DOI: http://dx.doi.org/10.4314/star.v5i1.9
ISSN: 2226-7522 (Print) and 2305-3372 (Online)
Science, Technology and Arts Research Journal
Sci. Technol. Arts Res. J., Jan-March 2016, 5(1): 61-68
Journal Homepage: http://www.starjournal.org/

Original Research

Quality Analysis of Breads Produced from Blends of Wheat (*Triticum aestivum* L) and Anchote (*Coccinia abyssinica* L.)

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Abstract

Bread making is currently limited to wheat and a few other commonly used cereal seeds in many countries. The study was conducted with the general objective of quality evaluation of breads produced from blends of wheat (*Triticum aestivum* L) and Anchote (*Coccinia Abyssinica* L). The result of proximate composition of composite breads of wheat and Anchote ranged from 4.00 to 5.89% for moisture, 1.00 to 2.03% for Ash, 4.25 to 5.35% for protein, 1.54 to 2.14% for fat, 0.43 to 0.93% for fiber, 90.37 to 91.25% for carbohydrate and 404.96 kcal/100g for energy. The iron and zinc content increased as the supplementation of Anchote flours increased from 5 to 15% and the calcium content was decreased. The Antinutritional contents of the result showed that as the supplementation level of Anchote flour increased, the phytate, oxalate, tannin and cyanide content were increased. Generally, the study revealed the effect of replacement of wheat flour with Anchote flour (5 to 15%). As the addition of Anchote flour increased from 5 to 15%, the overall acceptability decreased even though the produced breads were accepted. Anchote flour can be used for different food product development as it enhances the mineral and also fibers which is good for the health of human being.

Article Information

Article History:
Received : 05-01-2016
Revised : 11-03-2016
Accepted : 16-03-2016

Keywords:
Anchote
Bread
Proximate composition
Minerals
Antinutritional factors

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INTRODUCTION

Bread is made from the dough which is obtained from a mixture of flour, salt, sugar, yeast and water. It is a staple food for many people in the world. It is a good source of carbohydrates and micronutrients such as vitamins and minerals (Ebuehi *et al*., 2007). Bread is universally accepted as a convenient form of food that has desirability to all population. It is well accepted worldwide because of the low cost, ease of preparation, versatility, sensory attributes and nutritional properties. It also supplies irreplaceable nutrients for the human body in addition to being used as a significant source of energy and dietary fiber. It also provides protein, the B vitamins and minerals which are mostly magnesium, calcium and iron (Isserliyska *et al*., 2001).

Bread making is currently limited to wheat and a few other commonly used cereal seeds in many countries. Anjum et al. (2005) reported that wheat is the main ingredients in bread preparation being used as a dietary staple, averaging two-third of total consumption in the world which is responsible for formation of viscoelastic dough when hydrated with water, is capable of supporting gas cells and retaining gas. Yeast's is a leavening agent, strengthen and developing gluten in dough and contributing to the flavor generation in the bread and the most common one is *Saccharomyces cerevisiae*. The other ingredients which are used for bread production are salts, sugars and improvers.

Wheat is one of the most important cereals cultivated in Ethiopia. It ranks fourth after teff (*Eragrostis tef*), Maize (*Zea mays*) and sorghum (*Sorghum bicolor*) in area coverage and third in total production (CSA, 2007). The average per capital consumption of wheat in Ethiopia estimated to be 39 kg/year during 1995-97. The amount of wheat imported to meet the national wheat requirements during 1995-97 was 331,000 tons (CIMMYT, 2000). The natonal average yield of wheat in the country, which is 1.379 tons ha^{-1}, is 24% and 48% below the African and world average, respectively (FAO, 1994).

Anchote (Coccinia abyssinica (Lam) is one of the indigenous root tuber crops widely produced in south and southwestern parts of Ethiopia (PGRC/E, 1998). According to Fufa and Urga (1997) Anchote is widely cultivated and used in Jimma, Illu-Abba Bora and Wollega areas of the oromia regional state. It is a subsistence crop commonly produced to fill food security gaps during the hunger months (June to September). The production of Anchote has strong cultural ties with Oromo Nation, since it is used as cultural food during the finding of true cross locally called " Meskel Festival". According to Abera and Gudeta (2007), Anchote has enormous genetic diversity, as it is indigenous and long-stayed in the production systems.

Unlike many other crops, Anchote can be grown with minimal inputs and is able to produce reasonable yields in conditions of low soil fertility, acidic soils or drought and in intercropping with cereals. It is a co-staple crop during the hunger months in certain pocket areas of western Ethiopia. Despite this fact, Anchote has been historically given low attention in terms of research and production.

