MEDWIN PUBLISHERS
Committed to create value for Researchers

Food Science and Nutrition Technology
ISSN: 2574-2701

Published Date the Production, Quality and Acceptability Characteristics of Steamed Bread Enhanced with Cowpea Powder in Comparison to the Classical Bread

Siddeeg A[1]*, Salih ZA[1,2], Al-Farga A[3], Altayeb FT[1] and Ali AO[1]

[1]Faculty of Engineering and Technology, University of Gezira, Wad Medani, Sudan

[2]Agricultural and Veterinary Training station, King Faisal University, Saudi Arabia

[3]Biochemistry Department, College of Sciences, University of Jeddah, Jeddah, Saudi Arabia

***Corresponding author:** Azhari Siddeeg, Faculty of Engineering and Technology, University of Gezira, Wad Medani, Sudan, Email: azhari_siddeeg@yahoo.com

Research Article

Volume 4 Issue 3

Received Date: May 16, 2019

Published Date: May 22, 2019

DOI: 10.23880/fsnt-16000179

Abstract

This study was aimed to produce, access the quality and acceptability characteristics of steamed bread enhanced with cowpea powder and compared with the classical bread. Dough properties of wheat flour were determined using gluten and falling number parameters. The results of wet gluten and dry gluten were 32% and 22% respectively, while, the falling number of wheat flour was 441. The steamed bread was made supplemented with 0, 4, 6 and 8% cowpea flour to enhance the dough and nutritional characteristics and instead of that wheat flour which already used for steamed bread making. The proximate analysis of steamed bread was determined with the addition of cowpea 4%, 6% and 8%. The results of this study indicated that steamed bread was higher in protein (7.63-14.79%), fat (11.82-14.97%), ash content (1.50-1.98%), while was lower in carbohydrates content (38.92-41.45%) compared with the classical bread (69.38, 5.90, 1.67, 10.06 and 12.90%) for carbohydrates, fat, ash, protein and moisture contents, respectively. On the other hand, determination of minerals contents in the processed bread was reported. Sodium content was 38.0, 45.0, 47.0, and 48.0 mg/100g, while the potassium content was 33.0, 41.0, 42.0 and 43.0 mg/100g, for steamed bread processed with 0, 4, 6 and 8% cowpea, respectively, in comparison with the classical bread (30.51 and 28.90 mg/100g) for sodium and potassium, respectively. The sensory evaluation results, the panellists did not prefer steamed bread with 8% cowpea due to the brown colour, while the steam bread supplemented with 4 and 6% cowpea showed excellent attributes in comparison with other types of bread. Based on the results, it is recommended using extinsograph and farinograph to determine the rheological properties of fermented dough to investigate the optimum conditions of dough for making steamed bread.

Keywords: Steamed Bread; Classical Bread; Acceptability Characteristics; Cowpea Powder; Quality Properties; Proximate Composition

Introduction

Steamed bread, or "man-tou" by Chinese is the staple food of the wheat growing areas of Northern China. They represent approximately 70% of the end usage of flour produced in this region and a much lesser proportion in the south where noodles and rice are more popular [1]. Dough for steamed bread is made from fermented wheat flour, and the product is cooked in a steamer above boiling water to produce a roll-sized product with smooth, white skin and no crust. The texture varies from dense to open, and the flavour is dependent on the region of production, with two major types of steamed bread: Northern Style, which is preferred in Northern China and has a chewy and dense texture; and Southern Style, which is more open with a softer texture. Other forms of steamed bread include steamed twisted rolls and steamed stuffed buns - filled with meat, vegetables or sweet red bean paste. They are eaten throughout the day, and consumer preferences mean that they are eaten fresh as their sensory attributes deteriorate rapidly once manufactured. Although traditionally made at home, there is now a trend for production in small factories or workshops. However, most steamed bread facilities have imple equipment and are based on manual labour [2]. The main ingredients are flour, water, salt and yeast, although occasionally sugar is added for taste. Most steamed bread is fermented using either a freshly prepared starter dough or sour dough kept from the previous day. After fermentation, the dough is sour due to the by-products of fermentation by *Lactobacillus spp*. Yeast and baking powder tends to be used if making steamed bread in the home. A standard recipe with the percentages based on flour weight might be flour 100%, Yeast 0.5%, Water 50-55%. A range of spring and winter wheat are grown in China, with protein content ranging from 10 to 13%, the stronger wheat generally is grown in the North. Roller milling is used to produce two main flours: a white flour of 70%extraction and a standard flour of 80% extraction. The resulting protein quantity and quality of the flour is important for the production of acceptable steamed bread, with low protein soft wheat's best suited for steamed bread manufacture. Either type of yeast can be used but if instant dry yeast is chosen then additional 3% water with a slightly shorter mixing time is required [3]. Instant active dry yeast works as well as fresh yeast in steamed bread dough and offers reproducibility often difficult to achieve with fresh yeast over time. Trials have shown that shorter fermentation times with higher yeast quantity did not produce steam bread of equal quality to that with longer fermentation and less yeast. Quality characteristics of steamed bread are affected by dough water absorption, sugar-yeast combinations and fermenting and proof times [4]. In Sudan, there are many peoples they do not know the steamed bread because just they are consumed that bread processed by the oven. The nutritional value of steamed bread also is different compared with the other types. On the other hand, there are no previous studies in Sudan about the kind of bread. The current study was aimed to assess the physiochemical, nutritional and sensory characteristics of processed steamed bread compared with oven bread. Therefore, the idea of this topic is worthy to study.

