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Sensory evaluation and nutritional analysis of bamboo rice Payasa

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Abstract
India is one of the largest bamboo producing countries like other tropical countries and all type of climate is also suitable for growing bamboos, while some bamboo were planted others may be grown naturally by seed dispersal. Around 8.96 million ha of the total 63.3 million ha forest area of India is estimated to be covered by bamboo. Bamboo rice is special rice that is grown out of a dying bamboo shoot and it has become an important and major source of income for tribal living in the forest. The aim of the study was to develop payasa from bamboo rice and evaluation of nutritional and sensory acceptability of the product. The payasa was prepared and evaluated by using 9 point hedonic scale by 21 semi trained panel members. Sensory analysis shows that payasa prepared from 100 percent white rice and 50 percent bamboo rice and 50 percent white rice incorporation scores high for all attributes. Nutrient analysis of payasa revealed that control payasa was high in carbohydrate and energy, moisture and crude fiber was high in bamboo rice payasa but there was no much statistical difference was observed between control and bamboo rice payasa in other nutrients however, calcium, magnesium, phosphorous was much better in bamboo rice payasa but there was no much difference observed in iron content between control payasa and best accepted payasa. Thus the study shows that incorporation of bamboo rice increases the nutritional profile of the product.

Keywords: Bamboo rice, sensory analysis, payasa, nutritional profile, incorporation and value added products

1. Introduction
Over 90 per cent of the world's rice is produced and consumed in Asia and pacific regions. Over 2 billion people in Asia derive their energy from rice (Sima Chanu, 2019) [12]. India is one of the largest bamboo producing countries like other tropical countries. There are over 1,250 woody bamboos in the world in approximately 75 genera (Liese and Kohl, 2015) [4]. Bamboo is perennial tree that may grow even up to 60 to 100 years. When the bamboo shoot breathes its last, it flowers in to a rare variety of rice seeds, which are known as bamboo rice. (Sarika Rana, 2017) [9].

The edible nature of bamboo rice identified from some tribal areas. Bamboo rice harvesting and selling is a major source of income for some groups of the tribes in Southern and North Eastern India. Bamboo seeds are not only used as food by indigenous residents, but also traded as medicines and commodities. However, there is a lack of information about the nutrient profile of bamboo seeds, in contrast to the abundant literature available with nutritional information on cereal crops such as rice, wheat, maize, and so on (Kiruba *et al*., 2007) [2].

Bamboo rice is also known as Mulayri in Malayalam language and Moongil Arisi in Tamil language by the tribal of southern India. This rice is rich in carbohydrates, proteins, amino acids, fiber, vitamins and minerals (Shillpi Singh, 2021) [11]. Protein content of bamboo seed is higher than that of rice and wheat. Other than protein the rice also has vitamins including A, B1, B2, B3, B6 and minerals like calcium, iron, phosphorus, and magnesium (Meenakshi Bharathi, 2019) [6].

Bamboo seed is an underutilized species in India, especially bamboo rice or seed species offer enormous potential for contributing to the achievement of the Millennium Development Goal (MDGs), particularly in combating hidden hunger and offering medicinal and income generation options. They are also closely tied to cultural traditions and therefore have an important role in supporting social diversity (Manohari *et al*. 2016) [5]. Bamboo rice controls blood sugar, cholesterol and it is recommended for pregnant women to overcome vitamin deficiency. It is very rich in fiber content, thus preventing constipation. Diabetic patients are recommended to consume bamboo rice due to its low glycemic index (GI) of 20 instead of normal rice (Selvarajan *et al*. 2016) [10].

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There is a huge market for products prepared from the bamboo shoots. Farmers are facing several problems, including low yield due to adverse weather and natural calamities, besides poor prices. Climate change has simply made farmers face crop failure and as a result poor profit. Converting their produce into value-added products is the way to help farmers to earn more profit, improve socio-economic status and also to save them from getting duped by middle men (Kuruvila, 2019).

Payasam is one of the popular traditional products in southern states tied to their cultural heritage. Several varieties are in vogue, some of them have been documented and still several of them remain unknown to most parts of the country (Prajeesh et al.,) Hence, the aim of the study is sensory evaluation and nutritional analysis of bamboo rice payasa.

2. Materials and Methods

2.1 Procurement of samples
Bamboo rice was procured from local organic market and other ingredients were purchased from the local shop. Bamboo rice was refrigerated until further use.

