EFFECT OF DIFFERENT DOUGH IMPROVERS ON THE PROXIMATE COMPOSITION, MINERALS, VITAMINS AND SENSORY PROPERTIES OF WHEAT BREAD

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Abstract

Comparative evaluation of bread made from wheat flour using five different dough improvers was evaluated. The improvers were ascorbic acid, EDC-2000, (etheylene dough conditioner), *egg, STK (screw thread kneading), and azodicarbonamide. The samples were coded A, B, C, D, E and F where sample A with no improver served as the control. The proximate composition of the bread samples analyzed showed that the percentage crude protein content of the samples ranged between 7.06+0.06 to 8.37+0.11 and were significantly different at P<0.05 for all the dough improvers used. The highest value for the crude protein was recorded for bread baked with egg as the dough improver with a value of 8.37+0.11%. The % moisture, % ash and %crude fibre contents were not significantly different at P<0.05 while the fat and carbohydrate contents were significantly different for all the improvers used. The mineral composition of the bread samples analyzed were potassium, calcium, zinc, iron and phosphorus and all were significantly different with all the dough improvers used and the control sample A at P<0.05. The vitamin content analyzed comprised of water soluble and fat soluble vitamins. Vitamin A content of the bread samples ranged between 3.28+0.00mg/100g to 3.45+0.00mg/100g. The water soluble vitamins which comprised of Vitamins C,* B_1, B_2, *and* B_3 *were not significantly different with the control sample A at P<0.05 for all the dough improvers used. Bread samples were evaluated for sensory attributes of appearance, texture, crumb color, crust color, taste and general acceptability. Samples B, D, and E were rated significantly higher (P<0.05) for all the attributes except for taste. In terms of general acceptability, sample B (ascorbic acid improver) was rated highest with a mean value of 8.08+0.67 followed by sample D (egg improver) with a mean value of 8.0±0.43 while the least was recorded for bread without improver (control) with a mean value of 6.42±1.08.The bread volume was rated highest for sample B (ascorbic acid) with a value of* $3906.25cm^3$ *while the least volume was recorded for the bread without dough improver (control) with a value of* $2310cm^3$*. This work showed that acceptable bread could be produced from wheat flour using all the five bread improvers with ascorbic acid and egg giving better results in terms of sensory and physical characteristics of the bread.*

Key Words: wheat flour, dough improvers, bread.

INTRODUCTION

Bread is a food prepared by baking dough of flour, water and yeast and often additional ingredients, such as butter or salt to improve the taste (Osuji, 2006). Bread is one of the important staple foods in the world today. It has become an essential part of Nigerian diet, constituting the breakfast menu of many families, especially the medium and high income class. The consumption of which is steady and increasing in Nigeria as well as several countries of the world. Bread has come to symbolize existence. Hardly does a day pass without the commodity making appearance on the menu of many families (Okoroanyanwu *et al.*, 2007). Bread also comes in various sizes; small, medium and large loaves, thus making it affordable by everyone. Several ingredients are involved in bread making. Some are mandatory (flour, water, yeast) and others are optional (sugar, fat, emulsifiers, milk, malt flavour etc). Today in Nigeria many bread manufacturers add optional ingredients without regard to safety. For example potassium bromate added by Nigerian bakers is now prohibited in view of its health hazard (carcinogenic). Flour for bread making should be of good quality that is, flour with enough protein particularly gluten, must be capable of forming dough of satisfactory elasticity, strength and stability. In addition the flour should have good amylase activity, below 14% moisture and satisfactory colour. Flour treatment agents (also called improving agents, bread improvers, dough conditioners and dough improvers) are food addictives which are usually combined with flour to improve baking functionality. They are used to increase the speed of dough rising and to improve the strength and workability of the dough. In fact bakers in recent times cannot do without these improvers and they are the important component of modern plant baking, reducing the time needed to produce a loaf of bread to 2h from the 12 to 24h early bread making required. During preparation of the dough for bread making, a network of protein molecules is formed, linked together by disulphide bonds. The strength and elasticity of the network gives the dough its characteristics properties and is best when the network comprises of long chain proteins such as gluten. Unfortunately, short chain proteins are present such as glutathione, which reacts with gluten molecules breaking down the dough mixture. This can be prevented by adding oxidizing agents (Kent, 1984). Potassium bromate, ascorbic acid, azodicarbonamide are some of the examples of oxidizing agents. The reaction of these oxidizing agents increases the elasticity and reduces the extensibility of the dough. These oxidizing agents are also use to improve the handling characteristics of the dough, specific volume and texture of the finished product. Due to the disadvantage associated with the use of potassium bromate (carcinogenic), it has been banned by the National Agency for Food, Drug administration and control (NAFDAC) in Nigeria bakery industries. Since then research have been on going to get an alternative dough improver. Thus the objective of this study is to ascertain the effect of different dough improvers on proximate, mineral, vitamin and sensory attributes of the bread with the view of improving the prospect of bakery industries.

