Formulation and Quality Analysis of Nutrient-enriched Rusk

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Abstract **- Nutrient deficiencies are more feasible in children and women of reproductive age and aging, hence nutrient intake should be increased in their routine to reduce the risk. The aim of our study is to develop a nutrient-enriched product as it will be helpful to overcome nutrient deficiencies. Nutrient-fortified rusk was developed by using wheat flour, soy flour, dried beetroot, and Moringa oleifera leaves powder with milk, yeast, oil, salt, and sugar. The rusk was made by using standard procedure. The product was prepared under three variations of dried moringa leaves powder with beetroot powder as V1 (50:50), V2 (60:40), and V3 (70:30) with wheat flour and soy. It was evident that variation II scores high in all the parameters like appearance (4.7±0.43), colour (4.7±0.43), texture (4.7±0.45), taste (4.2±0.52), flavor (4.6±0.80) and overall acceptability (4.8±0.35) compared with variation I and III (significant at p<0.05). The moisture and ash value of variation II is 4.37g and 3.09g respectively. The nutrient analysis revealed that the developed rusk comprises energy 407.41kcals, carbohydrates 68.56g, Protein 17.49g, fat 6.49g, fibre 9.12g, Iron 14mg, and calcium 134.69mg which was found to be enhanced when compared to commercial rusk. Without any added preservatives, no bacterial growth was found in the analysis after 90 days. Hence the product was safe for consumption. The product was essentially healthier, without chemical additives and the nutritional quality was also certainly better than pure refined flavor-based commercially available rusks.**

Index Terms **- Anemia. Beetroot, Moringa oleifera, Nutrients, Rusk.**

1.INTRODUCTION

Bakery products once considered a sickman's diet have now become essential food items of the vast majority of people in India. Bread, buns, and biscuits have become popular among all sections of the population, irrespective of age groups and economic conditions. The cause for the rising popularity of baked products is mainly urbanization. This has called for an increased demand for convenience products, at reasonable costs, with greater nutritional qualities and variety with different textural and taste profiles.

Rusk is a very old product in our country. It is a bakery product that is made of flour and suji. It is slightly sweet in taste and is consumed as a snack with tea and milk. Its preparation process is very simple. It can be preserved for a long period of time i.e. up to 2 to 3 months. They have meager storage costs. This is a very cheap bakery product and even the common man can afford it easily. These are popular in urban as well as rural areas. Rusk is a top-rated baked product that everyone likes, particularly kids and working people classrooms, both rural and urban.

Now a day's consumers are also increasingly conscious about their health, they demand taste along with nutritive quality. There is an increasing realization that though bakery products processed from refined flour are tasty, they cause various harmful effects to the body, owing to the harmful additives. Thus there is a need felt to substitute refined flour with safe and healthy ingredients. Products from composite flours have thus become a trend in the market.

In products such as bread, the gluten network formation is desirable for gas retention in turn enhances the volume of the product, while in products such as biscuits, extensibility is required, so gluten formation and its gas retention network is undesirable. Getting the desired quality of flour for making specific kinds of bakery products is a challenging task for the bakery industry [1].

Moringa oleifera is a multi-purpose herbal plant used as human food and an alternative for medicinal purposes worldwide. It has been identified by researchers as a plant with numerous health benefits including nutritional and medicinal advantages.

Moringa oleifera contains essential amino acids, carotenoids in leaves, and components with nutraceutical properties, supporting the idea of using this plant as a nutritional supplement or constituent in food preparation. Some nutritional evaluation has been carried out on leaves and stems. An important factor that accounts for the medicinal uses of Moringa oleifera is its very wide range of vital antioxidants, antibiotics, and nutrients including vitamins and minerals. Almost all parts from Moringa can be used as a source for nutrition with other useful values [2].

Soy appears to be a good source of nutritional iron in marginally iron-deficient individuals. Intake of soybeans prevents anemia through high iron and ferritin content which is highly absorbed and provides a model for novel, utilizable, plant-based forms of iron for populations with low iron status. Hence the present study was carried out with the following objectives to standardize the wheat rusk incorporated with powdered drumstick leaves and beetroot, to conduct the sensory evaluation of the prepared product, to analyze the nutrient content of the wheat rusk, to Access the shelf life of the wheat rusk and to know the consumer acceptability of wheat rusk among consumers.

2. METHODOLOGY

Rusks were prepared using the method as described [3] with modifications. Yeast and water were mixed in a bowl and kept for 30 min then sugar was added for activation of the yeast. Flour and other ingredients except fat were added to the yeast water solution. Fat was added last. Mixing was carried out for 10-12 min. Two-stage proofing was carried out. First proofing for 105 minutes, knock back, and a further 45 minutes second proofing. Baking was done at 200oC for 15 minutes and the loaf was left to cool overnight. The next day, the loaf was sliced and then baked a second time at 160oC for 20 minutes and finally, the prepared rusks were packed in polyethylene packs and stored at room temperature for further processing. In the present study, the micronutrient fortified rusk was developed by using wheat flour, soy flour, dried beetroot, and Moringa oleifera leaves powder with milk, yeast, oil, salt, and sugar. The above ingredients were quality-checked and purchased from the wholesale market. The moringa leaves were washed and cleaned; beetroots were washed and grated with skin. The wheat, moringa leaves, and grated beetroot were sundried to remove the moisture content and ground into powder for the preparation of dough to develop the rusk. The rusk was made by using standard procedure. The product was prepared under three variations (V1, V2, and V3).

