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Utilization of Bamboo Rice for Product Development

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Authors Contribution

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Abstract

India is one of the largest bamboo producing country among other tropical countries like China, Egypt, United States, Malaysia and Sri Lanka. 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 bamboo rice shavige, (shavige is very long, thin strands of noodles made from rice flour and water) evaluation of nutritional composition and sensory acceptability of the product. Nutrient composition of raw flour showed moisture, protein and crude fiber were higher in soaked and dried bamboo rice flour. Whereas, in fat and ash there was no much difference was observed. Carbohydrate and energy were high in white rice flour. Treatment 3 (T3) *i.e.,* 50 per cent white rice flour and 50 per cent soaked and dried bamboo rice flour had the highest score for all the sensory attributes. Whereas nutrient analysis of shavige mix revealed that white rice shavige mix had 10.56g moisture, 4.89g protein, 0.34g fat, 0.20g fiber, 1.24g ash, 81.55g carbohydrate and 355.03Kcal energy whereas, bamboo rice shavige mix had 8.91g moisture, 8.77g protein, 0.90g fat, 0.20g crude fiber, 0.53g ash and 80.89g carbohydrate.

Keywords : Bamboo rice, Sensory attributes, Nutrient analysis, Shavige mix , Product development

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 (Chanu and Shivaleela, 2019). Rice is consumed as polished white rice with the husk, bran and germ fractions removed. However, consumption of brown rice (hulled rice) is increasing in recent years, due to the increased awareness about its health benefits and good nutritional properties due to higher amounts of proteins, ash, dietary fibre and minerals than white rice (Muttagi *et al.,* 2017). India is one of the largest bamboos producing country among other tropical countries like China, Egypt, United States, Malaysia and Sri Lanka. There are over 1,250 woody bamboos in the world in approximately 75 genera. They are native to Africa, the Americans, Asia and Oceania and have been introduced to Europe (Liese and Kohl 2015). Bamboo rice has become an important and major source of income for tribal living in the forest (Siyanna, 2020). Bamboo rice is special rice that is grown out of a dying bamboo shoot. When the bamboo shoot breathes its last, it flowers in to a rare variety of rice seeds, which are known as bamboo rice (Rana, 2017). In bamboo, the fruit is one seeded structure that does not split when ripe (Wong, 2004).

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).

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 (Singh, 2021). 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 (Bharathi, 2019).

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).

Rice noodles are the most consumed form of rice product next to cooked rice grain in Asia. Noodles may either be served by frying and mixing with vegetables and meats or served as a soup noodle by boiling in a broth (Ahmed *et al.,* 2016).

So, the study was taken up with the objective of development and sensory evaluation of the shavige prepared by incorporation of bamboo rice flour.

Material and Methods

Procurement of Samples

Bamboo rice were procured from local organic market and white rice, jaggery were purchased from the local shop. Bamboo rice was refrigerated until further use.

Processing of Bamboo Rice

Bamboo rice was cleaned, washed in running water 2-3 times, soaked overnight and dried under shade. Then it was powdered and stored in air tight container for further use. White rice was cleaned, powdered and stored in air tight container for further use.

Analysis of Proximate Composition of White Rice and Bamboo Rice Flour

Nutrient analysis was carried out for dried white rice and bamboo rice flour in dehydrated form using Association of Official Agricultural Chemists (AOAC, 2005). Moisture content was determined by drying the sample using oven in triplicates, protein by per cent total nitrogen by the kjeldhal procedure, fat was estimated as crude ether extract using moisture free samples and crude fiber of the sample was estimated by using moisture and fat free samples. Total ash content of sample was obtained by dry ashing the samples completely by heating it oven a flame. Carbohydrate (CHO) calculated by difference method and energy by calculation method.

