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Production and evaluation of malted soybean-acha composite flour bread and biscuit

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ABSTRACT

The research work is aimed at producing quality biscuit and bread from malted soybean flour and acha flour. The malted soybean flour was substituted into the acha flour at 0, 10, 20, 30, 40, and 50%. The biscuits were analysed for physical chemical and sensory properties was determined. The result of the chemical analysis of biscuit showed increased in percentage content of fat (23.71 -30.09%), protein (5.26 -11.65%), ash (2.63 -3.67%), crude fiber (1.12 -1.40%) and moisture (0.42 -1.69%). However carbohydrate content decreased from (66.86 -51.50%). The physical analysis of the malted soybean –acha composite biscuit showed increase in the weight (9.60 -9.66g) and spread ratio (7.33 -7.93%) but decrease in the break strength (400 -300g). The biscuit was accepted up to 30% malted soybean. The chemical analysis of the bread showed increase in the fat content (12.02 -18.40%), protein (5.99 -16.76%), moisture (27.81 -33.84%), ash (1.39 -2.25%), crude fiber (0.47 -1.04%), but decrease in carbohydrate (52.32 -27.71%). The physical analysis of the malted soybean –acha composite bread showed increase in the weight (460.1 -464g), volume (475 -555g), volume index (1.03-1.21%). The bread was generally fairly accepted up to 50% added malted soybean. In conclusion, the biscuit was most accepted up to 30% added malted soybean. The addition of dough improver is recommended to improve the quality of malted soybean-acha bread

Keywords: Production, quality- evaluation, malted soybean-acha, bread, biscuit.

INTRODUCTION

Acha (*Digitaria exillis*) is a cereal grain in the family of gramineae and commonly referred to as folio or hungry rice (Alamu, 2001). The grain is grown in areas with at least 800mm of rainfall such as the mountain Fouta Dyallon region of Guinea and dry Savanna zone of Mali and upper Volta (Lasekan, 1994). The major traditional foods from the grain are: thick (tuwo) and thin (kuku), porridge, steamed product (burabusko or couscous) and alcoholic beverages (Jideani and Akingbala, 1993). Acha grains may be boiled like rice; flour from acha may be fortified with other cereals flour especially for the production of porridge or pudding (Gibson and pain, 1985). Acha can be used for porridge (kunu) in the morning as “gwete” and “tuwo” in the afternoon and evening with different kinds of stew and vegetables. Other traditional preparations of acha into food exist. Some of these are grain acha and acha jollof. It is also

used in the form of “couscous” in some countries in West Africa. It is also an African oat (Nzlibe, 1995). Nigerian people of Plateau, Bauchi and Kaduna states burns straw and Ash extracted with water through perforated basket. The filtrates are used as potash for cooking indigenous delicacies. Acha grain can also be grounded into flour to produce biscuit (Obafunmi et al, 2001).

Acha are also classified on the color and sizes of the grain. Acha is also one of the most nutritious of all grains. Its seed is rich in methionine and cystine, they are vital to human health and deficient to today’s major cereals. Like wheat, rice, maize, sorghum, barley and rye (Jideani and Akingbala, 1993). Acha have a high water absorption capacity a property that could be linked to appreciable amount of pentosan. The high water absorption capacity of acha could be utilized in baked goods (Obafunmi et al, 2000). Enrichment of cereal food with other protein

sources such as legumes (soybean) has received considerable attention because its high lysine content (an essential amino acid) which is limiting in most cereals (Alabo, 2001).

In a recent study, acha grain has shown to have high water absorption capacity, a property that could be linked to appreciable amount of pentosan. Acha contains about 33g pentosan/kg. The high water absorption capacity of acha could be utilized in baked food pentosan present in baker's patent flour at a 2-3% level, consist primarily of polymetric pentosan sugars, rather than hexose sugar of starch. Pentosan have been found to be a very important regulator of water absorption and distribution in dough. (Mallesh , 1990). Most tropical cereal grains and some tubers have been used to make composite flour for bread making. The use of sorghum flour in bread making has shown that sorghum bread still has eating qualities and good volume compared to rye bread. Although sorghum flour does not contain functional protein for bread making, baking test have shown that up to 50% sorghum flour could produce bread with desirable properties. Characteristics of acha protein could also potentially produce bread with desirable properties (Peter, 2001).