Anchote can withstand dry conditions and produce food for the poor smallholder farmers when other crops fail to grow. Usually farmers sow Anchote seed in April or May and harvest in July or August. Anchote harvesting date often depends on farmers' wealth condition. In times of staple food crops depletion from store, farmers forced to harvest Anchote as early as possible. It is interesting to note that early harvest may result in low yield and poor quality produce. Anchote produces one root per plant, which is usually harvested after 4-5 months of planting whean the leaves turn yellow (Hora, 1995; Abera, 1997).

Traditionally ,in Anchote birth place, Wollega, people use over stayed (over matured) Anchote tuber when they face a problem of bone-fracture and when women give birth, due to the fact that Anchote is supposed to contain high Ca and Fe (Abera and Gudeta ,2007;Yambo and Feyissa , 2013). In other words, the local people believe that Anchote has medicinal value in healing many maladies.

Methods of traditional preparation of Anchote in Ethiopia are limited to boiling, steaming, and preparing as sauce .But keeping the boiled or roasted tuber under ambient condition does not go beyond a day or two without a change in sensory attributes and microbial safety .This form of consumption does not lend itself to use the crop for commercial purpose due to short shelf life. The limited forms of consumption coupled with difficulty of storing the fresh tuber for long period forced the crop to remain secondary staple food.

Anchote as a high source of starch may be utilized to replace or in combination with other source of starch .Partial substitution of wheat by Anchote in bread making can be used in order to improve the nutritional value of bread and reduction of dependence on wheat imports which will also lead to savings in foreign currency.

Therefore research toward wheat bread product development that comprises Anchote as component will address the nutrition deficiency challenges in wheat breads and postharvest loss minimization of Anchote tubers .In addition, the use of Anchote flour with other cereals like wheat for different food product development will be an opportunity to enhance the use underutilized root crops like Anchote with value addition and minimized postharvest loss. The objective of the study was quality evaluation of breads produced from blends of wheat (*Triticum aestivum* L) and Anchote (*Coccinia Abyssinica* L)

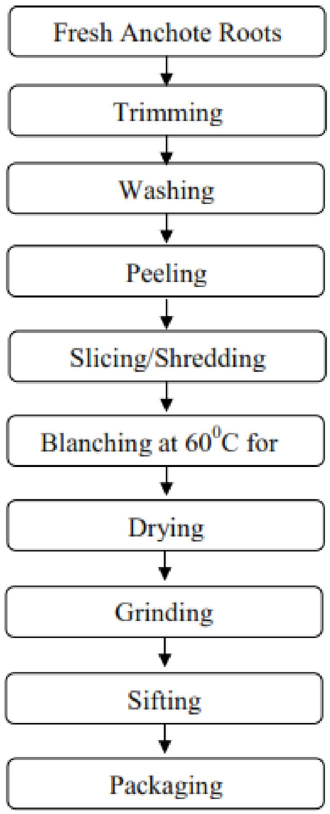
MATERIALS AND METHODS

Experimental Materials

Matured roots (about 20kg) of Anchote were randomly collected from Bako Agricultural research center, Bako, Ethiopia. The raw material preparation was conducted at Wollega University Shambu Campus in Food science and Nutrition laboratory. Bread production was conducted at Kality food complex share company, quality control laboratory and proximate composition of the flours of wheat and Anchote and also proximate composition of breads produced with different blending ration of Anchote were conducted at Jimma University College of agriculture and veterinary medicine in the department of Food science and post harvest technology laboratory. Wheat flour, salt, sugar and oil were purchased from Kality food complex share company. Analytical grade reagents and standards were used in the analysis of all parameters.

Sample Preparation

The Anchote tubers were thoroughly sorted to remove foreign materials from the lot. The Anchote tubers identified to be normal and seem fitting for experimentation were cleaned and washed to remove adhering soil, dirt and extraneous materials. The tubers were peeled and sliced in to chips of 2-2.5 cm thickness using Jagson slicer (Food Slicer, JAG0100089, California) to facilitate fast rate of drying and easy milling operations. The sliced tubesr were blanched at 60^0C for 5 min in water bath (GLC 400, Grant struments, England) in order to inactivate enzymes that may cause browning reaction. Blanched tuber were then cooled in cold water and drained which was followed by drying at 60^0C for 6 hrs in oven (Memmert, 845 Schwabach, West Germany) (Okigbo, 1989 and FAO, 2011). The slices were then milled by Electric Grinder (Nima, model NM-8300, Japan) and sieved through a 300 µm sieve and packed in an air-tight polythene bag at 4^0C until used for different chemical analysis.



Source: Okigbo (1989) and FAO (2011).