MATERIALS AND METHODS

Sample collection

The bread wheat flour of the golden penny brand and other ingredients like fat, sugar, salt, instant dried yeast, milk, dough improvers: EDC 2000, ascorbic acid, STK, azodicarbonamide and eggs used in this work were purchased at Owerri Main Market, Imo State, Nigeria.

Sample preparation

The method described by Oti and Aniedu (2006a,b) was used in the bread production. The ingredients – salt, water, sugar, fat, yeast, wheat flour and the dough improver were thoroughly mixed, fermented, kneaded, proved, baked, cooled, packed and stored prior to analysis. The bread production was repeated with the other four dough improvers.

PROXIMATE ANALYSIS

The percentage moisture, crude protein, fat, fibre, ash and carbohydrate were determined by the standard methods of AOAC (1990).

Determination of mineral content of bread samples

The mineral element (phosphorus, zinc, iron, potassium, and calcium) were determined by atomic absorption spectrometer method described by AOAC (1990).

Determination of vitamin content of the bread samples

The vitamins A, C, B_1, B_2, and B_3 were determined by the method described by AOAC (2000)

Determination of loaf volume

This was done by measuring the volume of the loaf from the dimensions. This was done by multiplying the dimension of length, width and height of the rectangular shaped loaf in cm^3.

SENSORY EVALUATION

Sensory evaluation of the five bread samples produced each with different dough improvers with the control sample (zero dough improver) was conducted using 12 member panelists. Bread samples quality was judged in terms of appearance/colour, crust texture, crumb texture, flavour/aroma, taste and overall acceptability. The 9-point hedonic scale (9 -like extremely, 5 – neither like nor dislike, 1 – dislike extremely) as described by Iwe (2002) was used

STATISTICAL ANALYSIS

All data were subjected to analysis of variance (ANOVA) and means were separated by Fisher's Test at 5% level of significance to establish where there were significant differences between the means (O'Mahony, 1986).

Results and Discussion

Proximate Composition of bread Samples

The result in Table 1.0 shows the proximate composition of the bread samples made with five different dough improvers.

The percentage crude protein content

The crude protein content for bread samples A, B, C, D, E and F were 8.22±0.03, 8.21±0.06, 7.06±0.06, 8.37±0.11, 8.17±0.11 and 7.53±0.39 respectively (Table 1.0). The bread sample produced with egg as bread improver had the highest value of protein with value of 8.37± 0.11 (Sample D). The reason for sample D having the highest protein content could be that the egg used which is a good source of protein contributed to the protein content. These values were within the range reported by Okezie (2006) that crude protein of baked samples using eggs are found to range from 8.36% to 9.26%. This implies that bread produced with egg as bread improver will help alleviate problem of protein malnutrition. The protein content of sample C was lowest with a value of 7.06±0.06 which could be attributed to the ability of EDC (etheylene dough conditioner) to denature protein molecules in baked products (Corrine, 1994).

Percentage ash Content

The ash content which is an indication of the mineral content of the bread samples ranged from 1.06±0.03 to 1.14±0.03. The ash content for all the samples were not significantly different from the control sample A at $P < 0.05$. This implies that the different bread improvers did not alter so much the mineral content of the bread. The sample E produced with STK improver had the highest ash content. The increase in the mineral content of baked products using STK as an improver was also reported by Corrine (1994) with an increase of 1.02%.

Percentage crude fibre

The crude fibre content of the bread samples produced from different dough improvers ranged from 0.92±0.04 to 1.05±0.00. Sample A (zero improver) had the least crude fibre content of 0.92±0.04 % while sample D (egg improver) had the highest crude fibre content of 1.05±0.05%. It was highest when compared with the recommended standard of crude fibre (0.80-0.98%) in some cereal flour. The highest crude fibre in sample D (egg improver) showed that egg could have inhibited the digestibility of polysaccharides in wheat flour. The high crude fibre obtained could add bulk to faeces thereby making defecation easier. When enough crude fibre is consumed they are passed into large intestine where they absorb water and swell thereby increasing the mass of the stool and also makes it soft (Olusanya,2008).

