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A Study on the Effects of Different Forms of Diet on the Performance Characteristics of Broiler Chickens

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Abstract

The study was conducted to determine the effects of different forms of diet on performance of broiler chickens. 225 day old broiler chicks were allotted to 3 different treatment groups. Each group was divided into 5 replication with 15 birds each, in a Completely Randomized Design. The chicks were raised in deep litter system throughout the period of experiment. All data generated were subjected to Analysis of Variance. The results for starter phase showed significant differences (P<0.05) in body weight gain and feed conversion ratio across the dietary treatment. No significance differences (P>0.05) was observed for feed intake and mortality. But higher water intake for birds on mash and pellet groups was observed. For finisher phase all the parameters were not significant (P>0.05) with exception of feed conversion ratio which reflected better in mash and pellet groups compared to crumbs group. It could be concluded from the study that mash could give better performance at starter phase and feeding mash or pellet forms at finisher could give better performance. It was recommended that, feeding mash form of feed for the

starter phase and mash or pellet forms at finisher phase should be adopted for optimum performance.

Keywords: *Effects, Different, Diet, Performance, Characteristics, Broiler Chickens*

Introduction

Nigeria is among the least consumers of animal protein in the world. While North America, western and Eastern Europe consumed 66.39, and 33 g/head/day of animal protein respectively, the average value for Nigerians is estimated to be 7.5g/head/day [1]. This is far below the recommended 33g/head/day by the Food and Agricultural Organization [2]. According to report of [3], Nigerians consumed only 6.8 g of protein from animal origin per day, which is one of the lowest animal protein intakes in the world. The low animal protein consumption in Nigeria is a reflection of poor state of the Nigerian livestock industry, which has continued to show a discouragingly slow rate of growth [4].

Improvement in poultry production is considered as an assured means of alleviating the problem of acute shortage of animal protein [5]. Poultry production is regarded as a means of sustainable livelihood and way of achieving a certain level of economic independence [6]. According to [7], poultry farming has significant contribution to increase income as well as nutritional status of the populace. [8]. Noted that eggs and poultry meat provide an excellent source of critically important nutrient, protein, together with minerals and vitamins. Poultry products such as meat and eggs are considered as excellent source of proteins necessary to meet the requirements of both infants and vulnerable people [9].

Broilers are the important source of table meat in Nigeria. They are fast growing and are efficient converters of feeds. [10] Reported that, broiler chicken remain the fastest source of animal protein because of their rapid growth. The choice of broilers was most favoured among other poultry species to meet the protein needs of Nigerians because of its fast growth rate and high feed conversion potentials [11}, [12]. According to [13], broiler birds can attain market

weight of between 1.6 to 2 kg in 6-8 weeks with a feed conversion ratio of 2:1. Today, fast growing broiler chicken can reach 2 kg body weight within 35 days, consuming only 3 kg of feed [14].

The high cost of animal products could be traced to the high cost of feed which sometimes accounts for about 70% of the total cost of broiler production [15]. The form (mash, crumbs or pellets) in which a diet is fed to poultry played significant role in growth rate [16]. Therefore, diet form directly influences the cost of feed and production performance of broiler [17].

Generally, mash is a form of complete feed that is finely ground and mixed so that birds cannot easily separate out ingredients; each mouthful provides a well-balanced diet. Mash diet gives greater unification of growth and less death loss and is more commercial [18]. Crumbs and pelleted diets are modifications of the mash form. Pellets are prepared by mechanical pressing of mash into hard dry form. Pelletizing can be simply described as the change of phase of raw materials due to the application of medium to raise the temperature in order to have final phase in solid and capsular forms after passing through the diet of desired shape. It resulted from the combination of the heat treatment during extrusion, moisturization and gelatinization of some dietary components, which act as binder. The binding effects prevent nutrient loss by slowing down the pellet disintegration process in water. Pelleted diets have several advantages compared to mash, such as improving feed conversion, feed intake and broiler performance [19]; [20]; [21]. The enhancing of broiler performance fed crumble or pellet could be attributed to increased digestibility, decreased ingredient segregation, decreased feed wastage, reduced energy utilization and improved palatability [22].

