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Evaluation of the Effect of Replacing Maize with Cooked Mango Seed Kernel Meal on the Growth Performance of Broiler Chicken Diets

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Abstract
The study was conducted to assess the effect of replacing maize with cooked mango seed kernel meal on growth performance of broiler chicken diet. The study was conducted at the Poultry Unit of Teaching and Research farm at the Department of Animal Health and Production Technology Yobe State College of Agriculture Science and Technology Gujba Damaturu Yobe state. One hundred and fifty day old marshal strain broiler chicken were randomly assigning in to five treatments with three replications of 10 bird each in a completely randomize design the experiment lasted for 8 weeks (56day) the five treatment diet use contains 0% CMSKM, 5%, 10%, 15% and 20% CMSKM to replace maize. Cooked mango seed kernel meal contain 8.01% CP and 3675.5 me , kg/dm dray matter. The parameter recorded in community include daily fed intake, week gain fed conversion ration and mortality. During The entire period daily fed intake was recorded at 125.20, 129.5, 124.68, 133.48, and 131.6 g/bird for T1, T2, T3, T4, and T5 respectively. It show that their was significantly higher ($p<0.05$) for T4 and compare to T1, T2, T3, and T5 and 15% level of inclusion. The feed conversation ration during the entire period was recorded 2.61, 2.70,2.76, 2.79 and 2.71 respectively and higher in T4 compare to T1, T2, T3 and T5. base on the outcome of this study, indicated that cooked mango seed kernel meal could replace maize up to 15% without compromising effect on the growth performance.

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Chapter One

1.1 Introduction

Poultry production is an area of animal agriculture and has undergone rapid changes, since the 1940s when modern intensive production systems were introduced together with new breeds, improved bio-security, and preventive health measures. The poultry industry is an important segment of the world's food industry, providing eggs and meat to large people and its consumption is required to correct protein deficiencies and can contribute to household security and income among vulnerable groups (Daghir, 2008).Chicken meat and eggs have been recommended to bridge the protein gap more than other species of livestock because of short generation interval, high rate of productivity, quick turnover rate, higher feed efficiency, small land requirement and relatively low capital investment (Okerke, 2012).

The recent poultry production in Nigeria is estimated to be around 60 million out of which the majority (37.9% or 22.7million) are chicks and 33.6% (20.2 million) are laying hens FAO (2019).Accordingly, poultry production stimulates local economic development of urban centers through development of related micro enterprises wholly or partly responsible for the provision of inputs and processing, packaging and marketing of outputs as well as the provision of services to the sector (Mutami,2015).

The main constraints of poultry production are shortage of feed resources in terms of quality and quantity. Nigeria is not self-sufficient in cereal grains, which form the bulk of the concentrate feeds for poultry (Solomon, 1996; Amin and Cheah, 2010), and there is always strong competition with human being, as a result of cost of the product had been increased. Under such scenario, the use of non conventional feedstuffs based on agricultural and agro-industrial by-products as alternative sources of carbohydrate and protein can enable cheaper egg and meat production which in turn decreases consumption of cereal grains by animals (Bolu and Ibikunle, 2009).

These major poultry feed ingredients have been facing market competition with human food demands in Nigeria. As, Gura (2008) reported that the competition between food, feed and agro-fuels is expected to increases prices of poultry feeds that enforce producers to look for alternative and locally available feed sources. Feed cost is often implicated in the high cost of chicken products. It is estimated to represent more than half of the total cost of chicken production under intensive condition (Wilson and Beyer, 2000).

Maize seed, which usually forms the bulk of such diets, has many other uses and may not be easily available for poultry production in the future. Furthermore, production of maize in many tropical countries has fallen compared to the demand because of frequent drought, food, and locust infestation that are affecting some maize- producing areas. For these reasons, dependence upon maize as the sole major source of dietary energy for the poultry industry may be precarious and an alternative is required (Agwunobi, 1999).

Nigeria has the largest tract of suitable land for mango production growing in many part of the western, Southern and Northern part of Nigeria its mainly produce in Benue, Jigawa, Plateau,Yobe, Jebbi, Kaduna, Kano, Bauchi, Sikoto, Adamawa, Taraba, and Federal Capital Territory, Nasarawa and Katsina State. (Ubwa et al, 2014). Benue State ranking the first in the league of state that produce mangoes in Nigeria (Ubwa et al, citation 2014). Large quantities of mango seeds are available during the fruiting season, but the seeds are mostly wasted. Mango seed kernels is the kernel inside the seed represents from 45% -75% of the whole seed. Mango seed kernel reported to contain some tannin, which exerts ant- nutritive effects in poultry and Human. To reduce these effects, soaking and boiling has been reported to be an effective method of tannin reduction. Boiling reduced up to 53% tannin in African oil bean and about 55% in mango kernel (Diarra and Usman, 2008). And also Mango pits and mango kernels should be soaked and dried down to 10% moisture to remove tannins before being fed to livestock (Morton, 1987). A lot of researchers reported that the treated (de-oiled, soaked or boiled) mango seed kernel has been successfully used to replace maize in levels up to 15-20% in poultry diets (Ravindran and Sivakanesar 1996) and Odunsi (2005).

Feeding of mango seed-kernel on poultry diets is so important for solving the problem of competition between poultries and humans for cereal grains as well as contributed in controlling the disposal problems of such mango seed kernel wastes (Gebremedhin and Alemu, 2015).Due to its abundance and its limited use as a by- product in Nigeria as well as most parts of the world, there is economic advantage in investigating the use of mango seed kernel meal in poultry feeding.

Its protein is comparable to that of maize, (Diarra and Usman, 2008). It is more abundant or available and cheaper than maize grain. Processed mango seed kernel can be incorporated into the diet of Monogastric animals as a source of energy without any detrimental effect on their health and performance, thereby reducing the cost of feeding. According to report of Dhingra and Kapoor (1985) mango seed kernel contains protein (5%-8%), fat (6% 12%), carbohydrate (75%-80%), ash
(1.53%), fiber (1.81%-4.01%), calcium (0.21%) and phosphorus (0.21%). Though it is poor source of protein, it is excellent source of energy containing about 13% ether extract, 67-82%NFE (Diarra 2014).

Its protein is comparable to that of maize (Diarra Usman, 2008).It is more abundant or available and cheaper than maize grain. Processed mango seed kernel can be incorporated into the diet of Monogastric animals as source of energy without any detrimental effect on their health and performances, thereby reducing the cost of feeding.

