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

Abstract

Now a days bakery products are very high in demand worldwide, o 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 have 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. Proximate analysis is conducted to assess the nutritional composition of the fortified rice cakes, including parameters such as protein, fat, carbohydrate, fiber, and moisture content. Additionally, sensory evaluation is performed to gauge 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 and fiber 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. But as time went on, humankind began to seek a wider range of food types, tastes, and quality **((Hassan, 2021)**. 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 tonnes. With 80% of the market, bread and biscuits are the most popular bakery products **(Bijlwan et al., 2019).** 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 **(Martins et al., 2017b).** 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 too. 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 **(F., 2019)**.

The food sector places a lot of importance on 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 **((Hui Y. H., 2008)T**he bread sector offers a wide variety of baked goods, which gives consumers more options. 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 based on cereals on a daily basis, while bakery products are the most popular foods consumed overall **(Edwards, 2007).** 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 **(F., 2019)**. 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 **(Alashbayeva et al., 2021).** More and more legume flours are used in the production of bread goods high in protein. Legumes' proteins have a balanced amino acid composition and offer nutritional advantages **(al., 1997)**are therefore the best components to enhance the nutritious qualities of baked goods **(Koubaier et al., 2015).**

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 that not only supply basic nutrients but also help to prevent certain diseases **(WHO/FAO, 2003).**

Iron deficiency has historically been mostly caused by inadequate nutrition, particularly in adolescent girls who are enrolled in school **(Ramzi et al., 2011).** While there could be other elements at play, the primary ones are likely to be poverty, ignorance, lack of supplies, improper cooking methods, personal interests, etc **((Killip, 2007).** Finding a means to provide for the population's dietary demands is therefore imperative. The food sector faces a problem in producing foods that are practical, healthy, and economical. 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 **(S., 2022).** Rice products are staple foods, particularly in Asia where rice provides the majority of calories for almost 50% of the population. The bland flavor, ease of digestion, and hypoallergenic qualities of rice products are just a few of their many distinctive qualities. A balanced diet should definitely include rice **(Luh, 1980).** 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 **(FAO, 1997).**
In addition to providing a wealth of rice-based products, the enormous diversity of rice is utilized to cure a wide range of illnesses, including diabetes, indigestion, arthritis, paralysis, and epilepsy. mothers who are expecting or nursing **(Kharsahnoh et al., 2021).**

An estimated 3.5 billion people worldwide are thought to suffer from iron deficiency (ID)5, the most of these are small children and women in poorer nations **(United Nations Standing Committee on Nutrition; 2000)**. It can cause developmental and cognitive impairment in young children, as well as raise their risk of infection and perinatal death **(Pollitt, 1991).** Studies based on populations have discovered prevalences of anemia in several Brazilian locations.thirty

percent among young children **((Monteiro CA, 1984-1996).** Data on iron status are more limited, but smaller studies have also found high prevalences of ID anemia **((Camillo, 2007)** .

In its unmilled state, rice is a rich source of macro and micronutrients **(Sreenivasan, A. 1939)**. To create the widely consumed starch-rich white rice, the fat and micronutrient-rich bran layers are removed during the rice milling process **((Afzalinia, p. 7).** 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 meal. 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% **(FAO;2009) .**

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 wholesome 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 crucial to identify wholesome options that kids can nonetheless savor in these situations. 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.MATERIAL AND METHODS

2.1 Material

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

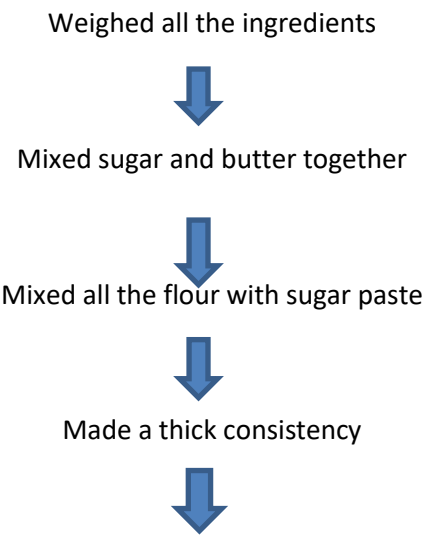
Considering the outcomes of earlier laboratory testing, we developed three formulation with different gram of fortified rice flour (FRF) as shown in Table1.

