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Full Length Research Paper

The leavening ability of baker's yeast on dough prepared with composite flour (wheat/cassava)

O. O. Aboaba* and E. A. Obakpolor

Department of Botany and Microbiology, University of Lagos, Lagos, Nigeria.

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The leavening ability of baker's yeast on dough prepared with composite flour (wheat/cassava) was investigated. The composite flour was prepared in four different proportions and it was discovered that an increase in the quantity of cassava flour caused a decrease in the ability of the baker's yeast to leaven the dough. However, the composite flour with 10% cassava flour produced an appreciable level of leavening. The effect of temperature on leavening of the composite dough by the baker's yeast was also investigated. It was found that fermentation of dough at 37ºC increased the rate of leavening and an appreciable level of dough size was achieved. The degree of agitation/mixing and the time used for the composite dough was investigated and it was found that longer periods of agitation in minutes produced increased level of dough. The results from the sensory evaluation showed that the bread baked with 10% composite dough was the most acceptable by the panellists. There was no disparity in the scores given to the samples based on age, as the three different age groups gave similar results.

Key words: Composite, wheat flour, sensory evaluation.

INTRODUCTION

Flour is a fine powder commonly made from wheat, but also from maize, rye, barley, and rice, amongst many other grasses and non-grain plants. Usually, the word "flour" used alone refers to wheat flour. Wheat flour is the main ingredient in most types of breads and pastries. When wheat flour is mixed with water, a complex protein called gluten is formed. The gluten development is what gives wheat dough an elastic structure that allows it to be worked in a variety of ways, and which allows the retention of gas bubbles in an intact structure, resulting in a sponge-like texture to the final product. This is highly desired for breads, cakes and other baked products. However, certain individuals suffer from intolerance to wheat gluten known as coeliac or celiac disease. Increased awareness of this disorder, as well as a rising belief in the benefits of a gluten-free diet for persons suffering certain other conditions, led to an increased demand for bread, pasta, and other products made with flours that do not contain gluten.

Composite flour technology initially referred to the process of mixing wheat flour with cereal and legume flours for making bread and biscuits. However, the term can also be used in regard to mixing of non-wheat flours, roots and tubers, legumes or other raw materials (Dendy, 1992).

Also, the addition of wheat flour to locally available cereals and root crops was found to be desirable to encourage the agricultural sector and reduce wheat imports in many developing countries. Although actual consumer trials have been rare, products made with composite flour have been well accepted in Colombia, Kenya, Nigeria, Senegal, Sri Lanka and the Sudan (Dendy, 1992). Consumer acceptance trials in Nigeria indicated that bread made with 30% sorghum flour was comparable to that from 100% wheat bread (Aluko and Olugbemi, 1989; Olatunji et al., 1989). Bread with 30% sorghum and 70% wheat are also prepared in Senegal (Thiam and Ndoye, 1977). In recent times, the use of composite flour has become more popular in bread making (Shittu et al., Ade-Omowaye, 2008).

Many types of bread are leavened with yeast. The yeast used for leavening bread is *Saccharomyces cerevisae* the same species used for brewing alcoholic beverages. When yeast is used for making bread, it is mixed with flour, salt, and warm water (or milk). The dough is kneaded until it is smooth and then left to rise, sometimes until it has doubled in size. The dough is then shaped into loaves, left to rise until it is the correct size

*Corresponding author. E-mail: simboaboaba@yahoo.com.

and then baked to produce the final product. The ability of the Yeast to produce bread from composite flour (wheat/cassava) that will be widely acceptable in our environment is still a subject of debate. This work was undertaken to determine the exact composition of the composite flour that will compare favourably with 100% wheat bread in term of quality attributes and consumer acceptability.

MATERIALS AND METHODS

Sample collection

The commercial bakers yeast (Saf Leuvre active dry yeast, manufactured by S.I.L Lesaffre, France), wheat flour (Honeywell brand), sugar and salt (Dangote brand) and baking fat (Rosa Brand) were also purchased from the market, in Lagos metropolis. The cassava flour used was obtained from the Federal Institute of Industrial Research Oshodi (FIIRO), Nigeria.

Preparation of baker's yeast

The commercial baker's yeast was prepared for use according to the manufacturer's instructions. A known weight of 1.5 g active dry yeast granules was weighed and dissolved in 56 ml sterile, warm (40ºC) distilled water in 100 ml sterile conical flask. The yeast granules were allowed to dissolve completely in the water before use.

