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Processing Effects on the Chemical and Sensory Evaluation of Breakfast Cereal Produced from Malted, Fermented and Roasted Sorghum and African Yam Bean

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Abstract— The proximate composition and sensory properties of breakfast cereals (flakes) produced from malted, fermented and roasted sorghum and African yam bean flour were investigated. The seeds of sorghum and African yam bean were obtained and divided into three portions and were processed into malted, fermented and roasted flours respectively. The samples were analyzed for proximate composition. The proximate analysis showed that the protein content of malted sample which had the value 7.36±0.06 was the highest and roasted sample which had the value 5.95±0.01 was the lowest. Roasted sample had the highest fat content with the value 6.98±0.12 and the highest carbohydrate content with the value 72.85±0.03. Fermented sample had the highest moisture content with the value 15.36±0.01 followed by malted sample with the value 15.00±0.06 and the lowest was the roasted sample with the value 10.50±0.10. The sensory scores of the sample showed that roasted sample had the highest overall acceptability with the value 7.90±0.57 followed by fermented sample with the value 6.80±1.68 and the lowest malted sample which had the value 6.20±6.62. The roasted sample had the highest score in all the sensory attributes. The results from these processing methods showed different effect on the proximate and sensory attributes of breakfast cereal produced from sorghum and African yam bean flours.

Keywords— *Sorghum flour, African Yam bean flour, breakfast cereals, proximate composition and sensory Properties*

I. INTRODUCTION

Breakfast cereals are defined as foods obtained by swelling, grinding, rolling or flaking of any cereal [11]. They can be categorized into traditional (hot) cereals that require further cooking or heating before consumption and ready-to-eat (cold) cereals that can be consumed from the box with the addition of milk [11] .

In developing countries, particularly sub Sahara Africa, breakfast meals for both adults and infants are based on local staple diet made from cereals, legumes, cassava and potatoes tubers. However the most widely eaten breakfast foods are cereals [5]. According to [4], instantized and ready to eat cereal facilitate independence because of their ease of preparation which means that children and adolescents can be responsible for their own breakfast or snacks. Such foods may need to be reconstituted, pre-heated in a vessel or allowed to thaw if frozen before consumption, or they may be eaten directly without further treatment [8].

The common cereal products in Nigeria includes NASCO corn flakes, Good morning corn flakes, NABISCO flakes, weetabix, quaker oaks, Rice crips among others. A study has clearly shown that 42% of 10 year olds and 35% of young adults consume cereals at non-breakfast occasions [3]. This may be consumed dry as snack food, with or without cold or hot milk, based on their location, availability of resources and habits. Results from previous studies [9] indicated that most cereals are limited in some essential amino acids especially threonine and tryptophan. Though cereals are rich in lysine, they cannot effectively provide the nutrient required by the body, especially in the morning when the supply of nutrients from the previous day is exhausted. However, consumption of proteins from plant sources (legumes) is encouraged, since combination of legumes and cereals provide biologically high quality and cheaper protein that contain all essential amino acids in proper proportion and their amino acids complement each other [8]. According to [13], the sources of vegetable protein ranges from the highly utilized and popular legumes such as soybeans to lesser known ones like African yam bean *Sphenostylis stenoscarpa*. The protein in African yam bean (AYB) is more than twice the protein in sweet potato or Irish potato and higher than those in yam and cassava[1]. Moreover, the amino acid values in AYB seeds are higher than those in Pigeon pea, Cowpea, and Bambara groundnut[14]. However, the ultimate success of utilizing plant protein in food formulation depends largely upon the functionality which is the property of food ingredients that determines its usefulness in food systems as well as the sensory attributes. A combination of seed legumes and cereals is likely to yield products with

nutritionally higher quality than those produced from individual component. It is against this background that this study was carried out to produce breakfast cereal from sorghum and African yam bean flours and also to analyze the processing effect on chemical and sensory attributes of breakfast cereal produced from sorghum and African yam bean flours.

