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Research Paper

Effect of added Bambara groundnut on the quality of acha-date palm based biscuit

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Abstract. Biscuits samples were prepared from varying compositions of acha and Bambara groundnut flour. Date palm fruit flour was used in place of sucrose (sugar). The proximate (protein, ash, fat, moisture, fibre and carbohydrate), physical (weight, spread ratio and break strength) and sensory (taste, odour, colour, texture, general acceptability) properties of the acha– Bambara composite biscuits were analyzed. The average proximate composition for protein, fat, crude fibre, ash and moisture increased (5.70 to 7.90, 10.8 to 12.6, 2.6 to 3.7, 1.9 to 3.3, 0.75 to 0.95%, respectively) while carbohydrate decreased from 78 to 72% with increase in the added Bambara groundnut. The break strength and spread ratio of the biscuits increased from 700 to 1000 g and 7.33 to 8.90, respectively with increase in added Bambara groundnut.

Keywords: Quality, Bambara groundnut, acha, biscuit.

INTRODUCTION

Biscuits are ready-to-eat, cheap and convenient food product that is consumed among all age groups in many countries (Hussein et al., 2006). Biscuits are an important product in human diet and are usually eaten with tea and are also used as weaning food for infants. The school going children use them as snacks while at school (Javaid et al., 1995). They have been reported to be rich in carbohydrate and fat; hence they can be referred to as energy giving food as well as good sources of protein and minerals (Kure et al., 1998). The primary ingredients of simple biscuits include wheat flour, water, sugar, fat and eggs (Javaid et al., 1995). Other ingredients may include shortening, leavening agents, salt and flavour (Adebowale et al., 2012).

Wheat is the major ingredient in biscuit (Hui, 1992) and experience gained in the use of composite flours has clearly demonstrated that for reasons of both product technology and consumer acceptance, wheat is an essential component in many of these flours (Mepba et al., 2007). Furthermore, in many parts of sub-Saharan Africa and most especially Nigeria, advancing prosperity and urbanization coupled with tremendous increase in population in recent years have led to an increase in population in recent years have led to an increase in the consumption of wheat-based products especially biscuits and breads (Adebowale et al., 2012). However, the production of wheat in Nigeria is extremely low and far below domestic requirements (Adebowale et al., 2012) because the climate in Nigeria does not favour its cultivation (Olapade and Oluwole, 2013). Consequently, wheat is imported to Nigeria thus making the costs of baked products such as biscuit and bread to be very high (Mepba et al., 2007). The critical criteria of use of any food material in processing are its availability and cost (Olapade and Oluwole, 2013) and thus give impetus for further research into the use of other cereal flours for baking.

Acha (*Digitaria exilis*) also known as hungry rice is one of the indigenous and underutilized African cereals (Jideani and Akingbala, 1993). The cereal is uniquely rich

in methionine and cystine and evokes low sugar on consumption (Ayo et al., 2007). Lasekan (1994) reported that acha contains high pentosans, which gives it the property of absorbing water to produce very viscous solution, an attribute recognized for good baking operation. Recent findings of the unique property of acha in diminishing blood glucose level and subsequent reduction of diabetic populace have made this crop an attractive research focus (Jideani, 1999; Ayo and Okoliko, 2003). Several works have been done on the baking potential of acha either as whole or composite flour with appreciable level of acceptance (Ayo and Nkama, 2004; Ayo et al., 2007; Olapade et al., 2011; Olapade and Oluwole 2013).

Like most cereals, acha is deficient in essential amino acids such as lysine and tryptophan, therefore enrichment of cereal based foods with other protein source such as legumes has received considerable attention (Mensah and Tunkins, 2003). It is evident that when cereals and legumes are judiciously selected and combined, desirable pattern of essential amino acids of high biological value is obtained (Jideani, 1999).

Bambara groundnut (*Vandzeia substerranean* L.) is a legume specie of African origin which serves as an important source of protein in the diet of a large percentage of the population in Africa particularly the poorer people who cannot afford expensive animal protein (Ocran et al., 1998). The high water absorption property of acha is triggered by the presence of high residual protein coupled with high level of sulphur and hydrophobic amino acid residue (Obizoba and Egbenna, 1991; Okaka, 2005) which is resident in Bambara groundnut. The gross energy value of Bambara groundnut seed is greater than those of other common pulses such as cowpea and pigeon pea (Obizoba and Egbenna 1991). Alozie et al. (2009) reported that Bambara nut protein contain higher essential amino acid methionine than other grain legumes while the oil content is less than half of the amount found in legumes like peanut, thus, Bambara groundnut could be used to supplement acha in order to provide a balanced amino acid profile.

