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DEVELOPMENT OF VALUE-ADDED PRODUCTS USING BAMBOO RICE AND EVALUATION OF ITS NUTRITIONAL COMPOSITION

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Abstract:

Bamboo rice is belonged to *Bambusa arundinacea species,* which has many health benefits and also indigenous' food sources of South India. The aim of the current study is developing the value-added products incorporating the bamboo rice flour and analyse the nutritional composition. The bamboo rice was converted into flour and it is incorporated into products namely Ladoo's and Cakes at 3 different Variations (25%,50%,75%). Sensory evaluation was performed to assess the acceptability of the product. 30 semi trained panel members were selected and 5-point hedonic scale was used for rating the product. Highly accepted variations were undergone for proximate composition, Phytochemical and antinutrients analysis. The result shown that bamboo rice has Moisture 9.6g, ash 1.62, protein 7.2g, carbohydrate 80.2g, fat 0.91 g. In both Ladoo & Cake V2 were shown significant difference in the nutritional profile where they have less carbohydrate (134 &154g/100g) content than the respective controls, Protein (9.9g & 9.2g/100g) also have increased in both the products comparative to control products. Tannin content was two-fold high in V2 products than counterparts. Conclusively, this study suggested that Bamboo rice incorporated products enhance the nutritional and health benefits for human consumption.

Key words: Phytochemical, Antinutrients, Bamboo rice, Proximate, Acceptability.

I. Introduction:

Bambusa arundinacea, a bamboo species which is originated in India and it has considered as Ayurvedic medicinal tree. The different parts like plant's leaf, root, stem, and seed, has anti-oxidant, anthelmintic, anti-inflammatory, anti-ulcer, anti-diabetic, astringent, and emmenagogue activities [Shruthi 2022]. For human consumption plant foods which belongs to the family Gramineae have more contribution because of high nutritional value and dietary components [Khazaei 2020]. Especially rice and wheat are most common staple food across the global. Bamboo rice is obtained from *Bambusa arundinacea* is also called as seeds after de husking which also includes under the same family and looks similar to rice grain [Sanjana Potluri 2018]. The availability of bamboo seeds is very rare because these species only flower and the seeds are obtained after a long vegetative growth period and this varies from species to species. But in certain regions like southern India and southwest China, bamboo seed is the main food source. It is collected from the agroforest in India and sold in local markets for daily income. Bamboo rice is high in nutritional

composition, bioactive components which has utilised in ayurvedic treatment, allopathy medicines, and homeopathy treatment to overcome many medical conditions like diabetes, bone health, zinc and iron deficiency and general maintenance of health. Hence the objective of the study is to analyze the nutritive aspects of bamboo seeds/rice and develop value-added products using bamboo seeds/rice.

II. Materials & Methodology

Bamboo rice was procured from the organic shop in Kerela and undergone of process for further usage. Other ingredients like cashew nuts, cumin seeds, coconut, jaggery ghee were purchased from the local market. All the ingredients were cleaned, sorted and undergone the processing if it necessary.

2.1 Methods

Bamboo rice was collected from the market in Kerela

↓

Washed and soaked the rice for 8 hours with 1:2 ratio of water

↓

Drained the water and dried under the shade

↓

Ground the rice and flour was kept in air tight container for further use

Fig 1: Preparation of rice flour

Fig 2: Bamboo rice

Fig 3: Bamboo rice flour

1.2 Preparation of value-added products by incorporating bamboo seed flour

2.2.1 Preparation of Ladoos:

The value-added product ladoos was prepared using bamboo seed as one of the ingredients to improve the nutritive value of ladoo and also to reap the nutritional benefits of bamboo seeds. Three variations of the bamboo seed ladoos, 25%, 50% and 75% were developed. Ingredients for the rice ladoo were used in addition to the bamboo seed flour. The bamboo seed flour was substituted with the rice flour at 25, 50 and 70g for three variations. The developed product was subjected to sensory, proximate, antioxidant and phytochemical analysis.

