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Sensory Profiling of Pulpy Fruits Based Ready to Reconstitute Little Millet Smoothies

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Authors' contributions

This work was carried out in collaboration among all authors. Author BN carried out the proposed research work as part of post graduate thesis; drafted the manuscript and performed the statistical analysis. Author WJS designed the research work and monitored the writing of manuscript. Author BAK helped in compilation of data and managed the literature search. Author MT has been part of research team. All authors have read and approved the final manuscript.

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ABSTRACT

Convenience foods are the now a big trend in the food business. The Indian ready to eat (RTE), ready to cook (RTC) and ready to serve (RTS) food segments have emerged from its early days of being a fringe alternative to home cooked meals or eating out. The underutilised little millet like other nutricereals is nutritionally superior to regularly consumed cereals. Malting of little millet enhances the digestibility, reduces the antinutritional components and can provide appropriate food-based strategy to derive nutrients maximally. Hence, a ready to reconstitute (RTR) smoothie mix was developed with a malted little millet that promotes the incorporation of nourishing drinks in daily diet. The suitability of mix to blend with fruit pulps *viz*. banana, papaya and pineapple in 1:1 and 1:2 ratio was assessed for its sensory parameters. The results revealed that the best scores for sensory attributes were for 1:1 blend except for appearance. Further, the overall acceptability scores of banana, papaya and pineapple smoothies on a hedonic scale of 9.0 were 8.37±0.09, 8.17±0.07 and 8.27±0.08 respectively indicating that the evaluated pulpy fruits were suitable for preparation of RTR smoothies.

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1. INTRODUCTION

Convenience foods transfer the time and activities of preparation from the household manager to the food processor as they have undergone major processing in a manufacturing unit requiring little or no secondary processing [1]. A fast-paced urban lifestyle, increased nuclear families, rising disposable income, increased globetrotting with an experimentative palate and growth of modern retail provides unprecedented brand and category visibility to convenience foods has spurred its adoption in India too [2].

A smoothie is a thick, smooth, blended, sweetened, chilled beverage made with milk, fresh pureed fruits or vegetables and grain (cereal or millet or legume) flours that serves as a convenient vehicle for appropriate nutrient consumption appealing to all age groups with fresh fruit flavour and balanced nutrition [3,4].

Smoothie consumption has augmented in the current years due to the perceived health benefits and as the awareness on consuming at least five servings of fruit or vegetables per person every day to reduce the risk of lifestyle diseases is increasing. Smoothies contain different vitamins, antioxidants, polyphenols and fiber depending on the fruit/vegetable and grain flours used [5].

Millets have a potential to address not only for food security but also for nutritional security in India as they play significant role in dietary diversification and promotion of balanced diets at low cost [6]. The millets are nutritionally surpassing other grains, as they are rich in most essential amino acids, dietary fibre, minerals like calcium, iron, manganese, phosphorus, potassium and magnesium, flavonoids, polyphenols, E and B-complex vitamins. They are currently being referred as nutria-millets / nutria-cereals for their nutritional benefactions [7].

Although little millet like any other millet is nutritionally superior to cereals, its utilization is limited. The major factor discouraging its cultivation and consumption is the drudgery associated with its processing. However, there is a need to restore the lost interest in this millet due to the vast potential embedded in it through development of appropriate processing technologies [8].

Millet processing is the method used for converting the inedible grain into edible form to enhance its sensorial quality. Several traditional food processing and preparation methods include dehulling, soaking, fermentation, germination, malting, thermal and mechanical processings to enhance physicochemical accessibility of micronutrients, decrease antinutrients and improve bioavailability of minerals [9].

Malting involves the controlled germination of seeds and was practiced for production of alcoholic beverages since the Neolithic period [10]. Technically, malting involves steeping, germination and kilning bring in desired physiological changes in cereal grains [11,12]. Malting improves the nutrient quality and digestibility of foods and can be an appropriate food-based strategy to derive nutrient benefits maximally from food grains [13]. The improved nutritional quality is attributed to the accumulation of functional bioactive components along with degradation of antinutrients. Thus, malted millets have a potential for utilization as functional ingredients in weaning, geriatric and adult foods for augmentation of health benefits [14].

