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EFFECT OF CHARCOAL TREATMENT ON SOME KEEPING QUALITIES OF SOY-CASSAVA STARCH PASTE IN THE PREPARATION OF AKARA

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ABSTRACT

Soybean *(Glycine max)* is a protein-rich legume which until recently was not popularly consumed in Africa. It is necessary to popularize the crop and encourage it's consumption as means of promoting its utilization and also examine traditional practices associated with meals that can be prepared from it. Soybean flour was substituted for cassava starch (0 to 40%) for the production of akara of acceptable quality. The traditional preservative practices of dipping charcoal into pre-fried paste use for akara was evaluated during a 12 Hr. holding period by monitoring changes in Total Titrable acidity(TTA), pH, moisture contents, oil absorption capacity, microbiological profile of charcoal treated(0.2 to 4.0g) and untreated pastes. Resulting akara made from the pastes were also subjected to flavor and acceptability sensory tests. Akara of acceptable quality was obtained at 30% substitution level. Progressive increase in TTA and concurrent decrease in pH with holding time of the paste samples was observed with or without charcoal. Decrease in oil absorption between treated(16 to 8%) and untreated(16 to 14.7%) samples were observed while the latter has more moisture(61.8%) than the former(60.9%). Microbial population generally increased with holding time and lactic acid bacteria were the predominant organism, it is more in the untreated samples. Charcoal influences some of the chemical quality of the paste but it is doubtful if it actually delayed the on-set of souring of the paste.

Key words: Soybean, akara, Charcoal, treatment.

INTRODUCTION

Soybean *(Glycine max)* is a protein legume which until recent times was not popularly consumed in Africa. It has been known to produce the highest yield of protein per unit land area of any plant and animal food source, while at the same time, producing calories. Because of its immense potential, it has not only become necessary to popularize the crop and encourage its consumption (Weingarimer, 1987), but also to promote its utilization. Soybean (*Glycine max* (L) Merril) was believed to originate from China 5000 years ago from where it was introduced to Africa in 1889 and Nigeria in 1908 (Ezendinma, 1965). Soybean production in Nigeria has improved tremendously, available statistics as at 2006 was about 666,898 tonnes making the country the thirteenth major producer of the crop in the world

(FAO, 2006). It is therefore necessary to develop recipes that suit local taste and cook relatively quickly so that soybean processed or unprocessed can become a part of our daily diet (Singh, 1989).

Nutritionally, soybean is an excellent source of protein and contains appreciably good proportion of both essential and non-essential amino acids (Ferch, 1978). It has been found to satisfy the protein requirement of adult while in growing children, it must be supplemented with food that has sulphur containing essential amino-acid maize and other cereal foods. Cereal proteins is one major source of protein for people in many developing countries and it is generally low in quality due to their inadequate composition of essential amino-acids, particularly lysine. They are however, rich in methionine which is lacking in soy protein. Consumption of soybean food combined with cereal food such as can be found in akamus and akara will therefore be desirables as it is likely to supply a well-balanced intake of amino-acid equivalent to high protein quality. Though, soybean contains appreciable amount of carbohydrates most of which are sugars. The starch content is however very low (Kawamura, 1967). These characteristics limit the functional capability of the beans in relation to its use in preparing *akara* and *moinmoin;* a unique property of starch in particular is an important biochemical changes in the preparation of these food. Soybean like other legumes is rich in raffinose and starchyose sugars which unlike glucose and sucrose remain largely unhydrolysed, and therefore unabsorbed by the body due to lack of galactosidase activity. They are known to induce flatulence when fermented by intestinal microbes. However, soybean is a good source of water soluble vitamins (Vaidehi and Kadam, 1989). It is also very rich in polyunsaturated fatty acids which are essentially important to human, but the presence of Linolenic acid in soybean tends to reduce the stability of its oil to flavour reversion (Rackis and Wold, 1973). Raw soybean contains many biologically active anti-nutritional factors such as trypsin inhibitor and lipoxygenase which have been implicated with poor protein digestibility and production of beany off-flavour respectively (Eskin *et al.,* 1970). It has also been implicated with the formation of thyroid enlargement, a disease mainly caused by iodine deficiency. Soybean contains a goitrogen which is removed or destroyed during processing (Block *et al.,* 1961). It is therefore not possible for goitrogen in treated beans to affect the availability of iodine. In any case, the pre-treatment method of pre-soaking and blanching at $100^{o}C$ to which soybean is subjected have been known to eliminate the risk of anti-nutritional factors (Rackis, *et al.,* 1973)

Other food legumes of culinary importance in Africa include cowpea *(Vigna unquiculata)* and Groundnut *(Arachis hypogea)* among others. Cowpea is the most widely consumed legume in Nigeria. It may either be cooked directly and consumed, or may be used for making varieties of foods and may be made into pastes and cooked in molded wraps or leaves to make *moinmoin* and ekuru or deep fat fried to produce *akara.* A possible means of promoting the utilization of soybean is by assessing the production of African foods for which other legumes are currently been utilized with the aim of substituting soybean in part or whole into such foods.

