Effect of Functional Property and Anti-Nutritional Factor of Kocho- Flaxseed Flat Bread in Ethiopia

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2Department of Food Science and Technology, Haramaya University, Ethiopia

Abstract

Kocho is one of the main energy sources fermented products of Ensete Vetricosum and the most common food in southern Ethiopia. Study was designed to assess functional property and anti-nutritional factor of kocho-flaxseed flat bread. In order to investigate, two factors flaxseed varieties and blending ratio 95:05, 90:10, and 85:15 of kocho to flaxseed flour with control 100% kocho flour using completely randomized design. Result showed the functional properties were observed to have water absorption capacity (4.08, 4.26 and 4.43 ml/g); oil absorption capacity (2.48, 2.58, 2.40 and 2.65 ml/g); solubility values (3.90, 4.20 and 4.06%); Swelling power (5.03, 5.23 and 6.31%) in blending of kocho with flaxseed varieties of Belay 96, Jeldu and Kulumusa 1 respectively, having no significant difference (p > 0.05) between them and better performance from kocho flour W AC (2.52 ml/g), OAC (2.65 ml/g), solubility (1.50 %) and SP (8.88%). Effect of variety and blending ratios on antinutritional content of kocho breads were observed to significant difference (P < 0.05) due to flaxseed variety to have tannin and phytic acid content of Belay96 (6.97, 3.10 mg/g), Jeldu (6.44, 3.01 mg/g) and Kulumusa1 (6.66, 3.07 mg/g) respectively. Similarly, interaction between flaxseed variety and blending ratio had a significant effect (P < 0.05) on condensed tannin and phytic acid contents of the breads. hence, anti-nutritional factors were decreased as the quantity of flaxseed flour increased.

Keywords: Kocho; Flaxseed; Kocho-flaxseed bread; Functional property; Anti-nutritional factor

Introduction

Kocho are one of the main energy sources fermented products of Enset (Ensete Vetricosum) species of the separate genus of banana family and the most common traditional food in southern regions of Ethiopia [1]. It is baked as a form of thin bread with the application of heat. Kocho bread is provide a good source for calcium and iron minerals. It is poor in protein and fat contents and substantially improve by blending with nutrient rich food grains such as flaxseed [2]. Enset plant is cut before flowering, scraped the pseudo stem and leaf midribs, squeezed out the pulp (juice) and stored in a suitable pit for fermentation in several months, and finally baking of fermented steam to prepare a flat-bread. Fermented products of the enset plant are used to make different dishes such as thin, unleavened kocho bread (simply called kocho), bulla porridge (Genfo), a thick cooked bulla gruel (Atmit), and shredded flake made of a mixture of kocho and bulla (firfir). Fermentation decreases various nutrient content such as proteins, carbohydrates etc., possibly due to excessive leaching following the peak of microbial activity and a slight decrease of protein content but, at the same time, improved the quality of the lysine protein as determined by amino acid profiles [3]. The length of fermentation time varies from a few weeks or several months depending on ambient temperature of incubation. The chemical composition of kocho changes during the prolonged fermentation.


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ratio, and by the characteristics of amylose and amylopectin in terms of molecular weight/distribution, degree and length of branching, and conformation. Swelling power is a measure of hydration ability of starch granule and it is determined by weighing the swelled starch and retained water. A direct consequence of starch swelling is the increase of solubility, paste clarity and viscosity properties of interest, especially in food industry [11]. Therefore, this study was designed to assess the effect of functional property and anti-nutritional factor of kocho-flaxseed flat bread prepared from kocho flour blend with flaxseed variety.

Materials and Method

Experimental Area

The study experiment was conducted in 3 x 3 factorial design with three flaxseed varieties and blending ratio (95:05, 90:10, and 85:15) of kocho to flaxseed flour with control 100% kocho flour using completely randomized design and with three replications. The samples were taken from South West Shoa Worchit Woreda and three flaxseed varieties from Holleta Agricultural Research Center, Ethiopia. Three flaxseed varieties (Kulumsa1, Belay96 and Jeldu) samples were collected from farms at Holleta site with availability, agroecological (Kolla, welda Dega, and Dega) respectively. The sample were conducted at Haramaya University in Food Science and technology laboratory for functional property and anti-nutritional factors of kocho-flaxseed bread. The Experimental plan is shown in Table 1.