Leavening profile of dough (wheat/cassava)

The composite dough used for this experiment was prepared in the following ratios:

Sample A: 90% wheat flour and 10% cassava flour.
Sample B: 80% wheat flour and 20% cassava flour.
Sample C: 70% wheat flour and 30% cassava flour.
Sample D: 60% wheat flour and 40% cassava flour.
Sample X (control): 100% wheat flour.

A known weight (40 g) of sample A was mixed with 1 g of granulated sugar in a 100 ml beaker. The yeast suspension was added and the mixture stirred with a sterile glass rod. This procedure was repeated with samples B, C, D and X (control).

The dough mixtures for the samples were individually poured into 250 ml measuring cylinders. The volume of the dough was measured and recorded. They were transferred to a room temperature (28ºC) incubator. The volume of dough for each sample was recorded every 10 min till it remained constant.

Effect of increased temperature

Samples A, B, C, D and X (control) were prepared as above. The dough mixtures were poured into 250 ml measuring cylinders and the volume of dough was measured and recorded. They were placed in a 37ºC incubator. The volume changes were recorded at 10 mins intervals till it remained constant

Effect of agitation/mixing on leavening

Sample A was selected for the next stage of the study as it had the best leavening profile. Four samples were prepared following the procedure above. One was agitated for 10 mins and labelled A1. Another portion was agitated for 20 mins and labelled A2, A3 and A4 were agitated for 30 and 40 mins, respectively. The agitation/mixing was done with an electric hand-held mixer. Sample A1 was agitated / mixed for 10 mins. The mixtures were poured as above into 250 ml measuring cylinders and volume was recorded for every 10 mins. The values obtained for volume changes were plotted against time for agitation.

Preparation of bread from composite flour

The dough for sample X was prepared by weighing 500 g wheat flour, 50 g sugar, 7.5 g salt, 10 g baking fat and 5 g baker's yeast into a clean metallic mixing bowl (FIIRO, 2006). An industrial mixer was used to mix the ingredients in order to homogenize the mixture for 30 min. 300 ml of water was added to the dough until the desired consistency was achieved. The dough was removed, weighed and divided into 2 equal portions. These were placed in separate baking pans of equal size and left for 1 h. They were transferred into an oven pre-heated to about 180 - 250ºC and allowed to bake for 20 min. The baked products were left to cool. This procedure was repeated for all other samples (A, B, C and D).

Sensory evaluation

The consumer acceptability of all the samples was evaluated by a panel of 30 individuals from three (3) age groups:

Group 1: 16 – 25 years (10 members)
Group 2: 26 – 50 years (12 members)
Group 3: Over 50 years (8 members).

The panellists graded the bread on a scale of 1 to 9, with 1 being "very poor" and 9 being "excellent". The parameters tested included general appearance, texture of crumb, colour of crumb, size of loaf, taste and overall quality.

Sample codes were given to all baked samples:
Sample A: BC10 (bread with 10% cassava flour and 90% wheat flour)
Sample B: BC20 (bread with 20% cassava flour and 80% wheat flour)
Sample C: BC30 (bread with 30% cassava flour and 70% wheat flour)
Sample D: BC40 (bread with 40%cassava flour and 60% wheat flour)
Sample X (control): BPW (bread with 100% wheat flour).

RESULTS

Leavening of composite dough (wheat/cassava)

Change in volume was observed for all samples. The time taken for dough leavening decreased as the quantity of cassava flour increased. The composite sample which attained the highest volume was sample A (Figure 1).

Effect of increased temperature (37ºC)

This temperature gave an increase in dough size compared with that at room temperature (28ºC). The The

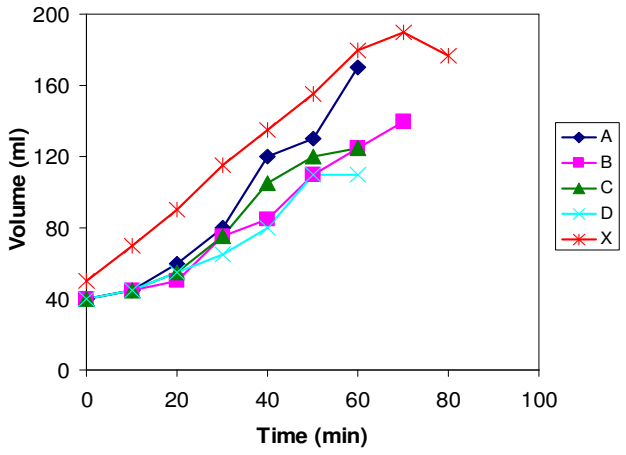

Figure 1. Leavening profiles of dough prepared from composite flour of different proportions (Samples A, B, C, D and X) at room temperature (28ºC)