Akara is a fried cowpea paste product flavored with chopped onion and salt, (McWatters and Hung, 1990). The paste once prepared, is likely to sit at ambient condition for several hours before being fried and consumed. *Akara* vendors often complain that the unused paste has to be discarded after long holding at room temperature due to souring which makes it unsuitable for processing to *akara* or *moinmoin* of acceptable quality. This may therefore account for an old-traditional practice of dipping some pieces of charcoal into the paste to prolong the shelf-life of the paste as it is believed to delay the on-set of souring during holding period before frying and consumption. Charcoal is an amorphous form of carbon made up of small crystal of graphite. The holding of paste at ambient condition for several hours may encourage the proliferation of several types of microorganisms which may not only pose a possible health hazard but could also influence many of the functional properties of the paste (Mcwatters, 1983). The increase in acidity of cowpea paste with time in a reported study by Ogunmoyela *et al.* (1991) over a 12hours holding period may also be due to the proliferation of lactic acid bacteria and activities of *Candida species* (Bulgarelli *et al.,* 1988).

In spite of this, akara is still the most common cowpea based food product in West Africa, (Reber *et al.,* 1998) which makes its contribution to the diet very significant. Because of the high protein nature of soybeans relative to other legumes, its utilization in part or whole in *akara* production will go along way in improving the quality of the product. The purpose of this study therefore, is to produce akara of acceptable quality from blends of soybean and cassava starch and to examine the claimed preservative influence of charcoal on the paste by monitoring certain expected biochemical and microbiological changes during the holding period.

MATERIALS AND METHODS

Materials: Soybean variety TGX923 used for the study was obtained from Ogun State Agricultural Development Project (OGADEP), Abeokuta. The cassava starch used for the study was extracted from cassava roots obtained from University of Agriculture, Abeokuta (UNAAB) farm at the University Permanent site.

Methods:

Proximate analysis: Crude protein (Nx6.25) was determined by micro-kjeldahl method as modified by Oyekanmi et al. (1984). Moisture, ash and fat contents were determined in accordance with AOAC (1997) methods with modifications where necessary. Total carbohydrate content was determined by substitution.

Paste preparation: Whole soybeans was washed sorted to remove dirt and damaged beans. It was soaked in water for 10 hours and blanched for 10 minutes at 100^{o}C, after which it was drained, rinsed with water, manually dehauled, washed and bone dried before being milled in a moulinex blender to paste.

Preparation of cassava flour: Cassava roots were peeled, washed and grated to pulp and suspended in 0.5 per cent sodium meta bisulphite solution to prevent the fermentation of the starch during extraction. The starch extracted was dried in the oven at 35-40^{o}C and blended (0-40%) with the soy-paste and fried to obtain *akara*.

Storability test of soy-cassava paste

Storability test was carried out on the most acceptable blend of soy-cassava paste based on the result of sensory analysis. Charcoal of 0 to 4g were dipped into the selected paste sample and stored under ambient(27 ± 1 °C) and refrigeration condition(7 ± °C). Changes in the acidity condition of the paste was monitored over a 12hrs holding period. Treated sample containing 2g of charcoal was selected for further monitoring (Ogunmoyela et al., 1991) through repeated chemical (Variation in moisture content, and oil absorption capacity), microbiological and sensory analyses at 4hrs interval of the holding period.

Chemical analysis

Proximate composition of soy flour and akara samples determined according to AOAC(1990) while carbohydrate was determined by difference.

Chemical analyses carried out on the paste are; pH and Total Titrable acidity (TTA) expressed as percentage lactic acid using AOAC (1997) method as modified by Elimosara et al. (1990). Moisture content and Nitrogen solubility AOAC (1997) Oil absorption capacity Duna (1980).

Microbial examination as described by Bulgarelli *et al.,* (1988) and McLandsborough (2003) with necessary modifications. Populations were determined by plating on Man Regosa and Sharpe agar for lactic acid bacteria (LAB), nutrient agar for total aerobic population (TAP), potato dextrose agar for yeast and mould populations (YMP) and Mckonkey agar for total coliform population (TCP)

Sensory evaluation in terms of colour, texture, flavour attributes and over all acceptability of akara were evaluated by ten panelists selected on the basis of familiarity with akara and non allergic and abhorrence of soybean. The panelists assessed the quality parameters on a 5-point hedonic scale of 1-5 (Disliked extremely-Liked extremely).

