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Study on effect of sugar and carbonation level on carbonated kokum (*Garcinia indica* C.) drink

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Abstract
Kokum has a long history in ayurvedic medicine as it was traditionally used to treat sores, tumors, dermatitis, heart complaints, stomach and liver disorders. It contains hydroxycitric acid, which is claimed to have fat reducing properties; hence it is gaining wide importance in reducing obesity. Because of high acidity it is not preferred for direct consumption, but it has excellent therapeutic value which offers enormous potential for processing. Refreshing carbonated drinks available in market are made of artificial flavors which provide immediate refreshment but are neither nutritious nor healthy; hence, natural fruit juice like that of kokum is more relishing and nutritious. In this context, different sugar (12, 13 and 14°Brix) and carbonation pressure (80, 90 and 100 psi) levels were standardized for preparation of carbonated kokum drink. In the present study results indicated that, sugar level and carbonation pressure level does not have any significant difference on biochemical composition (TSS, pH, acidity, ascorbic acid, HCA, total antioxidants, total sugars, reducing sugars and total anthocyanin) of the prepared drink but it influences the organoleptic scores, which finally influences the consumer acceptance.

Keywords: kokum, health benefits, carbonated drink, carbonation level, sugar level

Introduction
Kokum *(Garcinia indica* C.) belongs to Clusiaceae (Guttiferae) family, it is an indigenous tree spice of India which is mainly found along coastal belt of Konkan region of Maharashtra and Goa, Kasargod area of Kerala, Uttara Kannada; Udupi and Dakshina Kannada Districts of Karnataka, evergreen forests of Assam, Khasi, Jantia hills, West Bengal and Gujarat. It is known by various names across India including *Bindin, Bhirand, Bhinda, Biran, Punarpuli, Katambi, Ratamba or Amsol.* It has a pleasant acceptable flavor and sweet acidic taste which makes it a popular food-additive.

Kokum fruit appears to be a promising industrial raw material for commercial exploitation in view of its interesting chemical constituents. It contains moisture (80.0 g/100 g), protein (1%), tannin (1.7%), pectin (0.9%), total sugars (4.1%), fat (1.4%) and anthocyanins (2.4 g/100 g of kokum fruit) (Nayak *et al*., 2010) [12]. The cyanidin- 3-glucoside and cyanidin-3-sambubioside present in ratio of 4:1 which are the major anthocyanin pigments present in kokum. Consumption of hydroxyl-citric acid inhibits fat synthesis, lipogenesis, decreases food intake and reduces body weight (Jena *et al*., 2002) [9]. Hence, it is used in some vegetable dishes and to prepare chutneys and pickles. Kokum is often used in variety of ways such as small fruit pieces, dried or kokum powder.

Carbonated drinks are beverages that contain dissolved carbon dioxide and the process by which the gas dissolves under high pressure in the drink is known as carbonation. Because of appetizing nature, nutritious and also delicately flavored they are very popular and in demand throughout the world. Juice blending not only enriches nutritional quality of the base raw material but also offers an opportunity to develop new product (Nath and Yadav, 2005) [11]. In this context a thirst quenching and functionally rich kokum blended carbonated drink was developed by using aonla and ginger with different levels of sugar and pressure.This helped to increase the nutritional and sensory quality of product.

