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Formulation of Functional Multigrain Bread and Evaluation of their Health Potential

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A B S T R A C T

In the present investigation, an effort has been made to prepare functionally enriched multigrain bread. The multigrain grain bread was composed of wheat and germinated kodo millet seeds (multigrain flour) in different ratios (30:70, 40:60, 50:50, 60:40 and 70:30). Among these, 50:50 ratio was standardized for further studies. Two sets are formulated i.e. Control and Set A. The nutritional evaluation of this product when compared with the commercial wheat bread was found out to be very rich in proteins, fibers and antioxidants. The sensorial study showed high acceptance of Set A compared to Control. Thus, proving it to be a better product for health conscious consumers.

Introduction

Bread has been regarded for centuries as one of the most popular and appealing food product both because of its relative high nutritional value and its unique sensory characteristics (texture, taste, and flavor). In recent years, with the increasing urbanization as well as the advancement in baking technology and changing food habits, the bakery food products such as bread are now becoming popular in urban and semi urban areas of the most developing countries (Aggarwal, 1990). The objective of supplementing alternative ingredients in bread formulation is to improve the nutritional value of wheat flour particularly proteins, minerals, vitamins and dietary fibre (Hallen *et al.*, 2004). One of the most important cultivated species includes Kodo millet (*Paspalum scrobiculatum*) which is grown primarily in India. It is a very hardy crop that is drought tolerant and can survive on marginal soils where other crops may not survive, and can supply 450–900 kg of grains per hectare. Thus millets have great potential for being utilized in different food systems by virtue of their nutritional quality and economic importance. However, Recognition of the beneficial nutritional attributes of this crop grains due to the complementarily of their essential amino acids with those of wheat has led to world-

wide attempts to fortify traditional wheat bakery products, such as bread with locally grown unexploited grains (Patel and Rao,1995) Several studies about the influence of the addition of cereal flours such as sorghum, maize and barely, as well as rich lysine legumes, on the physicochemical properties of bread dough and its final products quality have been reported in the last three decades. (Gayle *et al.,* 1986; Shefali and Sudesh, 2001; McWatter *et al.,* 2004).

Formulation of composite flour is vital for development of value added products with optimal functionality (Rehman *et al.,* 2007). A variety of wheat flour substitutes such as soy or defatted soy flour (Junqueira *et al.,* 2008), defatted wheat germ (Arshad *et al.,* 2007), flax seed (Koca and Anil, 2000), sunflower seed (Skrbic and Filipcey, 2008), chem- pedak seed flour (Mardiana, 2008), and rice bran (Sharpe and kitchen, 1990; Sharma and Chauhan, 2002) have been tried in bakery formulation with varying success.

Therefore there is an enormous scope growing in this crop to explore the technological possibilities of its utilization in food industry for the preparation of various food products. However, an increasing number of individuals are suffering from celiac disease (CD), the life-long intolerance to the gluten fraction of wheat, rye and barley. In particular, celiac patients are intolerant to some cereal prolamins containing specific toxic oligopeptide sequences. The gliadin fraction of wheat, secalins of rye, hordeins of barley, and possibly avenins of oats are involved in the CD mechanism. There is an enormous scope of exploring the technological possibilities of the utilization of kodo millets in food industry for the preparation of various healthy food products (Sharma *et al.,* 2017). The aim of this work was to evaluate the nutritional pattern of gluten free breads regarding their chemical composition in order to determine their contribution to the daily intake of nutrients. An attempt has been made to formulate the product which is gluten free and highly nutritious in nature.

Materials and Methods

Collection and processing of grain sample

Kodo millet grains were collected from different districts of Himachal Pradesh i.e. Kangra, Mandi and Hamirpur and brought to the laboratory. All samples were segregated, cleaned and stored in air tight containers. Malting was done by germination of kodo millet seeds at 25-30˚C under dark place. The pooled grains (native and malted millet grains) were grinded in a mixer to get whole flour of 1.0 mm sieve size and used for the preparation of multigrain bread.

Phytochemical analysis of millet grains

The aluminium chloride method was used for the determination of the total flavonoid content of the sample (Madaan *et al.,* 2012). The concentrations of flavonoid in the test samples was calculated from the calibration plot and expressed as mg quercetin equivalent /g of sample. DPPH (2, 2-diphenyl-1-picrylhydrazyl) was used as a source of free radical (Brand *et al.,* 1995). The amount of total phenols in the sample was determined with the Folin-Ciocalteau reagent according to method of Bray and Thorpe (1954).

Formulation of multigrain bread

Composite flour

Multigrain flour was prepared by combining wheat and kodo millet in different ratios i.e. 30:70, 40:60, 50:50, 60:40 and 70:30 (wheat: kodo millet). Among these, 50:50 ratio of wheat and kodo millet was standardized for further studies.

Preparation of dough and fermentation

Ingredients

Millet flour: 50 g
Wheat flour: 50 g
Yeast: 1 mg
Sugar: 10 g
Salt: 5 g
Oil: 10 ml

Recipe

Nutritional evaluation of multigrain bread

Proteins, crude fats, carbohydrates, crude fibers and antioxidants were measured as per different standard methods (Ranganna, 1990; Folch, 1957; Sadasivam and Manickam, 1992; Brand *et al.,* 1995).

Sensorial Evaluation

Nine point hedonic scale method as given by Amerine *et al.,* (1965) was followed for conducting the sensory evaluation of multigrain bread. The panel of 10 judges was selected to evaluate multigrain bread.

