International Journal of Agriculture Sciences
ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 8, Issue 57, 2016, pp.-3110-3114.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

DEVELOPMENT OF COMPOSITE FLOUR BREAD AND ITS EFFECT ON PHYSICAL, SENSORY AND NUTRITIONAL CHARACTERISTICS

DHANIMSETTI SANKARARAO[1*], KOTHAKOTA ANJINEYULU[2], RANASALVA N.[2], BODHANKAR H. B.[3] AND CHAVAN P. D.[3]

[1]Vasantrao Naik Marathwada Agricultural University, Krishinagar, Parbhani, 431402, Maharashtra
[2]Kelappaji College of Agricultural Engineering and Technology, Kerala Agricultural University, Thavanur, Kerala, 679473
[3]College of Food Technology, Naigaon, Vasantrao Naik Marathwada Agricultural University, Krishinagar, Parbhani, 431402, Maharashtra
*Corresponding Author: Email-sankarfst06@gmail.com

Received: September 01, 2016; Revised: November 12, 2016; Accepted: November 13, 2016; Published: November 24, 2016

Abstract- The composite flour bread would be a healthy alternative for wheat flour bread. This study was conducted with a view of producing fortified wheat flour bread to increase the nutritive value of wheat flour bread. The soya bean, ragi and flax seed flour were composited with different fortification levels. The whole wheat flour was fortified with 15, 20 and 30% with equal ratios of all the three flours. The fortified bread was evaluated for its nutritional, sensory, physical characteristics with control bread prepared from wheat flour. The bread characteristics like loaf expansion, specific volume, crust colour and crumb firmness showed bread fortified with 15% composite flour was comparable with control bread. The sensory analysis again revealed that bread fortified with 15% of soya bean, ragi and flax seed flour was as good as control bread.

Keywords- *Fortified bread, Soyabean, Flax seed, Ragiflour.*

Citation: Dhanimsetti Sankararao, et al., (2016) Development of Composite Flour Bread and its Effect on Physical, Sensory and Nutritional Characteristics. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 8, Issue 57, pp.-3110-3114.

Academic Editor / Reviewer:

Introduction

Bread is a staple food prepared by cooking dough of flour and water and often additional ingredients. Bread being a FMCG (Fast Moving Consumer Good), need to have consumer acceptability for better marketing. Scientifically Bread is "soft and, like many other foodstuffs, is comprised, at a macroscopic level, of two phases- a fluid (air) and a solid (cell wall material)" [1,2].The commonly used flour for the bread preparation is wheat flour due to its high gluten content which makes the bread to expand and gives good acceptable texture for bread. An increased consumer demand for healthy bread has led to considerable efforts to develop breads that combine health benefits with good sensory properties. Fortified food the term given to those food with enriched nutrition than in commonly available. Fortification of bread with other healthy flour increases the nutritive value also consumer acceptability. The common white bread contains only wheat so people getting only one specific nutrient, grains are a part of human diet for about 10,000 years. Grains are the most important food source of Indian population, due to this carbohydrate consumption constitutes approx. 60-70% of total food intake. Varieties of grains are available in India, and different grains form staple diets of people in different part of the country. Whole grains are now recognized as an important source of fiber and other nutrients like trace minerals and vitamins [3].

Soybeans have been widely recognized for their health benefits for some time, while other functional foods such as flaxseed have only more recently come under investigation for their potential health benefits. Soybeans contain 30 to 45% protein with a good source of all indispensable amino acids .The protein content of soybean is about 2 times of other pulses, 4 times of wheat, 6 times of rice grain, 4 times of egg and 12 times of milk. Soybean has 3% lecithin, which is helpful for brain development.The use of small amounts of soy flour in bread increases water absorption and bread moisture, resulting in increased yield, decreased cost, and increased shelf life.

