



Haematological Indices of Poult Fed Fermented Mango Kernel Composite Meal FMKCM as a Replacement for Maize

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ABSTRACT

The objective of this study was to examine the impact of substituting maize with fermented mango kernel composite meal on the hematological indices of local poults. Sixty unsexed day-old local poults were randomly allocated to four dietary treatments, each consisting of fifteen poults, following a completely randomized design. The diets were formulated to fulfill their nutritional requirements during the starter phase. Each treatment was replicated three times with five poults per replicate. In treatments I, II, III, and IV, fermented mango kernel seeds meal (FMKCM) replaced maize at 0%, 10%, 15%, and 20% respectively. Feed and water were provided ad libitum for a period of four weeks (28 days). At the conclusion of the experiment, two poults were randomly selected and slaughtered from each dietary treatment group, resulting in six poults per treatment group for blood collection and analysis. Hematological parameters, including Red Blood Cells (RBC), White Blood Cells (WBC), Hemoglobin (Hb), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Volume (MCV), platelets, and differential counts, were assessed using the Systine X K2INI hematological auto analyzer. The results indicated that MCV (134.6 – 140.0 fl), monocytes (0.7-5.0%), Eosinophils (0-2.0%), and Neutrophils (4.3-16.4%) values fell within the normal reference range. White Blood Cells (249.9-267.5 g/dl), Red Blood Cells (2.5 – 2.9 x 10⁶/L), Hemoglobin (11.8 – 12.7g/dl), MCHC (33.0 – 33.4g/dl), MCH (44.8 – 46.8 Pg), and Lymphocytes (67.33-92.33%) values were above the normal reference range. Conversely, Mean Platelets values (7.0-10.3 x 10³/UL) were lower than the normal reference values. Notably, the observed abnormalities in the hematological parameters were not exclusively linked to poults fed fermented mango kernel composite meal (FMKCM), suggesting that FMKCM was not responsible for the variations observed. Consequently, maize can be substituted up to a 20% inclusion level in local turkey poult meal without adversely affecting hematological indices.

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INTRODUCTION

Animal protein consumption in Nigeria is estimated at 8g/day which is about 27g less

than the minimum requirement by World Health Organization (Obioha, 1992). This is as a result of rapid increase in cost of animal protein

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sources due to high feed cost which has put it out of the reach for most Nigerians (Gyang *et al.*, 2021; Ogana *et al.*, 2020).

Improving the turkey industry will increase meat and egg production thereby increasing protein availability. The turkey farming is an area of animal production that calls for critical attention as its availability will lead to increase in meat and egg production. Turkey egg and meat are very significant sources of high quality protein, Vitamin and minerals in human diet. However, the productivity of turkey in the tropics has been limited by scarcity and consequent high prices of the conventional protein and energy sources (Abang *et al.*, 2023, 2016, 2013a, b & c). In recent years, maize production has not kept pace with demand, this may be attributed to several reasons which include reduced production due to climate change, food-feed competition for this grain, as well as its increased use for bio fuel production in the developed countries (Adeyi *et al.*, 2021; Abang *et al.*, 2018). Several researchers have emphasized the need for utilizing alternative feed ingredients not competed for by man and industrial uses (Abang *et al.*, 2017a, 2015; Nsa *et al.*, 2007). This is because feed cost accounts for about 70-75% of the total cost of livestock production and thereby considered a major determinant of the profitability, sustainability and development of the poultry enterprise (Dzungwe, 2010; Adestirimi *et al.*, 2011).

Mango is an important fruit crop grown in the tropics mostly for its pulp. Mango seed represents 20-60% of the fruit, it has limited food or industrial use in most producing countries and is therefore wasted (Diarra, 2014). The kernel is a good source of carbohydrate (58-80%), moderate protein (6-13%) and fat (6-16%) (Diarra and Usman, 2008; Abang *et al.*, 2015). Mango kernel has ability to supplement methionine and lysine which are limiting in plant protein feeds stuff (Arogba, 1989). It has a lysine value of 3.13-5g per 100g protein compared to 0.26g and 2.22g for maize and soya bean meal respectively (Diarra, 2014). The oil is also a good source of stearic acid and linoleic acid. There are few reports on the use of mango kernel in livestock feeding Dzungwe (2013) reported 50% inclusion

