Nutritional and Sensory Quality of Breads from Bread Wheat and Soybean Flour Blends

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Abstract

The present study was carried out to optimize wheat bread supplementation with different concentration levels of soybean flour. Standard methods were utilized to evaluate composite flour functional property, baking quality and sensorial analysis. Effects of different flour of soybean incorporation levels (0%, 10%, 20%, 30% and 40%) into completely floured wheat on bread nutritional and sensorial qualities were also evaluated. The results showed that soybean flour fortification up to 10% can be done without significantly ($p<0.05$) affecting the sensorial acceptability of the breads. At this incorporation level, crude protein, crude fiber, fat and ash contents of the breads were 8.8%, 20.9%, 13.75% and 81%, respectively, which were higher than the bread made from 100% whole wheat flour. However, further research work is required to determine the shelf stability of the enriched breads.

Introduction

Bakery foods are the major cereal products available to consumers. Bread may be described as a fermented confectionary product produced mainly from wheat flour, water, yeast and salt by a series of process involving mixing, kneading, proofing, shaping and baking (Dewettinck *et al*., 2008). The consumption of bread and other baked goods, such as biscuits, doughnuts and cakes produced from wheat flour. This is very popular, but the low protein content of wheatflour, especially after moving the germ and bran during wheat milling process, has been major concern in its utilization (Young, 2001).

The use of white flour is aimed at improving the aesthetic value of white bread. This has also led to the drasticreduction in the nutritional density and fiber content when compared to bread made from whole grain cereals (Maneju *et al*., 2011).

Recently, consumers' awareness of the need to eathigh quality and healthy foods known as functionalfoods, that is, foods that contain ingredients thatprovide additional health benefits beyond the basicnutritional requirements, is increasing (Ndife and Abbo, 2009). Consumption of whole grain is being practiced as researches showed the potential to reduce the risk of colorectal cancer, cardiovascular diseases, diabetes and obesity (Slavin, Topping, 2007). Moreover, use of composite flours for bread making is also recent development across the globe owing to some economic, social and healthreasons. Pulses are rich in essential amino acids, including lysine, threonine, isoleucine, leucine, phenylalanine and valine. They also have a good mineral profile containing K, Fe, Cu, Mg, Zn and Mn. Enrichment of bread and other cereal based confectioneries with legume floursparticularly in regions where protein utilization isinadequate has long been recognized.

Protein enriched wheat bread can be an important carrier of nutrition to vulnerable groups like pregnant and nursing mothers, young and school children in reducing the incidence of malnutritionand at the same time encourage the farmers to growmore soybeans due to the increased utilization. Therefore, the objective of this study was to formulate and develop functional breads from wheat flours composited with soya flour.

Materials and Methods

Sample collection and preparation

Refined wheat flour prepared for bread making was purchased from Chilalo Food Complex processing company. Soybean variety selected based on its highcontent of protein was collected from PaweAgricultural Research Center was used in this study. The soybean grain was cleaned from dirt by sorting out contaminants such as sands, sticks and leaves, andlater washed, sun dried and then roasted for further drying. The dried soybean was milled and sieved into fine flour to obtain almost similar particle size with the purchased wheat flour. Finally, the flourswere stored at 4^{o}C in airtight containers until use for further analysis.

Formulations for product development

Soybean flour was incorporated at inclusion level of 10% interval from 0 to 40% in the following ratios based on preliminary study:

T_1 = 100% Wheat flour + 0%soybean
T_2 = 90% Wheat flour + 10% Soybean flour
T_3 = 80% Wheat flour + 20% Soybean flour
T_4 = 70% Wheat flour + 30% Soybean flour
T_5= 60% Wheat flour + 40% Soybean flour
T_1…..T_5 = Treatments

Ingredients and formulations utilized under each treatment are presented in Table 1.

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Experimental Design

The nutritional analysis of samples was done in duplicates and the sensory evaluation was undertaken in triplicates. Completely Randomized design (CRD) for nutritional data as well as for sensory scores experimental design was used.

Flour functional properties

The effect of compositing wheat and soybean flour on flour water absorption Capacity was determined with the method followed by Ayinadis*et al*. (2010).25 ml of distilled water was added to a sample of 3g composite flour (W1) in a weighed centrifuge tube (W2) and stirred six times for 1 min at 10 min intervals (Model D-72, Andreas Hettichs, Germany). The mixture was centrifuged at 3000 rpm for 25 min and the clear supernatant was decanted and discarded. Pellets were dried at 50^{o}C for 25 min. The adhering drop of water was removed then reweighed (W3). The amount of water retained in the sample was recorded as weight gain and was taken as water absorbed. Water absorption capacity was expressed as the weight of water bound by 100 g dried flour.

$$\text{Water Absorption Capacity (g/g)} = \frac{W3-(W1+W2)}{\text{Weight of the sample}} \times 100$$

Swelling power and solubility of flours were assessed following the methods of Schoch (1964).

A known amount of sample (W1) was weighed in a centrifuge tube and weight recorded (W2). To this 20 ml, of distilled water was added (VE) and heated for 30 min in a water bath at 90°C with occasional stirring. The cooled content was centrifuged at 5000 rpm for 10 min. The supernatant was carefully decanted in a Petri plate (W4), dried at 105°C and weighed (W5).The inner side of the centrifuge tube which was been free from supernatant was wiped andweighed (W3).

$$\text{Swelling power (g/g)} = \frac{W3-W2}{W1} \times 100$$

$$\text{Solubility} = \frac{W5-W4\times VE}{VE\times W1} \times 100\%$$

Dispensability can be defined as the percentage by mass of the dry matter of the sample that can be dispersed in water.Disperse ability was determined by the method of Kulkarni (1991) as cited by Edema (2005). Ten g of flour sample was weighed into a 100 ml-measuring cylinder. Distilled water was added up to 100 ml volume. The sample was vigorously stirred and allowed to settle for 3hr. The volume of settled particles was recorded and subtracted from 100 to give a difference that was taken as percentage dispersesability.