Percentage moisture content

The moisture content of the bread samples made from different dough improvers and the control sample (zero improver) were 34.71±0.13, 33.85±0.01, 32.80±0.05, 32.46±0.06, 32.53±0.11 and 32.78±0.11 for samples A, B , C ,D, E, and F respectively. They moisture contents were not significantly different for all the samples at $P<0.05$. The values obtained did not exceed the recommended moisture content of baked products of 35% by Standard Organization of Nigeria (SON). The values also did not differ much with what was reported by Lawrence and Adewumi (2012). The samples moisture content indicates that the product will likely have good shelf stability which will extend the usefulness of the products.

Percentage fat content

The fat content of the of the bread samples made from different improvers ranged from 11.92±0.03 to 12.84±0.00. Sample D (egg improver) had the least fat content of 11.92±0.03 Table 1.0. This could be as a result of the emulsifying property off the eggs which could have broken down the fat molecules enabling it to mix with water leading to reduction in its value. The fat content of the samples were higher when compared to the value reported by Lawrence and Adewumi (2012). This could be as a result of the recipe used in the production of the bread samples.

Carbohydrate content

The carbohydrate content of the bread samples made from different bread improvers ranged from 42.21±0.21%to 45.17±0.05%. The least carbohydrate content was recorded for the control sample A with zero improver with a value of 42.21±0.21%. The higher values of carbohydrate obtained for bread samples with improvers could be as a result of the presents of simple sugars in the bread improvers (Osuji, 2006).

Table 1.0: Proximate composition of wheat bread produced with different dough improvers

Parameters \ Samples	A (Control)	B	C	D	E	F	LSD
% Crude Protein	8.22±0.03^{a}	8.21±0.06^{a}	7.06±0.06^{c}	8.37±0.11^{a}	8.17±0.11^{a}	7.53±0.39^{b}	0.42
% Ash	1.11±0.02^{a}	1.06±0.01^{a}	1.12±0.01^{a}	1.10±0.03^{a}	1.14±0.03^{a}	1.08±0.01^{a}	------
% Crude fibre	0.92±0.04^{a}	0.94±0.00^{a}	1.02±0.00^{a}	1.05±0.00^{a}	0.94±0.03^{a}	0.95±0.01^{a}	------
% Moisture	34.71±0.13^{a}	33.85±0.01^{a}	32.80±0.05^{a}	32.46±0.06	32.53±0.11^{a}	32.78±0.11^{a}	------
% Fat	12.84±0.00^{a}	12.77±0.02^{a}	12.82±0.03^{a}	11.92±0.03^{b}	12.63±0.04^{a}	12.59±0.57^{a}	0.35
% Carbohydrate	42.21±0.21^{c}	43.18±0.08^{b}	45.17±0.05^{a}	45.10±0.00^{a}	44.61±0.19^{a}	45.08±0.57^{a}	0.65

Means in the same row with the same superscript are not significantly different at ($P<0.05$).

The means were separated using least significant difference (LSD) fisher's test

Sample A= wheat bread + zero improver (Control)

Sample B= wheat bread + ascorbic acid improver

Sample C= wheat bread + EDC 2000

Sample D= wheat bread+ egg improver

Sample E=wheat bread +STK improver

Sample F= wheat bread +azodicarbonamide

Mineral composition of wheat bread samples produced with different dough improvers.

Phosphorus

The phosphorus content of the bread samples is as shown in Table 2.0. The values ranged from 240.80±0.00mg/100g to 244.82±0.03mg/100g. The highest value was recorded with bread improver named azodicarbonamide (sample F). This could be as a result of the chemical composition of the improver. According to Gordon and Margaret (2002) about 20 to 30% of dietary phosphorus comes from food additives, especially in baked goods, cheeses, processed meat, and many soft drinks.

Zinc

The zinc content of the bread samples were 13.71±0.13mg/100g, 14.64±0.02, 12.66±0.2, 12.72±0.09, 14.49±0.09 and 14.65±0.07mg/100g for samples A (control), B, C, D, E and sample F respectively. The highest value was obtained in the bread sample with azodicarbonamide as dough improver with a value of 14.65±0.07mg/100g. According to Gordon and Margaret (2002) zinc is not part of the enrichment process of flour so refined flours are not a good source of zinc. This result corresponded with the range of value (12.28mg/100g to 15.28mg/100g) obtained by Fayemi (1999).