Figure 1: Anchote flour production flow chart

Bread Preparation

Bread were prepared by straight dough method bread production process (mixing and kneading, bulk fermentation, molding, rounding, intermediate proofing, molding, final proofing, baking, cooling and packaging). The control flour (100% wheat flour (wf)), blended flours at ratios of 5 of: 95 wf, 10 of: 90 wf and 15 of: 85 wf, were employed in the production of bread. The baking formula were 62% wheat flour or the blend, 0.3 % yeast, 0.3% bread improver, 0.6 % salt and 37.0 % water. All ingredients were mixed in a dough mixer for 15 minutes. The dough was fermented in a bowl covered with polyethylene plastic for 30 minutes at room temperature. It was then knocked back and molded. The dough pieces were then allowed fermenting for 60 minutes at room of temperature. The fermented dough was baked at 250^{0}C for 20 minutes (Olaoye *et al*., 2006). Bread of Anchote flour blended with wheat flour along with other ingredients was formulated by the following figure 2.

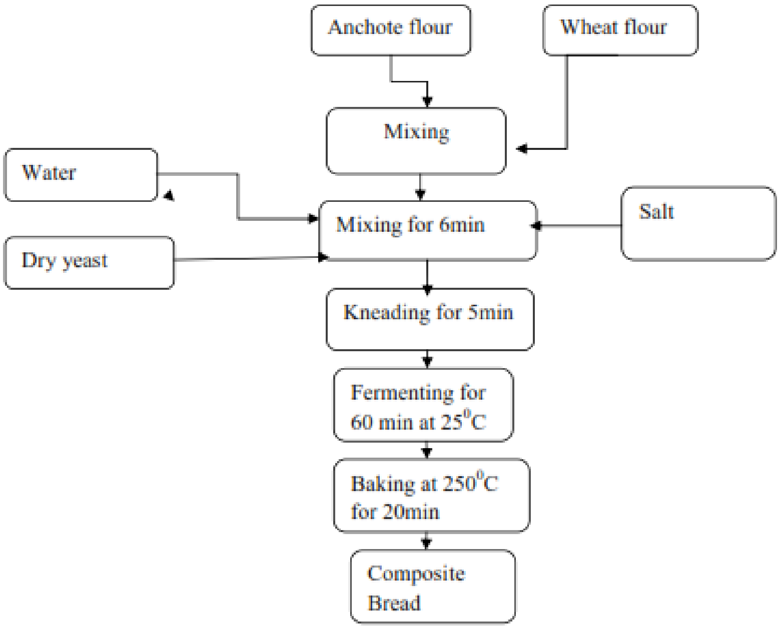


Figure 2: A modification of AACC optimized straight dough bread making method 10-10B (AACC, 10th edition, 1995).

Chemical Analyses
Proximate Composition

The moisture content was determined by taking 5 g samples by air draft drying (103±1^{0}C, 6 h) oven drying method (AOAC, 2000 Method No 925.10). The crude protein content was determined after digestion of about 0.5 g sample by micro-Kjeldhal method of nitrogen content analysis (HYP-1014 digestion and KDN-102F distillation systems, Shanghai Qian Jian Instruments CO, LTD, China), (AOAC, 2000, Method No 979.09) using urea as a control. Protein (%) = N (%) × 6.25. Crude fat content was determined by Soxhlet extraction (SZC-C, China) from 3.5 g sample using n-hexane as a solvent (AOAC 2000, Method No 920.39). The crude fiber content was determined by taking about 1.5 g sample as portion of carbohydrate that resisted sulfuric acid (1.25%) and sodium hydroxide (1.25%) digestion followed by sieving (75 µm), washing, drying and ignition to subtract ash from fiber (AOAC 2000, Method No 962.09). Total ash content was determined after ashing about 5 g samples in a muffle furnace at 550^{0}C until ashing was complete (AOAC 2000, Mehtod No 920.03).

Total carbohydrate content was calculated by difference as (100-% protein + %fat + %ash + %moisture) (AOAC, 2005). All the results were expressed as g/100g of dry matter of Anchote flour. Energy value (kcal per 100g) was estimated using the Atwater conversation factors (Osborne and Voogt, 1978). E (kcal per 100 g) = [9*lipids (%) + 4* proteins (%) + 4* carbohydrates (%)].

Dietary Minerals Analysis

Dietary mineral elements (iron, calcium, zinc in (*mg/100g*) contents were determined as described in AOAC (2000) by dry-ashing method using atomic absorption spectrophotometer (Model 200, and Germany) using air-acetylene as a source of energy for atomization. The absorbance for iron, zinc and calcium were estimated from a series of 1-5 mg/kg, 0.5-2.5 mg/kg, and 2-10 mg/kg standard calibration curve prepared from analytical grade iron wire, ZnO and $CaCO_3$ respectively.

Antinutritional Factors Analysis
Phytic Acid Content Determination

Phytate content was determined as described in Vaintraub and Lapteva (1988) after extraction of sample with 2.4% HCl for 1 h, centrifuged and reacting sample extract (3 ml) with one ml of wade reagent (0.03% $FeCl_3.6H_2O$ and 0.3% sulphosalicyclic acid in distilled water). The absorbance of sample was measured at 500 nm using UV-Vis Spectrophotometer (DU-64 spectrophotometer, Beckman, USA), subtracted from blank absorbance and the phytate content (mg/100 g sample) was estimated from phytic acid standard curve (5-36 mg/kg).

