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PHYSICO–CHEMICAL, NUTRITIONAL AND SENSORIAL CHARACTERISTICS OF RAGI PASTA ENRICHED WITH RICE AND GUAR GUM

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Abstract–Ragi pasta is convenient, versatile, cheap and healthy as a carrier of bioactive compounds. This work is focused on increasing the nutritional quality and organoleptic properties of pasta by using composite flour in addition to monitoring the physico-chemical and sensory attributes of functional ragi pasta. Five treatments of ragi pasta were prepared from finger millet, rice and guar gum in different compositions. Moisture content, ash fat, protein, iron, calcium and sensory properties were evaluated. Moisture content was found to be ranging from 8.0%-10.2%, ash 1.1%-1.5%, fat 2.1%-4.5%, protein 8.7%-9.9%, iron 3.33 mg/100g-4.95 mg/100g and calcium 290 mg/100g-320 mg/100g during estimation. On the basis of sensory attributes T4 sample was more acceptable and these ragi pasta are good sources of nutrient and essential minerals and useful for human health.

INTRODUCTION

Pasta has recently become one of India's most popular dishes, with consumption rates increasing quickly. More than 30 pasta brands are available in the nation (Anon., 2016), and the majority of them are made of semolina from durum wheat (*Triticum durum*), which contains the gluten protein. Global frequency of roughly 5%, the gluten-related diseases such as celiac disease, wheat allergy, and non-celiac gluten sensitivity are starting to be recognized as epidemiological phenomena (Elli *et al.,* 2015). Wheat are excesses of harmful ions or deficits of crucial micronutrient ions (Abecassis *et al.,* 2000). Therefore, wheat completely or partially replaced for pasta and other comparable products are still being made through study.

The most widely cultivated minor millet in the world is finger millet (*Eleusine coracana*), also known as ragi and *mandau* in India. India is the world's top producer of finger millet, accounting for roughly 60% of global output (Shukla and Srivastava, 2014). This millet is high in iron, calcium, phosphorus, fiber, protein, and vitamin content. Minor millet is an indigenous grain that is used to make both natural and malted geriatric, baby, and health foods. Typically, it is utilized to make roti, pudding, and porridge (Chaturvedi and Srivastava, 2008). Because of its useful components, including slowly digesting starch and resistant starch, this millet has become more significant as the usage of processed foods and consumer understanding of the health benefits has changed (Wadikar *et al.,* 2007). This millet has a tinge of dark brown due to the high polyphone content of the seed coat. Thus, the degree of tinge can be used as a sign that finger millet has been added and shows the improvement in nutrition.

Rice flour has a number of significant qualities, including being naturally hypoallergenic, colourless, and flavourless, making it one of the more suitable cereal flours for making gluten-free dishes. Rice contains a lot of other qualities like hypoallergenic protein, little salt, little fat, and a lot of easily absorbed crabs (Gujral and Rosell, 2004). For the purpose of creating various viscoelastic characteristics, rice flour must be combined with a little amount of prolamin, some gum emulsifier, dairy products, and enzymes.

The seeds of the drought-tolerant plant *Cyamopsis tetragonoloba*, a member of the Leguminosae family,

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are used to make guar gum (Prem *et al.,* 2005). The water-soluble gum found in guar seed endosperm is employed as a thickening, emulsifier, and stabilizer in a variety of culinary products. It also contributes to the soluble dietary fiber (SDF) part of the seed's total dietary fiber (TDF). TDF and SDF, respectively, constituted up 52–58% and 26–32% of the dry weight of the seeds (Kays *et al.,* 2006). It emulsifies, binds water, stops ice crystals from forming in frozen foods, moisturizers, thickens, stabilizes, and suspends numerous liquid solid systems as a food ingredient.

The goal of the current study is to create newly, highly nutritious gluten-free pasta using composite flour and to analyze its physicochemical, dietary, and sensory properties.

MATERIALS AND METHODS

Raw materials

Finger millet (brand name *Manna*), Rice (brand name *Manna*) and Guar gum (brand name *Nature vit*) flour were obtained from local market made from Southern Health Food (p) Ltd. and Nature Vitamin. Finger millet, Rice and Guar gum flour were passed through 100 μm sieved with the help of sieve shaker (Macro scientific works ltd.) and they were mixed in different composition to prepare composite flour in the form of T0, T1, T2, T3 & T4. These composite flour samples were packed and sealed in poly bags and stored at desired room temperature for further uses.