Iron

The iron content of the bread samples made from different dough improvers ranged between 25.77±0.44 and 32.54±0.37. The highest was sample B made with ascorbic acid as dough improver. According to Gordon and Margaret (2002) bakery products including white breads, rolls, and crackers are among major sources of iron. Most of the iron in these products is elemental forms of iron added to refined flour as part of the enrichment process. This result obtained is within the recommended dietary allowance according to Olusanya (2008) which stated that an adult man needs 30mg/100g to 500mg/100g iron. Iron helps to prevent anemia when included in the human diet.

Potassium

The potassium content of the bread samples were 206.78±0.00mg/100g, 209.53±0.11mg/100g, 208.18±0.03, 207.54±0.08, 209.62±0.00, 209.68±0.11mg/100g for samples A, B, C, D, E, and F respectively. Samples B (ascorbic acid improver), sample E (STK improver) and sample F (azodicarbonamide improver) had the highest potassium content (above 209mg/100g) while the least was the control sample A (zero improver) with a value of 206.78±0.00mg/100g. The values for the samples corresponded with the range recommended by world health organizations (200mg/100g to 240mg/100g). Potassium helps to maintain osmotic pressure and the acid base balance of the body. It also helps to activate several enzyme reactions (Olusanya, 2008).

Calcium

The calcium content of the bread samples ranged from 160.77±0.00mg/100g to 164.63±0.18mg/100g. The least was sample A (zero improver) with a value of 160.77±0.00mg/100g. The calcium contents for all the samples were below the recommended intake for calcium for adults which ranged from 1000 to 1200mg/day (Gordon and Margaret, 2002). This intake is required to build higher bone mass.

Ta ble 2.0. Mineral contents of wheat bread produced with different dough improvers

Parameters \ Samples	A (Control) mg/100g	B mg/100g	C mg/100g	D mg/100g	E mg/100g	F mg/100g	LSD
Phosphorus (P)	240.80±0.00[f]	243.88±0.04[b]	242.77±0.10[d]	242.56±0.08[de]	243.68±0.11[bc]	244.82±0.03[a]	0.25
Zinc (Zn)	13.71±0.13[b]	14.64±0.02[a]	12.66±0.20[cd]	12.72±0.09[c]	14.49±0.09[a]	14.65±0.07[a]	0.42
Iron (Fe)	25.77±0.44[f]	32.54±0.37[a]	29.67±0.10[d]	28.77±0.04[e]	31.62±0.02[b]	31.34±0.08b[c]	0.42
Potassium (K)	206.78±0.00[d]	209.53±0.11[a]	208.18±0.03[b]	207.54±0.08[c]	209.62±0.00[a]	209.68±0.00[a]	0.25
Calcium (Ca)	160.77±0.00[c]	164.63±0.18[a]	163.83±0.04[a]	162.79±0.01[b]	164.62±0.11[a]	164.19±0.01[a]	0.25

Means in the same row with the same superscript are not significantly different at ($P<0.05$).

The means were separated using least significant difference (LSD) fisher's test

Sample A= wheat bread + zero improver (Control)

Sample B= wheat bread + ascorbic acid improver

Sample C= wheat bread + EDC 2000

Sample D= wheat bread+ egg improver

Sample E=wheat bread +STK improver

Sample F= wheat bread +azodicarbonamid

Vitamin contents of wheat bread samples produced with different dough improvers.

The vitamin content of the bread samples made with different improvers is as shown in Table 3.0

Vitamin A

The vitamin A for the bread samples made with different dough improvers ranged from 3.28±0.00 to 3.45±0.00mg/100g. The bread sample A with zero improver (control) had the highest value of 3.45±0.00mg/100g. This could be as a result of non addition of dough improver that resulted in the non oxidation of vitamin A. The value obtained were within the range (3.26 to 3.60mg/100g) reported in baked products comprising of cake and bread (Uzor, 2008). Vitamin A is required for better vision.

Vitamin C

The vitamin C content of the bread samples ranged from 0.68±0.05 to 8.76±0.05mg/100g. Sample B (ascorbic acid dough improver) had the highest value of 8.76±0.05. The higher content of vitamin C could be as a result its composition of ascorbic acid (vitamin C). The value of the vitamin C contents of the different samples corresponded with value of (0.68 to 9.23mg/100g) reported by Hussan (2006). According to Hussan (2006) heat during baking decreases the level of Vitamin C in baked products. Vitamin C helps in prevention of scurvy.