level of sundried mango kernel seed meal which had no effect on hematological parameters of Japanese quails. Abang *et al.* (2017b) also observed that replacing 20% dietary maize with fermented mango kernel seed (MSK) has no adverse effect on growth performance of broiler chicken; Teguia (1995) recorded similar findings with 20% MSK as replacement for maize and Abang *et al.* (2016) reported a reduced cost as levels of SMKM increased in diets of growing Japanese quails. However, the presence of anti-nutritional factors such as tannins, cynogenic glycosides, oxalates, saponins and trypsin limits its usage. These anti-nutrients could be reduced to a more tolerable level by the following processing methods: boiling, sun drying, fermenting, autoclaving, etc. Research in the past have indicated the suitability of mango seed kernel in livestock feeding but the level of inclusion in poultry diets have been low because of the presence of tannins which have been reported to inhibit chicks growth (Abang *et al.*, 2013a; Jabsman *et al.*, 1995; Diarra and Usman, 2008). However, processing methods such as boiling, fermentation, Sun-drying is able to reduce these anti nutrients to a tolerable level. The need to assay for blood parameters which are good indicators of the health status of an animal becomes necessary (Kwari *et al.*, 2011). The objective of this study is to examine the effect of replacing maize with fermented mango kernel composite meal (FMKCM) on the haematological indices of local Turkey poult.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the poultry unit of the teaching and research farm of the University of Agriculture Makurdi, Benue State. The farm is located within the guinea savannah zone of Nigeria with a mean daily temperature of 30 degrees centigrade and an annual rainfall of 508mm-1060mm per annum.

Preparation of Experimental Materials

Soybeans

100kg of soybeans was purchased from Tarka Local Government of Benue State. The soybean was toasted to a brownish colour

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when it has become crispy and taken off the fire. This was done for every milling and most importantly to reduce the anti-nutrients to a more tolerable level.

Mango kernel Seed

Mango seeds of waste fruit and already consumed pulp of the mangoes was gotten from Tarka Local Government in Benue state. The fleshy pulp was removed, they were manually cracked, and the kernels removed and soaked in water for 72 hours to ferment in an air tight container. The kernels were removed and rinsed in clean water, drained in a basket and sundried for 7days in order to reduce moisture content to less than 10% for prolonged storage. The dried kernels were crushed into fine grit separately.

Feeders and Drinkers

The feeders and drinkers were thoroughly washed and disinfected with izal and rinsed with clean water .daily and allowed to dry.

Chemical analysis

Chemical analysis of fermented mango kernel was carried out using AOAC (2006) methods.

Growth Study

Feeding trials were conducted on turkey poultz using fermented mango kernels (*Magnifera spp*).

Formulation of Diets

The feeds were formulated to meet the nutritional requirements for poultz during the starter phase (28% CP). The fermented mango kernel seeds replaced maize at 0%, 10%, 15% and 20% in treatments I, II, III and IV respectively (Table 1).

Animal Acquisition and Acclimatization

Sixty unsexed day old local poultz were purchased from National Veterinary Research Institute, Vom, in Plateau State, Nigeria. Acclimatization of experimental birds lasted for one week prior to data collection.

Animal Grouping

Sixty unsexed day old local poultz were randomly assigned to one of the four dietary treatments comprising of fifteen poultz per treatment. Each treatment was replicated thrice with 5 poultz per replicate. The treatment was administered over a period of four weeks (42 days) by this time they were 6 weeks of age.

Housing

The poultz were housed in a half wall open sided building protected with nets to prevent predators' access. Each replicate was housed in compartment measuring 3.3m x 1.7m. The floor was cemented and covered with wood shaving as litter.