Finger millet (*Eleusinecoracana*) also known, as 'ragi' is popular millet in India, consumed without dehulling. It is the principal food grain of the rural population belonging to low-income groups in the Southern region. At present finger millet is usually used for preparation of flour, pudding, porridge and roti [4,5]. Ragi is considered to be ideal food for diabetic individuals due to its low sugar content and slow release of glucose/sugar in the body [6,7]. Ragi products are consumed in various states of the southern region. It is used to make flat breads (named bhakari), dosa and rotis. Ragi grain is malted too and mixed with milk, water or yogurt and used at breakfast time. The sprouted ragi is used to make baby food. It is also useful for elderly people as it is easy to digest. It contains high fiber, proteins, calcium, B complex vitamins and also vitamin E. It is rich in minerals and helps in lowering cholesterol [3]

Flaxseed *(Linumusitatissiumum)* also known as linseed, is thought to be one of the world's oldest cultivated crops with evidence of cultivation dating back thousands of years. Typically, flaxseed contains 42 to 46 percent fat, 28 percent dietary fiber, 21 percent protein, 4 percent ash, and 6 percent carbohydrates. Flaxseed fat has a very healthy fatty-acid profile, with low levels of saturated fat, moderate levels of monounsaturated fat and high concentrations of polyunsaturated fatty acids (PUFAs).

Fortified foods come into the spot light for this reason. Consumption patterns of Indians change as new health information about certain foods becomes available. Fortified foods have a positive effect on health when consumed on a regular basis as part of a varied diet.The present study was therefore undertaken with the intention to formulate and develop functional bread with soy flour, flaxseed flour, ragi flour. The sensory, nutritional and physical properties were evaluated for the formulated bread.

Materials and Methods

The present investigation was carried out in Soyabean, flaxseed, and ragi seeds were procured from local market. Seeds were cleaned and ground in hammer mill in laboratory. Sugar, maida, shortening, yeast, was procured from local market Parbhani.

Table-1 *Process parameters for fortified bread*

Independent variables	Dependent variables
• Percentage of soybean, ragi and flax seed flour with wheat flour (15, 20 and 25%). All the three flours are mixed in equal proportion. T_0 – Control T_1 – 15% Fortified flour T_2 – 20% Fortified flour T_3 – 25% Fortified flour	• **Physical characteristics of bread** -Loaf volume, Specific Volume, Crust Colour, Crumb firmness • **Nutritional composition of bread** -Moisture, Crudeprotein, Crude fat, Crude fibre, Carbohydrate and Ash content • **Sensory quality attributes** - Colour and appearance, Texture and grain, Flavour, Crispiness, Taste and Overall acceptability

Formulation and preparation of bread

The breads were prepared in the Bakery pilot Plant of the College of Food Technology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, using straight dough method [8]. The common procedure used for preparation of bread is outlined and mentioned in [Fig-1]. The process parameters taken into concern for the dependent and independent variables of the bread are presented in the [Table-1].

Sieving and Mixing of ingredients along with Soyabean, Ragi, and Flaxseed flour with 1% improver

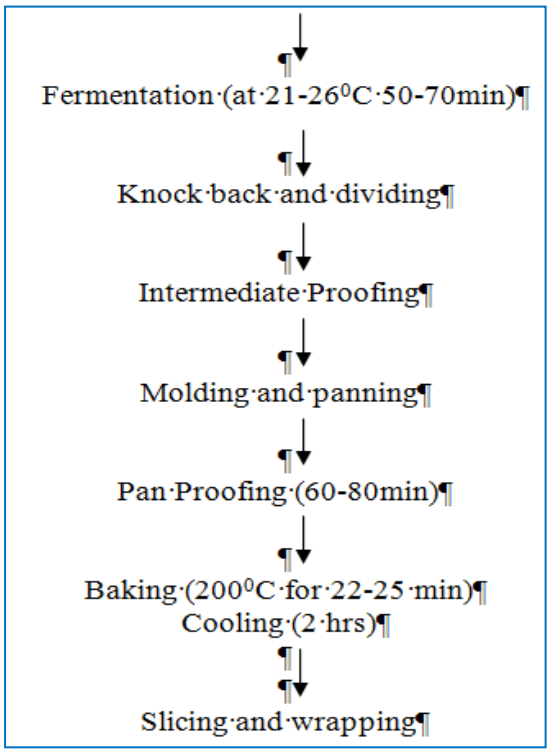

Fig-1 Flow chart for preparation of bread

Loaf and specific volume

The loaf and specific volume was determined by [9], method. The loaf was cooled for 3hrs and its volume was measured using the rapeseed displacement method. Each loaf was put in a container and covered with rapeseed to fill the container. The volume of seed displaced by loaf was considered as loaf volume. The specific volume of bread was calculated using the below [Eq-1].

Loaf specific volume = Loaf volume (cc) / Loaf weight (g) in cc /g ...[Eq-1]

Crumb to crust ratio

It was determined by separating crust and crumb using sharp blade and weighing each component as described by[10].