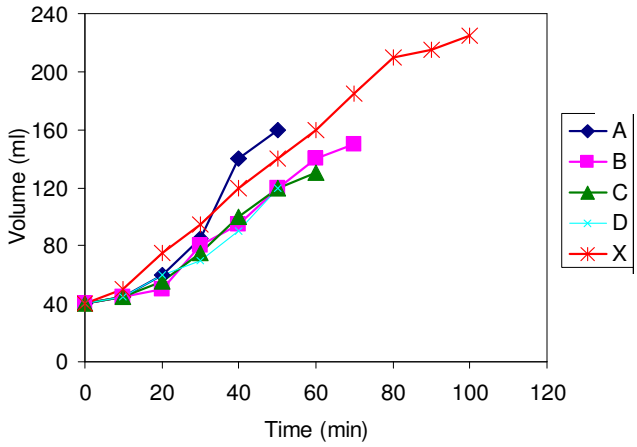

Figure 2. Leavening profiles of dough prepared from composite flour of different proportions (samples A, B, C, D and X) at 37ºC.

highest volume recorded for the composite flour was in Sample A (160 ml) followed by B, C and D though the wheat flour (control) rose to 225 mls (Figure 2).

Effect of agitation/mixing on leavening profile

Increase in agitation time favoured increase in leavening ability of the yeast and thus an increase in dough volume (Figure 3). However, agitation time of 40 mins gave a sharp increase in the first seventy minutes (145 mls) but dropped immediately after.

Preparation of bread from composite flour sample

All samples were baked under the same set of conditions. Dough volume for all samples did not show

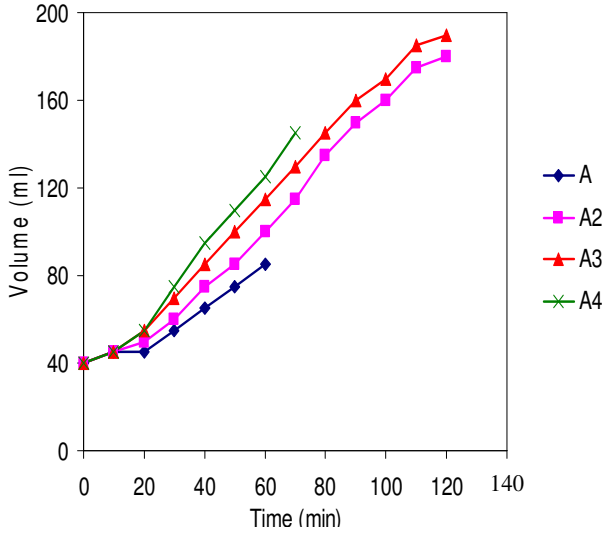

Figure 3. Leavening profiles of sample A agitated/mixed for varying period of time (mins).

any obvious signs of disparity before baking. However, on baking, the appearance of the bread samples showed the effect of the addition of increasing amounts of cassava flour. The brown colour of the crust of the bread was less evident with the samples containing high concentration of cassava flour (Samples C and D). The overall colour and size were also affected (Plate 1).

Sensory evaluation

The panellists all showed preference for samples BPW (control). This was closely followed by BC10 and 20 irrespective of the parameters tested and age group. Samples BC30 and 40 were the least preferred. This can be seen in the mean value of scores given for all samples (Figure 4).

DISCUSSION

The leavening ability of commercial baker's yeast on composite flour (wheat/cassava) was investigated. The leavening of dough during bread production is as a result of carbon dioxide produced by the fermenting organism which is usually *Saccharomyces* Species (Plyer, 1973). Yeast, specifically *Saccharomyces cerevisiae*, is used in baking as a leavening agent, where it converts the fermentable sugars present in the dough into carbon dioxide. This causes the dough to expand or rise as the carbon dioxide forms pockets or bubbles. When the dough is baked it "sets" and the pockets remain, giving the baked product a soft and spongy texture.