Ragi Pasta Preparation

In the manufacturing of five different varieties of ragi pasta, rice and guar gum were substituted. According to the manufacturing guidelines (USDA, 2015), all of the dried ingredients from formulations T0 to T4 were combined for 1 minute at low speed before 30 ml of distilled water (40 °C) was added very gradually and combined for 1 minute, preparing dough with the right consistency for making ragi pasta. The resulting dough was then run through a single screw extruder with a movable die (diameter 7 mm) (model number HS/FN/EXPL/03). Ragi pasta that had been extruded in the form of tubes was cut into identical pieces (2.5 cm) using an autonomously moving knife across the outside die surface. Freshly extruded pasta had a moisture content of 25% when it was dried in a cabinet dryer (model number: Science Tech. India) at 60 °C for 3 hours, resulting in a final moisture content of 8%, before being packed in low density zip bags and stored at room temperature for further examination.

Proximate Analysis and Nutritional value

Moisture, ash, fat, and protein contents of ragi pasta were assessed using AACC (2000). The Kjeldahl method was used to calculate the protein content (percent N5.7) (AACC, method 46-13). Moisture content was ascertained by oven drying method at 100–105 °C, four hour (AACC, method 44-15A). Ash content was assessed using the dry combustion method (AACC, method 08-01), and fat content was assessed using the Soxhlet method after a weighed sample had been partially dried before a soxhlet extraction (AACC, method 30-25). Three replicate measurements of each sample were performed.

Analysis of essential mineral content

Essential minerals content such as Iron and Calcium were determined by using atomic absorption spectroscopy, AAS (Perkin Elmer 4100ZL) in ragi pasta sample. A standard curve was plotted once the absorbencies were recorded. Results were given as mg/100 g of a single sample.

Sensory assessment

Sensory evaluation was conducted by 15 panellists-10 men and 5 women in Department of Processing and Food Engineering SHUATS, on cooked ragi pasta samples. Pasta products were prepared according to optimum cooking time guidelines for the ideal cooking time in boiling water without salt, rinsed, and stored in warm conditions until testing. Panelists were told to evaluate the pasta products with respect to their degree of acceptance, according to Torres *et al.,* (2007). The sensory attributes of the pasta products, colour, taste, texture, appearance, and odour were assessed by the panels.

Statistical analysis

Three replicates of each experiment were performed. By using multiple comparisons one-way analysis of variance (ANOVA), where probability ($p < 0.05$) was judged statistically significant, data were reported as means standard deviation (SD).

RESULTS AND DISCUSSION

Proximate analysis and nutritional composition

Raw material used for pasta preparation ragi flour, rice flour and guar gum flour were analysed for suitable composition of composite flour. Composite

flour was prepared in the form of T0, T1, T2, T3 and T4 with different composition of finger millets, rice and guar gum flour. Proximate analysis and nutritional composition of prepared ragi pasta are shown in Fig. 1. It shows the moisture content of the different composition of ragi pasta are 8.0%, 9.2%, 10.2%, 9.1% and 8.0 % respectively. Similar results were obtained by Hymavathi *et al.,* (2019) and Kudake *et al.,* (2017) where moisture content ranged from 8.0% to 9.0 %. Ash content in ragi pasta was 1.2%, 1.3%, 1.1%, 1.4% and 1.5% for various samples. When the concentration of guar gum increased the amount of ash content increased because of the presence of organic substances in the guar gum. Similar results for ash content were obtained by Dnyaneshwar *et al.,* (2018). Fat content obtained for ragi pasta were 2.2%, 2.7%, 2.1%, 3.7% and 4.5% for T0 to T4 samples. A similar result for fat content was observed by Gull *et al.,* (2015) and Hymavathi *et al.,* (2019). Ragi had low amount of fat as compared to guar gum, when amount of ragi decreased and guar gum increased. The fat content increased in Ragi pasta due to guar gum. Fig. 1 shows the result of protein content of different composition of ragi pasta is 8.79%, 8.85%, 8.89%, 8.95% and 9.95% samples respectively. This finding agrees with the observation of Hymavathi *et al.,* (2019). Shukla and Shrivastava (2014) reported that when finger millet amount were increased then protein content decreased. So T0 pasta have low amount of protein content as compare to T4 composition pasta.