Condensed Tannin Content Determination

Condensed tannin content was determined by the modified vanillin-HCl methanol method (Price *et al*., 1978; Siwela, 2007). The flour sample (about 0.2 g) was extracted with 10 ml of 1% HCl (24 h), extract (1 ml) reacted with extracted with 5 ml vanillin-HCl reagent (8% concentrated HCl in methanol and 4% vanillin in methanol, 50:50, v/v) and the absorbance of the color developed was measured after 20 minutes incubation at 30 ^{0}C at 450 nm using UV-Vis Spectrophotometer (DU-64 spectrophotometer, Beckman, USA). The tannin content was estimated from catechin calibration curve as mg of catechin/g of sample using the following equation.

$$\text{Tannin (mg/100g)} = \frac{\underline{c \times 10}}{200} \times 100$$

Where C= Concentration of corresponding to the optical density

10 = Volume of the extract (ml)

200 = Sample weight

Oxalate Content Determination

Oxalate was analyzed using the method originally employed by Ukpabi and Ejidoh (1989) in which the procedures involve three steps: digestion, precipitation and permanganate titration. About 2.00 g of Anchote samples of each treatment in triplicate was suspended in 190 ml de-ionized water contained in a 250 ml volumetric flask;10 ml of 6 M HCl was added and the suspension digested at the boiling point of water for 1 hr that followed by cooling. Then filled up to 250 ml and flittered. Duplicate portion of 125 ml of filtrate was measured into a beaker and four drops of methyl red indicator added, followed by the addition of concentrated NH4OH solution drop wise until the test solution changes from salmon pink color to faint yellow color (PH4-4.5). Each portion was then again heated to 90^0C, cooled and filtered to remove precipitate containing ferrous ion. The filtrate was then again heated to 90^0C and 10 ml of 5% $CaCl_2$ solution and cooled and left overnight in refrigerator. The solution was then centrifuged at a speed of 2500 rpm for 5 min and the supernatant was decanted and the precipitate completely dissolved in 10 ml of 20% (v/v) H_2SO_4 solution. At this point the total filtrate resulting from digestion of 2 g of flour was made up to 300 ml aliquots of 125 ml of filtrate are heated until near boiling, and then titrated against 0.05 M standard $KMnO_4$ solution to a faint pink color which persists for 30 seconds.

Cyanide Content Determination

Cyanide content of the samples was determined according to the official standard method of AOAC (1984), by silver nitrate titrimetric methods, in which the steps of distillation and titration was involved. About 10 g of sampes of each treatment in triplicates was weighed into a flask and soaked in 100 ml of distilled water in separate 500 ml round bottom flask for 2 hr. The Kjeldahl flask was adjusted before distilling the tip of delivery tube below surface of liquid and 100 ml distilled water was added. Thereafter, the mixtures in the flask were heated by steam distillation. The released cyanide was collected in a conical flask containing in 20 ml 0.01 N $AgNO_3$ acidified with 1 ml concentrated HNO3. When the gas has passed over, the distillate was filtered through sintered glass crucible and rinsed the test tube with little water. The distillate was then titrated against excess AgNO3 with 0.02 N KSCN, using ferric alum indicator. At the end point of titration, the color of indicator changed from red to purple color. Using the relationship 1 ml N $AgNO_3$ = 0.27 of cyanide.

Sensory Analysis

Sensory evaluation of composite breads was carried out by 30 consumer panelist according to the method described by Barnes *et al*., (1991). The samples were served in random order, identified by three digits codes. This analysis was conducted at Kality food complex share company in quality control laboratory, Addis Abeba, where most of the judges was quality controllers and other employees of the company, who are familiar with sensory evaluation. Panelists was advised to avoid strong adorous materials, such as soaps, lotions and perfumes prior to participating on panels and to avoid eating, drinking or smoking at least 30 minutes prior to sensory test. Consumers was asked to fill questionnaire prepared to evaluate sensory attributes of the bread samples, i.e., color, appearance, body and texture, flavor and overall acceptability using a 9-point hedonic scale (1 = dislike extremely, 5 = nether like or dislike, 9 = like extremely). Packaged drinking water was provided for rinsing their mouth between samples.

Statistical Analysis

All determinations were performed in triplicate. Data were subjected to analysis of variance (ANOVA). Statistical differences in samples were tested for at $P \leq 0.05$. Least significance difference were used to separate mean values. The results were expressed as mean ± standard error. All analyses were done with SAS software.

