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Development of Orange-White Pumpkin Crush and Analysis of its Physicochemical, Nutritional and Sensory Properties

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Abstract: The objective of this study was to develop orange (*Citrus aurantium*) - white pumpkin (*Benincasa hispida)* crush in different variations and analyse its quality attributes. The crushes were analysed for its physicochemical characteristics (pH, titratable acidity, total soluble solids, reducing sugar, non reducing sugar and moisture), nutrient content (carbohydrates, vitamin A, B1, C, niacin, calcium and iron) and sensory properties (colour, taste, flavor, body and overall acceptability). The physicochemical properties of the crush were affected by the incorporation of white pumpkin juice. The vitamin C content of the crush increased with the proportion of orange juice incorporated. All variations showed good overall acceptability, sample with orange and white pumpkin juice in the ratio 75:25 (v/v) scored highest in sensory analysis.

Key words: Orange · White pumpkin · Crush · Blended beverage · Physicochemical properties

INTRODUCTION

Fruit juices are a ready and rich source of vitamins, fiber and mineral salts for human consumption [1]. The increased popularity of commercial fruit juices had resulted in increased consumption of fruits, especially the citrus variety. Fruits are a part of human diet and food supplement over the years. They are considered as healthy food supplements because they contain high quantity of water, carbohydrates, protein, vitamin A, B1, B2, C, D and E; and minerals such as Ca, Mg, K, Zn and Fe [2, 3]. Fruit consumption had been reported to be beneficial to health and contributes to the prevention of degenerative processes, particularly lowered the incidence and mortality rate of cancer and cardio- and cerebro- vascular diseases [4].

Juice obtained from citrus fruits like orange, grapes and lemon dominate the market. Consumers like orange juice in particular because of its high vitamin C content and its delicate flavour. Most fruits are perishable in their natural state after harvest. Fresh orange juice has a limited shelf-life (12-14 days at 4°C) [5]. The perishable nature makes it difficult to store and preserve the juice; hence, there is gradual loss of flavor and nutrients. Thus, being difficult to keep for a considerable length of time the juice can be utilized to produce ready to serve beverages like orange crush.

Food Product Order of 1955 defined fruit crush as a drink produced by squeezing or crushing the fruit and should contain at least 25% fruit juice and 55% sugar [6]. Development of preserved products like crushes reduces post harvest losses and prolongs the shelf life of the product.

Orange (*Citrus aurantium*) is a member of the family Rutaceae. It is an evergreen tree native of Asia and also cultivated in parts of Europe, America and West Indies [7]. Orange juice are more nutrient dense than many commonly consumed 100 percent fruit juices, such as apple, grape, pineapple and prune [8]. It is a rich source of vitamin C, folate and flavonoids and improves blood lipid profiles in hyper cholesterolemic subjects [9]. It is a very important source of ascorbic acid, a nutrient that, besides its vitamin action, is valuable for its antioxidant effect, stimulation of the immune system and other health benefits which are being actively investigated and reported, such as inhibition of formation of cancer-causing N-nitroso compounds in the stomach [10]. Orange juice is also used in herbal medicines as a

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stimulant and appetite suppressant. It has antiviral, antibacterial and antifungal properties. It is clinically used in the treatment of heart burn, dyspeptic symptoms, weight loss, superficial dermatophyte infection and aromatherapy [11].

White pumpkin (*Benincasa hispida)* is a member of the family Cucurbitaceae. It is an herbaceous climbing plant, for which artificial support are necessary. It is extensively cultivated in India [12]. Fruit is nutritious and acts as a laxative and diuretic. Along with other ingredients it is administered for cough, asthma, ulceration of lungs. Fresh fruit juice is useful in insanity, epilepsy and other nervous disease [13]. White pumpkin extract has anti-vascular inflammatory activity [14] and is recommended in Ayurveda for the management of peptic ulcers [15].

In this work a value added orange-white pumpkin crush in different variations were developed and its quality attributes (physicochemical, nutritional and sensory properties) were analysed. The objective of developing a blended crush is to enhance and compare the physicochemical, nutritional and organoleptic properties of different variations of orange-white pumpkin crush and to create an economically viable product for all age groups.

MATERIALS AND METHODS

Raw Materials: Orange, white pumpkin and sugar used for the preparation of the crush were obtained from a local market in Chennai, India.