<table>
<thead>
<tr>
<th>Blending Ratio</th>
<th>Flaxseed Variety</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>B</td>
<td>S</td>
</tr>
<tr>
<td>10</td>
<td>B10</td>
<td>J10</td>
</tr>
<tr>
<td>15</td>
<td>B15</td>
<td>J15</td>
</tr>
</tbody>
</table>

Where: 5 = 5% flaxseed flour, 10 = 10% flaxseed flour, 15 = 15% flaxseed flour, K = Kulumsa 1 flaxseed variety, J = Jeldu flaxseed variety, B= Belay 96 flaxseed variety, Flaxseed Variety.

Sample preparation and processing

Preparation of flaxseed kocho bread: Kocho flour containing flaxseed of the desired proportion was mixed with potable water in a 1:1 (w/v) ratio and made into dough by hand kneading until a constant consistency was attained. The dough was immediately baked on a pre-heated baking griddle or plate. The baking time and the temperature of the unleavened bread was about 35 min and 155°C respectively.

Preparation of flaxseed kocho bread: Kocho flour containing flaxseed of the desired proportion was mixed with potable water in a 1:1 (w/v) ratio and made into dough by hand kneading until a constant consistency was attained. The dough was immediately baked on a pre-heated baking griddle or plate. The baking time and the temperature of the unleavened bread was about 35 min and 155°C respectively.

Analysis of Functional Property

Water absorption capacity (WAC): To 1 g of the sample, 10 ml of distilled water was added in a 25 ml centrifuge tube and agitated on a vortex mixer for 2 minutes. It was centrifuged at 4000 rpm for 20 minutes. The supernatant was decanted and the precipitate was washed by 20 mL of distilled water. The precipitate was digested by concentrated H2SO4 and H2O2 (30%) to converts phytic acid in to phosphate. The phosphate generated was analyzed by measuring the absorbance of phosphomolybdate blue generated on addition of ammonium molybdate [(NH4)6Mo7O24.4H2O]. Stock P solutions were prepared by taking 0.1 mg KH2PO4 in to 250 mL H2O. From the stock solution series of solutions (0, 0.2, 0.4, 0.6, 0.8, 1.0 and 1.2 ppm) was prepared for calibration curve (Figure 2).

Solubility and swelling powers: Solubility and swelling powers of the samples were determined in triplicate. 1 g of each sample was suspended in 10 ml of deionized water and heated at 90°C for 10 minutes. The supernatant was pipette in to a test tube containing 5 ml of Vanillin-HCl reagent. Absorbance at 450 nm was read on spectrophotometer after 20 minutes incubation at 30°C blank sample was also analyzed and its absorbance was subtracted from sample absorbance. A standard curve was also be prepared for catechin (0-1.2 mg/ml) Figure 1.

Phytic acid: Phytic acid was Analyzed through phytate phosphorus (Ph-P) analysis according to Wheeler and Ferrel [13]. About 0.25 g of flour sample was extracted with 12.5 mL of 3% trichloroacetic acid for 45 min in a water bath with vortex mixing at an ambient temperature (23°C) and centrifuged (4000 rpm/10 min). The supernatant was used for phytate estimation. About 4 mL of FeCl3 was added to 10 mL of the sample solution and centrifuged. The clear supernatant was carefully decanted and the precipitate was washed by 20 mL of 3% TCA, 0.2 M of HCl and 20 mL distilled water. The precipitate was digested by concentrated H2SO4 and H2O2 (30%) to converts phosphorus in to phosphate. The phosphate generated was analyzed by measuring the absorbance of phosphomolybdate blue generated on addition of ammonium molybdate [(NH4)6Mo7O24.4H2O].

where:

\[ \text{Phytic acid (mg/g)} = \frac{\text{Absorbance at 450 nm}}{\text{Concentration of sample used for absorbance reading}} \times 3.55 \]

Phytic acid was Analyzed through phytate phosphorus (i.e., phytate = P x 3.55). Phytate: mineral molar ratios were calculated using the molecular weight of IP6=660. Phyric acid content was calculated by the following formula:

\[ \text{Phytic acid (mg/g)} = \frac{\text{(Ph-P) x 100 x 3.55}}{\text{Sample mass (mg)}} \]

where: µg/mL is the concentration of sample used for absorbance reading.