Vitamin B_1, B_2 and B_3

Vitamin B_1 (thiamin) content of the bread samples ranged from 0.034mg/100g to 0.044mg/100g, Vitamin B_2 (riboflavin) ranged from 0.027mg/100g to 0.037mg/100g, while vitamin B_3 (niacin) ranged from 0.038mg/100g to 0.053mg/100g. According to Gordon and Margaret (2002) the low values obtained in all the B vitamins is as a result of heat destruction or alkalinity and all are subject to leaching into cooking water. The B vitamins and vitamin C is greatest in foods that are prepared by steaming, stir-frying, microwaving, or simmering in minimal moisture. Vitamin B_1, B_2 and B_3 help to prevent or cure these disease conditions of beriberi, ariboflavinosis and pellagra respectively (Gordon and Margaret, 2002).

Table 3.0. Vitamin contents of wheat bread produced with different dough improvers

Samples / Parameters	A (Control) mg/100g	B mg/100g	C mg/100g	D mg/100g	E mg/100g	F mg/100g	LSD
Vitamin A	3.45±0.00^{a}	3.43±0.00^{a}	3.28±0.00^{a}	3.42±0.00^{a}	3.38±0.03^{a}	3.29±0.01^{a}	……
Vitamin C	5.25±0.05^{a}	8.76±0.05^{a}	0.68±0.05^{a}	1.45±0.05^{a}	6.40±0.05^{a}	0.87±0.05^{a}	…….
Vitamin B_1	0.034±0.00^{a}	0.044±0.00^{a}	0.035±0.00^{a}	0.038±0.00^{a}	0.039±0.00^{a}	0.037±0.00^{a}	…….
Vitamin B_2	0.027±0.00^{a}	0.031±0.00^{a}	0.029±0.00^{a}	0.031±0.00^{a}	0.030±0.00^{a}	0.037±0.00^{a}	……..
Vitamin B_3	0.038±0.00^{a}	0.053±0.00^{a}	0.039±0.00^{a}	0.040±0.00^{a}	0.038±0.00^{a}	0.038±0.00^{a}	……...

Means in the same row with the same superscript are not significantly different at ($P<0.05$).

The means were separated using least significant difference (LSD) fisher's test

Sample A= wheat bread + zero improver (Control)

Sample B= wheat bread + ascorbic acid improver

Sample C= wheat bread + EDC 2000

Sample D= wheat bread+ egg improver

Sample E=wheat bread +STK improver (**Screw type kneading) machine improvers**

Sample F= wheat bread +azodicarbonamide

Sensory evaluation of bread samples made with different dough improvers

The mean sensory scores of the bread made with different dough improvers were as shown in Table 4.0.

Colour

The scores of the colour were 6.41±1.56, 7.33±0.65 and 6.80±0.83, 8.10±0.29, 7.00±0.60 and 6.3±0.89 for samples A, B, C, D, E and F respectively. There is significant difference in the colour of all the samples at P <0.05. Sample D (egg improver) was rated highest in terms of colour with a mean value of 8.10±0.2. It could be as a result of egg used as an improver which might have induced mailliard reaction. This is a reaction involving proteins and carbohydrate resulting in browning or darkening of colour of food products. According to Ihekoronye and Ngoddy (1985) drying of eggs results in the darkening of the colour by the process of maillard reaction.

Crust texture

The mean scores for the crust texture of the bread samples made with different dough improvers ranged from 5.75±0.86 to 8.1±0.39. The bread sample with egg improver was most preferred by the panelist while the least preferred was sample A with zero improver Table 4.0. The high mean value for the bread sample with egg improver could be attributed to maillard reaction which is involved in the crust formation as well as caramelization of the sugars (Ihekoronye and Ngoddy, 1985).

Crumb Texture

The mean score for the crumb texture of the bread samples made with different improvers ranged from 5.91±1.2 to 7.5±0.80. Sample D (egg improver) was rated highest while the least was sample F (azodicarbonamide improver) Table 4.0. The reason for the bread sample with egg improver being rated highest in terms of crumb texture could be that the protein content from the egg may have aided in the smooth consistency of the dough during kneading and formation of tiny smooth pores in the crumb after baking. According to Ihekoronye and Ngoddy (1985) eggs help in structure formation in food products and the egg white proteins ovalbumin and globulins are important in foam formation. When these proteins partially coagulate at the interface, they facilitate retention of air which provides leavening and volume and gives the dough light porous structure which is retained to form open honey comb texture of the finished bread. This also takes place during fermentation of sugar in the dough.

