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Research Article

Anti-nutrient and mineral properties of Complementry Food produced from Malted Red Sorgum and Defatted Soybean Flour Blend

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Abstract

This study was aimed at producing a high nutritious food that will meet the nutritional requirements of consumers. Blends of malted red sorghum and defatted soybeans flour were processed and the resulting flours were formulated at ratios of 100:00; 95:5; 90:10 and 80:20 (malted red sorghum: defatted soybeans flour). The resulting products were subjected to antinutrients and minerals properties determination. The results obtained showed that the antinutrients decreased linearly with increase in the mineral elements. Antinutrients in the blends decreased from 2.25-1.80mg/g (oxalate); 2.45-2.16mg/g (phytate); 14.16-9.26g/100g (Alkaloids); 2.12-1.69/100g (saponin) and 0.18-0.13mg/g (Tannin). A percentage increase of 12.6% (sodium); 10.8% (calcium); 9.5% (potassium); 3.7% (magnesium) and 14.1% (Iron) was recorded as the quantity of defatted soybeans flour increased in the blends. The low levels of antinutrients in the blends produced make them safe and suitable for human consumption. Substitution of malted red sorghum with 20% defatted soybean flour showed a remarkable improvement in the mineral contents of the diets.

Introduction

Childhood malnutrition is a major public health problem throughout the developing world, and is one of the principal underlying causes of death for many of the world's children [1]. Grantham-McGregor et al, suggested that poor nutrition during infancy is likely to lead to poor academic achievement, low incomes in adulthood and inadequate care for the children of subsequent generations [2]. Commercially available complementary foods in the developing countries are too expensive for average family [3]. Consequently, nursing mothers often depend on traditional complementary foods, which are often inadequate in energy density, protein and micronutrient. These traditional weaning foods are often prepared, stored or fed to the children in ways that increase risk of illness [4]. Although there are many indigenous and unexploited grain legumes, which can be processed and when properly complemented with commonly available carbohydrate source. It will provide relatively affordable weaning foods that will help to alleviate protein-energy malnutrition (PEM) and improve infant nutrition. Protein energy malnutrition is widespread in both rural and urban communities in Nigeria. This is due to strict economic measure, inadequate production and supply of foods, especially protein and micronutrients rich foods. There are little advances in the processing and preservation techniques and neglect of our indigenous crops. Furthermore, artificial complementary foods are expensive; especially the low income

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group cannot afford them. Such families often depend on inadequate processed traditional food consisting mainly of supplemented cereal porridge made from maize or sorghum or millet.

Red Sorghum (*S. bicolar*) has been for centuries, one of the most important staple foods for millions of poor rural people in the semi-arid tropics of Asia and Africa. For some impoverished region of the world, Sorghum remains a principal source of energy, protein, vitamins and minerals. Sorghum grows in harsh environment, where other crops do not grow well, just like other staple foods, such as cassava, that are common in impoverished regions of the world. It is usually grown without application of any fertilizer or other inputs by a multitude of small-holder farmers or many countries [5]. Sorghum is about 70% starch; so is a good energy source and also has some antinutritional factors such as tannins [6]. Sorghum's nutritional profile includes several minerals, phosphorus, iron, zinc and also a good source of B-complex vitamins.

Soybean (Glycine max) commonly known as Soybean in Northern America or Soybean in British English Anderson et al, [7] is a species of legume native to East Asia, widely grown for its edible bean which has numerous uses. Soybean is produced extensively in Nigeria, with protein content of approximately 43% [8]. Like other legumes, Soy protein is rich in lysine and relatively low in methionine (Sulphur containing amino acid). The bean contain significant amount of phytic acid, dietary minerals and B-Vitamins. Traditional non-Fermented food uses of soybeans include soymilk from which tofu and tofu skin are made. Fermented soy foods include soy sauce, fermented bean paste, natto and tempeh. Plant foods are fermented to enhance or create unique flavor, change textural properties and to improve quality and digestibility [9]. Red sorghum (like other cereal) and soybean used in this study have been shown to adequately complement each other to produce quality food blends. Thus, this present study was aimed at producing complementary diets from malted red sorghum and defatted soybean flours. Anti-nutrients and mineral elements of the diets produced at different proportions were also evaluated.

