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Sadaf Aleem
Warner School of Food and Dairy Technology Sam Higginbottom University of Agriculture Technology and Science, Allahabad, India

PW Ramteke
Warner School of Food and Dairy Technology Sam Higginbottom University of Agriculture Technology and Science, Allahabad, India

Correspondence
Sadaf Aleem
Warner School of Food and Dairy Technology Sam Higginbottom University of Agriculture Technology and Science, Allahabad, India

Sensory and Nutritional study of locally available fresh and processed Fruit and Vegetable juices in Allahabad City

Sadaf Aleem and PW Ramteke

Abstract
Fresh fruit and vegetable juice samples (169) and processed fruit juices (11), viz, (71 samples of sweet lime, 40 samples of sugarcane juice, 25 mango juice samples, 22 mixed vegetable juices and 11 pineapple juice samples) were collected during the practical analysis from different carts and shops in different areas of Allahabad city. Under processed fruit juices, readily available packed samples sold under different brand names were also analysed for their sensory attributes physiochemical properties and microbial load. The juices were extracted either by manual juicer or electric juicer with minimal hygienic precautions. On analyzing the sensory evaluation of fruit juices it was found that Sweet lime, Sugar cane and Mango has the highest overall acceptability (8.00) whereas mixed vegetable juice showed the lowest value (6.33) overall acceptability in processed fruit juice sample showed that apple juice (9.00) scored highest and orange juice scored lowest value for two different brands (7.00). on analyzing the physico chemical properties of fruit juices it was observed that the highest mean percentage of moisture recorded for sugarcane juice was(90.53) which was closely followed by mixed vegetable juice (90.37). Mean TSS observed was highest in sugarcane juice (19.83) which was followed by pineapple juice (13.94) and mango juice (3.80). Titrable acidity recorded was highest in pineapple juice (1.39) and lowest in sweet lime (0.47). Mean pH recorded was highest in mixed vegetable (6.03) and the lowest in mango juice (3.84). Total sugar observed to be more in sweet lime (12.86) and mixed vegetable (12.80) and lowest in pineapple (8.89). The highest mean value for reducing sugar was recorded for pineapple juice (8.27) and lowest in sugarcane juice (3.00). Vitamin C was found to be highest in sweets lime (49.53) and lowest in sugarcane juice (1.26mg/100gm).

Keywords: Sensory attributes, physio-chemical parameters, Sweet lime, sugarcane juice, mango juice, mixed vegetable juices and pineapple juice

1. Introduction
Codex Alimentarius defines juice as—the fermentable but unfermented juice, intended for direct consumption, obtained by the mechanical process from sound, ripe fruits, preserved exclusively by physical means (FAO, 2005) [3]. The juice must have the characteristic colour, flavour and taste typical of the fruit from which it comes. Fruit and vegetable juices are well recognized for their nutritive value, mineral and vitamin content that are essential for human being and play important role in the prevention of heart diseases, cancer, and diabetes. Due to their potential nutritional and biological importance fruit juices are foods with multiple implications for body balance (DHFS, 1998). Consumption of fresh juices increased dramatically due to their freshness, high vitamin content, and low caloric consumption Rathnayaka *et al.,* (2013) [13]. The high potassium and low sodium characteristic of most juices help in maintaining a healthy blood pressure. Vitamin C is naturally present in juices which are essential for the body to form collagen, cartilage, muscle, and blood vessels. It also helps in the absorption of iron, International Federation of Fruit Juice Producers Union (2011).
Raw fruit juices are among the street foods that are vended in urban areas mostly in developing countries. They are prepared by low income vendors who have poor premises and facilities and lack basic needs such as portable water. Water for street food preparation is not enough resulting in vendors using little water for washing utensils hence hygiene is compromised (Mensah *et al.,* 2002; Muinde and Curia, 2005) [14, 15]. In spite of the potential benefits offered by street fruit juices, concerns over their safety and quality have been raised. The critical factors affecting the spoilage of juices include juice pH, oxidation reduction potential, water activity, availability of nutrients, presence of antimicrobial compounds, and competing microflora. Among these factors, pH and water activity are the most influential factors affecting the spoilage of juices.

