



Effects of Replacing Maize with *Rhizopus Oryzae* Fermented *Mangifera Indica* Seed Kernels on Broilers Chicken Growth Performance



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Abstract

This study was conducted to evaluate the nutritional status of *Rhizopus oryzae* fermented *Mangifera indica* seed kernels and its effect on the growth performance of broilers. Fermentation increased the crude protein value of unfermented mango seed kernel from 4.61 to 7.06% while a decreased was observed in ash, lipid and fiber content of fermented mango seed kernel. Fermentation also increased the bioavailability of phosphorous (2.67mg/kg), potassium (2433mg/kg) and calcium (0.4mg/kg). Fermentation caused a decrease in the anti-nutritional content of unfermented mango seed kernel with an initial value of 0.02mg/g for oxalate, phytate (15.27mg/mol), Tannin [0.53mg/mol], nitrate (2.62 mg/mol), cyanide (0.80 mg/mol) to 0.01mg/g for oxalate, phytate (5.24 mg/mol), tannin (0.31mg/mol), nitrate (0.05 mg/mol) and cyanide (0.07mg/mol). Broilers fed fermented mango seed kernel plus conventional feed ration had a lower final body weight (2.2kg) compared to the fermented mango kernel based diets chicks (2.6kg) and control (2.9kg). The study shows that *Rhizopus oryzae* caused an improvement in the protein, mineral and antinutritional values of raw mango seeds. It also shows that replacing maize at 50% level of inclusion with *Rhizopus oryzae* fermented mango seed kernel in broilers rations had no adverse effect on the growth performance of broilers thereby suggesting that it could be used in poultry feed formulation especially for small scale farmers.

Keywords: Anti nutritional factors; Broilers; Fermentation; Poultry rations; Minerals

Introduction

Livestock production plays an important role in the agricultural sectors of every nation particular in the West African sub region. The satisfactory outcomes of agricultural quality livestock industries usually formulate feeds from materials that are either edible or inedible by man. These feeds, when ingested by the animals enhance the animal productivity in terms of number and nutrients, to meet of the immediate nutrients requirement of man [1].

World feeds resources are on the aerographic decline, caused probable by increase in the number of humans and human's activities. Hence, it is inevitable that conventional animal feeds should become increasingly more expensive. This was led to a search for now often unconventional feeds and effective method of processing presently inedible roughages into more acceptable and nutritional feed [1].

Agricultural practices in West Africa and indeed most developing countries consist of small scale farming. The farmers in this sub-region have, in general, low level of

agricultural education and at the same time are handicapped by insufficient capital. According to Payne and Wilson [1], the unavailability of capital and increasing worldwide cost of energy, purchased feeds, equipment and pharmaceuticals may in this long run delay or even halt the complete industrialization and urbanization of poultry production in tropical countries, under such circumstances, substances and small-scale production methods with additional improvement may become relatively attractive to this sector of the population [1].

There are two types of broilers rations, namely; the broiler starter mash fed from day one to fourth or fifth week and the broiler finished mash, fed from week 4 or 5 until slaughter. The high cost of feed still remains the greatest constrain to poultry production in Nigeria [2].

Mango (*Mangifera indica*) is a tree crop well adapted to all ecological zones in Nigeria and the trees are found all over the country, mango kernel, a byproduct of mango pulp is reported to be a good source of starch [3]. In India, mango kernel is

consumed by human beings in the form of porridge [3,4]. In Nigeria however, it is regarded as waste thus contributing to environmental pollution. These are few reported on the use of mango kernel in livestock feeding but the level of incursion in poultry diets had been low because of the presence of tannin which have been reported to reduce chicks growth [5,6]. Drying, soaking, leaching and fermentation are simple means of detoxifying these feed sources to reduce the presence of anti-nutritional and toxic compounds [7].