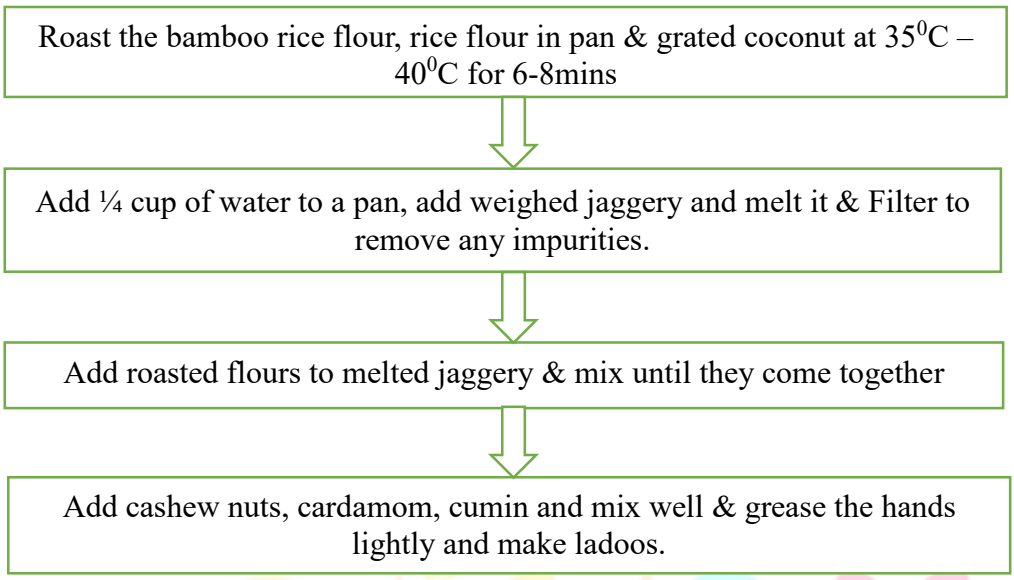

Fig 4: Preparation of ladoo

2.2.2 Preparation Of Cake

Bamboo seed flour was used as a substitute for all-purpose flour to develop three variations of the cake. 25%, 50% and 75% Variations were developed by substituting 25g, 50g and 75g of all-purpose flour with bamboo seed flour respectively. The sensory evaluation of the products was conducted using a semi trained panel member. The product was also subjected to proximate, antioxidant and phytochemical analysis.