The spoilage caused by microorganisms in juices includes cloud loss, development of off-flavours, CO_2 production, and changes in colour, texture, and appearance resulting in degradation of product, Lawlor *et al.* (2009) [16] and Saspendra *et al.*, (2012) [17].

In developing countries like India, where street food vending is very common, there is lack of information on the incidence of food borne illnesses. On the other hand the quality of fruit juices is strictly maintained in developed countries under several laws and regulations but in many developing and underdeveloped countries, the manufacturer are not concerned about the microbiological safety and hygiene of fruit juices because of lack of enforcement of the law. Thus the transmission of certain human diseases through juice and other drinks in recent years is a serious problem. One of the aim of this present investigation is to assess the sensory attributes of freshly available fruit and vegetable juices, their physico chemical qualities and their comparison with the processed juices sold under different brand names.

Materials and Methods

The laboratory work of this study entitled "Sensory and nutritional study of locally available fresh fruit and vegetable juices in Allahabad city" was carried out in the research laboratory of the Department of Food Science and Dairy Technology, SHIATS, Allahabad. A total of 169 fresh fruit and vegetable juice sample and 11 processed fruit juice samples were collected from various shops and carts of Allahabad city. The juices collected included sweet lime (71 samples), sugar cane (40 samples), mango (25 samples), mixed vegetable (22 samples) and pineapple (11 samples). Under processed fruit juices, readily available packed samples sold under different brand names were analyzed for their physicochemical properties and microbial load. Fresh fruit and vegetable juices which are sold all over our country can also be seen in the city of Allahabad. For the present study heavily crowded carts and shop were randomly selected. Six location viz, three carts (College campus, Khan Chouraha and Gaughat) and three shops (Meerapur, Kareli and Noorullah Road) were chosen for the study. These carts and shops have on site facility for extraction of juices. Being easily accessible and cost effective large crowds are drawn particularly during the summer season. The sample of fresh fruit and vegetable juice and processed fruit juice was evaluated for their Color, Taste, Flavor, Aroma, Appearance and Overall acceptability. The sample were evaluated and tasted by a panel of judges using 9- point hedonic scale. The sensory evaluation was quantified using a sensory evaluation card in which the grades of different samples for different properties were awarded by the panel of judges. Score between 1-9 as per liking 9-Liked very much, 4- Slightly disliked, 8 -Liked much, 3- Disliked moderately, 7 -Liked moderately, 2- Disliked much, 6- Slightly liked, 1- Disliked very much, 5- Neither like nor disliked. The sample of fresh fruit and vegetable juice and processed fruit juice was analysed for physico-chemical properties to determine the Moisture, Total soluble solid, Tritable acidity, pH, Total sugar, Reducing sugar and Vitamin C (mg/100) content present in the juices. The data recorded during the course of experimental investigation were subjected to statistical analysis of "Analysis of variance" technique (Fisher and Yates, 1967) for drawing conclusion. The significance and non-significance of the treatments were judged with the help of 'F' (Variance ratio) test the significant differences between the means were tested with the critical differences at 5% probability level.