Moisture content

Moisture content of fortified bread was found by weighing 5g sample accurately and subjecting it at 105°C temperature for 4-6 hrs. Oven dried samples were cooled in desiccators and weighed. The resultant loss in weight was calculated as percent moisture content. [11].

Crude Fat

Crude fat was determined by taking 5 g bread sample in thimble and defatted with n-hexane (boiling point 68-720C) in soxhlet apparatus for 8hrs. The resultant extract was evaporated and crude fat content was calculated as per [11].

Crude protein

Protein was estimated by Microkjaldhel method using 0.5g of moisture free defatted bread by digesting with concentrated sulphuric acid at 130-140˚C. Then it was distilled with 40 per cent sodium hydroxide and liberated ammonia was trapped in 4 per cent boric acid, using mixed indicator (methyl red : Bromo-ceresol green 1: 5). It was then titrated with 0.1N hydrochloric acid; the percentage nitrogen was estimated. The protein percent was calculated by multiplying percent nitrogen with 6.25 [11].

Crude Fiber

Crude fibre was determined according to [11]. 2 g fat free bread residue was taken and digested with 200 ml boiling sulphuric acid for 30 min. Then it was filtered and washed with hot water or potassium sulphate solution. The residue was returned to digestion flask by washing with hot water, 200 ml boiling sodium hydroxide was added and boiled for 30 min and filtered. The residue was transferred into crucible and washed with 15 ml alcohol and kept for drying at 110°C for 2 hrs. The crucible was cooled in desiccators and weighed. The crucible was ignited in the furnace at 550°C for 30 min. then cooled and weighed. The loss in weight represented the crude fibre.

Total ash

Total ash was determined according [11]. Sample (5g) was weighed into a crucible and burnt completely at low flame till all the material became smokeless. Then it was kept in muffle furnace for 6 hrs at 600°C, cooled in desiccators and weighed. The sample was again put in muffle furnace at 550°C till two consecutive weights were constant and per cent ash was calculated.

Total carbohydrate

Total carbohydrate of bread was determined by standard procedure using phenol and sulphuric acid AOAC (1990). Sample (500 mg) was mixed with 2 ml of 72 per cent H_2SO_4. Then the volume of solution was made to 23 ml with distilled water. The sample was refluxed in water bath at 90 + 5°C for 3 hr. The standard curves was prepared using standard glucose solution corresponding to 0.2, 0.4, 0.6, 0.8 and 1 µg of glucose. The intensity of colour was measured at 480 nm by spectrophotometers. From the standard curve, the concentration of total sugar was calculated.

Texture Profile Analysis

TA-XT.PLUS Texture Analyzer (Stable Micro System, Surrey, UK) was used for texture profile analysis (TPA) of fortified bread prepared at different levels of soy flour, flaxseed flour and ragi flour. The crumb firmness was the major parameter found using texture profile analysis. The details of the test setting are given below:

Sensory evaluation of fortified bread

Freshly prepared bread was evaluated for sensory characteristics color, flavor, taste, texture and overall acceptability at room temperature in sensory evaluation laboratory by semi trained 50 judges, comprised of college department and academic staff members of the faculty on 9-point Hedonic Scale.

Statistical analysis

The analysis of variance of the data obtained was done by using Completely Randomized Design (CRD) for different treatments as per the methods given by [12]. The analysis of variance revealed at significance of P< 0.05 level, S.E. and C.D. at 5 % level is mentioned wherever required.

Results and Discussion

The present investigation was conducted with the objective to study the effect of addition of soy flour, flaxseed flour and ragi flour on chemical, nutritional, textural and sensory characteristics of bread. The study was focused on standardizing the concentration of multigrain flour in bread to a level of acceptable quality.

Physical Characteristics of Fortified Bread

The effect of adding of fortified flours at different levels in bread preparation and on its physical characteristics is presented in [Table-2].

