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Evaluation of chemical and acceptability of flaked breakfast cereals from sprouted Sorghum, Soyabeans and Pineapple juice blends

Onyekwelu, C. N. [1*] and Onuoha, N. L.[2]

[1] Department Food Technology, Federal Polytechnic, Oko, Anambra State, Nigeria
[2] Department of Agriculture Education, Federal college of Education Technical Asaba, Delta state, Nigeria

For correspondence: chykems@gmail.com

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ABSTRACT

The chemical and sensory evaluation of flaked breakfast cereals produced from blends of sprouted sorghum, sprouted sorghum flour and pineapple juice were investigated. The sprouted sorghum flour, sprouted soybean flour and the pineapple juice were blended in the ratio of 100:0:0, 80:5:5, 70:20:10, 6025:15 and 50:30:20 designated as S100, SSP5, SSP10, SSP15 and SSP20 respectively. Inclusion of sprouted soybean flour and pineapple into sprouted sorghum flour for flaked breakfast cereals production significantly ($p<0.05$) increased the protein content from 10.98 to 12.14 %, fat content from 6.25 to 7.23%, ash contents from 4.97 to 6.55% and fibre contents from 2.66 to 3.85%. Increase in addition of the sprouted soybean flour and pineapple juice in sprouted sorghum for flake production significantly decreased moisture contents from 6.55 to 7.46% and carbohydrates contents from 63.70 to 76.25%. Addition of sprouted soybeans up 10 % improve the nutrition and consumer's acceptability of flaked breakfast cereals.

Key words: flaked breakfast cereals, sorghum, sprouting, soybeans, pineapple juice

1. INTRODUCTION

Flaked breakfast cereals are legally defined as food products obtained by swelling, grinding, rolling or flaking of any cereals that served for breakfast [1]. The breakfast cereals is categorize into hot traditional cereals that require further cooling or heating before consumption. Ready to eat cereals that can consumed with addition of milk it is ease in preparation which means the

children and adolescence can prepare their own breakfast with easy [2]. Cereals such as wheat, maize, barley and rice have been used in flaking. Flaking s the process whereby starch in cereals gelatinized and probably hydrolysed which result to dextrinization and carmelization. Flakes serve as a good source of strength which is essential for human consumption. Cereals are known to be deficient in lysine and sometime tryptophan which is essential amino acids for body growth for both infant and adult.

Sorghum (*Sorghum bicolor* L.) is one of major cereals cultivate in Nigeria. Nigeria is the largest producers of millet and sorghum in African and second in the world [3]. According NAS [4] sorghum contain about 12% protein, 3% fat, 70% carbohydrate, 2% fiber and 1.5% ash [4]. The high content of Carbohydrate is the major constituent sought for by the industrialist. Sorghum rich in 32-79% starch while the remaining are largely sugary. Sorghum starches have as much as 100% arnylopectin and 62% amylose. Sorghum is used for the preparation of alcoholic beverages, roasted and eaten as snack milled into flour and used for solid paste breakfast cereal among others [5]. This grain is rich in some essential amino acids but deficiency in lysine.

Soya bean (*Glycine max* L.) is a leguminous seeds that contain complete protein which provide all essential amino acids in quantity needed for body growth, maintenance and reproduction [6]. It is a staple food in many part of the globe. It is richest, cheapest and best source of vegetable available to mankind when compared with animal protein. It contains polyunsaturated fat and low in saturated fatty acid. It is a good source of minerals and vitamins [7]. soybean contain anti-nutritional factor such as trypsin inhibitor this can be reduced by using appropriate processing techniques such as sprouting, flaking, gelatinization among others.

Sprouting is essential processing methods used to improve the nutritional composition of plants seeds whereby the viable seeds induce to start growing seedling. During this process endogenous enzyme convert stored foods such as insoluble carbohydrates and protein into soluble component [8]. Sprouting improve vitamin (vitamin C and riboflavin) and minerals. It reduces anti-nutritional factors such phytate, tannin and oxalate in cereals and trypsin inhibitor in legumes [9]. It also impart desirable flavor to food products.

Pineapple (*Ananas comosus*) contains vitamin C and iron among other minerals [10]. It contains a proteolytic enzyme bromelain, which digests food by breaking down protein. Pineapples are rich in manganese; a trace mineral that is needed for body to build bone and connective tissues as well as significant amounts of Vitamins C and B1. It is a rich source of soluble and insoluble dietary fiber like pectin. Juice of the ripe fruit cures gastric irritability in fever and is very helpful in jaundice.