Results and Discussion

Organoleptic evaluation of different types of fresh fruit and vegetable juices

It can be observed from the table 1 and Fig. 1 that the average colour score of different types of fresh fruit and vegetable juices *viz.,* Sweet lime (S_1), Sugar cane (S_2), Mango (S_3), Mixed Vegetable (S_4) and Pineapple (S_5) were 8.00, 7.22, 7.78, 7.00 and 8.67 respectively. The highest average colour score was observed in Pineapple (S_5) juice (8.67). The average taste score of different types of fresh fruit and vegetable juices *viz.,* Sweet lime (S_1), Sugar cane (S_2), Mango (S_3), Mixed Vegetable (S_4) and Pineapple (S_5) were (8.00), (8.33), (8.00), (7.00) and (7.56) respectively. Mixed blend juice beverages are gaining popularity to satisfy consumer taste and preferences (Jan and Masih, 2012). The highest average taste score was observed in Sugar cane (S_2) (8.33). Taste is determined mainly by organic acid–sugar content balance of the fruit, and these compounds serve as unequivocal markers for sensory attributes assessment and genotype characterization (Melgarejo *et al.*, 2000; Poyrazoglu *et al.*, 2002) [10, 11]. The average flavour score of different types of fresh fruit and vegetable juices *viz.,* Sweet lime (S_1), Sugar cane (S_2), Mango (S_3), Mixed Vegetable (S_4) and Pineapple (S_5) were (8.00), (7.00), (9.00), (6.00) and (8.00)respectively. The highest average flavour score was observed in Mango (S_3) (9.00). The average aroma score of different types of fresh fruit and vegetable juices *viz.,* Sweet lime (S_1), Sugar cane (S_2), Mango (S_3), Mixed Vegetable (S_4) and Pineapple (S_5) were (7.67), (8.67), (7.33), (7.67) and (7.33) respectively. The highest average aroma score was observed in sugar cane (S_2) (8.67). The average appearance score of different types of fresh fruit and vegetable juices *viz.,* Sweet lime (S_1), Sugar cane (S_2), Mango (S_3), Mixed Vegetable (S_4) and Pineapple (S_5) were (8.00), (7.33), (8.67), (7.00) and (8.67) respectively. The highest average appearance score was observed in Mango (S_3) and Pineapple (S_5) (8.67). The average overall acceptability score of different types of fresh fruit and vegetable juices *viz.,* Sweet lime (S_1), Sugar cane (S_2), Mango (S_3), Mixed Vegetable (S_4) and Pineapple (S_5) were (8.00), (8.00), (8.00), (7.33) and (7.67) respectively. The highest average overall acceptability score was observed in Sweet lime (S_1), Sugar cane (S_2) and Mango (S_3) (8.00). Sensory scores for colour is in close agreement with the report of Ndife *et al.,* (2013). Data for average colour, taste, flavour, aroma, appearance and overall score of different types of fresh fruit and vegetable juices were statistically analyzed to find out significant difference between samples. 9 – point hedonic scale reported by Banigo *et al.,* (2015).

Table 1: Sensory evaluation of fresh fruit and vegetable juice

Types of juices	No. of samples	Colour	Taste	Flavour	Aroma	Appearance	Overall acceptability
Sweet lime (S_1)	71	8.00	8.00	8.00	7.67	8.00	8.00
Sugar cane (S_2)	40	7.22	8.33	7.00	8.67	7.33	8.00
Mango (S_3)	25	7.78	8.00	9.00	7.33	8.67	8.00
Mixed Vegetable (S_4)	22	7.00	7.00	6.00	7.67	7.00	7.33
Pineapple (S_5)	11	8.67	7.56	8.00	7.33	8.67	7.67
F-test		S	S	S	S	S	S
C.D. at 0.05%		0.996	0.720	1.835	1.166	1.498	1.405
SEd (±)		0.432	0.312	0.796	0.506	0.650	0.609