RESULT AND DISCUSSION

The proximate composition of wheat flour and Anchote flour were analyzed for moistrure content, ash, protein, fat, fiber, carbohydrate and energy (Table 1). The results revealed that wheat flour contained 12.49% moisture, 0.64% total ash, 5.92% protein, 2.16% fat, 0.52% fiber, 90.75% carbohydrate and 376.3 kcal/100g energy respectively. The result of proximate analysis showed that Anchote flour contains 9.785 moisture, 4.83% total ash, 1.68% protein, 1.18% fat, 2.57% fiber, 89.73% carbohydrate and 406.19 kcal/100g respectively.

The moisture contents of wheat flour and Anchote flour were significantly ($P<0.05$) different from each. The moisture contents of Anchote flour are lower than that of wheat flour. The low level of moisture contents of the flours could be the result of the extent of drying done on the sample. The moisture content is the main parameter of food products which influences the storage time. It is known that the shelf life of products with high moisture content is shorter than of products with lower moisture content.

The ash content of Anchote flour and Wheat flours were significantly ($P<0.05$) different from each other having values of 4.83% in Anchote and 0.64% in Wheat flour. The protein contents of the Anchote and Wheat flour was significantly ($P<0.05$) different form each other having values of 5.92% in wheat and 1.68% in Anchote flour. The crude fat content of wheat flour and Anchote flour were 2.16% and 1.18% respectively. The fat content in wheat is higher than Anchote flour with values of 2.16% and 1.18% respectively. However, there were significant differences between the fat contents of wheat and Anchote flours.

Crude fiber contents of wheat and Anchote flour were found significantly ($P<0.05$) different from each other. Anchote flour had greater crude fiber contents (2.57%) than wheat flour (0.52%). Dietary fiber has recently gained much importance as it is said to reduce colon cancer, diabetes, heart diseases and the level of low density lipoprotein cholesterol in blood (Felicity and Maurica, 1992). The carbohydrate content of wheat and anchote flour were 90.75% and 89.73% respectively. The result exhibited significant ($P<0.05$) differences between them.

Table 1: Proximate composition of Wheat and Anchote Flour

Sample	Moisture	Ash	Protein	Fat	Fiber	Carbohydrate	Energy (kcal/100g)
Wheat Flour	12.49+0.08[a]	0.64+0.03[b]	5.92+0.10[a]	2.16+0.07[a]	0.52+0.02[b]	90.75+0.13[a]	376.30+0.37[a]
Anchote Flour	9.78+0.11[b]	4.83+0.17[a]	1.68+0.07[b]	1.18+0.04[b]	2.57+0.02[a]	89.73+0.26[b]	406.19+0.49[b]
LSD	**0.39**	**0.46**	**0.35**	**0.24**	**0.08**	**0.81**	**1.73**
CV	**1.54**	**7.55**	**4.02**	**6.34**	**2.49**	**0.40**	**0.19**

LSD= Least significance difference and CV= Coefficient of variation

On the other hand, the energy contents of wheat and anchote flour were 376.3 and 406.19 kcal/100g respectively and exhibited significant (*P<0.05*) difference among each other. The energy content difference could be due to variation in their protein, fat and carbohydrate contents (Giami *et al*., 2000).

Mineral and Antinutritional Content

Iron, zinc and calcium are the main important nutrients for normal healthy, growth and reproduction for human beings. The mineral contents of the flours of wheat and anchote are presented in Table 2. The Iron contents of wheat and Anchote flour were significantly (*P<0.05*) different form each other with values of 4.47 mg/100g in wheat flour and 5.23 mg/100g in Anchote flour.The Zinc contents showed also significant differences among the wheat and Anchote flours with values of 1.17 and 2.05 mg/100g respectively. Wheat flour contains high calcium content as compared to Anchote flours with values of 10.36 mg/100g in wheat flours and 7.78 mg/100g in Anchote Flours.

The antinutritional factors of wheat and Anchote flours are also presented on the same table in Table 2 along with mineral contents. The phytate contents of Anchote flours were higher (46.33 mg/100g) than wheat flours (0.29 mg/100g) and exhibited significance (*P<0.05*) differences from each other. Currently, there is evidence that dietary phytate at low level may have beneficial role as an antioxidant, anticarcinogens and likely play an important role in controlling hypercholesterolemia and atherosclerosis (Phillippy *et al*., 2004).

The oxalate contents were higher in Anchote flours (84.09 mg/100g) as compared to wheat flours (7.21 mg/100g) and there were significant (*P<0.05*) different among each other. The cyanide content of Anchote flours was (7.95 mg/100g) which is higher than wheat flours (0.08 mg/100g) different between Anchote and wheat flours. This is in line with the work of Habtamu (2014) on his conduction effects of boiling on anti-nutritional factors of Anchote tubers grown in Western Ethiopia and resulted 8.23 mg/100g oxalate, and 12.67 mg/100g in raw Anchote flour. Oxalates can have a harmful effect on human nutrition and health, especially by reducing calcium absorption and aiding the formation of kidney stones (Noonan and Savage, 1999). Currently, patients are advised to limit their intake of foods with a total intake of oxalate not exceeding 50-60 mg per day (Massey *et al*., 2001).

