Original Research Article

COMPARATIVE EFFECT OF FEEDING MAIWA AND PEARL MILLET AS DIETARY ENERGY SOURCE FOR BROILER CHICKEN

ABSTRACT

This study compared the effects of feeding broiler chickens, maiwa and pearl millet as dietary energy sources. The effectiveness, performance, and carcass features of broiler chickens given varying amounts of maiwa and pearl millet as dietary energy sources were evaluated in a feeding trial/experiment. Two hundred (200) day-old chicks were used in the experiment. The experiment lasted nine (9) weeks and was divided into two phases: starter and finisher. Five experimental meals containing 20 and 23% crude proteins, respectively, were created for each phase. For T_1, T_2, T_3, T_4, and T_5, five experimental diets were developed for starters and finishers, with different inclusion levels of 0, 25, 50, 75, and 100%, respectively. After being randomly weighed at two weeks of age, the chickens were divided into five (5) treatment groups, each consisting of forty birds. In a randomized completely block design (RCBD), each treatment was duplicated four times, with ten birds each replication. Feed and water were provided *ad libitum* from 2nd to the 9th week of age. The result of the experiment on percentage composition of the experimental diets for broiler chickens fed in starter and finisher phases indicated that crude protein and metabolizable energy are within the range adequate for raising broiler chickens. The daily feed intake values (53.80-57.05g; 120.30-124.35g; 82.79-85.35g) and the daily weight gain values (29.95-33.82g; 41.77-44.66g; 34.22-35.88g) obtained from the performance of broiler chickens fed graded levels of maiwa and pearl millet as dietary energy source revealed non-significant differences among the treatments in the three (3) phases. The dietary treatments had no effect on the carcass and visceral organ parameters of broiler chickens, with the exception of caecal weight and small intestine length, which differed significantly ($P \leq 0.01$), with values ranging from 0.41% to 0.72% and 160.85 to 191.33 cm, respectively. Thus, the study comes to the conclusion that broiler chickens can safely be fed maiwa and pearl millet along with other items as nutritional energy sources.

Key words: Maiwa, Pearl millet, Diet, Broiler, Feed, Performance

Commented [A1]: rewrite

Commented [A2]: doses review please?

Commented [A3]: concise please?

Commented [A4]: rewrite result

1. INRODUCTION

Millets, which belong to the Poaceae family of grasses, are among the earliest crops to be grown. In general, the two main millets utilized in Nigeria for food and feed are maiwa and pearl millet (*Pennisetum glaucum*). Native to the Sahara desert, maiwa and pearl millet are widely farmed as grain crops and fodder in arid regions of Africa, especially Nigeria. It thrives in hot weather, uneven rainfall, and unfavorable soil conditions. Because of these agronomic traits, pearl millet is a desirable grain choice for areas like the southern U.S. coastal plain, where soils are acidic, naturally fertile, and prone to drought. Furthermore, in the southern United States, pearl millet has a long planting season and grows quickly. According to earlier studies using this hybrid, pearl millet exhibited greater protein content (12–14%) and a similar TMEn value (3,300–3,448 kcal/kg) to maize (Davis *et al*., 2003). Furthermore, broilers fed meals containing up to 50% ground pearl millet performed as well as or better than broilers fed diets containing conventional corn-soybean meal (Davis *et al*., 2003).

The supply of animal protein that humans need to achieve his daily protein consumption is largely provided by poultry, particularly broilers (Ogundipe, 2003; Igwebuike *et al*., 2009; Maidala and Istifanus, 2012). They have characteristics that react to feeding and nutritional manipulations in a matter of days, as well as a high growth rate, a high feed conversion ratio, a short generation interval (5–6 months), and a short intestinal feed transit of 2-3 hours (Atteh, 2003). Since chicken meat has higher protein content than other meat sources and is linked to a comparatively lower calorie and sodium intake, it is superior to that of other livestock species (Atteh, 2003). When processed, poultry meat is palatable, soft, juicy, nutritious, and generally regarded as acceptable (Omole *et al*., 2006). Possibly the most crucial factor in cattle management is nutrition. Low livestock productivity in the tropics can be caused by a variety of causes, including stale feeds, nutritionally unbalanced meals, contaminated ingredients, and inadequate feed supplies (Ogundipe *et al*., 2003). In addition to nutrition, the poultry sector has been significantly impacted by the high cost of feed because human consumption and livestock feed compete for the same grains (Olomu, 2011). Due to a drop in productivity brought on by an unfavorable climate, maize, the primary energy source for poultry in the tropics is becoming more scarce and costly ((Oluyemi and Roberts, 2013); Kwari *et al*., 2011). Due to its scarcity brought on by population growth, maize has been under increasing pressure globally (Agbabiaka *et al*., 2013). According to Etuk *et al*. (2012), these changes necessitate a significant variety of poultry energy feedstuffs. The main factor limiting poultry productivity is feeding. Since birds will typically eat to meet their energy needs, the feed's energy content is the primary determinant of feed intake (Akinola and Sese, 2011). If they are not to become deficient with low feed intake or consumed more with low energy diet, the other dietary nutrients typically vary in connection to the diet's dietary energy content. According to Ojowola and Olugbemi (2011), maize makes up 50-70% of grill rations and is the primary energy source in poultry feeds.