Table 1

Composition of the product mix

Variation	White rice flour (%)	Bamboo rice flour (%)	Jaggery (%)
T1	100	00	40
T2	75	25	40
T3	50	50	40
T4	25	75	40

T1- 100 % White rice flour; T2- 25% bamboo rice flour: 75% white rice flour; T3- 50% bamboo rice flour: 50% white rice flour; T4- 75% bamboo rice flour: 25% white rice flour

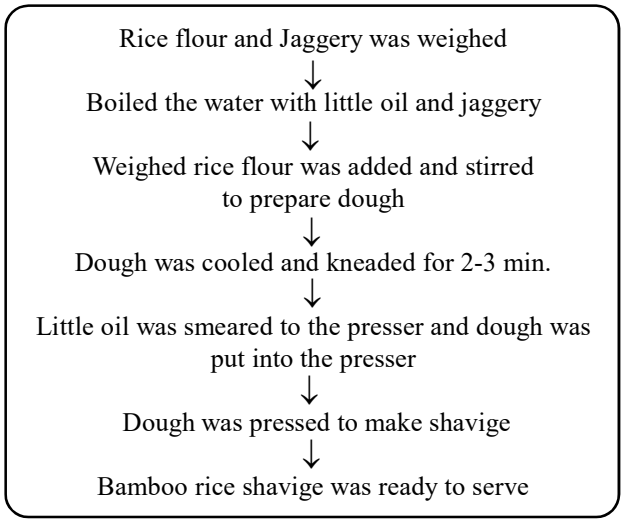

Fig. 1: Flow chart for shavige preparation

Development of Bamboo Rice Shavige

Shavige was standardized by using white rice flour along with bamboo rice flour at 75: 25, 50: 50 and 25: 75 per cent, respectively and shavige prepared

Flow Chart for Shavige Mix Preparation

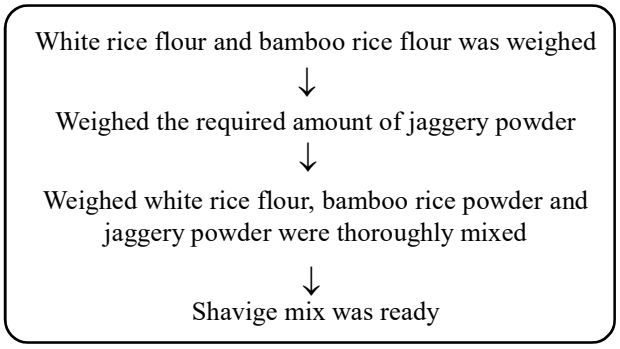

Fig. 2: Flow chart for shavige mix preparation

by using white rice flour considered as a control (Table 1). The method of preparation of shavige is depicted in Fig.1.

So shavige mix was prepared using best accepted *i.e.,* T3 variation by mixing 50 per cent white rice flour and 50 per cent bamboo rice flour with jaggery and method of preparation of shavige mix is depicted in Fig. 2. Further, Nutritional analysis was done.

Sensory Evaluation of Developed Product

In order to select best acceptable level of bamboo rice powder incorporation. Sensory evaluation was carried out by a panel of 21 semi trained panel member using 9 point hedonic scale (Ranganna, 1986) for appearance, color, texture, flavor, taste and overall acceptability.

Nutrient Analysis of Developed Product

Developed bamboo rice shavige mix was analyzed for moisture, protein, fat, fiber, ash using Association of Official Agricultural Chemists (AOAC, 2005) method, Carbohydrate was calculated by difference method and energy content was determined by calculation.

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 per cent significant level.

Results and Discussion

Nutrient Analysis of White Rice and Soaked & Dried Bamboo Rice Flour

Moisture, protein, fat, fiber, ash, carbohydrate and energy were analyzed for both white rice flour and soaked & dried bamboo rice flour. Results are depicted in Table 2.