Materials and Methods

Materials

Wheat flour, yeast, salt, sugar, edible oil and cowpea powder were purchased from a local market in Wad Medani City, Gezira State, Sudan, and then will be transferred to the laboratory of food analysis, Department of Food Engineering and Technology, Faculty of Engineering and Technology, University of Gezira, Sudan. All other chemicals and reagents will be of the highest grade commercially available.

Methods

Steamed Bread Processing: According to Rubenthaler, et al. [3] who recommended that from their research that ideal ingredient and processing methods would be as follows: 160 g flour, 8% sugar, 2% shortening, 1% instant active dry yeast with optimum water and dough mixing.

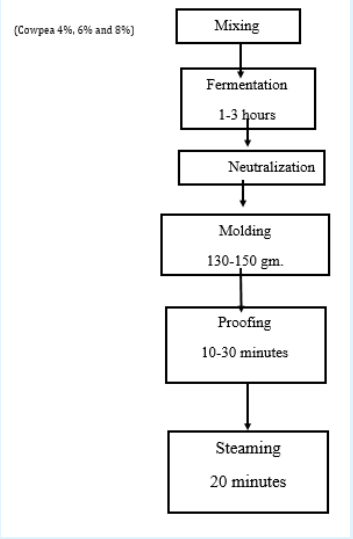

Figure 1: Outline of steamed bread making with cowpea

Bread Baking by Oven: Oven bread was prepared by using the flour wheat-based baking formula, which constitutes 1.0 g sugar, 1.50g salt, 1.0 g active dry yeast, 1.0 g shortening and the addition of an appropriate amount of water as determined using the farinograph absorption test. This was followed by a straight dough preparation procedure that involved 3 hours fermentation, 55 min proofing at 30°C and 25 min baking at 220°C [5].

Dough Physiochemical Properties

Gluten Content: Wet gluten content was determined by washing the flour sample by a salt solution to remove the starch and other soluble from the sample. The residue remaining after washing was the wet gluten. This determination was adapted according to the AACC method [6]. A 10g sample was weighed and placed into the glutamate washing chamber on top of the polyester screen. The sample was mixed and washed with 2% salt solution (NaCl) for 5 minutes. At the end of the wash cycle, the wet gluten was removed from the washing chamber, placed in the centrifuge holder, and centrifuged. The residue retained on top of the screen and through the screen was weighed to get total gluten. Wet gluten content results were expressed as a percentage on 14% moisture basis. It was then dried in a heater to give the dry gluten. Calculation of wet, dry, and gluten index was as follows:

I. Wet gluten % = (total gluten (g)/ sample weight (g)) × 100.
II. Dry gluten % = (weight of dry gluten (g)/ sample weight (g) ×100.

Falling Number: Falling number method determines alpha-amylase activity using the starch in the sample as substrate. The method of falling number weight 7.00g of the flour and added 25 ml distilled water and fit a rubber stopper onto the tube and mix to obtain a homogenous suspension, remove the stopper and the place the viscometer stirrer. Scarping into the suspension any flour adhering to the walls of the tube. The tube with stirrer into the boiling water bath within 20 seconds after mixing swing the motor unit immediately into its working position above the viscometer tube and viscometer. The apparatus has built-in functions to carry out the test automatically from now on. The red light and bumper indicate the conclusion of the test. Swing back the motor unit by releasing the lever at the back. The beeper stops and the cuter show the falling number value remote the viscometer tube wash the tube and stirrer. Read the falling number from the cuter display.

Chemical Analyses

Moisture Content: Moisture determination was conducted using the AOAC method [7]. Disposable aluminium weighing dishes, (<50 mm diameter and <40 mm deep) which had been numbered, dried in the oven for 30 minutes, cooled in a desiccator and weighed again were used. A two-g sample was weighed out and repeated in triplicate. Using tongs, aluminium weighing dishes containing the samples were placed in an air-drying oven at 130° C for about one hour. The samples were removed and placed in a desiccator to cool for 30 minutes and reweighed. The moisture content was calculated according to the following equation:

$$\text{Moisture Content (\%)} = \frac{W1-W2}{\text{Moist sample Weight}} \times 100$$

Where:
W_1= weight of dish and dry sample.
W_2=weight of the dish.

