EFFECT OF ROASTING ON THE PROXIMATE, MINERAL AND ANTI-NUTRIENT COMPOSITION OF Tamarindus indica SEED NUTS

A.Y. Bashir*, S.A. Abdullahi and B. Suleiman

Department of Biological Sciences, Ahmadu Bello University Zaria, Nigeria

*Corresponding author: bashirabdulmalik02@gmail.com

Received: June 12, 2016   Accepted: August 20, 2016

Abstract: Proximate, mineral and anti-nutrient composition of raw and roasted Tamarindus indica seed nuts was investigated. Sample was pretreated by roasting at 100°C for 10 min, to enhance removal of seed coat. 500 g of the seeds were roasted in an open pan and mechanically de-hulled. The proximate composition of raw and roasted samples for dry matter, ash, lipid, crude fiber, crude protein and carbohydrate contents were 96.15, 1.17, 14.59, 3.08, 31.44, 46.49 and 99.21, 1.73, 7.03, 4.96, 26.86, 58.62%, respectively. Mineral compositions were Na (0.13 mg/g\textsuperscript{-1}), K (0.31 mg/g\textsuperscript{-1}), Ca (0.29 mg/g\textsuperscript{-1}), Mg (0.87 mg/g\textsuperscript{-1}) and P (0.14 mg/g\textsuperscript{-1}) for raw sample and Na (0.38 mg/g\textsuperscript{-1}), K (0.82 mg/g\textsuperscript{-1}), Ca (0.67 mg/g\textsuperscript{-1}), Mg (1.31 mg/g\textsuperscript{-1}) and P (0.30 mg/g\textsuperscript{-1}) for the roasted sample. Phytochemical screening showed that the pretreatment increased alkaloid and saponin contents significantly (p<0.05) while, the increase in tannin and phytate contents was not significant (p>0.05). Tamarindus indica seed nut can serve as an alternative to common legumes for protein supplement; roasted Tamarindus indica seed nut is more proteinous than the raw.

Keywords: Anti-nutrient, mineral, nutrient, Tamarindus indica, raw, roasted

Introduction

Some wild nuts and seeds used as food in several parts of the world have considerable potential as protein source. Large segments of human population and animals in developing countries suffer from protein malnutrition (Conway & Toenniessen, 1999). Tamarindus indica L. of the Fabaceae family, subfamily Caesalpinioideae, is an important plant in the tropics. It is a multipurpose tree of with almost every part finds at least some use (Kumar & Bhattacharya, 2008), either nutritional (Orwa et al., 2009) or medicinal in treatment of trypanosomiasis, dracunculosis, dysentery, diarrhoea and snake bite (Atawodi et al., 2002). Tamarindus indica is indigenous to tropical Africa but it has been introduced and naturalized worldwide in over 50 countries (Orwa et al., 2009). It grows well over a wide range of soil and climatic conditions, occurring in low-altitude woodland, savannah and bush, often associated with termite mounds. It grows in most soils but prefers well-drained deep alluvial soil. Its extensive root system contributes to its resistance to drought and wind.

The seed is a by-product of the Tamarindus indica pulp industry. The presence of tannins and other dyeing matter in the testa makes the whole seed unsuitable for direct consumption (Kumar & Bhattacharya, 2008). In the past, the great bulk of seeds available as a by-product of processing tamarinds have gone to waste. In Northern Nigeria, there is usually no use for the seed after the pulp have been removed for making “kununtsamiya”, usually the seeds are discarded. The major industrial product of Tamarindus indica seed is the tamarind kernel powder (TKP) which is an important sizing material used in the textile, paper, and jute industries (Kumar & Bhattacharya, 2008). Tamarindus indica seed is also the raw material used in the manufacture of polysaccharide (jellose), adhesive and tannin (De Caluwe et al., 2010). Roasted seeds of Tamarindus indica are claimed to be superior to groundnuts in flavour (ICRAF, 2007). Legumes such as soybean contain high concentration of proteins, carbohydrates and dietary fiber and make an important contribution to human diet in many countries. Legumes have to be processed prior to consumption due to their content of anti-nutritional compounds, such as trypsin inhibitors, phytic acid, galactosides (Valverde et al., 2002). Amongst the important antinutritional compounds of Tamarindus indica are trypsin inhibitors, phytate, tannins and saponin. Unconventional legumes have good potential for commercial exploitation but remain ignored. They offer a good opportunity to meet the ever-increasing demands for vegetable protein. Although they have high protein content and possess good nutritional value, their utilization is limited by the presence of some anti-nutritional, anti-physiological and toxic substances (Shlini & Murthy, 2015). Processing techniques such as soaking, de-hulling, cooking or autoclaving, germination and fermentation have been found to reduce significantly the levels of phytates and tannins by exogenous and endogenous enzymes formed during processing (WHO, 1998).