The composite flour programme initiated by the Food and Agriculture Organization of the United Nations (FAO), countries which could not meet their wheat

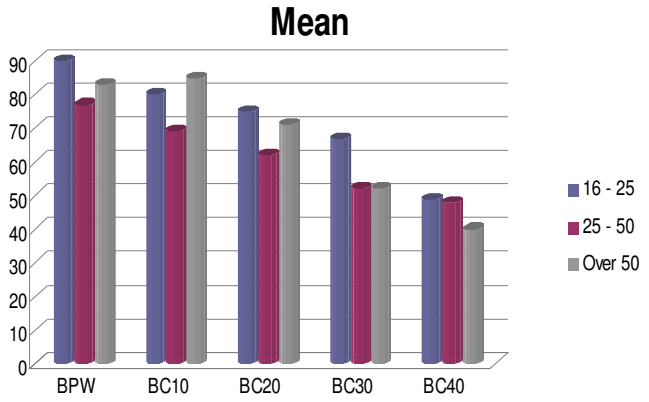

Figure 4. Mean scores of all attributes tested for sensory evaluation.

Plate 1. Samples after baking (left to right): BPW, BC10, BC20, BC30 and 40.

requirements. Although the bakery products obtained were of good quality, similar in some of their main characteristics to wheat-flour bread, the texture and palatability of the composite-flour bakery products were different from those made from wheat flour. The light, evenly structured bread made of wheat flour and the characteristic soft crumbs are due to the swelling properties of wheat-flour gluten in water.

Efforts have been made in many countries to produce bread by conventional methods from wheat flour to which other flours such as cassava flour were added. It was generally found that the upper limit of such an addition was about 10% as the quality of the resultant bread was rapidly impaired beyond this limit of non-wheat flour content. In this study, the composite flour containing 10 and 20% cassava flour gave products that compared favourably with the control (100% wheat).This supports the findings of similar studies. Eddy et al. (2007) produced bread from 20% plantain and 80% wheat, Ade-Omowaye et al. (2008) from 10% tigernutflour and 90% wheat While Shittu et al. (2007) from 10% cassava and 90% wheat.

It was observed that increase in quantity of cassava flour in the dough was responsible for the change in the leavening profile of the dough. The inclusion of cassava flour significantly reduced the leavening profile of the dough especially as the quantity increased beyond 20% at room temperature (Figure 1). This can be explained by the fact that as the concentration of wheat flour in each successive sample was reduced, the concentration of wheat gluten was also reduced and thus a corresponding decrease in dough volume. Gluten is responsible for the entrapment of carbon dioxide evolved by yeast respiration and ultimately for the elasticity of dough. Thus, a reduction in its concentration would cause a reduction in dough elasticity. The reduction in leavening of the 10 and 20% composites however did not have was conceived primarily to develop bakery products from locally available raw materials, particularly in those significant effects on the dough volume and the finished product (Bread). An appreciable level of leavening was obtained at 37°C. Activity of the Yeast was favoured at this increased temperature is required for optimal enzyme activity (Figure 2).

Dough mixtures are usually agitated by mixing to ensure that air pockets are created. It was found that the dough volume increased as agitation time increased but only to a limited extent as longer period (40 min) caused a drastic drop in volume. The period for mixing therefore is important as if influences the size and quality of bread. The agitation enhances the ability of the dough to trap more air.

Prospects for commercial production and widespread consumption of bread made of composite flours in different countries will depend upon local acceptance (taste and characteristics of the bread) and the price at which the bread will be available to the public (www.FAO.org). Sensory evaluation results showed that the bread containing 10 and 20% cassava flour was acceptable judging by all parameters used. However, those with 30 and 40% were not acceptable by the panellists (Figure 4). The size, colour of the crust (Plate 1), loaf texture and taste were most undesirable. This is not surprising as the high content of cassava made binding of the dough difficult, thus affecting the overall quality of the product and thus its acceptability. However, in recent times it is possible to increase the level of the non-wheat flour considerably without too great a change in the bread characteristics, provided certain bread improvers such as calcium stearyl lactylate are added or a relatively high percentage of fat and sugar used. Bread of acceptable quality was obtained by the use of 30% of either cassava or corn (maize) starch and 70% wheat (Grace, 1977).

Conclusion

In many developing countries such as Nigeria, bread has become a staple food. This has increased the dependence on importation of wheat flour as wheat is not indigenous to the region. There is need therefore to look inwards and supplement the wheat with other sources of starch such as cassava or cereal flour to be able to conserve foreign exchange as bread from composite flour is comparable with that obtained from wheat flour. Thus composite flour technology should hold excellent promise for developing countries.

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