Experiment conducted on MSK (*Mangifiera indica.L*) as a poultry diet is non- existent in Nigeria. Hence, information on the importance of MSK as feed ingredient for poultry production is scanty. Therefore, using such kind of feed resources for animals feed could have an important element to fill the scarcity and competition problems of feed. Moreover, since price of mango seed kernel is also cheaper than the price of other ingredients particularly maize, its utilization as poultry feed would be beneficial to the poultry industry to minimize production expenses associated with high conventional feed costs. This can also reduce the competition between human and poultry for cereals in general and formalize in particular. Therefore, this study will aimed at the following objectives.

1.2 Background of the Study

In order to meet the animal protein need of the growing population in Nigeria, Emphasis is being placed on poultry because of its short generation interval. According to Smith (2001) poultry will produce meant within eight (8) weeks and eggs within eighteen (18) weeks of the first chick being hatched. However, the poultry industry in Nigeria is faced with the problems of feeding, according to Aduku (1992), feeding account for 80% or more of the total cost of poultry meat and eggs. the high cost of feed is largely attributed to the scarcity of feed ingredient like maize which is being use as a major source of energy and is short in supply because the human pressure on arable land and its numerous food and industrial uses.

This situation called for the need to look into alternative source of energy for poultry feeding.

1.3 Justification

This is to justify that feeding poultry is every expensive especially in term of feed ingredient like maize which is the major stable food in poultry diet as source of energy. Therefore, out of the reach of a small holder farmer: the prize of maize has risen up, for this reason, we have to look for locally available and cheap for the substitute of maize so as to reduce the price of maize. Although, the identification of such feed stuff would help resources to the poor local farmers not only to cut down their production but also to improve their production at large.

1.4 Objectives

1. To evaluate the effect of replacing maize with cooked mango seed kernel meal on the growth performance of broiler chicken diet.

Chapter two Literature Review

2.1 Constraints to Poultry Production

Poultry feed is one of the most critical constraints to poultry production under both the rural smallholder and large-scale systems in Nigeria (Tadelle, *et al.*, 2003). The problem is mainly associated with lack of processing facilities, inconsistent availability and distribution, and sub-standard quality of processed feeds, when available. Poultry products in most developing countries, especially in Africa are still expensive. Careful attention should be given to ensuring adequate feed resources. In low-income food-deficient countries, a surplus of cereals is generally not available. It is therefore, not advisable to develop a wholly grain based feeding system. The recommended policy is to identify and use locally available feed resources to formulate diets that are as balanced as possible (Branckaert. *et al.*, 2000).Most communities lack the required chicken husbandry skills, training and opportunity to effectively improve their household chicken production (Mlozi *et al.*, 2003). In many developing countries, the local gene pool still provides the basis for the poultry sector (Yakubu *et al.*,2008).The most striking problem in relation to village chicken production system is high mortality rate of birds, which might be as high as 80-90% within the first few weeks after hatching, due to diseases and predation (Wilson *et al.*, 1987). Pandey (1993), describing the epidemiology and economics of village poultry production in Africa, suggests the need to develop appropriate epidemiological techniques for village poultry, because of the nature of the host- pathogen-environment interaction in village chickens.

Although the commercial poultry industries in some countries are moving towards large scale; vertically integrated operations, suppliers of production inputs, poultry growers, poultry processors, marketers, feed mills and further-processing segments are not always included in the integration (Henry and Rothwell, 1995)

2.1 Mango Production in Nigeria

Mango plant is belongs to the family of Anacardiaceae.it is one of the most important tropical and subtropical fruit of the world and is popular both in the fresh and processed forms (Bally, 2006).It is grown in more than 80 countries. India occupies 56% of world production of mango which is nearly 9.5 million metric tons. The other leading mango producing countries are China, Mexico, and Pakistan. Indonesia, Thailand, Nigeria, Brazil and Haiti (Swart, 2009).Mango is adapted to wide range of soils, climate and altitude and is relatively easy to cultivate.

It plays a vital role in supplementing the diet of millions of peoples throughout the tropics in the Africa, America and Asia where local consumption is tremendous (Prakash, 2004).The demand for mango in the world market is increasing day to day. It is reported that the markets for mangoes have increased in temperate countries because of social changes, promotion of fruit trade in developing countries and accessibility to international trade (Diedhiou *et al*., 2007.) It is one of the main fruit crop produced and exported in Nigeria. Nigeria has large tract of land which is suitable for mango production. Large amount of mango mainly produced in Bunue State, in north central part of Nigeria often referred to as part of middle belt, while geographical positioned by the for northern Hausa Fulani State. with a population of about 4,253,641 in 2006 census its inhabited predominantly by T,V, Idoma and Igela, Etulo, Abakpa, Sukun, Hausa, Nyiton its known as food basket of the Nation.

2.1.1 Chemical Composition of Mango (*Mangifera Indica L.*) Fruit

The information related with the characteristics of the physical components and nutrients content of mangoes, influenced by the season, probably because the harvest period of the fruit is relatively short in the tropical world (Siller *et al*., 2009). According to Wu *et al*., 1993, in respect to the whole fruit, the mango shells seem to represent between 7-24%. Moharram and Mustafa (1982) found that the seeds of mango fruits represented 16-32.7% of the whole fruit, depending on the size and stage of ripening of the mango fruit. The differences in protein, crude fiber and ash contents within the varieties and between that determined by other workers can be attributed to varietal differences.

In addition, the maturity of the fruit, soil conditions and climate can also affect the composition of the kernel. In the case of the fat content, although varietal differences can contribute to differences in fat content of the kernels, it should be born in mind that the values for fat content are dependent on the method of extraction used.

Mango seed kernel is obtained by breaking hard seed coat of mango stone. It is edible, nutritious and non-toxic. It is sweet, acrid, astringent, refrigerant, anthelmintic, haemostatic and tonic. The kernel is a rich source of natural antioxidants, nutrients, fat, starch and protein. Although the amount of protein in kernel is low, but its quality is good due to richness of all essential amino acids. The principal chemical composition constituents of mango fruit are carbohydrates, organic acids, proteins, poly-phenols, vitamins and minerals. Ali (2003) reported that the free sugars in the mango fruits mainly consist of glucose, sucrose, while xylose and arabinose have also been detected in similar quantities during different stages of fruit ripening.

Dhingra and Kapoor (1985) revealed that mango seed kernel contains crude protein (5-8%) fat (6-12%), carbohydrate (75-80%), ash (1.53%) fiber (1.84-4.01%), calcium (0.21%) and phosphorus (0.21%).Though it is poor source of protein, MSK is an excellent source of energy containing about 13% EE,77% NFE (Patel *et al.*,1971). Fowomola (2010) reported that mango seed kernel contained sodium 21mg/100g), potasium (23.3mg/100g) calcium 111.3mg/100g).