Objectives of the Study

The broad objective of this study is to evaluate the performance characteristics of broiler chickens fed different forms of diet.

The Specific objectives were to:

i. Determine the performance characteristics of broiler chickens fed different forms of diets at starter stage.
ii. Determine the performance characteristics of broiler chickens fed different forms of diets at finisher stage.

MATERIALS AND METHODS

Background of the Study area

The experiment was conducted at the Poultry Production Unit, Directorate of Animal Health and Livestock Development Old Kara area Gusau, Zamfara state. Zamfara state was created out of Sokoto state in 1996. The state covers a geographical land area of 38,418 square kilometers with an estimated population of about 3,259846 [23]. It is located between Latitude 12^0 09^l 15" N and Longitude 06^0 40^l 0" E [24]. The state shared border with Sokoto state and Niger republic to the North, Kebbi and Niger State to the west, Katsina state to the east, and Kaduna state to the south. The climate of Zamfara state is characterized by a long hot-dry season lasting from October to May and a short warm wet (rainy) season that usually starts in mid-May and ends in September. The annual rainfall of the area ranges between 550-900mm, with duration of 3-5 months. The maximum temperature of the area is 41^0C in April and minimum of 13.2^0C in January. Relative humidity varies from 20 to 72% in the morning and from 7.5 to 63% in the afternoon [25].

Experimental Design

A total of 225 day old Arbor acre broiler chicks of mixed sexes were used, for the experiment in a completely randomize design. The birds were divided into three treatments groups each treatment was replicated five times with 15 birds per replicate. The three treatment diets were formulated to contain the same levels of nutrients and ingredients, only to differ in the form in which the diet was offered (mash, pellets and crumbs).

Preparation of the Experimental Diet

A single diet was formulated to contain the same levels of nutrients and ingredients, only to differ in the form in which the diet was offered (mash, pellets and crumbs). The table 1. represents the gross and chemical composition of the experimental diets at starter and finisher phases.

Table 1. Gross and Chemical Composition of the Experimental Diets at Starter and Finisher Phases

Ingredient	Starter	Finisher
Maize	49.00	49.00
Ground nut cake	18.40	13.00
Soya beans meal	22.00	17.45

Wheat offal	5.00	16.40
Blood meal	1.00	0.00
Lime stone	1.50	1.00
Bone meal	2.00	2.00
Vitamin/Mineral Premix*	0.25	0.25
Methionine	0.30	0.30
Lysine	0.30	0.30
Salt	0.30	0.30
Total	**100.05**	**100.00**
Calculated Chemical Analysis		
ME (Kcal/kg)	3,100.00	2,924.00
Crude Protein (%)	24.00	21.00
Lysine (%)	1.40	1.20
Methionine (%)	0.60	0.60
Calcium (%)	1.00	1.00
Available Phosphorus (%)	0.60	0.50
Crude Fibre (%)	5.30	5.60
Ether Extract (%)	5.00	4.70

***Vitamin/Mineral Premix contained; Vitamin A, 1000 I.U, Vitamin D1, 3000 I.U, Vitamin E 8.0 I.U, Vitamin K, 2.0mg, Vitamin B1, 2.0mg, Vitamin B6, 1.2mg, Vitamin B12, 0.12mg, Pantothenic acid, 7.0mg, Mg 1000mg, Cu, 8.0mg, Co, 0.45mg and Se, 0.1mg per kg of diet.**

The Mash diet was presented as formulated to the chicks at all stages i.e. starter and finisher stages.

The mash form of the diet was used to form the crumbs. A total of 1% of edible starch was diluted with water and spread on the mash. It was thoroughly mixed and allowed to dry under shade for 2 hours. The dry diet was broken into desired crumbs and fed to the chicks at starter and finisher stages of growth.

