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Development of red rice noodles fortified with soy flour

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Abstract

This research explores the formulation of red rice noodles enriched with soy flour to improve their nutritional value. Red rice is rich in antioxidants, fiber and minerals, while soy flour provides high-quality protein, essential amino acids, and micronutrients. The formulation of fortified noodles was optimized by incorporating varying proportions of soy flour into red rice flour to assess its impact on nutritional composition, texture, and sensory attributes. The final product was evaluated for consumer acceptability. The results indicate that fortification significantly improves the protein content and overall nutritional value without compromising taste and texture. Noodles were prepared by incorporating soy flour at different levels. The prepared noodles were evaluated for various sensory characteristics with 5 members. The data provides a clear idea about sensory scores. This research highlights the potential of red rice-soy flour noodles as a cost-effective, sustainable, and nutritious alternative to conventional noodles. The present study aimed to develop a product using red rice, which was then assessed for acceptability and organoleptic qualities.

Keywords: Red rice, soy flour, fortified noodles, sustainable, antioxidants

Introduction

Red rice, characterized by its red bran layer, is valued for its culinary and medicinal uses, as well as its significance in cultural and religious ceremonies. It is available in various varieties, cultivated in specific regions, and utilized in breeding programs to enhance cultivated rice strains. In recent years, there has been a renewed interest in red rice. According to Ayurveda, red rice is considered the finest among the shali rice varieties.

Recently, red rice has regained interest due to its rich antioxidant content. It has been a staple food in India, China, Korea, and Japan for over 3,000 years. As a primary food source for more than half of the global population, especially in Asia, rice holds immense importance. Acknowledging this, the United Nations declared 2004 as the International Year of Rice (IYR), marking the first time an entire year was dedicated to a single agricultural crop. The theme, *Rice for Life*, emphasized its vital role in food security.

Rice is commonly consumed as cooked rice or used as a raw material in various foods and stock feed industries. In India, rice cultivation covered an area producing approximately 172.8 million metric tons in 2019. Naturally, rice is brown after milling but when the nutrient-rich outer bran layer is removed, it becomes white, which is the most commonly consumed form. However, there are several other coloured rice varieties, distinguished by unique pigmentation in the bran or whole endosperm, including red rice, purple rice, and black rice.

Since ancient times, Asian people have consumed noodles as a staple food due to their convenience, ease of cooking, delicious taste, and rich nutritional value. In recent years, noodles have gained widespread popularity beyond Asia. Rice noodles, in particular, are typically made up of rice flour, salt, water, and other ingredients. Rice flour is combined with water and salt to create a dough. The dough is then rolled into sheets, layered, steamed, and cut into noodle tendrils. These tendrils can undergo further processing—such as drying, frying, boiling, or freezing—to create different types of noodles based on consumer preferences.

The red color of red rice is primarily found in the bran layer, and a slight reddish hue remains even after extensive milling. The bran color can range from light to deep red and is rich in polyphenols and anthocyanins, giving it antioxidant properties. Despite the difference in bran color, the inner part of both red and white rice remains white in color. However, red rice has two to three times the zinc and iron content of white rice. (Ramaiah and Rao).

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With the rising prevalence of lifestyle-related health issues such as diabetes, cancer, and heart disease, scientists are exploring food quality traits beyond carbohydrates, protein, and fat. The assessment of food now prioritizes antioxidant properties, glycemic index, and mineral content, highlighting the increasing focus on nutrition and health benefits. Rice is no longer viewed merely as a starchy staple; researchers are analyzing the antioxidant potential of colored rice varieties. Additionally, the mineral composition of different rice types is gaining importance in nutritional evaluations. Studies have shown that red rice possesses higher antioxidant properties than both black and white rice. As its nutritional and medicinal value is rediscovered, red rice is regaining its historical significance and prestige.

Naturally fragrant red rice could be a promising source of antioxidants and phytochemicals, making it a valuable ingredient for nutraceuticals and functional food products. Studies on developing red rice noodle which is fortified with soy flour without detracting their organoleptic properties. Flavonoid and anthocyanin compounds play a key role in the antioxidant properties of black rice (Zhang *et al.*). According to (Oki *et al.*), red rice exhibits higher DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging activity compared to black and white rice, with this activity being closely associated with its polyphenol and proanthocyanidin content. Given that red rice exhibits the highest scavenging activity due to its polyphenol content compared to black and white rice (Oki *et al.*), it has the potential to regain popularity among health-conscious consumers. It is essential for people in India to reevaluate the nutritional benefits of the country's diverse indigenous red rice varieties. Additionally, there is a pressing need for clinical validation of the medicinal properties of red rice, as documented in ancient literature, and for further research on developing food products such as poha (Flake rice), noodles, and sewai (Vermicelli) from red rice.