Extraction of Juices: Fully ripe juicy oranges with thin rind were selected, washed thoroughly in cold water, the fruit was cut into halves and the juice was extracted with the help of a juice extractor and filtered to remove seeds and fibers. White pumpkins were separately washed, cut and the skin and seeds were removed, it was then grinded and the juice was extracted. The extracted juice was strained with a help of a strainer and measured. Both the juices were immediately chilled to 4°C and stored until the crush preparation.

Blended Crush Preparation: Two standard crushes (orange crush and white pumpkin crush) and five samples of blended crush containing different percentages of orange and white pumpkin juice were prepared. The orange and white pumpkin juice content of the each formulation (v/v) were 25:75 (S1), 37.5:62.5 (S2), 50:50 (S3), 62.5:37.5(S4) and 75:25 (S5), Std1 was prepared with 100% orange juice and Std 2 with 100% white pumpkin juice without blending the two juices. Sugar syrup was prepared by boiling the sugar with water till one thread stage and 66% of sugar syrup was added to all the formulation. The syrup was filtered, cooled and mixed with the blended juice of orange and white pumpkin in different formulations as shown in Table 1. Finally, the preservative potassium meta bisulphate was dissolved in a little warm water, mixed thoroughly with the crush and packaged in clean sterilized glass bottles.

Physicochemical Analysis: Two standards and five samples of orange-white pumpkin crush were assessed for their physicochemical properties. pH was determined using digital pH meter standardized with buffer solution of 7.0. Titratable acidity was estimated by titration with standard NaOH and expressed as citric acid [16]. Total soluble solid (TSS) was determined using a digital hand refractometer and results were reported in °Brix. Reducing and non-reducing sugars were determined by Fehling's method [17].

Nutrient Analysis: Two standards and five samples of the crush were subjected to nutrient analysis. Nutrients such as carbohydrates, vitamin A, B1, niacin and C, minerals like calcium and iron were estimated. Carbohydrate was determined using gravimetric method. β-carotene, vitamin B1 and niacin were estimated using HPLC. Estimation of Vitamin C was done by titrimetric analysis [16]. Minerals like calcium and iron was determined using atomic absorption spectrometer.

Sensory Analysis: All the samples of orange-white pumpkin crush were presented as coded samples to twenty five semi trained panel for sensory analysis.

Table 1: Percentage composition of Orange-White pumpkin Crushes

INGREDIENTS	Std 1	S1	S2	S3	S4	S5	Std 2
Orange juice (%)	33.4	8.3	12.5	16.7	20.4	25	-
White pumpkin juice (%)	-	25	20.4	16.7	12.5	8.3	33.4
Sugar (%)	66.6	66.6	66.6	66.6	66.6	66.6	66.6
Potassium meta bisulphate (g)	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Flavor/ Emulsion (ml)	2	2	2	2	2	2	2

The tests were performed by the hedonic rating option, were panellists were asked to rate colour, taste, flavour, body and overall acceptability using a structured nine-point hedonic scale, where 9 meant "like extremely," and 1 meant "dislike extremely" [16]. Samples were served refrigerated (9 ± 1°C) in transparent glass cups.

Statistical Analysis: Data obtained from sensory analysis were subjected to analysis of variance. Association between varying concerntration of orange and white pumpkin juice in the crush and sensory characteristics were done using correlation analysis.

RESULTS AND DISCUSSION

Physicochemical Analysis: Table 2 and Fig. 1 shows the physicochemical properties of the two standards and five samples of orange-white pumpkin crush. pH of the crushes were within the range of 3.75 - 4.73. Orange juice is acidic and white pumpkin juice is less acidic in nature so the low pH of the crush was attributed to the acidic nature of the orange [5]. The pH of the crushes increased with the proportion of white pumpkin juice. Std 2 with 100% pumpkin juice had the highest pH of 4.73 and the Std 1 with 100% orange juice had the lowest pH of 3.75. Titratable acidity was within the range of 0.04-0.14% and according to the study acidity of the crush increased as the pH decreased.

TSS of the crushes were within 55-58°Brix. A high °Brix in oranges is perceived as a high sugar-to-acid ratio [19]. °Brix increased when the sample contained more sugar, mineral, protein and less water. Sample S1 with the least amount of orange juice (25%) had the lowest soluble solids of 55°Brix. As sugars constitute more than 75% of the total soluble solids in the orange juice, a high correlation between total soluble solids and sugar content was observed in a similar study by Bartholomew and Sinclair, Sinclair and Bartholomew [20, 21].

