Direct Research Journal of Agriculture and Food Science (DRJAFS)
Vol.7 (6), pp. 131-136, June 2019
ISSN 2354-4147
DOI: https://doi.org/10.5281/zenodo.32360235
Article Number: DRJA3702965315

http://directresearchpublisher.org/journal/drjafs/

*Full Length Research Paper*

# Nutritional Evaluation of Processed *Jatropha curcas* Seed Meals

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Received 17 May 2019; Accepted 6 June, 2019

This research was aimed at evaluating the proximate composition, mineral, vitamins, fatty acids and level of anti-nutrients compositions of raw and processed *Jatropha curcas* seeds and examined the effect of processing on the parameters. From the proximate composition analysis, the protein, crude lipid, ash, crude fibre and nitrogen free extract content showed a significant difference ($p<0.05$) between the processed and unprocessed (raw) seed meals. Evaluation of the mineral composition showed that processing significantly affected the compositions. Vitamins compositions were significantly ($p<0.05$) improved due to soaked and fermented methods. Fatty acids compositions of the raw and processed were significantly different ($p<0.05$). Analyses of the anti-nutrient compositions showed that the processed *J. curcas* registered a significant reduction in compositions compared to the unprocessed seed meals. These results suggested that the consumption of *J. curcas* will go a long way in reducing the level of competition with *Glycine max* (soybean) in the feed industries.

**Keywords**: Proximate, anti-nutrients, processed and unprocessed

## INTRODUCTION

*Jatropha* also called Bindazugu (Hausa) are multipurpose plant species which is widely distributed in many tropical and subtropical countries (Makkar *et al.,* 2008; Workagegn *et al.,* 2013). *Jatropha curcas* is a perennial, monoecious shrub or small tree up to 6m high; bark pale brown, papery, peeling; slash exudes acopious watery latex, soapy to tough but soon becoming brittle and brownish when dry; branches glabrous, ascending, and stout (Orwa *et al.* 2009). Leaves alternate, palmate, petiolate, stipulate; stipules minute; petiole 2-20 cm long, blade 3-5 lobed, 12.5-18 x 11-16 cm, lobes acute or shortly acuminate at the apex, margins entire or undulating, leaf base deeply cordate, glabrous or pubescent only on the veins below, basal veins 7-9, prominent, venation reticulate (Makkar *et al.,* 2012). The current distribution of *J. curcas* shows that introduction has been most successful in drier regions of the tropics. It is very tolerant and thrives under a wide range of climatic and edaphic conditions. It is particularly hardy at medium altitude and in humid zones. It is not sensitive to day length. Dry jatropha fruits contain about 38% husks and 63% seeds. The seeds look like castor seeds in shape and are black in colour (Raheman, 2012). They contain 30-40% testa (shells) and 60-70% kernels, kernels contain 44-62% oil (Antyev, 2018). Recently, this plant is highly cultivated for commercial production of bio-diesel.