This study would be useful in improvement of protein and micronutrient of cereals by supplementing sorghum with legume such as soybean, African yam beans, Bambara groundnut among others would improve its protein and micronutrient.. This study would also provide avenue for the utilization of raw materials used i such as sorghum, soybeans, and

pineapple juice which are presently underutilized for industrial production of breakfast cereals. The data obtained in this study would provide a baseline for researcher health and nutrition policy makers, dietary counsellor as well as household [11]. It is against this study that this study seeks to evaluation of chemical and acceptability of flaked breakfast cereals from sprouted sorghum, soybeans and pineapple juice.

2. METHOD AND MATERIALS

2.1. Procurement of raw materials

Sorghum grains were purchased from Ogige market Nsukka in Enugu State, Nigeria. Soybean seeds, pineapple salt and sugar were purchased from Eke Oko market, OKo in Anambra state Nigeria.

2.2. Processing of flours

Sprouted Sorghum and sprouted soyabean was processed into flour using the method described by Mbaeyi and Osuji and Anyaiwe with little modification [12-13]. Two kilogram (2 kg) of each were cleaned by sorting and winnowing, washed and steeped in water for 12hour and 1 hours of "air rest". The grains were spread on a moist Jute bag to sprout for five days. The germinated seeds were dried at 60 °C in a cabinet dryer to a moisture content of 10-12% and de-vegetated to remove rootlets and cleoptile. The sprouted dried sorghum was milled and sieved using 250mm. Sprouted sorghum flour was packaged in an air tight container and kept for further use.

2.3. Processing of Pineapple Juice

Pineapple fruits were washed, peeled cut into smaller size then ground in blender. The extracted juice was filtered to obtained pineapple juice. The filtered pineapple juice was packed in air tight containers stored in refrigerator for further analysis.

2.4. Production of flaked breakfast cereals

The breakfast cereals were produced according to methods of Okafor and Usman [14]. The blended samples (sprouted sorghum, sprouted soyabeans and pineapple juice) were mixed homogenously. Sugar, salt and water were added and mixed manually. It was kneaded and allowed aged at 4 °C for, cut into desired shapes and toasted at 280 °C. The flake were cooled and packaged in air tight containers

2.5. Determination of Proximate Composition

The moisture, protein, fat, ash and crude fibre content of the flaked breakfast cereals was conducted according to the methods of AOAC

Table 1. Formulation of sprouted sorghum, sprouted soybeans and pineapple juice

Sample codes	Sprouted sorghum	Sprouted soybeans	Pineapple juice
S100	100		
SSP_5	80	15	5
SSP_{10}	70	20	10
SSP_{15}	60	25	15
SSP_{20}	50	30	20

[15], while carbohydrate was calculated by differences.

2.6. Determination of Mineral Content (Calcium, Iron)

Calcium was determined using method described by Shahid *et al.* [16]. Calcium was determined using flame photometer (Perkin-Elmer model 52A) while iron was determined using atomic absorption spectrophotometer (Buck Scientific model).

2.7. Sensory Evaluation

A ten members panel was trained on sensory attributes for the evaluation of flaked breakfast cereals on a 9-points Hedonic scale (where 9= extremely like and 1= dislike extremely). The samples were scored for colour, flavor, taste, texture and overall acceptability.

2.8. Statistical Analysis

The experiment adopted was complete randomization design (CRD). The data generated from all analyses and sensory evaluation were subjected to statistical analysis of variance (ANOVA) using the Statistical Package for Social Statistics (SPSS) version 20. Means were separated using the Duncan's Multiple Range Test and significance was accepted at $p < 0.05$ [17].

3. RESULT AND DISCSSION

Proximate Composition of Flaked Breakfast Cereals Produced from Blends of Sprouted Sorghum, Soybeans and Pineapple Juice.

The result of proximate composition of flaked breakfast cereals from sprouted sorghum, sprouted soybean and pineapple is present in Table 2. Moisture content of flakes ranged from 6.26 to 7.46%. The moisture content increased with increase in proportion of sprouted soybeans and pineapple juice. Similar trends were observed by Mbaeyi-Nwaoha and Uchendu in breakfast cereals produced from ach and fermented soybeans the value of moisture content of flaked breakfast cereals in this study was low [18]. This implies that this food product would have longer shelf life. The moisture content of food product is indication of food stability and quality.