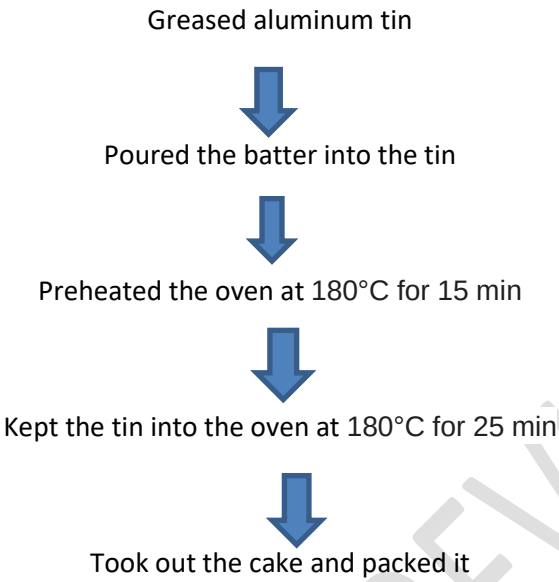
All the ingredients were weighed on electronic weighing balance. Sugar and butter were whisked to prepare the smooth batter after that add 1tsp of vanilla essence. Refined flour, Fortified rice flour, green gram flour, dry fruit powder, cocoa powder, baking powder and baking soda sieve all together for 2 to 3 times into the prepared batter. 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.

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**

Flow chart of 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 petri-plate, 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 ("AOAC ,2007) .

$$MC\ \% = \frac{W_i - W_f}{W_i} \times 100$$

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 (AOAC, 2003). 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 oC. 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.

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 (**NIN 2003)** . After estimating amount of nitrogen it is multiplied with 6.25 (general factor).

Method: 100 mg of a moisture-free sample was digested in triplicate on a digestion rack using 0.5g of the digestion mixture (98 parts K2 SO4 + 2 parts CUSO4) 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:

$$\text{Total Nitrogen (g) \%} = 14.01 \times 0.1 \times (\text{titer value} - \text{blank value}) \text{ Weight of the sample (mg)} \times 100$$

$$\text{Protein \%} = \text{Total Nitrogen \%} \times 6.25 \text{ (general factor)}$$

2.3.4 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 100–109ºC in the eliminating solvent, the sample inside the thimble was washed for 45 minutes. Ultimately, the beakers were placed in the oven at 100ºC 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 **(AOAC 2000).**

fat (%) = weight of fat extract/weight of the sample × 100

2.3.5 Crude Fiber Determination

50 cc of 1.25 percent H2SO4 was used to digest about 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 **((Madhu, 2017)**

2.3.6 Carbohydrate

The sample's carbohydrate content was determined by deducting 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:

% CHO = 100 - (Protein + Fat + Ash + Moisture content)

2.3.7 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 nine according to standard james formula.

Energy Value = (Crude protein × 4) + (Total carbohydrate × 4) + (Crude fat × 9)

2.3.8 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. The following formula was used to determine the sample's iron concentration ((**Nielsen, 2017**)):

Iron (μg/dL) = [Absorbance of Test/ Absorbance of Standard] X 200

2.3.9 Determination of Ph

A food sample is often first dissolved in distilled water to generate a solution before being tested with a pH meter. In this instance, the food sample was dissolved using 10 mL of pure 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.

2.3.10 Estimation of TSS

The procedure was completed with the help of a refractor. Just a drop of the sample solution was used to take the measurement on the detector. 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.

3. Result and Discussion

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

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.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. 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.