Protein Content: Protein content was determined according to the Kjeldahl method described by AOAC [8]. Two grams of each sample were placed in digestion flask (500 ml), KSO_4 was added to it. Then 25 ml of concentrated sulfuric acid were added, and the content was heated in a fume cupboard until a clear solution was obtained (2-3 hours) and left to cool before those antidumping granules were added. The digested samples were poured in a volumetric flask (100 ml) and diluted to 100 ml with distilled water. Five ml were distilled using 10 ml of 40% NaOH, 25 ml of boric acid with drops of methyl red were placed in a conical flask. Distillation of the reaction mixture liberated ammonia and reacted with boric acid, changing the colour from red to light greenish blue. Excess alkali was then titrated using 0.1 N hydrochloric acid until the colour changed to light purple. The titration reading was reported. The protein content was determined by multiplying the percentage nitrogen by empirical factor 6.36; as follow:

$$N\% = \text{Volume of HCl} \times N \times 14 \times \frac{\text{dilution factors}}{1000 \times \text{weight of sample}} \times 100$$

Protein % = N% × 5.7
Where 14 =the molecular weight of nitrogen
N = Normality of acid of HCl.

Ash Content: The ash content was determined according to the AOAC method [7] using a muffle furnace. Four grams of the sample was weighed and repeated in triplicate into porcelain crucibles, which have been ignited, cooled in a desiccator and weighed and placed in a cool electric muffle furnace. The temperature was 540°C overnight for complete ashing. The ash crucibles were transferred directly into a desiccator, then cooled for 30 minutes and weighed immediately. The ash was determined by calculation and expressed as a percentage using the equation:

$$\text{Total ash (\%)} = \frac{Ash\ Weight}{\text{Sample weight}} \times 100$$

Fat Content: The fat content was determined according to the AOAC method [7] with some modification. It was extracted by petroleum ether on a Goldfish extractor. Gold fish beakers were washed, dried and labelled by placing in an air oven at 130°C for one hour; then cooled in desiccators for 30 minutes and weighed; repeated to constant weigh. Samples of 2g in triplicate were wrapped in filter paper and placed in a cellulose thimble condenser. 40 ml of the solvent petroleum ether were added to the weighed Gold fish beakers. The extraction was carried out for 4 hours until all the soluble components of the sample were removed. Burners were allowed to cool for 30 minutes then the beakers were moved to a tray, covered with an evaporation-type watch glass, and set in a hood to allow all ether to evaporate overnight. The air oven removed the traces of solvent at 130° C for 15 minutes; cooled in a desiccator for 30 minutes and re-weigh. The fat content was calculated according to the following equation:

$$\text{Crude fat (\%)} = \frac{\text{Weight of oil extracted}}{Weight\ Sample} \times 100$$

Total Carbohydrates: The number of carbohydrates was calculated by difference. The values refer to "total carbohydrate by difference" that is, the sum of the figures for moisture (MC%), protein (PC %), fat (FC %), and ash (Ash %) are subtracted from 100.

Total Carbohydrate % = 100 - [MC% + PC% + FC% + Ash C%].

Minerals

According to AOAC Official Method [7] samples were dried and ashed at 525C for 4 hours. The ash was dissolved in (1 ml hydrochloric acid +3 ml distilled water) and a few drops of nitric acid, brought to a final volume of 250 ml with distilled water and filtered. Sodium and calcium were determined by flame atomic absorption spectroscopy according to AOAC Official Method [7].

Sensory Evaluation

Sensory evaluation will be performed using Triangle test and then a 10-member panel (trained) to measure colour, appearance flavour, taste and overall acceptability. A hedonic scale of 1 to 9 was used; 1: extremely bad, 2: very bad, 3: bad, 4: fairly bad, 5: satisfactory, 6: fairly good, 7: good, 8: very good, 9: excellent.

Statistical Analysis

The analysis of variance (ANOVA) was performed to examine the significant level in all parameters measured. (SPSS) The test was used to separate between the means. All analyses were performed in triplicate (n = 3). The level of significance was 0.005.

Results and Discussion

Falling Number

As shown in Table 1, the result of a falling number of wheat flour was 441. The falling number of wheat flour was lower than the falling number of wheat flour obtained by Mariam was 536.4. Also, the falling number of wheat flour was lower than studies obtained by Salim, et al. [9] was 521.