There was significant ($p<0.05$) difference in protein content of flaked breakfast cereals. Sample SSP20 had highest value (12.14%) of protein while sample S100 (100% sorghum) had lowest value (10.38%) of protein. This may be attributed to increase in proportion of sprouted soyabeans. This is in agreement with the previous reports about the breakfast cereal which are blended with legume [11, 19]. High protein in the samples blended with sprouted soyabeans, showed effect of supplementing legume in flaked breakfast cereals production [11].

Fat content of flaked ranged from 2.98 to 7.23%. There was a significant ($P<0.05$) differences in fat content among the samples. Fat content decreases with increase in addition of sorghum grain [20]. The decrease could be due to the synthesis of fatty acids. The free fatty acids might have reacted with other products of hydrolysis to form esters. Sprouts are also responsible for decrease of fat content in breakfast cereals [12]. The value of fat content

when compared to other works was lower than the reported value [11].

Significant ($p<0.05$) difference was observed in ash content of flaked breakfast cereals. The ash content ranged from 1.29% in sample S100 to 6.55% in sample SSP20. Increase in addition of sprouted soyabeans and pineapple juice increase the ash content of flaked. The high value of ash content in formulated samples might be due to addition of pineapple juice and sprouted soyabeans. The range of ash content obtained in this study was within the reported studies in formulated breakfast cereals from blends of acha, mungbeans and orange flashed sweet potatoes [21]. The ash content is indication of minerals present in the food. Form

Table 2. Proximate Composition of Flaked Breakfast Cereals Produced from Blends of Sprouted Sorghum, Soybeans and Pineapple Juice

Sample	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Fibre (%)	Carbohydrates (%)
S100	$6.26^{e} \pm 0.00$	$10.38^{e} \pm 0.00$	$2.98^{e} \pm 0.01$	$1.29^{e} \pm 0.01$	$1.69^{e} \pm 0.01$	$77.40^{a} \pm 0.01$
SSP_5	$6.67^{c} \pm 0.00$	$10.98^{d} \pm 0.01$	$6.25^{d} \pm 0.00$	$4.97^{d} \pm 0.01$	$2.66^{d} \pm 0.01$	$68.47^{b} \pm 0.01$
SSP_{10}	$6.56^{d} \pm 00$	$11.24^{c} \pm 0.01$	$6.97^{c} \pm 0.01$	$5.63^{c} \pm 0.06$	$3.36^{e} \pm 0.01$	$66.24^{c} \pm 0.01$
SSP_{15}	$6.77^{b} \pm 01$	$11.86^{b} \pm 0.00$	$7.06^{b} \pm 0.01$	$6.13^{b} \pm 0.01$	$3.57^{b} \pm 0.01$	$64.61^{d} \pm 0.03$
SSP_{20}	$7.46^{a} \pm 01$	$12.14^{a} \pm 0.01$	$7.23^{a} \pm 0.01$	$6.55^{a} \pm 0.01$	$3.85^{e} \pm 0.01$	$62.77^{e} \pm 0.01$

Table 3. Mineral Composition of Flaked Breakfast Cereals Produced from Blends of Sprouted Sorghum, Soybeans and Pineapple Juice

Samples	Calcium (mg/100)	Iron (mg/100g)
S100	$60.0^{e} \pm 0.00$	$0.70^{d} \pm 0.12$
SSP_5	$60.65^{d} \pm 0.00$	$1.08^{c} \pm 0.02$
SSP_{10}	$65.00^{b} \pm 0.50$	$2.47^{a} \pm 0.25$
SSP_{15}	$70.06^{a} \pm 0.12$	$2.48^{a} \pm 0.00$
SSP_{20}	$62.56^{c} \pm 0.10$	$1.68^{b} \pm 0.00$

Table 4. Sensory Scores of Flaked Breakfast Cereals Produced from blends of Sprouted Sorghum, Soybeans and Pineapple Juice

Sample	Colour	Flavour	Texture	Taste	Crispness	Overall acceptability
S100	$6.20^{ab} \pm 1.22$	$6.10^{ab} \pm 1.22$	$6.00^{ab} \pm 1.94$	$6.30^{a} \pm 1.56$	$6.60^{ab} \pm 1.57$	$6.10^{bc} \pm 1.10$
SSP_5	$6.40^{ab} \pm 1.71$	$5.80^{b} \pm 1.39$	$6.10^{ab} \pm 2.12$	$5.80^{b} \pm 1.93$	$6.60^{ab} \pm 1.93$	$6.50^{b} \pm 1.57$
SSP_{10}	$7.10^{a} \pm 1,28$	$7.40^{ab} \pm 1.00$	$7.00^{a} \pm 1.42$	$7.50^{a} \pm 1.50$	$7.10^{ab} \pm 2.18$	$7.30^{a} \pm 1.70$
SSP_{15}	$6.10^{b} \pm 1.28$	$6.00^{ab} \pm 1.22$	$7.10^{a} \pm 1.22$	$6.50^{b} \pm 0.97$	$6.50^{ab} \pm 1.95$	$6.30^{b} \pm 1.10$
SSP_{20}	$5.0^{c} \pm 1.28$	$5.60^{b} \pm 2.17$	$6.30^{ab} \pm 0.82$	$4.90^{c} \pm 1.59$	$5.60^{ab} \pm 1.83$	$5.90^{c} \pm 0.56$