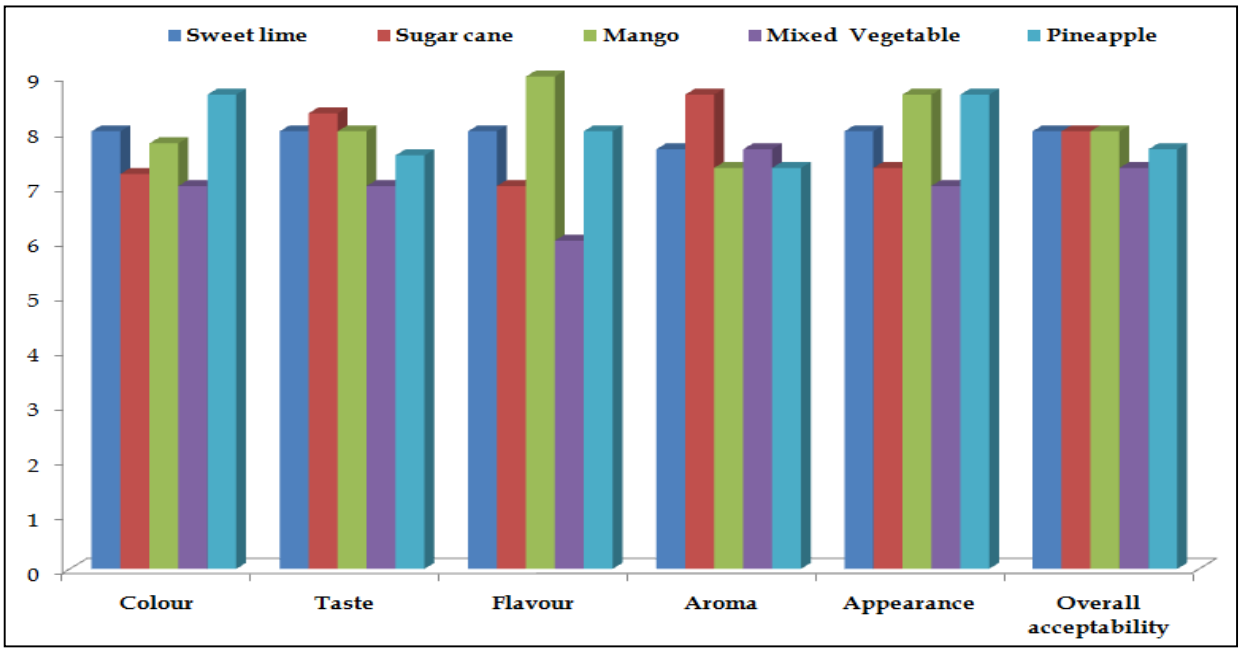

Fig 1: Average sensory evaluation of different types of fruit juices samples

Organoleptic evaluation of different types of processed fruit juice samples

It can be observed from the table 2 and Fig. 2 that the average colour score of different types of processed fruit juice samples *viz.*, The highest average colour score was observed in S_7T_{11} (Mixed fruit juice) (9.00). The highest average Taste score was observed in S_1T_1 (apple Juice) S_1T_4 (Mango juice), S_1T_5 (Pineapple juice) and S_1T_{10} (Apple) (8.33). The highest average flavour score was observed in S_1T_1 (apple Juice), S_1T_2 (Mango Juice), S_1T_7 (Pineapple juice) and S_7T_{11} (Mixed fruit) (8.00). The highest average Aroma score was observed in S_1T_2 (Mango Juice) and S_1T_{10} (Apple) (8.00). The highest average appearance score was observed in S_1T_1 (apple Juice), S_1T_4 (Mango juice) and S_7T_{11} (Mixed fruit) (8.00). The highest average overall acceptability score was observed in S_1T_6 (apple juice) (9.00). Data for average Colour, Taste, Flavour, Aroma, Appearance and Overall score of different types of processed fruit juice samples were statistically analyzed to find out significant difference between samples. Sensory scores for colour is in close agreement with the report of Ndife *et al.*, (2013).

Table 2: Sensory evaluation of different types of processed fruit juice samples

Sample	Colour	Taste	Flavour	Aroma	Appearance	Overall acceptability
S_1T_1 (apple Juice)	8.33	8.33	8.00	7.33	8.00	8.00
S_1T_2 (Mango Juice)	7.34	7.67	8.00	8.00	7.00	7.67
S_1T_3 (Orange juice)	7.00	7.00	7.33	5.67	5.00	7.00
S_1T_4 (Mango juice)	8.33	8.33	7.00	5.67	8.00	8.33
S_1T_5 (Pineapple juice)	6.11	8.33	6.33	6.33	8.67	8.46
S_1T_6 (apple juice)	8.75	8.00	6.30	7.33	7.67	9.00
S_1T_7 (Pineapple juice)	7.33	7.33	8.00	7.33	7.65	7.33
S_1T_8 (Mixed fruit)	8.67	8.67	4.72	6.00	7.33	8.67
S_1T_9 (Orange)	6.33	7.00	7.00	7.33	7.33	7.00
S_1T_{10} (Apple)	8.33	8.33	6.67	8.00	5.67	8.33
S_7T_{11} (Mixed fruit)	9.00	8.00	8.00	7.33	8.00	8.00
F-test	S	S	S	S	S	S
C.D. at 0.05%	1.79	1.57	1.74	1.64	0.83	1.53
SEd (±)	0.86	0.75	0.88	0.78	0.83	0.73