Gluten Content

The results of gluten content of wheat flour are shown in Table 1 for wet gluten, and dry gluten of wheat flour was 32% and 22% respectively. These results were higher than that reported by Rao, et al. [10] who concluded that dry gluten from different cultivars of hard wheat ranged between 9 to 11%. As reported that, gluten can be defined as a composite of storage proteins termed prolamins and glutelins and stored together with starch in the endosperm (which nourishes the embryonic plant during germination) of various grass-related grains. It is found in wheat, barley, rye, oat, related species and hybrids (such as spelt, Khorasan, emmer, einkorn, triticale, kamut, etc.) and products of these (such as malt). Gluten is appreciated for its viscoelastic properties. It gives elasticity to dough, helping it raise and keep its shape and often gives the final product a chewy texture [11].

Parameters	Value
Falling number	441±0.03
Wet gluten (%)	32±0.01%
Dry gluten (%)	22±0.30%

Values are means ± standard deviations of 3 determinations.

Table 1: Falling Number of wheat flour and the wet and dry % gluten protein.

Proximate Composition of Wheat Bread

Moisture Content: As shown in Figure 2, the moisture content of wheat bread was 5.90%. This result was lower than that reported by Carson & Sun [12] who found that the moisture content of wheat bread was 9.9%. Moreover, reported the moisture content of wheat flour was 11 - 10%.

Protein Content: Results in Figure 2, illustrated the protein content of wheat bread was 10.06%. This result is lower than the result obtained by Abed Elmonem [13] who found 11.5% and also lower than 12.68 which reported by Eladawy [14] However, it is higher than that obtained by Olaoye, et al. [15] who stated that the protein content of wheat bread was 7.01 % and similar to that result to obtained by Abdalla [16] who reported that the protein content of wheat bread, and reported that the protein content was 10.3%.

Ash Content: Data in Figure 2 showed that the ash content of wheat bread was 1.76%. This result was lower than that reported by Noor, et al. (2007) which was found 1.83%. Also, this result was lower than (1.90%) which was reported by Abou Azm [17]. However, was higher than the result of Mohsen, et al. [18] (1.2 %) and also higher than that result 1.18% which reported by Eladawy, [14]. On the other hand Ammar, et al. [19] reported that the ash content of wheat bread was 0.5%.

Fat Content: The results showed that the fat content of wheat bread was 5.9 % (Figure 2), this value was higher than that obtained by Malomo, et al. [20] who found fat content of 2.60 %.

Total Carbohydrates

The chemical composition of wheat bread in Figure 2 also showed the total carbohydrates content of wheat bread was 69.38%. This result was higher than that reported by Abdalla [16] who studied the total carbohydrate content of Indian wheat flour (75.39%), and also lower than that obtained by Abed Elmonem [13] who found to be 75%. However, it is lower than that obtained by Eladawy, et al, [14] who reported total carbohydrates content of wheat bread was 83.8%.

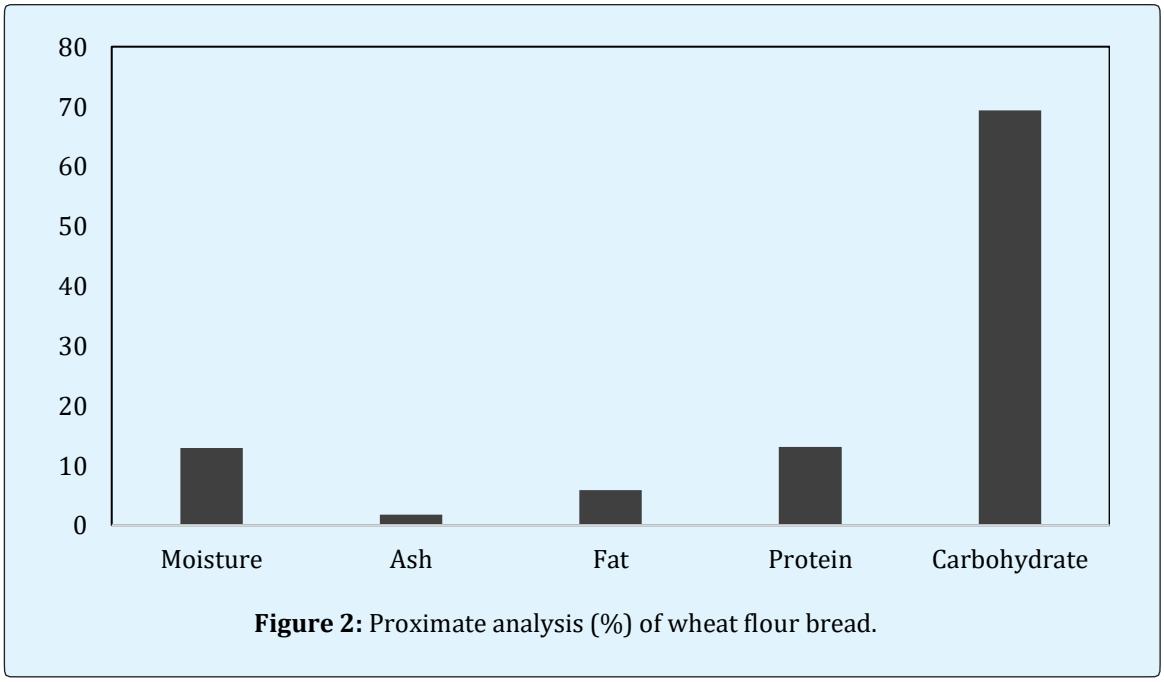

Figure 2: Proximate analysis (%) of wheat flour bread.