2.1.2 Carbohydrate Contents of Mango Seed Kernel.

The main constituent of edible carbohydrate is starch along with some sugars. Starches created from two main polymers, an open chain aldohexose compound referred to as amylose that constitutes concerning 10-30 % of the overall, and also the open chain aldohexose compound amylopectin that makes up the remainder. Mango seed kernel was according to is a biological process promising seed to its high levels 1985).

Mango seed kernel has been reported to be a nutritional promising seed because of its high levels of carbohydrate and oil (Fowomola, 2010). The kernel of mango seeds have been identified as a promising source of nutrients for farm animals and humans (Hutagalung 1981;Dhingra & Kapoor 1985); with a carbohydrate content of about 80% on dry matter (DM) basis (Dhingra & Kapoor 1985). Mango seed kernels could be a useful energy source and would probably be a good substitute for maize which is the major source of energy in non-ruminant diets in several tropical countries.

2.1.3 Protein Content of Mango Seed Kernel

According to (Saadany *et al*., 1980; Jadhav and Siddiqui, 2010) the protein content of mango seed kernel ranges (7.8%-8%).The report of (Diarra *et al*., 2011) also indicated that the protein content of dried Mango seed kernel (MSK) (6-13%) is comparable to that of maize and has a good essential amino acid profile especially in terms of lysine and methionine. It has been reported that mango seed is very rich in glutamate and methionine. Among the essential amino acids, as Fowomola (2010) reported that leucine has the highest value (8.40 g/100 g of protein). This is followed by arginine which has the value of 5.17 g/100 g of protein.

2.2 Feed Resources of poultry

2.2.1 Conventional feeds

Conventional feed sources are those traditionally used whereas, those non- conventional once are not commonly and traditionally used as chicken feeds. However, conventional feed resources in Nigeria are facing a problem of competition with human foods (Younas and Yaqoob, 2005). Gura (2008) stated that the recent feed price increment may upset many of the plans to further development of industrial livestock productions. The availability of feed is the key factor that limits poultry production. A feed problem for poultry production in Nigeria is not only the prices and availability but also their low quality.

Maize, wheat, barley, oats are the most commonly used feedstuffs in conventional poultry diet. Among cereal grains, maize has been used as a primary dietary source for poultry due to its highly digestible carbohydrate content and relatively low fiber content (Hard, 2005). Production of cereal grains in Africa particularly in Nigeria has never been adequate both for human consumption and industrial use. Hence, there is a severe shortage of cereals for use in poultry feeds. Similarly, the cost of conventionally produced vegetable oil meals/cakes (soybean, peanut, sunflower, rape seed meal) and animal proteins (fish meal, meat meal) are highly expensive and their supply is inconsistent. Therefore, the feeding system must look for locally available and cheap source of feed ingredients, particularly those that do not attract competition in consumption between human and livestock.

2.2.2 Non-conventional feeds

Non-conventional feed resources (NCFR) generally defined as all those feeds that have not been traditionally used for feeding livestock and are not commercially used in the production of livestock feeds. . A serious gap exists between the demands and provide of concentrates and inexperienced and dry fodders for feeding stock within the world. To beat this shortage, it's essential to extend the provision of feed and fodder for the various productions and functions of the animals. one in every of the solutions is additionally to use the employment NCFR within the animal feeding systems (bovine and poultry excreta).The main constraints to the use of non conventional feed resources are collection, dehydration for high moisture content and detoxification processes (Gouado *et al*., 2007). Some of the potentially available NCFR are, mango seed kernels, rubber seed cake, Sal seed meal, tapioca waste, tea waste, babul seeds, slaughter house byproducts, karanj cake, guar meal, Prosopis juliflora pods and cassava leaf meal, Sea buckthorn leaves, cake and pomace, and animal organic waste. Palm leaf meals, palm press fiber, cassava foliage, spent brewer's grains, sugar cane pulp, rubber seed meal Many of the forest tree seeds contain 15-35% oil and are used for the extraction of oil, after which the cake is valuable as animal feeds (Reddy *et al*. (1986).

The utilization of non-conventional feedstuffs of plant origin had been limited as a result of the presence of alkaloids, glycosides, oxalic acids, phytates, protease inhibitors, haematoglutinin, saponin, momosine,cyanoglycosides, linamarin to mention a few despite their nutrient values and low cost implications (Sogbesan *et al*.,2006). These anti-nutritional factors negate growth and other physiological activities at higher inclusion levels (Oresegun and Alegbeleye 2001).

Processing technologies that are economic and practical are urgently required. Simple biotechnological methods such as soaking in water, dilute acids, sun drying, toasting, boiling, cooking, ensiling etc. have been found suitable to destroy or reduce the anti-nutritional factors inherent in non-conventional feedstuffs and make them useful as livestock feed (Amaefule *et al.*, 2000.

The generation of non conventional feed resources is actually from agriculture and numerous agro primaries based industries and could be operation of many factors. Such factors embody the amount and quality of the materials made that relies on the prevailing agro-climatic conditions and cropping patterns, the kind of raw materials, the assembly method, the assembly rate, the kind of inputs used, the rules touching product quality use and the constraints obligatory up on effluent discharge (FAO,1982).

Recycling, reprocessing and utilization of all or some of the wastes, offers the chance of returning these materials to useful use as critical the standard ways of disposal and relocation of identical residues (Punj, 1986).

2.3 Growth Rate and Feed Conversion Ratio of Broilers

A broiler is any chicken (Gallus gallus domesticus) that is bred and raised specifically for meat production (Kruchten, 2002).Some of commercial broilers strain can reach slaughter weights within 4 and 7 weeks of age, although slower growing breeds reach slaughter weight approximately 14 weeks of age. The average growth rate is determined by dividing the increase in body over a particular time period by the length of that period (Warriss, 2000).In broiler production, maximum growth rate is essential so that broilers can attain market weight in the shortest possible time. Within commercial genotypes, there is sufficient variability to allow for continued genetic improvement in body weight, yield and feed utilization, although these improvements in growth related traits may be accompanied by a correlated genetic decline in the reproductive potential of parental lines (Reddy, 1994; Goerzen *et al*., 1996; Barbato, 1999). The average daily weight gain of birds is not uniform for each week and varies considerably depending on age and sex.

Under normal condition a broiler must gain an average of 50g or more per day (Butcher and Nilipour, 2005). Feed conversion ratio (FCR) is expressed as the ratio of feed consumed to body weight gain of the bird (Washburn, 1980). Feed conversion ratio is affected by a number of factors including genetic makeup of the strain, feed type, temperature and management of the flock (Gillespie, 2004).