The findings indicated that mean moisture, protein, fat, fiber and ash content were significantly higher in soaked & dried bamboo rice flour (11.78g, 7.78g, 0.45g, 5.78g and 0.73g respectively) compared to white rice flour (8.80g, 4.84g, 0.43g, 1.02g and 0.39g

Table 2

Nutrient composition of white rice flour and soaked & dried Bamboo rice flour

Parameters	White rice flour (Mean ± SD)	Soaked Bamboo rice flour (Mean ± SD)	't' test
Moisture (g)	8.80 ± 0.213	11.78 ± 0.252	*
Protein (g)	4.84 ± 0.064	7.78 ± 0.072	*
Fat (g)	0.43 ± 0.001	0.45 ± 0.003	*
Crude Fiber (g)	1.02 ± 0.015	5.78 ± 0.168	*
Ash (g)	0.39 ± 0.005	0.73 ± 0.086	*
Carbohydrate (g)	64.16 ± 0.351	57.83 ± 0.552	*
Energy (Kcal)	279.92 ± 1.167	266.27 ± 1.225	*

*: Significant at 5% level

TABLE 3
Sensory evaluation of the prepared product

Treatment	Characteristics (Mean ±SD)				
	Appearance	Color	Taste	Texture	Overall acceptability
T1	7.45^{a} ± 0.83	7.40^{a} ± 1.10	7.65^{a} ± 1.14	7.10^{a} ± 0.85	7.40^{a} ± 0.87
T2	7.45^{a} ± 0.76	7.10^{a} ± 0.79	7.10^{a} ± 0.97	7.15^{a} ± 0.59	7.20^{a} ± 0.51
T3	7.50^{a} ± 0.51	7.40^{a} ± 0.50	7.70^{a} ± 0.80	7.20^{a} ± 0.62	7.45^{a} ± 0.39
T4	7.00^{a} ± 0.86	6.85^{a} ± 0.81	6.80^{b} ± 0.83	6.80^{a} ± 0.83	6.86^{a} ± 0.71
F test	1.473 ^{NS}	1.521 ^{NS}	2.829*	0.888 ^{NS}	2.507 ^{NS}
SEm±	0.195	0.215	0.247	0.190	0.168
CD at 5%	-	-	0.685	-	-

*: Significant at 5% level NS: Non-significant

Common letter indicates Non- significant

T1- control; T2- 25% bamboo rice flour: 75% white rice flour ; T3- 50% bamboo rice flour: 50% white rice flour ; T4- 75% bamboo rice flour: 25% white rice flour

respectively). The computed carbohydrate and energy content of white rice flour was 64.16g/100g and 279.92 Kcal/100g which is significantly higher than soaked and dried bamboo rice flour (57.83g/100g and 266.27 Kcal/100g).

Verma and Srivastav (2017) investigated the proximate composition of aromatic and non-aromatic Indian rice who reported that 100gm of aromatic rice variety Badshah Bhog contains moisture (8.90g), fat (0.61g), protein (7.23g), ash (0.59g), fiber (0.85g), carbohydrate (82.70g) and energy (365.23 Kcal/100g). Hundred grams Non aromatic rice variety contains moisture (11.25g), fat (0.06g), protein (6.87), ash (0.35), fiber (0.64), carbohydrate and energy (353.89 Kcal/100g).

The results of the study is in line with findings of Ahmed *et al.* (2016) reported that cultivars of rice contained quality attributes such as protein, fat and ash range from 6.92 to 8.65, 0.63 to 2.17 and 0.55 to 0.77 per cent, respectively.

Sensory Evaluation of the Developed Product

Bamboo rice shavige was standardized by in corporating soaked and dried bamboo rice flour with white rice flour at 25 per cent (T2), 50 per cent (T3) and 75 per cent (T4) and control shavige (T1) was prepared from 100 per cent white rice. The mean sensory score of bamboo rice shavige is presented in table 3.