Materials and Methods

Collection of raw materials

Red sorghum (*Sorghum bicolor*) and soybean (Glycine max), were purchased from "Oja Oba " in Owo town, Owo Local Government Area, and from Ogbese market in Ogbese town , Akure North Local Government Area, in Ondo state.

Production of malted red sorghum flour

The method of Hellen et al, was used to prepare red sorghum flour [10]. The grains were sorted to remove stones, dirt and other extraneous materials. The clean grains were thoroughly washed and steeped in water for 12 hours so as to attain a 42-46% moisture level and then dried at 60^{o}C in a cabinet dryer to a moisture content of 10-12%. The grains were gently brushed off and were dry milled sieved and packaged in an air tight container until needed for use.

Production of defatted soybean flour

The method of Iwe was used with some modification to prepare defatted soybean flour [11]. Soybean seeds were sorted, blanched for some minutes and soaked for about 12 hours; the grains were dehulled, dried in hot air oven at 40^{o}C for 4 hours. The dried beans were milled using attrition mill (dry mill). Water was added to the milled to form a mixture in the ratio of 4:1 of water to flour, the resultant mixture was stirred vigorously for 20 minutes and the oil was skimmed off and the process was repeated until the milk stopped foaming. The defatted soy slurry was drained using clean muslin cloth, oven dried at 40^{o}Cfor 4 hours and dry milled into flour. The flour was sieved to obtain fine particles and packaged in an air tight container until needed for use.

Composite flour production

Red sorghum and defatted soybean flour blends were prepared by blending the red sorghum and defatted soybean flour at varying proportion of 100%, 95:5, 90:10, and 80:29% respectively. The flours blends were individually packaged in a sealed polyethylene bag and kept at room temperature until used for analysis. Red sorghum flour (100%) was used as control.

Determination of anti-Nutritional properties

The anti-nutritional properties (tannin, alkaloids, phytate, oxalate and saponin) of the samples were determined using AOAC method [12].

Determination of mineral composition

The method of AOAC was used for the mineral composition of the composite flours. The minerals analysed for were; Magnesium, Potassium, Calcium, Sodium, and Iron [12].

Result and Discussion

The result of the antinutrient and mineral compositions of flour blends produced from malted red sorghum (MRS), and defatted soybean flours (DSF) are presented below.

Antinutrient properties of complementary flours

The levels of antinutrient properties of diets produced from malted red sorghum (MRS) and defatted soybean flours (DSF) are shown in table 1. The result shows that the antinutrient properties were reduced by the increased addition of deffated soybean flour and were inversely proportional to the increased addition of deffated soybeans flour. This implies that the antinutritional properties table 1 decreased linearly with increase in the mineral elements as shown in table 2. The decrease in the antinutrient properties might be as a result of leaching in the soaking water during the production of malted red sorghum and defatted soybean flour. This confirms previous studies carried out by Laurena et al, who observed that soaking cowpea in both acidic and alkaline solutions led to decrease in phytic acid [13].

Oxalate content was lowest in the diets produced with 80% MRS and 20% DSF (1.80mg/g). The oxalate contents decreased from 2.25 to 1.80mg/g as the quantity of

Table 1: Antinutrient Composition of flour blends.

Properties	100:00	95:5	90:10	80:20
Oxalate (Mg/g)	2.25	2.13	2.01	1.80
Phytate (mg/g)	2.45	2.39	2.29	2.16
Alkaloid (g/100g)	14.16	11.40	9.84	9.26
Saponin (g/100g)	2.12	2.01	1.88	1.69
Tannin (mg /g)	0.18	0.16	0.15	0.13

MRS: DSF

Table 2: Mineral Composition of Flour Blends.

Properties	100:00	95:5	90:10	80:20
Sodium (ppm)	81.70	85.00	90.10	92.00
Calcium (ppm)	97.50	104.00	107.40	108.00
Potassium (ppm)	48.50	50.30	51.00	53.12
Magnesium (ppm)	3.48	3.52	3.55	3.61
Iron (ppm)	0.64	0.66	0.70	0.73

MRS: DSF

the defatted soybean decreased in the blends. Oxalate has been implicated to complex with mineral elements such as calcium, magnesium and iron leading to the formation of insoluble oxalate salts and resulting in oxalate stone [14]. This also interferes with the utilization of the minerals.