Table 1 Standardization of wheat rusk

Ingredients	Variations		
	V1	V2	V3
Wheat flour	90	90	90
Soy flour	10	10	10
Beetroot powder	50	40	30
Drumstick leaves powder	50	60	70
Total	200	200	200

2.1 Organoleptic evaluation

Using a five-point rating hedonic scale, the formulated wheat rusk was subjected to organoleptic evaluation for its quality attributes like flavour, appearance, taste, texture, and overall acceptability by 30 semi-trained panel members. From the sensory evaluation, the variation found to be with high scores was subjected to physiochemical, nutrient, and microbial analysis.

2.2 Physicochemical properties, nutrient and microbial analysis

The highly scored variation of wheat rusk was subjected to analyze moisture and ash using standard protocols of the AOAC method. The highly scored variation of wheat rusk underwent nutrient analysis which includes energy, carbohydrate, protein, fat, fibre, calcium, and iron by using standard test protocols of the AOAC method. To determine the storage stability, the standardized wheat rusk was tested for microbial analysis, and total plate count was done to find the presence of bacteria, yeast, and mold as no preservatives were added.

3. RESULTS AND DISCUSSION

3.1 Organoleptic evaluation of the developed rusk

Sensory evaluation is a scientific discipline that analyses and measures human responses to the composition of food and drink, e.g. appearance, touch, odour, texture, temperature, and taste. The results of the organoleptic evaluation for the three developed rusk variations are depicted in the below table.

Table-II Organoleptic evaluation of the developed nutri enriched rusk

Parameters	Variations		
	V1	VII	VIII
Appearance	4.4±0.62*	4.7±0.43*	4.2±0.76*
Color	4.3±0.47*	4.7±0.43*	3.8±0.61*
Texture	4.3±0.47*	4.7±0.45*	3.4±0.56*
Taste	4.2±0.40*	4.2±0.52*	3.3±0.61*
Flavor	4.3±0.53*	4.6±0.80*	3.8±0.64*
Overall acceptability	4.4±0.62*	4.8±0.35*	4.31±0.66*

* Significantly different ($p<0.05$) from each other

The above table indicates the average sensory scoring with standard deviation of different attributes and overall acceptability of three variations for the developed rusk. It was evident that variation II scores high in all the parameters like appearance (4.7±0.43), colour (4.7±0.43), texture (4.7±0.45), taste (4.2±0.52), flavor (4.6±0.80) and overall acceptability (4.8±0.35) compared with variation I and III.

3.2 Physiochemical analysis of formulated rusk

The Manufacturing of Rusk involves the preparation of partially baked bread, slicing, and again roasting in the oven to remove the moisture. Good Roasted rusk will have no moisture and be crisp and dry. The high-scored variation II was analyzed for moisture and ash.

Table-III Moisture and ash content of nutri-enriched rusk

Parameters	Test result (g/100gm)
Moisture	4.37
Total ash	3.09

The moisture and ash value of variation II is 4.37g and 3.09g respectively. These were acceptable values for the developed rusk and the developed product was found to be with good physicochemical properties and shelf life. Another study also reported that the rusks prepared by the modified process had 2.5% moisture, 12.1% fat, 9.4% total protein, 1.9% ash and 74.1% total carbohydrate [4].

3.3 Nutrient analysis of the developed rusk

Analysis of nutrient content is an important aspect in formulating and developing new products and evaluating new processes for making food products and identifying the sources of problems with unacceptable problems. Adequate analytical methods for nutrients in foods, food ingredients, and food products are the basic first step in determining the nutritional adequacy of a food supply. Whatever the ultimate use of nutrition data, i.e. consumer education via the food label, or databases for nutrient and deficiency disease studies, the assay used to provide the data must determine the analyses of interest adequately.

Table-IV Nutrient analysis of the nutrient enriched rusk

Nutrients	Test result for 100gm	
	Test Sample (Developed rusk)	Control sample (Commercial rusk)
Energy (Kcals)	407.41	325
Carbohydrate (g)	68.56	48.45
Total Protein (g)	17.49	6.8
Fat (g)	6.49	8.2
Fibre (g)	9.12	2.06
Iron (mg)	14.00	2.12
Calcium (mg)	134.69	34.16

Lohana et al., reported that bakery products are generally made up of refined flour that may be deficient in both fibre and essential fatty acids. In their study α-linolenic acid and fibre enriched rusk using flax seeds and finger millet were developed. The proportions of finger millet, flax seed and flours were optimized using Response Surface Methodology (RSM). On the basis of fibre and ALA content and baking quality characteristics of rusk 13.13%, 6.0% and 80.6% of finger millet, flax seed and flours, respectively were finalized. The developed rusk contained 4.81% fibre and 1.36% α-linolenic acid. Wet and dry gluten content, SDS sedimentation, falling number, dough raising capacity of yeast and baking time of mixed flour of these components were statistically ($p>0.05$) similar to that of flour (control). However, higher loaf weight and lower loaf height were observed in mixed flour rusk in comparison to control rusk. α-linolenic acid and fibres enriched rusk was developed with similar quality parameters and improved functional properties [5].