However, by making inexpensive animal products available, Nigeria and other developing nations must boost their use of animal protein. Since feed accounts for 55-80% of production costs in the cattle business, finding inexpensive feed sources might be the best way to accomplish this goal (Kwadwo, 2014). One of the main obstacles to intensive poultry production in poor nations has been the high cost of conventional feedstuffs, particularly protein and energy sources. Although there are many bye-products and other unconventional feedstuffs available that can be used as alternative sources of energy and protein feedstuff for livestock production, the methods for making them more profitable for animal feeding systems are frequently unknown or too difficult to implement for efficient livestock

production. This is due to the fact that the cost per unit of feed has increased over the past few years, making grill production more expensive. In light of this, the study compared the effects of feeding grill chickens maiwa and pearl millet as dietary energy sources.

Commented [A5]: ?

Commented [A6]: ?

2. MATERIALS AND METHODS

Commented [A7]: good

2.1 Experimental Site

The study was carried out at the Yobe State College of Agriculture, Science and Technology Gujba poultry unit, which is part of the college teaching and research farm in Damaturu. Damaturu is 456 meters above sea level and is between latitudes 11^0 43' and 37" North and longitudes 11^0 58' and 26" East. It is situated in Nigeria's semi-arid, tropical continental area. The region is distinguished by a lengthy dry season (October-May) and a brief period of rainfall (June-September). In July and August, the average daily maximum temperature is 29.20°C, whereas in March and April, it is 430°C. Rainfall typically occurs between June and September and ranges from 500 to 1000 mm annually (El-Idriss, 2000).

Commented [A8]: make short/concise please

2.2 Collection and Processing of the Test Ingredients:

The local markets in the vicinity of the research location provided the maiwa and pearl millet. Until they were needed for feed formulation, the seeds were being stored in polythene bags after being partially (coarsely) ground in a hammer mill.

2.3 Experimental Diets and Design

Two (200) 100-day-old chicks were used in the experiment. There were two nine-week phases to it: the starting phase and the finisher phase. Five experimental meals containing 23 and 20% crude proteins, respectively, were created for each phase. In addition to the constant ingredients; wheat offal, fishmeal, lysine, palm oil, bone meal, limestone, min-vit premix, methionine, NaCl (common salt), and experimental diets were created in this study employing maiwa millet instead of pearl millet and full fat soya bean (FFSB). For T_1, T_2, T_3, T_4, and T_5, five experimental diets were developed for starters and finishers, with different inclusion levels of 0, 25, 50, 75, and 100%, respectively. After being randomly weighed at two weeks of age, the chicks were divided into five (5) treatment groups, each consisting of forty birds. Using a Randomized Completely Block Design (RCBD), each treatment was duplicated four times, with ten birds each replicate. Ad libitum feeding will be provided from the second to the eighth week of life.

2.4 Measure of Productive Parameters:

2.4.1 Feed Consumption/Intake

Each treatment's daily feed consumption was calculated by deducting leftover feed from the amount of feed each group received. Adequate precautions were also taken to prevent spills and the associated waste. On a weekly basis, the average daily feed intake was determined by dividing the quantity consumed by the total number of birds in the group.

2.4.2 Body Weight

To calculate the weight gain, each bird was weighed once a week using an electronic weighing balance. Each treatment group's mean live weight was calculated by dividing the total number of members by their individual weight.