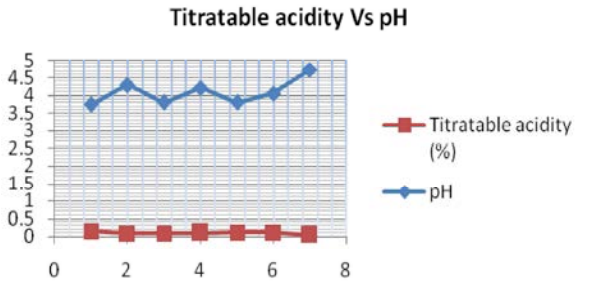

Fig. 1: pH and titratable acidity of orange-white pumpkin crushes.GH3

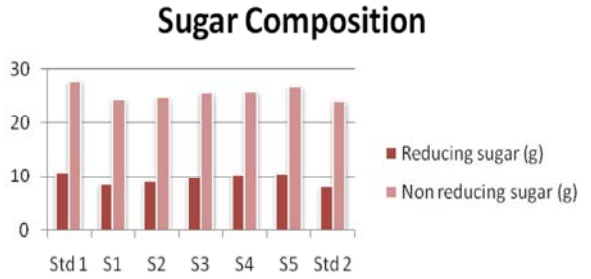

Fig. 2: Sugar composition of orange-white pumpkin crushes

The reducing and non reducing sugars in the crushes were estimated by Fehling's method [17] and were within the range of 8.12 - 10.92g and 24.2-27.9g respectively as shown in Fig. 2. Orange juice has more amount of reducing and non reducing sugar compared to the pumpkin juice, so the amount of reducing and non reducing sugar increased with the increase in the amount of orange juice in the crush.

Table 2: Physicochemical properties of orange-white pumpkin crushes.

Physicochemical Properties	Std 1	S1	S2	S3	S4	S5	Std 2
pH	3.75	4.3	3.81	4.22	3.81	4.07	4.73
Titratable acidity (%)	0.14	0.08	0.09	0.10	0.11	0.12	0.04
Total Soluble solids (°Brix)	57	55	56	57	57	58	56
Reducing sugar (g)	10.92	8.63	9.23	9.72	10.45	10.78	8.12
Non reducing sugar (g)	27.9	24.56	24.9	25.75	25.9	26.91	24.2
Moisture (%)	41.4	32.8	33.3	34.7	35.6	39.6	38.1

Table 3: Nutrient composition of orange-white pumpkin crush. (Each 100g of sample contains).

Nutrients	Std 1	S1	S2	S3	S4	S5	Std 2
Carbohydrates (g)	66.9	67.6	68.15	69.1	69.04	70.8	65.32
Beta carotene (µg)	45	30.8	32.85	34.6	40.1	43.2	0
Vitamin B1 (mg)	0.02	0.014	0.013	0.013	0.012	0.012	0.031
Vitamin C (mg)	19.85	15.95	17.24	18.52	19.3	19.25	0.55
Niacin (mg)	0.2	0.15	0.19	0.23	0.28	0.29	0.22
Calcium (mg)	198.67	261.8	232.02	201.2	175.6	100.54	240.63
Iron (mg)	0.33	0.47	0.46	0.44	0.41	0.38	0.55

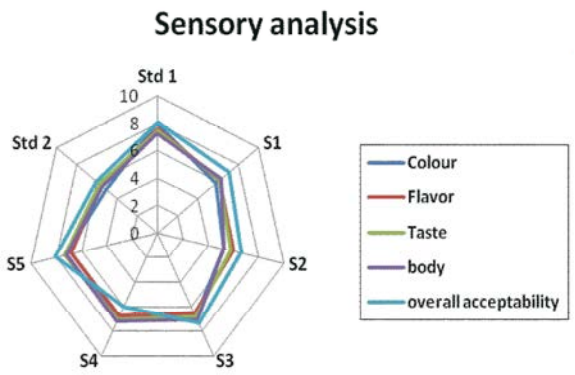

Fig. 3: Sensory analyses of orange-white pumpkin crush

The moisture content of the crushes was in the range of 32.8-41.4%. The moisture content in the crushes decreased with the increase in the proportion of white pumpkin juice in the crush (Table 2).

Nutrient Analysis: Table 3 show the nutrient composition of orange-white pumpkin crush. The carbohydrate content of the crushes ranged from 65.32-70.8g per 100g of sample; sample S5 with orange and white pumpkin juice in the ratio 150:50 (v/v) had the highest carbohydrates content of 70.8g. Sugar was the major ingredient contributing to the carbohydrates in the crush.