II. METHODOLOGY

Sorghum and African yam bean seeds were purchased from Ogige market, Nsukka in Enugu State. Sorghum and African yam bean seeds were properly cleaned and sorted to remove dirt, chaff, weevil and other extraneous matters. The seeds were divided into three portions each. The first portions of each of the seeds were washed, steeped in water for 12 hours so as to attain a 42% moisture level. The hydrated seeds were spread on a moist jute bag which had previously been sterilized by boiling for 30 minutes and the seeds were allowed to germinate for 3 days. Non germinated seeds were discarded and the germinated seeds were dried at 100^{o}C for 1 hour in a hot air oven to a moisture level of 10%. The seeds were divagated, dry milled, sieved, packaged and were tagged as malted flour. The second portion of each of the seeds were washed and soaked in water for 48 hours. They were hydrated, dried in hot air oven at 100^{o}C for 1 hour; dry milled, sieved, packaged and was tagged fermented flour. The third portion of the seeds was sun dried for two days to enable efficient roasting. The seeds were poured into a pot placed on a stove. The pot was first heated for five minutes before putting the seeds. They were allowed for 2 minutes to make pop sound before turning them with a wooden pestle in a clockwise direction for 45 minutes. They were cooled, dry milled, sieved and were tagged roasted flour.

Two hundred (200) g of each sample were mixed with 150ml of water, 10g of sugar and 2g of salts, kneaded, oven dried, shaped and packaged.

Flour formulation

The sorghum and African yam bean flours were blended at a proportion of 50:50. The malted, fermented, and roasted sorghum fours were blended with malted, fermented, and roasted African yam bean flours respectively. They were coded sample 301 (50% sorghum flour: 50% malted AYB flour), 302 (50% sorghum flour: 50% fermented AYB flour) and 303 (50% sorghum flour: 50% roasted AYB flour) respectively.

Determination of proximate composition

Moisture content, crude fibre, ash, protein, fat were determined using [2] method while carbohydrate content was determined by difference.

Statistical analysis

Data were subjected to analysis of variance and Duncan's multiple range tests was used to separate means where significant. Significance was accepted at $p< 0.05$.

III. RESULTS AND DISCUSSION

The results of the proximate composition of samples 301(50% sorghum flour: 50% malted AYB flour) had the value of 7.36 ± 0.01 in protein content, this was higher than those of sample 302 (50% sorghum flour: 50% fermented AYB flour) and 303(50% sorghum flour: 50% roasted AYB flour) which had the values 6.67 ± 0.01 and 5.95 ± 0.01 respectively. The high protein content in sample 301 may be due to the synthesis of enzymes or a compositional change following the degradation of other constituents [12]. Sample 303 which had low value of protein content, which could be attributed to its denaturation when heated [6]. Sample 302 which had the value of 15.36 ± 0.01 had the highest moisture content; followed by sample 301 which had the value of 15.00 ± 0.00 and sample 303 had the value of 10.50 ± 0.10 which was the lowest. The carbohydrate content of the samples 301,302 and 303 were 65.90 ± 0.01, 66.45 ± 0.01 and 72.85 ± 0.03 respectively. The carbohydrate content of sample 301 was lower than that of sample 302, and 303. The low content of carbohydrate content in sample 301 could be due to the utilization of carbohydrate for biochemical activities of the germinating seeds [13]. Ash content of sample 301 which had value of 4.86 ± 0.01 was higher than sample 302 and 303 which had the values of 3.45 ± 0.01 and 1.16 ± 0.15 respectively, sample 303 had the lowest ash content. The fat contents of the samples were significantly different. Sample 303 had the highest fat content (6.98 ± 0.12) followed by sample 301 (6.26 ± 0.06) and the lowest was sample 302 (5.43 ± 0.06). The decrease in the fat content in sample 302 may likely be due to the use of lipid as energy source during fermentation. The fibre contents of the samples 301,302 and 303 were as follows 1.45 ± 0.01, 2.00 ± 0.01 and 2.45 ± 0.01 respectively. Sample 303 had the highest fibre content followed by sample 302 and the lowest was sample 301.