The research is aimed at determining the effect of roasting on proximate, mineral composition and anti-nutritional factors of raw and roasted Tamarindus indica seed nut.

Materials and Methods

Sample preparation

Tamarindus indica seeds were collected from local traders in the Sabon-gari market, Zaria, Kaduna State. The seeds were taken to the Herbarium of Biological Sciences department, Ahmadu Bello University Zaria for identification. Tamarindus indica seeds were sorted to remove dirt and bad seeds; they were dried within a shaded area for 72 h, weighed and then pretreated. The seeds were pretreated by roasting. Roasting was carried out according to the recommended methods of Akaijaku et al. (2014). 500 g of the seeds were roasted in an open pan at a temperature of 100°C for 15 min and mechanically de-hulled. The roasted seeds were milled into flour and further dried under the sun at 36°C. The samples were sieved to obtain fine flour and packaged in an air tightplastic container pending further analyses.
Proximate analysis

Moisture, ash, ether extract, crude fiber and protein contents were determined for raw and roasted samples using the recommended methods of Association of Official Analytical Chemists (AOAC, 1990).

Determination of ash

The sample (2.0 g) was ignited at 600°C for 6 h to burn all organic material. The inorganic material which did not burn or volatilize at that temperature is the ash.

Determination of ether extract

Ether was continuously volatilized, condensed and then allowed to pass through the sample to extract ether soluble materials. When the process was completed, the ether was distilled, collected in another container, remaining crude fat was dried, weighed and percent oil was calculated. The crude lipid was determined by the continuous solvent extraction method in a Soxhlet extraction apparatus as described by AOAC (1990). The sample (2.0 g) was taken in the thimble and extracted with petroleum ether for 16 h. The miscella obtained was evaporated on hot water bath, dried at 105°C for 30 min, cooled in desiccator and weighed.

Determination of crude fiber

The crude fiber was determined by the method of Maynard (1970). The sample (2.0 g) was extracted with 200 mL of 0.255M H₂SO₄ for 30 min, filtered through muslin cloth and washed with boiling water until acid free. The residue was further extracted with 200 mL of 0.313N NaOH for 30 min, filtered through muslin cloth and washed successively with 25 mL of hot 1.25% H₂SO₄, 50 mL of water (thrice) and 25 mL of alcohol. The residue obtained was dried for 2 h at 130°C, cooled in desiccator and weighed.

Determination of crude protein

The protein content of the samples was determined by the micro-kjeldhal method. 100 mg of the sample was weighed and transferred into a 30 mL digestion flask. To this, 0.5 mL of 14% of HgSO₄ solution in 4N H₂SO₄ and a pinch of K₂S₂O₃ was added along with 2.5 mL of concentrated H₂SO₄. The sample was digested till the solution became colourless. After cooling the digest, it was diluted with a small quantity of ammonia-free distilled water and transferred to the distillation apparatus and 10 mL of NaOH-Na₂S₂O₃ solution was added. The sample was steam distilled and the liberated ammonia was collected in boric acid solution. This was then titrated against standard H₂SO₄ (1 mL of 0.1N H₂SO₄ acid was equivalent to 1.401 mg N). The total nitrogen content was multiplied with 6.25 to obtain total protein content.

Determination of the carbohydrate

Carbohydrate content was determined by difference; the sum of measured moisture (% M.C); ash (% wash); protein (%N); crude fiber (%C.F) and fat (%F) deducted from 100 (i.e. 100 - %M.C + %A+%N + %C.F + %F).

Determination of mineral contents of tamarindus indica seed nuts

The dry ash obtained by dry ash method was used to determine Ca, Mg, K, Mn, and P. The ash after cooling was digested with 100 mL 0.5M HCl on a hot plate until the volume reduced to about 10–15 mL. It was then filtered using Whatman No. 1 filter paper and the volume of the filtrate was made up to 100 mL mark. The filtrate was transferred into a polythene bottle for analysis using H183200 multi parameter Bench Photometer.

Anti-nutrients in Tamarindus indica seed nut

Tannin, saponin, alkaloid and phytate contents were determined using the recommended methods of Association of Official Analytical Chemists (AOAC, 1990).

Extraction of tannins

100 mg of sample is mixed with 5 mL of 2.5N HCl on boiling water bath for 2.30 h, and cool to room temperature. This mixture is neutralized with solid sodium carbonate. The volume in each case is made up and centrifuged.

