HOSTED BY
ELSEVIER
CrossMark
Available online at www.sciencedirect.com
ScienceDirect
Nigerian Food Journal 33 (2015) 12–17
www.elsevier.com/locate/nifoj

Physico-chemical properties of wheat-yam flour composite bread

C. Amandikwa[a,*], M.O. Iwe[b], A. Uzomah[a], A.I. Olawuni[a]

[a]Department of Food Science and Technology, Federal University of Technology, PMB 1526 Owerri, Imo State, Nigeria
[b]Department of Food Science and Technology, Michael Okpara University of Agriculture Umudike, PMB 7267 Umuahia, Abia State, Nigeria

Available online 23 May 2015

Abstract

This work investigated the effect of yam flour substitution on characteristics of wheat bread and also determined the functional properties of the experimental flour samples. Flours were obtained from three varieties of yam (*Dioscorea rotundata, Dioscorea alata* and *Dioscorea bulbifera*) and blended with wheat flour at 25, 50 and 75 percent levels of substitution for bread production. Wheat flour (WF) and each of the yam flours were used as the positive and negative controls respectively. The functional properties (bulk density, water/oil absorption capacities, emulsion activity) of the flour samples were determined while the proximate, physical and sensory characteristics of loaves were also determined. The functional properties of the flour samples ranged from 0.42 g/ml to 0.67 g/ml packed bulk density; 0.39 g/ml to 0.47 g/ml loose bulk density; 0.88 ml/g to 2.10 ml/g oil absorption capacity; 1.50 ml/g to 3.90 ml/g water absorption capacity and 43.75% to 49.37% emulsion activity. The proximate composition of the bread samples ranged from 26.82% to 38.90% moisture, 4.23% to 5.10% fat, 6.10% to 9.25% protein, 1.90% to 2.45% ash, 0.12% to 0.64% crude fiber and 46.43% to 56.71% carbohydrate. The volume, weight and specific volume of loaves varied from 200 ml to 400 ml, 142.6 g to 170.2 g and 1.18 ml/g to 2.81 ml/g respectively. The crack formation of bread samples showed that there were no cracks on wheat bread (WF) and 25% yam flour substituted breads while 100 percent yam flour breads had large cracks. The sensory properties of the 25% yam flour substituted breads were statistically ($p > 0.05$) the same with the 100% wheat bread but differed from all the other bread samples. The mean score of the sensory attributes decreased as yam flour increased in the formulation. Sensory Evaluation of the bread samples showed that substitution level of 25% yam flour produced bread that was acceptable to the consumers whereas up to 50% and above were not acceptable. It is therefore recommended that substitution level of not more than 25% yam flour be used for yam/wheat composite bread production.

Keywords: Physico-chemical; Wheat; Yam; Composite; Bread

1. Introduction

Yam belongs to the order *Lilliales*, family *Dioscoreacea* and genus *Dioscorea*. Yam comprises of many varieties which are edible and some others which are not edible (Eke, 1990). Yam is a staple food for millions of people in the world, providing an important source of carbohydrate and more protein on dry weight basis than is commonly assumed (IITA, 1992). Yam may be boiled, baked, fried, roasted and mashed to suit regional tastes and customs of the people. Bread generally represents a food prepared from dough and baked to produce an outer crust and an inner cell structure (Barret, 1975). Bread is described as a loaf made from wheat or rye flour.

Previous studies have shown the incorporation of non – wheat flours in bread production. Cardenas et al. (1993) replaced 30% of wheat flour with sweet potato flour in bread and there was no difference in sensory characteristics or protein quality of the sweet potato-wheat bread.

Furthermore, Greene and Bovel–Benjamin (2004) investigated the microscopic and sensory properties of bread supplemented with sweet potato and found that substitution level of 65% can be used in bread making. Similarly, Ukpabia and Uchechukwu (2001) investigated the potentials of Chinese yam (*Discorea esculenta*) flour in bread making and found that at 30% level of substitution, the yam/wheat bread showed no significant difference from

*Corresponding author.
E-mail address: amandikwa125@yahoo.com (C. Amandikwa).
Peer review under responsibility of Association of Vice-Chancellors of Nigerian Universities.

http://dx.doi.org/10.1016/j.nifoj.2015.04.011

the whole wheat bread. In some other studies with cereal grains, Edema et al. (2005) evaluated the production of sour maize bread using soybean flour blends. These workers suggested the addition of not more than 10% protein supplement in the form of soybean flour or other legumes (with amino acid profile comparable to that of soybean) that is expected to give nutritionally balanced and acceptable maize-bread.