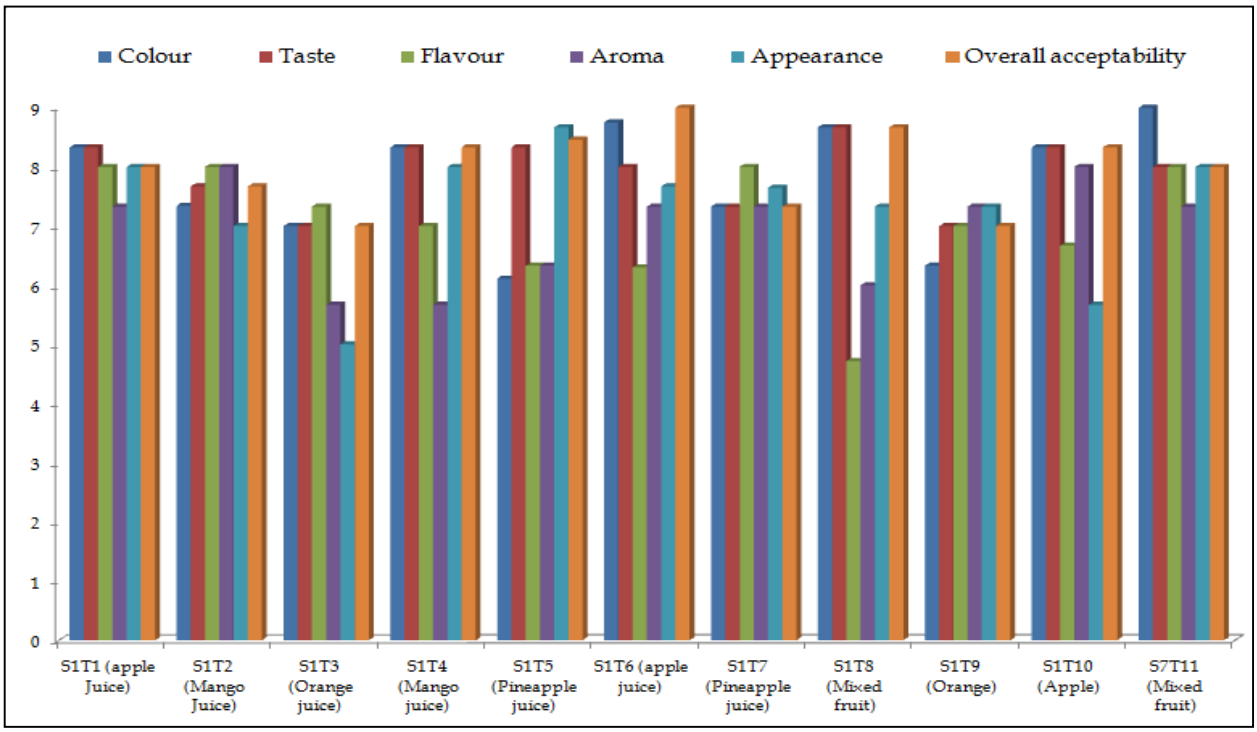

Fig 2: Average sensory evaluation of different types of fruit juices samples

Physico chemical properties of fruit and vegetable juices locally available in Allahabad city