Therefore, present study was development of red rice noodle with soy flour, where the red rice is lacking in the calcium content; it is fortified with soy flour.

Objectives

1. To utilize the red rice in development of noodles.
2. Fortification of noodles with soy flour enhances their calcium content.
3. To evaluate sensory properties of noodles.

Methodology

1. Procurement of sample

The primary raw material, red rice, along with other ingredients such as soybean flour, was sourced from the local market. All materials were gathered in a single batch and then processed.

2. Formulation and development of sample

The product which is developed is preparation of noodles from red rice enriched with soy bean flour.

a) Ingredients Used

The ingredients used for the preparation of red rice flour enriched with soy bean flour are whole wheat flour, red rice flour, soy bean flour, vegetable oil, salt and water.

b) Preparation and Processing of Red Rice and Soybean Flour

i) **Red Rice Processing Techniques:** The red rice was sourced from the local market in Coimbatore city. It was

then thoroughly cleaned to remove any impurities, dust, and foreign particles before further processing. After cleaning, any unwanted particles were carefully removed to ensure the purity of the red rice. These grains were sun dried, powdered and stored in air tight container.

ii) **Processing of soy bean flour:** The soybean flour was prepared by roasting whole soybeans on a low flame for 5–10 minutes. After roasting, the soybeans were cleaned and ground into a fine flour using a domestic electric mixer. The resulting flour was then used for the preparation of value-added products.

c) Fortification of Soy Flour

As red rice was deficit in calcium, so it is fortified by addition of soybean flour where it has the nutritive value of about 277 mg per 100 g.

d) Method of preparation

Ingredients

- Wheat flour -50 g
- Red rice flour -100 g
- Soy flour-50 g
- Oil-10 g
- Water-50 ml
- Salt-1/2 teaspoon

1. Mix the Dough

- In a large bowl, combine 1¾ cups of flour and salt. Create a well in the centre.
- In a separate small bowl, mix water and oil until well combined.
- Gradually pour the liquid into the well and stir until a rough dough forms.

2. Knead the Dough

- Lightly flour a clean kneading surface.
- Transfer the dough onto the surface and knead until smooth and elastic.
- Continue folding and pressing the dough until it reaches the desired consistency.
- Cover the dough and let it rest for 10 minutes.

3. Roll the Dough

- Split the dough into four equal sections.
- Gently coat both sides of each portion with a light dusting of flour.
- Let the dough rest uncovered for about 20 minutes.

4. Cut the Noodles

- Roll each dough portion loosely into a spiral.
- Using a sharp knife, cut the spiral crosswise into ¼-inch-wide strips.
- Unroll the strips to separate them.
- Cut the strips into 2-to-3-inch lengths.

5. Store the Noodles

- Spread the cut noodles on a rack and let them air dry for 2 hours.
- Transfer them to an airtight container and refrigerate for up to 3 days.

3. Evaluation of product acceptability

a) **Sensory Evaluation:** Sensory evaluation of any food product is based on its organoleptic appeal, storage quality, and nutritional properties. In this study, the

product assessed was red rice noodles. To determine its sensory attributes, the value-added soybean flour was evaluated for organoleptic quality using a 5-point Hedonic Scale. A panel of ten semi-trained judges Department of Home science had participated in the evaluation, ranking their responses accordingly.

b) Consumer Acceptance: The evaluation was conducted to assess consumer acceptance and document their responses to the product.

4. Packaging of noodles

a) Selection of Packaging Material: The noodles which were prepared were packed with the help of the aluminum pouch were used where it has the benefits of providing optimal protection by offering an impermeable metal barrier to light, water vapor and micro-organisms.

b) Labelling of Product: The products were labeled where it contains net quantity of product, ingredients, nutritive value, cost calculation are all included in it.

i) Nutrition Calculation: The nutrient calculation of raw ingredients is calculated by using National Institute of Nutrition (NIN) Nutritive value book, where the nutrients of macromolecule and macromolecule are calculated as per the amount Incorporated.

ii) Cost Calculation: The cost calculation of red rice noodles is calculated by including fuel, man power. Ingredients used and amount of profit assigned for 200g of product were calculated and included in the label.

5. Documentation

The obtained values were noted down and the data were tabulated in the respective tables. The tabulated data were analyzed and discussed upon using varied figures and graphs.