Analysis of Anti-Nutritional Factors

Condensed tannins: Condensed tannin was analyzed by vanillin-HCl method of Price et al. [12] using the modified Vanillin-HCl methanol method. The Vanilli-HCl reagent was prepared by mixing equal volume of 8% concentrated HCl in methanol and 1% Vanilli in methanol. The solution of the reagent was mixed just before use. About 0.2 g of the ground sample was placed in small conical flask. Then 10 ml of 1% concentrated HCl in methanol was added. The conical flask was capped and continuously shaken for 20 min and the content then is centrifuged at 2500 rpm for 5 minutes. About 1 ml of the supernatant was pipette in to a test tube containing 5 drops of water were removed and the tube reweighed again.

where:

\[ \text{Tannins content was expressed as catechin equivalent as follows:} \]

\[ \text{Tannin(%) = } \frac{C \times 100 \times 100}{200} \]

Where: C = concentration corresponding to the optical density, 10 = Volume of the extract (ml), 200 = Sample weight (mg).

Phytic acid: Phytic acid was Analyzed through phytate phosphorus (Ph-P) analysis according to Wheeler and Ferrel [13]. About 0.25 g of flour sample was extracted with 12.5 mL of 3% trichloroacetic acid for 45 min in a water bath with vortex mixing at an ambient temperature (23°C) and centrifuged (4000 rpm/10 min). The supernatant was used for phytate estimation. About 4 mL of FeCl3 was added to 10 mL of the sample solution and centrifuged. The clear supernatant was carefully decanted and the precipitate was washed by 20 mL of 3% TCA, 0.2 M of HCl and 20 mL distilled water. The precipitate was digested by concentrated H2SO4 and H2O2 (30%) to converts phosphorus in to phosphate. The phosphate generated was analyzed by measuring the absorbance of phosphomolybdate blue generated on addition of ammonium molybdate [(NH4)6Mo7O24.4H2O].

where:

\[ \text{Phytic acid (mg/g)} = \frac{\text{Absorbance at 450 nm}}{\text{Concentration of sample used for absorbance reading}} \times 3.55 \]

Phytic acid was Analyzed through phytate phosphorus (i.e., phytate = P x 3.55). Phytate: mineral molar ratios were calculated using the molecular weight of IP6=660. Phyric acid content was calculated by the following formula:

\[ \text{Phytic acid (mg/g)} = \frac{\text{(Ph-P) x 100 x 3.55}}{\text{Sample mass (mg)}} \]

where: µg/mL is the concentration of sample used for absorbance reading.

Analysis of Functional Property

Water absorption capacity (WAC): To 1 g of the sample, 10 ml of distilled water was added in a 25 ml centrifuge tube and agitated on a vortex mixer for 2 minutes. It was centrifuged at 4000 rpm for 20 minutes. The supernatant was decanted and discarded. The adhering drop of water was removed and the tube reweighed again.

where:

\[ \text{WAC(%) = } \frac{\text{(Weight of tube + Sediment)} - \text{Weight of empty tube}}{\text{Weight of sample}} \times 100 \]

Oil absorbing capacity (OAC): To 1 g of the sample, 10ml of vegetable oil was added in a 25 ml centrifuge tube and agitated on a vortex mixer for 2 minutes. It was centrifuged at 4000 rpm for 20 minutes. The supernatant was decanted and discarded. The adhering drops of water were removed and the tube reweighed again.

where:

\[ \text{OAC(%) = } \frac{\text{(Weight of tube + Sediment)} - \text{Weight of empty tube}}{\text{Weight of sample}} \]

Solubility and Swelling Power: Solubility and swelling powers of the samples were determined in triplicate. 1 g of each sample was suspended in 10 ml of deionized water and heated at 90°C for 20 minutes. The supernatant was pipette in to a test tube containing 5 ml of Vanillin-HCl reagent. Absorbance at 450 nm was read on spectrophotometer after 20 minutes incubation at 30°C blank sample was also analyzed and its absorbance was subtracted from sample absorbance. A standard curve was also be prepared for catechin (0-1.2 mg/ml) Figure 1.
1 hour in a bath under constant stirrings. Then resulted suspension was cooled to 30°C and centrifuged at 4000 rpm for 15 minutes. The supernatant was decanted into aluminum dishes, and the swollen granule was weighed. The supernatant was dried at 110°C for 12 hours and the weight of dry solids was determined by Anderson et al [15].