It can be observed from the table 3 and Fig. 3 that the average moisture content percentage of different types of fresh fruit and vegetable juices. In citrus juices, brix is used to indicate the percentage of soluble sugars and is one of the most important factors for grading the quality of a citrus juice (McAllister, 1980) [1]. Generally, pH and titratable acidity of juices are used primarily to estimate consumption quality. They could be considered as indicators of fruit maturity or ripeness. The pH has influence on the flavour (sweet or sour) of the fruit and to a large extent determines the marketable quality of the fruit juices. The highest average moisture content percentage was observed in Sugar cane (40) (90.535). The highest average and TSS percentage was observed in Sugar cane (40) (19.837). According to FAO (2005) [3], the juices containing more than 1.2% acid are sour, independent of °Brix/Acid (Bates *et al.*, 2001) [4, 7]**.** ºBrix indicates the percentage of water-soluble solids in fruit juice and can be affected by many factors: cultivar, growth region, growth year and maturity level of the fruit (Türkmen and Ekşi, 2011) [6]. The highest average titrable acidity percentage was observed in Pine apple (11) (1.398). The highest average pH percentage was observed in Mixed vegetable (22) (6.03) which were within the range of 3 to 5 for fruit and vegetable juices (Harris and Silcocks, 1991) [8]. Brix to acid ratio is crucial since it constitutes a measure of the balance between sugars and acids as well as serves as an indication of the palatability of the juice.Large values indicate a sweeter taste, but very high values may be indicative of an insipid tasting juice (FAO, 2006) [12]. The highest average total sugar percentage was observed in Sweet lime (71) (12.861). Čolarić *et al.* (2005) [5] suggested that analytical measurements of titratable acids and soluble solids could not be substituted for sensory evaluation of perceived sweetness and sourness. For instance, acidity (or sourness) could be an interesting trait for several purposes (blending juice of other fruits forexample) (Hasnaoui *et al.*, 2010) [9]. The highest average reducing sugar percentage was observed in Pine apple (11) (8.277). The highest average vitamin (c) (mg/100g) percentage was observed in Sweet lime (71) (49.539). Data for average physio-chemical properties of different types of fresh fruit juices and vegetable were statistically analyzed to find out significant difference between sample with regard to the physio-chemical properties in different types of fresh fruit and vegetable juices.

Table 3: Physico chemical properties of fruits and vegetables juice locally available in Allahabad city

Types of juices	No. of samples	Moisture content (%)	Total soluble solid (%)	Titrable acidity (%)	Ph	Total sugar (%)	Reducing sugar (%)	Vitamin C (mg/100g)
Sweet lime (S_1)	71	89.063	9.857	0.476	4.18	12.861	4.446	49.539
Sugar cane (S_2)	40	90.535	19.837	0.575	5.01	12.689	3.006	1.265
Mango (S_3)	25	82.460	13.805	0.6412	3.84	11.788	4.202	16.461
Mixed vegetable (S_4)	22	90.378	7.660	1.066	6.03	12.804	4.117	31.494
Pine apple (S_5)	11	88.446	13.942	1.398	4.081	8.897	8.277	23.958
F-test		S	S	S	S	S	S	S
C.D. at 0.05%		1.40	0.53	0.087	0.053	0.199	0.039	0.47
SEd (±)		0.60	0.23	0.037	0.023	0.086	0.017	0.20

