Full Length Research Paper

Evaluation of the nutritional value of sprouted sorghum fortified with cowpea and groundnut

Baba Gana M, Modu S, Falmata AS, Hajjagana L, and Ibrahim Z

Department of Biochemistry, Faculty of Science University of Maiduguri

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The effect of sprouting and fortification of sorghum with legume on chemical composition, tannin, mineral element content and in vitro protein digestibility was studied. Sprouting Singly Significantly increased protein, moisture content and decreased fiber, dry matter, fat and ash level. Moreover, the Sprouted sample increased protein digestibility and decrease tannin content. Calcium, magnesium, potassium and phosphate decreased in the Sprouted sample and so also the trace element Zn, Cu and Fe. The result obtained Shows that, Sprouting greatly reduces tannin content, improves protein digestibility and decrease mineral element respectively. In addition, Sprouting and further fortification with legume, greatly improved the nutritive value and quality of Sorghum by removing the anti nutritional factor such as tannin.

Key Words: Sprouting, fortification, tannin and digestibility

INTRODUCTION

Cereals are the most important Staple food for many People in the developed and developing Countries. In the developed countries, 70% of the Cereal production is used as animal feed while in the developing Countries about 68 -98 % of the Cereal production is used for human consumption Betschart, (1982). The principal Cereal crops are wheat, barley, oats, rice, Sorghum, millet and Maize, FAO (1994).

Sorghum (Sorghum bicolor) is one of the five top Cereal Crops in the world. It's originated in Africa having been Cultivated in Egypt in intiguity and the largest producer of Sorghum in the modern era is still Africa, although the Crop spread to Southern Asia and the America as well Steven (2003). Grain Sorghum provide the Staple food of a large population of Africa, India and the semi arid parts of the tropics, FAO (1997).Like other slightly exotic grain Crops, Sorghum is used primarily for animals feed in the United State. The seed Stalks and leaves can also be fed to livestock or left in the field and used as a forage Crop, Steven (2003).

In the united State, a wet milling method is used to make Sorghum Starch used in a variety of Industrial application such as adhesive and Paper making. In most part of world, Sorghum is consumed by humans as well as animals, Vogel (2003). Sorghum is commonly eaten with the hull, which retains the majority of the nutrient. The Plants is very high in fibre and iron, with a fairly high Protein level as well (Vogel, 2003). Unfortunately, Sorghum has nutritional value and inferior organoleptic quality due to the presence of anti-nutritional factors such as tannins and phytates which complexes with protein and irons thereby inhibiting proteins digestibility and absorption of iron. Among the Cereals, Sorghum is known to have least Protein digestibility due to tannins. This can however to overcome by adequate Processing techniques such as Sprouting and Fermentation, and supplementation with grain legumes improves the nutritional quality of the grain, Singh et, al (1999).

Processing methods such as Soaking, Sprouting and Fermentation has been reported to improve the nutritional and functional properties of Plant seeds (Jirapa et, al 2001). Sprouting was reported to be more Superior to Cooking. This Confirm the use of this Processing method such as Sprouting in order to achieve the Set goals. Considering the fact that different Plant Proteins like
Cowpea are deficient in different amino acids, hence there is a need to compliment the missing amino acids. Cowpea, which is rich in essential amino acids such as Tryptophan, lysine and threonine but lacked the Sulphur containing amino acids nethionine and Cystein can be used to compliment Sorghum (Singh, et-al 1999). One of the important factor that affect the nutritional quality of Sorghum is the presence of tannins whose biological effect in human and animals vary considerably.

OBJECTIVES OF THE STUDY

The aim is to produce and evaluate the nutritional value of the Sprouted local Sorghum variety (Tumbuna) fortified with ground nut (Arachis Hypoaea) and cowpea (Virgna Unguiculata)

SOURCES OF RAW MATERIAL

The Sorghum, (Sorghum bicolor) Cowpea Vigna Unguiculata and groundnut, Arachis hypogaea were Purchased at Maiduguri Monday Market and identified by Dr O. Olabanji head of Department Cereals Crop Lake Chad research Institute Maiduguri Borno State.

PREPARATION OF COWPEA SAMPLE

Cowpea grain was sorted to get rid of foreign matter. The grain were weighed and then Soaked in tap water, this is to facilitate Dehulling of the grain and this was done using pestle and motor. The dehulled Cowpea was then roasted in a frying pan for 3-4 minutes and subsequently milled and Sieved to obtain a fine flour.

