International Journal of Global Affairs , Research and Development (IJGARD) Vol.2, No.2, 2024, 116-125
ISSN 2992-2488

PROXIMATE COMPOSITION OF RAW, TOASTED AND FERMENTED MANGO (*Mangifera indica*) SEED KERNEL MEAL AND THEIR IMPLICATIONS AND POTENTIALS FOR POULTRY AND RUMINANT ANIMAL NUTRITION.

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ABSTRACT

The study determined the proximate composition of raw, toasted and fermented mango seed kernel Mango seeds were collected from dump sites within Kumo Town. They were cut and opened manually .The kernels were removed from each half of the seed. The removed kernels were divided into 2 parts for further processing.One part of the mango seed kernel was soaked in water at room temperature and allowed to ferment for two days (48 hours) rinsed thoroughly with water and sun dried for 7 days.The second part was toasted for 30 minutes at l00°C, and milled to form toasted mango seed kernel meal (TMSKM). Proximate composition of raw, toasted and fermented mango seed kernel meal, were determined by The Standard analytical methods (AOAC, 2000) to determine Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Crude Fibre (CF) and Nitrogen Free Extract (NFE). The crude fibre values ere 10.50, 9.40 and 10.04% for raw , fermented and toasted, the crude fibre values ere 3.00, 2/90 and 2.40% respectively for raw , fermented and toasted. The values for the toasted samples were 65.50, 64.47 and 62.06 in that order. Toasting and fermentation did not improve the nutrient composition appreciably .Mamgo seed kernel can serve as a good energy source for poultry and ruminant animals The fibre content is adequate for poultry diets ,but grossly inadequate for ruminant diets.Based on the results of this study , the treatment methods used in treating mango seed kernel may not be a viable option in improving the nutrient content and therefore not recommended.Other treatment methods should be explored. Mango seed kernel is recommended as an energy source in poultry and ruminant diets

Keywords: Fermented, Mango Seed Kernel, Proximate Composition, Raw, Toasted

1.0 INTRODUCTION

The livestock sub-sector contributed about 24.18 % from an initial value of 23.86 % in the fourth quarter of 2014 of the Gross Domestic Product (GDP) in Nigeria, (CBN, 2016). Livestock feeds have become very expensive resulting in decrease in livestock production (Bamgbose *et al.*, 2004). Unfortunately, there is also an increasing competition between man and livestock for available feedstuffs, for food, feed and industrial raw materials. (Bamgbose *et al.* 2004) reported that maize account for about 45 to 55% of poultry feed, therefore, any effort to substitute maize in poultry feed will significantly reduce the cost of production. It had been reported that the level of performance of livestock in the livestock production industry have gone down remarkably below expectation due to the high cost of production, mainly arising from the costs of the conventional feed ingredients of protein and energy sources (Dairu and Ogunmodede, 2004) High cost of conventional feed resources such as maize due to high competition with man, livestock and industries has contributed to low poultry and ruminant animal production in the country, Low level of maize production due to drought and other effect of climatic change in Nigeria ,contributes also to the high cost of maize for poultry feeding (Attia, *et al.*, 2014)

. There is therefore the need to explore unconventional / alternative and cheaper energy sources for poultry feeding, these alternative feed resources must be cheap, readily available and less competed for by man and industries (Akinmutimi, 2006). Mango seed kernel is a good source of carbohydrates (58-80%), with moderate quantities of protein (6-10%), fat (6-16%) and it is a good source of vitamins and minerals, (Ogunsipe *et al.,* 2020). The major problem affecting the nutritional value of mango seed kernel is that it contains various anti-nutritional factors. (Dakare *et al., 2012)* Amongst these factors, tannins are largely responsible for the poor nutritional value of MSK (Dakare *et al., 2012)*. Using suitable processing methods such as Drying, fermenting, toasting, soaking, and boiling have been reported to be simple means of detoxifying these feed sources to reduce the presence of anti-nutrients and toxic components (Diarra., *et al.,* 2011). So, if this waste is processed and used in a commercial way, it will produce a very important feed stuff as a source of energy in poultry and ruminant diets without competition with humans.