2.4.3 Body Weight Change

The difference between the current week's mean live weight and the previous week's mean live weight was used to determine the body weight change for each treatment group.

2.4.4 Feed Conversion Ratio
This was obtained on a weekly basis. It was measured by dividing the mean feed intake per birds in grams by the mean live weight gain per bird for each treatment group.

$$\text{Feed conversion ratio} = \frac{\text{Feed intake}}{\text{Body weight gain}}$$

2.4.5 Mortality/ Morbidity
In the event of death, the carcass was taken to the veterinary pathology laboratory for post mortem examination to ascertain the cause of death.

2.4.6 Carcass Measurements
Two birds were chosen at random for carcass analysis from each of the four replicates of each treatment at the conclusion of the experiment. By weighing a representative chicken live, draining the blood, and then weighing it again, the quality of the carcass was assessed. After that, they are defeathered by immersing them in hot water at 80^0C for ten to fifteen minutes. Then, visceral organs and chopped-up portions were also weighed.

2.4.7 Cut-up Parts
Shanks, head, breast, neck, drumsticks, thighs, wings, back, and thorax were the anatomical sections of each corpse. The weight of each chicken's component parts was then measured with an electronic sensitive balance and reported as a percentage (%) of the slaughter weight.

2.4.8 Organs and Other Visceral Components
Individual carcasses from each treatment group had their organs and other visceral components; liver, gizzard, proventriculus, heart, crop, and abdominal fat removed. The organs and other visceral components were then weighed using an electronic sensitive balance to the closest whole number, and the results were expressed as a percentage (%) of the slaughter weight.

2.5 Blood Sample Collection and Haematological Indices Determination
Eight chickens were chosen at random from each treatment at the tenth week of age, or nine weeks into the trial. To prevent excessive bleeding, the birds were bled in the morning (7:00-8:00am) after fasting for 12 hours the previous day. Birds fast in order to prevent feeding from temporarily raising a number of blood metabolites (Jain, 1986). A 23 gauge needle and a sterile, disposable 5ml syringe were used to draw blood samples from the birds' wing veins. Ethylene diamine tetra-acetic acid (EDTA) containing bottles and test tubes were used to collect samples from each treatment replicate. Hematological parameters were calculated from the blood samples in the EDTA bottles. To separate the serum from the blood for serum biochemical indices, the samples in the test tubes were centrifuged for five minutes. According to the procedures described by Bush (1991), the following hematological parameters were measured: packed cell volume (PCV), red blood cell (RBC) count, white blood cell (WBC) count, leucocyte differential counts, and hemoglobin concentration (Hb). According to the standard equations of Schalm *et al*. (1975) and Jain (1986), erythrocyte indices, which include mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC), were calculated as follows:

$$\text{MCV} = \frac{\text{PCV}}{\text{RBC Count in } 10^6/\text{mm}^3} \times \frac{100}{1}$$

$$\text{MCH} = \frac{\text{Hb (g/dl)}}{} \times \frac{100}{}$$

$$\text{MCHC} = \frac{\text{Hb (g/dl)}}{\text{PCV (\%)}} \times \frac{\text{RBC (in } 10^6/\text{mm}^3)}{1} \times \frac{100}{1}$$

2.6 Serum Biochemical Analysis:

2.6.1 Total Protein, Albumin and Globulin

The Baker and Silverston (1985) method was used to measure the serum protein and albumin; the albumin value was subtracted from the total protein value to estimate the amount of globulin. Sigma test kits (Sigma Chemical Co. St. Louis, Missouri, USA) were used to analyze the serum's total protein, albumin, and globulin levels. Biuret activities were used to measure serum albumin and total protein (Bush, 1991). After estimating the amount of total serum protein, the sample's volume was fractionated to precipitate and eliminate globulins, leaving just albumin in solution.

Commented [A9]: good

2.6.2 Serum urea

The Diacetyl Monoxime was used to estimate the serum urea. In this case, trichloro-acetic acid precipitated the protein first. In the presence of acid, oxidizing reagent, and thiosemicarbazide, the urea in the filtrate then interacted with diacetyl monoxime to produce a colored solution. This was then measured at a wavelength of 520 nm using a photoelectric colorimeter. AT/AR x 100 is the urea concentration (mmol/l).