The results of the sensory attributes of the samples 301, 302 and 303 were shown in Table 2.

There were significant difference among the samples in taste and Aroma. Sample 303 had the highest mean score in colour followed by sample 302 and sample 301 was the lowest in consistency. The samples 301,302 and 303 had the values of 5.60±1.71, 6.00 ± 2.11 and 7.40 ± 1.07 respectively. Sample 301 had the lowest mean score in consistence. Sample 303 had the highest mean score. In overall acceptability, sample 303 had the highest mean score (7.90 ± 0.50). There was no significant difference between sample 301 and 302 which had the values of 6.20 ± 0.63 and 6.80 ± 1.69 respectively. The relatively higher mean score of sample 303 could be due to the roasted flavor and aroma imparted on the sample during roasting. Controlled roasting of grains brings about development of desirable roasted aroma in foods, which are described nutty, burnt due to the formation of pyrazine compounds that also reflects the extent of browning colour development in the product[10]. The lower mean score of sample 301 observed in taste, aroma and overall

acceptability could be due to the slight bitter after taste observed in malted grains.

IV. CONCLUSION and Future Scope

The results from this study showed that different processing methods (malting, fermentation and roasting) had marked effects on the proximate composition and sensory attributes of breakfast cereals produced from sorghum and African yam bean flours.

Malting resulted in high protein content and ash contents. Fermentation resulted in high moisture content while roasting resulted in fat, fiber and carbohydrate contents. Roasting had the highest mean score in all the sensory attributes. There were no significant difference in malting and fermentation in terms of overall acceptability.

It is therefore recommended that malting, fermentation and roasting method be employed in processing of cereal legume mix products (breakfast cereal). The products could serve as sole source of nutrients for children and supplements for adults. I therefore recommend roasting method since it was generally accepted.

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TABLE 1: Proximate composition of the sample

Samples	Protein Content (%)	Moisture Content (%)	Fat Content (%)	Ash Content (%)	Fibre Content (%)	Carbohydrate Content (%
301	7.36^{a}±0.01	15.00^{b}±0.06	6.26^{b}±002	4.86^{a}±0.01	1.45^{c}±0.01	65.90^{c}±0.0
302	6.67^{b}±0.01	5.36^{a}±0.01	5.43^{c}±0.06	3.45^{b}±0.01	2.00^{b}±0.01	66.45^{b}±0.01
303	5.95^{c}±0.01	10.50^{c}±0.10	6.98^{a}±0.12	1.16^{c}±0.02	2.45^{a}±0.01	62.85^{a}±0.03

All values are expressed as mean ± standard deviation. Mean value in the same column with different superscripts are significantly different.
Key: 301 = (50% sorghum flour: 50% malted AYB flour).302 = (50% sorghum flour: 50% fermented AYB flour). 303 = (50% sorghum flour: 50% roasted AYB flour).

TABLE 2: Sensory evaluation scores of the samples.

Sample	Taste	Aroma	Color	Consistency	Overall acceptability all acceptability
301	5.50^{b}±1.18	4.90^{c}±1.60	6.30^{c}±2.06	5.60^{b}±1.71	6.20^{b}±0.63
302	5.40^{b}±1.65	5.60^{b}±1.84	6.80^{b}±2.54	6.60^{ab}±2.11	6.80^{b}±1.69
303	7.30^{a}±0.67	7.50^{a}±0.71	7.10^{a}±0.87	7.40^{a}±1.071	7.90^{a}±0.57

All values are expressed as mean ± standard deviation. Mean values in the same column with different superscripts are significantly different.
Key: 301 = (50% sorghum flour: 50% malted AYB flour), 302 = (50% sorghum flour: 50% fermented AYB flour), 303 = (50% sorghum flour: 50% roasted AYB flour).