The usefulness of Bambara groundnut in developing high protein foods in meeting the needs of vulnerable groups is attracting attention. Several workers have reported the enrichments of foods with Bambara groundnut (Alozie et al., 2009; Olapade and Oluwole, 2013) but there is dearth of information on Bambara nut enriched acha based biscuit. This research therefore aimed at improving the quality of acha based biscuit using Bambara groundnut and date palm (*Phoenix dactylifera*) as a substitute for sucrose.

MATERIALS AND METHODS

Acha grain (*Digitaria exilis*), Bambara nut (*V. subterranean*), date palm fruit (*Phoenix dactylifera*), baking fat (Simas), baking powder (Wise men), milk (Peak), were purchased from Muda Lawal market, Bauchi.

Preparation of Bambara groundnut flour

Bambara groundnut grains were sorted, cleaned, toasted, and allowed to cool. The grains were milled with the use of hammer mill into fine flour and sieved through a sieve with aperture 0.300mm, packed in a polythene bag and stored in a cool dry environment as Bambara groundnut flour.

Preparation of acha flour

Acha flour was prepared by washing the grains with tap water, draining and drying in cabinet drier (at 50°C for 6 h). The resultant dried acha was milled into flour (using the hammer mill) and sieved (0.3 mm screen size).

Preparation of date palm flour

Date palm fruits were sorted to remove immature, overripe and damaged ones. The seeds were removed and the pulp was pulverized and dried (in a cabinet drier at 40°C for 5 h) and sieved (0.5 mm screen size) (Obiora, 2011).

Formulation of samples

The flours were separately packaged in moisture proof polyethylene bags, sealed and stored under refrigeration until when required. Subsequently formulation of samples was made as shown in Table 1.

Preparation of biscuit

Biscuits were prepared according to the method described by Javaid et al. (1995), cooled and packed in polythene bags for subsequent analyses.

Analyses of samples

Physical (weight, height, spread ratio, break strength) and sensory (taste, texture, colour, flavour, crispiness) qualities of the biscuit samples were determined using methods described by Gomeez et al. (1997) and Ihekoronye and Ngoddy (1985), respectively. Proximate quality (protein, fat, ash, moisture, crude fibre) of the samples were evaluated using standard methods (AOAC, 1990). The data (mean score) collected were analyzed using Analysis of Variance (ANOVA) and difference

Table 1. Biscuit recipe.

Ingredient	Samples					
	A	B	C	D	E	F
Acha flour (g)	100	95	90	85	80	75
Bambara nut flour(g)	0	5	10	15	20	25
Date palm (g)	45	45	45	45	45	45
Baking powder(g)	3.6	3.6	3.6	3.6	3.6	3.6
Baking fat (g)	50	50	50	50	50	50
Milk (ml)	30	30	30	30	30	30

Table 2. Effect of Bambara groundnut flour on the proximate qualities of acha-date palm based biscuit.

Sample (Acha: Bambara)	Crude protein (%)	Fat (%)	Crude fibre (%)	Ash (%)	Moisture (%)	Carbohydrate (%)
100:0	5.7 ± 0.2^{c}	10.8 ± 0.3^{a}	2.6 ± 0.2^{c}	1.97 ± 0.1^{c}	0.95 ± 0.3^{a}	78.0 ± 3.3^{a}
95:5	6.11 ± 0.4^{b}	11.9 ± 0.7^{a}	2.73 ± 0.1^{c}	2.88 ± 0.1^{b}	0.98 ± 0.2^{a}	76.0 ± 2.5^{a}
90:10	6.51 ± 0.2^{b}	12.0 ± 0.8^{a}	3.05 ± 0.1^{b}	2.97 ± 0.2^{ab}	0.86 ± 0.4^{a}	75.0 ± 1.4^{a}
85:15	7.16 ± 0.7^{a}	12.4 ± 1.0^{a}	3.18 ± 0.2^{b}	3.03 ± 0.2	0.82 ± 0.1^{a}	73.4 ± 2.6^{ab}
80:20	7.51 ± 0.4^{a}	12.50 ± 0.9^{a}	3.50 ± 0.1^{a}	3.07 ± 0.2^{a}	0.78 ± 0.2^{a}	73.0 ± 1.8^{b}
75:25	7.90 ± 0.6^{a}	12.6 ± 0.8^{a}	3.65 ± 0.2^{a}	3.3 ± 0.3^{a}	0.75 ± 0.2^{a}	72.0 ± 4.1^{b}

Values are means of triplicate scores. Values with different superscript in column are significantly different ($p < 0.05$) from one another.

between the mean were separated using Duncan multiple test (Larmond, 1977).

