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EVALUATION OF THE POTENTIAL OF SOURSOP (*ANNONA MURICATA*) FLOUR IN BREAD PRODUCTION

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ABSTRACT

The effect of addition of soursop flour to wheat flour at the rates of 15, 20, 25 and 30g on the nutrient and physical properties of wheat-soursop composite bread was evaluated. Standard methods were used in flour production; determinationof proximate composition, proving rate, loaf weight, loaf volume, specific loaf volume and sensory attributes. The additionoffreeze dried soursop flour significantly ($p \leqslant 0.05$) increased the carbohydrate, ash and energy contents of composite bread samples whileoven dried soursop flouraddition elevated protein and fiber contents of bread samples. Theincrease in freeze and oven dried soursop flours significantly ($p \leqslant 0.05$) decreased ether extract, proving rates and loaf weight of bread samples. The loaf volume and specific loaf volume of wheat-freeze dried soursop composite bread samplesdecreased significantly ($p \leqslant 0.05$)while those ofwheat-oven dried soursop bread samplesincreased significantly ($p \leqslant 0.05$) with increase in soursop flour. Wheat-freeze dried bread sample A_2(250:20) was most accepted with a sensory score of (7.6). Soursop fruit flour has quality attributes that could be harnessed in bread production thereby diversifying its utilization as a food material and improving the nutritional quality of bread.

Keywords:Soursop flour, composite flour, bread, proximate composition, sensory properties

1.0 INTRODUCTION

In most parts of the world, baked foods, based on wheat flour in particular, are popular foodstuffs. The consumption of these products has been consistently on the increase in developing countries like Nigeria as a result of increasing population, urbanization and changing food habits (Edema *et al*., 2005; Eggleston *et al*., 1992). The basic ingredient for the production of bread is wheat flour. However, the use of non-wheat or composite flour in bread making is recently being practiced in many countries of the world for some social, cultural, economic, agronomical and nutritional/ heath reasons (Gallagher *et al*., 2004). For example in Europe, the increasing incidence of celiac disease or allergic reactions/intolerances to wheat gluten has caused food markets to be filled with wheatless breads (Gallagher *et al*., 2004). The use of non-wheat or composite flour for baking in Nigeria could be justified from both the agronomic and economic perspectives. Also, in choosing the appropriate flour type for non-wheat baking, full consideration should be given to the realities of the local agricultural resources prevalent in the area. Nations all over the world have developed their own bread specialties based on their available agricultural resources (Edema *et al*., 2005). Nigeria's climatic condition is not adaptable for growing wheat suitable for baking purposes. Consequently, a lot of the nations scarce foreign earning is spent on wheat importation to satisfy local use.

It has long been established that bread could be produced from partial or complete substitution of wheat flour with flours from other non-wheat sources such as cassava, potato, rice, sorghum, millet, rye, barley and corn (Kim and de Ruiter,

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1969; Ciacco and D'Appolonia, 1977). More recently, it was demonstrated that triticale flour could replace wheat flour to a level of 30-70% and still produce bread quality comparable to 100% wheat flour (Doxastakis*et al*., 2002). In Nigeria, considerable information is available on composite breads (Ade *et al*., 2012, Ochemee*t al*., 2010; Adebowale*et al*., 2009; Idowu*et al*., 1996; Adeyemi*et al*., 1992).

Soursop belongs to the family *Annonaceae*and genus *Annona*which consist of some 800 tropical tree species with fleshy berries. It is a rich source of B-vitamins and minerals (particularly calcium and potassium) but very low in fat and sodium content. Its low sodium content makes it to be highly recommended in cases of cardiovascular disease. Its heart shape has given it the ancient reputation of strengthening the heart (Pamplona-Roger, 2004).In Nigeria, large quantities of fruits are produced annually and good quantities of these fruits are lost due to poor postharvest handling and storage. The use of fruits in the production of bread has not been fully investigated and exploited in Nigeria. Mepba*et al*.(2007) reported that acceptable bread from wheat-plantain composite flour can be formulated using up to 80:20 w/w ratios of wheat:mature plantain flour. Ochemee*t al*.(2010) investigated the effect of fermented plantain flour on the baking qualities of bread. In this study, the effect of soursop flour addition on the proximate composition, physical and sensory properties of bread was investigated.