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

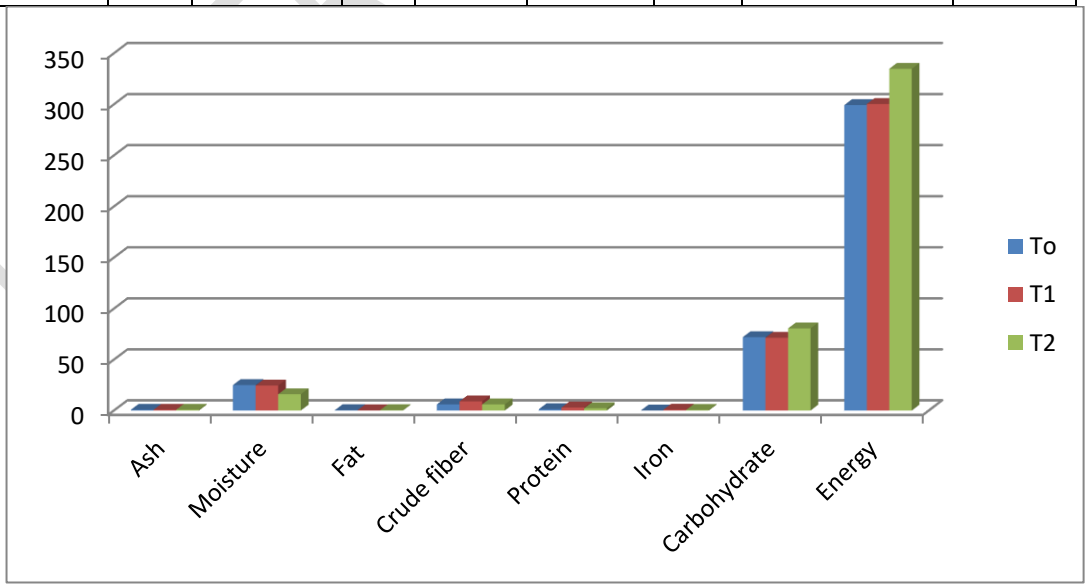


Fig 1: Graphical presentation of proximate analysis

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

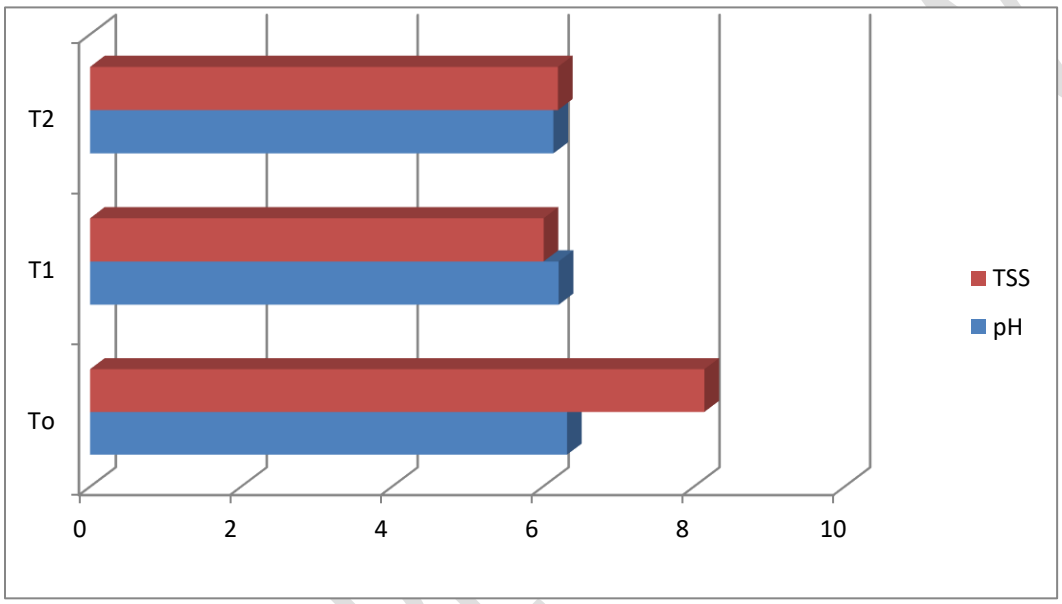


Fig 2: Graphical presentation of pH & TSS

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(Srilakshmi, B. (2007)).

References

1. Nawaz F. Bakery industry in India needs improvements in hygiene and technology, 2019.
2. Hassan, Z. M., Sebola, N. A., & Mabelebele, M. (2021). The nutritional use of millet grain for food and feed: a review. *Agriculture & food security*, *10*, 1-14.