Table 2: Mineral and antinutritional contents of Wheat and Anchote flours

Sample	Iron	Zink	Calcium	Phytate	Oxalate	Condensed tannin	Cyanide
Wheat Flour	4.47+0.07[b]	1.17+0.02[b]	10.36+0.23[a]	0.29+0.01[b]	0.03+0.01[b]	7.21+0.02[b]	0.08+0.01[b]
Anchote Flour	5.23+0.02[a]	2.05+0.01[a]	7.78+0.05[b]	46.33+0.02[a]	4.13+0.03[a]	84.09+0.03[a]	7.95+0.05[a]
LSD	**0.22**	**0.05**	**0.64**	**0.05**	**0.08**	**0.09**	**0.15**
CV	**1.97**	**1.34**	**3.12**	**0.10**	**1.62**	**0.08**	**1.61**

LSD= Least significance difference and CV= Coefficient of variation

Effects of Anchote Flours on Proximate Composition of Breads

The proximate composition of breads produced with the different mix ratios of wheat and Anchote flours are presented in Table 3. The values ranged from 4.00 to 5.89% for moisture, 1.00 to 2.03% for Ash, 4.25 to 5.35% for Protein, 1.54 to 2.14% for fat, 0.43 to 0.93% for Fiber, 90.37 to 91.25% for carbohydrate and 395.85 to 404.96 kcal/100g for Energy. The highest (5.89%) and lowest (4.00%) Moisture contents of composite bread produced from Anchote and wheat were observed from samples with 0% and 10% level of supplementation.

There was significance (*P<0.05*) difference in moisture content of wheat bread as compared to 10% and 15% substitution level of Anchote flour. But there is no significance difference between whole wheat breads and 5% substitution of Anchote flours. Moisture is a very important factor in the keeping quality of bread and high moisture can have an adverse effect on storage stability Madukwe *et al*. (2013).

The highest ash contents were recorded in 15% level of substitution of Anchote composite breads with values of 2.03% and the lowest were found in whole wheat bread samples with value of 1.00%. Results showed that the ash contents of whole wheat bread were significantly (*P<0.05*) different from those of Anchote composite bread samples with different supplementation level. This finding was in agreement with the work of Aniedu and Agugo, (2010) who reported that the ash content increased with progressive increase in supplementation of sweet potato flour in wheat for bread production.

The highest protein content was found in whole wheat bread with value of 5.35% and lowest were recorded in composite breads of 15% Anchote flour with values of 4.25%. The protein content decreased as percentage of Anchote flours increased. this may have been due to the low protein content of the Anchote flours which resulted in reducing the protein level of the mixed flour as its proportion increased. This is similar to Olaoye *et al* (2007) who reported that the protein contents of snacks reduced with supplementation of bread fruit flour starch based products.

The high and low contents of bread made with addition of flours of Anchote with wheat ranged from 1.54 and 2.14% in 15% substitution and 100% wheat breads.

Table 3: Proximate composition of Breads Produced from wheat and Anchote

Sample	Moisture	Ash	Protein	Fat	Fiber	Carbohydrate	Energy (kcal/100g)
100% WF	5.89+0.11[a]	1.00+0.00[c]	5.35+0.04[a]	2.14+0.03[a]	0.43+0.02[c]	91.09+0.08[a]	404.96+0.14[a]
95:5(WF:AF)	5.89+0.11[a]	2.00+0.00[a]	5.09+0.02[b]	2.02+0.07[a]	0.52+0.01[c]	90.37+0.10[b]	400.02+0.34[b]
90:10(WF:AF)	4.00+0.19[c]	1.57+0.03[b]	4.69+0.07[c]	1.82+0.02[b]	0.67+0.02[b]	91.25+0.06[a]	400.127+0.29[b]
85:15(WF:AF)	4.78+0.11[b]	2.03+0.03[a]	4.25+0.06[d]	1.54+0.03[c]	0.93+0.06[a]	91.24+0.07[a]	395.850+0.36[c]
LSD	**0.44**	**0.07**	**0.16**	**0.14**	**0.11**	**0.26**	**0.96**
CV	**4.54**	**2.23**	**1.81**	**3.91**	**8.73**	**0.15**	**0.13**

Where, WF = Wheat flour, AF = Anchote flour, LSD = least significance difference, CV = Coefficient of Variation

The result showed that fat content of the breads of the composite flours decreased as the proportion of Anchote flours increased. This is due to low level of fat in Anchote flours and this could be an indication that the occurrence of oxidative rancidity might be reduced in the composite breads.