The high level of competition between man and livestock for available feed ingredients has posed a great concern to nutritionists over the years particularly in developing countries. The fact that feed alone accounts for up to 70 - 80% of the recurrent production input in intensive monogastric animal production also makes the sourcing for alternative feed ingredient expedient [8,9]. The high cost of conventional ingredients used in feed formulation contributes immensely to the high cost of the finished feed. This is a major obstacle to the feed expansion of poultry industry in Nigeria and by extension most developing countries in the world [10-13]. The high cost of maize as an energy source in feed formulation has generated a lot of controversy as to its economic justification [14]. Beer production has been on the increase in Nigeria with the attendant shift in imported barley to local grains as the major raw material. Maize and sorghum thus became ready substitutes in the beer making industry. The use of maize and sorghum in beer making further exacerbated the scarcity of the cereal grains and thus its inclusion in feed formulation [14]. It is light of this increasing cost that this research work was conducted with the aim of: determining the proximate, mineral and antinutritional factors composition of unfermented and *Rhizopus oryzae* fermented mango seed kernel and to determine the effect of replacing maize with fermented mango seeds kernels on the growth performance of Broiler chicken.

Material and Methods

Sample collection

Fresh mango (*Mangifera indica*) seeds were collected from "Kofar mata" area of Usmanu Danfodiyo University Sokoto into seven clean polythene bags. The kernel was obtained by cutting the seed open using knife. The fresh kernel was chopped to reduce the particle size, sundry for 72 hours, grinded and used in the formulation of feed.

Two weeks and four days old boilers chicks (Rhodes Island) were purchased from Razaki feeds and chick "Kofar Atiku" old market area Sokoto. Commercial feed, Bone meal and vitamins premix were purchased from "Kofar Gabas" Sokoto central market.

Inoculum preparation

Rhizopus oryzae was previously isolated from mango seed kernel and maintained on PDA slants. The spores were sub-cultured onto a molten PDA and incubated at room temperature

for 5 days. Inoculum preparation was done as described by Negi and Banerjee [15]; Ibrahim et al. [16]. For inoculum preparation, 45ml of sterile distilled water was added to the 5 days old slant growth on PDA and scrapped aseptically with inoculating loop. 45ml of this suspension, having spores concentration of approximately 1.17×10^9 cells/ml was used as inoculum for the fermentation.

Fermentation

This was done as described by Lawal et al. [17] with little modification. Twelve kilograms (12kg) of the powdered mango seed kernel was moistened with 800ml of distilled water, autoclaved at 121 °C for 15 °C and allowed to cool at room temperature. It was seeded with *Rhizopus oryzae* inoculum earlier prepared, mixed thoroughly and allowed to ferment for 10 days, after which it was then oven dried at 60 °C for 45 minutes to arrest the fermentation process.

Proximate composition

Samples were analyzed in triplicate for proximate composition in accordance with the Official Methods of the Association of Official Analytical Chemists [18]. Ash was determined by incinerating two grams (2g) of powdered mango seed kernel at 550 °C in lenton furnaces (England) over night. Fibre was determined by drying two gram (2g) of powdered mango seed kernel over night at 105 °C in the oven (Gallenhamp Oven BS) and incinerated at 550 °C for 90minutes in lenton furnaces (England). Moisture Content was determined by drying two gram (2g) of powdered mango seed kernel over night at 105 °C in the oven (Gallenhamp Oven BS). Crude lipid was determined using saturated method. Two grams (2g) of powdered mango seed kernel were weighed into 50ml conical flask and N-hexane was added and allowed to stand at room temperature overnight. It was drained into an empty flask, earlier weighed and designated W1. It was placed in an oven to allow the N-hexane to evaporate in the oven (Gallenhamp Oven BS). Protein (% N*6.25) was determined by the Micro-kjeldahl Method. Soluble carbohydrate is not determined directly but obtained as a difference between crude protein and the sum of ash, protein, crude lipid and crude fibre.

Mineral Content

Analysis of minerals in unfermented, and fermented were done in triplicate according to methods described by Anhwange et al. [19]; Walinga et al. [20]. The investigated minerals include Phosphorus, Potassium, Sodium, Calcium, and Magnesium. Phosphorus was determined using Spectrophotometer (JENWAY 6100) at 660 (wavelength), Potassium, Sodium was determined using flame photometer (Corning 400 Essex, England), determination of calcium and Magnesium was done by ethylene diamine tetra acetic acid (EDTA) Titration Method.