The *Jatropha curcas* kernel meal obtained after oil extraction is also an excellent source of nutrients for animal feed if the anti-nutritional factors are reduced. After oil extraction, (Makkar *et al.,* 2008) documented that about 50% of the weight of the seed remains as press cake, and contains 58-62% crude protein with an excellent amino acid profile and good proportion of carbohydrates. *Jatropha curcas* can also be a good source of both saturated and unsaturated fatty acids particularly, polyunsaturated fatty acids (PUFA) such as linoleic acid (18:2n-6) and alpha linoleic acid (18:3n-3) fatty acids. Therefore, it is expected to be an excellent feed ingredient in the future to replace fish and soybean meal. Despite the high content of protein, excellent amino acid profile and good proportions of carbohydrates: the toxic and anti-nutritional substances (lectin, phytic acid, saponins, phorbol ester and trypsin inhibitors) concentrations restrict the use of *J. curcas* seeds in animal production (Makkar *et al.,* 2008). *Jatropha curcas* meal in animal nutrition is however faced with several problems of anti-nutritional factors such as lectin, saponin, tannin, phytate, trypsin inhibitors and phorbol esters (Makkar and Becker, 1999). Due to these phytotoxins, the seeds or cakes or its oil cannot be used for human or animal consumption. Processing methods, such as soaking, germination roasting and autoclaving has been reported to improve the nutritional properties of plant seeds (Ojediran *et al.,* 2014). Processing techniques caused important changes in the biochemical, nutritional and sensory characteristics of legumes. In many parts of the world, legumes are often consumed after soaking and germination, during which the nutritional value is enhanced. During germination of food grains, it has been reported that certain minerals and vitamins were increased (Sangronis and Machado, 2007). The above named toxins can be removed either by chemical or physical methods while phorbol ester is the most difficult toxin to be detoxified by these methods (Belewu and Sam, 2010). This study therefore attempts to investigate the effect of various processing methods on nutrient compositions of *Jatropha curcas* seed meals.

## MATERIALS AND METHODS

### Experimental site

The feeding trial was conducted at the Fisheries Research Farm of the Department of Fisheries, Moddibo Adama University of Technology (MAUTECH), Yola. Adamawa State is located on latitude 9.14°N, longitude 12.38°E and an altitude of 185.9 m. Girei is located on latitude 9.22°N, longitude 12.33°E and altitude of 245 m. It has an average annual rain fall of about 759 mm with maximum temperature of 39.7°C. The rainy season run from May through October, while the dry season commences November and ends in April. The driest months of the year are January and February when the relative humidity drops to 13% (CGIDD, 2014).

### Seeds collection and identification

Matured *Jatropha curcas* seeds were collected from Girei surroundings. They were identified using a field handbook by (Arbonnier, 2004) by plant Taxonomist in Forestry and Wildlife Department of Modibbo Adama University of Technology, Yola (MAUTECH).

### Preparation of the seeds and processing

*J. curcas* seeds were cracked open manually to remove the coats. The seeds were clean of dirty by hand picking and winnowed according to (Doss *et al.,* 2011; Antyev, 2018).

(i) Raw seeds were milled and tag raw seed meal (RSM).
(ii) Raw seeds were soaked in tab water to the ratio of 1:3 for 72 h, oven dried at 50°C to constant weight then milled and tag soaked seed meal (SSM).
(iii) Raw seeds were boiled for 30 min, oven dried at 50°C to constant weight then milled and tag boiled seed meal (BSM).
(iv) Raw seeds were toasted at 70°C using electric hot plate until seeds turn brown in colour then milled and tag Toasted seed meal (TSM).
(v) Raw seeds were moistened with water, kept in a container with cover in a dark place to ferment for 72 h under laboratory condition, oven dried at 50°C then milled and tag fermented seed meal (FSM).

### Laboratory analysis

The samples were packaged and send to animal nutrition laboratory, Adamawa State University Mubi for the analysis. Proximate, Minerals, Essential amino acids, vitamins, fatty acids and anti-nutrients were determined using standard methods of AOAC, (2012).

### Data analysis

Data collected were recorded as Mean ± standard deviation and subjected to analysis of variance (ANOVA), mean were separated using Duncan multiple range test at 5% significant level.

## RESULTS AND DISCUSSION

Table 1 shows proximate and mineral compositions of the raw and processed seeds of *Jatropha curcas*. The processed method recorded the lowest protein and crude lipid values compared to the raw, fibre and ash values were recorded highest from toasted method and Nitrogen free extract (carbohydrate) were greatly affected by the processing methods. Highest mineral values were recorded from the raw seed meal. There were significant difference ($p<0.05$) in the proximate and mineral compositions of the seed meals with processing. Table 2 shows the essential amino acids compositions which were significantly affected ($p<0.05$) by processing the methods. Table 3 shows that processing methods (soaked and fermented) increases the vitamins compositions of *Jatropha curcas* seed meals when compared with the raw seed. Table 4 shows that processing method affects the fatty acids compositions of the seed meals. Table 5 shows that processing significantly ($p<0.05$) reduces the anti-nutrient compositions