β-carotene content of the two standards and five samples varied from 0-45 µg. Vitamin C content of the crushes was within the range of 0.55-19.85 mg. According to the results, Beta carotene and vitamin C content increased when higher proportion of orange juice was used in the crush. Orange juice is a rich source of vitamin C, a bioactive compound contributing to the antioxidant potential of orange juice [22], but fruit handling can affect on the vitamin content in fruits and fruits juices [23] and Burdulu *et al.* [24] reported vitamin C losses ranging from 27.3 to 45.3% for orange juices during two months of storage at 28°C. Beta carotene content of the crushes was directly proportional to the quantity of orange juice in the crush because white pumpkin juice does not contain any beta carotene.

Vitamin B1 content of the three crushes varied from 0.012-0.031 mg and niacin varied from 0.12- 0.29 mg. White pumpkin juice has more amount of vitamin B1 and niacin compared to orange juice, so the crush with higher proportion of white pumpkin had more amount of vitamin B1 and Niacin. Orange and white pumpkin are good sources of calcium and were found within the range of 100.54-261.8 mg, the calcium content of the crush was directly proportional to the amount of pumpkin juice. Iron content of the crushes was within the range of 0.33 - 0.55 mg. Iron content increased to 0.47 mg in Sample S1 with 75% white pumpkin juice.

Table 4: Sensory Scores of orange-white pumpkin crush using 9 point hedonic scalePER

Sample	Colour	Flavor	Taste	Body	Overall acceptability
Std 1	8±0.7	7.6±1.14	7.45±1.2	7.26±1.38	8.06±0.77
S1	5.8±1.9	6.1±1.92	6.15±1.85	6.33±1.29	7.65±1.18
S2	5.26±1.2	6±1.71	5.85±1.75	5.26±1.33	6.65±1.01
S3	6.8±2.75	6.6±1.08	6.8±1.40	7.06±0.09	7.45±0.87
S4	6.9±0.71	6.8±1.04	7.06±1.23	7.2±1.16	6.65±1.38
S5	7.3±0.86	6.86±1.14	7.33±1.77	7.2±1.22	8.35±0.95
Std 2	5±1.46	5.6±1.19	5.66±1.44	5.4±1.66	6±1.03

Table 5: Statistical Analysis of orange-white pumpkin crush based on sensory parameters.

Sensory Parameters	ANOVA					
Colour	Source of Variation	SS	df	MS	F	P-value
	Between Groups	84.13	6	14.02	6.857	4.26E-06
	Within Groups	200.4	98	2.04		
	Total	284.53	104			
Flavor	Between Groups	32.38	6	5.39	2.96	0.01
	Within Groups	178.66	98	1.82		
	Total	211.04	104			
Taste	Between Groups	40.8	6	6.8	2.53	0.02
	Within Groups	262.4	98	2.67		
	Total	303.2	104			
Body	Between Groups	65.79	6	10.96	6.04	2.08E-05
	Within Groups	177.86	98	1.81		
	Total	243.65	104			
Overall acceptability	Between Groups	73.18	6	12.19	9.5	3.20E-08
	Within Groups	125.73	98	1.282		
	Total	198.914	104			