Table-2 *Effect of adding bread improver on physical characteristics of fortified bread*

Sample	Loaf Volume (ml)	Specific volume(cm3/gm)	Crust to crumb ratio	Crumb firmness (g force)
T_0	740	3.15	0.280	1.20
T_1	735	3.18	0.280	1.20
T_2	720	3.18	0.295	1.20
T_3	700	2.80	0.265	1.10
SE +	11.72	0.056	0.054	0.02
CD at 5%	34.53	0.165	0.159	0.07

Loaf and Specific volume of fortified bread

The [Table-2] indicated that addition of bread improver increased physical qualities significantly and scored almost equal to the control sample. The loaf volume varied from T_0 (740 ml) to T_3 (700 ml). In general, addition of bread improver soft B-60 improved loaf volume to great extent in fortified bread. The loaf volume of T_1 (735 ml) was comparable that of control (740 ml). The loaf volume of T_2 and T_3 (720 ml) and (700 ml) respectively were also improved as compare to beads without improver.[13] also reported decrease in volume in flaxseed-soy flour bread. [14] Concluded that the substitution of hard wheat flour significantly decreased the loaf volume of pan bread. This can be attributed to lower level of gluten network in the dough and consequently less ability of dough to rise due to the weaker cell wall structure.

Specific volume of bread for control T_0 (3.15 cm^3/gm) to T_3 (2.80 cm3/gm). The specific volume was significantly increased over that of control sample. The specific volume varied for control (3.15cm^3/gm) to (3.18 cm^3/gm) in T_1 and (3.00 cm^3/gm) in T_2. It clearly indicates much improvement in specific volume of fortified bread. [15] also reported same that the specific volume decreased with increased incorporation of finger millet and foxtail millet. On the other hand [16] reported that adding 10 percent millet sorghum flour to the standard baking formula slightly increased loaf volume and improved crumb grain. Breads prepared by adding soy flour, flaxseed flour and ragi flour up to 5 percent produced bread with good loaf volume and specific volume and better grain structure compared to other treatments. The result of present investigation are in agreement with the findings of [16] who found that dough containing dough improver had higher values of specific volume compared to dough without improver.

Crust to crumb ratio in the present investigation was found to be decreased progressively and linearly highest crust to crumb ratio was found in control T_0 (0.280) followed by T_1 (0.276). Whereas, minimum was found in T_3 (0.245). It clearly indicates that addition of fortified flour up to 15% level do not affect adversely on crust to crumb ratio. However, further addition more than 15% affected adversely on crust to crumb ratio. The results of present investigation are in close agreement with the findings of [16] who reported that addition of flaxseed in wheat flour at 15 and 20% levels resulted in lower crust to crumb ratio as compared to control bread prepared by 100% wheat flour.

It is also clear from [Table-2] that crumb firmness increased progressively with increase in percent multigrain flour in composite bread. The control sample scored minimum T_0 (1.20 g force) followed by T_1 (1.30 g force) and maximum was found in T_3 (3.10 g force). The increased level of crumb firmness may be attributed to decreased aeration and compact texture of multigrain fortified bread, these findings are in close agreement with the work of [13] who reported that crumb firmness increased with increased concentration of soy and flaxseed in bread.

Sensory Quality of fortified bread

It is evident from the table that addition of soy flour, flaxseed flour and ragi flour reduced the score for almost all the parameters as compare to control. The color of the product decreased progressively with increasing level of multigrain flours. The color reduced from (8.50) T_0 control to (6.00) in T_3 treatment. It clearly indicates that addition of multigrain flours at higher level decreased the color score. However, addition of multigrain flour up to 15% was quite acceptable when compared to control sample. The decreasing color may be attributed to the reduction of reducing sugars in the composite flour, as reducing sugar present in flour caramelize forming a brown color on surface of the bread. The findings of present investigation are in close agreement with the findings of [17] who reported decreased color characteristics in baked loaf prepared from soy flour.

The flavor and taste of product also decreased progressively with increase in level of multigrain flour. The score for flavor and taste was highest in T_0 control (8.5 and 8.5), where as the lowest score was in T_3 treatment (6.00) and (6.5) for flavor and taste respectively. The decrease in flavor and taste at higher levels of multigrain flour maybe assigned to the presence of disagreeable be any and nutty flavors in soybean flour and flaxseed flour respectively. Similar, observation with respect to taste and flavor were also reported by [17] who found that the flavor of soybean supplemented breads did not differ significantly up to the level of 10 percent.

The textural properties showed significant difference among all the treatments, the textural properties of all the treatments decreased progressively with increase in level of fortification with multigrain flours. Maximum textural score was secured by control T_0 (9.0) while minimum score was observed in T_3 (6.50). The score obtained by T_1 sample (8.50) was quite comparable to the control sample. The decrease in score for textural qualities of multigrain flour may be assigned to the higher levels of fiber in the composite flour as fiber interfere with development of proper gluten during fermentation process. Similar, results with respect to textural qualities were also reported by [17] found that increase in addition of soy flour decreases textural properties of bread.