Antinutritional Factor

Oxalate was determined by the method of Krishna and Ranjhan [21], phytate and hydrocyanic acid were determined

by the AOAC [18] method. Nitrate was determined by IITA [22] method.

Feed formulation

The feed were formulated according to the National research council specification as cited by Aduku (1992).

Feeding trials A (fermented mango seed kernel)

Five hundred gram (500g) of *Rhizopus oryzae* fermented mango seed kernel was mixed with five hundred gram (500g) of maize. Then supplemented with 100g of groundnut cake powder, 100g of bone meal, 100g of vitamins premix and 10grams of salt.

Feeding trial B (Fermented Mango Seed Kernel + Conventional Feed)

Five hundred grams 500g of *Rhizopus oryzae* fermented mango seed kernel was mixed with five hundreds gram 9500g) of conventional feed. Then supplemented with 50g of groundnut cake powder, 50g of borne meal, 50g of vitamins premise and 5grams of salt.

Feeding trial C (Conventional feed only as Control)

Commercially prepared conventional feed, vital feed, broilers starter was used in feeding the birds.

Weighting birds

The weight of the birds were measured using a weighting balance to obtain the weight at weekly intervals for a period of eight weeks for the three different feeding diets used in feeding the birds.

Results

Analysis of the proximate composition of unfermented and fermented mango seed kernel was conducted and the result in presented in Table 1. From the result, unfermented mango seed kernel has highest value of carbohydrate 83.50, Moisture (43.67), Ash (3.83), lipid (12.17), fibre (1.33) while the fermented mango seed kernel has high percentage of crude protein (7.06).

Table 1: Proximate composition of unfermented and fermented mango seed kernel.

| Proximate Composition (%) | Unfermented Mango Seed Kernel | Fermented Mango Seed Kernel |
|---------------------------|-------------------------------|-----------------------------|
| Carbohydrate | 83.50 ± 7.682 | 77.82 ± 0.04 |
| Moisture | 43.67 ± 0.76 | 3.67 ± 0.883 |
| Ash | 3.83 ± 0.29 | 1.33 ± 3.21 |
| Lipid | 12.17 ± 0.29 | 2.67 ± 9.657 |
| Fibre | 1.33 ± 0.29 | 0.67 ± 0.836 |
| Crude protein | 4.61 ± 0.43 | 7.06 ± 0.217 |

Analysis of the mineral composition of fermented and unfermented mango seed kernel was conducted and the result is presented in Table 2. From the resulted unfermented mango

seed kernel had the highest value of sodium (84.77mg/kg), magnesium (1.05mg/kg) while the ferment mango seed kernel has the highest value for phosphorous (2.67mg/kg), potassium (2433mg/kg) and calcium (0.4 mg/kg).

Table 2: Mineral content of unfermented and fermented mango seed kernel.

| Mineral Composition (mg/kg) | Unfermented Mango Seed Kernel | Fermented Mango Seed Kernel |
|-----------------------------|-------------------------------|-----------------------------|
| Sodium | 84.17 | 31.33 |
| Potassium | 1200 | 2433 |
| Calcium | 0.30 | 0.40 |
| Magnesium | 1.05 | 0.82 |
| Phosphorous | 2.64 | 2.67 |

Analysis of the antinutritional composition of unfermented and fermented mango seed kernel was conducted and the result is presented in Table 3. From the result, fermentation caused a decrease in the antinutritional content of unfermented mango seed kernel with an initial value of 0.02mg/g for oxalate, phytate (15.27mg/mol), tannin [0.53mg/mol], nitrate (2.62 mg/mol), cyanide (0.80mg/mol) to 0.01mg/g for oxalate, phytate (5.24 mg/mol), tannin (0.31mg/mol), nitrate (0.05 mg/mol) and cyanide (0.07 mg/mol).

