



EVALUATION OF PELLETED AND MASH FEED FORMS ON PERFORMANCE AND HAEMATO-BIOCHEMICAL PARAMETERS IN BROILER CHICKENS

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Abstract: Broiler chicken production is a vital component of the global meat industry, with feed costs representing 60-70% of total production expenses. This study investigates the effects of pelleted and mash feed forms on growth performance and haemato-biochemical parameters in broiler chickens. Eighty (80) one-day-old Arbor Acres broilers were randomly assigned to pelleted or mash feed groups over a 42-day period. Results indicated that pelleted-fed birds achieved significantly higher ($P<0.05$) final body weights and weight gains in later weeks, though feed intake was also higher in this group. Haemato-biochemical analysis revealed higher ($P<0.05$) globulin and high-density lipoprotein levels in pelleted-fed birds, suggesting potential immune and metabolic benefits. These findings emphasize the importance of feed form in optimizing broiler performance and health. Pelleted feed demonstrated superior growth outcomes compared to mash feed, with potential health benefits, emphasizing the need for tailored feed strategies in broiler production.

Keywords: Broiler, Feed, Mash, Pelleted, Growth, Health.

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Introduction

Broiler chicken production is a significant global industry, contributing substantially to the meat supply worldwide. Feed costs account for approximately 60-70% of the total production costs in broiler farming, making feed efficiency a critical factor in determining profitability (Adeola and Ileleji, 2009). One strategy to reduce feed costs and improve efficiency is optimizing feed utilization through the use of different physical feed forms, such as pelleted and mash feeds. Pelleting involves mechanically compressing finely ground mash into dense, dry pellets, while mash feed consists of a finely blended mixture of ingredients without further processing (Amerah *et al.*, 2007).

Numerous studies have demonstrated that broilers fed pelleted diets exhibit superior feed conversion ratios (FCR) and greater body weight gains compared to those fed mash diets. For instance, a study by Abdollahi *et al.* (2013) found that pelleting improved feed efficiency by 5-10% due to reduced feed wastage and enhanced nutrient digestibility. The physical structure of pellets reduces selective feeding and increases energy intake, leading to better growth performance (Svihus *et al.*, 2004). However, the benefits of pelleting depend on factors such as pellet quality, ingredient composition, and broiler age (López *et al.*, 2007).

On the other hand, some researchers argue that mash feed may offer advantages in terms of digestibility. Mash feed has a larger surface area and smaller particle size, which can enhance enzymatic action and nutrient absorption in the gastrointestinal tract. A study by Engberg *et al.* (2002) reported that mash diets resulted in better nutrient utilization in younger broilers, although this effect diminished as the birds aged. The debate over the relative efficacy of pelleted and mash feeds highlights the need for further research to clarify their impacts on broiler performance under varying conditions.

In addition to growth performance, evaluating the haemato-biochemical parameters of

broilers is essential for assessing their overall health and nutritional status. Haemato-biochemical parameters, such as blood glucose, cholesterol, protein levels, and enzyme activities, provide insights into metabolic processes and organ function (Khan *et al.*, 2006). For example, elevated serum cholesterol levels may indicate excessive energy intake, while abnormal liver enzyme activities could signal hepatic stress or damage (Alagawany *et al.*, 2017).

Studies have shown that feed form can influence these parameters. For instance, pelleted diets have been associated with higher blood glucose levels due to increased energy availability, while mash diets may promote better lipid metabolism (Zanu *et al.*, 2012).

Furthermore, the physical form of feed can affect gut health and immune function, which in turn influence haemato-biochemical profiles (Rezaei *et al.*, 2018). Therefore, understanding the relationship between feed form and these parameters is crucial for optimizing broiler health and productivity.

This study aims to evaluate the effects of pelleted and mash feed forms on the performance and haemato-biochemical parameters of broiler chickens. By comparing growth metrics, feed efficiency, and blood profiles, the research seeks to provide evidence-based recommendations for feed form selection in broiler production systems.

Materials and methods

Experimental Site, Design and Birds Management

The experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Ekiti State University, Ado-Ekiti, Nigeria to evaluate the effects of pelleted and mash feed forms on the performance and haemato-biochemical parameters of broiler chickens. A total of eighty (80) one-day-old Arbor Acres broiler chicks were procured from a reputable hatchery. The birds were randomly allocated to two dietary treatment groups in a completely randomized design (CRD). Each treatment group consisted of 40 birds, further divided into 4 replicates of 10 birds each. The two feed forms evaluated were: (1) pelleted feed and (2) mash feed. The experiment lasted for 42 days, divided into two phases: starter phase (0–21 days) and finisher phase (22–42 days).