Mango (*Mangiferaindica*) is a tree crop well adapted to all ecological zones in Nigeria and the trees are found all over the country. (Sahoo,*et al* (2012).The world production of mango is

estimated to be 42 million tons per year (FAO, 2021). Mango consists of about 33-85% edible pulp, 9-40% inedible kernel, and 7-24% inedible peel (Berardini*et a*l., 2015)

In mango fruit, mango seed kernel (MSK) constitutes about 45% to 75% of the whole seed. Mango seed kernel composes greater amount of carbohydrate, protein, fiber, fat, amino acids, important anti-oxidants and minerals comparable to maize. Mango seed kernel contains some important acids which can be fractionated in to the different oils and used in chocolate making by replacing some forms of butter in developed countries (Beriso&Tesfaye, 2024). Although MSK is cheap and contains high amount of metabolizable energy ,it is rich in anti-nutritional factors like tannin which is difficult for animals to consume. However, research reports showed that effective treatment methods like boiling, soaking and drying reduced the anti-nutrient to the level safe for both ruminants and monogastric animals (Beriso&Tesfaye, 2024) Inclusion of mango seed kernel up to 25% in layer, up to 30% in broiler nutrition and up to 40-60% in ruminants nutrition has no detrimental effect. .MSk is therefore a potential energy feed resource for farm animals, and can be good alternative feed sources if well treated by using the best technical methods of anti-nutritional factors (Beriso&Tesfaye, 2024). Moustafa (2019) reported that MSk can be included in the ration of broilers up to 10% without affecting their performance (Kumar et al., 2010). Plasma cholesterol, CK and MDA was significantly decreased by increasing MSK levels. Serum alkaline phosphatase (ALP) activity was significantly reduced when cockerels were fed diet containing 10 and 15% MSK. Bacterial count in the intestine and in fresh breast and thigh meat were decreasing by increasing MSK levels. They further reported that MSK can be used up to 10% without any adverse effect on performance and improve blood parameters. The potentials of MSK as animal feed, especially for the chicken feed have been elaborated and reported to balance in the limiting amino acids like lysine and methionine (Abang *et al*., 2023). The findings of Farag *et al.* (2022) indicated that MSK up to 20% could be considered a successful nutritional and health approach and can be partially substituted for YC with no adverse impact on the productive, reproductive and physiological performance of laying hens .Processed mango seed kernel meal can replace maize at 40% level in the diet of weaner rabbit with better performance and tremendous reduction in feed cost.. Sun dried mango (*Mangifera indica)* fruit waste meals (SMFWM) can be included up to 20% in the diets of growing Red Sokoto bucks for improved weight gain at low production costs, without any compromise on health. The use of this non-conventional feed ingredient of no human value had led to lower production cost and more revenue will accrue to the farmers thus

encouraging (Ibrahim *et.al.*, 2022) the. Inclusion of MSK in ewe's diet at a rate of 10%, with the possibility of increasing the rate to 20% without negatively affecting the animal's health and economic benefit has been reported (Shwerab *et al*., 2023)

Mango seed is readily available in the study area and their indiscriminate dumping could pose danger of environmental pollution, their use as feed material will help to clean up the environment, (Joshi and Patil, (2018). Mango seed kernel meal is a potential feed resources that could replace costly maize but there are paucity of information on the best processing methods and its optimum level of inclusion in livestock feeds production. (Sogi, *et al*., 2017). There is very scanty information about the usefulness of mango seed kernel as alternative energy source in livestock nutrition mainly in Nigeria. (Sogi, *et al*., 2017).

This study was therefore designed to evaluate the proximate composition of raw, toasted and fermented mango seed kernel

2.0 MATERIALS AND METHODS

2.1 Collection and processing of Mango Seeds

Mango seeds were collected from dump sites within Kumo Town, Gombe state, Nigeria. They were cut and open manually, the kernesl were removed from each half of the seed. The removed kernels were divided into 2 parts for further processing.

2.1.1 Fermentation of Mango Seed Kernel Meal

One part of the mango seed kernel was soaked in water at room temperature and allowed to ferment for two days (48 hours) rinsed thoroughly with water and sun dried for 7 days.

2.1.2 Toasting of Mango Seed Meal

The second part was toasted for 30 minutes at l00°C, and milled to form toasted mango seed kernel meal (TMSKM).