In general, overall acceptability of fortified bread decreased progressively with increase in percentage of multigrain flour in the bread. The overall acceptability was highest in control (8.50) followed by T_1 (8.00), T_2 (7.50) and minimum was in T_3 (6.50). Among various treatments, the acceptability of T1 was almost comparable to control for sample.

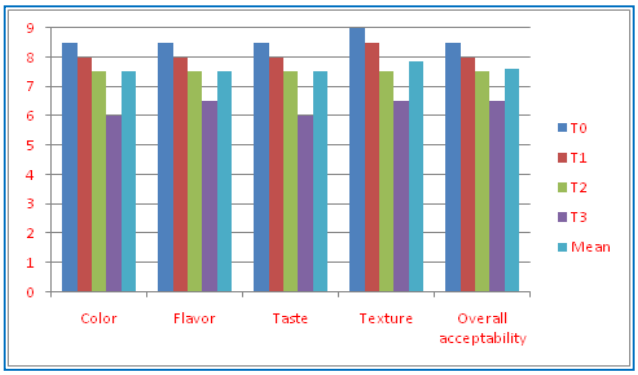

Fig-2 Bar Chart Representing Sensory Evaluation of Fortified Bread

Texture Profile Analysis of Fortified Bread

Texture of bread is one of the most important criteria, which shows the freshness, quality of bread. The hardness, springiness, cohesiveness and chewiness of the all bread samples were analyzed by using Texture Analyser TA-XT.PLUS (Stable Micro Systems, Surrey, UK) that applies mechanical compression on the foodstuff and generates a deformation curve of it response. Texture profile analysis is "two-bite" test, which includes the first and second compression cycles. One slice of bread with 25mm thickness is with 6.25 compression distance. Three

measurements per loaf for a replication were recorded and three replications were done per batch.

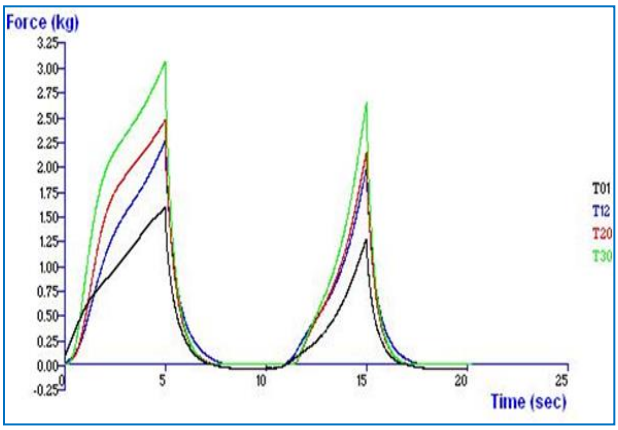

Fig-3 Texture measurement of all Fortified bread

Table-3 *Texture Profile of Bread prepared with different incorporation level of multigrain flour*

Sample	Hardness (kg)	Springiness	Cohesiveness	Chewiness (kg-sec)
T_0	1.581	1	0.424	0.670
T_1	2.256	1	0.553	1.247
T_2	2.467	1	0.470	1.159
T_3	3.057	1	0.443	1.354
SE ±	0.042	0.052	0.010	0.016
CD at 5%	0.125	0.154	0.029	0.047

* Each value represents the average of three determinations

The hardness of bread samples was increased significantly (P<0.05) and proportionally with the levels of Multigrain flour in the bread formulations. The values presented in [Table-3]. Ranged from T_0 (1.581 kg) to T_3 (3.057 kg). The increase in hardness might be attributable to higher water absorption of fibre-rich incorporated dough, which is explained by an interaction between water and hydroxyl groups of polysaccharides through hydrogen bonding [18]. The results in present investigation in agreement with the research of [13], where the hardness of baked products showed significant increase with increasing level of soya and flaxseed.