Minerals Content Of Wheat Flour Bread (Control)

The minerals content of wheat bread is shown in Figure 3 among major minerals sodium, and potassium content in wheat bread had been 30.51mg/100g, and 28.9mg/100g, respectively. Micheal [21] studied the minerals content; sodium and potassium of wheat flour (305.25 and 80.74 mg/100g), respectively.

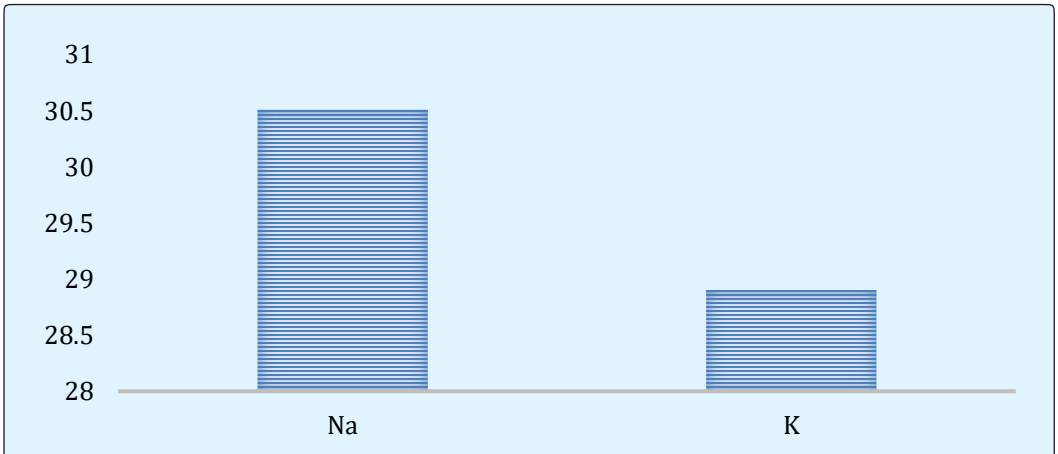

Figure 3: Minerals content (mg/100g) of wheat flour bread.

Chemical composition of steamed bread

The results of moisture, ash, crude protein, fat, carbohydrates, and some minerals contents of steam bread are illustrated in Table 2. The moisture content of the steam bread 0% and steam bread which have been added cowpea 4%, 6 % and 8% are shown in Tables 2 and were 30.18%, 32.17%, 31.37% and 30.33%, respectively. These results at the range 30.18-32.17%. This indicates the moisture content of steam bread higher than the moisture content of classical bread and the similar with results reported by Noor, et al. [22] which was found moisture content of steam bread at the range 30 -32.98%. As shown in Table 2, the protein content of steam bread (0%, 4%, 6% and 8%) were 7.36%, 11.10%, 12.89% and 14.79%, respectively. This result indicates when added cowpea the rated of protein was increase because cowpea is a high source of protein. The result steam bread 0% is lower than the result obtained by Abed Elmonem [13] who found 11.5% but near the result steam bread when we added cowpea 4% and also lower than 12.68% which reported by Eladawy [14]. However, it is higher than that obtained by Olaoye, et al. [15] who stated that the protein content of bread was 7.01 %. And the similar with results reported by Noor, et al. [22] which was found protein content of steam bread at the range 5.72 -8.75%.

Steam bread	Moisture	Ash	Crude fat	Crude protein	Carbohydrate
Control 0%	30.18±0.11	1.5±0.26	12.67±0.44	7.63±0.35	48.02±1.0
Cowpea 4%	32.17±0.08	1.83±0.18	14.97±0.26	11.10±0.36	39.93±0.35
Cowpea 6%	31.37±0.26	1.98±0.06	14.84±0.29	12.89±0.11	38.92±0.47
Cowpea 8%	30.33±0.35	1.91±0.06	11.82±0.60	14.79±0.23	41.45±0.46

Values are means ± standard deviations of 3 determinations.
Table 2: Proximate chemical composition (%) of processed steam bread.