Tables 3: Antinutritional composition of unfermented and fermented mango seed kernel.

| Anti-nutritional Factors (mg/mol) | Unfermented | Fermented |
|-----------------------------------|-------------|-----------|
| Oxalate | 0.02 | 0.01 |
| Phytate | 15.27 | 5.24 |
| Tannin | 0.53 | 0.31 |
| Nitrate | 2.62 | 0.05 |
| Cyanide | 0.80 | 0.07 |

Analysis of broilers growth performance at weekly intervals for the period of four weeks was conducted to ascertain the effect of replacing maize with fermented mango kernel at 50% level of inclusion and the result presented in Table 4. During the periods of feeding, birds fed on fermented mango seed kernel plus conventional feed had a lower final body weight (2.2kg) compared to the fermented mango kernel based diets chicks (2.6kg) and control (2.9kg).

Table 4: Result of bird weight gain during the feeding trial period.

| Period (Week) | Feeding Trail A | Trail B | Trail C |
|---------------|-----------------|-------------|-------------|
| 1 | 1.44 ± 0.36 | 1.38 ± 0.42 | 2.08 ± 1.33 |
| 2 | 1.70 ± 0.23 | 1.60 ± 0.36 | 2.40 ± 0.98 |
| 3 | 2.04 ± 0.29 | 1.80 ± 0.01 | 2.46 ± 1.53 |
| 4 | 2.60 ± 0.24 | 2.20 ± 0.27 | 2.90 ± 0.85 |

Value presented are mean ± SD of five replicate

Key:

Trail A= *Rhizopus oryzae* fermented mango seed kernel

Trail B= fermented mango seed kernel ± conventional feed (1:1)

Trail C= conventional feed

Discussion

The result of proximate analysis shows that mango seed kernel have substantial amounts of crude protein. Fermentation increased the bioavailability of crude protein. This increment could be attributed to the *Rhizopus oryzae* metabolism involving polysaccharides hydrolysis and proteogenesis during fermentation [23]. Similar protein increment was also reported during the African Locust bean (*Parkia biglobosa*) fermentation [24].

The result of mineral analysis of unfermented and fermented mango seed kernel shows that fermentation increases the bioavailability of minerals. Fermented mango seed kernels could be exploited as cheap source of minerals for poultry feed formulations. The variation in mineral content could be related to the type of soil from which the seed were harvested in the case of raw seeds and fermentation recipients in case of fermented seeds [25,26].

The reduction in oxalate, phytate, cyanide, nitrate and tannins observed after fermentation may have resulted due to microbial degradation of these toxic compounds to less toxic ones. It has also been reported that toxic antinutritional factors could be reduced by fermentation [7]. This implies that *Rhizopus oryzae* could be exploited to decrease the antinutritional factor in mango seed kernel there by making them less harmful for broilers consumption.

An increasing weight gain was observed in all the feeding trials with no mortality recorded during the feeding experiment. However, birds fed with *Rhizopus oryzae* fermented mango seed kernel alone had higher weight gain compared to that fed with *Rhizopus oryzae* fermented mango seed kernel and conventional feed (1:1) and not much difference was observed between the *Rhizopus oryzae* fermented feed and conventional feed in terms of growth performance. This implies that *Rhizopus oryzae* fermented feeds was able to support the broilers chicken energy and growth requirement. Diarra and Usman [2] reported that 20% of maize could be replaced with boiled mango kernel meal in the diet of broilers without adverse effect on growth and blood parameters.

Joseph and Abolaji [27] observed no adverse effect on broilers which have been fed 10% of raw mango seed kernels and two-fold improvement on the 10% inclusion level of incorporation into broilers chicken rations [28-31].

Conclusion

The study shows that *Rhizopus oryzae* caused an improvement in the protein, mineral and antinutritional values of raw mango seeds. It also shows that replacing maize at 50% level of inclusion with *Rhizopus oryzae* fermented mango seed kernel in broilers rations had no adverse effect on the growth performance of broilers thereby suggesting that it could be used in poultry feed formulation especially for small scale farmers which will go a long way to cut the cost of poultry meat assisting to achieve food safety concerns issues in Nigeria.

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