2.0 MATERIALS AND METHODS

2.1 Source of materials

Fresh soursop (*Annonamuricata*) fruits were purchased from Railway market, Makurdi, Benue State, Nigeria. The purchased fruits were packed into clean polyethylene bags and transported to the Food and Nutrition Laboratory of the Department of Home Science and Management, University of Agriculture, Makurdi for processing.

2.2 Sample preparation

The fresh soursop fruits were carefully sorted and washed using clean tap water. The were peeled, sliced (5mm thick), seeds removedand ground into pulp with kitchen blender(Sonik model: SB-735, Japan).One thousand grams (1000g) of the ground fruit pulp was then oven dried at 30^0C (72hr), to obtain the oven dried flour while another 1000g of the fruit pulp was frozen for 1hr at-30^0C and freeze dried at -40^0C (72 hr) to obtain
the freeze dried soursop flour.

2.3 Recipe for bread production

Ingredients used were wheat flour (2000g), soursop flour (oven and freeze dried) (90 g each), sugar (66g),warm water (160ml), milk (20g), yeast (7.5g), butter (2.5g), eggs (1 big egg),salt (5 g). Bread loaves were produced using each of the formulated flour blends 250:15; 250:20; 250:25; 250:30 w/w of wheat and soursop flour while 100:0 whole wheat flour served as control. The straight dough mixing method ofBrabet*et al*.(1998) was employed in this study. Baking was performedusing Fisher Scientific Isotemp Oven(model: 655F, Chicago, USA) at 180^0C for 20 min.

2.4 Determination of proximate composition of bread samples

Moisture, crude protein, crude fibre, fat and ash content were determined by the AOAC (1990) method while carbohydrate was by difference.

2.5 Sensory Evaluation

The bread samples were subjected to sensory evaluation one hour after production. Ten (10) semi-trained panelists evaluated the bread samples using a 9 – point hedonic scale, with 1 = disliked extremely and 9 = liked extremely (Taiwo, 1997). The bread samples were evaluated on the basis of colour, texture, aroma, taste, after taste, thickness, and overall acceptability.

2.6 Cost Benefit Analysis

Cost benefit analysis was performed using the formula below:

Total **c**ost of flour = Cost of wheat flour + Cost of soursop flour

2.7 Data analysis

Data generated were subjected to analysis of variance (ANOVA) using SAS (2000) statistical

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Data generated were subjected to analysis of variance (ANOVA) using SAS (2000) statistical software while mean values were separated from triplicate laboratory determinations using fisher's least significant difference (F-LSD) at 5% level of probability.

