



Enhancing Nutritional Value: Formulation and Analysis of Rice Cake Enriched with Green Gram Pea

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Now a days bakery products are very high in demand worldwide. People are searching for substitute which is healthy to consume as well as help in fulfilling daily nutritional requirement and beneficial for the health. Fortified rice has been used with green gram pea in the sponge cake because of that nutritive value of this product is highly increased, after developing the product nutritional profiling has been done to check its nutritive value. The study investigates the formulation and nutritional analysis of rice cakes fortified with green gram pea, aiming to enhance their nutritional value. In response to the global challenge of malnutrition and the need for nutrient-rich food options, this study explores the potential of incorporating green gram pea into rice cake formulations. The research methodology involves the development of fortified rice cakes using varying proportions of green gram pea powder blended with rice flour. Nutritional value was

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assessed through analysis of the fortified rice cakes, including parameters such as protein, fat, carbohydrate, fiber, and moisture content. Additionally, sensory evaluation was carried out to determine the acceptability of the fortified rice cakes in terms of taste, texture, and overall palatability. The findings of this study reveal the nutritional enhancement achieved through the incorporation of green gram pea, with notable increases in protein 2.98% and fiber 9% content compared to traditional rice cakes. Sensory evaluation results indicate favorable acceptance of the fortified rice cakes among consumers. Overall, this research contributes to the development of nutritious food options by demonstrating the feasibility of fortifying rice cakes with green gram pea, thereby addressing nutritional deficiencies and promoting healthier dietary choices.

Keywords: Formulation; fortification; green gram pea; proximate analysis; rice cake.

1. INTRODUCTION

People in the past stuck to eating simple meals like chapatis, rice, lentils, corn, and bajara (pearl millet). Because they were unaware of modern culinary techniques, there was little advancement in eating habits. With the passage of time, humankind began to seek a wider range of food types, tastes, and quality [1]. Consequently, the baking sector was born. The food processing industry in India is dominated by the bread sector, which has enormous growth potential. Approximately 1.3 million tonnes of bakery products are produced by more than 2,000 organized or semi-organized bakeries in India, while 10,00,000 small-scale unorganized bakeries produce 1.7 million tones of bakery products. With 80% of the market, bread and biscuits are the most popular bakery [2]. Unsurprisingly, India is the world's second-largest biscuit maker, right after the United States. In the processed food industry, the bread sector has emerged as the third highest revenue-generating industry. In 2015, the industry's market size was projected to be valued at US\$7 [3]. Cake is a new bakery product compared to the others. It was earlier famous in the Western countries but now becoming popular in other parts of the world. It is a perishable product made of wheat flour, cream, gel, sugar and milk. It is of two types viz egg cakes and fruit cakes [4].

The food sector has attained high position in the production of bakery goods. Customers now have more options for bakery products because of the large selection of products that are being produced at a faster rate [5]. The bread sector offers a wide variety of baked goods, which gives consumers a wide range. As a result, the industry has an incentive to innovate and fortify its products in order to appeal to consumers who are health-conscious. Most people consume items which are derived from cereals on a daily

basis, while bakery products are the most popular foods consumed overall [6]. The food business has so turned its attention to improving the nutritional content of these goods. Encouraging bakery items to be healthier is the current trend [4]. The food sector has seen significant transformation in the last several decades, primarily as a result of the creation and application of new technologies to satisfy the increasing expectations of consumers for convenience goods [7]. More and more legume flours is being used for bread production with high protein contents. Legumes' proteins have a balanced amino acid composition and offer nutritional advantages [8] are therefore the best components to enhance the nutritious qualities of baked items [9].

Due to various health issues linked to wheat flour consumption, such as diabetes, coronary heart disease, and celiac disease, the current trend in nutrition is the consumption of functional foods, or "foods which not only supply basic nutrients but also help to prevent certain diseases [10].

Iron deficiency is mainly due to inadequate nutrition, particularly in adolescent girls who are enrolled in school [11]. While there could be other elements at play, the primary ones are likely to be poverty, ignorance, improper cooking methods, personal interests, etc [12]. Finding a means to provide for the population's dietary demands is therefore imperative. It is a challenge for food sector to produce a healthy and economically satisfied food items. Since cyanobacteria are now commonly cultivated, they offer an affordable source of nutrients including protein, iron, and other minerals that can help satisfy nutritional needs [13]. Rice is used as staple food, particularly in Asia approximately 50% of calories are fulfilled from directly or indirectly from rice items. The bland flavor, ease of digestion, and hypoallergenic qualities of rice products are just a few of their many distinctive

qualities. Rice is an essential component of a balanced diet [14]. Rice is devoid of fat, cholesterol, and salt. Fatty acids are among the rice lipids that are being studied for their ability to prevent cancer and cardiovascular disorders as well as their antibacterial properties [15].