The fortification of acha flour to enhance and improve nutritional value when used for the production of biscuit. The consumption of cereal based foods like biscuit has triggered required development of an adequate substitute for wheat (Dupaigne and Richard, 1965). Acha is also known for its nutritional properties. Although the protein content of acha is similar or slightly lower than that of other grains, it contains amino acid like methionine and cystine which are essential to human health. These are often deficient in today's major cereals. Acha is known to be easy to digest, it is traditionally recommended for children, old people and for people suffering from diabetes or stomach diseases. Local pharmacist also recommended acha for people who went to lose weight (Jideani, 1999). Acha does not contain any glutenin or gliadine proteins which are the constituents of gluten, making this cereal suitable for people with gluten intolerance (Harlan, 1993)

Acha does not contain any glutenin or gliadine proteins which are the constituents of gluten, making this cereal suitable for people with gluten intolerance. Acha has been identified as a major food for diabetic patients in Nigeria, by medical practioners (Jideani, 1991). It is of great interest to develop acha biscuit that will be of great benefit to teaming number of diabetic patients in Nigeria. It is though that biscuit could be baked from acha flour.

The research work is aimed at accessing the effect of added malted soybean on the quality of biscuit and bread.

MATERIALS AND METHODS

Acha (*Digitaria exillis*) was purchased from Tafawa

Balewa (5kg), baking fat (Monita), granulated sugar (250kg), baking powder (stk royal active), 25g, salt (5g) Dangote, soybean (*Glycine max*) 3kg, evaporated milk 2 tins (peak) was purchased from Wunti market in Bauchi metropolis.

Preparation of Materials

Malted Soybean

Soybean seeds were cleaned, washed, steeped in water(2days), drained, spread on jut bag, moistened, covered(jut bag) to allow germinating (three days with constant wetting and turning of grains), oven dried(50oc), plumule are removed, milled, packed(polyethene) and store at 4oC.

Acha Flour

Acha grains were cleaned, destoned(water sedimentation), dried(APV, Drier at 45oC), milled(attrition mill), sieved(0.04mm aperture), vacuum packed and keep at 40oc).

Production of Malted Soybean-Acha composite flour

The malted soybean flour was substituted (0, 5,10,15,20%) into the acha flour to produce composite flour that was used in the production of bread and biscuit.

Production of Malted soybean-Acha Composite Biscuit

The malted soybean-acha composite flour were mixed with the ingredients (0.6% baking powder, 0.6% salt, 55% fat, 45% sugar and 30% milk).The process include: creaming of the sugar into the fat, aerating)incorporating air by mixing), rolling(on flat stainless surface), cutting into shape(using biscuit cutter), arranged on racks and baked at 180Oc, cool and vacumn packed in polyethene material.

Production of Malted Soybean-Acha composite Bread

The malted soybean-acha composite flour was mixed with principal bread ingredients(3.5% fat, 8.0% sugar, 1.5% yeast, 10% salt and 55% water), fermented(2hrs at room temperature of 30-32°C), remixed, cut into sizes(100g), molded, panned, proofed(30min. at room temperature 30-32°C), baked (Air oven at 210°C), cooled, packed in polyethene) and store at room temperature.

Table 1. Proximate Composition of Malted soybean-Acha composite Bread (%)

Acha	Malted Soybean	Fat	Protein	Moisture Ash	CHO	Crude	Fibre
100	0	12.02	5.99	27.81	1.39	52.32	0.47
90	10	13.91	8.99	30.69	1.48	44.43	0.50
80	20	16.78	11.42	30.72	1.51	39.06	0.51
70	30	17.29	14.57	30.92	1.61	35.09	0.52
60	40	18.54	15.57	33.38	1.98	29.95	0.58
50	50	18.40	16.76	33.84	2.25	27.71	1.04

Average mean scores with the same alphabet letter are not significant, $p = 0.05$.