PREPARATION OF SORGHUM SAMPLE

Sorghum grain were Sorted to get rid of foreign matters and damages. The Sorghum was then soaked in water and then the water was decanted and the Sorghum was placed in a jute Bag and allowed to Sproout for 72 hours, then after Sprouting, the Sprouts are then air dried, then milled and sieved to obtain fine flour.

PREPARATION OF GROUNDNUT SAMPLE

The groundnut were sorted to get rid of matter, and then roasted for about 4-7 minutes and then allowed to cool and the bran was removed and milled to obtain fine flour.

FORMULATION OF WEAINING BLEND

Three weaning blend was formulated in the ratio 70:20:10 as described by Akpapunam and Modu et al. That is 70g of Sprouted Sorghum, 20g of Cowpea and 10g of groundnut was mixed to obtain a 100g of the weaning blend.

PROXIMATE ANALYSIS

The Proximate analysis carried out on the Sorghum bicolor were analyzed to determine the moisture content, Dry matter Crude Protein, Crude fibre ether extract (fat) and ash using AOAC Method (2000).

PROCESSING TECHNIQUES

The sample were processed by sprouting singly as described by Part, 100g of Sorghum grain was weighed, washed with water and decanted. The grain was transferred on filter paper for moisture absorbance. A Jute bag was wetted, and the grain was placed on it and Covered in a petri dish. The sample (Sorghum grain) Sprouted on wet jute bags for 72 hours. At the end of sprouting, the sample were removed from the jute bag, air dried and milled.

DETERMINATION OF IN VITRO PROTEIN DIGESTIBILITY

In vitro protein digestibility was determined by Nills(1979). 1ml of the 11% trypsin was introduced into 3 test tubes, 4ml of phosphate buffer pH 7.5 was added to each test tube and 1ml of 0.1N HCl was added and allowed to stand to equilibrate. 1ml of 1% grinded Sorghum grain was added to all the test tubes (labeled as digestibility at 1 hrs and 6hrs) the reaction of each of the tube was stopped with 5ml neutralized formalin at 60 minutes and at 360 minutes. The content of the test tubes were then filter using filter paper. The filter paper was dried in an Oven at 108oC for 3 hour. The nitrogen of the undigested sample was determined by Kjedahl method.

% In vitro Protein digestibility = \( \frac{\text{CP1} - \text{CP2}}{\text{CP1}} \) \times 100

Where: \( \text{CP1} \) = Total protein of unprocessed grain
\( \text{CP2} \) = Total protein after digestion with trypsin.

TANNIN CONTENT DETERMINATION

1. 0.2g of the milled sample was weighed into a flask and 10ml of 4% helin methanol was pipette and close the flask with Paraffin.
2. Shake for 20 minutes on a wrist action Shaker
3. Centrifuged for 10 minute (4500 revolution per minutes)
4. Read the absorbance of the standard Solution, Sample extract and Sample blank in the Spectrophotometer at
Table 1: Effect of Processing on proximate Composition of Sprouted Sorghum Fortified with Cowpea and Groundnut

<table>
<thead>
<tr>
<th>(%)</th>
<th>Raw</th>
<th>Sprouted</th>
<th>Fortified Sprouted Sorghum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>5.70 ± 0.44a</td>
<td>8.60 ± 0.17a</td>
<td>5.90 ± 0.11a</td>
</tr>
<tr>
<td>Crude Protein</td>
<td>5.07 ± 0.04a</td>
<td>7.09 ± 0.93b</td>
<td>11.46 ± 0.09c</td>
</tr>
<tr>
<td>Fat</td>
<td>4.00 ± 0.44a</td>
<td>3.00 ± 0.02b</td>
<td>3.00 ± 0.10a</td>
</tr>
<tr>
<td>Ash</td>
<td>4.00 ± 0.51a</td>
<td>1.00 ± 0.05b</td>
<td>1.00 ± 0.11b</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>73.83 ± 3.97a</td>
<td>75.31 ± 4.02a</td>
<td>64.64 ± 4.02a</td>
</tr>
<tr>
<td>Fiber</td>
<td>11.30 ± 0.03a</td>
<td>8.00 ± 0.10b</td>
<td>14.00 ± 0.08c</td>
</tr>
<tr>
<td>Energy</td>
<td>351 ± 3.9a</td>
<td>356 ± 6.33a</td>
<td>331 ± 4.15a</td>
</tr>
</tbody>
</table>

Values are mean of three determination ± SD
The value with different superscript horizontally along a row are Statistically Significant (P<0.05).