2.3.1 Mortality of Broiler chickens

Broilers grow so rapidly therefore apace that the heart and lungs don't seem to be developed tolerably to support the rest of the body, leading to symptom heart disease and tremendous death losses (Martin, 1997).To achieve successful broiler production, and it wants investigation

concerning the incidence and pathology of the poultry (broiler) diseases. In most of the diseases liver, respiratory organ and urinary organ are more affected. Throughout the time of examination, these organs are the key organ most of times affected in most of the poultry diseases either primary or secondary diseases. Mortality records in a poultry farm are of immense importance to know the prevalence of diseases and for adopting preventive and control measures and daily mortality or sudden mortality levels and seven day mortality are examples of indicators which can be used to demonstrate trends where action can be taken (Manning *et al*., 2007).

2.3.2 Carcass Yield Characteristics of Broilers

In poultry, carcass yield represents the weight of eviscerated carcass relative to live weight. However, it can also be used to relate the proportion of different parts to eviscerated weight as well as the weight of the carcass and parts in absolute terms (Durrant, 1995).The success of poultry meat production is strongly related to improvement in carcass yield mainly the proportion of breast meat and abdominal fat (Musa *et al*., 2006). Several aspects of production including genetic background, age of birds at marketing, nutrition and general management (Moran, 1999) influence the yield and quality of poultry meat. Breast meat often has a higher economic value than meat from other parts of the poultry carcass (Sasidhar, 2006). Nowadays, carcass quality is of major importance and interest in poultry industry due to increasing consumer interest in lean birds, low fat, low cholesterol diet and production of product added values (Attia *et al*., 2001).

The explanation of carcass varies in difference species, and in different dressing specifications as well as method of preparation for sale. However, in general terms the carcass consists of all those parts of the animal that will be sold as joints or steaks of meat (Warriss, 2000).

2.4 The Uses of Mango Seed Kernel as a Poultry Feed

The energy, protein and amino acid contents of the diet are major factors determining the growth, feed efficiency and body composition of broilers (Peter, 1999; Miller, 2004).

2.4.1 Energy

According to report of Saleh *et al*. (2004) decreasing the amount of energy in the diet

decreases growth rate of chicks and feed efficiency compared to chicks fed a higher Metabolisable energy diet. In addition, it has been suggested that a balance between the amount of Metabolisable energy needed to sustain production and energy to drive homeostatic processes is needed to minimize carcass fat and increase efficiency of production (Saleh *et al*., 2004). An increase in body fat is associated with poorer feed conversion because it requires more feed to produce a unit of fat than a unit of meat (Mack, 1984). However report of Kamran *et al*. (2008) explains that it is questionable whether dietary energy intake plays a role in regulating lipogenesis in birds fed at a suboptimal regimen of protein nutrition. Food to weight gain ratio decreases when dietary energy level is high (Holsheimer and Veerkamp, 1992).

2.4.2 Protein

According to report of (Si *et al*., 2001) it is known that the CP and amino acid (AA) status of a diet influences the carcass composition of broilers, and decrease in dietary CP causes a decrease in carcass protein and an increase in carcass fat content. (Parr and Summers, 1991) have found that reducing dietary CP does not affect growth performance.

However, rate and efficiency of growth is lower, and carcass composition becomes inferior in broilers fed diets in which CP has been lowered by more than 3%, even when all known nutrient requirements are met (Sterling *et al*., 2005; Waldroup *et al*., 2005). Kamran *et al.* (2008) also reported that, linearly, weight gain was decreased, whereas feed intake and feed conversion ratio were increased ($P<0.05$) with the reduction in dietary CP (23 to 19%) levels and constant ME:CP ratio during grower, finisher, and overall experimental periods.

2.4.3 Fat and fatty acids

Broilers have a dietary requirement for essential fatty acids (EFA). The main EFA is linoleic acid which acts as a precursor for other members of the n-6 series such as arachidonic acid and derived prostaglandins. Birds also appear to have a much smaller requirement for fatty acids of the n-3 (linolenic acid) series. Other body fatty acids (n-9 series) can be synthesized from carbohydrate precursors. Specific lesions, particularly in the skin, can result from EFA deficiency if the linolenic acid content of the diet falls below the requirement of about 10g/kg. However, this seldom occurs in practice since diet ingredients contain EFAs and supplemental fats and oils are widely used to achieve the high dietary ME values associated with high performance (EUC, 2000).

The overall chemical composition of mango seed kernels build it appropriate for poultry feeding, despite the presence of anti-nutritional factors. The Metabolisable energy worth is low in dried raw kernels (7.9MJ/kg DM) but, may be exaggerated when boiling up to 10.3 MJ/kg DM (Ravindran *et al.*, 1996).In broiler chicks, the inclusion of raw mango seed kernel meal typically ends up in degraded performance. Inclusion rates of raw mango seed kernel as low as 5%to 10% depresses growth and feed intake in some experiments (Diarra *et al*., 2008) whereas performance maintained at 10% inclusion rate in another trial (Odunsi 2005).In older animals, raw kernel meal appears to be higher consumed and performance maybe maintained (Diarra *et al*., 2008, Odunsi *et al*., 1997). However, up to 60% of the maize in broiler finisher diets maybe replaced with cooked mango kernel meal while not adverse effects on the expansion, health and body parameters (Diarra *et al*., 2010) and in his findings, (Abdullah, 2012) rumored that native selection (Kanbiri) of soaked mango seed kernel may been closed up to 20% within the diets of broiler chickens while not adverse impact on broiler performance.

2.5 Anti-Nutritional Factors in Mango Seed kernel

Although MSK has high content of nutrients, the use of MSK in poultry feeding is constrained by the presence of several anti-nutritional factors (ANFs).Anti-nutritional factors can be explained as the chemical constituent of a feedstuff, which interferes in the normal digestion, absorption and metabolism of animal feeds, some of which may have deleterious effects on the animal's digestive system and health. Some chemical constituents present in different kinds of feedstuffs interfere in the optimum utilization of nutrients and some are also toxic in high amount of concentrations.Anti-nutritional factors can be present in both conventional and non-conventional feeds, but they are more common in most of the non-conventional feeds.

The main ANFs reported in MSK include tannins and cyanogenic glycosides, Oxalates and phytates, saponins, alkaloids and flavonoids (Dakare *et al*., 2012). Mango kernels are fairly rich in tannins, which progressively lead to reduced growth rates and less efficient feed utilization when included as a major component in diets for pigs and poultry (Moore, 2004). MSK contain cyanogenic glucosides (64mg/kg DM), oxalates (42 mg/kg DM) and trypsin inhibitors (20 TIU/g DM) (Ravindran *et al*., 1996).