Methods

Chemical Composition of Malted soybean-acha composite biscuit and bread

The protein, fat, ash, fibre and carbohydrate content of the malted soybean-acha biscuit and bread were determined using AOAC(2006) method.

Physical Quality of Malted soybean-acha composite biscuit and bread

The physical quality of the biscuits including spread ratio and break strength were determined using Gomeaz et al(1997) and Okaka and Iseih 1990, respectively. The loaf volume and loaf volume index of the malted soybean-acha composite bread was determined (Ayo and Nkama 2003) .

RESULTS AND DISCUSSION

Effect of added malted soybean flour on acha bread

The effect of the added malted soybean flour on the quality of the acha based bread is summarized as below:

The Effect on proximate composition of acha based bread

The effect of added malted soybean on the chemical composition of the bread is summarized in Table 1.

The fat content increased from 12.02-18.34% with an increase in the percentages (0-50%) of malted soybean flour. The increase in fat content could be due to the high fat content of the malted soybean as observed by Iwe(2000).The high fat content can cause rancidity however the low moisture content of the product could reduce this effect. The increase in the fat content could be a good source of energy to human body. Fats and oils provide more than twice as much energy as the carbohydrate on a weight-weight basis (Iwe 2000). One gram of fat or oil will yield about 368kj/gkcal of energy

when oxidized in the body (Okaka, 2001). Also the high fat content of the product may not provide a conducive environment for microbial growth and activities hence improving the shelf life of the product.

The protein content increased from 5.99-16.76% with increase in the percentages (0-50%) of added malted soybean flour. The increase in protein content could be due to added malted soybean containing high percentage (36.49%) of protein (Wolf, 2012). The increase in the protein content proven the added malted soybean to be a good source of inexpensive protein (Akinkugbe, 2009). Also, the protein when digested and metabolized in the body provides energy proteins are important biomolecules. The protein content of the biscuits was significantly increased when malted soybean flour was added. The increased protein content agreed with Apapunam and Darbe (1984), Apapunam and Sefa-Dedeh(1995) and Bressani et al (1987) in their respective works using soybean flour observed its potential usefulness as protein supplement.

The moisture content of the product acha based bread increased from 27.81-33.84% with increase in the percentages (0-50%) of added malted soybean flour. This could be due the added soybean which has been proven to have high affinity for moisture (Jideani, 2003). The relative high moisture content of the product calls for proper packaging to prevent spoilage.

The ash content (mineral) of the product increased from 1.39-2.25% with increase in the percentage (0-50%) of the malted soybean flour. Ash is a non-organic compound containing mineral content of food and nutritionally its aids in the metabolism of the other compound (De humen, 2003). The high ash content of the product could be a source of the minerals which apart from its nutritional value are good for good skin and bones (Akinkugbe, 2009).

The crude fiber of the product increased from 0.47-1.04% due to increased in the malted soybean with increased in the percentages (0-50%).The increase could be due to the fact that malted soybean are relatively high crude fiber(Iwe 2000) which are importance in bowel movement, and reduces constipation.

The carbohydrate content of the product decreased from 52.32-27.77% with increase in the percentages (0-50%) of the malted soybean flour. However, the effect of added

Table 2. Sensory evaluation bread

Raw Materials		Sensory Qualities							
Acha Gen. Accept. Texture	M. Soy	Taste	Flavor bean	Texture	Color of	Color of Crumb	Crust Crust	Color Sementary	Crumb
100	0	3.35f	3.30f	3.55f	3.50f	3.50eh	3.50f	3.55f	3.65f
3.50f									
90	10	4.10e	4.50e	4.00e	4.20eh	4.00dgh	3.65e	3.70e	4.05e
3.75e									
80	20	4.20d	4.60d	4.65d	4.40dh	4.10cg	4.00d	4.05d	4.30d
3.95d									
70	30	5.15c	5.35c	5.05c	4.60cg	4.20bf	4.15c	4.15c	4.25c
4.05c									
60	40	5.25b	5.35b	5.10b	4.75bg	4.65af	4.20b	4.60b	4.30b
4.25b									
50	50	5.35a	5.55a	5.15a	4.70a	5.10a	4.30a	4.55a	4.45a
4.40a									

Average mean scores with the same alphabet letter are not significant, $p = 0.05$

malted soybean flour on the carbohydrate was significant at 50% and above. The decrease in carbohydrate content could be due to the low carbohydrate content of added malted soybean flour.