The mash diet form was used to produce the pellets diet. Silver tray which was perforated at the bottom with desired holes (3 mm in diameter for the starter diet and 6 mm in diameter for the finisher diet) were used to prepare pellets. A total of 1% of edible starch was diluted with 1 liter of water per 2 kg of feed. The starch served as binder. The diluted starch was spread on the mash and thoroughly mixed together. The perforated silver tray was filled with the mixed

diet and used mechanical forces to insert pressure to press the feed out from the holes. After that, the feed was allowed to dry under shade for 5 hours and fed to the chicks at starter and finisher stages.

Proximate Analysis of Different Diet Forms

Proximate analysis was conducted using [26] method in order to determine the proximate composition of the diet. To determine the energy, crude proteins, ether extract, crude fibre, and ash.

Sources and Management of the Experimental Birds

The birds used for the experiment were sourced from commercial farm called Yamfy farm at Kwara State Nigeria through their authorized Poultry Vendor in Gusau. The experimental birds were kept for three days after transport to take care of stress due to transportation. During the period, anti-stress and anti-biotic drugs were administered to the birds. After three days the birds were weighed and allotted to their replicate groups. Each treatment was replicated five times. Routine vaccination, antibiotic, and Coccidiostats were administered according to the recommendation of [13]. The birds were housed on a deep litter with open sided walls. Prior to the arrival of the chicks, the house was cleaned, washed, fumigated and disinfected. After drying, the experimental room was divided into fifteen separate pens of equal size 5x5 feet length and breadth with wire net. The height of each net partition was 90cm. Litter materials were spread on the floor two days before the chicks arrived. Feeder trays and small drinkers were placed in each replicate in such a way that the chicks were able to eat and drink conveniently for starter phase. Conical feeder and large drinker size with grid wire were used for finisher phase. A 100 watt electric bulb was hanged at a height of 2.8 meters in the middle of each pen as a source of heat and light. Feeds and cleaned water were given *ad-libitum* during the experimental period. Drinkers were washed and cleaned daily in the morning and feeders were cleaned weekly before being used. Sanitation measures were fallowed during the experimental period. Dead birds were sent to the pathology laboratory for diagnosis during the experimental period.

Data Collection

Feed intake and water intake were recorded on daily basis by subtracting the left over from the quantity of feed offered the previous day. Body weight gain

was recorded weekly by weighing the birds and determining increase or loss of weight. Record of feed intake and weight gain were used to calculate the feed conversion ratio for each replicate. Mortality record was also carried out. The cost of feed ingredients, diets processing for the three diet forms were used to compare with weight gain which were used to calculate the cost analysis.

At the end of finisher phase i.e. eight week, three birds were slaughtered from each replicate for carcass evaluation. Weight of primal cuts, internal organs, feathers and dressed weight were recorded. Weight of cut parts, fat and internal organs relative to dressed weight were also determined. Dressing percentage was determined from live weight and dressing weight, using the formula:

$$\text{Dressing \%} = \frac{\text{Dressed weight}}{\text{Live eight}} \text{ x } 100$$

Data Analysis

Data collected from feed intake, weight gain, feed conversion ratio, and carcass evaluation were subjected to analysis of variance (ANOVA) using star view analytical Computer Package (SAS), and Least Significant Difference (LSD) would be used for mean separation. Mortality record was calculated in percentage.

RESULTS AND DISCUSSION

Results of proximate analysis of the experimental diets for starter and finisher phases are represented in table 2.

Table 2. Proximate Analysis of the Experimental Diet

	Diets	
Parameters	Starter	Finisher
Moisture (%)	8.70	8.60
Crude Protein (%)	24.50	21.90
Crude Fibre (%)	3.50	4.20
Ash (%)	10.06	12.27
Metabolizable Energy, ME Kcal/kg	3046.00	2970.55
Fat (%)	5.90	6.50

Result showed that, the moisture content of the starter diet was higher than that of finisher diet. The dry matter was (93.00%) and (94.00%) respectively for starter and finisher diet. Starter diet had higher crude protein content than that of finisher diet. Crude fibre was lower in starter diet than finisher diet which had higher crude fibre content. Similarly, ash content of the finisher diet was higher than that of starter diet. The Ether Extract also was higher in finisher than that of starter diet.