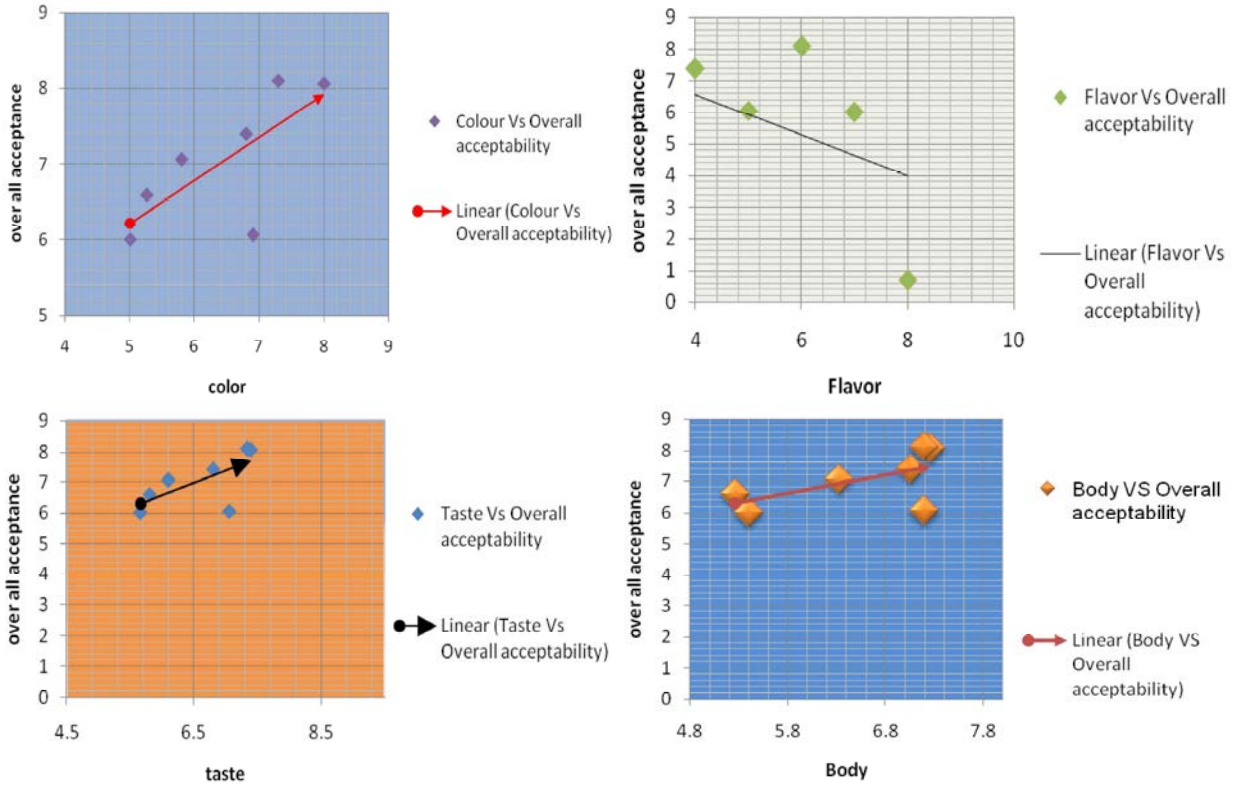

Fig 4: Correlation of sensory parameters and over all acceptance of orange-white pumpkin crush

Sensory Analysis: The sensory analysis for the two standards and five samples of the crush were carried out as per the 9-point hedonic scale viz. colour, flavor, taste, body and overall acceptability (Table 4 and Fig 3). The sensory scores of five samples of crushes were compared with the sensory scores of the two standards to evaluate the overall organoleptic qualities of the crush. The results showed that there was insignificant ($P < 0.05$) difference in the flavor and taste and significant differences in colour, body and overall acceptability of the two standards and five samples.

The results showed that in terms of colour there was significant ($P > 0.05$) difference. Addition of white pumpkin juice lightened the orange colour of the crush, higher the proportion of white pumpkin juice, lighter was the colour of the crush. Sample S5 containing orange and white pumpkin juice in the ration 75:25 (v/v) scored highest for colour followed by S4 in the ratio 62.5:37.5 (v/v). The formulation that presented the low score for colour attribute was S2 the one containing 37.5:67.5 (v/v) of orange and white pumpkin juice.

A significant ($P < 0.05$) difference was not found for the flavour and taste and significant ($P < 0.05$) difference was found in body of the crushes. Sensory scores of flavour, taste and body showed that the sample S4 and S5, containing orange and white pumpkin juice in the ratio 75:25 (v/v) and 62.5:37.5 (v/v) respectively scored high. The flavor, taste and body of the crush increased with the increase in the proportion of orange juice.

The results showed that in terms of overall acceptability there was significant ($P < 0.05$) difference. Higher proportion of orange juice in the crush increased the overall acceptability along with colour, flavour, taste and body of the crush. The crush with the highest proportion of orange juice 75% had the highest score and the crush with lowest amount of orange juice 25% had the lowest score in terms of overall acceptability. However, there was a strong correlation between each of the sensory parameters - color, taste, flavor, body and over all acceptance of the crushes (Fig. 4).

CONCLUSION

Present study shows that the blend of orange and white pumpkin juice enhanced the nutritional quality of the crush in terms of vitamins and minerals and resulted in the development of a new product. Incorporation of white pumpkin juice affected the physicochemical properties of the crush. Sensory analysis showed that addition of white pumpkin juice did not affect the taste

and flavor of the orange crush. Sample S5 with the blend of orange and white pumpkin in the ratio of 75:25 (v/v) scored highest in sensory analysis. Addition of pumpkin juice made it economically viable and is also a good alternative for the commercial orange crush in terms of nutritional and therapeutic properties.

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