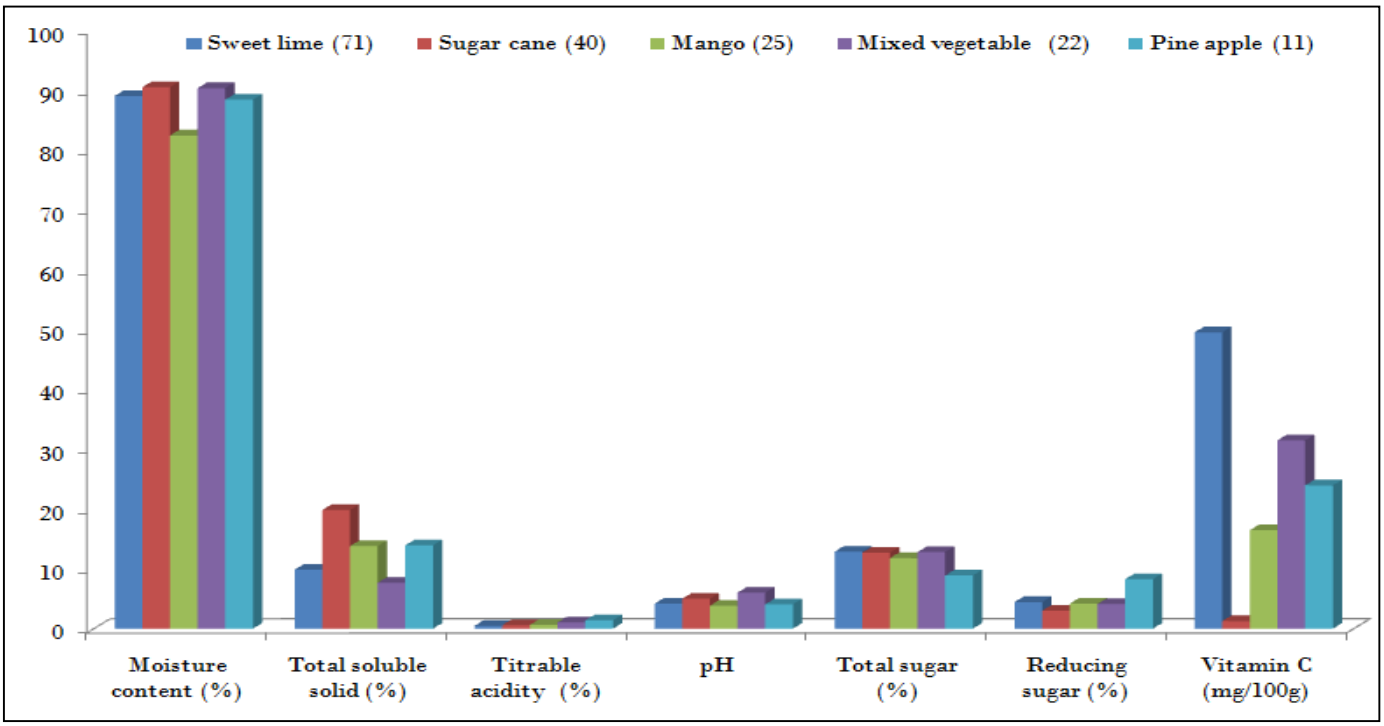

Fig 3: Physico-chemical properties of fruits and vegetables juice locally available in Allahabad city

Physico chemical properties of processed fruit juices locally available in Allahabad city

It can be observed from the table 4 and Fig. 4 that the average moisture content percentage of different types of processed fruit juice samples the highest average moisture content percentage was observed in S_1T_9 (Orange) (90.69). The highest average total soluble solids was observed in S_1T_8 (Mixed fruit) (14.69). The highest average titrable acidity was observed in S_1T_5 (Pineapple juice) (1.48). The highest average pH was observed in S_1T_2 (Mango Juice) (4.62). The highest average total sugar was observed in S_7T_{11} (Mixed fruit) (14.33). The highest average reducing sugar was observed in S_1T_9 (Orange) (10.68). The highest average vitamin (c) (mg/100g) was observed in S_1T_9 (Orange) (40.41). The high content of total solids in the orange juice is attributed to the high fibre as reported by Gelroth and Ranhotra (2001) [2].

Table 4: Physico chemical properties of processed fruit juices locally available in Allahabad city.

Sample	Moisture content	Total soluble solids	Titrable acidity	pH	Total sugar	Reducing sugar (%)	Vitamin (mg/100g)
S_1T_1 (apple Juice)	87.11	11.03	0.59	3.69	11.48	8.70	6.52
S_1T_2 (Mango Juice)	81.81	14.49	0.67	4.62	11.59	7.69	32.72
S_1T_3 (Orange juice)	89.58	10.62	1.24	3.78	9.46	4.36	38.59
S_1T_4 (Mango juice)	85.11	12.45	0.61	4.50	12.30	6.87	30.22
S_1T_5 (Pineapple juice)	88.29	12.88	1.48	3.76	10.23	9.32	38.14
S_1T_6 (apple juice)	84.77	10.35	0.37	4.08	12.14	7.76	7.83
S_1T_7 (Pineapple juice)	86.34	13.30	0.45	4.15	8.70	10.44	28.73
S_1T_8 (Mixed fruit)	89.73	14.69	0.31	4.26	12.58	9.87	32.61
S_1T_9 (Orange)	90.69	12.85	0.21	4.55	13.70	10.68	40.41
S_1T_{10} (Apple)	88.17	12.11	0.29	3.85	12.32	8.34	9.85
S_7T_{11} (Mixed fruit)	90.23	13.32	0.80	4.08	14.33	10.52	35.34
F-test	S	S	S	S	S	S	S
C.D. at 0.05%	0.84	0.23	0.15	0.16	0.181	0.24	0.371
SEd (±)	0.40	0.11	0.71	0.078	0.086	0.11	0.178