2.2 Processing of bamboo rice
Bamboo rice was cleaned, washed in running water 2-3 times, and soaked overnight and drained.
White rice was cleaned, and soaked for 4 to 5 hours and drained.

2.3 Development of bamboo rice products
Payasa was standardized with different proportion of bamboo rice such as 25, 50, 75 and 100 percent with white rice as control depicted in table 1. The method of preparation of payasa is given in fig.1.

Table 1: Formulation of the payasa

Variations	White rice(g)	Bamboo rice (g)	Jagerry (g)	Coconut milk (ml)	Cashew nut (g)	Raisins (g)	Cardamom (g)	Ghee (ml)
T1	100	00	40	150	5	5	5	10
T2	75	25	40	150	5	5	5	10
T3	50	50	40	150	5	5	5	10
T4	25	75	40	150	5	5	5	10
T5	00	100	40	150	5	5	5	10

T1- Control
T4- 75% Bamboo rice: 25% White rice
T2- 25% Bamboo rice: 75% White rice T3- 50% Bamboo rice: 50% White rice
T5- 100% Bamboo rice

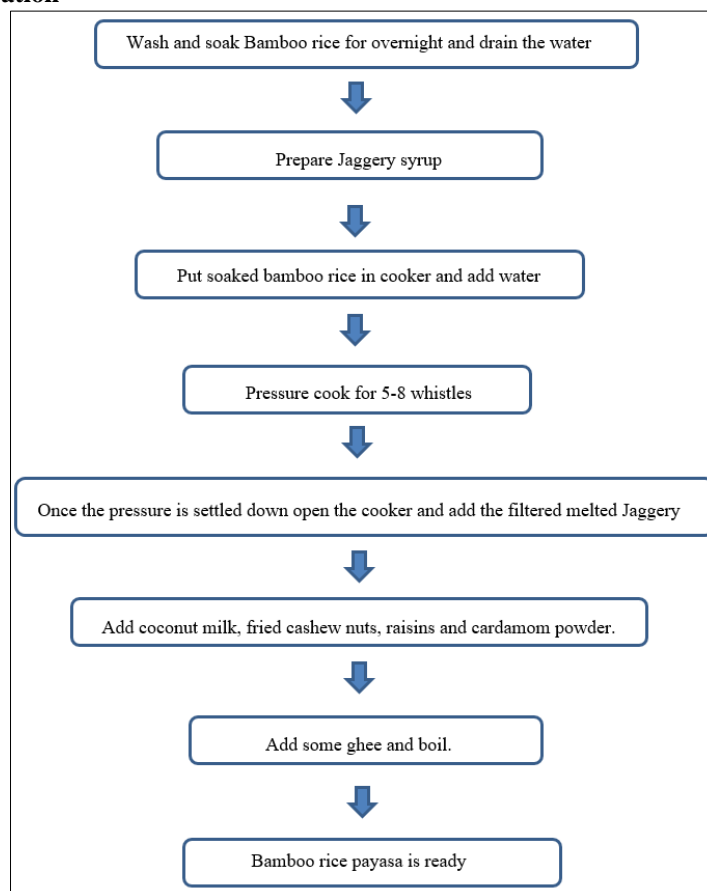## Flow chart of product preparation

Fig 1: Flow chart of product preparation

2.4 Sensory evaluation of developed product
Sensory evaluation was carried out by a panel of 21 semi trained panel member using 9 point hedonic scale (Ranganna, 1986) [8] for appearance, color, texture, flavor, taste and

overall acceptability.

2.5 Nutrient Analysis of developed product
Developed bamboo rice payasa was analyzed for moisture, protein, fat, fiber, ash using Association of Official Agricultural Chemists (AOAC, 2012) [1] method, CHO was calculated by difference method and energy content was determined by calculation method.

2.6 Statistical analysis
The data reported in the tables are the averages of triplicate observations. The data was analyzed statistically for the mean standard deviation and ANOVA to test the significance among different levels of bamboo rice flour incorporation at 5 percent significant level.

3. Results and Discussion
3.1 Sensory evaluation of the developed product
The formulated payasa was prepared by using bamboo rice with 25, 50, 75 and 100 percent incorporation. The results are presented in table 2.