Where:

AT = Absorbance of the test sample
AR = Absorbance of the reference sample

Commented [A10]: good

2.6.3 Serum Cholesterol

Bush's (1991) colorimetric enzyme technique was used to determine this. A red solution is produced as a result of the process's enzymatic hydrolysis and oxidation steps. After reading the colorimetric at 546 nm, the concentration was ascertained.

2.6.4 Serum Glucose

The ortthotoliudine technique was used to estimate the serum glucose. This approach used trichloro-acetic acid to precipitate the protein first. A photoelectric colorimeter set to 630 nm was used to measure the green color that resulted from the filtrate's glucose reacting with the ortthotoliudine reagent. Glucose concentration (mmol/l) is equal to AT/AR times 200.

Where:

AT = Absorbance of the test sample.
AR = Absorbance of the reference sample

2.7 Chemical Analysis:

Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Crude Fiber (CF), and Nitrogen Free Extract (NFE) were determined using the Standard Analytical Methods (AOAC, 1990). Bomb calorimetry was used to determine the samples' gross energy.

2.7.1 Dry matter (DM)

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

Moisture (%) = $\frac{W1-W2 \quad x \quad 100}{}$

W

Where W1 = weight of sample + Petri dish before drying
W2 = weight of sample + Petri dish after drying
W = weight of sample

2.7.2 Crude protein (CP)

The Kjeldahl method was used to determine the crude protein (AOAC, 1990). There are three stages to this, as shown below. About 2.0g of the produced sample was digested after being thoroughly combined with 3ml of concentrated H2SO4. Following digestion, the sample was put into a distillation machine, where it was distilled by adding NaOH, which combines with the ammonium sulphate to produce NH4OH + Na2SO4. The green distillate was then taken for titration with 0.IN HCl when the distilled samples turned green, signifying the presence of a base (NH3). After that, crude protein will be calculated as follows:

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

9% Crude Protein N x 6.25 (factor for feeds)

2.7.3 Crude Fibre (CF)

A digestion reagent made up of 20 ml tricholoro-acetic acid, 20 g glacial acetic acid, and 500 ml NHO3 mixed to 1 liter with distilled water was used to digest about 1.0 g of the produced sample. After being taken out and allowed to cool to room temperature, the digested sample was filtered through ash-free filter paper that had been weighed beforehand. After removing all the moisture from the paper by placing it in an oven set to 800 degrees Celsius for the entire night, it was weighed. The residue after drying (paper + fibre + ash) was ash in a muffle of 55^0 C for 3 hours and the ash is weigh. The fibre was determined by calculation using the formula of Van Soest and Wine (1967):

18% Crude fibre = weight of fibre x 100 / 2 g of sample

2.7.4 Ether Extract (EE)

About 2.0g of the prepared sample and 200ml of petroleum ether were put into a Soxhlet device extraction chamber. After five hours at 600C on the heating mantle, the flask was oven-dried for an hour at 1000C, cooled in a desiccator, and weighed. The calculation for ether extract was:

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

2.7.5 Nitrogen Free Extract (NFE)

The percentages of moisture, crude protein, crude fiber, ether extract, and ash were subtracted from 100 for each sample. NFE = 100 - (% CP + %CF + 26%EE + %Ash). Following sample ashing at 550°C in a muffle furnace, calcium, magnesium, and iron levels will be measured using an atomic absorption spectrophotometer. A flame photometer was used to estimate sodium and potassium, a spectrophotometer (spectronic20) was used to measure phosphorus, and a conventional colorimetric technique was used to assess sulphur.

2.7.6 Costs Benefit Analysis

At the conclusion of the study, the experimental diets' cost-benefit analysis was established. The market prices of the feed ingredients used during the study period served as the foundation for the economic analysis. Each diet's cost as well as the cost per kg of weight

Commented [A11]: excellent

gain for each bird was evaluated. Each bird's cost was also established. To determine their acceptability, the control diet will be contrasted with the other diets.

2.8 Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA) using Statistical Package for Social Science (SPSS, 2016 version). Moreover, where significance differences among treatment exist, LSD was used to separate them.