The result of crude fiber obtained in Anchote supplemented bread samples were higher than those of pure wheat bread samples implying that addition of Anchote flour increased crude fiber. The highest values were recorded in 15% supplementation level of Anchote flours with value of 0.93% and the low crude fiber recorded in 100% wheat flours. The crude fiber contents increased progressively with increased proportion of Anchote Flour. This increase in crude fiber content of the breads of the composite flours is the effect of the relatively higher percentage (2.57%) of the crude fiber present in the Anchote flours (Table 1). The high level of dietary fiber is an indication in which it helps lowers the risk of constipation, colon and rectal cancer and the level of density lipoprotein cholesterol in blood (Felicity and Maurica, 1992).

Regarding the carbohydrate contents of the breads made from the composite flours of wheat and Anchote, there is no significance difference among the treatment with whole wheat breads except 5% supplementation level of Anchote flours. The highest values were recorded in 10% supplementation level of Anchote flours with 91.25% and lowest were recorded in 5% substitution level of Anchote with values of (90.37%). Generally, all the breads had very high carbohydrates of 90.37 to 91.255. The high level of carbohydrate is desirable in baked products because on heating starch granules in the presence of water, it swells and forms agel which is important for the characteristics texture and structure of baked goods (Okorie and Onyeneke, 2012).

The energy contents of breads made from composite flours of wheat and Anchote flours ranged from 395.85 to 404.96 kcal/100g. the lowest energy content was recorded for breads with 15% Anchote flours. The energy content of wheat bread was significantly (*P<0.05*) the highest as compared to those of wheat-anchote composite breads in all level of supplementation. The difference in energy content could be due to variation in their protein, fat and carbohydrate contents (Giami *et al*., 2000).

Mineral and Antinutritional contents of Bread

The mineral contents of bread samples produced from composite flours of wheat and Anchote are presented in Table 4. The Iron contents of the breads increased with increase in the proportion of Anchote flour added with significant (*P<0.05*) differences among all of them and with whole wheat bread samples. The highest (4.26 mg/100g) and lowest (3.61 mg/100g) values of iron were recorded in bread samples of 15% and 0% addition of Anchote flours.

The zinc contents of the breads produced from flours having different proportion of Anchote flour exhibited significant (*P<0.05*) differences among all of them, the highest (1.90 mg/100g) being of bread samples with 15% Anchote and lowest (1.27 mg/100g) in whole wheat breads. As the proportion of Anchote addition increased the zinc content of the breads also increased. This is due to the high content of zinc in Anchote (5.23 mg/100g) than wheat flour (4.47 mg/100g) (Table 2).

The calcium contents of composite bread decreased with increase in the proportion of Anchote with significant (*P<0.05*) differences were observed between (5, 10 and 15%) of Anchote flour addition. The highest and lowest calcium content were observed in whole wheat breads (9.33 mg/100g) and in 15% Anchote addition (6.90 mg/100g). The decrease in calcium contents of the bread produced is due to the high content of calcium in wheat flours (10.36 mg/100g) and low in Anchote (7.78 mg/100g). Similar works are reported by Ifie (2011) on Madiga production from composite flour of wheat and sweet potato.

The phytate content increased with increase in the proportion of Anchote flour added with significantly (*P<0.05*) differences among all the breads including the whole wheat bread. This clearly indicated the impact of the Anchote addition on the phytate content of breads produced. This came about because of the high phytate content (46.33 mg/100g) of Anchote flours (Table 2).

The oxalate content increased with increase on the proportion of Anchote flour added. As the supplementation level of Anchote increases, the oxalate content in the composite breads increased which is due to the high content of Anchote flours.

Table 4: Mineral and Antinutritional contents of bread made from blends of wheat and Anchote flour

Sample	Iron	Zink	Calcium	Phytate	Oxalate	Condensed Tannin	Cyanide
100%WF	3.61+0.02[d]	1.27+0.05[d]	9.33+0.03[a]	0.17+0.01[d]	0.02+0.01[c]	6.04+0.07[d]	0.06+0.01[d]
95:5(WF:AF)	3.77+0.04[c]	1.41+0.03[c]	8.25+0.05[b]	22.26+0.05[c]	2.29+0.03[b]	18.22+0.02[c]	8.33+0.02[c]
90.:10(WF:AF)	4.02+0.04[b]	1.67+0.04[b]	7.76+0.04[c]	28.36+0.04[b]	2.35+0.02[b]	24.29+0.02[b]	9.25+0.04[b]
85:15(WF:AF)	4.26+0.05[a]	1.90+0.04[a]	6.90+0.04[d]	32.12+0.03[a]	2.71+0.05[a]	26.39+0.05[a]	9.63+0.03[a]
LSD	**0.13**	**0.12**	**0.12**	**0.12**	**0.09**	**0.16**	**0.08**
CV	**1.80**	**4.32**	**0.80**	**0.31**	**2.71**	**0.46**	**0.66**

Where, WF = Wheat flour, AF = Anchote flour, LSD = least significance difference, CV = Coefficient of Variation

The tannin content increased with increase in the proportion of the Anchote flour added with significant (*P<0.05*) differences among all the breads including the whole wheat bread. As the supplementation level of Anchote increased, the tannin content increased which actually due to the high content of tannin in raw Anchote flours (84.09 mg/100g) (Table 2).