3.0. RESULTS AND DISCUSSION

The proximate composition of the bread samples ispresented in Table 1. Significant differences ($p \leqslant 0.05$) were observed in the moisture, carbohydrate, protein, fat, fibre, ash and energy content of most of the samples.The moisture content of wheat-freeze dried soursop bread samplesranged from 14.80% - 21.00% and 14.70% - 19.00% for wheat-oven dried soursop bread samples. The moisture content of bread samples of this study were lower than 20.54% - 21.22% reported for wheat-fermented plantain bread (Ochemee*t al*., 2010). The low moisture content of the bread samples could contribute to long shelf life of the bread when stored at ambient temperature. Carbohydrate content of the bread samples ranged from 43.26% - 54.66% (wheat-freeze dried soursop bread) and 54.16% - 57.54% (wheat-oven dried soursop bread). The result showed that wheat-freeze dried soursop bread samples (A_1(250:15) to A_4(250:30)) had lower carbohydrate content than wheat-oven dried soursop bread samples (B_1(250:15) to B_4(250:30)). The carbohydrate content of wheat-freeze dried soursop bread samples increased with increase in soursop flour addition while those of wheat-oven dried soursop bread samples decreased.The carbohydrate values of this study were however, lower than those reported for wheat-plantain bread (57.25% – 59.75%) by Kure *et al*. (1998) andwheat-fermented plantain bread (61.10% - 61.36%) byOchemee*t al*. (2010) but higher than 16.10%- 16.44% reported for wheat-Cactus pear bread byArandu*et al*.(2008). The low carbohydrate content of wheat-freeze dried soursop bread samples could be beneficial to those individuals desirous of loosing or maintaining a healthy weight and for diabetic patients in particular. As the carbohydrate content of a food material affects its glycemic load and hence weight gain.Wheat-freeze dried soursopbread samples had higher (19.09-19.69%) protein content relative to control (10.94%). The protein content of wheat-freeze dried soursop bread samples were however, significantly not different ($p \geqslant 0.05$). The protein content of wheat-oven dried soursop bread samples ranged from 15.31% to 19.69% with significant differences ($p \leqslant 0.05$). The inconsistency in protein content of wheat-oven dried soursop bread samples could be attributed to inappropriate mixing of wheat and soursop flours. The protein content of wheat-soursop bread samples were higher than those reported for wheat-fermented plantain bread (8.91%-11.37%), sour cassava bread (7.42%-13.88%), wheat-banana cake (6.99%-9.48%) andAfrican pear biscuit (9.51%-14.13%) as reported by Ochemee*t al*. (2010); Adegunwa*et al*. (2010); Eke *et al*. (2009) and Onuegbu*et al*.(2011), respectively. The fibre content of wheat-freeze dried soursop bread samples ranged from 2.75 % - 4.45% while those of wheat-oven dried soursop bread samples ranged from 2.45 % - 2.85%. The wheat-freeze dried soursop bread samples have higher fibre content than those of wheat-oven dried soursop bread samples. The fibre content of wheat-freeze dried soursop bread samples however, decreased with increase in soursop flour while those of wheat-oven dried soursop bread samples increased with increase in soursop flour. The fibre values of wheat-soursop bread samples were higher than those reported for wheat-fermented plantain bread (Ochemee*t al*., 2010). Fibre has been reported to boost bowel movement thus lowering the transit time of food in the stomach, binds excessive fats and aid in management of constipation. The ether extract of wheat-freeze dried soursop bread samples ranged from 2.60% - 8.60% while those of wheat-oven dried soursop bread samples ranged from 3.305 – 6.80%. The ether extract of the bread samples decreased with increase in soursop flour addition. The ether extract of the bread samples also decreased with increase in fibre content showing the binding effect of fibre on fat. The fat content of the bread samples were higher than those reported for wheat-fermented plantain bread (Ochemee*t al*., 2010) but lower than 15.75 – 17.91% reported for fortified sour cassava starch bread (Adegunwa*et al*., 2010). Low-fat diets are desirable to guide against excessive energy intake that may predispose individuals to excessive weight gain. The ash content of the bread samples

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increased significantly with increase in soursop flour addition. The high ash content of breads baked from wheat-freeze dried soursop flour may impact positively on the plasma mineral levels of consumers thereby alleviating the incidence of deficiency diseases. The energy content of the breads ranged from 328.30 - 531.40Kcal inwheat-freeze dried soursop bread and 296.40 -356.60Kcal inwheat-oven dried soursop bread. The energy contents of wheat-freeze dried soursop bread samples were higher than those of wheat-oven dried soursop bread samples.

The result of the physical properties of the bread samples is presented in Table 2. The proving rates of bread samples A_1(250:15w/w) to A_4(250:30w/w) and B_1(250:15w/w) to B_4(250:30w/w) decreased with increase in quantity of soursop flour. The proving rates of the bread samples however, improved with time and were better than control. Wheat-freeze dried soursop bread sample A_1(250:15) had highest proving rate, loaf weight (200g), loaf volume (1.30cm^3) and specific loaf volume (0.0065cm^3/g). The loaf weight of composite breads decreased with increase addition of soursop flour. The loaf volume and specific loaf volume of wheat-freeze dried soursop breads decreased with increase soursop flour while those of wheat-oven dried soursop breads increased with soursop flour. The loaf weight of samples A_1(250:15) to A_4(250:30w/w) were higher than control (100:0 w/w). The decrease in loaf weight, loaf volume and specific loaf volume of wheat-freeze dried soursop breads was in agreement with the report of Ochem*eet al*.(2010) but lower than their values for wheat-fermented ripe plantain bread. This could be attributed to decrease in gluten content of composite flours occasioned by substitution of wheat flour with soursop flour.