Flavour/Aroma

The flavour/aroma of the bread sample with egg improver was rated highest with a mean score of 7.8±0.58 by the panelist. Table 4.0. Maillard reaction of the egg protein with the sugar in the flours could be responsible for the high rating of the flavour of the bread sample with egg improver. According to Ihekoronye and Ngoddy (1985) maillard reaction is responsible for many of the specific taste, aromas, and colours of foods. This is in addition to alcohol and other products of yeast fermentation which the products formed in the crust by heat of the oven.

Taste

In terms of the taste, the bread sample D made with egg as the dough improver was scored highest with mean value of 8.25±0.62 Table 4.0 while the least scored was sample F, bread made with azodicarbonamide as dough improver with a mean value of 5.50±1.0. The highest score of the taste for sample D with egg as dough improver according to Ihekoronye and Ngoddy (1985) could be attributed mostly to the maillard reaction just as it is with the colour and aroma.

General Acceptance

In general acceptability the sample B (ascorbic acid improver) was rated highest with a mean score of 8.08±0.67 .This was followed by sample D (egg improver) with a mean score of B (8.00±0.43) while sample A (zero improver) was rated the least with mean score of 6.42±1.08. The least rating of the bread sample with zero improver (sample A) in terms of general acceptability emphasis the need for addition of dough improver in the production of bread by bakery industries. It also implied that ascorbic acid and egg dough improvers which were most preferred should be the best choice of bakers inorder to improve the sensory and physical properties of their bread products.

Volume of bread samples made with different dough improvers

The volumes of the bread samples made with different dough improvers were included in Table 4.0. The volumes were 2310.00cm^3, 3906.25 cm^3, 2783.00 cm^3, 2662.00 cm^3, 3456.00 cm^3, and 3272.14 cm^3 for samples A, B, C, D, E and F respectively. The highest bread volume was recorded with bread sample baked with ascorbic acid as dough improver (Sample B) while the least was the control sample A (zero improver). The bread volume of all the dough improvers used was higher than the control sample A, with zero improver. This implied that addition of dough improvers in bread increases the volume of the bread and hence its acceptability.

Table 4.0. Sensory evaluation and volumes of bread produced with different dough improvers

Parameters \ Samples	**A (Control) mg/100g**	**B mg/100g**	**C mg/100g**	**D mg/100g**	**E mg/100g**	**F mg/100g**	**LSD**
Colour	6.41±1.56^{cd}	7.33±0.65^{ab}	6.8±0.83^{cd}	8.1±0.29^{a}	7.00±0.60^{bc}	6.30±0.89^{d}	0.89
Crust texture	5.75±0.86^{d}	7.33±0.89^{ab}	6.83±0.72^{bc}	8.10±0.39^{a}	6.83±0.71^{bc}	5.75±0.87^{d}	0.75
Crumb texture	6.40±1.31^{bc}	7.00±0.43^{ab}	6.67±0.65^{abc}	7.50±0.80^{a}	7.10±0.51^{ab}	5.91±1.20^{c}	0.86
Flavour/Aroma	6.3±1.23^{b}	7.50±0.80b	6.33±0.49b	7.80±0.58a	6.60±0.51b	6.10±1.16b	0.73
Taste	6.25±0.87^{cd}	7.83±0.94^{a}	6.58±0.79^{bc}	8.25±0.62^{a}	5.83±0.83^{cd}	5.50±1.0^{d}	0.81
Overall acceptance	6.62±1.08^{d}	8.08±0.67^{a}	7.17±0.58^{c}	8.00±0.43^{a}	7.58±0.51^{ab}	6.58±0.67^{cd}	0.69
Bread volume	2310.00cm^{3}	3906.25cm^{3}	2783.00cm^{3}	2662.00cm^{3}	3456.00cm^{3}	3272.14cm^{3}	

Means in the same row with the same superscript are not significantly different at ($P<0.05$).

The means were separated using least significant difference (LSD) fisher's test

Sample A= wheat bread + zero improver (Control)

Sample B= wheat bread + ascorbic acid improver

Sample C= wheat bread + EDC 2000, Sample D= wheat bread+ egg improver

Sample E=wheat bread +STK improver (**Screw type kneading) machine improvers,** Sample F= wheat bread +azodicarbonamide

Conclusion

This work showed that acceptable bread could be produced from wheat flour using all the five bread improvers with ascorbic acid and egg giving better results in terms of sensory and physical characteristics of the bread. Bread produced without dough improver will likely have poor physical and sensory attributes like poor volume, taste, flavour, crust colour, crumb texture and crust texture.

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