Ash Content

Data in Table 2, showed that the ash content of steam bread (0%, 4%, 6% and 8%) were 1.5%, 1.83%, 1.98% and 1.91%respectively. The results were similar with results reported by Noor, et al. [22] which was found 1.83%. Also, this result was similar (1.90%) which reported by Abou Azm, [16]. However, was higher than the result of Mohsen, et al. [18] 1.2% and also higher than

that result 1.18% which reported by Eladawy [14]. On the other hand, Ammar et al. [19] reported that the ash content of bread was 0.5%. The ash content of cowpea supplemented bread samples were significantly higher ($p<0.05$) than that of the control, therefore, the addition of cowpea to wheat flour increased the ash content of the bread samples. In a study carried out by El-Soukkary [23] on pumpkin seed protein concentrate and isolate and wheat flour blends, it was as observed that the ash content of wheat flour bread (1.53%) was increased after addition of pumpkin seed protein isolate and concentrate (1.61 and 1.93%), respectively. The fat content of steam bread (0%, 4%, 6% and 8%) were shown in Tables 2, were 12.57%, 14.97%, 14.84% and 11.82% respectively. These results were higher than that reported by Noor, et al. [22] which was found fat content of steam bread 3.16%, 3.07% and 4.47%. Chemical composition of steam bread in Table 4.2, showed total carbohydrates content of steam bread (0%, 4%, 6% and 8%) were 48.02%, 39.93%, 38.92% and 41.45% respectively. These results are lower than results reported by Noor, et al., (2012) [22] which was found 55.71%, and lower than that reported by Elsayed [24] who reported 78.967%. The low carbohydrate content of the cowpea supplemented steamed bread samples compared to the control, and cowpea bread samples could have been due to multiple extractions using alkali and acid. The low carbohydrate content after addition of cowpea to wheat flour is in full agreement with those reported by Salama, et al. [25].

Minerals

As shown in Figures 3, sodium and potassium content of steam bread 0%, 4%, 6% and 8%. Sodium content was 38.0 mg/100g, 45.0 mg/100g, 47.0 mg/100g and 84.0 mg/100g, respectively, while the potassium content was 33.0 mg /100g, 41.0 mg /100g, 42.0 mg/100g and 43.0 mg/100g, respectively. The mineral content is associated with the ash content studied the minerals content; sodium and potassium of wheat flour 305.25% and 80.74% respectively. The result of potassium is lower than results reported by Noor, et al., [22], [26,27] which was found 85.4 mg/100g.