Material and Methods

The experiment was carried out at the Department of Postharvest Technology, College of Horticulture, University of Horticultural Sciences Campus, GKVK (Post), Bengaluru. The dried kokum rind was procured from a local farmer in Vanalli village in Sirsi Taluk, Uttara Kannada district, Karnataka. Matured aonla fruits of uniform size and colour were purchased from Regional Horticultural Research and Extension Centre, UHS Campus, GKVK (Post), Bengaluru while ginger was purchased from a local vendor in Vidyaranyapura, Bengaluru. Extraction of juice: Dried kokum rind (100 g) was coarsely powdered and soaked in 500 ml of hot water (80 °C) (Kokum : Water, 1:5 w/v) overnight and it was filtered using muslin cloth to get a clear extract. Aonla fruits and ginger rhizomes were extracted in water at 1:1 and 1:2 w/v ratios respectively. The juice was extracted by using muslin cloth and the obtained clear juice was used in the present study. Treatment details: T_1: Kokum (10%) + Aonla (1%) + Ginger (1%) + 12^0Brix + 80 psi, T_2: Kokum (10%) + Aonla (1%) + Ginger (1%) + 12^0Brix + 90 psi, T_3: Kokum (10%) + Aonla (1%) + Ginger (1%) + 12^0Brix + 100 psi, T_4: Kokum (10%) + Aonla (1%) + Ginger (1%) + 13^0Brix + 80 psi, T_5: Kokum (10%) + Aonla (1%) + Ginger (1%) + 13^0Brix + 90 psi, T_6: Kokum (10%) + Aonla (1%) + Ginger (1%) + 13^0Brix + 100 psi, T_7: Kokum (10%) + Aonla (1%) + Ginger (1%) + 14^0Brix + 80 psi, T_8: Kokum (10%) + Aonla (1%) + Ginger (1%) + 14^0Brix + 90 psi, T_9: Kokum (10%) + Aonla (1%) + Ginger (1%) + 14^0Brix + 100 psi. Procedure for carbonation: As per treatment required quantity of sugar syrup was prepared by blending Kokum (10%), Aonla (1%), Ginger (1%) extract. Extracted blended juice was made into three equal parts and was added with different quantity of sugar to obtain 59, 61 and 63°Brix of sugar syrup to get 12, 13 and 14°Brix in the end product, respectively. 50, 51 and 52 ml of the blended kokum syrup was filled in pre-sterilized 275ml capacity bottles. Carbonation was done by using industrial carbonation unit supplied by M. G. Industries, Coimbatore. During carbonation chilled RO water was filled at varying pressure adjusted manually at 80, 90 and 100 psi for respective treatment. Biochemical analysis: Carbonated kokum drink was analyzed for TSS using digital hand refractometer (Make: Erma Optical Works Ltd., Tokyo, Japan, 0-32°B range). Acidity (AOAC, 2000) and HCA (Asish *et al*., 2008) [5] of blended juice was determined by titrating against 0.1N sodium hydroxide and per cent acidity was expressed in terms of anhydrous citric acid and HCA was determined by replacing equivalent weight of acid with equivalent weight of HCA and the pH of the juice was measured by using pH meter. Ascorbic acid was determination by 2, 6-dichlorophenol-indophenol dye method suggested by AOAC, 2006 [4]. Reducing and total sugars were determined according to the method suggested by Lane and Eynon, 1923 [10]. The total anthocyanin concentration was estimated as described by Fuleki and Francis (1968) [8] and antioxidant activity was determined by FRAP method explained by Benzie and Strain (1996) [6]. Sensory evaluation was recorded using 9-point Hedonic scale as laid out by Amerine *et al*. (1965) [2]. All the data were statistical analyzed in according to the Completely Randomised Design (CRD) suggested by Sunderraj *et al*., 1972 [15].

Results and Discussion

There was no significant difference recorded in acidity, HCA, ascorbic acid, anthocyanin, antioxidants and reducing sugar content indicating that sugar and carbon dioxide pressure levels doesn't have any significant impact on these parameters is presented in Table 2.