The effect of added malted soybean on the sensory quality of the acha –based bread

The effect of added malted soybean on the quality of acha based bread is summarized in Table 2.

Taste

The addition of malted soybean flour increased the average mean score of taste from 3.35-5.35 of the bread as the concentration (0-50%) of malted soybean increases. The increase in the average mean score could be due to the fact that malted soybean contain relatively high sugar content and some compound of sensory desire.

Odor

The addition of malted soybean flour increased the mean score of the odor from 3.30-5.55 as the percentage(0-50%) of the bread increases. This could be due to inherent fat content of the malted soybean which at high baking temperature produces some volatile compounds which have been known to be desired(Fenema, 2005).

Texture

The addition of malted soybean flour increased the mean score of the texture from 3.55-5.15 as the percentage(0-50%) of the bread increased. This could be due to plasticity of the crumb which are principally that of fat

from the added malted soybean, producing a soft texture often desired of bread.

Color of crumbs

The addition of malted soybean flour increased the mean score of the color of crumb from 3.50-4.70 as the concentration (0-50%) of the bread increases. This could be due to the color of malted soybean added and the fat content contained in the malted soybean. The increase in average mean score could be due to the fact that the natural color of the variety of the soybean used is relatively close to the common wheat used for bread , hence tend to improve that of acha –malted soybean composite flour.

Color of crust

The addition of malted soybean flour increased the average mean score of the color of crust from 3.50-5.10 as the concentration (0-50%) of the bread increases. This could be due to the increase in the protein content from the added malted soybean which could have significant contribution to color development under high temperature of baking(Fenema, 2005, Ayo and Nkama 2003).

Crumb texture

The addition of malted soybean flour increased the mean score of the crumb texture from 3.65-4.45 as the concentration (0-50%) of the bread increases. This could be due to malted soybean concentration which makes the crumb to be loosely packed.

Table 3 . Effect of added malted soybean on physical quality of acha –based biscuit

ACHA	MALTED SOYBEAN	AVERAGE WEIGHT	VOLUME	VOLUME INDEX
100	0	460.1	475	1.03
90	10	463.8	485	1.05
80	20	462.5	500	1.08
70	30	462	510	1.10
60	40	464	520	1.12
50	50	460.1	555	1.21

Table 4. Chemical Composition of malted soybean-acha

Raw Materials					Composition (%)		
Acha	M. Soybe	SSSan Fats	Protein	Moisture	Ash	CHO	Crude Fibre
100	0	23.71	5.26	0.42	2.53	66.96	1.12
90	10	23.97	7.22	0.44	2.63	64.52	1.22
80	20	28.22	7.86	0.49	2.70	59.50	1.23
70	30	28.71	8.09	1.11	3.04	57.78	1.27
60	40	28.73	9.97	1.23	3.16	55.65	1.28
50	50	30.09	11.65	1.69	3.67	51.50	1.40

General acceptability

The addition of malted soybean flour increased the mean score of the general acceptability from 3.50-4.40 as the concentration (0-50%) of the product increases. This could be due to the fact that the higher the concentration of the product, the more its acceptability.

Effect of added malted soybean on the physical quality of acha – based bread

Effect of added malted soybean on the loaf volume index and average weight of bread are summarized in table 3 .

Loaf volume index, average weight

The weight of the bread was not affected is within the same range 460.1-464 and the loaf volume index increases from 1.03-1.21 respectively, with increase in malted soybean flour (0-50%).The relatively low loaf volume of malted soy bean–acha composite bread(1-05-1.21) compared to standard wheat bread(3.5) could be due to the absence of gluten which is the active compound in rising of dough. It is therefore important that dough improver be added to obtain acceptable bread.