**Table 1.** Effect of processing methods on proximate and mineral compositions of *Jatropha curcas* seed meals.

| Nutrients/Minerals | Raw | Boiled | Toasted | Soaked | Fermented |
|---|---|---|---|---|---|
| Protein % | 37.68±0.01$^{a}$ | 28.33±0.01$^{e}$ | 30.46±0.01$^{c}$ | 29.65±0.01$^{d}$ | 31.46±0.01$^{b}$ |
| Lipid % | 42.36±0.01$^{a}$ | 12.35±0.01$^{c}$ | 6.75±0.00$^{d}$ | 12.96±0.00$^{c}$ | 13.55±0.00$^{b}$ |
| Fibre % | 3.40±0.00$^{b}$ | 2.86±0.01$^{c}$ | 6.13±0.01$^{a}$ | 3.02±0.00$^{b}$ | 2.16±0.01$^{c}$ |
| Ash % | 3.27±0.01$^{c}$ | 4.66±0.01$^{b}$ | 7.25±0.00$^{a}$ | 4.71±0.01$^{b}$ | 4.84±0.01$^{b}$ |
| Nitrogen free extract % | 6.79±0.03$^{e}$ | 45.93±0.06$^{a}$ | 44.21±0.03$^{b}$ | 43.54±0.73$^{c}$ | 41.49±0.04$^{d}$ |
| Dry Matter % | 93.50$^{b}$ | 94.13$^{a}$ | 94.80$^{a}$ | 93.88$^{b}$ | 93.50$^{b}$ |
| Calculated Gross Energy (Kcal/g) | 620.55$^{a}$ | 456.72$^{b}$ | 410.22$^{b}$ | 459.52$^{b}$ | 466.44$^{b}$ |
| Ca(g/100g) | 0.586±0.01$^{a}$ | 0.275±0.01$^{d}$ | 0.455±0.01$^{b}$ | 0.347±0.02$^{c}$ | 0.381±0.01$^{c}$ |
| Fe (g/100g) | 0.01±0.01$^{a}$ | 0.006±0.01$^{b}$ | 0.009±0.01$^{b}$ | 0.007±0.00$^{b}$ | 0.008±0.01$^{b}$ |
| Mg(g/100g) | 0.236±0.01$^{a}$ | 0.192±0.01$^{b}$ | 0.242±0.01$^{a}$ | 0.182±0.01$^{c}$ | 0.204±0.01$^{a}$ |
| Na(g/100g) | 0.355±0.01$^{a}$ | 0.246±0.00$^{d}$ | 0.326±0.01$^{b}$ | 0.227±0.01$^{e}$ | 0.294±0.01$^{c}$ |
| K (g/100g) | 1.354±0.01$^{a}$ | 0.765±0.01$^{c}$ | 1.142±0.01$^{b}$ | 0.845±0.01$^{c}$ | 1.022±0.01$^{b}$ |
| P (g/100g) | 0.224±0.02$^{a}$ | 0.124±0.01$^{b}$ | 0.186±0.01$^{b}$ | 0.144±0.02$^{b}$ | 0.161±0.01$^{b}$ |

abcde Mean on the same row with different superscripts are significantly different (P<0.05).
Cal. Gross energy as 5.64, 9.44 and 4.11 Kcal/g for Protein, lipid and Nitrogen free extract respectively (NRC, 1993).