3. RESULT AND DISCUSSION

The percentage compositions of the experimental diets for broiler hens fed in the starter and finisher stages are shown in Table 1 and 2, respectively. According to Olomu (2019) and Oluyemi and Roberts (2013), the range of crude protein and metabolizable energy is suitable for producing broiler chickens in the tropics. Table 3, shows the performance of broiler chickens given varying amounts of pearl millet and maiwa as dietary energy sources. According to the table, there was no significant difference in the daily feed intake values (53.80-57.05g; 120.30-124.35g; 82.79-85.35g) between the treatments during the starter, finisher, and overall phases. The daily weight gain values obtained (29.95-33.82g; 41.77-44.66g; 34.22-35.88g) also showed no significant difference between treatment groups at the starter phase, finisher phase and overall phase. The results were in agreement with that of Kwari *et al.* (2014) who observed that performance were not affected when broiler chickens were fed maize, sorghum, millet, and their combinations as dietary energy sources in the semi-arid zone of Northern Nigeria. However, slightly below values reported by Medugu *et al.* (2010). Feed conversion ratio results also showed non-significant difference at both starter and finisher phases and overall performance.

Table 4 shows the carcass and visceral organ features of broiler chickens given varying amounts of pearl millet and maiwa as an energy source. The live weights, which ranged from 2.00 to 2.40 kg, were not substantially affected. The eviscerated weight ranged from 1.42-1.66 kg and the plucked weight ranged from 1.61 to 2.20 kg; however, none of these were impacted by the nutritional interventions. The range of the dressing percentage values was 63.08 to 64.77%. In a related study, comparable results were found to be marginally higher (58.24-63.85%) than those published by Yunusa *et al*. (2014) and lower (67.18-81.247%) than those reported by Kwari *et al*. (2014). There was no significant difference in the liver values of 1.44 and 1.77%, the heart values of 0.30 and 0.35%, or the lungs values of 0.41 and 0.55% across the dietary levels of the therapies. The gizzard weight ranged from 1.51% to 1.90 percent, the abdominal fat ranged from 0.95% to 1.55%, while the kidney weight remained constant at 0.03%. All did not, however, vary depending on the dietary intervention. The weights of the pancreas ranged from 0.14 to 0.18%, the small intestine ranged from 2.49% to 3.33%, and the caecal weight varied considerably ($P \leq 0.01$). Nonetheless, there was a significant difference *($P \leq 0.01$)* in small intestine lengths between the treatment groups; diet 3 had the longest at 191.33 cm, while diet 4 had the shortest at 160.85 cm. The large intestine length measurements ranged from 12.23 to 14.33 cm, whereas the large intestine weight values fell between 0.15 and 0.29%. The dietary levels of the treatments had no effect on the spleen weight values, which ranged from 0.07% to 0.11%. These figures are consistent with the results of Yunusa *et al*. (2014) and Lakurbe *et al*. (2019), who fed broiler chickens various dietary energy sources.

Table 1: Percentage composition of graded levels of maiwa and pearl millet fed as energy source for starter diets experiment (1-4weeks)

Ingredients	Experimental Diets				
	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)
Maiwa	38.01	29.19	18.34	7.48	0.00
Pearl millet	0.00	10.00	20.00	30.01	37.41
Soya beans	33.29	34.11	34.96	35.81	35.89
Palm kernel cake	10.00	10.00	10.00	10.00	10.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Lime stone	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Natuzyme™	-	+	+	+	+
Total	100	100	100	100	100
Calculated Composition Analysis (%)					
CP	23.00	23.00	23.00	22.99	22.8
ME (kcal/kg)	3640.46	2608.64	2576.51	2544.36	2525.35
Ca	1.68	1.71	1.71	1.69	1.69
P	0.75	0.76	0.79	0.81	0.83
CF	5.01	5.69	5.68	7.05	7.55
Feed cost/kg	110.56	108.97	107.40	100.82	104.41

Key: C.P = crude protein; M.E = metabolizable energy; Ca = calcium; P = phosphorus; C.F = crude fibre.

Nutrient premix supplied the following per 100kg of diet: Vitamin A, 1,200,000 I.U; Vitamin D3 250,000 I.U; Vitamin E, 3,000 I.U; Vitamin K, 200mg; Thiamine, (B1) 225mg; Riboflavin, (B2) 600mg; Pyridoxine (B6), 450mg; Niacin, 4000mg; Vitamin B12, 2mg; Pantothenic acid, 1,500mg; Folic acid, 150mg; Biotin, 8mg; Choline chloride, 30,000mg; Anti-oxidant, 12,500mg; Manganese, 8,000mg; Zinc, 5,000mg; Iron, 2,000mg; Copper, 500mg; Iodine, 100mg; Selenium, 20mg; Cobalt, 50mg.