Effect of added malted soybean on acha biscuit

Effect of added malted soybean on the chemical composition of acha –based biscuit

The effect of added malted soybean on the chemical composition of acha –based biscuit is summarized in the table 4.

The fat content increased from 23-30.09 with an increase in the percentages (0-50%) of malted soybean flour. The product was acceptable up to 30% added malted soybean, with corresponding fat content 28.71%, hence increase 21.10% fat content. The increase in the fat content could be a good source of energy. Fats and oils provide more than twice as much energy as the carbohydrate on a weight-weight basis. One gram of fat or oil will yield about 368kj/gkcal of energy when oxidized in the body (Okaka, 2001)..

The protein content increased from 5.26-11.65 with increase in the percentages (0-50%) of the malted soybean flour. At the 30% malted soybean was accepted, the corresponding protein was 8.09%, hence increase of 53.8% protein content. The increase in the protein content indicates that the product could be a good source of inexpensive protein (Akinkugbe, 2009). Also, the protein when digested and metabolized in the body provides energy proteins are important bimolecules. The effect of added malted soybean on the protein content of biscuit had a high and positive correlation ($r= 0.8$) relationships The protein content of the biscuits was significantly increased when malted soybean flour was added. The increased protein content of the biscuity agreed with Apapunam and Darbe,(1984), Apapunam and Sefa-Dedeh(1995) and Bressani et al (1987) in their respective works using soybean flour observed its potential usefulness as protein supplement.

The moisture content of the product (acha based bread) increased from 0.42-1.69% with increase in the percentages (0-50%) of the malted soybean flour. The product was accepted up to 30% added malted soybean, with corresponding moisture content of 1.60% moisture content. This could be due to the protein content

Table 5. Physical Quality of malted soybean-acha biscuit

Raw Materials		Physical Properties		
Acha	Malted Soybean	Average Wt (g)		Break Strength (g) Spread Ratio.
100	0	9.60	400	7.33
90	10	9.74	380	7.17
80	20	9.64	360	7.50
70	30	9.66	340	7.83
60	40	9.70	320	7.66
50	50	9.66	300	7.93

increased, as protein has more affinity for moisture than carbohydrate (Jideani, 2003). Also because of the relatively low moisture content of the product, it is not much likely to be contaminated by micro-organisms as bacteria if properly stored as these conditions not provide a conducive environment for their growth and activities. The effect of added malted soybean on moisture content of the biscuits was not significant, $p < 0.05$ with increase in malted soybean flour. The low moisture content of the biscuit could be an advantage to long keeping quality (shelf-life) as most spoilage organisms may not be able to survive.

The ash content of the product increased from 2.63-3.67% with increase in the percentage (0-50%) of the malted soybean flour. The biscuit was accepted up to 30% added malted soybean, with corresponding ash content of 20.2% ash contents. Ash is a non-organic compound containing mineral content of food and nutritionally its aids in the metabolism of the other compound (De humen, 2003). This high ash content of the product could be a source of the minerals and vitamins (vitamin A, D and E) which apart from its nutritional value are good for good eye sight, skin and bones (Akinkugbe, 2009).

The crude fiber of the product increased from 1.12-1.40% with increase in the percentage (0 -50%) of malted soybean flour. The biscuit was accepted up to 30% added malted soybean with corresponding fiber content of 13.40% of fiber content.

The carbohydrate content of the product decreased from 66.86-51.50% with increase in the percentages (0-50%) of the malted soybean flour which indicate the presence of reducing carbohydrates. However, the effect of added malted soybean flour on the carbohydrate was significant at 10-30%. The decrease in carbohydrate content could be due to the low carbohydrate content of malted soybean flour.

Effect of added malted soybean on the physical quality of acha –malted soybean composite biscuit

Weight

The weight of the biscuit decreases from 9.66-9.54 with increase in malted soybean (0-50%)(Table 5). Odorica

and Parades (1991) and Claughton and Pearce (1989) reported a reduction in spread ratio and weight of cookies by increasing the enrichment levels of flour with sunflower and safflower protein isolates. It has been suggested that spread ratio as affected by the composition of ingredients for available water, flour or any other ingredients which absorb water during dough mixing will reduce it. The increase in protein content with an accompanying increase in the spread ratio of the biscuits suggests protein may have low affinity for water.