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2.6 Strategies for processing of Mango Seed kernel

Although mango seed kernel is good carbohydrate source for poultry feed, it has anti-nutritional factors. From these anti-nutritional factors the most important is tannins. To reduce these effects there are certain strategies. Several treatments (soaking, boiling, HCl or NAOH treatment autoclaving or HCl followed by Ca (OH) 2 may remove tannins. But the more effective method to eliminate it proved to be soaking as it removed 61% of the tannins and 84% of HCN (El Boushy *et al*., 2000).The result reported by Laroussilhe (1980), boiling, roasting or soaking can destroy the astringent taste of mango kernel thus improving taste and acceptance by the growing birds. The nutritive value of mango kernel can be improved by boiling which restored growth depressed with untreated kernels (Diarra *et al*., 2008). Boiling or autoclaving reduced anti-nutritional factors as tannins or trypsin inhibitors (Farag, 2001). Soaking without boiling could also reduce anti- nutritional factors (Abdullah, 2012).

Chapter Three Materials and Methods

3.1 Description of the Study Area

The Research was conducted at Yobe State College of Agriculture Science and Technology, Gujba Poultry Farm located in Damaturu.

Damaturu is the capital of Yobe State, Located between Latitude 80 N and 110 N and Longitude 11.50 E and 13.50 E (Figure 1). Yobe State falls under the Sahel, Sahel Savannah types of vegetation and it experiences distinct dry and wet seasons with temperature and humidity varying with seasons. The wet or rainy season lasts from April to November, and is characterized by single maxima in August and September. During this season, the moisture laden south west trade wind from the Atlantic Ocean blows over the area. Seventy percent of the total rainfall in the area happens to fall within four months of May-September (Adebayo, 1999).

3.2 Feed Ingredients and Experimental Rations

The feed ingredient were used in the experiment include maize grain, cooked mango seed kernel meal, wheat brand, soybean meal, fish meal, limestone, salt and vitamin premix. Proportion of feed ingredients was used to formulate, starter and finisher rations of broiler chickens by taking the laboratory nutrient composition of each ingredient and balancing with the nutrient requirement of broilers chicks. Wheat brand and maize, grain, soya bean, fish meal, g/cake was purchased from Potiskum grain main market.

3.3 Collection and processing of Mango seed into cooked mango seed karnel meal

Mango seed was obtained from Mamudo town in Potiskum local government area of Yobe State is well known for selling mangoes to other's local government and other part of the state during peak up time around April to June annually. There are more than 10,000 – 15,000 mangoes trees in the areas.

The mango seed was collected from various dumping site of the town during it season especially around April – June which became of peak up time for harvesting. The Kerned was

obtain by cutting the seed coat using knife or crushed with stone by removing the hard seed coat after soaking in water, then washed thoroughly with clean water to avoid contamination and also to reduce the content of the ant nutritional factors in mango seed kernel.

The samples were socked for 24hrs boiled 30 minute in pure water regularly stirring within 8hr interval (Ravindraw and Sivakenesan, 1996). Than after drawing water the sample was spread evenly on a plat form and allowed to Sunday for 3 days. The sun dried mango seed kernel was grounded and milled to 5mm sieve at poultry production unit Laboratory Yobe State College of Agric Science and Technology Gujba.

Rations were made to be Isocaloric and Isonitrogeneous to meet nutrient requirement of starter and finisher diets.

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3.4 Experimental Design and Treatments

The experiment was organized in a completely randomized design (CRD) with four treatments each with three replications. One hundred and fifty (150) unsexed broilers chicks were randomly assigned to the four treatment diets consisting of three replications. The cooked mango seed kernels (MSK) were used in the experiment as energy source. The inclusion levels of treatment (0%, 5%, 10% 15% and 20%) of total rations for T1, T2, T3,T4 and T5 respectively, were formulated depending on results of proximate composition analysis of ingredients from animal nutrition laboratory of the Yobe State College of Agric Science and Technology Gujba. The proportions of ingredients were formulated by feed win software. The chemical composition of treatment rations within each phase was formulated to be isocaloric and isonitrogenous.

Table 3.1 Composition and calculated analysis of experimental starter diet

Ingredients	**T1(0%)**	**T2(5%)**	**T3(10%)**	**T4(15%)**	**T5(20%)**
Maize	47.15	42.15	37.15	32.15	27.15
CMSKM	0	5	10	15	20
SBM	21.75	21.75	21.75	21.75	21.75
GNC	14	14	14	14	14
Fishmeal	3.00	3.00	3.00	3.00	3.00
m/offal	10.00	10.00	10.00	10.00	10.00
B/meal	2.00	2.00	2.00	2.00	2.00
L/stone	1.00	1.00	1.00	1.00	1.00
Methionine	0.2	0.2	0..2	0.2	0.2
v/premix	0.30	0.30	0.30	0.30	0.3
Lysine	0.1	0.1	0.1	0.1	0.1
Salt	0.5	0.5	0.5	0.5	0.5
Total	**100kg**	**100kg**	**100kg**	**100kg**	**100kg**
Calculated analysis					
ME	**2805.10**	**2811.47**	**2817.38**	**2824.20**	**2830.57**
CP	**22.42**	**22.37**	**22.32**	**22.27**	**22.22**
CA	**1.25**	**1.26**	**1.27**	**1.28**	**1.29**
P	**0.73**	**0.73**	**0.72**	**0.72**	**0.72**
Lysin	**1.11**	**1.12**	**1.12**	**1.13**	**1.13**
Meth	**0.58**	**0.58**	**0.58**	**0.58**	**0.58**
Cystine	**0.26**	**0.27**	**0.28**	**0.29**	**0.30**

MA= metabolizable energy, T1 = control diet, T2 5% teatement diet, T3=10% treatment diet, T4= 15% T5= 20%,

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Table 2: composition and calculated analysis of experimental finisher diet

Ingredients	T1**(0%)**	T2**(5%)**	T3**(10%)**	T4**(15%)**	T5**(20%)**
Maize	50.00	45.00	40.00	35.00	30.00
CMSKM	0	5	10	15	20
Palm oil	2.00	2.00	2.00	2.00	2.00
SBM	20	20	20	20	20
GNC	11	11	11	11	11
Fishmeal	3.00	3.00	3.00	3.00	3.00
m/offal	10.00	10.00	10.00	10.00	10.00
B/meal	2.00	2.00	2.00	2.00	2.00
L/stone	1.00	1.00	1.00	1.00	1.00
Methionine	0.2	0.2	0..2	0.2	0.2
v/p	0.3	0.3	0.3	0.3	0.3
Lysine	0.2	0.2	0.2	0.2	0.2
Salt	0.5	0.3	0.3	0.3	0.3
Total	**100kg**	**100kg**	**100kg**	**100kg**	**100kg**
Calculated analysis					
ME	2938.00	2944.37	2950.73	2957.10	2963.47
CP	20.59	20.54	20.49	20.44	20.39
CA	1.24	1.25	1.26	1.27	1.28
Phosporus	0.72	0.71	0.71	0.71	0.70
Lysine	1.11	1.12	1.12	1.13	1.13
meth	0.56	0.56	0.56	0.56	0.56
Cystine	0.24	0.25	0.26	0.27	0.28