Commented [A12]: remove space

Table 2: Percentage composition of graded levels of maiwa and pearl millet fed as energy source for finisher diets experiment (5-9weeks)

Ingredients	Experimental Diets				
	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)
Maiwa	42.50	31.04	19.50	7.97	0.00
Pearl millet	0.00	10.64	21.28	31.92	39.89
Soya beans cake	26.74	27.62	28.52	29.41	30.03
Palm kernel cake	14.00	14.00	14.00	14.00	14.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Lime stone	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Wheat offal	10.00	10.00	10.00	10.00	10.00
Natuzyme™	-	+	+	+	+
Total	100	100	100	100	100
Calculated Composition Analysis (%)					
C.P	23.00	23.00	23.00	22.99	22.8
ME (kcal/kg)	3640.46	2608.64	2576.51	2544.36	2525.35
Ca	1.68	1.71	1.71	1.69	1.69
P	0.75	0.76	0.79	0.81	0.83
CF	5.01	5.69	5.68	7.05	7.55
Feed cost/kg	110.56	108.97	107.40	100.82	104.41

Key: C.P = crude protein; M.E = metabolizable energy; Ca = calcium; P = phosphorus; C.F = crude fibre.

Nutrient premix supplied the following per 100kg of diet: Vitamin A, 1,200,000 I.U; Vitamin D3 250,000 I.U; Vitamin E, 3,000 I.U; Vitamin K, 200mg; Thiamin, (B1) 225mg; Riboflavin, (B2) 600mg; Pyridoxine (B6), 450mg; Niacin, 4000mg; Vitamin B12, 2mg; Pantothenic acid, 1,500mg; Folic acid, 150mg; Biotin, 8mg; Choline chloride, 30,000mg; Anti-oxidant, 12,500mg; Manganese, 8,000mg; Zinc, 5,000mg; Iron, 2,000mg; Copper, 500mg; Iodine, 100mg; Selenium, 20mg; Cobalt, 50mg.

Commented [A13]: remove space

Table 3: Performance of broiler chickens fed graded levels of maiwa and pearl millet as energy source for finisher diets experiment

Parameters	Experimental Diets					SEM
	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)	
Production performance						
Initial weight (g)	76.37	80.34	81.00	84.11	80.0	4.29^{NS}
Body weight at 4 wks (g)	962.41	952.08	983.82	973.44	960.41	12.70^{NS}
Final weight (g)	1941.4	1900.1	1910.4	1902.33	1915.1	41.63^{NS}
Total weight gain (g)	1861.2	1821.9	1827.2	1817.7	1826.9	38.71^{NS}
Starter phase (1-4 weeks)						
Daily feed intake (g)	55.8	53.80	55.82	56.11	57.06	0.68^{NS}
Daily weight gain (g)	31.22	29.95	33.82	30.79	31.66	0.71^{NS}
Feed conversion ratio	1.79	1.83	1.79	1.83	1.81	0.01^{NS}
Mortality (Number)	2	2	1	2	1	------
Finisher phase (5-9 weeks)						
Daily feed intake (g)	123.78	122.96	120.3	124.35	121.79	1.24^{NS}
Daily weight gain (g)	44.66	43.23	41.77	42.01	43.34	1.92^{NS}
Feed conversion ratio	2.6	2.75	2.80	2.88	2.74	0.10^{NS}
Mortality (Number)	1	2	2	1	2	------
Overall phase (1-9 weeks)						
Daily feed intake (g)	85.35	84.34	83.88	82.79	84.09	0.79^{NS}
Daily weight gain (g)	35.88	35.24	34.22	34.99	36.33	0.77^{NS}
Feed conversion ratio	2.30	2.31	2.30	2.33	2.20	0.03^{NS}
Mortality (Number)	------	-----	------	------	-----	-----

NS= Not significant, SEM= Standard Error of the Mean

Table 4: Carcass and visceral organ characteristics of broiler chickens fed graded levels of maiwa and pearl millet as energy source