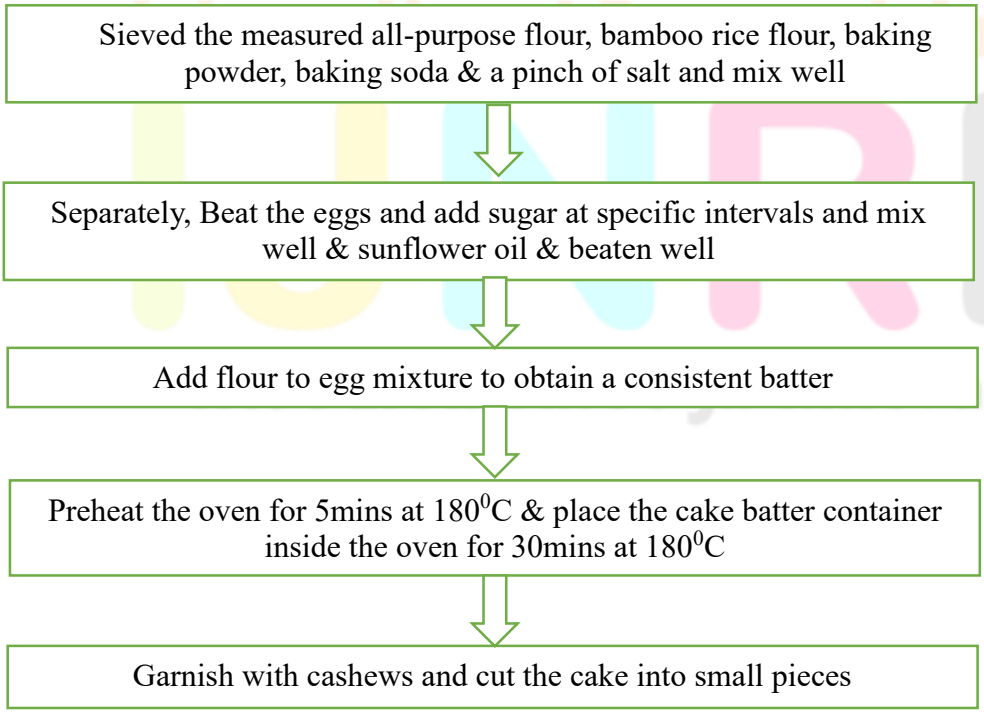

Fig 5: Preparation cake

2.3. Organoleptic evaluation:

The organoleptic evaluation of the product was conducted using 30 semi trained panel members. A five-point Hedonic scale was used to determine the acceptability of the product. The hedonic scale ranges from 1= dislike to 5= like very much. Various sensory attributes such as colour, texture, taste, flavour, and appearance were assessed using the hedonic scale for the developed products. To select the best acceptable level of bamboo rice powder incorporated product. Sensory evaluation was carried out by a panel of 30 semi-trained panel members using a 5-point scale for appearance, color, texture, flavor, taste and overall acceptability [Berdos 2020].

2.4 Proximate composition analysis

The moisture content was determined by oven drying at 105°C for 8 hours. Ash content was determined by incinerating the charred sample at 550°C in a muffle furnace for 6-8 h, and the percentage of ash was determined gravimetrically. Protein was determined by the Kjeldahl method using an automated nitrogen distillation unit and crude protein was obtained by multiplying the nitrogen content by 6.25 [Goyal 2022]. Fat content was determined by extracting the samples in petroleum ether at 40°C under reflux for 8 h using the Soxhlet apparatus; the ether extractives were desolventised and determined gravimetrically [Palmquist 2003]. Total carbohydrate was analysed the by anthrone method [David 1990].

2.5 Phenolic compounds:

Phenolic compounds such as tannins and polyphenols were estimated using ferric chloride test [Hagerman 1978] and HPLC method [Šeruga 2011].

2.6 Antioxidant activity:

The antioxidant activity of the product was estimated by using DPPH method [Bondet 1997].

III. Result & Discussion:

The results of the present work in recipes/products incorporated with bamboo rice flour are discussed as follows;

Fig 6: Standard ladoos

Fig 7: Ladoos incorporated with bamboo rice flour

Fig 8: Standard cake

Fig 9: Cakes incorporated with bamboo seed flour

As Bamboo rice was least utilised by the people, to improve the usage frequency and include the nutritional benefits of bamboo, two products such as ladoo (figs. 6 &7) and cake (figs. 8 & 9) were developed by

incorporating processed Bamboo rice flour. Products were developed in different variations to check the nutritional and sensory acceptance.

3.1 Sensory Evaluation of prepared products

Table 1: Comparison of sensory evaluation of ladoos standard with ladoos incorporated with bamboo rice flour at different variation

Sample	Colour	Texture	Taste	Flavor	Appearance	Overall acceptability
CS	4.1±0.29	3.9±0.21	4.2±0.36	4.0±0.21	4.0±0.27	4.0±0.14
CV1	3.2±0.40	3.2±0.38	3.3±0.35	3.1±0.48	2.9±0.35	3.1±0.31
CV2	3.8±0.33	3.7±0.36	4.1±0.38	3.9±0.24	3.8±0.35	3.8±0.17
CV3	3.2±0.43	3.0±0.45	3.2±0.46	3.2±0.50	3.0±0.53	2.9±0.35

Table 2: Comparison of sensory evaluation of cake standard with cake incorporated with bamboo seed powder at different variation

Sample	Colour	Texture	Taste	Flavor	Appearance	Overall acceptability
CS	4.1±0.33	3.9±0.15	4.3±0.39	4±0.32	4.0±0.30	4.0±0.16
CV1	3.3±0.37	3.2±0.43	3.2±0.34	3.1±0.29	2.9±0.49	3.1±0.25
CV2	3.8±0.34	3.6±0.45	4.1±0.45	4±0.32	3.8±0.28	3.8±0.26
CV3	3.1±0.27	2.9±0.46	3.1±0.49	3.1±0.49	3.0±0.35	3.0±0.26

Tables 1 & 2 mentioned that Prepared products were subjected to sensory evaluation by 30 semi-trained panel members. Three variations and one control in each product were subjected to the sensory assessment. The sensory attributes included colour, texture, taste, flavour, appearance and overall acceptability. In both ladoo and cake, control groups were highly accepted by the panel members. Among experimental variations, the rate of overall acceptability of variation 2 was more accepted than other counterparts. The sensory score of CV2, taste & flavour were more similar to control which is highly accepted but differs from the other two variations. The mean overall acceptability of variation 2 for ladoo and cake was 3.8.