Table 2: Proximate Composition of fortified Sprouted Sorghum Compared with Commercial weaning food

<table>
<thead>
<tr>
<th>(%)</th>
<th>Sorghum/Cowpea/Groundnut 70:20:10</th>
<th>Commercial weaning food Frisocrem (rice)g/100g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>5.90 ± 0.11</td>
<td>2.0</td>
</tr>
<tr>
<td>Crude Protein</td>
<td>11.46 ± 0.09</td>
<td>16.30</td>
</tr>
<tr>
<td>Fat</td>
<td>3.00 ± 0.10</td>
<td>13.20</td>
</tr>
<tr>
<td>Ash</td>
<td>1.00 ± 0.11</td>
<td>ND</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>64.64 ± 4.02</td>
<td>65.10</td>
</tr>
<tr>
<td>Fibre</td>
<td>14.00 ± 0.08</td>
<td>ND</td>
</tr>
<tr>
<td>Energy</td>
<td>331.4 ± 4.15</td>
<td>0.9</td>
</tr>
</tbody>
</table>

500nm exactly, 20 minute after incubation.

CALCULATION

\[
AU = \frac{A \text{ Std}}{C \text{ Std}} \\
CU = \frac{AU \times C \text{ Std}}{A \text{ Std}} = \text{mg/g}
\]

Where,

\( AU \) = Absorbance of unknown

\( CU \) = Concentration of Standard

\( C \text{ Std} \) = Concentration of Standard

\% Reduction = \( \frac{\text{CRS} - \text{CPS}}{\text{CRS}} \) \times 100

Where,

\( \text{CRS} \) = Concentration of raw sample

\( \text{CPS} \) = Concentration of Processed Sample

MINERAL ELEMENT ANALYSIS

Part, 30g of each sample was weighed using electric weighed machine. The sample was then ashed in a furnace at ashing temperature of 550 ° C. After words, 1.083g was weigh and out of which 1g of the sample was digested. The 1g, part of the sample was placed into a beaker and 30ml of Nitric acid and distilled water was then added to the sample in the beaker. The sample is then warmed over water bath for 35 minutes and then allowed to cool. The digested sample is then filtered using Whitman filter paper and diluted with water to volume of 100ml.

Sample was then run at a particular wavelength using the Atomic Absorption Spectrophotometer to determine the various mineral Elements present in the sample.

WATER ABSORPTION CAPACITY (WAC)

The water absorption capacity was determine by the method of Cegla et' al (1977).10g of the sample was weighed in a 100ml beaker, a known volume (5ml) of water was pipette into the beaker, carefully Stirred and allowed to equilibrate for one hour at room temperature (23 -25oC). After complete water absorption, the sample was further treated with 0.01ml water portion at 10minute interval before visual observation. The volume that gives a complete absorption of water was recorded. WAC was calculated as the ratio of the maximum amount of water in grams absorbed by 100g dry material.

DISCUSSION

Table 4.1 presented Shows the grain hardness of the Sorghum and Cowpea. The Sorghum showed a hardness number of 3 – Calcite while the Cowpea showed 4-fluorite. The sieve analysis of the grain diameter (mm) in table 2 for Sorghum at different mesh sizes ranged between 0.00 – 28.92 with mesh size 6.70 having the highest retention of 28.92.

There was no significant difference in the moisture and Carbohydrate Content of raw, Sprouted and fortified
Table 4: Shows the mineral element Composition of the fortified Sprouted Sorghum at 70:20:10 ratio compared with commercial weaning food (frisocrem).

<table>
<thead>
<tr>
<th>Mineral elements mg/g</th>
<th>Fortified Sprouted Sorghum</th>
<th>Frisocrem (rice) g/100g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>722.8 ± 3.81</td>
<td>52</td>
</tr>
<tr>
<td>Mg</td>
<td>407.0 ± 1.08</td>
<td>ND</td>
</tr>
<tr>
<td>K</td>
<td>665.4 ± 1.61</td>
<td>500</td>
</tr>
<tr>
<td>P</td>
<td>184.02 ± 4.83</td>
<td>425</td>
</tr>
<tr>
<td>Zn</td>
<td>17.90 ± 1.31</td>
<td>180</td>
</tr>
<tr>
<td>Cu</td>
<td>5.30 ± 0.91</td>
<td>665</td>
</tr>
<tr>
<td>Fe</td>
<td>19.30 ± 2.79</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Table 5: Shows the in vitro Protein digestibility of the raw Sample, Sprouted and fortified Sprouted Sorghum.