Table 3 shows mean sensory scores of wheat-soursop bread samples. Bread sample A_1(250:15) have highest sensory score for colour and texture, sample A_3(250:25) for thickness and taste while sample A_2(250:20) for aroma, after taste and overall acceptability. Among samples B_1(250:15) to B_4(250:30), bread sample B_1(250:15) have the highest score for colour, thickness, texture, taste and after taste while sample B_2(250:20) have the highest score for aroma and overall acceptability. Wheat-soursop bread samples A_1(250:15) to A_4(250:30) have higher sensory scores for all the parameters assessed than control (wheat bread). Substitution of wheat flour with oven dried soursop flour in bread production impacted negatively on sensory and acceptability rating of bread samples B_1(250:15) to B_4(250:30).Increasedsubstitution of wheat flour with freeze dried soursop flour in bread production gave rise to decreased colour, thickness and texture ratings but enhanced the taste, aroma and overall acceptability rating of bread samples. The cost of producing a loaf of bread using wheat-soursop composite flour is shown in Table 4. The cost analysis showed that it cost more (₦416.67 to ₦883.33) to produce a loaf of wheat-soursop bread than whole wheat bread (₦50).This cost can however be reduced with commercialization of soursop flour production using cost effective technologies and methods.

4.0 CONCLUSION

Soursop flour with baking qualities can be produced using freeze drying technology. The utilization of freeze and oven dried soursop flour in bread production significantly improved nutritional and physical quality as well as organoleptic attributes of bread. In order to obtain bread of high quality and overall acceptability 20% soursop flour incorporation is recommended.

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Table 1: Effect of soursop flour addition on the proximate composition of Wheat-soursop Bread (%)

Samples (Wheat + Soursop flour (g)	Moisture	Carbohydrate	Crude Protein	Crude Fibre	Ether Extract	Ash	Energy (kcal)
Wheat-freeze dried soursop breads							
A_1 (250: 15)	21.00 ± 0.58	43.26 = 0.02	19.09 ± 0.01	4.45 ± 0.02	8.50 ± 0.06	3.10 ± 0.06	328.30 ± 0.06
A_2 (250: 20)	14.80 ± 0.12	50.70 = 0.01	19.16 ± 0.02	3.30 ± 0.06	8.60 ± 0.81	2.30 ± 0.17	368.00 ± 0.58
A_3 (250: 25)	17.20 ± 0.12	54.66 = 0.02	19.37 ± 0.01	3.45 ± 0.03	2.60 ± 0.12	2.40 ± 0.12	531.40 ± 0.12
A_4 (250: 30)	19.70 ± 0.17	51.96 = 0.02	19.69 ± 0.01	2.75 ± 0.02	4.00 ± 0.06	6.60 ± 0.12	344.80 ± 0.06
Wheat-oven dried soursop breads							
B_1 (250: 15)	17.90 ± 0.06	56.04 = 0.01	15.31 ± 0.01	2.45 ± 0.03	6.60 ± 0.23	1.70 ± 0.12	344.80 ± 0.06
B_2 (250: 20)	14.70 ± 0.12	54.16 = 0.02	19.69 ± 0.01	2.75 ± 0.01	6.80 ± 0.23	1.90 ± 0.17	356.60 ± 0.12
B_3 (250: 25)	19.00 ± 1.15	57.54 = 0.01	15.31 ± 0.01	2.85 ± 0.02	3.30 ± 0.06	2.00 ±0.06	303.70 ± 0.12
B_4 (250: 30)	17.90 ± 0.06	55.63 = 1.33	19.69 ± 0.01	2.82 ± 0.02	3.30 ± 0.06	2.00 ± 0.12	296.40 ± 0.01
Control (Whole wheat bread)	19.50 ± 0.29	54.61 = 0.01	10.94 ± 0.01	4.45 ± 0.03	7.40 ± 0.06	3.10 ± 0.17	328.80 ± 0.23
F-LSD$_{0.05}$	**1.34**	**1.32**	**0.03**	**0.09**	**0.89**	**0.37**	**0.69**
Cv (%)	4.31	1.44	0.11	1.52	8.87	9.53	1.00

Means are values of three replicates. F-LSD$_{0.05}$ = Fisher's Least Significant Difference at 5% level of probability. Cv = Coefficient of Variation