The germination at 25°C for 48 hr, steaming and roasting at 165°C for 75 sec of little millets showed significant improvement in nutraceutical properties in terms of total phenols, flavonoids and tannins by 21.2, 25.5 and 18.9 mg/100 g respectively compared to the native sample [15]. Antioxidant properties as DPPH free radical scavenging activity and iron reducing power assay also improved significantly especially in roasted millet extracts than other processed extracts. Fractionation of phenolic extracts showed that the analytes as derivatives of benzoic acid that include gallic acid, proto-catechuic acid and vanillic acid, aromatic carboxylic acid like gentisic acid and cinnamic acid that includes syringic acid and ferulic acid [16].

In the light of above perspectives, a malted little millet based ready to reconstitute (RTR) smoothie mix was developed that promotes the incorporation of nourishing drinks in daily diet.

The present investigation was undertaken to assess the suitability of developed mix to blend with the fruit pulps through profiling of sensory parameters.

2. MATERIALS AND METHODS

2.1 Procurement of Raw Materials

The present study was carried out in the Post Graduate & Research Centre, PJTSAU, Rajendranagar, Hyderabad. Little millets and other ingredients were purchased from the local markets of Hyderabad.

2.2 Development of RTR Little Millet Smoothie Mix

Raw little millets were soaked for 12 hours at room temperature, germinated at 30°C for 24 hours, dried at 60°C to a moisture content of below 12%, mildly roasted till the sweet aroma emaciates, cooled and dehulled to prepare malted little millet grains. They were further pressure cooked for 10 min without losing the grain structure, cooled, tray dried at 60°C to a moisture content of below 12%, pulverised, sifted using 105 µ size sieve to prepare the malted and pregelatinised little millet flour. Finally, the developed flour was mixed with the milk and sugar powders in the proportion of 45:45:10 to prepare RTR little millet smoothie mix and was stored in airtight LDPE bag until further use.

2.3 Sensory Profiling of Fruit Pulps Incorporated RTR Smoothies

The developed smoothie mix was reconstituted with 1.5 times water and was incorporated with fruit pulps in 1:1 and 1:2 ratios. Further, they were evaluated for sensory properties using a semi-trained panel of 15 members from PGRC, PJTSAU with 9-point hedonic scale for colour, texture, flavour, taste and overall acceptability. The samples were presented in bowls coded with three digits in individual booths of sensory evaluation lab. Panellists rinsed their mouth after evaluating each sample. The scores were based on a hedonic rating of 1 to 9 where: 1 indicated disliked extremely (very bad) and 9 was liked extremely (excellent) [17].

2.4 Statistical Analysis

The obtained sensory responses were statistically analysed to test the significance of the results using means, standard deviations, coefficient of variation, and percentages [18].

3. RESULTS AND DISCUSSION

The sensory response for control smoothie without addition of fruit pulp scored for each of the sensory attributes as 8.07±0.51, 7.93±0.46, 7.93±0.46, 7.87±0.51 and 8.07±0.49 for appearance, texture, taste, flavour and overall acceptability respectively. Further, the sensory response for banana, papaya and pineapple incorporated smoothies of both the combinations was analysed and the mean values of each of the sensory attributes was tabulated in the Table 1.

The best score for appearance was for pineapple smoothie with 8.53±0.52 (C_1) and 8.60±0.51 (C_2) while the least was for banana smoothies with 8.13±0.35 (C_1) and 8.00±0.38 (C_2) probably due to browning. Between the two combinations, the best scores for appearance were for C_2 expect for banana smoothies. Statistically significant difference at $p \leq 0.05$ was found for banana and other smoothies in terms of appearance. No significant difference was observed for the proportion of fruit pulps added.

The best score for texture was for banana with 8.47±0.52 (C_1) and 8.40±0.51 (C_2) followed by pineapple smoothies with 8.33±0.49 (C_1) and 8.27±0.46 (C_2). Between the two combinations, the best score for texture were for C_1 for all the fruit pulps incorporated. There was statistically no significant difference at $p \leq 0.05$ for the texture of smoothies in terms of fruit pulp type and their proportions added.

The best score for flavour was for both the combinations of banana with 8.47±0.52. The least score was for both the combinations of papaya smoothies with 8.27±0.46. Among the pineapple smoothies, the best score was for C_1 with 8.33±0.49 than C_2 with 8.27±0.46. There was statistically no significant difference at $p \leq 0.05$ for the flavour of smoothies in terms of fruit pulp type and their proportions added.