The solubility was determined using the following formulas:

\[ \text{So(\%)} = \frac{\text{Weight of dried supernatant}}{\text{Weight of fresh sample}} \times 100 \]

The swelling power was determined using the following formulas:

\[ \text{Sp(\%)} = \frac{\text{Weight of sediment}}{\text{Weight of fresh sample} \times (100 - \text{So})} \]

Where: so is solubility, SP swelling power

Statistical Analysis

Triplicate data were analyzed using two factors analysis of variance (ANOVA) using SAS (Version 9.1; SAS Institute, Cary, NC, USA). DMRT was used for mean separation at P < 0.05.

Result and Discussion

Anti-nutritional Factors

The anti-nutritional factors of the kocho flour and of the flaxseeds are presented in Table 2. The Tannin content of kocho and those of Belay 96, Jeldu and Kulumusa1 were 11.98, 3.05, 2.77 and 2.39 mg/g, respectively. These values were statistically (P < 0.05) different from each other. Likewise, the phytic acid content of the flaxseed varieties and of the kocho flour were significantly (P < 0.05) different from each other. Kocho flour and flaxseed varieties Belay 96, Jeldu and Kulumusa exhibited phytic acid values of 4.85, 0.70, 0.57 and 0.62 mg/g, respectively. This is in agreement with the work of Tewodros etal [16] who reported the level of phytic acid of flaxseed flour.

Effect of flaxseed Variety and Blending Ratios on Antinutritional Content of Kocho Breads

The data of the tannin and phytic acid contents of the breads are shown in Table 3. Significant (P <0.05) differences were observed in tannin values due to variety with values of 6.97, 6.44 and 6.66 mg/g for breads having variety Belay96, Jeldu and Kulumusa1, respectively. These values are also significantly (p < 0.05) lower than that in the control sample. A decrease in tannin content was observed in the breads with increase in the flaxseed proportion. That was because flaxseeds generally had less tannin than kocho. The tannin content of the three varieties were reduced highly and the reasons for this reduction were processing condition and fermentation process which were known to dramatically reduce the condensed tannin levels of food [17,18]. The phytic acid content of the breads, also shown, differed significantly (P < 0.05) due to flaxseed variety. The values were 3.10, 3.01, and 3.07 mg/g for those substituted with varieties Belay96, Jeldu and Kulumusa1, respectively. The control sample showed higher (3.63 mg/g) value than the composite breads. Increase in proportion of flaxseed resulted in low of phytic acid content. Such phytic acid destruction is nutritionally important since it makes the minerals (Fe and Zn) bio available. Previous studies [19] on 100% grain teff injera also indicated a destruction of 91% to 93% phytic acid.

Functional Properties of Kocho Flour and Flaxseed Flours

Data of functional properties of kocho flour and flaxseed flour are presented in Table 4. The water absorption capacity of the flaxseed powder of Belay 96, Jeldu and Kulumusa 1 were determined to be 4.08, 4.26 and 4.43 ml/g, respectively, having no significant difference (p > 0.05) among them. These values, however, were significantly (p < 0.05) higher than the 2.52 ml/g of kocho flour. The oil absorption capacity of the flaxseed samples and of the kocho flour also exhibited significant differences among each other with value of 2.48, 2.58, 2.40 and 2.65 ml/g for Belay 96 flaxseed, Jeldu flaxseed, Kulumusa flaxseed and Kocho flour, respectively. Values of Jeldu flaxseed (2.58 ml/g) and Jeldu and Kulumusa1, respectively. The control sample showed higher (2.65 mg/g) value than the composite breads. Increase in proportion of flaxseed resulted in low of phytic acid content. Such phytic acid destruction is nutritionally important since it makes the minerals (Fe and Zn) bio available. Previous studies [19] on 100% grain teff injera also indicated a destruction of 91% to 93% phytic acid.