Parameters	Experimental Diets					SEM
	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)	
Live weight (kg)	2.40	2.37	2.22	2.21	2.00	0.09^{NS}
Plucked weight (kg)	2.20	1.75	1.91	1.77	1.61	0.07^{NS}
eviscerated weight (kg)	1.66	1.58	1.56	1.55	1.42	0.06^{NS}
Carcass weight (kg)	1.54	1.42	1.42	1.41	1.30	0.06^{NS}
Dressing percentage	64.77	64.36	63.08	64.82	63.81	1.27^{NS}
Lung weight (%)	0.41	0.55	0.49	0.43	0.44	0.02^{NS}
Heart weight (%)	0.31	0.34	0.35	0.31	0.30	0.02^{NS}
Liver weight (%)	0.44	1.77	1.73	1.35	1.73	0.26^{NS}
Kidney weight (%)	0.03	0.03	0.03	0.03	0.03	0.006^{NS}
Abdominal Fat wt (%)	1.39	1.34	1.55	1.41	0.95	0.22^{NS}
Gizzard weight (%)	1.51	1.53	1.65	1.55	1.90	0.10^{NS}
Caecal weight (%)	0.41^{a}	0.66^{ab}	0.72^{a}	0.49^{b}	0.65^{ab}	1.25^{**}
Caecal length (cm)	18.36	21.02	19.39	18.88	21.71	0.77^{NS}
Pancrease weight (%)	0.14	0.18	0.18	0.14	0.17	0.21^{NS}
Small int. weight (%)	2.49	2.66	2.87	2.70	3.33	0.22^{NS}
Small int. length (cm)	182.22^{ab}	181.71^{ab}	191.33^{a}	169.23^{b}	160.85^{b}	32.35^{**}
Large int. weight (%)	0.22	0.22	0.17	0.24	0.27	0.03^{NS}
Large int. length (cm)	12.23	13.25	12.82	14.33	13.33	1.59^{NS}
Speed Length (%)	0.07	0.11	0.10	0.08	0.11	0.01^{NS}

The superscripts (x^{abc}) indicate that values within the same row differ. NS = Not significant, ** = statistically significant at *(P≤0.01)* level of significance, and SEM = standard error of means.

4. CONCLUSIONS

Since maiwa and pearl millet have no effect on the majority of growth parameters, carcass yield, or gut characteristics, the Nigerian poultry feed industry must promote their use as energy sources for broiler chickens. This will lower feed costs and diversify the feed ingredients used as energy feedstuffs. The study found that the use of graded levels of maiwa and pearl millet and their different combinations had no effect on the performance or carcass characteristics of broiler chickens. Furthermore, a number of research and publications have emphasized the potential of maiwa and pearl millet as a substitute energy source for poultry diets. Its competitive nutrients are on par with, or sometimes even higher than, those of traditional cereals like rice, wheat, and maize. Furthermore, millets are given additional significance in terms of their health advantages, particularly for humans, due to the existence of nutraceuticals. It is possible to incorporate up to 100% millets into broiler meals without affecting their performance.

5. RECOMMENDATION

1. To lower the cost of raising broiler chickens with starter and finisher, understanding of the usage of maiwa and pearl millet as dietary energy sources must be raised in the research area.
2. To provide complete food security, the government should endeavor to give poultry producer's subsidized supplies of chicken feed and mixer.
3. To reduce the expenses related to feed production and processing, farmers should be urged to embrace and incorporate maiwa and pearl millet into chicken diets.

REFERENCES

Commented [A14]: follow the journal guideline

Agbabiaka, L. A., Okorie, K. C. & Ezeafulukwe, C. F. (2013). Plantain Peels as Dietary Supplement in Practical Diets for African Catfish (Clarias gariepinus) Fingerlings. *Agriculture and Biology Journal of North America (ABJNA)*, *4*(2), 155-159.

Akinola, L. A. F. & Sese, B. T. (2011). The Feeding Value of Different Dietary Nutrients for Japanese Quails. In: Adeniji, A.A., Olatunji, E.A. and Gana, E.S. (Eds) Value Reorientation in Animal Production: A Key to National Food Security and Sustainable Economy. *Proceedings of 36th Annual Conference of Nigerian Society of Animal Production*, Pp 481-483.

AOAC, (1990). Association of Official and Analytical Chemist. Official Methods of Analysis 15th Edition Washington D.C.

Atteh, J. O. (2003). Romancing The Chickens. The Sixty Eight Inaugural Lectures Series. University of Ilorin, Nigeria.

Davis A. J., Dale., N. M. & Ferreira, F. J. (2003). Pearl Millets as an alternative feed Ingredient in Broiler Diets. *Journal of Applied Poultry Resources*, 12, 137-144.