RESULTS AND DISCUSSION

Effect on the proximate compositions of samples

The effect of added Bambara groundnut on the quality of acha based biscuit is presented in Table 2. The protein content increased significantly ($p < 0.05$) from 5.70 to 7.90% with increase in the percentage (0 to 25%) of Bambara groundnut flour. The fat content increased from 10.8 to 12.6% with increasing concentration of Bambara groundnut flour. The moisture content of the biscuit increased from 0.75 to 0.95% with increasing concentration of Bambara groundnut flour. The ash content of the product increased significantly ($p < 0.05$) from 1.97 to 3.30% with an increase in the percentage of added Bambara groundnut flour. The crude fibre of the product increased from 2.6 to 3.6% with increasing Bambara groundnut. The carbohydrate content of the product decreased from 78 to 72% with increase in the percentage of Bambara groundnut flour. The increase in protein contents of the samples could be due to the added Bambara groundnut which from former work has been observed to contain high protein content (Boateng et al., 2013; Alozie et al., 2009). The protein has been confirmed to contain some essential amino acids of great importance to the body. The increase in fat content though relatively low, could be a good source of energy supply to the body when eaten since in human body (Alozie et al., 2009). The relative low increase in the fat content of the product could be an advantage in extending the shelf life of the product as the level of rancidity could be minimal. The increase in moisture is relatively low (not significant) and could be due to the decrease in the carbohydrate content (Jideani, 1999). The low moisture content of the product agreed with other composite biscuits- acha-soybean, amaranths-wheat, acha-malted acha, Bambara groundnut-wheat flour, acha-beneseed, wheat-African bread fruit (Ayo and Nkama, 2004; Ayo et al., 2008; Ayo et al., 2010). This relatively low moisture content could be an advantage in extending the keeping quality (shelf life) of the product as most spoilage organism may not be able to thrive, and the biochemical and enzymatic reactions could be minimal (Ayo et al., 2010). The increase in the ash content could be due to the added Bambara groundnut which has been noted to be high in the same. High ash content has been related to high mineral content (Ayo and Okoliko, 2003), hence could improve the mineral level of the product and invariably that of the consumer. High ash content is usually as a result of high mineral which apart from the nutritional value are good for bones (Ayo et al., 2007). The increase in the fibre content could help to improve the digestion, aid waste elimination in the body and guide against anthracites (Ayo and Okoliko, 2003). The decrease in carbohydrate content could be due to relatively low carbohydrate content of added

Table 3. Effect of Bambara groundnut flour on the sensory qualities of acha-based biscuit.

Acha (g)	Bambara (g)	Taste	Texture	Colour	Flavor	Crispiness	Overall acceptability
100	0	6.15^{b}	6.6^{b}	7.7^{a}	6.35^{b}	6.85^{b}	7.10^{ab}
95	5	7.05^{a}	6.95^{ab}	7.15^{a}	7.35^{a}	7.60a	7.25^{a}
90	10	7.5^{a}	7.55^{a}	6.7^{b}	7.8^{a}	7.85a	7.80^{a}
85	15	6.5^{b}	6.4^{b}	6.55^{b}	6.7^{b}	5.95c	6.80^{b}
80	20	5.9^{c}	6.15^{bc}	5.85^{c}	5.7^{c}	5.4^{cd}	6.10^{bc}
75	25	5.45^{c}	6.06^{c}	5.55^{c}	5.0^{d}	5.00^{d}	5.45^{c}

Values are means of twenty scores. Values with different superscript in column are significantly different ($p < 0.05$) from one another.

Table 4. Effect of bambara groundnut flour on the sensory qualities of acha-date palm based biscuit.