The best score for taste was for banana smoothies with 8.40±0.51 (C_1) and 8.33±0.59 (C_2) while the least for both the combinations of papaya smoothies with 8.13±0.35 with a statistically significant difference at $p \leq 0.05$. Between the two combinations, the best scores for taste were for C_1 for the banana and pineapple smoothies. No significant difference was found for taste in terms of proportion of fruit pulps added.

Table 1. Sensory scores for fruit pulp incorporated smoothies

Fruit (F)	Appearance			Texture			Flavour			Taste			Overall acceptability		
	C_1	C_2	Mean ±SE	C_1	C_2	Mean ±SE	C_1	C_2	Mean ±SE	C_1	C_2	Mean ±SE	C_1	C_2	Mean ±SE
Banana	8.13 ±0.35	8.00 ±0.38	8.07^{a} ±0.07	8.47 ±0.52	8.40 ±0.51	8.43^{a} ±0.09	8.47 ±0.52	8.47 ±0.52	8.47^{a} ±0.09	8.40 ±0.51	8.33 ±0.49	8.37^{a} ±0.09	8.40 ±0.51	8.33 ±0.49	8.37^{a} ±0.09
Papaya	8.33 ±0.49	8.40 ±0.51	8.37^{b} ±0.07	8.27 ±0.46	8.20 ±0.41	8.23^{a} ±0.08	8.27 ±0.46	8.27 ±0.46	8.27^{a} ±0.08	8.13 ±0.35	8.13 ±0.35	8.13^{b} ±0.06	8.20 ±0.41	8.13 ±0.35	8.17^{a} ±0.07
Pineapple	8.53 ±0.52	8.60 ±0.51	8.57^{b} ±0.09	8.33 ±0.49	8.27 ±0.46	8.30^{a} ±0.09	8.33 ±0.49	8.27 ±0.46	8.30^{a} ±0.09	8.27 ±0.46	8.13 ±0.35	8.20^{ab} ±0.07	8.33 ±0.49	8.20 ±0.41	8.27^{a} ±0.08
Mean ± SE	8.33^{1} ±0.07	8.33^{1} ±0.08	*8.33 ±0.05*	8.36^{1} ±0.07	8.29^{1} ±0.07	*8.32 ±0.05*	8.36^{1} ±0.07	8.33^{1} ±0.07	*8.34 ±0.05*	8.27^{1} ±0.07	8.20^{1} ±0.06	*8.23 ±0.04*	8.31^{1} ±0.07	8.22^{1} ±0.06	*8.27 ±0.05*
CD F	0.23			0.24			0.22			0.20			0.23		
C	0.19			0.19			0.18			0.16			0.19		
F*C	0.33			0.34			0.32			0.28			0.32		
CV%	5.43			5.52			5.19			4.70			5.38		

Note: *Values are expressed as mean ± standard deviation of three determinations.*
Means within the same column and row followed by a common superscript do not significantly differ at $p < 0.05$.
C_1: Smoothie incorporated with fruit pulp in 1:1
C_2: Smoothie incorporated with fruit pulp in 1:2