Results and Discussion

The aim of the present study "Development of red rice noodles fortified with soy flour to investigate possibility of utilizing red rice, to improve the nutritional value of noodles. Therefore, an attempt has been made to develop and formulate rice-based noodles. These products were studied for sensory evaluation. The results are presented after subjecting to statistical analysis and discussed under appropriate sections as below:

1. Development and standardization of rice-based products
2. Consumption pattern of red rice
 - i) General information
 - ii) Awareness about importance of red rice
3. Sensory evaluation of product developed from red rice
4. Market survey

Development and standardization of rice based products

Formulation of red rice noodles with 3 variations is done. Red rice noodles developed were evaluated for color, texture, taste, flavor and overall acceptability. Each member independently examined the noodles and assigned the score on 9 point hedonic scale for its acceptability.

2. Consumption pattern of red rice

Consumption pattern of noodles are assessed by providing a framed questionnaire to the consumer where it includes following details

General Information

The general information of the respondents covered their socio-economic background, literacy level, occupation type, monthly income, and food habits. Additionally, data regarding

their age, family type, and education level were collected. The details of these factors are presented in the following table.

Table I: Socio economic status of respondent:

Si. No	Particulars	Percentage (%)
1.	Age Group (years)	
	20-30	30
	30-40	30
	40-50	20
2.	Education Status	
	Primary	2
	secondary	3
	Higher secondary	3
3.	Occupation	
	Business	30
4.	Income Level	
	Less than 10000	50
5.	Food Habit	
	Vegetarian	0
	non vegetarian	100

The socio-economic status of the respondents includes age group, Education status, Occupation, Income level and Food habit of the selected sample. The information pertaining to the respondents with respect to their age, educational status, occupation, income level and food habit income is presented in the table. The respondents in the age group of 20-60 were selected for the survey. Among them 2% of the people were under primary Grades. The percentage of people pursuing secondary and higher secondary were 6% and the remaining were graduates. Among the respondents 30% were doing their business and 70% of the people home makers. When coming to their income level, 50% of the people were earning below 10,000 and the remaining 50% earns above 10,000 and everyone who was surveyed was non-vegetarian respectively.

Table 2: Frequency of consumption of red rice:

Frequency	Percentage (%)
monthly once	30
weekly once	-
rarely once	70

The Frequency of consumption of red rice among people was collected. The table reveals that none of the respondents consumed red rice on a daily or weekly basis. 30% of the people were consuming it monthly once and 70% of the people are consuming it rarely.

Table 3: Cost pattern of red rice:

Cost pattern	No. of person
High	70
Moderate	20
Low	10

Cost pattern of red rice was surveyed. From the 70% people reveals that it is costly than other varieties.

Organoleptic evaluation of red rice noodles

Noodles was prepared by incorporating soy flour at different level (30, 50, 70). The prepared noodles were evaluated for various sensory characteristic with 5 members. The data which gives clear idea about sensory scores are presented in

table 4 and illustrated in figure 1.

The mean acceptability scores for red rice noodles incorporating soy flour are presented in the table. A significant difference was observed among the variations for different sensory attributes. The mean acceptability scores ranged from 7.2-8. Variation II scores significantly high compare to other.

The sensory score for color of noodles for studied varied from 7 to 9. The noodles prepared and fortified with soy flour was recorded highest score of 9 and lowest score of 7. The mean score also calculated from the sensory evaluation highest score was given to the variation in all organoleptic characteristic.

Table 4: Mean calculation of red rice noodles

Variation	Level of Incorporation (%)	Mean Value of Sensory Scores				
		Color	Texture	Taste	Flavor	Overall Acceptability
I	30	8.2	7.4	7.6	7.8	8
II	50	8.6	8.2	8.2	8	8.6
III	70	7.4	7.6	7.2	7.4	7.2
S.D		0.61	0.42	0.50	0.31	0.70

