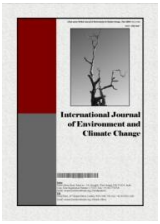

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Organoleptic Properties of Ready to Reconstitute Little Millet Smoothie with Fruit Juices

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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 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

Millets being climate resilient crops with high nutritional value are far better than staple grains like wheat and rice. Being adaptable to wide range of agro ecological conditions, the nutricereals little millet can grow on low fertility dry lands meeting demands of exploding population and providing solution to agrarian and nutritional challenges the world is dealing with. Further, value addition could be a strategic intervention in popularization of underutilized small millets and transform the billions of people from nutrient insufficiency to nutrient adequacy. The present fast-paced era with increased nuclear families and changing eating habits due to rapid urbanisation and globalisation demands for development of ready to consume nutrient dense food. In addition, growing awareness regarding health benefits of millets demands for millet-based designer foods to meet diversified needs of consumers. In view of these aspects, a ready to reconstitute (RTR) little millet

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smoothie mix was developed and tested for its suitability to blend with fruit juices through sensory profiling. The nourishing little millet and fruit-based smoothies would be a healthy inclusion in one's daily diet with a great market potential.

Keywords: Millets; nutricereals; nutritional security; little millet; value addition; ready to reconstitute smoothie; sensory profiling.

1. INTRODUCTION

The inseparable link between agriculture, climatic variables and food security have been at the forefront of the research and policy agenda in recent times [1]. The climate change can have economic impact on agriculture impacting farm profitability, prices, supply, demand, trade and regional disparities [2].

The multi-faceted interactions between humans, microorganisms and biosphere has increased the concentration of greenhouse gases in the atmosphere causing global warming leading to unprecedented changes in rainfall pattern, melting of icebergs, rise in sea level, depletion of ozone layer, drastic rise or fall in temperature, salinity, osmotic stress, floods, drought, cyclones and so on [3].

The findings Ashfaq et al. [4] projected a delay in the monsoon onset upto 15 days by the end of the 21st century, accompanied by increase in occurrence of monsoon break periods and overall suppression of summer precipitation. Similarly, Indian Institute of Tropical Meteorology (IITM) in collaboration with Hadley Centre for Climate Prediction and Research, UK speculated that increasing greenhouse gas concentrations and sulphate aerosols indicates the marked increase in rainfall by 10-30% and temperature by 3-4^{0}C over India towards the end of 21st century [5].

Such a scenario calls for urgent and strategic interventions towards adaptive agricultural measures that while ensuring a continued food production to an ever-growing population, will buffer populations against the threats of climate change. The plant genetic resources of minor millets that are well suited to enhance resilience of local production systems and strengthen food and nutrition security, particularly among the rural poor, represent a great ally to that end [6].

Hence, millets might provide alternative climate-smart crops, due to potential to withstand the severe edaphic-climatic stresses better than the current major crops like wheat and rice that may gradually become less competitive because of climate change. These qualities could be combined with excellent nutritional values and opportunities for strengthening income generation through value addition. These nutricereals are one of the major food sources in arid and semiarid areas of the world [7].

Little millet is a quick growing crop possessing excellent rejuvenating capacity and is staple food for the low-income groups of some parts of world [8]. Being eco-friendly, the crop is suitable for fragile and vulnerable agro-ecosystems. It is grown in both tropical and sub-tropical climates, in elevated areas up to 2100 m, in both plains and hilly regions [9,10]. As little millet gives consistent yields on marginal lands in drought prone arid and semiarid regions and it can provide regional food stability and security [11].

Further, storage feasibility and high nutritional value of little millets together have led to considering this kernel as an important staple food by ancient and modern people. Insect pests do not attack the little millet grains during prolonged storage under ordinary conditions as it has proteinaceous defense factors in the endosperm [12].

Little millet is a marvellous source of protein (7.7%), carbohydrate (67.0%), fat (4.79%), iron (9.5 mg/100 g), phosphorous (220.0 mg/100g), niacin and polyphenols [13]. It contains amino acids in balance proportions and rich in methionine, cysteine, lysine being beneficial to vegans for protein nourishment [14]. It has a highest amount of total dietary fiber (38.0%) among cereals of which 1.33 % is soluble fibre and is also rich source of phenolic compounds with antioxidant, metal chelating and reducing powers [15,16,17].

Value addition can be a strategic intervention in popularization of underutilized small millets and transform the billions of people from nutrient

insufficiency to nutrient adequacy. Both ethnic and novel foods prepared with little millet proved good scope for enhancing nutrition security, marketing, income generation among rural women with less laborious and low-cost technologies [18].

However, the current situation of the country with increased nuclear families, fast-paced lifestyle and changing eating habits due to rapid urbanisation and globalisation, a shift towards the development of ready to consume nutrient dense food products is on the rise. In addition, the growing awareness amongst the consumers regarding the health benefits of millets necessitated the need to meet the diversified demands of millet-based designer foods [19].

In light of above perspectives, value addition of little millet was done through development of a ready to reconstitute (RTR) smoothie mix that could enhance its utilisation in daily diet as a nourishing and energy dense drink. The present investigation was undertaken to assess the suitability of developed mix to blend with the fruit juices through profiling of sensory parameters.