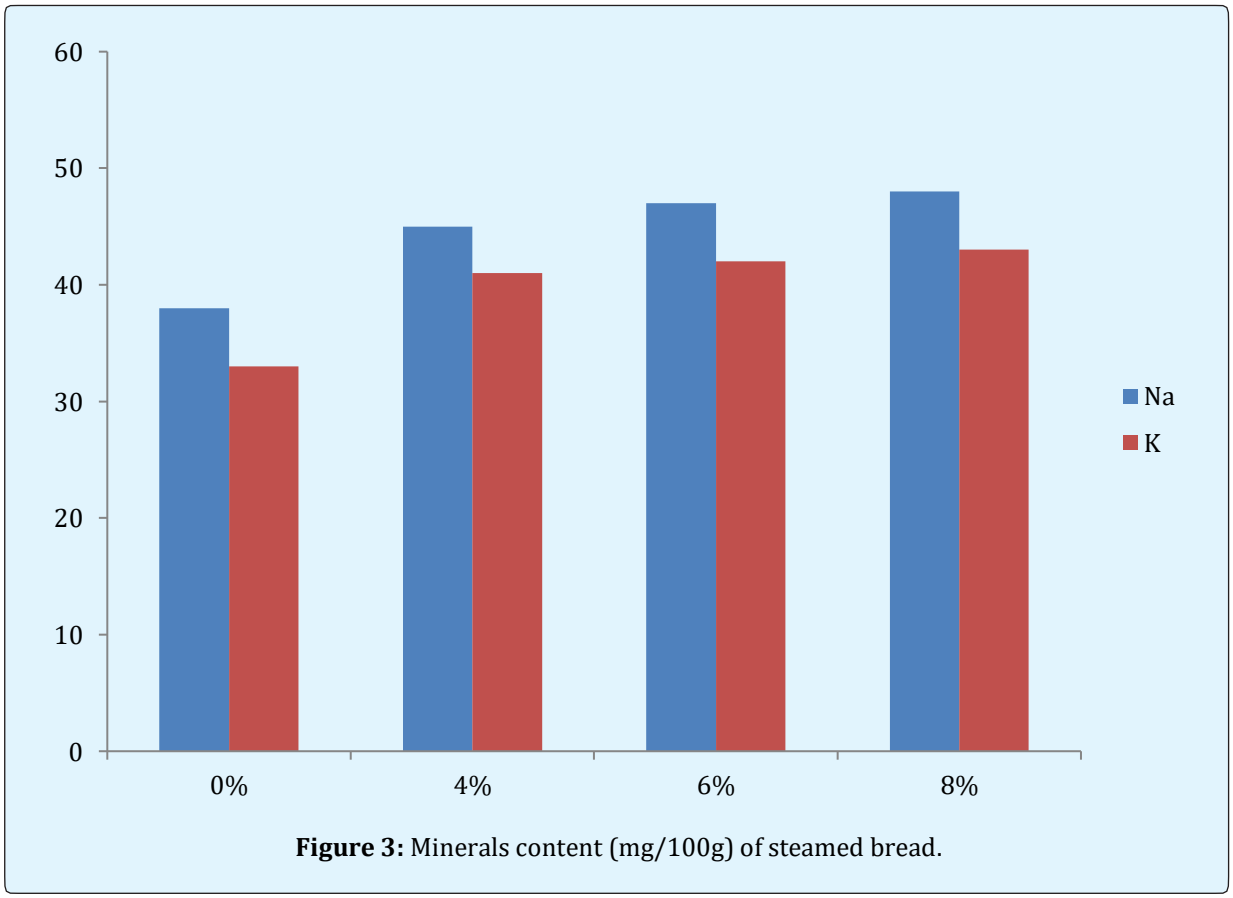

Figure 3: Minerals content (mg/100g) of steamed bread.

Sensory Evaluation of Bread

Sensory scores of steamed bread, bread and classical bread are presented in Table 3. The analysis of variance (ANOVA) of the data showed that the effect of steam bread on sensory properties was statistically significant ($p<0.005$) for all types of bread evaluated in this study.

Sensory evaluation of bread samples was undertaken with consideration of the most acceptable parameters; crust colour, crumb colour, texture, flavour, taste and the overall acceptability was taken and used as a control. The sensory properties of steam bread (control), bread and classical bread are presented in Table 3. All sensory scores crust colour, crumb colour, texture, flavour, taste and overall acceptability were significant. All bread was rated as acceptable by the panel except crust colour. The result from sensory evaluation revealed the panellists not to prefer for the darker coloured bread. According to the results in Table 3, steam bread (control) showed excellent attributes in comparison with other types of bread.

Sensory attributes	Steam bread	Bread	Classical
Crust color	7.5^{a}	6.7^{ab}	6.7^{b}
Crumb color	7.9^{a}	7.9^{a}	7.1^{a}
Texture	7.7^{a}	7.2^{a}	5.7^{a}
Flavor	8.6^{a}	7.9^{a}	7.4^{a}
Taste	8.7^{a}	7.8^{a}	7.0^{a}
Overall acceptability	8.2^{a}	7.7^{a}	6.9^{a}

The same superscript letters in a row are not significantly different (Duncan's test), significance at ($p<0.05$).
Table 3: Sensory evaluation of steam bread 0%, bread and classical bread.

The sensory properties of steam bread (control), steam bread with cowpea 4% and classical bread are presented in Table 4a. All sensory scores crust colour, crumb colour, texture, flavour, and overall acceptability were significantly different among blend samples, except flavour and taste. All bread was rated as acceptable by the panel except mouthfeel attribute of the samples steam bread (control) and steam bread with cowpea 4%, but the preference was classical bread. According to the results in Table 4, classical bread showed excellent attributes in comparison with other types of bread.

Sensory attributes	Classical bread	Steam Bread with cowpea 4%	Steam bread (control) 0%
Crust colour	7.9^{a}	5.7^{a}	6.5^{a}
Crumb colour	7.3^{a}	6.9^{a}	6.8^{a}
Texture	7.2^{a}	6.4^{a}	6.8^{a}
Flavor	7.7^{a}	6.5^{ab}	7.5^{b}
Taste	7.9^{a}	6.3^{ab}	7.1^{b}
Overall acceptability	7.8^{a}	5.9^{a}	6.6^{a}

The same superscript letters in a row are not significantly different (Tukey's test), significance at ($p<0.05$).
Table 4: Sensory analysis of classical bread, steam bread with cowpea 4% and steam bread 0%.

Conclusion

The general conclusions which can be derived from this research the difference between steam bread and bread made by the oven. The moisture content of steam bread was higher than the moisture content of classical bread. Even though, the only significant difference was observed in the steam bread with cowpea. Breadcrumb and crust colour showed a significant difference between steam bread and classical bread. Regarding sensory evaluation, no significant differences were detected in any aspect in classical bread, steam bread with cowpea 6% and steam bread (control). The addition of cowpea significantly improved the quality of the bread and its acceptability. The study also established that up to 6% cowpea substitution was unacceptable and produced bad quality bread compared to the others. There was the observation that the best effect of the additives achieved when the additives added at the lowest addition of cowpea and no further improvements were obtained by increasing the additives up to 6%.

References

1. Addo K, Pomeranz Y, Huang ML, Rubenthaler GL, Jeffers HC (1991) Steamed bread. II Role of protein content and strength. Cereal Chemistry 68(1): 39-42.