Table 2: Anti-nutritional contents of kocho and flaxseed flour.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Tannin (mg/g)</th>
<th>Phytic acid (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>3.05±0.03b</td>
<td>0.70±0.01b</td>
</tr>
<tr>
<td>J</td>
<td>2.77±0.12c</td>
<td>0.57±0.02d</td>
</tr>
<tr>
<td>K</td>
<td>2.39±0.01d</td>
<td>0.62±0.01c</td>
</tr>
<tr>
<td>Con.</td>
<td>11.98±0.19a</td>
<td>4.85±0.01a</td>
</tr>
<tr>
<td>CV</td>
<td>1.98</td>
<td>0.72</td>
</tr>
<tr>
<td>LSD</td>
<td>0.19</td>
<td>0.02</td>
</tr>
</tbody>
</table>
| CV=Coefficient of Variation; LSD= Least Significance Difference; Con: Kocho flour; B: Belay 96 flaxseed variety; J: Jeldu flaxseed variety; K: Kulumusa1 flaxseed variety. Values are Means ± standard error. Means followed by the same letter in a column are not significantly different at p<0.05 level of significance.

Table 3: Effect of main factors (variety and blending ratio) on anti-nutritional content of flaxseed substituted kocho bread.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Tannin (mg/g)</th>
<th>Phytic acid (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flaxseed variety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>6.97±0.13b</td>
<td>3.10±0.09b</td>
</tr>
<tr>
<td>J</td>
<td>6.44±0.13d</td>
<td>3.01±0.08d</td>
</tr>
<tr>
<td>K</td>
<td>6.66±0.12c</td>
<td>3.07±0.06c</td>
</tr>
<tr>
<td>Con.</td>
<td>8.96±0.01a</td>
<td>3.63±0.01a</td>
</tr>
<tr>
<td>Blending ratio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5%</td>
<td>6.84±0.20b</td>
<td>3.18±0.01b</td>
</tr>
<tr>
<td>10%</td>
<td>6.69±0.21c</td>
<td>3.03±0.01c</td>
</tr>
<tr>
<td>15%</td>
<td>6.54±0.23d</td>
<td>2.97±0.04d</td>
</tr>
<tr>
<td>Con.</td>
<td>8.96±0.01a</td>
<td>3.63±0.01a</td>
</tr>
<tr>
<td>CV</td>
<td>0.17</td>
<td>0.003</td>
</tr>
<tr>
<td>LSD</td>
<td>0.008</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Values are Means± standard deviation Means with different letters after data within a column represents significant differences at P ≤ 0.05. Factor= Effect of variety and blending. CV=Coefficient of Variance LSD=Least Significant Difference. B; J, and K= Belay96, Jeldu and Kulumusa flaxseed varieties, respectively; 05%, 10%, and 15% = flour flaxseed substitution levels, respectively. Con. = control sample (100% kocho bread).
kocho flour (2.65 ml/g) were not different from each other while both are significantly (P < 0.05) higher than the 2.48 and 2.40 ml/g of the Belay 96 and Kulumsa flaxseed varieties, respectively. The flaxseed powders had shown water absorption capacity values of twice as much. On the other side all three flaxseed had solubility values of 3.90, 4.20 and 4.06% and significantly the same (P > 0.05) whereas all three of them are significantly greater than the 1.50% of kocho. The flaxseed flour solubility increased this is might be an increased in lipids had the potential to reduce the starch retro-gradation by amyllose-lipid complex formations. The swelling power values of the three-flaxseed powder were also shown in the same table and exhibit statistical difference at P < 0.05. The highest value (8.88%) was recorded for kocho sample with flaxseed kulumus1 showing swelling power of 6.31%, being significantly lower than that of kocho. Flaxseed varieties Belay 96 and Jeldu had values of 5.03 and 5.23%, respectively, and were statistically the lowest. The two had no difference between.

**Interaction Effects of Flaxseed Variety and Blending Ratio on Anti nutritional Contents of Kocho Composite Bread**

The flaxseed variety and blending ratio interactions had a significant effect (P < 0.05) on condensed tannin and phytic acid contents of the breads (Table 5). For the blended products the highest value (7.12 mg/g) was recorded for samples having 5% flaxseed. Belay96 and Kulumsa1 varieties and the lowest (6.29 mg/g) happened to those with 15% flaxseed of Jeldu variety. Similarly, the highest phytic acid (3.22 mg/g) was of breads having only 5% flaxseed of Belay96 variety and the lowest (2.92 mg/g) was of samples having 15% flaxseed of Jeldu variety. All composite breads showed lower phytic acid than the control sample.