Table 2: Sensory evaluation of the bamboo rice payasa

Variations	Characteristics				
	Appearance	Color	Taste	Texture	Overall acceptability
T1	8.095	8.095	8.023	8.166	8.119
T2	8.000	7.952	7.928	7.785	7.785
T3	8.142	8.095	8.071	7.833	8.119
T4	7.857	7.690	7.714	7.428	7.642
T5	7.595	7.523	7.476	7.357	7.642
f-test	NS	*	*	*	*
S.Em±	-	0.145	0.145	0.151	0.125
CD at 5%	-	0.410	0.408	0.408	0.353

*: Significant at 5% level NS: Non-significant
T1- Control
T2- 25% Bamboo rice: 75% White rice
T3- 50% Bamboo rice: 50% White rice
T4- 75% Bamboo rice: 25% White rice
T5- 100% Bamboo rice

Bamboo rice payasa score for appearance ranged from 7.59 to 8.14, for color ranged from 7.52 to 8.09, for taste ranged from 7.47 to 8.07, for texture ranged from 7.35 to 8.16 and for overall acceptability ranged from 7.64 to 8.11. T1 and T3 i.e., control payasa and 50 percent bamboo rice and 50 percent white rice incorporation had highest score for all the sensory attributes.
The difference in all sensory characteristics viz., color, taste, texture, overall acceptability among the variations was found to be statistically significant at 5 percent level except appearance which was found to be Non-significant.
Similarly, Kokani et al, (2019) [3] they did sensory evaluation for payasa prepared using 3 different rice viz, Wada colum, Indrayani and brown rice. Results showed that payasa prepared using brown rice were highly acceptable by the consumers.
Prajeesh and Rao, (2015) [7] developed bamboo seed payasam and sensory evaluation was done by using 9 point hedonic scale. The results revealed that bamboo seed payasam was liked very much in flavor by the panelists may be due to pleasant caramelized sugar taste with bamboo seeds flavor.

3.2 Nutrient composition of developed product
Nutrient composition and mineral composition of control

payasa and best accepted payasa was analyzed and depicted in table 3 and 4 respectively. Nutrient analysis of payasa viz, moisture, protein, fat, crude fiber, ash, carbohydrate and energy was carried out and the results obtained shows that moisture and crude fiber was high in bamboo rice payasa and carbohydrate and energy was high in control payasa however, there was no much difference was observed for fat and ash content. For mineral composition calcium, magnesium, phosphorous was comparatively high in bamboo rice whereas there was no much difference was observed in iron between control and best accepted payasa.
Kokani et al, (2019) [3] who reported that payasa prepared using brown rice had 3.6 percent moisture, 17.5 percent protein, 7.6 percent fat, 2.6 percent ash and 69.85 percent carbohydrate.
Prajeesh and Rao (2015) [7] developed bamboo seeds payasam and nutrient analysis was done it showed that the bamboo seeds payasa had a compositions of total solids 38.75 percent, fat 7.8 percent, protein 4.96, ash 0.84 percent and other carbohydrate 4.34 percent.

Table 3: Nutrient composition of bamboo rice payasa

Parameter	Control payasa	Bamboo rice payasa
Moisture	22.18	24.03
Protein	11.35	11.19
Fat	8.07	8.00
Crude fiber	4.44	7.41
Ash	2.83	3.00
Carbohydrate	154.63	134.2
Energy	748.66	658.59

Table 4: Mineral content of bamboo rice payasa

Minerals (mg/100g)	Control	Bamboo rice payasa
Calcium	74.39	75.99
Iron	22.08	22.04
Magnesium	140.86	145.66
Phosphorous	79.67	80.57

Hence, the study indicated that the payasa prepared from bamboo rice incorporation at 50 percent level was found to be best accepted when compared with other variations by the panelists.
The obtained results may vary with referred one in some nutrients this is due to variation in bamboo rice variety and environment condition.

4. Conclusion
The study showed that payasa prepared from bamboo rice incorporated at 50 percent was highly acceptable. Bamboo rice payasa was high in fiber, lower in energy and fat compared to control prepared by white rice. Bamboo rice is nutritionally rich in particular protein and fiber, most importantly the glycemic index is just 20 as compared white rice 80 and brown rice 55 so, bamboo rice can be advocated for consumption at larger population. Hence, it can be concluded that inclusion of bamboo rice will increase the fiber content and decreases the calories. Therefore bamboo rice can be recommended for overweight and obese individuals for weight reduction.

5. Acknowledgement

research is appreciated.

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