Feed Formulation and Preparation

The basal diets for both starter and finisher phases were formulated to meet the nutrient requirements of broiler chickens as recommended by the National Research Council (NRC, 1994). The same basal diet composition was used for both feed forms to ensure uniformity in nutrient content. The pelleted feed was processed using a commercial feed pelleting machine (Model SZLH250) with a die diameter of 3 mm and a conditioning temperature of 75°C for 30 seconds. The mash feed was prepared by grinding the ingredients to a uniform particle size of 1.5 mm using a hammer mill (Model L560x36). Both feed forms were stored in airtight containers to prevent contamination and nutrient degradation.

Housing and Management

The birds were housed in a well-ventilated poultry house with controlled temperature and lighting. The temperature was maintained at 32°C during the first week and gradually reduced by 2°C per week until reaching 22°C by the end of the experiment. A 18-hour light and 6-hour dark cycle was maintained throughout the study. Feed and water were provided *ad libitum*. Routine vaccinations and biosecurity measures were strictly followed to prevent disease outbreaks.

Data Collection

Performance Parameters: Body weight (BW) and feed intake (FI) were recorded weekly on a per-replicate basis. Body weight

gain (BWG) and feed conversion ratio (FCR) were calculated at the end of each phase. Mortality was recorded daily, and adjustments were made for FCR calculations.

Haemato-Biochemical Parameters: At the end of the experiment (day 42), blood samples were collected from 8 birds per treatment (2 birds per replicate) via the brachial vein into sterile EDTA-coated and plain tubes for haematological and serum biochemical analyses, respectively. Haemoglobin (Hb), packed cell volume (PCV), red blood cell count (RBC), white blood cell count (WBC), and differential leukocyte counts were determined using an automated haematology analyzer (Horiba Hematology Analyzer, Japan). Serum was separated by centrifugation at 3,000 rpm for 15 minutes and analyzed for total protein, albumin, globulin, cholesterol, glucose, and liver enzyme activities (alanine aminotransferase (ALT) and aspartate aminotransferase (AST)) using standard commercial kits (Eagle BioSciences, USA) and a spectrophotometer (UV-1800: Shimadzu, Japan).

Statistical Analysis

All data were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SAS (Version 9.4, SAS Institute, USA). Treatment means were separated using Duncan's Multiple Range Test at a 5% level of significance ($p < 0.05$).

Results

Growth Performance of Arbor Acre Broilers (5-8 Weeks of Age)

Table 1 presents the effect of feed forms on performance parameters of Arbor Acres Broiler Chicken at weeks 5 - 8. At week 5, there was no significant difference ($p > 0.05$) in the initial and final body weight, as well as body weight gain, between mash and pellet-fed birds. However, feed intake was significantly higher ($p < 0.05$) in pellet-fed birds compared to mash-fed birds. Feed conversion ratio did not differ significantly ($p > 0.05$) between treatments.

At week 6, no significant differences ($p > 0.05$) were observed in initial body weight, feed intake, and feed conversion ratio between the two groups. However, pellet-fed birds had significantly higher ($P < 0.05$) final body weight and body weight gain compared to mash-fed birds.

At week 7, there were no significant differences ($p > 0.05$) in initial body weight, feed intake, and feed conversion ratio. However, final body weight and body weight gain were significantly higher ($p < 0.05$) in birds fed the pellet diet compared to the mash diet.

At week 8, initial body weight was significantly higher ($p < 0.05$) in pellet-fed birds. The final body weight was also significantly higher ($p < 0.05$) in pellet-fed birds compared to mash-fed birds. However, no significant differences ($p > 0.05$) were observed in body weight gain, feed intake, and feed conversion ratio between the two treatments.

Table 1: Growth Performance of Arbor Acre Broilers (5-8 Weeks of Age)