Extraction of saponin

5 g of the sample was put in 20% acetic acid ethanol and allowed to stand in a water bath at 50°C for 24 h. This was filtered and the extract was concentrated using a water bath to one quarter of the original volume. Concentrated ammonium hydroxide (NH₄OH) was added drop wise to the extract until the precipitate was complete. The whole solution was allowed to settle and the precipitate was collected by filtration and weighed. The saponin content was weighed and calculated in percentage.

Determination of alkaloids

5 g of the sample was weighed into 250 mL beaker and 200 mL of 20% acetic acid in ethanol was added and covered and allowed to stand for 4 hours at 25°C. This was filtered with paper No.42 and the filtrate was concentrated using a water bath to one quarter of the original volume. Concentrated NH₄OH was added drop wise to the extract until the precipitate was collected and washed with dilute NH₄OH (1% Ammonia solution); then filtered with pre-weighed filter paper. The residue on the filter paper is the alkaloid which was dried in the oven (precision Electro thermal model BMP9052 England) at 80°C. The alkaloid content was calculated and expressed as percentage of the sample analysed.

Data analysis

Student’s t-test was adopted to test for significant difference (p<0.05) between the raw and roasted samples.

Results and Discussion

Proximate composition of Tamarindus indica seed nut

The proximate composition of pretreated and untreated seed samples are shown in Table 1. The values for dry matter content of raw and roasted samples were 96.15 and 99.21%, respectively. Pretreatment increased dry matter content significantly (p<0.05). Increase in dry matter could be as a result of heat treatment from roasting which
Chemical Analysis of Raw and Roasted Tamarindus indica Seed Nut

Reduced the seed’s moisture content. The values for ash content of raw and roasted samples were 1.17 and 1.73%, respectively. There was no significant difference (p>0.05) between the two samples. This could be due to the mild roasting period (10 min) which did not intensively burn the sample. Roasting significantly reduced (p≤0.05) the lipid content of the raw seeds (14.59%) to 7.03%. Nwanna et al. (2004) reported lipid content value of 0.35% for raw Tamarindus indica seed nut which is lower than that observed in this work. The values for crude fiber content of raw (3.08%) and roasted (4.96%) samples of Tamarindus indica seed nut differed significantly (p≤0.05). Crude fiber content was lower than that reported by Akajakwu et al. (2014), which were 6.15% for raw sample and 6.30% for roasted sample of the same seed. This variation in crude fiber could be due to the influence of environmental factors on the seed (Akajakwu et al., 2014).

The crude protein content of the raw (31.44%) and roasted (26.86%) samples differed significantly (p<0.05). These values are higher than the crude protein value of Tamarindus indica seed nut (15.4%) reported by Heuze & Tran (2015). The pretreatment method (roasting) could be the reason for the decrease in crude protein of the processed sample. Kumar et al. (2015) reported that heating feed for prolong periods at high temperatures decrease availability of amino acids. Total carbohydrate content of the raw sample (46.49%) differed significantly (p<0.05) from that of the roasted sample (58.62%). The value for roasted sample is higher than that of the carbohydrate value of roasted Tamarindus indica seed nut (58.08%) reported by Akajakwu et al. (2015). The values of the proximate composition obtained from this research are higher than those of Heuze & Tran (2012) except for ash and fiber contents, which could be as a result of difference in geographical locations in which the seeds were obtained.

Table 1: Proximate composition (%) of raw and roasted Tamarindus indica seed nut

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Dry matter</th>
<th>Ash</th>
<th>Lipid</th>
<th>Crude fibre</th>
<th>Crude protein</th>
<th>Carbohydrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw sample</td>
<td>96.15a</td>
<td>1.17a</td>
<td>14.59a</td>
<td>3.08a</td>
<td>31.44a</td>
<td>46.49a</td>
</tr>
<tr>
<td>Roasted sample</td>
<td>99.21b</td>
<td>1.73b</td>
<td>7.03b</td>
<td>4.96b</td>
<td>26.86b</td>
<td>58.62b</td>
</tr>
</tbody>
</table>

Samples in duplicates were taken and the average values are reported. Means with same superscript in the same column are not significantly (p>0.05) different.