<table>
<thead>
<tr>
<th>Digestibility</th>
<th>Raw</th>
<th>Sprouted</th>
<th>Fortified Sprouted Sorghum</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 1hour</td>
<td>89.7 ± 0.69</td>
<td>91.3 ± 1.11</td>
<td>96.9 ± 4.44</td>
</tr>
<tr>
<td>At 6 hour</td>
<td>91.5 ± 0.11</td>
<td>95.0 ± 0.95</td>
<td>96.5 ± 1.30</td>
</tr>
</tbody>
</table>

Table 5: Shows the effect of Sprouting on tannin Concentration.

<table>
<thead>
<tr>
<th></th>
<th>Raw</th>
<th>Sprouted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour reaction</td>
<td>Dark blue (high)</td>
<td>Light green (low)</td>
</tr>
<tr>
<td>Tannin Concentration</td>
<td>2.07 ± 0.09</td>
<td>1.54 ± 0.17</td>
</tr>
</tbody>
</table>

Sprouted Sorghum. The Protein content of the Sprouted and fortified Sprouted Sorghum showed a significant difference when compared with the raw Sorghum. The reduction in level of Fat, Fibre and ash Content of the Sprouted might be due to the germination of the Pericarp which is rich in fibre and minerals Kadam,(1989). Fortification of Sorghum with Cowpea and groundnut improves the nutritional quality of Sorghum as most Cereals are deficient in essential amino acid such as lysine, Tryptophan Singh el, al (1999). The protein content of fortified Sprouted Sorghum in table 4 is compared with respect to Commercial weaning food (frisocrem). The fortified Sprouted Sorghum provide one third of the recommended dietary allowance (RDA) as reported by WHO (FAO/WHO/UNU 1985).

There was significant increase in some mineral content of the Sprouted Sorghum such as (Ca, K, P and Zn) while a significant reduction was also observed in the level of (mg,Cu and Fe). Rooner and Serna-Saldiver 1999) they observed that Sorghum is a good source of magnesium, iron, Zinc and Copper but a poor source of calcium and sodium. The result of the mineral content of the Sprouted Sorghum is compared with the prepared commercial weaning food and the result showed a significantly different (p<0.05).

The results of the in vitro protein digestibility showed a significant difference. Sprouting increased in vitro Protein digestibility, due to the leaching out of the polyphenol in water and also enzyme activities. Polyphenol can formed complex with dietary Proteins thereby reducing their digestibility and Protein quality Butler (1989). The increase in the digestibility due to Sprouting might also be due to the germination of the pericarp during sprouting, since tannins are found to be located in the pericarp of the Sorghum grain.

The high level of tannin in the raw sample may be due to the presence of the color pericarp which are brown and red respectively El-hag et, al (2002). In these Studies, the tannin level of raw Sorghum is 2.07% but as a result of sprouting for 72 hour, the tannin level was significantly reduced to 1.54%. In Sorghum, tannin is known to be concentrated in the outer layer of the caryopsis. The tannin level reduced as a result of processing method such as Soaking, Sprouting, grinding and sieving El-hag et, al (2002).

CONCLUSION AND RECOMMENDATION

Sprouting has shown a significant (p<0.05) increase in the proximate composition in the level of Proteins and a significant reduction was observed in the level of fat, ash and fiber content. Processing significantly increase in vitro Protein digestibility and this could be due to the reduction in the tannin level especially in the Sprouted Sample. Sprouting reduced to the nearest minimum level of tannin and consequently increased protein in vitro digestibility.

It is therefore, recommended that Sorghum subjected to Sprouting and fermentation should be fortified with
mineral and vitamin Supplement to make up for the loss mineral due to Sprouting as evidence in this Study.

REFERENCES


Singh, U (1994). The inhibition of Digestive Enzymes by Polyphenols of Chick Pea, nutrition reports international. 29:74