For springiness attribute, no significant differences (P>0.05) was found in bread samples added with Multigrain flour at 15, 20 and 25% as compared to the control. Similar results has been studied by [19] where no change in springiness observed. A slight decrease in cohesiveness was observed in bread samples of T_0, T_2 and T_3(0.424, 0.470 and 0.443 respectively) as compared to T_1 (0.553). The results of present investigation are in agreement with [19,20]

The results further showed that chewiness was found to be increased progressively with increase in level of multigrain flour in the composite bread as compare to control (0.670 kg-sec), with increase in level of multigrain the chewiness increased from T_1(1.247 kg-sec) to T_3 (1.354 kg-sec). This may be attributed to the dilution of wheat gluten with increased proportion of other flours. This might be weakening the strength of gluten. The results of present investigation are approximately similar to findings of [21].

Control Sample **Sample T_1** **Sample T_2** **Sample T_3**

Fig-4 Bread Fortified with Different Levels of Multigrain Flour Proximate composition of Fortified Bread

In order to investigate the significance of addition of different levels of multigrain flour on nutritional quality characteristics of fortified bread, it is necessary to investigate the effects on chemical composition like moisture, protein, fat, carbohydrate, crude fiber, ash of bread sample. [Table-5] summarizes the result on effects of different levels of multigrain flour fortification on nutritional composition of bread.

Table-4 *Proximate composition of Fortified Bread*

Name	Moisture (%)	Crude Fat (%)	Crude Protein(%)	Ash(%)	Dietary Fibre(%)			Carbohydrate (%)
					Soluble	Insoluble	Total	
T_0	33.48	4.05	9.37	1.38	0.01	1.04	1.05	50.67
T_1	34.47	5.42	11.26	1.75	0.24	1.73	1.97	45.13
T_2	35.44	7.06	12.09	1.99	0.39	2.48	2.87	40.55
T_3	36.04	8.43	13.93	2.53	0.56	2.66	3.22	35.85
SE +	0.45	0.07	0.17	0.05	0.03	0.05	0.06	0.46
CD at 5%	1.32	0.22	0.50	0.14	0.09	0.11	0.18	1.35

The results for moisture content of breads prepared from different level of multigrain flour are presented in [Table-5] indicated that moisture content increased linearly with the increase in addition of multigrain flour. The results indicated that control bread sample T_0 showed lowest moisture content (33.48%). Sample T_3 showed the highest moisture content (36.04%) followed by T_2 (35.44%), T_1 (34.47%). Results of present investigation are well in accordance with those reported by [20] who quoted increased moisture content of finished bread may be a consequence of increased water absorption capacity of dough's due to addition of soybean flour, Because soy flour can retain large amounts of water during baking, each 1% addition of soy flour increases final bread moisture by 0.3 – 0.5%, This results in increased yield, decreased cost, and increased shelf life. The increase in moisture content with increase in level of dietary fiber, which may retain water by preventing evaporation during baking [22]. The increase in bread moisture may also reduce the rate of staling during storage.

The fat content was increased progressively from T_0 (4.05%) to T_3 (8.43 %) with increasing level of multigrain flour. The increase in fat content with increase in level of multigrain may be due to increased level of fat in the seeds selected for fortified bread. Similar results have been reported by Tariqul *et al.,* (2007) in preparation of bread by incorporation of soybean and by [22] in preparation of bread by addition of flaxseed at different levels.

The protein content was found to be increased progressively with increase in level of multigrain flour in bread. The protein content was increased to T_0 (9.37%) to T1 (11.26%), T_2 (12.09%) and T_3 (13.93%). Similar, results for increase in protein contain with incorporation of soybean have been reported by [24], for flaxseed [22] and similar results were investigated by in preparation of bread by incorporation of ragi at different levels.

The results pertaining to the total crude fiber content clearly indicated that fibre content was increased progressively with increase in level of multigrain flour in the composite bread. The total crude fiber content was increased from T_0 (1.05 %) to T_3 (3.22 %). Moreover, further investigation on soluble and insoluble fibre content of multigrain bread revealed that dietary fibre content increased linearly and showed highest in sample T_3 (0.56%), which is significantly higher than the control sample (0.01). Increase in soluble dietary fibre content of multigrain bread justify its suitability towards as consumption as nutritional bread. This may be due to increased level of fiber percent in the initial raw material used in preparation of multigrain bread. The results in present investigation are in close agreement with the findings of [23] for bread prepared with soybean flour. The ash content was found to be increased progressively for T_0 (1.38 %) to T_3 (2.53 %). This may be due to higher ash content in the grain used to add in multigrain bread. Similar findings were reported by [24] for soybean bread.