Bamboo rice shavige score for appearance ranged from 7.00 to 7.50, for color ranged from 6.85 to 7.40, for taste ranged from 6.80 to 7.70, for texture ranged from 6.80 to 7.20 and for overall acceptability ranged from 6.86 to 7.45. Control shavige had the highest scores for all the sensory parameters except texture. Among the variations highest score for appearance, color, taste, texture and overall acceptability (7.50, 7.40, 7.70, 7.20 and 7.45 respectively) were recorded for 50 per cent (T2) bamboo rice incorporated shavige and least score was for 75 per cent bamboo rice incorporated variation *i.e.,* T4 (75% bamboo rice and 25% white rice). The difference in all sensory characteristics *viz,* appearance, color, texture and overall acceptability among the variations was found to be statistically non-significant at 5 per cent level, except taste which was found to be significant.

Thomas *et al.* (2014) studied the sensory acceptance rate of Bario and Basmati rice noodles. Bario rice had a higher acceptability score of 6.67 compared with Basmati rice (4.8). In term of appearance and overall acceptability, noodles made from Bario rice were ranked higher as compared to Basmati rice.

TABLE 4
Nutrient composition of shavige mix

Parameter	White rice shavige mix (Mean ± SD)	Bamboo rice shavige mix (Mean ± SD)	't' test
Moisture (g)	10.56 ± 0.120	8.91 ± 0.347	*
Protein (g)	4.89 ± 0.055	8.77 ± 0.190	*
Fat (g)	0.34 ± 0.015	0.90 ± 0.045	*
Fiber (g)	0.20 ± 0.025	1.40 ± 0.041	*
Ash (g)	1.24 ± 0.072	0.53 ± 0.020	*
Carbohydrate (g)	81.55 ± 0.501	80.89 ± 0.231	NS
Energy (Kcal)	355.03 ± 0.724	366 ± 1.130	*

*: Significant at 5 % level NS: Non-significant

Ahmed *et al.* (2016) evaluated sensory characteristics for rice noodles. The overall acceptability of rice noodles depends upon appearance, aroma, taste, texture. Mean score for appearance ranged from 4.30 to 7.32, aroma ranged from 5.58 to 6.00, taste ranged from 5.14 to 6.12, texture ranged from 3.66 to 6.92 and overall acceptability ranged from 3.98 to 7.02.

Nutrient Analysis of Shavige Mix

Nutritional composition of white rice shavige mix and best accepted bamboo rice shavige mix were analyzed and depicted in Table 4. It was found that moisture, ash and carbohydrate were high in white rice shavige mix (10.56g, 1.24g and 81.55g) when compared with bamboo rice shavige mix (8.91g, 0.53g and 80.89g). Whereas, protein, fat, crude fiber, energy were high in bamboo rice shavige mix (8.77g, 0.90g, 1.40g and 366Kcal) when compared with white rice shavige mix (4.89g, 0.34g, 0.20g and 355.03 Kcal).

Poonsri *et al,* (2019) evaluated nutritional composition of rice noodles. Their findings shows that moisture (72.02%), ash (0.28%), protein (2.97%) and fiber (5.44%) was high in 40 g cassava leaves incorporated noodles and control noodles had moisture (69.50%), ash (0.13%), protein (2.28%) and fiber (0.77%) respectively. Fat (2.34%) and carbohydrate (24.98%) was high in control noodles whereas, 40 g cassava leaves incorporated noodles had 1.65 per cent fat and 19.80 per cent carbohydrate.

The results are on par with the study conducted by Zula *et al,* (2021) in moisture, protein, fat, ash, carbohydrate and energy.

Hence, the study indicated that the shavige mix prepared from soaked and dried bamboo rice flour incorporation at 50 per cent level was found to be the best accepted when compared with other variations including control by the panelists. The final product of shavige nutritional value was increased because of 50 percent incorporation of bamboo rice.

From the study, it can be concluded that moisture, protein and crude fiber were better in soaked and dried bamboo rice flour compared with white rice flour. Shavige prepared with incorporation of bamboo rice at 50 percent level was best accepted with having good amount of protein and energy compared with control. Proximate composition of the product mix revealed that protein and energy were better because of incorporation of bamboo rice flour. Acceptable value added products like shavige mix from bamboo rice can be developed and health benefits of bamboo rice can be exploited.

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