Table1: Composition of diets with fed fermented mango seed kernel meal (FMKM) for local turkey poultz

| Ingredient | T ₁ | T ₂ | T ₃ | T ₄ |
|----------------------------|----------------|----------------|----------------|----------------|
| Maize | 41.50 | 37.35 | 35.27 | 33.20 |
| Mango | 0.00 | 4.15 | 6.23 | 8.30 |
| Full-fat soybean | 20.00 | 20.00 | 20.00 | 20.00 |
| Fishmeal | 4.00 | 4.00 | 4.00 | 4.00 |
| Rice bran | 8.50 | 8.50 | 8.50 | 8.50 |
| Groundnut cake | 18.00 | 18.00 | 18.00 | 18.00 |
| Bone meal | 3.00 | 3.00 | 3.00 | 3.00 |
| Blood meal | 4.00 | 4.00 | 4.00 | 4.00 |
| Salt | 0.50 | 0.50 | 0.50 | 0.50 |
| Vit/min premix | 0.50 | 0.50 | 0.50 | 0.50 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |
| Analyzed nutrients: | | | | |
| ME (Kcal/kg) | 3290.48 | 3217.33 | 3203.15 | 3200.20 |
| Crude protein% | 25.54 | 25.13 | 25.14 | 25.10 |

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Floor Space

Each replicate was housed in compartment measuring 3.3m x 1.7m in an open sided poultry house measuring 16.8m x 4.5m x 2.25m. The floor was cemented and covered with wood shaving as litter.

Drug Administration and Vaccination

On the arrival of the poults, a stress reliever (Glucose) and vitalite (vitamins) was given to them via drinking water during the brooding stage that lasted for one week. No vaccines were administered.

Feeding

Feed was provided to the poults *ad libitum* with water.

Routine Operations

Cleaning of feed and water equipment was done daily with the use of clean water and detergent (Omro), the water and feed replaced with fresh water and feed respectively. The litter material removed and new ones replaced with the surroundings swept daily. The lamps were refilled with oil and their glasses washed

DATA COLLECTION AND ANALYSIS

On the 35th day of the feeding trial, between the hours of 7 and 9am, 2 poults were randomly selected from each replicate, giving a total of 6 poults per treatment for blood collection. About 5mls of blood was collected from the sub-clavicular vein of each poults using a scalp vein needle set after swabbing with methylated spirit. The blood was quickly discharged into sample bottles already treated with the anticoagulant; ethylene diamine tetra-acetic acid (EDTA) and gently mixed by inverting the bottle repeatedly. Samples were

RESULTS AND DISCUSSION

Mean white blood cells (WBC) values ranged between 249.9-267.5 g/dl, WBC values obtained were above the normal range (10 – 46 g/dl) reported for juvenile wild turkeys in the United States (Bounous et al., 2000). This report is in agreement with reports of Dzungwe (2013) and Zendesha (2017) who also reported white

blood cell values above the normal reference range of quails fed Sundried Mango Kernel Meal (SMKM) and broiler chicks Fermented Mango Kernel Composite Meal (FMKCM) respectively. The report of this study contradicts that of Diarra et al. (2010) who reported that WBC counts of broilers were not affected when 60% boiled mango seed kernel replaced dietary maize. The major functions of the white blood cell and its differentials are to fight infections, defend the body by phagocytosis against invasion by foreign organisms and to produce or at least transport and distribute antibodies in immune response. Thus, animals with low white blood cells are exposed to high risk of disease infection, while those with high counts are capable of generating antibodies in the process of phagocytosis and have high degree of resistance to diseases (Soetan et al., 2013) and enhance adaptability to local environmental and disease prevalent conditions (2012; Isaac et al., 2013). The WBC of this study could have abnormally increased due to the drugs induced antigen anti-body reaction.

Mean Red blood cells (RBC) counts ranged from 2.5 – 2.9 x 10⁶/L, this was slightly above the normal reference value (2.0 x 10⁶/L) reported by Aiello and Mays, (1998). This result disagrees with the report of Dzungwe (2013) who reported RBC count values within the normal range of Japanese quails fed sundried mango kernel meal (SMKM). RBC counts of broilers were also not affected when dietary maize was replaced with 60% boiled mango seed kernel (Diarra et al., 2010). Zendesha (2017) reported values lower than the normal reference range for broilers chicks when fed fermented mango composite meal (FMCM). Variations in these studies could be attributed to the variety of mango kernel seed, species of birds and mango seed kernel processing methods employed. Red blood cells (erythrocytes) serve as a carrier of hemoglobin. According to Isaac et al. (2013) red blood cell is involved in the transport of oxygen and carbon dioxide in the body. A reduced red blood cell count implies a reduction in the level of oxygen that would be carried to the tissues as well as the level of carbon dioxide returned to the lungs (Ugwuene, 2011; Soetan, Akinrinde and Alibied, 2013; Isaac et al., 2013). The use of