3. Biljwan, M., Naik, B., Sharma, D., Singh, A., & Kumar, V. (2019). Recent development in dough based bakery products: A mini review. *The Pharma Innovation Journal*, *8*(5), 654-658.
4. Martins, Z. E., Pinho, O., & Ferreira, I. M. P. L. V. O. (2017). Food industry by-products used as functional ingredients of bakery products. *Trends in Food Science & Technology*, *67*, 106-128.
5. Hui, Y. H., Corke, H., De Leyn, I., Nip, W. K., & Cross, N. A. (Eds.). (2008). *Bakery products: science and technology*. John Wiley & Sons.
6. Edwards, W. P. (2007). *The science of bakery products*. Royal Society of chemistry.
7. Alashbayeva, L., Shansharova, D., Mynbayeva, A., Borankulova, A., & Soltybayeva, B. (2021). Development of technology for bakery products. *Food Science and Technology*, *41*, 775-781.
8. Perez-Hidalgo MA, Guerra-Hernandez E, Garcia-Villanova B (1997) Dietary fiber in three raw legumes and processing effect on chick peas by an enzymatic–gravimetric method. J. Food Compost. Anal. 10: 66–72.
9. Koubaier HBH, Snoussi A, Essaidi, Chabir M, Bouzouita N. Cake quality evaluation made of wheat–lentil flour blends, J new sciences, Agri and Biotech. 2015; 17:937- 942.
10. WHO/FAO. (2003). Diet, nutrition and the prevention of chronic diseases. Report of a WHO/FAO expect consultation, World Health Organisation Technical report series 916, WHO Geneva.
11. Killip, S., Bennett, J. M., & Chambers, M. D. (2007). Iron deficiency anemia. *American family physician*, *75*(5), 671-678.
12. Luh, B. S. (1980). *Rice: production and utilization*. AVI Publishing Co., Inc.
13. Ramzi, M., Haghpanah, S., Malekmakan, L., Cohan, N., Baseri, A., Alamdari, A., & Zare, N. (2011). Anemia and iron deficiency in adolescent school girls in kavar urban area, southern iran. *Iranian Red Crescent Medical Journal*, *13*(2), 128.
14. Kanojia S. Development of value-added cookies incorporated with Spirulina platensis for the mitigation of malnutrition in children. Agriculture. 2022;5(1):102-8.
15. Aashitosh A, Inamdar D, Suresh Sakhare, PrabhasankarP. Chapati making quality rice flour (aata) obtained by various processing techniques. J Food Proc. Preseerv2015;39(6):3032-3039.
16. FAO. Carbohydrates in humannutrition. FAO Food and Nutrition Paper1997, 66.
17. AOAC International (2007) Official methods of analysis."
18. NIN, National Institute of Nutrition. A Manual for Laboratory Techniques. Raghuramulu, N., Madhavan, N. K. and Kalyanasundaram, S. ICMR, Hyderabad 2003.
19. American Association of Cereal Chemists. Approved Methods Committee. (2000). *Approved methods of the American association of cereal chemists* (Vol. 1). American Association of Cereal Chemists.
20. Madhu, C., Krishna, K. M., Reddy, K. R., Lakshmi, P. J., & Kelari, E. K. (2017). Estimation of crude fibre content from natural food stuffs and its laxative activity induced in rats. *Int J Pharma Res Health Sci*, *5*(3), 1703-1706.

21. Nielsen, S. S., Carpenter, C. E., & Ward, R. E. (2017). Iron determination by Ferrozine method. *Food analysis laboratory manual*, 157-159.
22. Easter Emika Kharsahnoh, Sk Aktar Hossain, Felicia Shabong, Shanker Suwan Singh and Avinash Singh; Studies on development of rice cake using rice flour with blackcherry pulp supplemented with basil; 2021.
23. United Nations Standing Committee on Nutrition in collaboration with the International Food Policy Research Institute. Fourth report on the world nutrition situation. Geneva: United Nations Standing Committee on Nutrition; 2000.
24. Pollitt E. Effects of a diet deficient in iron on the growth and development of preschool and school-age children. Food Nutr Bull. 1991;13:110–8.
25. Monteiro CA, Szarfarc SS, Mondini L. Tendeˆncia secular da anemia na infaˆncia na cidade de Sa˜o Paulo (1984–1996). [Secular trends in child anemia in S. Paulo city, Brazil (1984–1996)]. Rev Saude Publica. 2000;34:62–72.
26. Sreenivasan, A. (1939). Nutritive value of rice. *The Indian Medical Gazette*, *74*(1), 35.
27. Afzalinia, S., Shaker, M., & Zare, E. (2004). Comparison of different rice milling methods. *Canadian biosystems engineering*, *46*(3), 63-66.
28. Camillo CC, Amancio OM, Vitalle MS, Braga JA, Juliano Y. [Anemia and nutritional status of children in day-care centers in Guaxupe´]. Rev Assoc Med Bras. 2008;54:154–9.
29. Vieira AC, Diniz AS, Cabral PC, Oliveira RS, Lo´la MM, Silva SM, Kolsteren P. Nutritional assessment of iron status and anemia in children under 5 years old at public daycare centers. J Pediatr (Rio J). 2007;83:370–6
30. Food and Agriculture Organization of the United Nations (FAO). FAOSTAT. 2009. Food Consumption Tables.
31. Matin, A., Ahmed, S., & Badsha, M. (2019). Proximate Analysis of Dry Cake Available In Local Market Of Bangladesh. *Journal of Advances in Food Science & Technology*, *27*, 130-134.
32. James C. Analytical chemistry of foods. Blackie academic and professional, New York. foods: A survey. CRC. Crit. Review. Food Science and Nutrition. 1995.
33. Tandon, A., & Pal, A. D. (2017). Development of an ironfortified cake as an attempt to prevent anemia in adolescent girls. *International Journal of Home Science*, *3*(1), 406-414.
34. Kharsahnoh, E. E., Hossain, S. A., Shabong, F., Singh, S. S., & Singh, A. (2021). Studies on development of rice cake using rice flour with blackcherry pulp supplemented with basil. *Pharma Innovation*, *10*(2), 647-653.
35. Srilakshmi, B. (2007). *Dietetics*. New Age International.