2. Cauvain SP, Huang S (1986) Chinese steamed bread FMBRA Bulletin 4: 151-158.

3. Rubenthaler GL, Huang ML, Pomeranz Y (1990) Steamed bread. I. Chinese steamed bread formulations and interactions. Cereal Chemistry 67(5): 471-475.

4. Bernard C (2006) Bernard Clayton's New Complete Book of Breads. Simon & Schuster. Columbus, Ohio, USA.

5. El-Adawy TA (1997) Effect of sesame seed protein supplementation on the nutritional, physical, chemical and sensory properties of wheat flour bread. Food Chem 59(1): 7-14.

6. AACC (2010) International Approved Methods of Analysis 11th(Edn.) Methods 44-15.02A Association of Official Analytical Chemists. Arlington, VA, USA.

7. AOAC (2000) Official Methods of Analysis of the AOAC, 15th (Edn.) Methods 932.06, 925.09, 985.29, 923.03. Association of official analytical chemists. Arlington, VA, USA.

8. AOAC (1990) Official Methods of Analysis of the AOAC, 15th (Edn.) Methods 932.06, 925.09, 985.29, 923.03. Association of official analytical chemists. Arlington, VA, USA.

9. Salim UR, Paterson AS, Hussain S, Murtaza MA, Mohamed S (2005) Effect of pearling on physicochemical, rheological characteristics and phytate content of Shahidi, F. and M. Naczk, Phenolics in cereals and legumes Lancaster, Pa. Technomic Publishing Co.,pp: 9-52.

10. Rao VK, Mulvaney SJ, Dexter JE (2000) Rheological characterisation of long- and short- mixing flour relaxation. Journal of Cereal Science 31(2): 159-171.

11. Shewry PR, Halford NG, Belton PS, Tatham AS (2002) The structure and properties of gluten: An elastic protein from wheat grain (PDF). Philosophical Transactions of the Royal Society B: Biological Sciences 357(1418): 133-142.

12. Carson LC, Sun XS (2000) Bread from White Grain Sorghum: Rheological Properties and Baking Volume with Exogenous Gluten Protein. Applied Engineering in Agriculture 16(4): 423-429.

13. Abed-Elmonem AM (1994) Studies on some low-calorie food. M.SC Thesis, Food industries Department, Fac. of agric., Elmansoura University, Egypt.

14. Eladawy TA (1995) Effect of sesame seed protein supplementation on the nutritional, physical, chemical and sensory properties of wheat flour bread. Plant Foods Hum Nutr 48(4): 311-26.

15. Olaoye OA, Onilude AA, Idowu OA (2006) Quality characteristics of bread produced from composite flours of wheat, plantain and soybeans. African Journal of Biotechnology 5(11): 1102-1106.

16. Abdalla IA (2003) Biscuits from Composite flour of Wheat and Sorghum.

17. Abou Elazm YZ (1982) Studies on improvement of local bread. M.S.C Thesis, Food Science and Tech. Dept. Fac. of Agric. Cairo University, Egypt.

18. Mohsen MM, Hussein AA, Salem EM (1997) Balady bread characteristics as affected by the addition of corn, barley or soy flour. Presented at the International Conference and Exhibition for food.

19. Ammar A. E. Hegazy and S.H Bedrin (2009) Using to taro flour as partial substitute of wheat flour in bread making. Journal of Dairy and food science 4(2): 94-99.

20. Malomo SA, Eleyimni AF, Fashakin (2011) Chemical composition, rheological properties and bread making potential of composite flours from breadfruit, breadnut and wheat. Journal of food science 5(7): 400-410.

21. Ameh MO, Gernah DI, Igbabul BD (2013) Physiochemical and Sensory Evaluation of Wheat Bread Supplemented with Stabilized Undefatted Rice Bran Food and Nutrition Sciences 4(9B): 43-48.

22. Noor AAA, Ho LH, Noor Shazliana AA, Bhat R (2012) Quality evaluation of steamed wheat bread substituted with green banana flour. International Food Research Journal 19(3): 869-876.

23. El-Soukkary FAH (2001) Evaluation of pumpkin seed products for bread fortification. Plant Foods for Human Nutrition 56(4): 365-384.

24. Elsayed AA (1999) The use of sorghum malt to enhance conventional fermentation of sorghum flour used for Kisra preparation.

25. Salama NA, Abd El-Latef AR, Shouk, AA, Alian AM (1992) Effect of some improvers on the nutritional components and in vitro digestibility of Egyptian Balady bread. Egyptian Journal of Food Science 20: 135-146.

26. Mohammed MIO, Mustafa AI, Gammaa AMO (2009) Evaluation of wheat bread supplemented with Teff (Eragrostis tef (ZUCC.) Trotter) Grain flour. Australian Journal of Crop Science 3(4): 207-212.

27. Blonstein AD, King PJ (2012) Genetic Approach to Plant Biochemistry. Plant Gene Research.