wern *et al.* (2016) [32].

Aonla juice

The average value for the juice yield of aonla during processing was observed as 129.46 per cent as during juice extraction the equal proportion of water was used and for the total soluble solids value was reported 8.6 ^{0}Brix. The average values for moisture content, total solids, ash content, acidity, total sugars and reducing sugars were found 90.90, 9.1, 0.23, 1.38, 1.48 and 0.93 per cent, respectively (Table 2). The average values for ascorbic acid (mg/100ml), antioxidant activity (% inhibition), total phenols (mg GAE/100ml) and total flavonoids (mgQE/100ml) content were reported as 253.42, 88.32, 1536.6 and 167.3, respectively. The values for total flavonoids were found in accordance with the results reported by Karpagavalli *et al.* (2014) [13].

Lemon juice

The average juice yield of lemons was observed as 40.7 per cent during study. Mookerjee *et al.* (1964) [21] reported that juice content of different varieties of lemons varied from 21.26 to 42.86 per cent, while Mahajan (1989) [17] reported higher values (48.9 to 49.33 per cent) for lemon juice content from Himachal Galgals. According to Ranganna (2015) [24] the juice content in the lemons should not be less than 30 percent as per the USDA standards and not less than 28 per cent for green lemon fruits meant for export. The moisture content in lemon was 90.22 per cent; similar level of moisture content was reported by Verma and Sastry (1969) [31] and Gebhardt *et al.* (1982) [10]. The TSS 9.16^{0}B was observed while similar results were reported by Verma and Sastry (1969) [31], Jain *et al.* (1984) [12] and Khurdiya (1988) [15]. The titratable acidity recorded for the lemon juice was 4.95 per cent. The values of titratable acidity were in the range of acidity reported by Ranken (1984) [25]. The ash content was observed as 0.43 per cent which found conformity with the value reported by Ranken (1984) [25]. The pH value of lemon juice was observed as 2.44. The ascorbic acid content (mg/100ml) was 28.86 which found lower than value reported by Ranken (1984) [25]. The antioxidant activity (% inhibition), total phenols (mg GAE/100ml) and total flavonoids (mg QE/100ml) were observed as 67.41, 1021.3 and 17.63, respectively. The per cent values for total sugars and reducing sugars observed in juice were 4.39 and 1.16, respectively. The range for reducing sugar content reported by Mahajan and Lal (1991) [18] was 1.23-1.36 per cent, while Jain *et al.* (1984) [12] reported 1.08 per cent of reducing sugar.

Ginger juice

It was observed from Table 2 that, the average value for the juice yield was observed as 182 per cent as juice extracted with double proportion of water for the proper extraction of juice. The total soluble solids were reported 2.1 ^{0}Brix. The average values for moisture content, total solids, ash content, acidity, total sugars and reducing sugars were found 97.3, 2.7, 0.27, 0.27, 1.75 and 0.06 per cent, respectively. The value for

pH and viscosity (cp) were observed as 5.68 and 3.2, respectively. The values for ascorbic acid (mg/100ml), antioxidant activity (% inhibition), total polyphenols (mg GAE/100ml) and total flavonoids (mg QE/100ml) content were reported as 5.6, 78.2, 505 and 150 respectively. These values were found lower as the equal proportion of water was used during extraction of juice. The value for antioxidant activity was in accordance with the value reported by Maizura *et al.* (2011) [19].

Mineral contents in juices of sugarcane, kinnow, aolnla, lemon and ginger

The mineral content values (mg/100ml) for the sugarcane juice, kinnow, aonla, lemon and ginger are shown in Table 3. The mineral content values (mg/100ml) for juices of sugarcane, kinnow, aonla, lemon and ginger were found in good amounts. The calcium was found at par (10.07 – 13.87), while iron was found more in sugarcane juice (1.78), The maximum value for potassium (145) was reported in kinnow juice followed by lemon (103.27) and ginger (70.73). The sodium and magnesium content was found maximum in sugarcane (13.89 and 13.42, respectively). The values for the phosphorus and sulphur were reported maximum in sugarcane juice as compare to other juices. The mineral content values for the copper, zinc, manganese and nickel were reported at par for all juices.

Table 3: Mineral content of the of juices of sugarcane, kinnow, aonla, lemon and ginger (mg/100ml)

Mineral	Sugarcane	Kinnow	Aonla	Lemon	Ginger	CD at 5%
Calcium	13.87	11.95	11.82	11.29	10.07	0.05
Iron	1.78	0.17	1.81	0.18	0.17	0.15
Potassium	49.52	145.00	29.16	103.27	70.73	0.41
Sodium	13.89	4.26	7.52	2.48	3.47	0.02
Magnesium	13.42	6.42	5.08	5.66	6.82	0.01
Copper	0.52	0.11	0.10	0.12	0.13	0.01
Phosphorous	25.27	21.93	9.32	19.73	17.60	0.01
Manganese	0.40	0.33	0.34	0.33	0.59	0.01
Zinc	0.39	0.32	0.30	0.17	0.32	0.01
Sulphur	62.13	11.12	8.12	8.12	14.63	NS
Nickel	0.01	0.01	0.01	0.01	0.02	NS

Conclusion

The juices of sugarcane (with addition of 3% lemon juice), kinnow, aonla, lemon and ginger extracted using standard procedures and pasteurized at 82 0C temperature for 5 min with addition of 120ppm of sodium benzoate as a preservative were stored safe at room temperature for 6 months without microbial growth. These bottled nutritional juices can be stored at room temperature and used for the preparation of blended health beverages also for direct consumption due to content of limited concentration of preservative.