2. MATERIALS AND METHODS

2.1 Procurement of Raw Materials

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 12.0%, mildly roasted till the sweet aroma emaciated, 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 12.0%, pulverized, sifted using 105µ 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 Organoleptic Properties of Fruit Juice Incorporated RTR Little Millet Smoothies

The developed smoothie mix was reconstituted with 1.5 times water and was incorporated with fruit juices 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 appearance, texture, flavour, taste and overall acceptability. The samples were presented in glasses coded with three digits in individual booths of sensory evaluation lab. Panelists 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) [20].

2.4 Statistical Analysis

The obtained sensory scores were statistically analysed to test the significance using means, standard deviations, coefficient of variation and percentages [21].

3. RESULTS AND DISCUSSION

The sensory response for control smoothie without addition of fruit juice 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 black grape, watermelon and orange incorporated smoothies of both the combinations was analysed and the mean values of each of the sensory attributes were depicted in the Fig. 1.

The mean sensory scores for appearance, texture, taste, flavour and overall acceptability ranged from 8.47±0.52 to 8.40±0.51, 8.40±0.51 to 8.33±0.49, 8.40±0.51 to 8.27±0.46, 8.53±0.52 to 8.40±0.51 and 8.53±0.52 to 8.40±0.51 respectively. The obtained scores were in acceptable range and addition of fruit juices enhanced sensory attributes compared to control, though there was not much percentage difference between them. Further, the little millet smoothies added with fruit juices in 1:2 had better sensory scores than 1:1 although, there was no statistically significant difference at $p \leq 0.05$ for all sensory parameters of smoothies in terms of type of fruit juice or its proportion added. Thus the developed RTR smoothie mix blends with fruit juices with good overall acceptability.

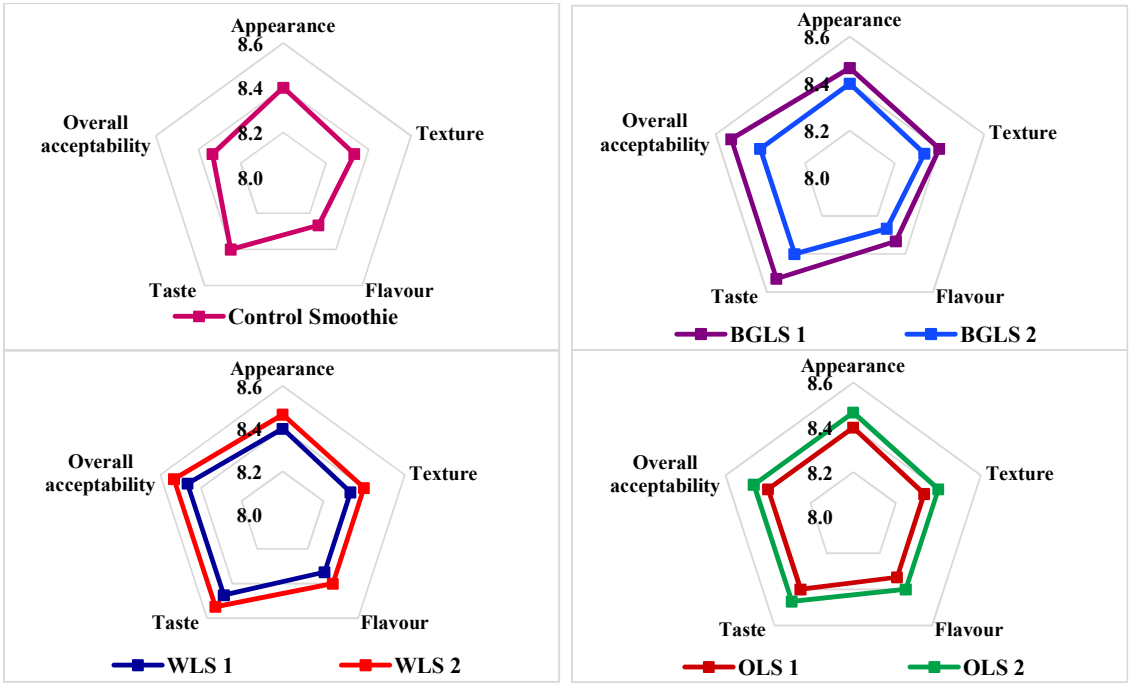

Fig. 1. Mean sensory scores for fruit juice incorporated little millet smoothies

Note: Values are expressed as mean ± standard deviation of three determinations. BGLS 1: Smoothie with black grape juice in 1:1; BGLS 2: Smoothie with black grape juice in 1:2, WLS 1: Smoothie with watermelon juice in 1:1; WLS 2: Smoothie with watermelon juice in 1:2, OLS 1: Smoothie with orange juice in 1:1; OLS 2: Smoothie with orange juice in 1:2

4. CONCLUSION

In the present fast-paced era, where time and health are the real assets, there is a need for consumers to make right food choices. However, the consumer often fails to choose right food and land up consuming that is easily available but unhealthy. Increased use of small millets in various ready-to-eat food products should be encouraged as it enhances their value and market price. Thus, the developed RTR little millet smoothie mix has a great potential to commercialize at vast scale, which will create an opportunity for entrepreneurship. Further, inclusion of fruit juices in smoothie enhanced all the sensory attributes and could be a nourishing healthy addition in one's diet appealing to all age groups.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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