In addition to providing a healthy food, rice is also used as a source of medicine to control different disorders in human body including diabetes, indigestion, arthritis, paralysis, and epilepsy. Women who are pregnant or doing breast feeding [16].

Approximately 3.5 billions are identified with the deficiency of Fe all around the world, major portion is covered by the children and women of developing countries [17]. It can cause developmental and cognitive impairment in young children, as well as raise their risk of infection and perinatal death [18]. Population-based studies have found anaemia prevalences in a number of Brazilian areas. Thirty percent of young children [19]. Data on iron status are more limited, but smaller studies have also found high prevalences of ID anemia [20].

In its unmilled state, rice is a rich source of macro and micronutrients (Suhendri et al. 2022). To create the widely consumed starch-rich white rice, the fat and micronutrient-rich bran layers are removed during the rice milling process [21]. In the rice-producing nations of southeast and northeast Asia, one of the world's most densely populated regions, white rice is the most popular staple food. Ninety percent of the rice produced worldwide is cultivated and consumed in Asia. Rice accounts for 30% of calories on average, but in some low-income nations, this number can reach 70% [22].

Developing a standard cake and performing a proximate analysis of the finished product are the study's goals. Consumers are looking for products with health advantages that they may take at any time. This fortified mix helps to address potential vitamin deficiencies and promotes a more complete and balanced diet. By assessing the nutritional features, one can make sure that the rice cake that has been fortified complies with dietary guidelines and promotes overall health and wellbeing. Occasionally, children and individuals suffering from anemia or vitamin deficiencies may find it difficult to eat due to a low appetite. It's difficult to identify food or snack items which are full of nutrition and easy to consume anytime anywhere. Occasionally,

children and individuals suffering from anemia or vitamin deficiencies may find it difficult to eat due to a low appetite. In these situations, it's critical to identify.

2. MATERIALS AND METHODS

2.1 Materials

The research was successfully completed within the duration of nine-month at the Food Science and Technology Laboratory (FSTL) of Babasaheb Bhimrao Ambedkar University, Lucknow. After planning a practical meal which stands accurately of the desirable measures, the ingredients were selected and collected from the Primary school and online platform (blink it).

The ratios of each ingredient were selected to guarantee that the finished product would have enough nutrients without compromising on flavor or texture.

2.2 Preparation of Fortified Rice Cake

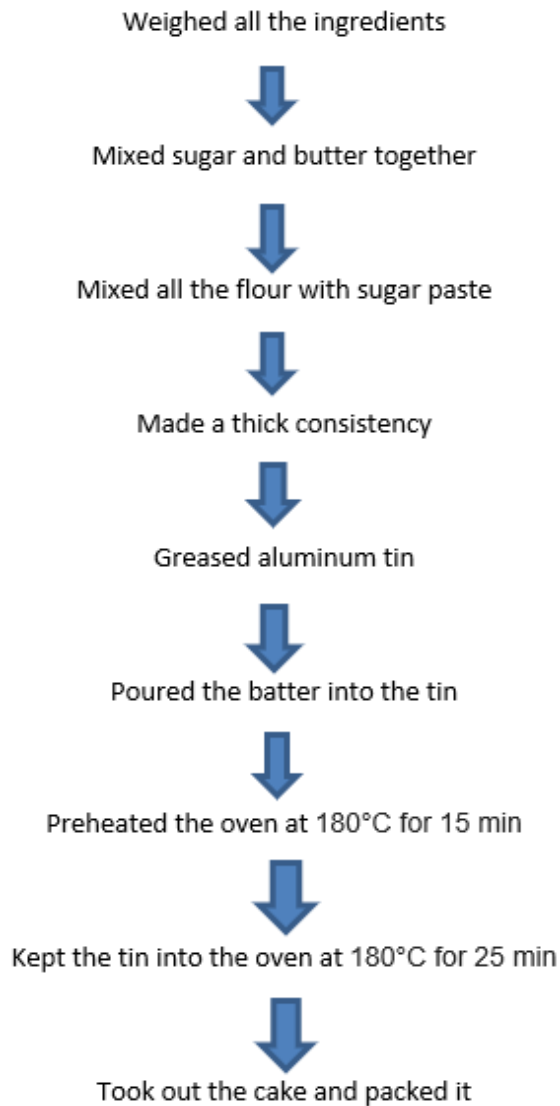
Considering the outcomes of earlier laboratory testing, we developed three formulation with different weight of fortified rice flour (FRF) as shown in Table 1.