Performance Characteristics of Broiler Starter Fed Different Forms of Diet

The results of the performance characteristics of broiler chicks at the starter phase were presented in Table 3.

Table 3**:** Performance Characteristics of Broiler Birds Fed Different Forms of Diet (0-4 weeks).

	Diet forms			
Parameters	Mash	Crumbs	Pellet	SEM
Initial body weight (g/b)	59.33	59.33	57.33	0.67
Final body weight (g/b)	557.37^{a}	494.68^{b}	474.76^{b}	13.55
Body weight gain (g/b)	498.03^{a}	435.35^{b}	417.42^{b}	13.23
Average daily gain (g/b/d)	17.25^{a}	15.098^{b}	14.46^{b}	0.45
Total feed intake (g/b)	1234.64	1202.60	1155.69	41.77
Average feed intake (g/b/d)	44.09	42.95	41.28	1.49
Total water intake (m/b)	1979.93^{a}	1630.33^{b}	1839.80^{a}	44.67
Aver. water intake (m/b/d)	70.64^{a}	58.23^{b}	65.71^{a}	1.59
Feed conversion ratio	2.48^{a}	2.78^{b}	2.77^{b}	0.09
Mortality (%)	20.00	17.33	17.33	2.38

Means along the same row with different superscripts are significantly different at ($P<0.05$)

Performance of Broiler Finisher Birds Fed Different Forms of Diet

From the results, of the research table 5. Shows the performance of broiler birds fed different forms of diet at finisher phases.

Table 4. Performance Characteristics of Broiler Birds Fed Different Experimental Diets (5-8 weeks)

	Diet Forms			
Parameter	Mash	Crumbs	Pellet	SEM
Initial body weight (g/b)	500.87	511.36	518.33	6.08
Final body weight (g/b)	1701.07	1508.27	1671.73	65.21
Body weight gain (g/b)	1200.19	996.91	1153.39	66.91
Average daily gain (g/b/d)	38.51	33.23	37.93	1.64
Total feed intake (g/b)	2966.00	2975.49	2995.72	111.43
Average feed intake (g/b/d)	105.93	106.27	106.99	4.16
Total water intake (ml/b)	5187.76	4983.62	5266.00	111.11
Average water intake (ml/b/d)	185.28	177.99	188.07	3.97
Feed conversion ratio	2.49^{a}	2.99^{b}	2.62^{a}	0.72
Mortality (%)	19.23	11.41	13.33	3.54

Means along the same row with different superscripts are significantly different at ($P<0.05$)

The result showed that, with exception of feed conversion ratio all other performance parameters were not significant difference ($P>0.05$) across the dietary treatment. However, some slight variations were observed numerically. Feed conversion ratio of chicks feed mash and pelleted diets were similar ($P>0.05$). Chicks fed crumbs had poorer ($P<0.05$) feed conversion ratio compared to the chicks fed mash and pelleted diets.

Cost Analysis

From the results presented in table 5. Showed the cost analysis of cost/ kg, cost of feed/ live gain (₦) of broilers fed different forms of diet at starter phase.

Table 5: Cost Analysis of Broiler Starter Fed Different Forms of Diet

	Diet Forms			
Parameters	Mash	Crumbs	Pellets	SEM
Total feed intake (kg/bird)	1.23	1.20	1.16	0.25

Body Weight Gain (kg/bird)	0.50	0.44	0.42	0.12
Cost of Feed (₦ /kg)	132.46[b]	139.66[a]	140.54[a]	0.97
Cost of Medication (₦/bird)	22.67	22.67	22.67	0.00
Cost of Feed consumed/b(₦)	163.54	167.95	162.42	3.26
Cost of Live Weight Gain/ bird (₦)	298.82[a]	261.21[b]	250.45[b]	7.08

Means along the same row with different superscripts are significantly different at (P<0.05**)**

Cost Analysis

From the results obtained in cost analysis of broilers fed different forms of diet at finisher phase, was presented in the table 6.