pH and reducing sugars were found significant with highest (2.6) pH was recorded in T_7 (14°Brix, 80 psi pressure) and T_9 (14°Brix, 100 psi pressure) which was on par (2.59) with T_8 (14°Brix, 90 psi pressure) the higher pH may be due to presence of higher organic acids in fruit juice and variation in pulp concentration. Carbonic acid produced during carbonation also contributes towards lowering the pH. While, the lowest (2.50) pH was recorded in T_1 (12°Brix, 80 psi pressure) and T_3 (12°Brix, 100 psi pressure) which was followed (2.51) by T_2 (12°Brix, 90 psi pressure).The highest Total sugar content 15.17 per cent was recorded in T_7 (14°Brix, 80 psi pressure) which was on par with T_8 (14°Brix, 90 psi pressure) and T_9 (14°Brix, 100 psi pressure) having 15.15 and 15.10 per cent, respectively. The lowest total sugars (13.78 %) was observed in T_2 (12°Brix, 90 psi pressure) which was on par (13.84 %) with T_3 (12°Brix, 100 psi pressure) and T_1 (12°Brix, 80 psi pressure). These results are in agreement with the results reported by Sunil (2004) [16] in guava carbonated at 60 and 80 psi pressure level and Sajad (2004) [13] in acid lime based carbonated beverage.

Table 1: Proximate composition of experimental raw materials

Extracts	Kokum	Ginger	Aonla
TSS (°Brix)	7.00	1.50	5.80
pH	2.59	5.20	3.11
Acidity (%)	6.08	0.24	1.56
Ascorbic acid (mg 100 ml^{-1})	246.25	2.70	448.70
Antioxidants (mg AEAC 100 ml^{-1})	2436.35	2134.15	2871.42
Reducing sugars (%)	4.11	0.64	4.59
Total sugars (%)	5.8	1.60	5.95
Anthocyanin (mg 100 ml^{-1})	27.38	-	-
HCA (%)	20.10	-	-

Table 2: Effect of sugar and carbonation pressure levels on biochemical properties of carbonated kokum drink

Treatments	pH	Acidity (%)	HCA (%)	Ascorbic acid (mg 100 ml^{-1})	Anthocyanin (mg 100 ml^{-1})	Antioxidants (mg AEAC 100 ml $^{-1}$)	Reducing Sugars (%)	Total sugars (%)
T_1	2.50^c	0.57	1.84	27.30	3.18	246.95	9.55	13.84^c
T_2	2.51^c	0.56	1.80	27.30	3.13	243.47	9.60	13.78^c
T_3	2.50^c	0.61	1.98	27.30	3.07	250.85	9.57	13.84^c
T_4	2.56^b	0.61	1.98	27.30	3.15	244.32	9.60	14.28^b
T_5	2.54^b	0.56	1.80	27.30	3.14	244.63	9.52	14.31^b
T_6	2.55^b	0.53	1.73	27.30	3.13	245.42	9.57	14.40^b
T_7	2.60^a	0.56	1.80	27.30	3.20	247.99	9.63	15.17^a
T_8	2.59^a	0.59	1.91	27.30	3.18	246.89	9.60	15.15^a
T_9	2.60^a	0.57	1.84	27.30	3.16	245.73	9.63	15.10^a
Mean	2.55	0.58	1.85	27.30	3.15	246.25	9.59	14.43
SE.m ±	0.01	0.02	0.08	--	0.028	1.62	0.07	0.03
CD @5%	0.03*	0.07 NS	0.22 NS	NS	0.084 NS	4.82 NS	0.21 NS	0.10*
CD @1%	0.04**	0.09 NS	0.33 NS	NS	0.11 NS	6.60 NS	0.28 NS	0.13**

NS- Non Significant * - significant at 5% **- significant at 1%
Similar alphabets in the superscript (column) are not significantly different ($P \geq 0.05$)