Etuk, E. B., Ifeduba, A. V., Okata U. E., Chiaka I., Okoli, Ifeanyi C., Okeudo N. J., Esonu B. O., Udedibie A. B. I. & Moreki, J. C. (2012). Nutrient Composition and Feeding Value of Sorghum for Livestock and Poultry: a Review. *Journal Animal Science Advances*, *2*(6), 510-524.

Igwebuike, J. U., Kwari. I. D., Ubosi, C. O. & Alade, N. K. (2009). Replacement Value of Spent Sorghum Grains for Maize in Broiler Finisher Diets. *Journal of Sustainable Agricultural Environment*, 3, 224-233.

Kwari, I. D., Igwebuike, J. N., Shuaibu, H., Titimaand, S. I. & Raji, A. O. (2014). Growth and Carcass Characteristics of Broiler Chickens Fed Maize, Sorghum, Millet and their

Combinations in the Semi-arid Zone of Nigeria. *International Journal of Science and Nature, 5*(2), 240-245.

Kwari, I. D., Saleh, B., Diarra, S. S., Mkighir, T. & Umanah, M. J. (2011). Nutrient Digestibility and Carcass Characteristics of Broiler Chickens Fed Different Cultivars of Sorghum Replacing Maize in the Semi-arid Zone of Nigeria. *Research Opinions in Animal and Veterinary Sciences, 1*(9), 578-581.

Lakurbe, O. A., Doma, U. D., Abubakar, M., Bello, K. M. & Garjila, Y. A. (2019). Comparative Performance and Carcass Characteristics of Broiler Chickens Fed Graded Levels of Sorghum and Pearl Millet. *Nigerian Agricultural Journal, 50*(2), 87-91. Available online at: http://www.ajol.info/index.php/naj

Maidala, A. & Istifanus, J. A. (2012). The Role of Micro Livestock in Alleviating Protein Deficiency and Poverty Reduction in Nigeria. *Proceedings of 2nd National Conference of School of Vocational and Technical Education, College of Education Azare. Bauchi State* .

Medugu, I. C., Kwari, I. D., Igwebuike, J., Nkama, I., Mohammed, I. D. & Hamaker, B. (2010). Performance and Economics of Production of Broiler Chickens Fed Sorghum or Millet as Replacement for Maize in the Semi-arid Zone of Nigeria. *Agriculture and Biology Journal of North America, 1*(3), 321-325.

Ogundipe, S. O., & Sanni, S. A. (2002). Economics of Poultry Production in Nigeria. A Training Workshop Manual. *National Animal Production Research Institute, A.B.U. Shika, Zaria*, Pp. 27-45.

Ogundipe, S. O., Abeke., F. O, Sekoni, A. A., Dafwang, I. I. & Adeyinka, A. I. (2003). Effect of Duration of Cooking on the Utilization of Lab Lab Purpureus by Pullet Chicks. In: *Proceedings of the 28th Annual conference of the Nigerian Society for Animal Production held at Ibadan, Nigeria.* Pp. 233-225.

Ojewola, G. S. & Olugbemi, F. (2011). Millet Meal: a Possible Alternative Dietary Energy Sources for Broiler Chickens. In: Adeniji, A. A., Olatunji, E. A. & Gana, E. S. (Eds.) Value Re-orientation in Animal Production: A Key to National Food Security and Sustainable Economy. *Proceedings of 36th Annual Conference of Nigerian,* Pp 481-483.

Olomu, J. M. (2011). Monogastric Animal Nutrition: Principles and Practices (Pp. 217-218). St. Jackson P., Benin City.

Oluyemi, J. A. & Roberts, F. A. (2013). Poultry Production in Warm Wet Climates (Pp. 153-155) Spectrum, Ibadan.

Omole, A. J., Adejimi, O. O., Adejurigbe, A. D., Tiamiyu, A. K. & Raji, A. M. (2006). Small and Medium Scale Broiler Chicken Farming. *Green Choice Agric Publications*, 55.

Yunusa, Y., Doma, U. D., Zahraddeen, D., Umar, A. & Abubakar, S. B. (2014). Carcass and Gut Characteristics of Broiler Chicken Fed Different Energy Sources. *International Journal of Poultry Science, 13*(9), 525-529.