Table 6. Cost Analysis of Broiler Finisher Fed Different Forms of Diet

	Diet Forms			
Parameters	Mash	Crumbs	Pellet	SEM
Total feed intake (kg/bird)	2.97	2.98	2.99	0.30
Body Weight Gain (kg/bird)	1.20	0.99	1.15	0.19
Cost of Feed (₦/kg)	130.85	138.05	138.94	3.75
Cost of Medication (₦/bird)	23.33	23.33	23.33	0.00
Cost of Feed consumed(₦/bird)	388.10	410.77	416.20	43.74
Cost of Live Weight Gain/ bird (₦)	720.12[a]	598.16[b]	692.02[a]	28.97

Means along the same row with different superscripts are significantly different at (P>0.05**)**

All parameters were similar (P>0.05) with exception of cost of live weight gain bird (₦). The cost of live weight gain bird (₦) were significantly (P<0.05) higher in broiler fed mash and pellet groups compared to crumbs group.

Feed intake

The feed intake of the experimental broiler birds for the three different diet forms was not statistically significant. The non-significant effects of the three forms of diet was similar to the report of [17] when they compared effect of mash and pelleted diet on broiler performance. The results were also in line with

the findings of [27] who compared performance and carcass characteristics of broilers fed pelleted and mash forms of diet. However, contrary to this result, [28], [29] and [30] reported poor performance of birds on mash form of diet. This result clearly showed that mash form of diet was comparable to the pelleted diets. The method of preparation of the pelleted diet could be the reason for the non-significant effect between the two forms in terms of weight gain and feed conversion ratio. The pelleted diet used in this experiment was locally fabricated and as such may be the likely reason for the similar performance of the chicks fed these diets. The results of water intake of broiler fed different forms of diet showed significantly different with high water intake for the birds fed mash and pelleted diet compared to crumbs group which has lower water intake. The results concord with the results obtained by [31] who fed whole millet to broiler starter.

The results of feed intake obtained for the finisher phase were in agreement with the results obtained by [27] who reported no significant differences in feed form when compared mash diet with pelleted form of diet. Similar result were obtained by [32], [33] and [34] who reported that feed form had no effect on feed consumption. The results were in contrary to the results obtained by [35], [36], [37], [38], [39], [40], [41] and [42] who found that chickens fed pellets and crumbs diets consumed more feeds compared to those fed mash diet. From the experiment it was evident that the mash feed give only better intake for the first four weeks of age as reported by [17]. The results of water intake of broiler fed different forms of diet showed no significant difference ($P>0.05$) for all treatment diets. The results were similar with the results obtained by [31] who fed whole millet to broiler starter.

Final body weight, weight gain and feed conversion ratio of chicks fed mash diet were significantly ($P<0.05$) better compared to those fed crumbs and pelleted diets. Average feed intake of the chicks for all treatment groups was similar ($P>0.05$). However, chicks fed mash and pelleted diets consumed more water ($P<0.05$) compared to the chicks fed crumbs diet. Similarly, mortality of chicks for all the groups were similar ($P>0.05$) across the dietary treatments.

Weight gain

Weight gain of broilers starter phase were in agreement with that obtained at the 4th weeks of age by [27] which showed that birds fed pelleted diet had lower weight gain compared to those fed the mash form. However, the results

disagreed with [43] and [44] who found that feed intake, weight gain and final body weight increased among birds fed pelleted diets compared with those fed on mash. Similarly, [45] reported that mash fed birds had lower body weight at 41days than birds fed on crumbs and pellet diets. Finding by [46] showed that mash form of diet gave significantly lower average weight gain than did crumbs. [47] Reported that feeding large particle may produce beneficial effects though the digestion and utilization of the feed and this may affect growth performance of the birds. According to [27], high pellet quality may be necessary to fully obtain benefits of pelleting. For the current results suggested that, the poor performance of birds fed pellet and crumbs may be due to low quality of processing the pelleting and crumbing diets. According to [48] suggested that vitamin A loss during pelleting and crumbing may be due to high pressure created in the diet.