Statistical analysis

Results of sensory evaluation were analyzed using analyses of variance (ANOVA) to test for mean difference between samples. Turkey test was used to separate the samples in cases where significant difference were recorded at 0.05 percent level(Ihekoronye and Ngoddy, 1985). Mean and standard deviations were used for results from chemical analysis

RESULTS AND DISCUSSION

Proximate composition of soybean (Table 1) are in close agreement with that obtained in literature (FAO, 1982). The mean sensory ratings of akara (Table 2) indicated that optimum quality was obtained at 70:30.

A progressive increase in acidity with holding time in the paste samples with or without charcoal was observed (Table 3) when paste samples were held at room temperature (27 ± 3^{o}C) and under refrigeration condition (Table 4). This evidence of increase in TTA values with corresponding decrease in TTA values with corresponding decrease in pH values for the paste samples is in agreement with the trends obtained by Ogunmoyela et al. (1991) and Bulgarelli *et al.* (1998) for cowpea paste. Acids reduce the sweetness and increase tartness of the foods in which they occur, and in this way influence palatability. The sour flavour of acid in foods has been known to be influence more by total acidity (Joslyn, 1970). The increase acidity value observed may therefore be responsible for the sour taste detected in akara paste sample held at room temperature and even in sample held under refrigeration condition after 12 hours.

The charcoal in the paste appeared to absorb the moisture as paste sample with charcoal(Table 5) appeared to have a relatively lower value than paste samples without charcoal. Moisture content of paste have great influence on the texture of akara.

Oil absorption of akara may be attributed to the physical entrapment of the lipid by the proteins (Bulgarelli *et al.*, 1990). Changes in oil absorption capacity for paste samples (Table 6) indicated that the hydrophilic and lipophilic protein groups may have been significantly affected by the 12 hour holding period. Paste sample containing charcoal tend to absorb less oil than sample without charcoal

Table 1: Proximate composition of soybean flour

Samples	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Carbohydrates (%)
Soybean flour	8.00 ± 1.0	37.4 ± 0.4	17.5 ± 0.4	4.75 ± 0.3	32.4 ± 3.6*
Soy-akara SF:CF 70:30	49.1 ± 0.8	20.3± 0.3	16.6 ± 0.4	2.6 ± 0.7	11.4 ± 2.1

*Values obtained by difference SF= Soy flour CF= Cassava flour

Table 2: Sensory scores of soy-akara prepared from different blending ratios of soybean and cassava starch

Blending Ratios	Sensory Quality			
	Flavour	Colour	Texture	Acceptance
SF:CF 100:00	1.70_a	1.66_a	2.20_a	1.70_a
SF:CF 80:20	2.50_b	2.83_b	1.70_b	2.50_b
SF:CF 70:30	3.17_c	3.17_c	2.30_c	3.50_c
SF:CF 60:40	3.50_c	3.33_c	3.20_c	3.20_c

a..Means in the same column followed by the same subscripts are not significantly different ($p < 0.05$).

SF:CF=Soybean: Cassava starch ratios

Table 3: Influence of charcoal treatments on changes in acidity of soy-cassava paste with holding time

Charcoal Treatments (g)	0	0.2	0.5	1.0	2.0	4.0
Holding Time (Hr.)			pH Values	of Pastes		
0	6.90^{c}	6.90^{c}	6.90^{c}	6.90^{c}	6.90^{b}	6.90^{c}
4	6.90^{c}	6.75^{b}	6.80^{c}	6.90^{c}	6.88^{b}	6.90^{c}
8	6.30^{b}	6.40^{a}	6.20^{b}	6.30^{b}	6.20^{a}	6.20^{b}
12	6.00^{a}	6.30^{a}	6.10^{a}	5.70^{a}	6.00^{a}	5.90^{a}
			TTA values of pastes			
0	.012^{a}	.012^{a}	.012^{b}	.012^{a}	.012^{a}	.012^{a}
4	.018^{b}	.010^{b}	.010^{a}	.015^{b}	.018^{b}	.019^{b}
8	.018^{b}	.015^{c}	.012^{b}	.015^{b}	.020^{c}	.019^{b}
12	.024^{c}	.017^{c}	.015^{c}	.019^{a}	.021^{c}	.025^{c}

a-- Means in the same column followed by the same superscripts are not significantly different ($p < 0.05$)

*Holding temperature at 7± 1°C, Charcoal treatment is for 70-30 Soy-cassava blend.