Statistical analysis

Data pertaining to the physicochemical attributes was analyzed by Completely Randomized Design (CRD) and sensorial evaluation of multigrain bread was analyzed by Randomized Block Design (RBD) as described by Mahony (1985).

Results and Discussion

Multigrain bread of kodo millet was prepared by mixing wheat and kodo millet in different ratios. Standardization of different ratios of wheat: kodo millet i.e. 30: 70, 40: 60, 50: 50, 60: 40, 70:30 has been done. Baker's yeast i.e. *Saccharomyces cerevisae* was added at the rate 10^8 cfu/ml. The best ratio was selected on the basis of its physical attributes and 50:50 was finally selected shown Table 1. It has been shown in the results that addition of high level of kodo millet in the wheat flour will lead in decrease in softness and appearance of the bread as shown in Plate 1. Similar studies had shown the same effect, where, Mathews *et al.,* (1970) mentioned that substituting high levels of sunflower flour resulted in deterioration of crumb colour and texture of the bread.

Table 2 represents the comparison of multigrain bread (kodo millet: wheat) with the commercial, wheat bread and the multigrain bread had been found to be rich in vital nutrients i.e. proteins, fats and overall contents as compared to the wheat bread. When nutrient facts were compared with commercial wheat bread, it has been observed that kodo millet multigrain bread had much higher proteins fiber and antioxidants as compared to commercial wheat bread. Thus, proving it to be a better product for consumers. Clopicka *et al.,* 2012 examined the phenolic contents of different kinds of flour and breads, and were expressed as mg gallic acid per gram of dry weight. Buckwheat flour had the highest phenolic content (7.25-0.23 mg/g) and the next one was wheat (6.96-0.11 mg/g dw). Amaranth and quinoa flour had the lowest phenolic content (2.71-0.1 mg/g and 2.8- 0.1 mg/g, respectively) and the differences between them and the former two were statistically significant.

Karwe *et al.,* (2003) observed lower content of total phenolics in buckwheat white, raw flour, but higher content of total phenolics of buckwheat dark, raw flour in comparison with phenolic content in our buckwheat flour. Consistently with the above results, the content of phenols in breads was highest in breads baked with 30g/100g addition of buckwheat flour (2.65-0.10 mg/g).

Table.1 Standardization of different ratio of wheat and kodo millet based on physical attributes

Sr. no.	Ratios (wheat: kodo millet)	Colour	Texture	Taste	Appearance	Softness	Mean
1	30:70	2	1	2	1	1	1.4
2	40:60	2	1	2	1	2	1.6
3	50:50	3	2	3	2	3	2.6
4	60:40	1	2	3	2	2	2.0
5	70:30	1	2	2	2	2	1.8

1: poor
2: fair
3: good

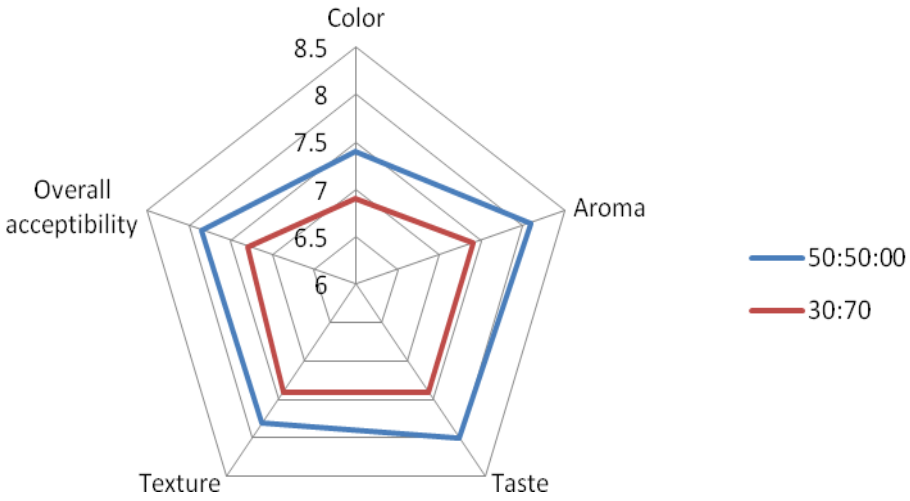
Table.2 Nutritional chart of multigrain bread (kodo millet: wheat) and wheat bread

Parameters	Nutritional facts per 100 g		t-test
	Multigrain bread	Wheat or whole bread* (commercial)	
Proteins (g)	9.7	3.0	165.72
Carbohydrates (mg/g)	80	144	9.89
Crude fibers (g)	21	-	75.7
Fats (g)	1.5	1.0	15.3
Total phenols (mg/ g)	6.13	-	22.07
Flavonoids (µg/ ml)	2.2	-	39.66

*: calorieking.com

Plate.1 Multigrain bread [Wheat: Kodo millet (50: 50)]

Fig.1 Sensorial evaluation of multi grain bread



Flow chart for preparation of multigrain bread

Multigrain flour

[50:50 (wheat: kodo millet)]

Salt (5 g) → ← Sugar (10 g)

Yeast (10^8 cfu/ml) → ← Oil (10 ml)

↓

Knead (water, 100 ml)

↓

Fermentation (37˚C, 2 h)

↓

Baking

(450˚F for 30 min)

The sensory evaluation showed maximum acceptability of Set A compared to control as it scored 8.1 out of 10.

The results showed a significant effect of different treatments on sensory attributes in gluten free bread as shown in Fig1. The novel functionally formulated multigrain bread have been shown to have high nutritional value along with other exceptional health benefits due to high antioxidants as compared to white bread as supported by sensorial evaluation thus fulfilling the quantitative traits or attributes proving its high market potential.

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