Sample	Weight (g)	Height (cm)	Break strength (g)	Spread ratio
A	22.00 ± 2.10^{d}	3.00 ± 0.30^{b}	700 ± 23.40^{e}	7.33 ± 1.00^{cd}
B	23.00 ± 1.8^{c}	3.00 ± 0.2^{b}	750 ± 25.5^{d}	7.67 ± 0.70^{c}
C	23.50 ± 1.40^{c}	3.00 ± 0.30^{b}	780 ± 15.80^{cd}	7.83 ± 0.90^{c}
D	23.80 ± 2.70^{c}	3.00 ± 0.20^{b}	820 ± 26.40^{c}	7.93 ± 1.20^{bc}
E	25.60 ± 2.50^{b}	3.10 ± 030^{a}	900 ± 27.80^{b}	8.30 ± 1.30b
F	27.50 ± 3.00^{a}	3.10 ± 0.40^{a}	1000 ± 30.50^{a}	8.90 ± 0.90^{a}

Values are means and standard deviation of triplicate scores. Values with different superscript in column are significantly different ($p > 0.05$) from one another.

Bambara groundnut (Ayo and Okoliko, 2003).

Effect on sensory qualities of samples

The effect of added Bambara groundnut flour on the sensory quality of acha based biscuit is summarized in Table 3. The addition of Bambara groundnut flour increased the mean score of the taste from 6.15 to 7.5 with increasing concentration of Bambara groundnut (0 to 15%) and then decreased to 5.45 with further increase to 25%. The addition of Bambara groundnut flour increased the mean score of the texture of the samples from 6.5 to 7.55 with increasing percentage (0 to 10%) of Bambara groundnut flour and decreased (from 7.55 to 6.06) on further increase (10 to 25%).

Mean score for colour of the samples decreased from 7.7 to 5.55 with increase in the percentage (0 to 25%) of added Bambara groundnut. The addition of added Bambara groundnut flour increased the mean score for flavour from 6.35 to 7.8 with increase in added Bambara groundnut (0 to 10%) and on further addition, deceased to 5.00 (10 to 25%).

The average mean score for the crispiness of the Bambara groundnut-acha biscuit increased from 6.85 to 7.85 with increase in percentage of added Bambara groundnut (0 to 10%) and decreased (7.85 to 5.0) on further increase in the Bambara groundnut (10 to 25%).

Mean scores for overall acceptability increased from 7.1 to 7.8 with increase in the percentage of added Bambara groundnut (0 to 10%) and decreased to 5.45 at 25% added Bambara groundnut.

Effect on physical qualities of samples

The effect of added Bambara ground nut flour on the quality of Acha based biscuit is shown in the Table 4. The spread ratio of the samples increased from 7.33 to 8.90 with increase in the percentage of Bambara groundnut flour (0 to 25%). The effect of added Bambara groundnut flour increased the break strength of the biscuit from 700 to 1000 g (Table 4). The relatively increase in the spread ratio could be due to the increase in the oil content in the added Bambara groundnut flour (Mazahib et al., 2013) which could enhance the same attribute.

The increase in break strength could be due to the rigid structure formed from the high protein content of Bambara groundnut and carbohydrate content from acha. This could be an advantage as it will prevent breaking of the biscuit during transportation and post handling of the biscuit (Ayo et al., 2010; Nwosu 2013).

CONCLUSION

This study showed that the addition of Bambara groundnut did affect all the assessed qualities of Bambara groundnut-ach biscuit. The composite biscuit was most preferred and acceptable at 10% of added Bambara groundnut which correspond to sample with 6.5% protein, 12% fat, 12% crude fibre and 2.97% ash

content. The added Bambara nut improve the protein, fat, fibre and ash content of the Bambara groundnut-acha composite biscuit by 10, 17, 20 and 58%, respectively.

REFERENCES

Adebowale AA, Adegoke MT, Sanni SA, Adegunwa MO, Fetuga GO (2012). Functional properties of biscuit making potential of sorghum-wheat flour composite. Am. J. Food Technol. 7:372-379.

Alozie YE, Iyami MA, Lawal O, Udifia U, Anil F (2009). Utilization of Bambara groundnut flour blends in bread production. J. Food Technol. 7(4):111-114.

AOAC. Official Methods of Analysis (1990). 17th Ed. Association of Analytical Chemists, Washington D.C.

Ayo JA, Ayo VA, Nkama I, Adewori R (2007). Physicochemical, in-vitro digestibility and organoleptic evaluation of acha-wheat biscuit supplemented with soybean flour. Nigerian Food J. 25:77-79;

Ayo JA, Okoloiko A (2003). Effect of Spray Drying temperature of Egg-white powder on the quality of Meringue. J. Arid Agriculture. 13:181-187.