3.2 Proximate Analysis

Table 3: Proximate analysis of bamboo rice flour

Sample (g/100g)	Moisture	Ash	Fat	Protein	Carbohydrate
Bamboo rice flour	9.6	1.62	0.91	7.2	80.2

Table 3 represents the Proximate analysis value of bamboo rice. It was inferred that the present study obtained similar values of nutrient composition such as Moisture, ash, carbohydrate than the previous studies [Chen 2023]. The protein content of bamboo rice was found to be significantly higher than rice and wheat.

Table 4: Comparison of proximate analysis of standard with bamboo seed flour incorporated product

Sample/ Characteristics	Moisture	Ash	Fat	Protein	Carbohydrate
Ladoo control	25.9	2.29	14.8	7.5	134
Ladoo variation 2	26.1	3.1	15.1	9.9	112
Cake control	18	0.9	19	6.5	154
Cake variation 2	23.9	2	14.6	9.2	98.2

Highly accepted products in sensory evaluation were undergone for analysis hence table 4 represents the proximal composition of bamboo rice flour incorporated product with control. Both ladoo & cake have less carbohydrate content than the respective controls as bamboo rice rich in fibre. Protein also have increased in both the products comparative to control products. Ladoo and cake prepared from other flours like finger millet flour, pearl millet flour also has shown high percentage of protein and reduced in carbohydrate as they are containing high fibre and low glycemic index effects [Sharma 2022 & Nazni 2016].

Table 5: Comparison of phytochemical and antioxidant analysis of standard with bamboo rice flour incorporated products

Sample	Antioxidants (mg/100)	Tannins (mg/100)	Phenols (mg/100)
Ladoo control	32	0.9	112
Ladoo variation 2	60.5	2	399
Cake control	40	1.0	212
Cake variation 2	62	2.1	405

Above Table 5 suggested the phytochemical and antinutrient composition in the developed food products. Cake and ladoo are having two-fold of antioxidant level than the control. Even tannins are one-fold high and phenol content were two-fold high in both products than the counterparts. Other study shown that high amount of tannins has anti-microbial activities which inhibits the developing of other microorganisms like fungi, yeasts, bacteria, viruses [Sharma 2021]. It also has anti diabetic components where it enhances glucose uptake and inhibit adipogenesis, thus being potential medicine for type 2 Diabetes Mellitus [Kumari 2012].

Even in the other study on bamboo shoots shown that this species containing high amount of antioxidant and phenol content which can minimize free radical damage to the body [Bajwa 2016].

IV. Summary & Conclusion

The study was carried out to develop value added products using bamboo seeds. The development of value-added products using bamboo seeds involves various processes and innovations to maximize the utilization of the natural resource. Bamboo seeds are rich in nutrients (protein 12.0g, fiber 2.6g, iron 9.2g, calcium 25.0mg%) and can be transformed into different products with high market value. Two products viz ladoos and cakes were used as vehicles to incorporate the bamboo seed flour. Bamboo seed flour was incorporated at different levels (25% ,50% ,75%). These products were subjected to sensory evaluation. For cakes and ladoos control scored high (ladoo -overall acceptability 3.8 and cake – overall acceptability3.8) followed

by variation 2 which was prepared by incorporation of 50% bamboo seed flour. From the nutrient evaluation it was evidenced that bamboo rice was rich in macro nutrients (Moisture 9.6g, ash 1.62, protein 7.2g, carbohydrate 80.2g). As per the analysis, more tannin content is present in the both experimental products which has antidiabetic, antimicrobial activities. Thus, the incorporation improved the overall nutrient value of the products. Additionally, they can improve the immune level, minimize the cell damage and other health benefits.

Bamboo rice is utilised as food but there is no enough data on its nutritional properties especially the rice incorporated developed products details. Hence this study was designed to develop the bamboo rice incorporated products where nutritional values have significant difference and shown it has abundant nutritional components than other grains which can promote for human consumption. Especially the native population, living in the south western ghats of India, where there is a better availability and consumption of bamboo rice.

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