**Table 2.** Effect of processing methods on vitamin compositions of *Jatropha curcas* seed meals.

| Vitamins | Raw | Boiled | Toasted | Soaked | Fermented |
|---|---|---|---|---|---|
| A (IU/100g) | 8863.45±0.01$^{b}$ | 4852.32±0.01$^{c}$ | 1425.40±0.01$^{d}$ | 91124.56±0.01$^{a}$ | 9653.49±0.02$^{a}$ |
| B1(mg/100g) | 0.35±0.01$^{c}$ | 0.30±0.00$^{d}$ | 0.13±0.01$^{e}$ | 0.36±0.01$^{b}$ | 0.38±0.01$^{a}$ |
| B3(mg/100g) | 0.28±0.01$^{c}$ | 0.24±0.01$^{d}$ | 0.06±0.01$^{e}$ | 0.29±0.01$^{b}$ | 0.33±0.01$^{a}$ |
| B6(mg/100g) | 0.14±0.00$^{c}$ | 0.12±0.00$^{d}$ | 0.06±0.01$^{e}$ | 0.17±0.00$^{b}$ | 0.23±0.01$^{a}$ |
| C(mg/100g) | 15.63±0.01$^{c}$ | 12.07±0.01$^{d}$ | 6.73±0.01$^{e}$ | 16.35±0.02$^{b}$ | 18.93±0.01$^{a}$ |
| D(mg/100g) | 0.46±0.01$^{d}$ | 0.52±0.01$^{b}$ | 0.47±0.01$^{c}$ | 0.47±0.01$^{c}$ | 0.58±0.00$^{a}$ |

abcde Mean on the same row with different superscripts are significantly different (P<0.05).

of the seed meals. The raw Jatropha seed has the highest metabolizable energy (ME) of 5066.36Kcal/g when compared with other processed groups (Table 1) is in agreement with the work of Antyev *et al.* (2017), this could be as a result of high ether extract in the seed (raw) Belewu *et al.* (2010). The low energy values could be due to defatting process. The processed groups metabolizable energy were higher when compared with *Centrosema pubescence* (3389.00 kcal/g) and *Calopogonium mucunoides* (3424.00 kcal/g) reported by Ogwu *et al.*(2001).

The crude protein of raw *J. curcas* 37.68%, and processed ranged between 28.33% - 31.46% (Table 1). This compared favourably with Ojediran *et al.* (2014) for raw and differently processed Jatropha seed. Ojediran *et al.* (2014) reported an increase in crude protein as result of processing which is contrary to the result of this study. Oladunjoye *et al.* (2014) reported 36.40% CP for raw Jatropha seed; 31.23% and 37.75% by Fakunle *et al.* (2013) for raw and boiled Jatropha seed; 30.21%, 32.54% and 30.08% by Obun *et al.,* (2016) for raw, boiled for 30mins and 45mins respectively; 33.07% by Ojo *et al.* (2013); 35.02% by Pasaribu *et al.* (2010) for raw Jatropha seed were lower than 56.4% reported by Makker and Becker, (1999). Agboola and Adenuga, (2015) reported a value of 47.97% for heat treated Jatropha seed cake. The differences in the results for raw and processed Jatropha seeds in this study as compared to values reported in literature may be due to the age, environmental conditions (edaphic factors) of the plants seed, processing, storage period and analytical methods applied. The value of fat for raw Jatropha seeds (42.36%) was observed due to oil extraction (de-fatting), it decreases in the processed seeds (Ojediran *et al.,* 2014) The value recorded in this study was lower than 52.04% reported by Ojediran *et al.* (2014), but higher than 12.7% reported by Oladunoye *et al.* (2014) and 16.47% by Pasaribu *et al.* (2010). As the fat increased, there was reduction in the ash content. It could be observed in the differently processed, that fat and ash had a negative correlation (Antyev *et al.,* 2017). It is obvious that defatting increase the concentration of minerals. The ash content of 3.27% from raw seed is lowered than 5.68% for raw seed of *Jatropha curcas* reported by Abou-Arab and Abu-Salem, (2010). Its increase in differently processed (4.66%–7.25%) signified that defatting increase the concentration of minerals. The higher oil content of *Jatropha curcas* makes it one of the most appropriate renewable alternative sources of biodiesel in terms of availability and cost (Umer *et al.,* 2010).