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antibiotics could have been the cause of the increase in RBCs Mean Hemoglobin (Hg) ranged from 11.8 – 12.7g/dL, the values were slightly above the normal range (11.0-11.4g/dL) reported for turkeys (Aiello and Mays, 1998; Bambos et al., 2007). The report is at variance with reports of Dzungwe (2013) and Zendesha (2017) who reported Hg values lower than the normal range for Japanese quails fed SDMCM and broiler chicks fed FMCM respectively. Mango seed kernel did not affect haemoglobin range when dietary maize was replaced with 30% dry heat processed MSK (Amao and Siyanbola, 2013). Hemoglobin is the iron-containing oxygen-transport metalloprotein in the red blood cells of all vertebrates (Maton et al., 1993) with the exception of the fish family, channichthyidae (Sidell & O' Brien, 2006) as well as tissues of invertebrates. Hemoglobin has the physiological function of transporting oxygen to tissues of the animal for oxidation of ingested food so as to release energy for the other body functions as well as transport carbon dioxide out of the body of animals (Ugwuene, 2011; Omiyale et al., 2012; Soetan et al., 2013; Isaac et al., 2013). Emenalom et al. (2004) observed that poor nutrient utilization might result in variation in Haemoglobin values. The use of antibiotics could have been the cause of the increase in hemoglobin concentration in this study.

MCV values ranged between 134.6 – 140.0 fL. MCV values of poult fed FMKCM were within the same range with the reference range (133.08-163.79fL) reported by Daniel-Igwe and Okwara (2017) for indigenous turkeys in Nigeria. This agrees with the result of Dzungwe (2013) who also reported MCV values within the normal reference range for quails when fed sundried mango seed meal. However, Zendesha (2017) reported MCV values above the normal reference range for broiler chicks fed FMCM. The result shows that FMKCM had no adverse effect on MCV. It implies that FMKCM had no deleterious effect on MCV.

MCH values obtained ranged between 44.8 – 46.8 Pg, MCH values of poult fed FMKCM were slightly above the reference range (34.34-51.77 pg) reported by Alleiro and Mars (2008) and Daniel-Igwe and Okwara (2017).

Zendesha (2017) also reported values higher than the reference range for chicks fed FMKCM. The reports disagree with report of Dzungwe (2013), who observed MCH values within normal range when Japanese quails were fed sundried mango seed meal. An increasing MCH could be interpreted as increased production of haemoglobin since MCH it's the average mass of haemoglobin per red blood cell.

MCHC values reported were between 33.0 – 33.4g/dL, MCHC values of poult fed FMKCM were slightly higher than the normal reference range (23.89-31.61 g/dl) reported by Daniel-Igwe and Okwara (2017). Dzungwe (2013) reported that MCHC values of quails fed sundried mango seed meal were within the normal reference range. However, Zendesha (2017) reported that MCHC values of chicks were slightly below the normal reference range when fed mango kernel composite meal. The mean capuscular haemoglobin concentration is a measure of the concentration of haemoglobin in a given volume of packed red blood cells. A low level is an indication of anemia (Aster, 2004). An increasing MCHC could be interpreted as increased production of haemoglobin. The increase in MCHC could be as a result of the increase in Hb concentration.

Mean platelets values ranged between 7.0-10.3 x 10³/uL, this is lower than the value (144.6-366.56) reported by Nilguin et al., (2014). The result did not agree with results of Dzungwe (2013) and Zendesha (2017) who observed platelets within the same reference range for quails when fed sundried mango seed meal and chicks fed FMKCM respectively. The low platelet values reported in this study could be attributed to the effect of the antibiotic given to the birds which must have destroyed blood platelets.

Mean Lymphocytes (67.33-92.33 %) reported in this study was above the range (35.7-61.9 %) reported by Schmidt et al. (2009). The result of this study is in agreement with reports of Dzungwe (2014) who also reported lymphocyte values above the normal reference range for Japanese quails fed SMKM. Reports by Diarra et al. (2010) also agrees with the report of this study when 60% boiled mango seed kernel replaced dietary maize replaced

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without effect on lymphocytes. The increases could be as a result of the intermittent treatment of poult with anti-biotics in drinking water.