The highest cyanide content were observed in 15% level of supplementation of Anchote flours with values (26.39 mg/100g) and the lowest were observed in 100% whole wheat bread with value of (0.06 mg/100g) and exhibited significant (*P<0.05*) differences between all the treatment and the whole wheat bread. Generally, as the supplementation level of Anchote increases, the cyanide content of composite bread produced increased this is due to the high level of cyanide in Anchote flour (7.95 mg/100g).

Sensory Evaluation of Breads Made of Blends of Wheat and Anchote Flours

Sensory acceptability data of breads produced by blending wheat with Anchote flours are presented in Table 5. Taste acceptability scores varied from 7.5 of the whole wheat bread in a 9-point scale to 5.41 of the bread containing 15% Anchote flour, with significant (*P<0.05*) difference among all of them. Breads containing 5, 10 and 15% Anchote flour obtained score of 6.51, 5.62 and 5.41 with significant (*P<0.05*) differences between them and the whole wheat bread. All the scores indicated moderate to very much degrees of liking.

Aroma acceptability scores ranged from 5.62 of the bread with 15% Anchote to the 6.78 of the whole wheat bread, and had significant (*P<0.05*) differences among all of the treatment. The highest acceptability scores of texture 6.4 belonged to breads with whole wheat breads. There were significant (*P<0.05*) different among the treatments of Anchote and also with whole wheat breads. Statistically, the lowest score at (*P<0.05*) was 5.46 of bread having 15% Anchote flour.

The color is one of the quality attribute and appeared to be a very important criterion for the initial acceptability of the baked products by the consumers. The addition of Anchote at different proportion for composite breads resulted minor color difference internally (crust color) when compared to whole –wheat bread. As the supplementation of Anchote flour increased, the brightness of bread produced decreased.

Table 5: Sensory evaluation of Breads made of blends of wheat and Anchote Flours

Sample	Taste	Aroma	Texture	Crust colour	Crumb colour	Over all acceptability
100%WF	7.50+0.03^{a}	6.78+0.01^{a}	6.40+0.01^{a}	6.52+0.02^{a}	6.70+0.01^{a}	7.45+0.03^{a}
95:5(WF:AF)	6.51+0.02^{b}	6.42+0.04^{b}	6.24+0.01^{b}	6.43+0.01b^{a}	6.18+0.01^{b}	6.64+0.01^{b}
90:10(WF:AF)	5.62+0.05^{c}	5.72+0.01^{c}	5.72+0.03^{c}	6.48+0.01^{b}	6.43+0.01^{c}	6.43+0.01^{c}
85:15(WF:AF)	5.41+0.02^{d}	5.62+0.01^{d}	5.46+0.01^{d}	5.62+0.02^{c}	5.74+0.01^{d}	5.54+0.01^{d}
LSD	**0.92**	**0.66**	**0.56**	**0.46**	**0.29**	**0.43**
CV	**0.11**	**0.08**	**0.06**	**0.05**	**0.03**	**0.05**

Where, WF = Wheat flour, AF = Anchote flour, LSD = least significance difference, CV = Coefficient of Variation

The result of crumb color showed that there were significant (*P<0.05*) differences among all the treatments and also with whole-wheat breads. The highest were recorded in whole wheat bread with value of (6.7) and the lowest were recorded in 15% supplementation level of Anchote flours.

The overall acceptability evaluation of the breads which are presented in the same table showed significant (*P<0.05*) differences among all the treatment with Anchote and whole wheat breads. The highest and lowest overall acceptability of the composite breads were recorded in whole wheat breads and 15% supplementation of Anchote flours with values of (7.45 and 5.54) respectively.

CONCLUSIONS

This study revealed the effect of replacement of wheat flour with Anchote flour (5-15%) on the proximate composition, minerals, antinutritional factors and sensory qualities of bakery products at different mix ratios. Addition of Anchote flour led to increased ash contents which an indication of increments of minerals, fat content increased, and fiber content increased. As addition of Anchote flour increased, from (5 to 15%), the overall acceptability decreased, even though, the produced breads were accepted. Generally, Anchote flour can be used for different food product development as it enhances the minerals contents and also fibers which is good for the health of human being.

Acknowledgements

The authors would like to acknowledge the financial assistance provided by Wollega University under research grant. The author also thanks laboratory technicians of Wollega University department of Food Science and Nutrition, Jimma University College of Agriculture and Veterinary Medicine department of Food Science and Post harvest Technology laboratory and also Kality Food complex Share Company for their support in different activities for the accomplishment of the manuscript.

Conflict of Interest

None declared.

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