Spread ratio and break strength

The spread ratio of the biscuit increase from 7.93-8.80 with an increase in malted soybean (0-50%) while the break strength of the biscuit decrease from 400-300 having the same thickness with increase in malted soybean (0-50%) respectively.

The increase in the spread ratio could be due to increase in the oil content of the added malted soybean. Oil has been proven to have the ability to spread as it is allowed to move over a surface(Fenema 2005). The decrease in the break strength could also be attributed to the same oil and decrease in the carbohydrate content with increase in the added malted soybean flour.

Effect of added malted soybean on sensory quality of acha based biscuit

The effect of added malted soybean flour on the quality of acha based biscuit is summarized in table 6.

The addition of malted soybean flour decreased the mean score of the taste from 7.55-3.65 as the percentage(0-50%) of the product increased. This could be due to increase in the sugar, fat and some other compounds in the added malted soybean.

The addition of malted soybean flour decreased the mean score of the texture from 7.30-4.95 as the percentage (0-50%) of the added malted soybean increases. This could be due to the increase in the sugar content and decrease in the carbohydrate content of the added malted soybean.

The addition of malted soybean flour decreased the mean score of the odor from 6.85-4.25 as the percentage (0-50%) of the product increases. This could be due to an

Table 6 . Effect of added malted soybean on sensory quality of acha based biscuit

Raw Materials		Sensory Qualities					
Acha	M.Soybean	Taste	Texture	Odour	Crispness	Color	Gen. Accept.
100	0	6.70a	5.95a	5.90ade	6.75ad	6.65acf	6.50ab
90	10	7.55a	7.30a	6.85a	7.30a	7.10acd	7.95a
80	20	6.95a	6.90a	6.75a	6.90ac	6.65agh	7.02ad
70	30	6.60a	6.85a	6.70a	6.45a	6.50a	6.80ab
60	40	5.60b	6.35a	4.80bdf	5.95bcd	5.55bceg	5.8bcd
50	50	3.85ac	4.95a	4.25cef	5.20b	4.55bdfh	4.25b

Average mean scores with the same alphabet letter are not significant, $p = 0.05$.

unacceptable inherent off flavor peculiar to soybean (Iwe 2000).

The addition of malted soybean flour decreased the mean score of the crispness from 7.30-5.20 as the concentration (0-50%) of the product increases. This could be due to the nature of the malted soybean which affects the crispness of the biscuit.

The addition of malted soybean flour decreased the mean score of the color from 7.10-5.20 as the concentration (0-50%) of the product increases. This could be due to the natural inherent pigment of the malted soybean added. The mean scores of the sensory evaluation have a higher average mean score particularly in color and texture at 10% malted soybean flour. The low appreciation (acceptability) at above 20% malted soybean flour could be attributed to sugar caramelsation (Berk, 1976) and mallard reaction between sugar and amino acids. The addition of sulphur dioxide could be an advantage to reduce this effect. In addition to acting as preservative (Rose, 1983), sulphur dioxide is known to reduce this type of browning (Berk, 1976 and Mayer, 1975); hence its use may help in the control of browning.

The addition of malted soybean flour decreased the mean score of the general acceptability from 7.95-4.25 as the concentration (0-50%) of the product increases. The most preferred product was that with 10% malted soybean.

CONCLUSION

The study on the effect of added malted soybean flour on the quality of Acha based-biscuit has shown improvement in the protein (53.8%), fat (21.1%) and mineral (20.2%), hence great improvement in the nutrient intake of the consumers, as well could serve as a good and inexpensive protein source above all the use of acha could serve as a convenient snacks for diabetes patient. The physical analysis of the malted soybean-acha composite bread is relatively poor which also accept its

acceptability sensorially. The use of dough improver could improve its acceptability.

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