* Values are means of triplicate determination ± standard deviation
Values on the same column with different superscript are significantly different ($p<0.05$).
S100= 100% sprouted sorghum
SPP_{10} = 80% sprouted sorghum: 15% sprouted soybeans: 5%pineapple juice
SPP_{15}= 70% sprouted sorghum: 20% sprouted soybeans: 10% pineapple juice
SPP_{20}= 60% sprouted sorghum: 25% sprouted soybeans: 15% pineapple juice
SPP_{25}= 50% sprouted sorghum: 30% sprouted soybeans: 20% pineapple juice

the result it showed that formulated samples would have mineral content than 100% sorghum.

Fibre content ranged from 1.67 in sample S100 to 3.85% in sample SPP25. Similar range was also reported in studies with breakfast cereals from blends of acha, mungbean and orange fleshed sweet potatoes [21]. Increase in addition of soyabean and pineapple juice increased the crude fibre of breakfast cereals. Fibre is important in digestion and also helps the smooth bowel thereby assist easy flushing out of waste from the body [19].

There were significant ($p<0.05$) differences in carbohydrate content among the samples. Sample S100 had highest value (77.40 %) of carbohydrate content while sample SPP25 had lowest values (62.77%)

The carbohydrate increases with increase in proportion of sorghum grain for production of flaked. The increase in carbohydrates content could be due to lower moisture content percentage which results in increase in carbohydrate depending on the percentage of all other components (protein, fat and ash content) [19, 21].

The mineral composition of flaked breakfast cereals produced from Blends of Sprouted Sorghum, Soybeans and Pineapple Juice was evaluvated (Table 3).

Calcium content ranged from 60.00-70.06 mg/100g. There was a significant ($p<0.05$) difference in calcium content among the samples. Calcium content increases with increase in proportion of soyabean and pineapple juice. The increase may be due to sprouting and blending effect. Calcium content is essential mineral that body require for growth and maintenance of strong teeth and bones, nerve signal, muscle contraction and secretion of certain hormone and enzymes [22-23].

There were significant ($p<0.05$) difference in iron content exist in iron content among flaked breakfast cereals. Iron content was significantly ($p<0.05$) higher in sample SSP15 than other samples. The iron content is essential constituent of haemoglobin and also is responsible for blood formation. The presence of iron in the flaked breakfast cereals can be used against anaemia, tuberculosis and growth disorder.

The Sensory evaluation of flaked breakfast cereals produced from blends of sprouted sorghum, soybeans and Pineapple Juice was evaluated (table 4). The Significant difference in all the sensory attributes among the flaked breakfast cereals was ($p<0.05$). Sample SSP10 has highest value in terms of colour (7.10), flavor (7.40), texture (7.0), taste (7.50), crispness (7.10) and overall acceptability (7.30) followed by sample SSP5 while sample SSP20 lowest values. Sample SSP10 (70% sprouted sorghum: 20% sprouted soybeans: 10%pineapple juice) was most preferred by the judges in all the sensory attributes to other samples while sample SSP20 was least accepted. As Increase in proportion of a soybeans and pineapple juice increases the consumer's likeness decline.

4. CONCLUSION

Flaked breakfast cereals can be produced from the blends of sprouted sorghum, sprouted soybeans and pineapple juice. Increase in addition of sprouted sorghum, sprouted soybeans and pineapple juice significantly ($p<0.05$) increased the protein, fat, ash, calcium and iron content. Addition of sprouted soybeans up to 15% improved the nutritional composition of flaked breakfast cereals.

Samples SSP10 (70% sprouted sorghum: 20% sprouted soybeans: 10% pineapple juice) was most preferred by the judges which the best. Formulated flaked breakfast was accepted by the panellists except sample SSP20 when compared with the control sample.

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6. CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest.

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NA

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