References

1. Anand JC. Retention of added vitamin C in alma preserves. Indian Food Pack. 1970; 24:19-20.
2. AOAC. Official Methods of Analysis. Association of Official Analytical Chemists International, 16th ed. Edited by Patricia Cuniff, Virginia, USA. Test. 1995; 17.2.01:3-4
3. AOAC. Official Methods of Analysis. Association of Official Analytical Chemists, 18th ed. Washington, D.C. USA, 2005.
4. Brand-Williams W, Cuvelier ME, Berset C. Use of free radicals method to evaluate antioxidant activity. Lebensm Wiss Technol - Food Sci Technol. 1995; 28:25-30.
5. Chauhan OP, Singh D, Tyagi SM, Balyan DK. Studies on preservation of sugarcane juice. Int. J Food Properties. 2002; 5:217-29.
6. Dachiya SP, Dhawan SS. Physico-chemical characteristics of aonla (*Emblica officinalis* Gaertn.) cv. Chakaiya. Indian Food Pack. 2001; 55:133.
7. Duarte-Almeida JM, Salatino A, Genovese MI, Lajolo FM. Phenolic composition and antioxidant activity of culm and sugarcane (*Saccharum officinarum*) products. Food Chem. 2011; 125:660-64.
8. Dubois M, Gilles KA, Hamilton JK, Rebers PA, Smith F. Colorimetric method for determination of sugars and related substances. Anal Chem. 1956; 28:350-56
9. Fahlberg. The Pungent principles of ginger and their importance in certain ginger products. Food Technol Australia. 1969; 21:570 -71.
10. Gebhardt SE, Cutrufelli R, Mathews RH. Composition of Foods: Fruit and fruit juices. US Deptt. Agric., 1982, 8-9p.
11. Goyal RK, Kingsly ARP, Kumar P, Walia H. Physical and mechanical properties of Aonla fruits. J Food Engg. 2007; 82:595-99.
12. Jain SP, Tirpathi VK, Ram HB, Singh S. Effect of storage conditions on the keeping quality of fruit squashes. Pat I Studies on storage behaviour of orange, lemon and bael squashes. Indian Food Packer. 1984; 38:33-39.
13. Karpagavalli B, Amutha S, Padmini T, Palanisamy R, Chandrakumar K. Effect of processing on retention of antioxidant components in value added amla products. Indian J Sci Technol. 2014; 7:672-77.
14. Karthikeyan J, Samipillai SS. Sugarcane in therapeutics. J Herb Medicin Toxicology. 2010; 4:9-14.
15. Khurdiya DS. Preparation of lime juice for carbonated drink. J Food Sci Technol. 1988; 25:315-16.
16. Larmond E. Methods of sensory evaluation of food. Can Deptt Agri Pubs, 1970, 1284.
17. Mahajan RK. Studies on evaluation of processing waste of some citrus species for oil and pectin. M.Sc. Thesis, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, H.P., India, 1989.
18. Mahajan RK, Lal BB. Evaluation studies on Himachal Galgal (*Citrus pseudomonas* Tan.) for processing industry. J Food Sci Technol. 1991; 28:378-80.
19. Maizura M, Aminah A, Wan Aida WM. Total phenolic content and antioxidant activity of kesum (*Polygonum*

minus), ginger (*Zingiber officinale*) and turmeric (Curcuma longa) extract. Int Food Res J. 2011; 18:529-34.
20. Marinova D, Ribarova F, Atanassova M. Total phenolics and total flavonoids in Bulgarian fruits and vegetables. J Univ Chem Technol Metallurgy. 2005; 40:255-60.
21. Mookerjee KK, Tandon GL, Siddappa GS. Varietal suitabiliyt of lemons for making lemon squash. Indian Food Packer. 1964; 18:4-6.
22. Nelson N. A photometric adaptation of the Somogyi method for the determination of glucose. J Biol Chem. 1944; 153:375-80.
23. Parrotta AJ. Healing Plants of Peninsular India. p. 308. New York: CABI publishing, 2001.
24. Ranganna S. Handbook of Analysis & Quality Control for Fruit and Vegetable Products, Tata McGraw Hill Publishing Co. Ltd., New Delhi, India, 2015.
25. Ranken MD. Food Indutries Manual 21st ed. Blackie and Son Ltd. Washington D. C., USA, 1984.
26. Singleton VL, Rossi JA. Colorimetry of total phenolics with phosphomolybdic- phoshotungustic acid reagents. Amer J Enol Viticult. 1965; 16:144-58
27. Sogi DS, Singh S. Studies on bitterness development in kinnow juice ready-to-serve beverage, squash, jam and candy. J Food Sci Technol. 2001; 38:433-38.
28. Somogyi M. Notes on sugar determination. J Biol Chem. 1952; 195:19-23.
29. Subbannayya K, Bhat GK, Shetty S, Junu VG. How safe is sugarcane juice. Indian J Med Micro. 2007; 25:73-74.
30. Swaminathan V. Food Science Chemistry & Experimental Foods, Bangalore Printing and Publishing Co. Ltd., Bangalore, 1995.
31. Verma AK, Sastry LVL. Preparation, composition and storage behaviour of comminuted orange and lime squashes. Indian Food Packer. 1969; 23:5-11.
32. Wern KH, Haron H, Keng CB. Comparison of total phenolic contents (tpc) and antioxidant activities of fresh fruit juices, commercial 100per cent fruit juices and fruit drinks. Sains Malaysiana. 2016; 45:1319-27.