**Conclusion**

The study intended to assessed the functional property and anti-nutritional factor of kocho- flaxseed flat bread prepared from blending of kocho flour with flaxseed varieties. Blending ratio was the most significant factor that had an effect on functional property and anti-nutritional factors of kocho-flaxseed flat bread. The interaction effect of variety and blending ratios showed significant influence on antinutritional content of kocho-flaxseed blended bread. The result obtained in the analysis of anti-nutritional content is reduced and rising the blending 15% flaxseed variety will have improved nutritional as well as functional property. Therefore, consumption of flaxseed variety blending with kocho flour in bread production will have complement dietary content.

**Acknowledgement**

First and for most we would like to thank the Almighty God who made everything for the completion of this study. Grateful to Haramaya University office, Holleta Agricultural Research

### Table 4: Functional properties of kocho and flaxseed flours.

<table>
<thead>
<tr>
<th>Sample</th>
<th>WAC (ml/g)</th>
<th>OAC (ml/g)</th>
<th>Solubility (%)</th>
<th>SP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>4.08±0.02a</td>
<td>2.48±0.03bc</td>
<td>3.90±0.10a</td>
<td>5.03±0.43c</td>
</tr>
<tr>
<td>J</td>
<td>4.26±0.01a</td>
<td>2.58±0.15ab</td>
<td>4.20±0.17a</td>
<td>5.23±0.02c</td>
</tr>
<tr>
<td>K</td>
<td>4.43±0.20a</td>
<td>2.40±0.01c</td>
<td>4.06±0.20a</td>
<td>6.31±0.39b</td>
</tr>
<tr>
<td>Con.</td>
<td>2.52±0.04b</td>
<td>2.65±0.07a</td>
<td>1.50±0.5b</td>
<td>8.88±0.29a</td>
</tr>
<tr>
<td>CV</td>
<td>5.17</td>
<td>3.41</td>
<td>8.44</td>
<td>5.14</td>
</tr>
<tr>
<td>LSD</td>
<td>0.37</td>
<td>0.16</td>
<td>0.54</td>
<td>0.61</td>
</tr>
</tbody>
</table>

### Table 5: Interaction effects of flaxseed (variety and blending ratio) on anti-nutritional content of kocho bread.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Condensed Tannin (mg/g)</th>
<th>Phytic Acid (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B*0%</td>
<td>7.12±0.01b</td>
<td>3.22±0.01b</td>
</tr>
<tr>
<td>B*10%</td>
<td>6.97±0.01c</td>
<td>3.07±0.01e</td>
</tr>
<tr>
<td>B*15%</td>
<td>6.82±0.01d</td>
<td>3.02±0.01g</td>
</tr>
<tr>
<td>J*0%</td>
<td>6.59±0.01f</td>
<td>3.12±0.01d</td>
</tr>
<tr>
<td>J*10%</td>
<td>6.44±0.01h</td>
<td>2.97±0.01i</td>
</tr>
<tr>
<td>J*15%</td>
<td>6.29±0.02i</td>
<td>2.92±0.01j</td>
</tr>
<tr>
<td>K*0%</td>
<td>6.81±0.01d</td>
<td>3.18±0.01c</td>
</tr>
<tr>
<td>K*10%</td>
<td>6.66±0.01e</td>
<td>3.03±0.01f</td>
</tr>
<tr>
<td>K*15%</td>
<td>6.51±0.01g</td>
<td>2.98±0.01h</td>
</tr>
<tr>
<td>Con.</td>
<td>8.96±0.02a</td>
<td>3.63±0.01a</td>
</tr>
<tr>
<td>CV</td>
<td>0.081</td>
<td>0.003</td>
</tr>
<tr>
<td>LSD</td>
<td>0.009</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Values are Means± standard deviation with different letters after data within a column represents differences at P ≤ 0.05. Treatment=Interaction of variety and blending CV=Coefficient of Variance LSD=Least Significant Difference, B, J, and K= Belay96, Jeldu and Kulumsa1 flaxseed varieties, respectively; 0%, 10%, and 15% = flour flaxseed substitution levels, respectively Con.=control sample (100% kocho bread).

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**References**