Ayo JA, Nkama I (2004). Effect of acha flour on the quality of bread. Int. J. Food Properties. 7:561-569.

Ayo JA, Haruna US, Ayo VA, Oyegun TM (2008). Effect of Malted Acha on the Quality of Acha Biscuit. Int. J. Food Agric. Res. 5(1):196-205.

Ayo JA, Ikuomola DS, Esan YO, Onuoha OG, Ayo VA, Ekele V (2010). Effect of Added defatted benniseed on the quality of acha based biscuit. Continental J. Food Sci. Technol. 4:7-13.

Boateng M.A, Addo JK, Okyoro H, Adu-Dapaah H, Borohio JN, Tottoh A. (2013). Physiochemical and functional properties of proteinates of two Bambara groundnut (*Vigna substerranean*) land races. African J. Food Sci. Technol. 4(4):64-70.

Gomeez MI, Obilanta AB, Martin D, Madran MT, Manjo ES (1997). Grain Quality Evaluation in Manual of Laboratory Procedure for Quality Ealuation of Sorghum and Pearl Millet Tech. Manual No. 2:5-15.

Hussein HM, Hussein MM, El-Damohery ST (2006). The effect of natural formulated functional biscuits on an elderly bone health. J. Med. Sci. 6:937-943.

Hui YH (1992). Encyclopedia of food science and technology. John Wiley and Sons, Inc, Canada pp. 204-210

Ihekoronye AI, Ngoddy PO (1985). Integrated Food Science and Technology for the Tropics. 2nd Edition, Macmillan Publishers, London p .154.

Javaid AA, Ateeq-ur R, Saleem-ur R, Muhammad IS, Abu SH (1995). Evaluation of biscuits prepared from composite flour containing mothbean flour. Pak. J. Agric. Sci. 32(1):211-217.

Jideani AI, Akingbala JO (1993). Some physical properties of acha and iburu grains. J. Sci. Food and Agriculture. 63:369-373.

Jideani AI (1999). Traditional and Possible Technology uses of *Digitaria exillis* (Acha) and *Digitaria ibrua*. Review Plant Foods Hum. Nutr. 54:362-373.

Kure OA, Bahayo EJ, Daniel EA (1998). Studies on the proximate composition and effect of flour particle size on acceptability of biscuit produced from blends of soyabean and plaintain flours. Namida Tech-scope J. 3:17-21.

Lasekan O (1994). Chemical composition of acha flour. Nigerian Food J. 12:19-23.

Larmond E (1977). Method for sensory evaluation of food. Food research control experimental form, Canada Department of Agriculture, Ottawa.

Mepba HD, Eboh L, Nwaojigwa SU (2007). Chemical composition, functional and baking properties of wheat-plantain composite flours. Afr. J. Food Agric. Nutr. Dev. 7(1):1-22.

Mensah P, Tunkins A (2003). Household level technologies to improve the availability and preparation of adequate protein and safe complementary foods. Food Nutr. Bullet. 24:104-125.

Obizoba IC, Egbenna HI (1991). Effect of germination and fermentation on the nutritional quality of Bambaranut and its product (milk). Plant Food Hum. Nutri. 41:1-10.

Obiora EC (2011). Production of acha based biscuit using date palm. HND Dissertation, Unpublished. Department of Food Science and Technology, Federal Polytechnic, Bauchi, Nigeria. pp. 14-22.

Ocran VK, Delmini LL, Asuboah RA, Asiedu EA (1998). Seed Management Manual for Ghana, MOFA, Accra, Ghana. pp. 1-25.

Okaka JC (2005). Handling, Storage and Processing Food Plant. OCJ Academic Publishers, Enugu . pp. 25-30.

Olapade AA, Oluwole OB (2013). Bread making potential of composite flour of wheat-acha enriched with cowpea flour. Niger. Food J. 31(1):6-12.

Olapade AA, Aworh OC, Oluwole OB (2011). Quality attributes of biscuit from acha flour supplemented with cowpea flour. Afr. J. Food Sci. Technol. 2:198-203.

Mazahib AM, Nuhu MO, Salawa IS, Babiker EE (2013). Some Nutritional attributes of Bambara groundnut as influenced by domestic processing. Int. Food Res. J. 2(2):1165-1171.

Nwosu JN (2013). Production and Evaluation of Biscuits from blends of Bmabara groundnut and wheat flours. Int. J. Food Nutr. Sci. 2(1):4-9.