The highly scored variation of wheat rusk underwent nutrient analysis which includes energy, carbohydrate, protein, fat, fibre, calcium and iron by using standard test protocols of the AOAC method. The fortified rusk was found to be rich in calcium and iron because beetroots are an excellent source of folic acid and a very good source of fibre, manganese and potassium. The leaves of *Moringa oleifera* are rich in minerals like calcium, potassium, zinc, magnesium, iron and copper. Vitamins like beta-carotene of vitamin A,

vitamin B such as folic acid, pyridoxine and nicotinic acid, vitamin C, D and E are also present in *Moringa oleifera*. From the above table, it was clear that the nutrient composition of the developed rusk was high compared with the commercially available rusk. The nutrient analysis revealed that the developed rusk comprises energy 407.41kcals, carbohydrates 68.56g, Protein 17.49g, fat 6.49g, fibre 9.12 g, Iron 14mg, and calcium 134.69mg which was found to be enhanced when compared to commercial rusk.

3.4 Microbial growth of developed enriched rusk

Shelf life is most influenced by several factors: exposure to light and heat, the transmission of gases, humidity, mechanical stresses, and contamination by micro-organisms. Microbiological analysis is important to determine the safety and quality of food. The total plate count was carried for the developed rusk. The developed rusk samples were stored in air-tight containers. The total plate count of the sample was estimated on the first day and finally after three months. The stability of the product was done by microbial analysis. The total plate count was analyzed initially and after 90 days (storage period at room temperature). The samples were stored in an airtight container. Without any added preservatives, no bacterial growth was found in the analysis after 90 days. Hence the product was safe for consumption. So, from the above result, we can conclude that the newly developed rusk is safe for consumption if it is stored properly.

3.5 Labeling and Packaging of nutrient enriched rusk

Today, it is required that they fulfill not only distinctive and promotion functions, but they should be carriers of commercial, educational and warning information. Hence, the nutri-enriched rusk was labeled with the information on nutrient content, cost of the product, manufactured and expiry date. Although the individual components of laminates and metalized films are technically recyclable, the difficulty in sorting and separating the material precludes economically feasible recycling. The developed nutri-enriched rusk was packed in aluminum foil packaging and they were sealed.

3.6 Consumer acceptance of formulated rusk

Use of refined flours in baked products is realized to be harmful to the body. However, refined flours cannot be totally done away with, owing to their functional qualities. Recent efforts in baking industry has been on incorporating composite flours of nutritional signicance [6].

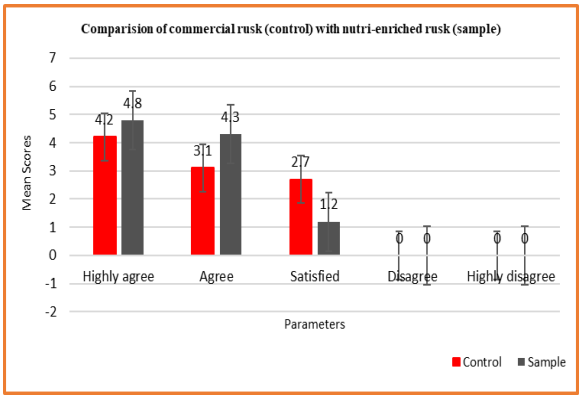

Figure 1. Consumer acceptance of formulated rusk

The highly scored nuti-enriched rusk was assessed for consumer acceptance through sensory valuation by 30 consumers (residents at Kovaipudhur, Coimbatore) compared with commercially available rusk made with refined flour. The consumer acceptance of the nutri rusk was calculated by five points hedonic scale and was presented in the below figure. From the graphical representation, it is clear that the test sample (nutri-enriched rusk) obtained high score when compared to the control (commercially available rusk made with refined flour).

4. CONCLUSION

It has been observed that the developed rusks were a good source of iron and fibre with excellent processing and storage stability. With time the market demand changes which, leads to new and innovative products. The leaves of moringa are used as a vegetable. The leaves are rich in protein, β-carotene, iron, calcium and fiber. Tender moringa leaves are used in dhal, soup, salad and as a substitute for spinach. The leaves also possess many medicinal properties. Traditional food could be replaced by reformulated traditional functional food products which, in the present study was achieved with whole wheat flour, beetroot and drumstick leaves powder with soy flour. The enriched Rusks have enhanced quality characteristics and sensory properties than the control sample and potentially provide more variety and health attributes to the human population, especially to menopausal women. Also, there is a need for such products in the

market as the burden of disease is increasing day by day. Mineral fortification and essential amino acids in addition to the bakery products will also be carried on in future research.

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