**Table 3.** Effect of processing methods on fatty acids compositions of *Jatropha curcas* seed meals (g/100g dry weight basis).

| Fatty acids | Raw | Boiled | Toasted | Soaked | Fermented |
|---|---|---|---|---|---|
| C10:0 (Capric) | 0.008±0.02[a] | 0.002±0.02[d] | 0.002±0.00[d] | 0.003±0.00[c] | 0.004±0.01[b] |
| C12:0 (Lauric) | 0.010±0.01[a] | 0.005±0.01[c] | 0.003±0.01[d] | 0.006±0.00[b] | 0.006±0.01[b] |
| C14:0 (Myristic) | 0.009±0.02[a] | 0.004±0.01[c] | 0.0036±0.00[d] | 0.004±0.01[c] | 0.005±0.01[b] |
| C16:0 (Palmitic) | 0.034±0.02[a] | 0.010±0.01[b] | 0.0076±0.01[d] | 0.011±0.02[b] | 0.009±0.01[c] |
| C18:0 (Stearic) | 0.046±0.02[b] | 21.45±0.01[a] | 0.011±0.02[e] | 0.022±0.02[c] | 0.015±0.01[d] |
| C18:1 (Oleic) | 0.050±0.02[b] | 0.029±0.00[d] | 0.019±0.01[e] | 0.030±0.01[c] | 22.65±0.01[a] |
| C18:2 (Linoleic) | 0.035±0.02[b] | 0.036±0.01[a] | 0.027±0.01[c] | 0.035±0.01[b] | 0.035±0.02[b] |
| C20:0 (Arachidic) | 0.015±0.01[b] | 0.008±0.01[c] | 0.005±0.02[d] | 0.008±0.01[c] | 0.035±0.01[a] |

abcde Mean on the same row with different superscripts are significantly different (P<0.05).

**Table 4.** Effect of processing methods on essential amino acid (EAA) compositions of *Jatropha curcas* seed meals (g/16N dry weight basis).

| EAA | Raw | Boiled | Toasted | Soaked | Fermented |
|---|---|---|---|---|---|
| Arginine | 6.24±0.01[a] | 4.62±0.01[b] | 6.00±0.00[a] | 4.21±0.01[b] | 6.32±0.01[a] |
| Histidine | 4.04±0.01[a] | 2.54±0.02[c] | 3.64±0.01[b] | 2.05±0.01[c] | 3.86±0.01[b] |
| Isoleucine | 5.13±0.01[a] | 3.01±0.01[c] | 4.53±0.01[b] | 2.86±0.01[d] | 4.04±0.01[b] |
| Leucine | 8.86±0.01[a] | 7.96±0.01[b] | 7.91±0.01[b] | 6.89±0.01[c] | 7.93±0.00[b] |
| Lysine | 5.85±0.01[a] | 4.54±0.01[b] | 5.68±0.01[a] | 4.24±0.01[b] | 5.17±0.01[a] |
| Methionine | 2.65±0.01[a] | 1.35±0.01[b] | 2.34±0.01[a] | 1.71±0.01[b] | 2.12±0.01[a] |
| Phenylalanine | 5.00±0.00[a] | 3.75±0.00[c] | 4.63±0.01[b] | 3.52±0.01[c] | 3.87±0.01[c] |
| Threonine | 3.13±0.01[a] | 2.46±0.01[b] | 2.95±0.01[b] | 2.32±0.01[b] | 2.66±0.01[b] |
| Tryptophan | 5.63±0.01[a] | 4.72±0.01[b] | 5.33±0.01[a] | 4.16±0.01[b] | 5.26±0.01[a] |
| Valine | 7.82±0.01[a] | 4.87±0.01[c] | 6.29±0.01[b] | 4.42±0.01[c] | 7.66±0.01[a] |

abcd Mean on the same row with different superscripts are significantly different (P<0.05).