Sensory evaluation

The sensory scores obtained for prepared carbonated drink by altering T.S.S and pressure level are given in Figure 1. The highest (8.63) score for color was recorded in T_9 consisting of 14°Brix T.S.S and 100 psi carbon dioxide pressure which was followed (8.47) by T_7 score. For flavor highest sensory score 8.27 was observed in T_3 (12°Brix T.S.S and 100 psi CO_2 pressure) was followed by T_9 (14°Brix T.S.S and 100 psi CO_2 pressure) which was in the range of "Like very much" having the score 8.23 and the minimum (7.52) score was recorded in T_4 having13°Brix T.S.S and 80 psi carbon dioxide pressure. The highest (8.24) sensory taste score was recorded in T_9 (14°Brix T.S.S and 100 psi CO_2 pressure) which was in the range of "Like very much" was followed by T_8 (14°Brix T.S.S and 90 psi CO_2 pressure) with 8.06 score. While the minimum score 7.42 was recorded for T_2 (12°Brix T.S.S and 90 psi CO_2 pressure) was followed by T_5 (13°Brix T.S.S and 90 psi CO_2 pressure). The highest sensory score 8.11 was received for after taste by T_9 (14°Brix T.S.S and 100psi CO_2 pressure) which was in the range of "Like very much" followed by T_3 (12°Brix T.S.S and 100 psi CO_2 pressure) getting 8.08 score. The minimum score 7.62 was recorded for T_1 (12°Brix T.S.S and 80psi CO_2 pressure) followed by T_6 (13°Brix T.S.S and 100psi CO_2 pressure) getting 7.65. The highest sensory score for overall acceptability 8.15 was received by T_9 (14°Brix T.S.S and 100 psi CO_2 pressure) followed by T_2 (12°Brix T.S.S and 90 psi CO_2 pressure) which was in the range of "Like very much" having the score 8.13. The minimum score 7.83 was received by T_8 having 13°Brix T.S.S and 90 psi carbon dioxidepressure. The overall sensory scores were highest for T_9, it might be due to the combined effect of higher sugar and carbonation level which gave clarity to the drink and influenced on appearance of the drink. Higher sugar and carbonation level might have contributed for the development of characteristic tart and sweet taste of carbonated beverages. The results are in agreement with Abhinav and Amol (2015) [1], Dnyaneshwar *et al.* (2013) [7] in carbonated pineapple, Shilpi *et al.*, (2014) [14] in aonla and lime carbonated beverage.

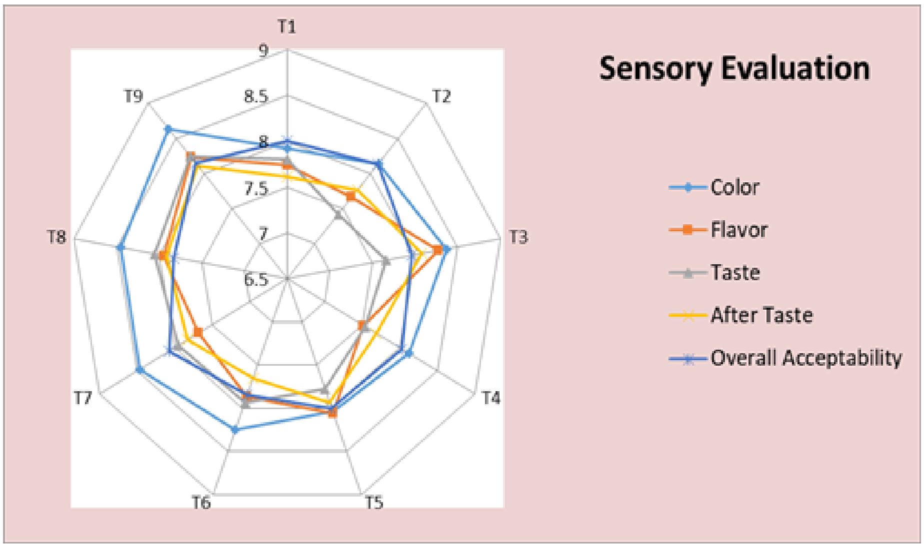

Fig 1: Sensory scores of carbonated kokum drink prepared by altering sugar and carbonation pressure level

Conclusion

Carbonation apparently enhances the organoleptic qualities through its effect on mouthfeel, described as tingling, which imposes a refreshing quality. The present study reveals that palatable beverages can be prepared from kokum, aonla and ginger by adjusting sugar and carbonation pressure level. It has further potential applications and uses yet to be fully explored, derived and understood. Kokum based Carbonated beverage is a new concept which provides nutritional elements of the fruit along with natural pigments and flavours, in addition carbonation effects could be utilised for commercial exploitation.

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