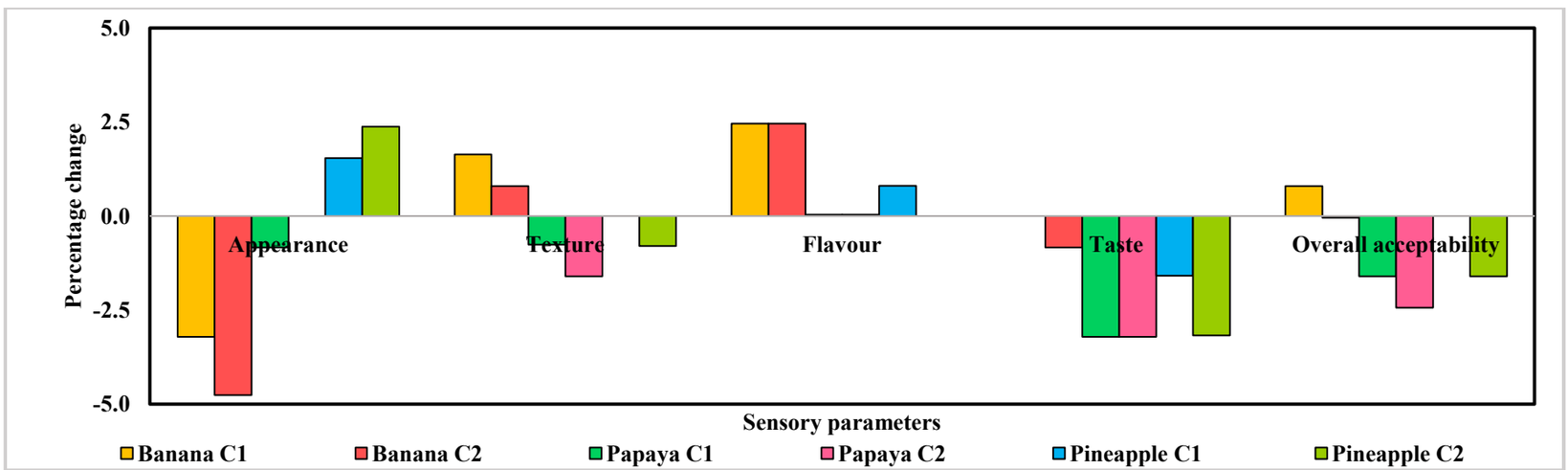

Fig. 1. Percentage change in sensory attributes due to incorporation of fruit pulps

The best score for overall acceptability was for banana smoothies with 8.40±0.51 (C_1) and 8.33±0.49 (C_2) while the least was for papaya smoothies with 8.20±0.41 (C_1) and 8.13±0.35 (C_2). Between the two combinations, the best scores for overall acceptability was for C_1 for all fruit pulps added. Statistically significant difference at $p \leq 0.05$ was found for banana and other smoothies in terms of overall acceptability. No significant difference was observed for the proportion of fruit pulps added.

The percentage difference in scores for each sensory attribute of smoothies due to incorporation of fruit pulps compared to control smoothie was depicted in Fig. 1. There was a decline in the appearance of smoothies incorporated with banana by 3.21% (C_1) and 4.76% (C_2) and papaya by 0.83 (C_1) while there was an improvement for those with pineapple by 1.55% (C_1) and 2.38% (C_2) when compared with the control. No difference was found for papaya C_2 and control smoothies.

Similarly, there was a decline in the texture of smoothies incorporated with papaya by 0.76% (C_1) and 1.60% (C_2) and pineapple by 0.80 (C_1) while there was an improvement for those with banana by 1.64% (C_1) and 0.80% (C_2) when compared with the control. No difference was found for pineapple C_1 and control smoothies.

The flavour was enhanced for smoothies incorporated with fruit pulps *viz*. banana, papaya by 2.46, 0.04% respectively for both the combinations and pineapple by 0.81% (C_1) when compared with the control. No difference was found for pineapple C_2 and control smoothies. However, the taste was declined for the smoothies incorporated with fruit pulps viz. banana by 0.83% (C_2), papaya by 3.21% for both C_1 and C_2 and pineapple by 1.59% (C_1) and 3.17% (C_2) when compared with the control. No difference was found for banana C_1 and control smoothies.

The overall acceptability of smoothies incorporated with banana was declined by 0.04% (C_2), papaya by 1.60% (C_1) and 2.44% (C_2) and pineapple by 1.60% (C_2). However, there was improvement in banana C_1 for overall acceptability by 0.80%. No difference was found for pineapple C_1 and control smoothies.

Likewise, Tanya et al. [19] formulated RTR fruit based malt pearl millet mix by incorporating fruits in two ways. Firstly, fruit powder (papaya or banana) was incorporated into malt at 10-50% level on flour basis. Secondly, malt was made into slurry by adding equal amount of water followed by incorporation of papaya and banana pulp at 10-50% level on wet basis, drying of malt slurry at 60°C and making into fine powder. Malt mixes with 50% papaya powder or 30% banana pulp incorporation were most acceptable on sensorial analysis.

4. CONCLUSION

In comparison with the control smoothie, the fruit pulp incorporated smoothies showed decline in the sensory parameters. Even though they were in an acceptable range with an overall acceptability of 8.37±0.09, 8.17±0.07 and 8.27±0.08 respectively for banana, papaya and pineapple smoothies respectively for C_2 combination, which is the most accepted one. Further, the banana smoothies exhibited better texture, flavour and the pineapple smoothies' better appearance than control. Thus in the present era of rising demand for nourishing convenience foods in food industry the developed ready to reconstitute malted little millet and fruit-based smoothies could be a fringe alternative for experimentative palate and health conscious consumers with a great market potential.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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