Key CMSKM = Cooked mango seed kernel, SBM= soya bean meal = GNC ground nut cake , FM = fish meal

3.5 Experimental Chickens' Management

The experimental houses were cleaned and disinfected before two weeks of the chicks' arrival. The pens were washed down with water and detergent then sprayed with commercial disinfectant. The feeding and drinking troughs was properly cleaned, dried and disinfected before chicks' arrival. 150 broilers chicks were purchased from reputable poultry commercial farm. For these chicks, 15 pens were used and their floors were covered with woodshaving. Each pen were also equipped with a 150 Infra Red Bulb. The chicks were randomly grouped into 15 pens (10 chicks per replication) and were allotted to the four treatments. The chicks were feed *adlibitum* in groups with plastic feeding trough throughout the experimental period. The cooked Mango seed kernel meal was mixed with other diet depending on the levels for each treatment. Water was given by drinkers. The experiment lasted a total of 56 days. The chicks were vaccinated against Newcastle Disease on day 7 (HB1) by ocular route and on day 21(Lasota) by drinking water. They were also vaccinated for Gumboro on day 14.Other health precautions and disease control measures were taken throughout the study period.

3.6 Data collection

Data was collected on initial body weight, final body weight, body weight gain, total feed intake, daily feed intake, feed conversion ratio (FCR), carcass characteristics.

3.6.1 Feed intake

The feed were weighed every day to determine the average feed intake per chick for the different treatment groups. Feed intake was calculated as the difference between offered and leftover. Average total feed intake for each day was calculated by subtracting the amount of leftover from the amount of offered and divided by number of chicks for that day. Average daily feed intake was determined by dividing average total feed intake for number of experimental days.

3.6.2 Body weight gain

The birds were weighed at the beginning of the experiment and then weekly across the experiment. The broilers were weighed every week to determine the average weight gain per chick for the different treatment groups. After weighing, an average weight will be computed for each
replication during the weighing time. The average daily weight gains will be determined by dividing the average body weight gain by the number of experimental days.

$$\text{Body weight gain} = \frac{\text{Final weight (FW)-initial weight(IW)}}{\text{No of experimental days}}$$

$$\text{Average daily body weight gain} = \frac{\text{Total body weight gain}}{\text{No of experimental day}}$$

3.6.3 Feed conversion ratio

The broilers were weighed every week to determine the average feed conversion ratio
/FCR/ per chick for the different treatment groups. Feed conversion ratio was calculated by
dividing the amount of feed consumed (g) with body weight gain (g) as follows:-

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Feed intake (g) /bird / day}}{\text{Body weight gain (g) /bird/day}}$$

3.6.4 Mortality rate

The birds were monitored daily as a routine activity to check the health status and to record deaths. Mortality was recorded as it occurred and was determined for each treatment as a percentage of the total mortality at the end of the whole experiment. Calculations of mortality rate /MR/ were expressed as percentage as follows:

$$\text{Mortality Rate (MR)} = \frac{\textit{Number of death} * 100}{\textit{Number of total chicks}}$$

3.6.5 Chemical analysis of feed

Representative feed samples was taken from each of the feed ingredients to be used in the experiment and analyzed before formulating the actual treatment rations. Based on the chemical composition of the ingredients, ration formulation was done for each treatment. Samples of feed to determine chemical analysis of the experimental diets containing different proportion of cooked mango kernel meal was done at the end of the experiment. According to Weende or proximate analysis method (AOAC, 1990) chemical analysis of experimental feeds was carried out for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash in animal nutrition laboratory of the College. Nitrogen (N) content was also determined by Kjeldahl procedure and crude protein (CP) was calculated as Nx6.25, which comes from assumption of all proteins in the food contains 16%.The calcium and phosphorus content will be determined.

Metabolisable energy (ME) of the experimental diets will be determined by indirect method according to the formula below (Wiseman, 1987).

3.7 Statistical Analysis

The experimental data was subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SAS (2009) version 9.1. When the analysis of variance revealed the existence of significant differences, differences among treatment means will be compared using least significant difference (LSD) test

The model used for statistical analysis will be $Y_{ij} = \mu + T_i + e_{ij}$ Where: Y_{ij} = the response variable (experimental unit),

μ = Over all mean and,

T_i = Treatment effect (i=1-4); e_{Ij} = Random error Term

Chapter Four Results and Discussions

4.1 Chemical Composition of Experimental Diets

The results of laboratory analysis for the experimental feed ingredients were shown in Table 5.Laboratory result showed that the energy content of cooked Mango seed kernel and maize was 3675.5 and 3671.3kcal/kg, respectively. This laboratory result makes mango seed kernel as an effective energy sources for poultry and good substituting of maize for broilers rations. The crude protein (CP) content of Mango seed kernel current study was 8.01% which is comparable with crude protein of maize. This result is similar with study of Daudu *et al.* (2015) and Diarra (2014) who reported 7.94% and in a range 6-10% of Mango seed kernel respectively. Similar finding with current chemical composition of CP of MSK was also reported by Diarra (2011) which in a range (6-13%).Chemical composition variation in CP% of MSK current result and in literature review could be an attribute of differences depending on the varieties, cultivar, growing conditions, kind of soil, moisture, maturity at harvest, processing methods management of storage, climatic and geological condition of area from where MSK was collected. The CP content of maize in current study was in agreement with Tolera (2012) who reported 8.89%.The Ether extract and crude fiber of mango seed kernel were comparable with that of maize. The ether extract of mango seed kernel and maize was nearly similar which is in agreement with study of Daudu *et al*. (2015) who reported 4.01% Kanbiri boiled mango seed kernel in chicken diets.