Table 4: Influence of charcoal treatments on changes in acidity of soy-cassava paste with holding time

Charcoal Treatments (g)	0	0.2	0.5	1.0	2.0	4.0
Holding Time (Hr.)	pH values of pastes					
0	6.90^{b}	6.90^{b}	6.90^{b}	6.90^{b}	6.90^{b}	6.90^{c}
4	7.60^{c}	6.80^{b}	7.60^{c}	7.40^{c}	7.00^{b}	6.80^{b}
8	6.95^{b}	6.80^{b}	7.00^{b}	7.90^{d}	6.80^{a}	6.80^{b}
12	6.60^{a}	6.60^{a}	6.80^{a}	6.70^{a}	6.70^{a}	6.50^{a}
			TTA Values of Pastes			
0	.012^{a}	.012^{b}	.012^{b}	.012^{a}	.012^{a}	.012^{a}
4	.018^{b}	.001^{a}	.010^{a}	.015^{b}	.018^{b}	.019^{b}
8	.018^{b}	.015^{c}	.012^{b}	.015^{b}	.020^{c}	.019^{b}
12	.024^{c}	.017^{d}	.015^{c}	.019^{c}	.021^{c}	.025^{c}

a..Means in the same column followed by the same superscripts are not significantly different ($p < 0.05$).

*Holding temperature at 7± 1°C, Charcoal treatment is for 70-30 Soy-cassava blend.

Table 5: Variation in moisture content of pastes with charcoal treatment and holding time

Holding Time(Hr)	0	4	8	12
Charcoal Treated* samples	49.1[a]± 0.8	57[b] ± 0.2	59.6[cd] ± 0.6	60.9[d] ± 0.5
Untreated Samples	49.1[a] ± 0.8	61.7[d] ±0.2	57.9[bc] ± 0.5	61.8[d] ± 0.3

a..Means with the same superscripts are not significantly different ($p < 0.05$).
* 2g of charcoal used for treatment, storage temperature of 27± 3°C

Table 6: Values of oil absorption of akara produced from Pastes held for 12 hours at room (27± 10°C)

Holding Time(Hr)	0	4	8	12
Charcoal Treated samples	16.0[c] ±1.2	15.7[c] ±1.0	8.0[a] ±1.0	8.0[a] ±1.0
Untreated Samples	16.0[c] ±1.2	15.0[bc] ±1.0	18.0[e] ± 0.5	14.7[b] ±1.5

a…Means with the same superscripts are not significantly different ($p < 0.05$).
* 2g of charcoal used for treatment, storage temperature of 27± 3°C

The control sample (i.e. paste without charcoal) has the highest microbial population over the holding period. The high microbial population in paste samples may be due to the presence of indigenous microflora in the soybean, frequent handling required in manual decortication as well as exposure to ambient temperature and humidity during paste preparation. Lactic acid populations increased in all the paste with holding time, but increase more in sample without charcoal (Table 7). This paste sample has a relatively higher acid content, giving an indication that the pastes samples underwent predominantly lactic acid fermentation over the 12 hours holding period. This line of reasoning is reinforced more by the behavioral pattern of the aerobic microbes that increase in population from zero to six hours and, thereafter, remained constant for paste containing charcoal while it decreased in value for paste without charcoal. This decrease in value may be due to inability of the paste to support further growth of the aerobes as a result of the inhibitory activities of lactic acid bacteria that resulted in increased acidity.

Finally, the mean sensory scores of the flavour quality and acceptability during the holding period (see Table 8) shows that sourness in akara as a result of lactic acid fermentation was not detectable until after 8 hours in both paste samples.

Table 7: Changes in microbial profile of soy pastes with holding time

Holding Time (HR)	Cultured Populations	*Populations X 10 9/g sample	
		Charcoal Treated	Untreated Samples
0	L.A.B	3	3
	T.A.P.	2	2
	Y.M.P	1	1
	T.C.P.	1	1
6	L.A.B.	10	15
	T.A.P.	3	6
	Y.M.K.	1	1
	T.C.P.	2	4
12	L.A.B	15	22
	T.A.P.	3	4
	Y.M.P.	2	2
	T.C.P.	3	2

Table 8: Mean sensory scores of akara produced from pastes held for 12 hours

Holding Time (HR)	Flavour		Overall Acceptance	
	Charcoal treated	Untreated	Charcoal treated	Untreated
0	4.75_a	4.75_a	4.75_a	4.75_a
4	4.71_a	4.71_a	4.71_a	4.71_a
8	4.57_a	4.00_a	4.00_a	3.86_a
12	3.14_b	3.57_b	3.60_b	3.71_b

a..Means in the same column with the same subscripts not significantly different (P 0.05).
* 2g of charcoal used for treatment, storage temperature of 27± 3°C

CONCLUSION

It may be concluded from the study that soybean akara of acceptable quality may be obtained from soybean paste blended with cassava starch. While the presence of charcoal in paste samples have been found to indeed influence some of the chemical quality of the paste, there is still no conclusive evidence to show that the charcoal delayed the on-set of souring of the paste. It is therefore hoped that this work will serve as basis for further studies on this subject.

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