Mean monocytes ranged between 0.7-5.0%. This was within the normal reference interval (0-3,958) reported by Bounous et al. (2000). The report agrees with reports of Dzungwe (2014) who also reported monocytes values within normal range for quails fed sundried mango kernel meal. Report by Diarra et al. (2010) also agrees with the report of this study when 60% boiled mango seed kernel replaced dietary maize replaced without effect on monocytes. This implies that FMKM had no adverse effect on the monocytes of poult.

Mean Eosinophils ranged between 0-2.0%. This was within the normal range (0-438) reported by Bounous et al. (2000) for juvenile and wild turkeys. The report agrees with reports of Dzungwe (2014) who reported that eosinophil values were within normal reference range for Japanese quails fed SMKM. Diarra et al. (2010) also reported that Hematology and blood

chemistry of broilers were not affected when dietary maize was replaced with 60% boiled mango seed kernel. Abdullahi, (2012) and Amao and Siyanbola, (2013) reports showed that 100% soaked and 30% dry heat processed Mango Seed Kernel respectively did not have adverse effect on eosinophils of broilers. This implies that FMKM did not affect eosinophils adversely.

Mean Neutrophils ranged between 4.3-16.4 %. This was within the normal range reported by Bounous et al. (2000) for juvenile and wild turkeys. The report agrees with reports of Dzungwe (2014) who reported that neutrophil values were above the normal reference range for Japanese quails fed SMKM. Hematology and blood chemistry of broilers were not affected when dietary maize was replaced with 60% boiled (Diarra et al., 2010), 100% soaked (Abdullahi, 2012) and 30% dry heat processed (Amao and Siyanbola, 2013) MSK. This implies that FMKM did not have adverse effect on neutrophils of poult.

Table 2: Haematological indices of local Poult fed fermented mango kernel composite meal (FMKCM)

| Variables | T1 | T2 | T3 | T4 | SEM | Sig. |
|---------------------------------|--------------------|---------------------|--------------------|--------------------|-------|------|
| WBC X 10 ³ /ul | 258.80 | 261.60 | 249.60 | 267.50 | 3.16 | 0.26 |
| RBC X 10 ⁶ /ul | 2.53 ^b | 2.67 ^{ab} | 2.94 ^a | 2.65 ^{ab} | 0.06 | 0.01 |
| Hg (g/dl) | 11.83 | 12.20 | 12.73 | 11.87 | 0.21 | 0.46 |
| HCT (%) | 35.33 | 37.00 | 38.33 | 35.67 | 0.65 | 0.37 |
| MCV (fl) | 140.20 | 139.27 | 136.97 | 134.57 | 1.55 | 0.64 |
| MCH (pg) | 46.80 | 46.07 | 45.47 | 44.77 | 0.58 | 0.71 |
| MCHC (g/dl) | 33.37 | 33.00 | 33.20 | 33.17 | 0.08 | 0.46 |
| Platelets (10 ³ /ul) | 6.67 | 6.67 | 8.67 | 10.33 | 0.71 | 0.20 |
| Differential counts: | | | | | | |
| Lymphocytes (%) | 92.33 ^a | 85.00 ^{ab} | 67.33 ^c | 80.00 ^b | 3.06 | 0.03 |
| Monocytes (%) | 0.67 ^c | 2.67 ^b | 5.00 ^a | 2.67 ^b | 0.49 | 0.01 |
| Eosinophils (%) | 0.00 ^c | 1.00 ^{ab} | 2.00 ^a | 1.00 ^{ab} | 0.275 | 0.05 |
| Neutrophils (%) | 4.33 ^c | 11.00 ^{bc} | 26.33 ^a | 16.67 ^b | 2.68 | 0.02 |

Means a, b, c, d, with different superscript across rows vary significantly ($P > 0.05$). WBC- white blood cells, RBC- red blood cells, Hg-haemoglobin, MCV- mean corpuscular volume, MCH-mean cell volume, MCHC-mean corpuscular haemoglobin concentration.

CONCLUSION

The study concluded that replacement levels with FMKM up to 20% can be included in local turkey poult diet without any harmful effects on haematological indices since the

abnormalities observed were not limited to only poult fed fermented mango kernel composite meal (FMKM).

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