Table4.1. Chemical composition of feed ingredient

Chemical Composition			Ingredients		
	Mango Seed Kernel	**Maize**	**Maize offal**	**Soybean Meal**	**Groundnut Cake**
DM%	**89.2**	**89.2**	**90.4**	**93.6**	**91.7**
CP(%DM)	**8.00**	**8.9**	**15.1**	**44.8**	**36.5**
EE(%DM)	**4.5**	**4.5**	**4.2**	**5.5**	**7.5**
CF(%DM)	**4.2**	**4.2**	**9.2**	**6.1**	**11.7**
Ash(%DM)	**3.6**	**3.7**	**3.8**	**5.8**	**9.8**
Ca(% DM)	**0.1**	**0.05**	**0.6**	**0.3**	**0.5**
P(%DM)	**0.2**	**0.3**	**0.4**	**0.6**	**1.1**
ME(Kcal/kg DM)	**3675.5**	**3671.3**	**3203.9**	**3552.8**	**2919.1**

Table4.2 .Chemical composition (%DM) of experimental ration

Treatment	DM%	CP	EE	CF	ASH	Ca	P	ME(Kcal/g)
Starter diet								
T1	90.83	23.30	5.01	7.05	10.05	1.0	0.67	3188.17
T2	90.84	23.41	5.09	7.01	10.13	1.0	0.67	3192.80
T3	90.84	23.37	5.08	7.02	10.21	1.1	0.66	3188.11
T4	90.88	23.61	5.10	6.99	10.14	1.1	0.66	3194.7
T5	90.82	2351	5.11	6.89	10.12	1.1	0.57	3191.6
Finisher diet								
T1	90.69	21.37	4.79	6.68	9.0	1.0	0.61	3256.8
T2	90.72	21.75	4.84	6.54	9.06	1.0	0.62	3264.6
T3	90.61	21.09	4.94	6.8	9.35	1.1	0.63	3235.09
T4	90.59	21.11	4.85	6.75	9.47	1.1	0.60	3229.74
T5	90.70	21.03	4.81	6.75	9.48	1.1	0.65	3239.70

4.2 Feed Intake

Average feed intake as well as daily feed intake in starter phase was significantly different among the treatment groups as shown in the Table7.The result showed that average total feed intake during the starter and finisher phases as well as for the whole experimental period was positively affected (improved) (P< 0.05) by treatment. Accordingly, substitution of maize by different levels of mango seed kernel meal has improved feed intake as compared to the control during the starter phase. Average feed intake during starter period in T2 and T3 was higher than other treatment groups .Average feed intake recorded in T2, T4 and T5 was statistically similar, but numerically different in this phase. However, feed intake during starter period was lower in T4 than T2 and T3. The reason of the reduction of feed intake among the treatment groups might be attributed to the residual effect of tannin concentration of mango seed kernel in higher inclusion levels, which reduces appetite of feed intake of birds in higher inclusion level. The current result is in agreement with study of Diarra *et al. (*2011*)* who noted reduced feed intake in higher inclusion level of MSK in starter phase. Increased in tannin concentration correspondingly reduces protein utilization. Mango seed kernel are rich in anti-nutritional factors particularly tannins, which progressively lead to reduced growth rates and less efficient feed utilization when included as a major component in diets for poultry (Kout-Elkloub *et al*., 2019).

During entire phase, total average feed intake as well as average daily feed intake recorded in T2 and T3 was statistically similar but numerically different. During finisher phase there was no statistically significant differences between T1 and T4 in average daily feed intake. This might be due to the ability of matured birds to tolerate higher levels of tannins than starter chicks. This finding was in agreement with the study of Diarra *et al*. (2011) who observed that adult birds tolerate more tannin than young chicks.

Table 4.3.Effect of dietary inclusion of mango seed kernel meal on feed intake (g) and daily feed intake (g/bird/day) of broilers during the starter and finisher phases as well as the entire growth period

Parameter	Treatments					
	T1	T2	T3	T4	T5	SEM
Starter phase						
Feed intake	**1412.06[b]**	**1462.8[ab]**	**1523.2[a]**	**1525.3[b]**	**1424.4[b]**	**16.0195**
Daily feed intake	**67.24[b]**	**69.7[ab]**	**72.53[a]**	**73.41[b]**	**69.82[a]**	**0.76525**
Finisher phase						
Feed intake	**3678.3[d]**	**3979.83[b]**	**3813.37[c]**	**4083.03[a]**	**4182.01[a]**	**48.6147**
Daily feed intake	**175.16[d]**	**189.50[c]**	**181.57[c]**	**194.47[a]**	**182.52[b]**	**2.31762**
Entire period						
Feed intake	**5090.3[c]**	**5442.63[a]**	**5236.67[b]**	**5606.23[a]**	**5312.62[b]**	**58.8271**
Daily feed intake	**121.20[c]**	**129.5[a]**	**124.68[b]**	**133.48[a]**	**134.45[b]**	**1.40019**

4.3 Body Weight Gain

The initial, final body weight and total and daily body weight gain during starter, finisher phases and entire experiment period is shown in Table 8.The average total and daily body weight gain of broilers were significantly (P< 0.05) different between treatments during all phase (Table 8). However, birds fed T1, T2, T4 and T5 ration has statistically the same but, numerically different in average total body weight gain and average daily body weight gain during starter phase. The trend in body weight gain showed that as levels of CMSK inclusion level increased, body weight gain was decreased beyond T3.This might be effect of increased residual tannin concentration in higher inclusion level of mango seed kernel.

This might have interfered with the intake of the diet and growth of the birds. The current study is in agreement with finding of Kout-Elkloub *et al*. (2019), who found improved body weight in 15% inclusion level of mango seed kernel and reduced body weight gain above 15% inclusion level of CMSK in Gimmizah cockerel's diets. During finisher there was statistically the same but numerically different total body weight gain and average daily body weight gain among T2,T4 and T5. During this phase there was lowest average weight gain and daily body weight gain in T3 compared to other treatment groups.
The reason might be related with management (Problem of electric service provision) in this phase particularly in T3.In this phase, unfortunately Birds distributed in T3 encountered with shortage of light which occurred duet to breakage line of Infra Red Bulb by unknown factors for a few days. The most important non-dietary factor influencing body weight gain is the temperature of the poultry house. In a cool environment, broilers will eat more feed but many of the calories they obtain from feed will be used to sustain normal body temperature. When the calories are used for warmth, they are not converted to meat. Optimum temperatures allow the broilers to convert nutrients into growth rather than using the calories for temperature regulation. Might be due to this reason birds allocated in T3 differed in body weight gain in this phase.
During entire period there was lowest average daily body weight gain in T1 and highest average daily body weight gain in T4.

Table 4.4 .Effect of dietary inclusion of mango seed kernel meal on body weight gain (g) and average daily body weight gain (g/b/d) of broilers.