The results obtain for the weight gain in the finisher phase, were in agreement with the finding of several researchers [33], [49], [[50], [51], [27].who reported no significant difference were observed in bird body weight and body weight gain when different diet forms were fed. The results disagreed with the finding of [35] who reported highest body weight gain for birds fed crumbs group throughout the experimental period. [53] Showed that chicks grew faster when fed pellets or crumbs than when the same diet fed as mash. [54] observed that pelleting of feed improved the body weight of poultry.

Feed conversion ratio (FCR)

From the results of feed conversion ratio for the broiler performance for the starter phase were in agreement with the report of [17] who showed from their finding the highest feed conversion ratio in mash group which is comparatively low and similar FCR value were observed in birds fed pellet diet group. The results also concord with the findings of [55] who reported that birds fed mash diet had better feed conversion ratio compared to those fed pelleted form of diet. The results were however, contrary with that of [49] and [50] who reported that feed forms did not affect feed conversion ratio in chicken. [54], also reported that pellets had better feed conversion ratio over mash. [45], concluded that crumbs-pellet treatment significantly, improved feed conversion ratio.

The results of feed conversion ratio for the finisher phase were in agreement with the report of [55] who showed that birds fed mash diet form had a better feed conversion ratio compared to birds fed pelleted diet form. Similarly, [28]

observed better feed conversion ratio in birds fed mash than those fed crumbs among the entire group. The results disagreed with the [17] who reported highest feed conversion ratio on pellet and poor FCE to mash diet. Similar results were obtained by [54] and [46] who reported that pellet had better feed efficiency over mash. [45] who concluded that crumble-pellet treatment significantly improved feed conversion.

Mortality

Mortality reported at starter phase was higher than the normal mortality of 5% as recommended by [13]. This was due to the outbreak of Gomboro disease at the 2nd day of 4th week. The results were in agreement with that of [35], [[50] and [[57] who found insignificant differences in mortality between the birds fed mash, crumbs or pelleted diets. The results are in disagreement with the results reported by [58] who reported significantly higher mortality rate for birds fed the pelleted diet.

The mortality rate at finisher phase was higher than the normal percent mortality of (5%) reported by [13]. The results were in agreement with the results obtained by [35] and [50] who reported insignificant differences in mortality between mash, crumbs and pellet feed which were in agreement with [57].

The results were in disagreement with the results reported by [58] who reported that the increased growth rate resulting from pellet feeding may increase mortality due to ascites especially in male birds. The results also disagree with the finding of [59], [33] and [60] who demonstrated that birds in the mash fed groups had a significantly lower mortality rate than birds in pellet feed groups. The higher mortality obtained for mash and pellet groups could be attributed to their rapid growth which may cause fat deposition making them highly vulnerable to high temperature.

Cost Analysis

The results of cost analysis for starter showed higher cost of feed/kg (₦) for crumbs and pellets forms compared to mash form. This was attributed to the additional cost of other materials used for crumbing and pelleting the diet such as edible starch, and tray for pelleting. The higher cost of live weight gain bird/ kg (₦) for mash form compared to pellet and crumbs was directly influence by the weight gain of the bird in the performance at starter phase. The higher the weight gains of the broiler the higher the cost of live weight gain bird /kg (₦).

The results obtained from the cost analysis for the finisher phase showed higher cost of live weight gain bird/ kg (₦) for mash and pelleted foams compared to crumbs foam which had lower cost of live weight gain bird/ kg (₦). This have directly influence by the weight gain of the bird in the performance at finisher phase. The higher the weight gains of the broiler the higher the cost of live weight gain bird /kg (₦).

Cost Analysis

From the results presented in table 4. Showed the cost analysis of cost/ kg, cost of feed/ live gain (₦) of broilers fed different forms of diet at starter phase.

Conclusion

From the result of the experiment it could be concluded that feeding mash form at starter phase improved body weight gain and feed conversion ratio. The performance of broiler birds at finisher phase, showed no significant effects for all parameters with exception of feed conversion ratio. The mortality recorded was attributed to the Gamboro disease outbreak at the 4th week rather than the experimental diets.

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