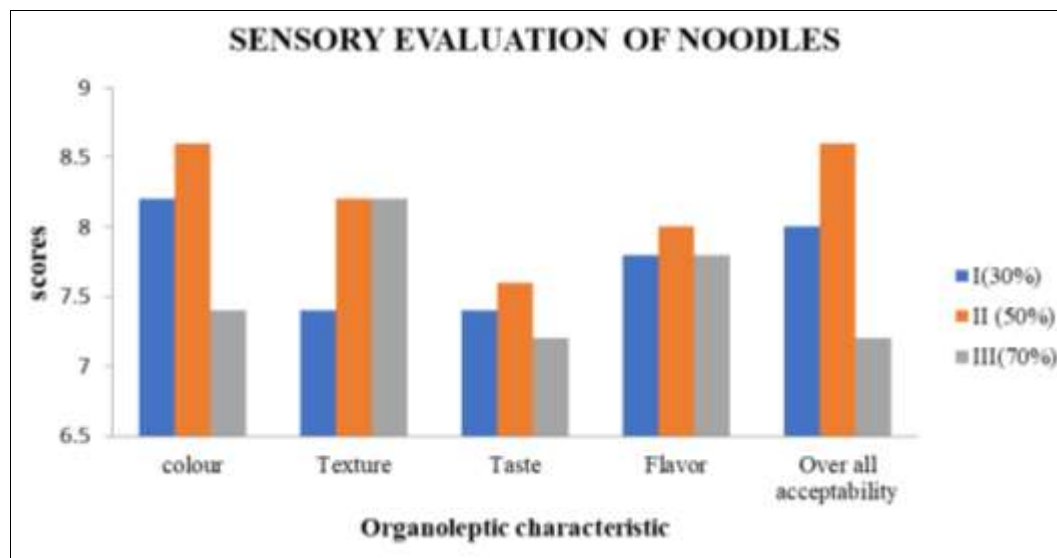


Fig 1: Noodles prepared with incorporation of soy flour

Market Survey

Market survey of the developed product is conducted by providing a preformed questionnaire to 10 consumer which include the below details

Table 5: Acceptability of product:

Acceptability of product	Percentage (%)
Agree	70
Slightly agree	20
Neither	10
disagree	-

The acceptability of the cost of the developed rice noodles was surveyed. From the table it is revealed that most of the people (70%) accept the fixed price of the product and some (20%) agreed slightly 10% of the people were not aware of that respectively.

Table 6: Resemblance of noodles

Resemblance	Percentage (%)
Strongly agree	50
Agree	30
Slightly agree	20
disagree	-

The resemblance of the developed red rice noodles and the regular noodles were examined. It is revealed that 50% of them strongly agreed that both the noodle resembles the same

and 39% of them agreed the same and remaining people slightly agreed that both resembles the same.

Table 7: Taste of Noodles

Taste of noodles	Percentage (%)
Agree	70
Slightly agree	20
Neither	10
disagree	-

The taste of the developed noodle in respective to the regular noodle were surveyed among people. It is revealed that 70% of the people accept that both resembles the same and 20% of people slightly accept the same and the remaining 10% doesn't have an idea about the noodles.

Table 8: Consumer satisfactory

Variable	Yes (%)	No (%)
Package	90	10
Reliability	70	30
Good for health	90	10

Consumer satisfactory of the product where 90% were accepted the packaging and design and 70% of the people accepted the reliability of the product.

Summary and Conclusions

Red rice is rich in iron and vitamins, which play a crucial role

in the production of red blood corpuscles (RBCs), an essential element for maintaining good skin health. The antioxidants present in red rice may help combat free radicals, protecting the skin from premature aging.

Among various food products, noodles serve as an ideal vehicle for delivering bioactive compounds due to their global availability, high consumer acceptance, and appealing sensory characteristics.

In the present study, an initial survey was conducted to gather information on the consumption patterns of red rice. The survey was carried out using personal interviews, collecting data on aspects such as red rice consumption, awareness of its nutritional benefits, and its medicinal significance.

In the second stage, red rice noodles were developed with varying levels of fortification using red rice flour, followed by an evaluation of their sensory and organoleptic qualities.

In the consumption survey it was clear that the consumption level of red rice is very less among the people, only people with disease conditions consumes it.

The identification of health promoting component in anthocyanin rich product would increase the demand of these commodities by consumer and the food industry expanding the market of fresh and processed anthocyanin containing food. An effort was made in this study to incorporate soy flour in red rice noodles and sensory evaluation of noodles was studied.

The level of incorporation of soy bean flour in the selected product were 30, 50 and 70%. Three variation with selected level of incorporation of soy bean flour with red rice were prepared. The prepared products were organoleptically evaluated.

As per the nutrient content of red rice it is deficit in calcium content, so it is fortified with soya bean flour which is rich in calcium. By in taking this noodle all the nutrients together is obtained easily.

Through the sensory evaluation of the products, 50% incorporation of soybean flour is accepted and which obtained higher scores comparing to other variation.

Fortification of soy flour in red rice increases the nutrient content significantly in case of protein, fiber and calcium.

From the above findings conclusions are drawn

- Soybean can be incorporated to any selected products from 30-50%
- Incorporation of soybean flour in red rice noodles where it improves nutritive value with particular reference to calcium.
- Soybean flour can be incorporated to any commonly consumed recipes.
- Consumption of red rice is very less among the community due to the high cost
- Soy flour fortified with 50% is highly acceptable comparing to the other variation.

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