2.2 Chemical Analysis

Proximate composition of raw, toasted and fermented mango seed kernel meal, were determined by The Standard analytical methods (AOAC, 2000) to determine Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Crude Fibre (CF) and Nitrogen Free Extract (NFE).

2.2.1 Dry matter (DM)

The raw and differently processed test ingredient was weighed and put into an oven at 105^0 C for 24 hours to dry up to constant weight. The differences between the original and final weight was determined as follows.

$$\text{Moisture (\%)} = \frac{W1 - W2 \times 100}{W \quad 1}$$

Where W1 = weight of sample + Petri dish before drying

W2 = weight of sample + Petri dish after drying

W = weight of sample

2.2.2. Crude protein (CP)

The crude protein was determined by the Kjeldahl method . This consists of 3 stages as indicated below. About 2.0 g of prepared sample well mixed with 20 ml of Conc $H_2SO_4$was digested. After digestion, the sample was placed in to distillation machine for distillation by adding NaOH to the digested sample which will react with the ammonium sulphate to give $NH_4OH + Na_2SO_4$. When the distilled samples become green, indicating the presence of a base (NH_3), the green distillate was carried for titrating with 0. IN HCl. Crude protein will then be obtained by calculation as follows:

$$\%N = \frac{14.01 \text{ (ml of titrant sample + ml of titrant of black) x molarity of standard}}{\text{g of sample x } 10}$$

% Crude Protein N x 6.25 (factor for feeds).

2.2.3 Crude fibre (CF)

About 1.0 g of prepared sample was digested using a digestion reagent consisting of 20 ml tricholoroacetic acid, 20 g glacial acetic acid, 500 ml of NHO_3, all diluted to 1 litre with distilled water. The digested sample was removed and allowed to cool to room temperature and then was filtered through an ashless filter paper that was initially weighed. The paper will then be placed in an oven at 80^0C over night to remove all the moisture and then weighed. The residue after drying (Paper + fibre + ash) is ashed in a muffle of 55^0 C for 3 hours and the ash is weigh. The fibre was determined by calculation using the formula of Van Soest and Wine (1967):

% Crude fibre = weight of fibre x 100 / 2 g of sample

2.2.4. Ether extract (EE)

About 2.0 g prepared sample and 200 ml of petroleum ether was placed into an extraction chamber of soxhlet apparatus. The heating mantle was turned on a temperature of 60^0 C for 5 hours and later the flask was oven-dried at 100^0 C for 1 hour, cooled in a dessicator and weighed. Ether extract was calculated as:

$$(\%) \text{ Ether Extract} = \frac{\text{weight of oil flask after extraction} - \text{wt. empty oil flask} \times 100}{\text{Weight of dried material taken}}$$

2.2.5. Nitrogen free extract (NFE)

This was calculated for each sample by subtracting the percentage of moisture, crude protein, crude fibre, ether extract and ash from 100. NFE = 100 - (% CP + %CF + %EE + %Ash)..

3.0 RESULTS AND DISCUSSION

3.1 Proximate Values

Table 1 shows the proximate composition of raw, toasted and fermented mango seed kernel. The results indicated that all the experimental samples (raw, fermented and toasted mango seed kernel) have appreciable quantities of crude protein, crude fibre and carbohydrates which is an added advantage when used in livestock diets The proximate composition of Toasted Mango seed kernel contains 7.2% dry matter (DM) 8.4% of crude protein (CP), 2.62% of Ash, 2.90% of crude fibers (CF), and 64.27% of nitrogen free extract (NFE). The CP recorded by Abang*et al*., 2016 and Abang *et al*., 2018 were higher probably as a result of the different processing methods employed. Heat is said to denature protein, this could have accounted for the lower value of CP for TMKCM. The proximate composition of Fermented Mango seed kernel also contains 11.03% dry matter (DM) 11.04% of crude protein (CP), 2.10% of Ash, 2.40% of crude fibers (CF), 62.06% of nitrogen free extract (NFE), these values were lower than those reported by Fowomola (2010) and Diarra (2010). The differences may have resulted from the varieties of seeds used which affected the