Table 2: Effect of soursop flour on the proving rate, Loaf weight, Volume and Specific Loaf Volume of wheat-soursop Bread

Samples	Proving Rate (min) 30	60	Loaf wt (g)	LV (cm^3)	SLV (cm^3/g)
90					
Wheat-freeze dried soursop Bread					
A_1 (250: 15) 40.00±0.58	20.00±0.58	35.00±2.31	200.00 = 1.55	1.30 = 0.17	0.0065 = 0.00
A_2 (250: 20) 31.00±1.73	12.00±1.15	25.00±0.58	180.00 = 2.89	1.10 = 0.06	0.0061 = 0.00
A_3 (250: 25) 30.00±0.58	10.00±0.58	22.00±1.15	150.00 = 2.31	0.90 = 0.15	0.0060 = 0.00
A_4 (250: 30) 27.00±1.15	9.00±1.73	17.00±0.58	160.00 = 2.89	0.20 = 0.06	0.0013 = 0.00
Wheat-oven dried soursop Bread					
B_1 (250: 15) 31.00±0.58	25.00±1.15	29.00±2.31	150.00 = 1.73	0.10 = 0.06	0.0006 = 0.00
B_2 (250: 20) 25.00±2.31	21.00±0.58	24.00±1.15	160.00 = 1.15	0.30 = 0.12	0.0019 = 0.00
B_3 (250: 25) 22.00±1.15	20.00±1.15	22.00±1.15	130.00 = 2.31	0.50 = 0.06	0.0038 = 0.00

B_4 (250: 30) 23.00±1.73	17.00±1.73	20.00±0.58	120.00 ± 0.58	0.90 ± 0.06	0.0075 ± 0.00
Control 26.00±2.31	14.00±1.15	21.00±0.58	150.00 ± 5.77	1.00 ± 0.06	0.0067 ± 0.00
F-LSD0.05 4.47	3.48	3.96	**13.959**	**0.2878**	**0.0012**
Cv (%) 9.19	12.33	9.07	5.23	24.22	13.76

Key: LV = Loaf Volume, SLV = Specific Loaf Volume

Table 3: Effect of soursop flour on the mean sensory scores of Wheat-soursop Bread

Samples	Colour	Thickness	Texture	Taste	Aroma	After Taste	Acceptability
Wheat-freeze dried soursop Bread							
A_1 (250: 15)	7.80	7.20	7.80	6.50	5.90	7.00	6.80
A_2 (250: 20)	6.50	6.40	7.00	6.80	6.90	7.60	7.60
A_3 (250: 25)	6.50	7.90	7.50	6.90	6.10	6.30	6.10
A_4 (250: 30)	5.20	6.70	6.20	6.20	6.20	7.00	7.30
Wheat-oven dried soursop Bread							
B_1 (250: 15)	6.00	7.40	7.10	6.20	4.30	6.50	6.10
B_2 (250: 20)	5.40	5.90	6.70	5.50	6.00	6.10	6.60
B_3 (250: 25)	4.60	6.90	6.50	4.90	3.80	4.40	3.90
B_4 (250: 30)	4.40	5.70	5.70	5.00	4.90	5.50	6.00
Control	7.60	6.90	6.40	6.80	6.30	6.30	5.20
F-LSD$_{0.05}$	**1.98**	1.38	**1.34**	**1.94**	**1.69**	**1.60**	**1.52**
Cv (%)	37.03	22.84	22.26	35.82	33.84	28.60	27.68

Means are values of three replicate determinations. F-LSD0.05 = Fisher's Least Significant Difference at 5% level of probability. Cv = Coefficient of Variation

Table 4: Cost analysis of bread samples based on flour cost rate.

Parameter	WB	A_1	A_2	A_3	A_4	B_1	B_2	B_3	B_4
Wheat flour (₦)	50	50	50	50	50	50	50	50	50
Soursop flour (₦)	-	416.67	555.56	694.44	833.33	416.67	555.56	694.44	833.33
Total cost (₦)	50	466.67	605.56	744.44	883.33	466.67	605.56	744.44	883.33

Key: WB = wheat bread, A_1 = A_1(250:15), A_2(250:20), A_3(250:25), A_4(250:30), B_1(250:15), B_2(250:20), B_3(250:25), B_4(250:30)

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