The crude fibre (CF) of raw Jatropha seed was 3.40%, toasted Jatropha seed was highest (6.35%), while boiled, soaked and fermented decreased in CF (2.86%, 3.02% and 2.16%) respectively. The raw CF from this study was lower when compared to 3.81% reported by Abou-arab and Abu-Salem, (2010) and similar to the report of Makkar *et al.* (1998). On the other hand, Ogbobe and Akano, (1993) reported that the untreated seed of *Jatropha gossypifolia* contains (9.25%). Ojediran *et al.* (2014) reported that heat browning does not affect fibre content but protein denatured, as such increased in fibre content, which corresponds with the result of this study on toasted jatropha seed. The raw Jatropha seed had 6.79% Nitrogen free extract (NFE), this value was lower to that obtained by Ojediran *et al.* (2014). The processed group had values higher than that reported by Ojediran *et al.* (2014); Oladunoye *et al.* (2014); Pasaribu *et al.* (2010); Ojo *et al.* (2013) and Agboola and Adenuga, (2015). De-fatting increased the NFE value in this study which did not agreed with the report of Ojediran *et al.* (2014) that da-fattening reduces the NFE content of the variously treated Jatropha Kernel Meal. The dry matter (DM) content in this study ranged from (93.5% - 94.8%). This agreed with the ranges of (94.26% – 97.71%) reported by Ojediran *et al.* (2014) for raw, toasted, cooked, Lye and roasted Jatropha seed, respectively. Ojo *et al.* (2013) reported 94.03% for raw Jatropha seeds and higher than 92.39% (Pasaribu *et al.,* 2010); 89.20% (Oladunjoye *et al.,* 2014) and 89.55% - 89.84% (Antyev *et al.,* 2017). The values of mineral compositions obtained in this study (Table 1) were lower than 8995, 304, 19882, 17947, 26652 and 21171 reported by Kumar *et al.* (2011) for Calcium, Iron, Potassium, Magnesium, Sodium and Phosphorus for defatted Jatropha kernel meal (Pirgozliev *et al.,* 2011). Potassium had the highest value, followed by Calcium, these agree with the result of Anhwange *et al.* (2004) for Calcium and Potassium. It then implies that *Jatropha curcas* could serve as good source of Potassium and Calcium. The balance of ions in animal tissues is important for cellular fluid, in order to maintain normal osmotic activity (Antyev, 2018). Aletor and Ojo, (1989) reported decrease in minerals after cooking soybean for prolong time lag which is attributed mainly by the enhanced permeability of seed coat of underutilized legumes of Nigeria.

Vitamins are organic substances required in small amount in diet for the maintenance of normal body functions and health. Vitamin A (Table 2) was highest, followed by Vitamin C. Vitamin B1, B3, B6 and D were low in this study and these vitamins can interfere with

**Table 5.** Effect of processing methods on anti-nutritional compositions of *Jatropha curcas* seed meals (g/100g dry weight basis).