Mineral composition of Tamarindus indica seed nut

The result of mineral composition of raw ad roasted Tamarindus indica samples are presented in Table 2. The values of sodium content for raw and roasted samples were 0.13 and 0.38 mg/g, respectively. There was significant difference (p<0.05) in sodium content of the two samples. The value in raw sample is low compared with that of Nwanna et al. (2004) for the same seed (0.23 mg/g). However, roasting increased sodium content of the seed. The values of potassium content for raw and roasted samples were 0.31 and 0.82 mg/g, respectively. There was significant difference (p<0.05) in potassium contents of the two samples. The values of calcium content for raw and roasted samples were 0.29 and 0.87 mg/g, respectively. There was significant difference (p<0.05) in calcium contents of the two samples. These values are low compared to that of Heuze & Tran (2015) who reported 3.0 mg/g for raw Tamarindus indica seed. The values of magnesium content for raw and roasted samples were 0.67 and 1.31 mg/g, respectively. There was significant difference (p<0.05) in magnesium contents of the two samples. The high content of magnesium can be linked to the high level of phytate in the seed. This is because phytate in legume grains and oil seeds is bound with calcium and magnesium (Kumar et al., 2012). The values of phosphorus content for raw and roasted samples were 0.14 and 0.30 mg/g, respectively. There was significant difference (p<0.05) in phosphorus contents of the two samples. The high availability of calcium and magnesium is a good indication that Tamarindus indica seed is rich in the minerals for bone formation and roasting has significantly increased its mineral content.

Table 2: Mineral composition (%) of raw and roasted Tamarindus indica seed nut

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Sodium (mg/g)</th>
<th>Potassium (mg/g)</th>
<th>Calcium (mg/g)</th>
<th>Magnesium (mg/g)</th>
<th>Phosphorus (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw sample</td>
<td>0.13a</td>
<td>0.31b</td>
<td>0.29a</td>
<td>0.87a</td>
<td>0.14a</td>
</tr>
<tr>
<td>Roasted sample</td>
<td>0.38b</td>
<td>0.82b</td>
<td>0.67b</td>
<td>1.31b</td>
<td>0.3a</td>
</tr>
</tbody>
</table>

Samples in duplicates were taken and the average values are reported. Means with same superscript in the same column are not significantly (p>0.05) different.

Anti-nutrient composition of Tamarindus indica seed nut

The results of anti-nutrient composition of Tamarindus indica is presented in Table 3. The values for alkaloid content of raw and roasted sample were 3.7 and 6.8%, respectively. The alkaloid content differed significantly (p<0.05). Alkaloids containing grain legumes, such as lupins (Lupinus albus), are otherwise ideally suited as a feedstuff in aquafeeds because of high digestible protein content (Kumar et al., 2012). The low level of alkaloid in the raw sample could be due to the soaking of the seed sample to remove the seed coat. Alkaloids are removed from seed materials by aqueous extraction and treatment.

Table 3: Anti-nutrient composition (%) of raw and roasted Tamarindus indica seed nut

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Alkaloid</th>
<th>Saponin</th>
<th>Tannin</th>
<th>Phytate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw sample</td>
<td>3.7a</td>
<td>2.3a</td>
<td>2.37a</td>
<td>6.75a</td>
</tr>
<tr>
<td>Roasted sample</td>
<td>6.8b</td>
<td>4.1b</td>
<td>2.38b</td>
<td>7.71b</td>
</tr>
</tbody>
</table>

Samples in duplicates were taken and the average values are reported. Means with same superscript in the same column are not significantly (P>0.05) different.

The values of the saponin content of raw and roasted samples differed significantly (p<0.05) and were 2.3 and 4.1%, respectively. Saponin are steroids or triterpenoid glycosides found in many of the potential, alternate plant-derived feed ingredients for fish, such as various legume seeds (18 – 41 mg/kg) and defatted roasted soybean flour (67 mg/kg) (Kumar et al., 2012). Saponins increase the digestibility of carbohydrate rich foods. However, simultaneous consumption of saponin and tannin results in the loss of individual toxicity because the formation of
Chemical Analysis of Raw and Roasted Tamarindus indica Seed Nut

The raw seed nut is a good source of protein (31.44%) and lipid (14.59%) with good nutritional value, while the roasted seed nut can be considered as a good source of lipid (7.03-14.59%) content, and can serve as an alternative to common legumes for protein supplementation. Thus, Tamarindus indica seed nut has a good nutritional profile with protein (26.86-31.44%) and lipid (7.03-14.59%) content, and can serve as an alternative to common legumes for protein supplementation.

Conclusion

This work showed that Tamarindus indica seed nut has a good nutritional profile with protein (26.86-31.44%) and lipid (7.03-14.59%) content, and can serve as an alternative to common legumes for protein supplementation. The raw seed nut is a good source of protein (31.44%) and lipid (14.59%) with good nutritional value, while the roasted seed nut can be considered as a good source of valuable minerals. Although the seed has high anti-nutrients, various pretreatment methods can be used to reduce their composition to a minimal consumption level for animals.

Acknowledgement

The authors wish to acknowledge General Laboratory of National Animal Production Research Institute (NAPRI) Shikka, Zaria, Kaduna State for offering their facilities for the analysis.

Conflict of Interest

There is no conflict of interest.

References