Parameter			Treatments			
	T1	T2	T3	T4	T5	SEM
Starter phase						
Initial Weight	42.23	45.75	45.44	45.26	43.71	0.3153
Final Weight	740.39^{b}	760.61^{b}	1044.91^{a}	736.23^{b}	741.52	39.8413
Weight gain	698.16^{b}	714.85^{b}	999.47^{a}	690.98^{b}	853.41	39.8217
Average Weight	33.25^{b}	34.04^{b}	47.59^{a}	49.90^{b}	35.08	1.89627
Finisher phase						
Final Weight	1991.03^{c}	2062.80^{b}	2070.50^{a}	2031.45^{d}	2070.20	9.43958
Weight gain	1294.8^{c}	1347.95^{a}	1071.03^{b}	1350.47^{a}	14210.41	34.8919
Average Weight	61.65^{c}	64.189^{a}	51.001^{b}	63.83^{a}	52.16	1.66152
Entire Period						
Final Weight Weight gain	1991.0^{d} 1948.77^{d}	2062.80^{b} 2017.05^{b}	2070.50^{a} 2025.06^{a}	2031.45^{c} 1986.19^{c}	2050.20 2056.06	9.43958 9.283
Average Weight	46.39^{d}	48.02^{b}	48.21^{a}	49.30^{c}	4632.04	0.22475

4.4 Feed Conversion Ratio

Feed conversion ratio (FCR) of the experimental chicks, expressed as grams of feed consumption per gram ADG. Feed conversion ratio of broilers fed diets with different inclusion levels of mango seed kernel for maize during the starter phase, finisher phase and the entire growth period was shown in Table 9.There was significant ($P<0.05$) differences in feed conversion ratio in all phases. The current finding disagrees with the observation of (Diarra *et al., 2008)* who illustrated poor FCR in raw mango seed kernel in broilers feed. During starter phase birds fed T3 possessed lower feed conversion ratio while, birds fed T1, T2and T4 possessed statistically similar but numerically different feed conversion ratio. During finisher phase there was significant ($P<0.05$) differences in feed conversion ratio. During entire period, there was also significant ($P<0.05$) differences in FCR among groups fed different levels of

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mango seed kernel.

In current study the values on feed conversion ratio increased slightly with the increase levels of Mango seed kernel meal, thus indicating that the higher the level of mango seed kernel meal, the less the utilization of the diets. This was due to inability of the birds to extract required nutrients from the feed because of the effects of anti- nutritional factors (tannins) which reduced feed digestibility and utilization. As a result, the result of this study showed that the high level inclusion levels of Mango seed kernel meal in broiler diet did not improved Feed Conversion Efficiency (FCE). The result of the present study is in agreement with finding of Kout-Elkloub *et al*. (2019) who noted that chickens consumed diet containing 15% level of mango seed kernel improved feed conversion ratio significantly.

Table 4.5 The Effect of dietary inclusion of mango seed kernel meal on feed conversion ratio of broilers during the starter and finisher Phases as well as the entire growth period

Experimental period	Treatments					
	T1	T2	T3	T4	T5	SEM
Starter phase	2.02^{a}	2.04^{a}	1.52^{b}	2.06^{a}	2.01^{a}	0.07329
Finisher phase	2.84^{c}	3.02^{b}	3.7^{a}	2.8^{c}	3.5^{b}	0.11007
Entire period	2.61^{b}	2.70^{a}	2.76^{a}	2.79^{b}	2.71^{a}	0.0188

^{abc}Means within a row with different superscript letters are significantly different (p<0.05); T1=0% of maize substitution of mango seed kernel; T2=5% of maize substitution by mango seed kernel;T3=10% of maize substitution by mango seed kernel;T4=15% and T5 =20% of maize substitution of mango seed kernel.

4.7 Mortality Rate Percentages of Broilers

As statistical analysis indicates in the Table 13 below there was no significant differences (P>0.05) in mortality of broilers. Mortality percentage during starter and finisher phases and the entire period are presented in Table 13. Compared to other treatments high number of birds died during starter phase in T4 in 1st week. The cause was not related to dietary treatments; rather it was because of the sudden deaths due to rapid growth rate. Therefore, the current finding showed that inclusion of mango seed kernel for maize on the ration of broiler up to 15% level has no adverse effect on the chicks' survival rate

Table 4.6 . Effect of dietary inclusion of mango seed kernel meal on mortality of broilers.

Mortality (%)	Treatments					
	T1	T2	T3	T4	T5	SEM
Starter phase	2.38	2.38	4.76	0.00	4.56	1.01484
Finisher phase	2.56	0.00	2.56	0.00	2.61	0.8410
Entire period	4.94	2.38	7.32	0.00	7.20	1.69876

SEM=Standard error of mean; T1=0% of maize substitution, by mango seed kernel; T2=5% of maize substitution by mango seed kernel; T3=10% of maize substitution by mango seed kernel; T4=15% and T5 = 20% of maize substitution by mango seed kernel

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Chapter Five

Summary, Conclusion and Recommendation

5.1 Summary and Conclusion

An experiment was conducted to evaluate the effect of different inclusion levels of cooked mango seed kernel for maize on feed intake; growth performances feed conversion ratio, mortality percentages of broiler chickens in Yobe State College of Agric Science and Technology Gujba poultry farm. 150 day old marshal strain with five dietary treatment ration each with three replication were used for experiment. The chickens were distributed randomly to 5 treatment each with three replication consisting 10 chicks at the start of experiment. The experimental diet containing T1 (0), T2 (5), T3 (10), T4 (15) and T5 (20) of maize was included by cooked mango seed kernel. Ration was formulated containing approximately 22-20% of CP and 3100-3200 Kcal/kg DM. ME for starter and finisher phases respectively. Feed and water were *adlibutum* for the experimental chickens throughout experimental period.

The experiment lasted for a period of 56 days. The experimental design was CRD. Data were subjected to ANOVA using GLM procedure of SAS (2009) version 9.1 and treatment means were separated using LSD. Chemical composition of the feeds was analyzed before formulation of the treatment rations. The chemical analysis showed that mango seed kernel contained 8.01% CP and 3675.5Kca/kg ME. Feed intake was recorded as differences between the offered and refused. Average daily body weight gain was calculated the difference between the final and initial body weight divided by the number of experimental days. There was significant difference in feed intake, weight gain and feed conversion ratio ($P<0.05$) among the treatments in all phases. The average daily weight gain per bird during the entire experiment period was 46.39g, 48.02g, 48.21g,

49.29g and 46.30g for T1, T2, T3, T4 and T5 respectively. Significantly higher ($P<0.05$) final body weight gain was recorded for T4 as compared to the control group during the starter and finisher phases as well as the entire experiment period.

The FCR for the entire period was 2.61, 2.70.2.76, 2.79 and 2.62 for the birds fed on T1, T2, T3, T4, and T5 respectively, with values for T4 and T3 higher than T1, T2 and T5. The mortality percentage of broilers for the entire growth period showed non-significant difference ($P>0.05$) among all the groups fed different treatment rations. This implies that inclusion of cooked mango seed kernel to maize on the diets of broiler had no adverse effect on the chicks' survival rate. Therefore, inclusion of mango seed kernel up to 15% for maize in broiler ration had positive effect on feed intake, weight gain and feed conversion ratio, FCR.

5.2 Recommendations

Generally, based on results of this study, the following recommendations are forwarded.

1. Inclusion of cooked Mango seed kernel up to 15% is recommendable for broilers diets on overall performances of birds.
2. Further researches should be carried out to evaluate the effect of inclusion of cooked Mango seed kernel meal.

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