proximate attributes of mango seed kernel. The potentials of MSK as animal feed, especially for the chicken feed have been elaborated and reported to balance in the limiting amino acids like lysine and methionine (Abang *et al*., 2023). The findings of Farag et al. (2022) indicated that MSK up to 20% could be considered a successful nutritional and health approach Mango seed kernel is a good source of carbohydrates (58-80%), with moderate quantities of protein (6-10%), fat (6-16%) and it is a good source of vitamins and minerals, (Ogunsipe *et al.*, 2020). The major problem affecting the nutritional value of mango seed kernel is that it contains various anti-nutritional factors. (Dakare *et al., 2012)* Amongst these factors, tannins are largely responsible for the poor nutritional value of MSK (Dakare *et al., 2012)*. Using suitable processing methods such as Drying, fermenting, toasting, soaking, and boiling have been reported to be simple means of detoxifying these feed sources to reduce the presence of anti-nutrients and toxic components (Diarra., *et al.*, 2011). So, if this waste is processed and used in a commercial way, it will produce a very important feed stuff as a source of energy in poultry and ruminant diets without competition with humans.

Table:1 proximate composition of Mango Seed Kernel.

Parameters	Raw	Toasted	Fermented
Moisture (%)	7.5	6.80	11.03
Crude Protein (%)	10.50	9.40	10.04
Ash content (%)	2.75	2.50	2.10
Ether Extract (%)	15.5	14.6	12.35
Crude fiber (%)	3.00	2.90	2.40
NFE	65.50	64.27	62.06

3.2 Implications and Potentials for Poultry Feeding

The nitrogen free extracts range of 62.06 – 65.50 and the ether extracts range of 12.35 – 15.50 makes mango seed kernel a good energy source for poultry .The crude fibre range of 2.40 – 3.00 is adequate for poultry diets. , since poultry and generally monogastric animals require very little fibre. (Olomu, 2022) The protein contents of both the raw and treated mango seed kernel are far below the requirements for poultry diets (Aduku , 2004) and so can not serve as a protein source, The ash content will not provide enough minerals and so will require fortification from other feed

components and synthetic mineral sources. Mango seed kernel can be used in poultry diets as filler materials and also to reduce feed cost Although MSK is cheap and contains high amount of metabolizable energy,it is rich in anti-nutritional factors like tannin which is difficult for animals to consume. However, research reports showed that effective treatment methods like boiling, soaking and drying reduced the anti-nutrient to the level safe for both ruminants and monogastric animals (Beriso&Tesfaye, 2024) Inclusion of mango seed kernel up to 25% in layer, up to 30% in broiler nutrition and up to 40-60% in ruminants nutrition has no detrimental effect. .MSk is therefore a potential energy feed resource for farm animals, and can be good alternative feed sources if well treated by using the best technical methods of removing the anti-nutritional factors (Beriso&Tesfaye, 2024). Moustafa (2019) reported that MSk can be included in the ration of broilers up to 10% without affecting their performance

3.3 Implications and Potentials for Ruminant Feeding

The nitrogen free extractss values recorded for both the raw and treated mango seed kernel makes it a good energy source for ruminant animals. The crude fibre value range of 2.5 – 3.0 is grossly inadequate for ruminant feeding , given that ruminants require much fibre in their diets, low fibre diets can lead to improper functioning of the rumen, acidosis and bloat (Lakpini *et a*l 2022) . The ether extracts value are above the values of 5 -6 % reporterd as the ceiling values for ruminant diets by Maithison *et al* (1997), which if exceeded can lead to milk fat depression, impaired appetite and crude fibre digestion . The protein content may be inadequate for growing ruminants but may be barely adequate for adult male and female ruminants , it can also guarantee adequate ammonia in the rumen, NRC (1996) recommended 12 – 18% protein for growing animals in the tropics Inclusion of mango seed kernel up to 40-60% in ruminants nutrition has no detrimental effect. .MSk is therefore a potential energy feed resource for ruminants, and can be a good alternative feed sources (Beriso & Tesfaye, 2024)

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Mango seed kernel contains fairly good array of nutrients , Toasting and fermentation did not improve the nutrient composition appreciably .

Mamgo seed kernel can serve as a good energy source for poultry and ruminant animals The fibre content is adequate for poultry diets ,but grossly inadequate for ruminant diets.

4.2 Recommendations

Based on the results of this study , the treatment methods used in treating mango seed kernel may not be a viable option in improving the nutrient content and there not recommended.

Other treatment methods should be explored.

Mango seed kernel is recommended as an energy source in poultry and ruminant diets

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