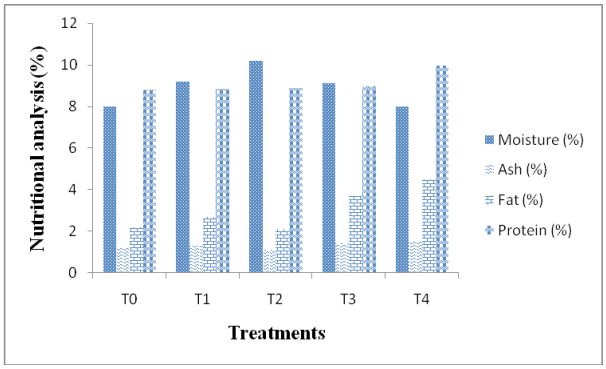

Fig. 1. Nutritional composition of Ragi pasta

Essential mineral content

The essential mineral content is shown in Table 1. The results showed that T0 have the higher amount of Iron content and T4 have the lower amount of iron content. Ragi have higher amount of iron content and guar gum have very less amount of iron. T0 have high amount of iron due to presence of maximum quantity of finger millet flour as compare to T4. Table 1 show the iron content of ragi pasta in different composition are 4.95 mg/100g, 3.57 mg/100g, 3.50 mg/100 g, 3.45 mg/100g and 3.33 mg/100g. The results agree with the findings of Hymavathi *et al.,* (2019).

Table 1. Essential mineral content of Ragi pasta

Sample	Iron (mg/100g)	Calcium (mg/100g)
T0	4.95	320
T1	3.57	318
T2	3.50	305
T3	3.45	297
T4	3.33	290

The values are expressed as the mean of three replicates samples ± standard deviation

Calcium content of the pasta is presented in Table 1. Calcium content in ragi pasta was 320 mg/100g, 318 mg/100g, 305 mg/100g, 297 mg/100g and 290 mg/100g for all treatments. As compared to all the millets and ragi grain has richest source of calcium. T0 sample have higher blend of finger millet as compared to T4 pasta sample. So amount of calcium is higher in T0 pasta sample. The results agree with the findings of Hymavathi *et al.* (2019).

Sensory evaluation

Sensory evaluation of ragi pasta blend with rice and guar gum was carried out comparing to each other on the basis of organoleptic properties. Despite that ragi pasta is a blend of finger millet, rice and guar gum showed to be comparable to each other, but T4 ragi pasta sample showed to be more preferred to panellists (Table 2). These results could be connected to the increase in finger millet uses with guar gum for pasta manufacturing that reflected on better cooking quality, nutritional value and texture that consequently positively affected the organoleptic properties. The high acceptability of ragi pasta blends with 40% finger millet, 40 rice and 20% guar gum flour. The findings in the present study are in agreement with what was previously reported by Sawant *et al.,* (2013).

CONCLUSION

Ragi pasta product enriched with finger millet, rice and guar gum have good nutritional values and sensory properties. On the basis of the present study

Table 2. Sensory evaluation of ragi pasta with different concentration

Sample	Color	Taste	Flavour	Texture	Appearance	Overall acceptability
T0	6.21±0.62	5.76±0.52	6.15±0.61	6.07±0.82	5.15±0.74	5.28±0.66
T1	6.50±0.71	6.00±0.63	6.07±0.72	7.14±0.94	7.15±0.81	6.66±1.12
T2	6.85±0.82	5.61±0.71	6.61±0.92	7.30±0.82	7.30±0.99	6.57±0.91
T3	7.14±0.93	6.07±0.25	6.15±0.72	7.32±0.71	7.23±0.63	7.28±0.84
T4	7.00±0.91	6.84±0.91	6.30±0.66	7.50±0.92	7.76±1.12	7.50±1.02

Values are the mean of fifteen replicates ± standard deviation (SD)

composite flour (finger millet, rice and guar gum) in the ratio of 40:40:20 best suits to manufacture desirable quality of pasta product such as high nutritive value and good sources of Iron and Calcium with high acceptable sensory properties.

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