Conclusion

The soya bean, flax seed and ragi flour are utilized to produce fortified bread. The bread produced with different proportion of the mixed flour 15, 20 and 25% of equally mixed three different flour replaced with whole wheat atta flour was tested for its physical, nutritional and sensory attributes. The results showed bread with 15% fortification of multigrain flour exhibited good physical attributes like loaf volume, textural property, specific volume and crumb to crisp ratio. The nutritive values, fibre and ash, crude fat and protein content were high in 25% fortified bread with multigrain flour. But the loaf raising showed decrease in trend with increase in percentage of multigrain flour. The cost of the developed fortified bread was calculated to be Rs. 15 / 250 g. This fortified bread with added fibre and nutrient of 15% mix of soya, flax seed and ragi flour showed similar score and similar physical and textural properties when compared with control bread.

Acknowledgement: The financial support received from Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharastra.

Conflict of Interest: None declared

References

[1] Clark A.H. (1991) Structural and mechanical properties of biopolymer gels Royal Society of Chemistry, Cambridge pp. 322–338.
[2] Scanlon M.G., Sapirstein H.D and Fahloul D (1995) *Journal of Cereal Science,* 32 x pp. 235–243.
[3] Misra, Kavita Rastogi and Shashank R Joshi (2009) Whole Grains and Health: Perspective for Asian Indians JAPI • VOL. 57.
[4] Serrem C, KockH and Taylor J, (2011) *Int. J. Food Sci. Technol.,* 46, 74-83.
[5] Chaturvedi R. and S. Srivastava (2008) *J. Food Sci. Technol.,* 45(5), 443-446.
[6] Kang R.K., R. Jain and D. Mridula (2008) *Am. J. Food Technol.,* 3(1), 50-55.
[7] Lakshmi K.P. and S. Sumathi (2002) *Food Nutr. Bull.,* 23(3), 241-245.
[8] AACC (2000) Approved Methods of the American Association of Cereal Chemists, 10th Ed. AACC, St. Paul, MN, USA.
[9] AACC (2000) Official Methods of Analysis of AACC International, American association of cereal chemists, Washington D.C.
[10] Barett P., Evans L. and James B. (2005) Texture and viscosity in foods. Academic Press, New York. p. 1-23.
[11] A.O.A.C (2005) Official Methods of Analysis of the AOAC International, 18thed. Association of Official Analytical Chemists, Gaithersburg, MD.
[12] Panse G.V. and Sukhatme P.V. (1985) Statistical Method for Agricultural Workers. ICAR, New Delhi.
[13] Frank D.C. and F.D. Sarah. (2006) *Int. J. Food Sci. Technol.,* 41(2),95-101.
[14] Morad M.M., Doherty C.A and. Rooney L.W, (1984) *J. Food Sci.,* 49, 1070-1074.
[15] Chhavi A and Sarita (2012) Evaluation of Composite Millet Breads for Sensory and Nutritional Qualities and Glycemic Response meavlajiunatuiotrn 18 C(1):p 8-9
[16] Badi, S.M., R.C. Hosney and P.L. Finney (1976) *Cereal Chem.,* 53, 718-724.
[17] Tariqual Islam A.F.M, Choudhury M. G. F., Islam M. N. and Islam M.S. (2007) *Int. J. Sustain. Crop Prod.,* 2(6),15-20.
[18] MildnerSzkudlarz S., Zawirska-Wojtasiak R., Szwengiel A. and Pacyn´ ski, M. (2011) *International Journal of Food Science and Technology,* 46, 1485–1493.
[19] Lim J.Y. and Wan Rosli W. I. (2013) *International Food Research Journal,* 20(2), 799-804.
[20] Abdelghafor R.F., Mustafa A.I., Ibrahim A.M.H. and Krishnan P.G. (2011) t *Advance Journal of Food Science and Technology,* 3(1), 9-15, 2011.
[21] Riaz M. N. (1999) *Cereal Foods World,* 44(3),136-139.
[22] Nasar-Abbas S.M. and Jayasena V. (2012) *Quality Assurance and Safety of Crops and Foods,* 4, 41–49.
[23] Shahzad Hussain, Faqir Muhammad Anjum and Mohammad Saleh Alamri (2011) *Australian Journal of Basic and Applied Sciences,* 5(11), 978-983.
[24] Joel Ndife, L. O. Abdulraheem and U. M. Zakari (2011) *African Journal of Food Science,* 5(8), pp. 466 - 472.