Flour and bread proximate composition

Flour and bread moisture, protein and ash were determined through oven drying, kjeldahl digestion and gravimetric methods respectively as described in AOAC method (AOAC, 1990). The crude fat content of the samples were also measured by AOAC (1990) method.

Bread making

The bread type prepared from completely floured bread wheat, soy flour composite for the study was based on cultural Ethiopian bread type called ‘‘diffo’’, and the commonly known procedure was followed. The flow diagram showing the steps followed for dough preparation and bread baking is presented in Figure 1 below.

Soya bean
Sorting
Washing
Sun drying
Roasting
Milling to fine soya flour
Sieving (2mm) to uniform wheat flour
Mixing with ingredients (composite flour, water, yeast)
Soya flour Wheat whole flour
Mixing
Kneading
Shaping
Proving
Baking

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Sensory evaluation

Twenty Semi trained panelists was given a hedonic scale questionnaire to evaluate the bread using a9 points scale (1- extremely dislike to nine - extremely like). Bread appearance, crust color, aroma, taste, texture and overall acceptability were evaluated on the same day the breads were prepared. During sensory evaluation, panelists were instructed to drink water or rinse their mouths to clear the palate after each evaluation.

Statistical analysis

The analysis of variance (ANOVA) wasperformed to examine the significance level of allparameters measured. Least significant difference (LSD) test was used for means comparison. The level of significancewas declared at<0.05 and SPSS version 20.0for Windows (SPSS Inc, Illinois, USA) was used for the analysis.

Result and Discussion

Flour functional properties

The result of flour functional properties tested is depicted in Table 2. Water absorption capacity and solubility of the composite flours significantly ($p<0.05$) increased with increasing level soy flour addition level from 2.75g/g and 19.30% (100% whole wheat) to 2.94g/g and 26.04% (40% soy and 60% whole wheat).

On the contrary, disperseablity and swelling significantly ($p<0.05$) decreased with increasing level soy flour addition level from 75.5% and 2.61g/g (100% whole wheat) to 66.5%. 2.13g/g (40% soy and 60% whole-wheat).Water Absorption Capacity (WAC) represents the amount of water that can be absorbed per gram of composite flour sample showing the potential of the flour for making leavened products like bread. Swelling power and solubility index properties may influence the characteristics like baking volume.

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Flour and bread proximate composition

The proximate compositions of the whole wheat, soy, and the composite flours are depicted in Table 3. As expected the protein, fiber, fat and ash contents of the composite flours significantly ($p<0.05$) increased with increasing soy flour incorporation level.

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The proximate composition of the breads varied significantly ($p<0.05$) in similar trend with the composite flour where the protein, fiber, fat and ash contents of the composite flours significantly ($p<0.05$) increased with increasing soy flour incorporation level (Table 4). This indicates that blending with soy flour led to significant enhancement of both bread the nutritional quality and health benefit.The trend obtained in this study agrees with the report by Islam et al (2007) and Ndife et al., (2011).

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Sensory evaluation

Results of sensory evaluation of bread sample are shownbelow in Table 5. As compared to the control (100% whole wheat) significant (p<0.05) difference in the sensorial score of the breads started to appear when the soy flour incorporation reaches 20% (Treatment 3) and goes beyond. The darker color of the crumbs of whole wheat bread and fortified breads and biscuits have been reported by several authors (Singh et al., 2000; Akhtar et al., 2008; Serrem et al., 2011). The brownish bread appearance could be directly related to the increase in fiber content. Moreover browning of the breads could also occur due to caramelization and maillard reactions, as the protein contributed by soybean flour must have reacted with sugar during the baking process (Dhingra and Jood, 2001; Mohsen et al., 2009).

The scores for texture (softness and chewiness) of the composite bread samples, increased with increase in soybean flour substitution, when compared to whole wheat bread (control). The incorporation of soybean flour into whole-wheat bread resulted in poor flavor scores especially at higher incorporation level (≥20%). Like earlier report by Serrem et al. (2011) most of the panelist complained of beany flavor and aroma from the composite breads with soy-flour incorporation level. Treatment 5 (with 40% soy-flour incorporation) led to the lowest value of consumers' preferences. In soybeans, enzymatic break down by lipoxygenases or autoxidation of linoleic and linolenic acid produces hydro peroxides such as ketones, aldehydes and alcohols that may be responsible for the beany-flavour which discourages soy consumption (Mannay and Shadaksharaswany, 2005; Awadelkareem et al., 2008; Serrem et al., 2011). The sensory evaluation also revealed that bread with soy-flour substitution of 10% (Treatment 2) had almost equivalent sensorial score and overall acceptability with the bread made from 100% whole wheat flour (check).

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Figures followed by same letter (s) within a column are not significantly different at P>0.05.

Conclusion

From the present study, it is concluded that incorporating 10% soy flour to whole- wheat flour could be done without significantly affecting the sensorial quality of the bread. Compared to the bread made from 100% whole wheat flour (the check), 10% soya bean flour incorporated bread had 8.8%, 20.9%, 13.75% and 81% higher crude protein, crude fiber, fat and ash contents, respectively. However, further research work is required to determine the shelf stability of the enriched breads.

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