Table 1. Composition of prepared fortified rice cake

Ingredient	Sample		
	To	T1	T2
Refined Flour	70g	35g	45g
Fortified rice flour	0	35g	25g
Green gram flour	10g	10g	10g
Dry fruit powder	10g	10g	10g
Sugar	40g	40g	40g
Cocoa powder	5g	5g	5g
Vanilla essence	2tsp	2tsp	2tsp
Butter	10g	10g	10g
salt	0.30g	0.30g	0.30g
Baking powder	5g	5g	5g
Total	150g	150g	150g

All the ingredients were weighed on electronic weighing balance. Sugar and butter were whisked to prepare the smooth batter after one tea spoon of vanilla essence was added. Refined flour, fortified rice flour, green gram flour, dry fruit powder, cocoa powder, baking powder and baking soda all the material was sieved 2/3 times in order to remove the impurities and making it homogeneous. The prepared batter was placed

in a cake tin, greased the butter paper with butter and put in the oven at 180°C for 25 minute and preheat the oven at 180°C for 15 minutes.



Flow chart1: Making Fortified rice cake

2.3 Proximate Composition Analysis

2.3.1 Moisture content

The sample's moisture content was measured 2 grams of sample was weighed and placed in a petriplate, which was then placed in a hot air oven at 105 degrees Celsius and cooled in a desiccator. The heating and cooling cycles were repeated until the weight remained consistent [23].

$$MC \% = \frac{w_i - w_f}{w_i} \times 100$$

Moisture Content (%) = (The final weight of the sample / The initial weight of the sample) × 100

2.3.2 Ash content

The AOAC standard method was used to determine the samples' ash content. In a crucible, two grams of the sample were carefully weighed. It was tarred and desiccated. After that, the crucible spent a whole day at 100 degrees Celsius in the drying oven. After that, the sample was placed in a cool muffle furnace, where the temperature gradually rose to 550 °C. Until white ash was discovered, the temperature was maintained for eight hours. Shortly after cooling, the crucible was taken out of the desiccator and weighed (AOAC, 2003).

Ash content (%) = weight of ash / the initial weight of the sample × 100

2.3.3 Protein Estimation

Estimation of protein content was determined by the nitrogen present in the sample by using the Micro Kjeldahl Method [24]. After estimating amount of nitrogen it is multiplied with 6.25 (general factor).

2.4 Methods

100 mg of a moisture-free sample was digested in triplicate on a digestion rack using 0.5g of the digestion mixture (potassium sulphate and copper sulphate in the ratio of 9:1) and 2ml of concentrated H₂SO₄. The sample was left uncooked until it turned clear. Simultaneously, a test tube with blank reagent was run. In order to make it alkaline, 10ml of 40% NaOH was added and the mixture was further diluted. During the distillation process, ammonia vapor was collected in a conical flask containing 25 milliliters of 4 percent boric acid and two drops of indicator. Using 0.1N HCl in a conical flask, the entire material was titrated until a pink end point was reached. The quantity of HCl used was recorded for the titration value and was subsequently computed using the following formula:

Total Nitrogen (g) % = 14.01 × 0.1 × (titer value - blank value) Weight of the sample (mg) × 100

Protein % = Total Nitrogen % × 6.25 (general factor)

2.4.1 Fat estimation

The duplicate sample was weighed in fine form into a thimble containing two grams. The substance and thimble were added to 50 milliliters of extracting solvent in beakers, and the Soxhlet technique was used to get this data. After being boiled for 25 minutes at 100–109°C in the eliminating solvent, the sample inside the thimble was washed for 45 minutes. Ultimately, the beakers were placed in the oven at 100°C for 45 minutes to allow the water-soluble substance to evaporate. The beakers were taken out of the oven, allowed to cool to room temperature in a desiccator, and had their fat removed [25].

$$\text{fat (\%)} = \text{weight of fat extract/weight of the sample} \times 100$$

2.4.2 Crude fiber determination

50ml of 1.25 percent H₂SO₄ was used to digest 2g of the powdered sample. After heating the solution for thirty minutes, hot liquid was used to filter and wash it. 50 ml of 1.25% NaOH was also used to digest the filtrate. After heating the solution for thirty minutes, it was filtered, hot water rinsed, and then it was over-dried. Ultimately, a furnace set at 550°C was used to ignite the oven-dried residue. The weight of the left after blastoff was used to calculate the fiber content, which was then represented in terms of the sample's weight prior to ignition [26].