Product diversification with yam tubers has been minimal and some of these yam varieties are not widely cultivated due to inadequate utilization. There is, therefore, the need to investigate the bread making potentials of some of these yam varieties. Successful production of bread supplemented with yam flour will not only encourage improved cultivation of this crop but will also enhance the economic value of the crop. Therefore the specific objective of the present research was to evaluate the effect of three yam varieties on the characteristic properties of bread.

2. Materials and methods

2.1. Study location

The study locations were at the Department of Food Science and Technology, Michael Okpara University of Agriculture Umudike, Abia State and the Department of Food Science and Technology, Federal University of Technology Owerri, Imo State, both in Nigeria. These locations are predominantly occupied by Ibo speaking ethnic groups in Nigeria who cultivate and consume a large proportion of annual yam production in Nigeria.

2.2. Materials

The different yam varieties namely *Dioscorea rotundata* (white yam), *Dioscorea alata* (water yam) and *Dioscorea bulbifera* (aerial yam) were purchased from the farmers in the respective locations in Abia State of Nigeria. Wheat flour (Golden Penny brand) and other ingredients for bread were purchased from the local market.

2.2.1. Preparation of yam flour samples

Five kilogram each of the yam varieties were peeled, thinly sliced, washed and blanched in boiling water for 4 min and then sun dried until the moisture content was between 10% and 13%. The dried chips were milled to pass through 250 μm mesh sieve to obtain the flour. Each flour sample *Dioscorea rotundata* flour (DRF), *Dioscorea alata* flour (DAF) and *Dioscorea bulbifera* flour (DBF) was stored separately in tightly covered plastic jars to prevent moisture re-absorption.

2.3. Research design

The research was laid out in a completely randomized design comprising of two factors. Factor A is yam variety, while factor B is level of substitution; 25%, 50% and 75% level of substitution. Hundred percent wheat flour (WF) bread was used as the positive control while 100% yam flour bread was used as the negative control. The individual flour samples were subjected to functional properties while the bread samples were subjected to proximate composition analysis, physical characteristics and sensory evaluation. Proximate and functional analyses were done in triplicate. Statistical differences of data obtained were determined by ANOVA ($p > 0.05$) using SPSS (12 Software for windows) while the significant means were compared using Fisher's Least Significant Difference (LSD) procedure (Roessler, 1984).

2.4. Determination of functional properties

2.4.1. Bulk density (BD)

Bulk density of the flour samples was determined by the gravimetric method described by Okezie and Bello (1988). A weighed sample (10 g) was put in a calibrated 25 ml measuring cylinder and the volume was recorded as the loose volume. The bottom of the cylinder was tapped repeatedly on a firm pad on a laboratory bench until a constant volume was observed. The packed volume was recorded. The loose bulk density (LBD) and packed bulk densities (PBD) were calculated as the ratio of the sample weight to the volume occupied by the sample before and after tapping.

2.4.2. Water/oil absorption capacity

Water and Oil absorption capacities (WAC/OAC) for each flour sample were determined by the method of Abbey and Ibeh (1988). The sample (10% w/v) was weighed into a clean conical flask and was mixed thoroughly with distilled water/oil using a warring mixer for 30 s. The sample was then allowed to stand for 30 min at room temperature, after which it was centrifuged at 5000 rpm for 30 min. The free water or oil (supernatant) was read directly from the graduated centrifuge tube. The absorbed water/oil was converted to weight (in grams) by multiplying by the respective density (water, 1 g/ml and soybean oil, 0.924 g/ml). The water and oil absorption capacities were express in grams of water/oil absorbed per gram of flour sample.

2.4.3. Emulsion activity (EA)

Emulsion activity was determined according to the modified method of Okezie and Bello (1988). Two grams of flour sample was blended with 25 ml distilled water at room temperature for 30 s in a warring blender at 1600 rpm. After complete dispersion, 25 ml soy oil was added gradually and blended for another 30 s. The blend was centrifuged for 5 min at 1600 rpm. The volume of oil which separated from the sample after centrifugation was read directly from the tube. Emulsion activity was calculated as the ratio of height of emulsion to the total height expressed as a percentage.

2.5. Bread making process

The bread was produced according to the method described by Edema et al. (2005). The flours obtained were blended with wheat flour (WF) at 25:75, 50:50 and 75:25 levels of substitution for bread production. Yam: WF at 100:0and 0:100 levels were used as control. The bread recipe consisted of 100 g of each blend, 6.2 g sugar, 1.7 g salt, 3.9 g margarine, 3.3 g yeast, 0.02 g ascorbic acid and 56 ml of warm water (43 °C). More water was