The phytate content was highest on the control sample (100% MRS) with a value of 2.45mg/g and lowest in the diets with 80%MRS and 20% DSF with a value of 2.16mg/g. Ene-Obong and Obizoba reported that a decrease in phytate content might be due to leaching of phytate ions into soaking water [15]. Phytic acid forms insoluble salts with essential minerals like calcium, iron, magnesium and zinc in food, rendering them unavailable for absorption into the blood stream [14]. The alkaloids were the most abundant in all the antinutrients evaluated in this study with values ranging from 9.26 to 14.16g/100g. A similar reduction in the alkaloids content was observed table 1 and this makes the sample with the 20% defatted soybean flour to be the best when compared to the other samples. Alkaloids have been found to cause gastro-intestinal upset and neurological disorders, especially in doses in excess of 20g/100g [16].

Saponin contents in the diets significantly reduced as the level of defatted soybeans flour increased from 2.12 to 1.69g/100g. A 20.3% decreased was obtained for saponin when 20% DSF was added in the blends. Tannin was the least available out of all the antinutrients evaluated in this study with values reducing from 0.18 to 0.13 mg/g across the diets. Onwuka reported that tannins bind to both proteins and carbohydrates which have several implications for commodities containing tannins [14]. The presence of tannins can cause browning or other pigmentation problems in both fresh food and processed products. The results obtained in this study will increase the availability of mineral elements in food, rendering them available for absorption into the blood stream.

Mineral composition of complementary flours

The mineral elements evaluated in this study followed the same trend as they increased in the blends with increase in the quantity of defatted soybean flour up to 20% level. The sodium content increased from 81.70-92.00ppm in the blends and this account for 12.61% increment. The increase in the sodium content might probably be due to the reduction of phytochemical such as oxalate, phytate and others in the diets table 1. Akinyeye et al, reported that sodium helps in nerve transmission in the body [17].

Calcium has been found to help in bone formation, and muscles and skeletal development [18]. Addition of defatted soybean flour increased the calcium content from 97.50ppm (100% MRS) to 108.00ppm (80% MRS and 20% DSF). The potassium content of 100% malted red sorghum was significantly lower (48.50ppm) than all other samples. Substitution of the malted red sorghum flour with defatted soybean flour might have brought about the increase in the potassium contents of the blends. Potassium helps in fluid balance and nerve transmission [17].

The magnesium contents of the blends ranged between 3.48 and 3.61 ppm. The slight increase in the magnesium content (3.7%) followed same trend. The diets with 80% MRS and 20% DSF had the highest value in magnesium with a value of 3.61ppm. Magnesium has been reported to be involved in maintaining the electrical potentials in leaves and activation of some enzyme systems [19]. Iron was the least abundant out of all the mineral elements evaluated in this study with values ranging from 0.64 and 0.73 ppm.

Conclusion

Complementary diets were produced from the blending of malted red sorghum and defatted soyabean flour at different ratios of 95:5, 90:10 and 80:20 respectively

while 100% malted red sorghum served as the control. The results showed that the antinutrients reduced from 2.25-1.80mg/g (oxalate); 2.45-2.16ppm (phatate); 14.16-9.26ppm (Alkaloids); 2.12-1.;69ppm (Saponin) and 0.18-0.13 ppm (Tannin) as the level of defatted soybean flour increased to 20% in the diets.A corresponding increase in the mineral elements evaluated was observed and the values increased from 81.70-92.00ppm (soium); 97.50-108.00ppm(calcium); 48.50-53.12ppm (potassium); 3.48-3.61ppm (magnesium) and 0.64-0.73ppm (iron). The increase in the mineral elements across the blends might be due to the decrease in the antinutrients evaluated. This result showed that the addition of 20% defatted soybeans flour was the best out of all the diets produced in terms of reduced antinutrients and increased mineral composition.

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