2.5 Carbohydrate

The sample's carbohydrate content was determined by subtracting the values of protein, fat, ash, and fiber from the total dry matter. This resulted in the difference between 100 and the total of the other proximate components, which was then computed using the following formula:

$$\% \text{ CHO} = 100 - (\text{Protein} + \text{Fat} + \text{Ash} + \text{Moisture content})$$

2.5.1 Total energy

The energy value of the samples was determined by multiplying the protein content by 4, carbohydrate content by four and fat content by according to the nutritional composition of fruit jams in the Malaysian market.

$$\text{Energy Value} = (\text{Crude protein} \times 4) + (\text{Total carbohydrate} \times 4) + (\text{Crude fat} \times 9)$$

2.5.2 Determination of Iron

Using the Ferrozine technique, which forms a violet-colored complex when Fe (II) ions react with it, iron was determined. The test tubes marked "Blank," "Standard," and "Test" were filled with the necessary volumes of kit reagents (Coral Clinical System, India), buffer solution, color reagent, and standard solutions. After five minutes of room temperature incubation, the reaction mixtures were measured for absorbance at 578 nm (spectrophotometer – 33050). The following formula was used to determine the sample's iron concentration [27]:

$$\text{Iron (\mu g/dL)} = [\text{Absorbance of Test} / \text{Absorbance of Standard}] \times 200$$

2.5.3 Determination of pH

A food sample is often first dissolved in distilled water to generate a solution before being tested with a pH meter [28-31]. In this instance, the food sample was dissolved using 10 mL of distilled water. After that, the pH meter probe is submerged in the solution and given time to acclimate before a steady reading is achieved. To get accurate and trustworthy readings, it's crucial to make sure the pH meter probe is correctly calibrated before using it, the determination process is done by using digital pH meter (model: cpH-102 & the buffer solution is used is pH7).

2.5.4 Estimation of TSS

The procedure was completed with the help of a refractor by using destructive method. Just a drop of the sample solution was used to take the measurement on the detector [32,33]. The proportion of light's speed through a sample to its speed in a vacuum was used to represent the TSS value, which was given as a percentage of brix (digital refractometer for brix analysis in foods- HI96801).

3. RESULTS AND DISCUSSION

3.1 Formulation of Fortified Rice Cake

Within this research, three distinct products are created, each with a unique composition. T1 and To comprise 35g and 40g of refined and green gram flour, respectively, while T2 contains 25g and 40g of refined and green gram flour, respectively, fortified rice flour. Upon completion of the proximate analysis, the results indicate

Table 2. Proximate composition of fortified rice cake

Sample	Ash	Moisture	Fat	Crude fiber	Protein	Iron	Carbohydrate	Energy
To	0.7	25	0.4	6	1.31	0	72.6	299.24
T1	0.8	24.5	0.3	9	2.98	0.90	71.42	300.3
T2	0.8	16	0.4	6	2.23	0.61	80.57	334.8

that T1 is superior due to its higher protein and iron content as well as its high acceptance rate among individuals [34,35].

3.2 Proximate Analysis

Table 2 shows the result of proximate analysis of fortified rice cake with green gram pea, The moisture content in sample To is 0.7%, in T1 is 0.8% and in T2 is 0.8 and the sample T1 & T2 content the equal amount of ash. The result of moisture content in samples, in To is 25%, in T1 is 24.5% and in T2 is 16% and the control (To) is content highest moisture percentage and the sample T2 contains lowest percentage of moisture. The pH value of fortified rice cake with green gram pea is are as follows in sample To is 6.32, in T1 is 6.21 and in T2 is 6.14. The TSS of the develop product is To is 8.14, in T1 is 6.01 and in T2 is 6.20. The fat content is nearly same of all the samples, in To is 0.4g, T1 is 0.3g and in T2 is 0.4g, sample T2 is containing lowest amount of fat. The amount of crude fiber in samples is To contains 6, in T1 is 9 and in T2 is 6. The protein content in the samples, To is 1.31g, in T1 is 2.98g and in T2 is 2.23 [36]. The iron content in sample 1 is 0 because in sample one 0 gram of fortified rice flour is used and in T1 and in T2 is 0.90 & 0.61 is present [37]. The amount of carbohydrate in the samples, To is 72.6, in T1 is 71.42 and in T2 is 80.57. the amount of energy in To is 299.24, in T1 is 300.3 and in T2 is 334.8 [38].

Table 3. TSS and pH of fortified rie cake

Sample	TSS	pH
To	8.14	6.32
T1	6.01	6.21
T3	6.20	6.14

4. CONCLUSION

The aim of the study to develop a tasty sponge cake which is full of nutrition and have health benefit which can be consume by all age group of people on daily basis as well as a dissert or in the form of snack which is easy carry and can be consume any time. This product contain both

cereal and pluses, cereals are rich in methionine and pulse are rich in lysine and when pulses and cereals are consumed together they complete requirement of essential protein in our body.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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