| Anti-nutrients | Raw | Boiled | Toasted | Soaked | Fermented |
|---|---|---|---|---|---|
| Tannins | 0.151±0.01[a] | 0.036±0.01[b] | 0.011±0.00[c] | 0.038±0.01[b] | 0.042±0.01[b] |
| Phytic acids | 0.094±0.02[a] | 0.029±0.01[b] | 0.008±0.01[c] | 0.030±0.01[b] | 0.032±0.01[b] |
| Saponins | 0.092±0.01[a] | 0.046±0.01[c] | 0.013±0.01[d] | 0.048±0.00[c] | 0.056±0.01[b] |
| Oxalates | 0.067±0.01[a] | 0.045±0.01[c] | 0.013±0.01[d] | 0.050±0.01[c] | 0.055±0.01[b] |
| Terpenoids | 0.022±0.01[a] | 0.016±0.01[b] | 0.006±0.01[c] | 0.019±0.01[b] | 0.020±0.01[a] |
| Trypsin inhibitor | 0.425±0.01[a] | 0.196±0.01[c] | 0.052±0.01[d] | 0.231±0.01[b] | 0.285±0.01[b] |
| Glycosides | 0.061±0.01[a] | 0.026±0.02[c] | 0.013±0.00[d] | 0.030±0.01[b] | 0.033±0.01[b] |
| Flavonoids | 0.101±0.01[a] | 0.061±0.01[b] | 0.022±0.01[c] | 0.066±0.01[b] | 0.068±0.00[b] |
| Alkaloids | 0.070±0.01[a] | 0.026±0.01[b] | 0.015±0.00[c] | 0.028±0.01[b] | 0.032±0.01[b] |

abcd Mean on the same row with different superscripts are significantly different ($p<0.05$).

metabolism of Phosphorus and Calcium that are directly involved in bone formation (Antyev, 2018).

The fatty acid profile of *J. curcas* (Table 3) seeds in respect of Oleic acid and Linoleic acid are the most highest in this study and in agreement with the work of Pradhan *et al.* (2011) to be the highest. The Oleic acid in this study was higher than that of Pradhan *et al.* (2011), while the Linoleic acid value was in agreement with the report of Pradhan *et al.* (2011).

The result of essential amino acids (Table 4) shows that the values for Lysine and Methionine were good enough to enhance performance of fish. The values obtained for indispensable and dispensible amino acids for *Jatropha curcas* in the present study were lower than those reported by Antyev, (2018); Pirgozlev *et al.* (2011); Kumar *et al.* (2011); Makkar and Becker, (1999) and Makkar *et al.* (2010) for both toxic and non-toxic genotypes of *Jatropha curcas* seed meal. The values agreed with the assertion of Makkar and Becker, (1999) that with high content of amino acid, Jatropha seed meal can be used as good quality protein source in animal nutrition. However some of the values were reduced in the processed groups which is evident that heat damage these sensitive amino acids after heat treatment. It was observed that heating affected the amino acid profile through leaching and destruction (losses) while soaking enhanced slight increase as reported by Anhwange *et al.* (2004) for raw legumes seeds.

The results of all the anti-nutrients determined were higher in the raw Jatropha meal (Table 5). Among the processing methods employed, toasting recorded higher reduction in the concentration of anti-nutritional factors. Reduction in trypsin inhibitors could be attributed to leaching out during processing as reported by Antyev *et al.* (2017). Similar result was reported by Duwa *et al.* (2002) when they subjected Sorrel seed to different processing methods and observed reduction in Trypsin inhibitors. Phytic acid, Saponin and Oxalate also showed reduction in concentration. However, the methods of processing employed did not completely remove these anti- nutritional factors. The results agree with the findings of Obun *et al.* (2008); Ojediran *et al.* (2014) and Antyev *et al.* (2017) who reported partial reduction of anti-nutritional factors when *Detarium microcarpum* and Jatropha seeds when subjected to differently processing methods.

## Conclusion

The results of the present study indicated that *Jatropha curcas* seeds have good nutritional profile with high level of protein, carbohydrate, lipid, minerals, and other nutrients comparable with that of other common legume grains. Processing drastically reduced the level of anti-nutrients in the *Jatropha curcas* seed meals with minimal effect on the nutritional quality.

## ACKNOWLEDGEMENTS

The authors are highly grateful to the management of the Modibbo Adama University of Technology Yola, for granting us a study fellowship to undertake this research. The authors would also like to thank the analyst of Animal Nutrition laboratory Adamawa State University, Mubi for analysis the samples.

## Authors' Declaration

We declared that this study is an original research by our research team and we agree to publish it in the journal.

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