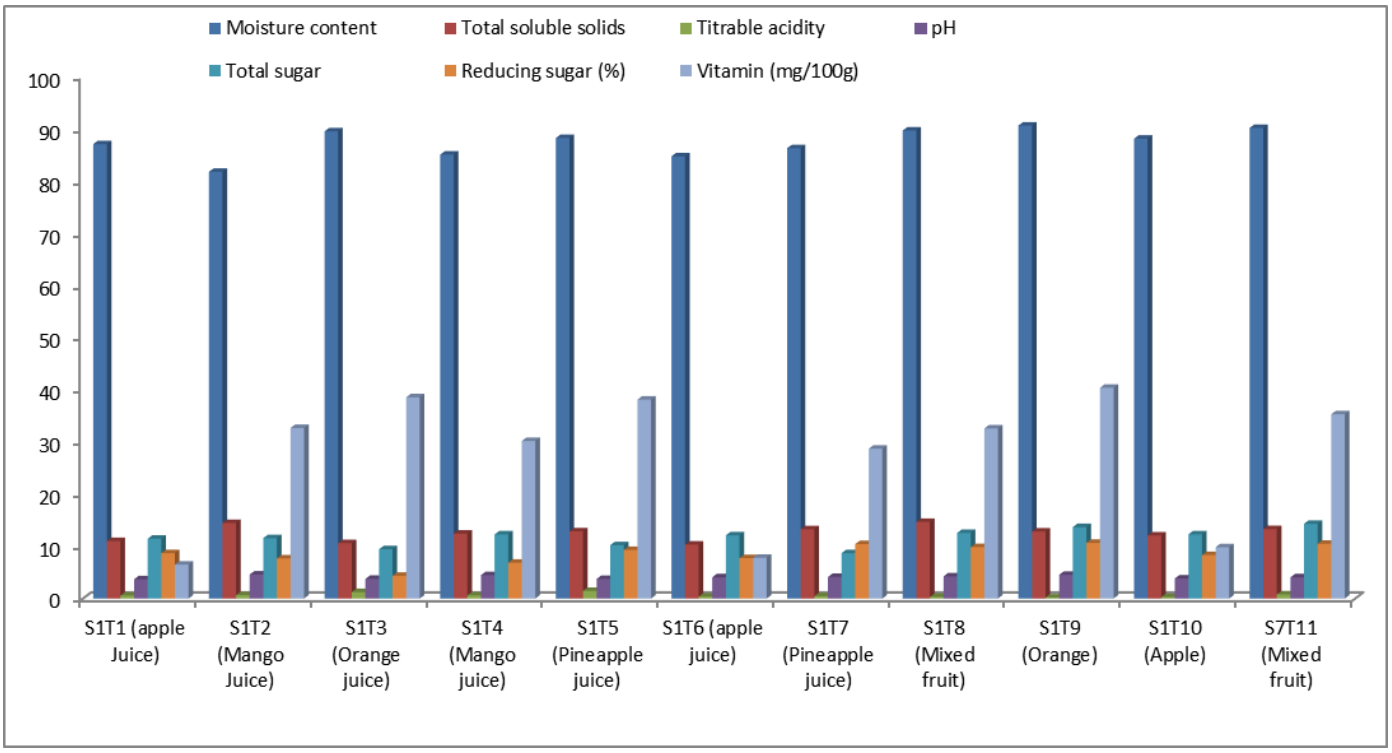

Fig 4: Physico chemical properties of processed fruit juices locally available in Allahabad city

Conclusion

The sensory investigation and physio-chemical analysis of different fresh fruit juices sold locally as well as processed tetra packed juices shows significance differences among the sensory parameter and different physio-chemical parameters. The physicochemical properties are the fundamental characteristics in food processing and should be well retained. Overall acceptability among fresh fruit juice was seen highest in sweet lime, sugar cane and mongo juice, whereas among processed fruit juice, apple juice showed the highest score. When analyzing the moisture content & TSS, sugar cane juice recorded the highest values. Pineapple juice recorded the highest titrable acidity and reducing sugar percentage whereas total sugar and vitamin C was found to be highest in sweet lime juice. Fruits and vegetable juices are packed with nutrients, if consumed in recommended amount could prevent us from major health diseases. Fresh fruit and vegetable juices are easily available during summer season by road side vendors.

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