Parameters	Week 5			Week 6			Week 7			Week 8		
	Mash	Pellet	P-value	Mash	Pellet	P-value	Mash	Pellet	P-value	Mash	Pellet	P-value
Initial BWT (g)	532.90 ±5.94	523.80 ±3.80	0.113	1099.55±6. 57	1102.45±3 .77	0.616	1497.1± 6.47	1504.42±2 .77	0.254	1789.33±5 .93b	1803.68 ±3.11a	0.027
Final BWT (g)	1099.55 ±6.57	1102.45±3. 77	0.616	1496.70±6. 16 ^b	1503.95±2 .67 ^a	0.033	1789.99± 5.93 ^b	1803.68±3 .11 ^a	0.027	2586.32±5 .24 ^b	2602.16 ±2.56 ^a	0.013
Body weight gain (g/day)	80.95 ±2.45	82.60 ±2.06	0.615	397.15±2.4 7 ^b	401.50 ±4.04 ^a	0.039	292.79±1. 33 ^b	299.26 ±2.58 ^a	0.037	796.42±3. 12	798.47 ±1.35	0.380
Feed intake (g/day/bird)	172.40 ±4.10 ^b	200.10 ±3.11 ^a	0.000	839.05 ±3.64	836.40 ±6.34	0.647	1093.89±1 .42	1098.37±5 .85	0.423	1209.89±1 .42	1214.37 ±5.85	0.422
Feed conversion ratio	2.13 ±0.06 ^b	2.42 ±0.08 ^a	0.402	2.11 ±0.01	2.09 ±0.02	0.129	3.74 ±0.02	3.68 ±0.04	0.119	1.52 ±0.01	1.52 ±0.01	0.862

^{a,b} = means with different superscripts on the same row before each of the p-values differ statistically (p<0.05)

The Haematological Parameters of Arbor Acre fed pellet and mash feed forms weeks of age is presented in Table 4.2. The results showed no significant differences ($P>0.05$) between birds fed mash and pellet diets. Packed cell volume, red blood cell count, and white blood cell count remained comparable between the dietary treatments. Haemoglobin concentration was slightly higher in birds on the pellet diet compared to those on the mash diet, though the difference was not statistically ($P>0.05$).

Differential white blood cell counts, including heterophils, lymphocytes, monocytes, eosinophils, and basophils, exhibited no statistical variations ($P>0.05$) across the dietary groups. The heterophil count was numerically greater in the pellet-fed birds, while lymphocyte, monocyte, and basophil counts remained identical ($P>0.05$) across treatments. Eosinophil count showed a slight numerical reduction in the pellet group.

Erythrocyte indices followed a similar trend, with no significant differences ($P>0.05$) between treatments. Mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration showed minor numerical reductions in mash-fed birds, whereas mean corpuscular volume was slightly lower in this group. However, these variations did not reach statistical significance.

The Biochemical Parameters of Arbor Acre Fed Pellet and Mash Feed Forms

The biochemical parameters of Arbor Acre broilers as presented in Table 2 showed no significant differences ($p>0.05$) between birds fed mash and pellet diets for most measured variables. Total protein and albumin concentrations were numerically higher in the pellet-fed birds, but the differences were not statistically significant ($P>0.05$). Glucose, urea, creatinine, cholesterol, low-density lipoprotein, and triglyceride levels remained similar ($P>0.05$) across both dietary treatments.

Table 2: The Haematological parameters of Arbor Acre Fed Pellet and Mash Feed Forms at 8 weeks of age

Parameters	Mash	Pellet	p-values
Packed (%)	32.00±1.16	30.50±0.29	0.374
Red blood cell ($\times 10^6$ /mL)	4.30±0.15	4.20±0.33	0.840
Haemoglobin (g/dL)	7.60±0.10	8.00±0.12	0.120
White blood cell ($\times 10^3$ /mL)	7.10±0.06	6.92±0.12	0.334
Heterophils (%)	48.00±2.02	51.00±2.52	0.574
Lymphocyte (%)	40.00±0.58	40.00±1.53	1.000
Monocyte (%)	10.00±0.58	10.00±1.16	1.000
Eosinophil (%)	9.00±0.58	8.55±0.67	0.569
Basophil (%)	3.00±0.58	3.00±0.58	1.000
Mean corpuscular haemo (pg)	29.21±0.13	28.34±0.36	0.079
Mean corpuscular haemo conc. (%)	27.77±0.47	28.57±0.27	0.062
Mean corpuscular volume (fl)	95.73±0.15	97.96±0.15	0.064

means with no superscript on the same row are statistically similar ($p>0.05$)

Table 4.2: The Biochemical Parameters of Arbor Acre Fed Pellet and Mash Feed Forms at 8 weeks of age

Parameters	Mash	Pellet	p-values
Total protein (g/dl)	31.03±0.42	35.20±1.06	0.109
Albumin (g/dl)	16.67±0.47	19.50±1.27	0.224
Globulin (g/dl)	14.30±0.21 ^b	15.53±0.19 ^a	0.009
Glucose (g/dl)	352.00±7.85	347.13±9.53	0.190
Urea (g/dl)	3.60±0.12	3.80±0.10	0.074
Creatinine (g/dl)	0.73±0.07	0.74±0.06	0.529
Cholesterol (g/dl)	113.97±0.81	113.37±0.58	0.546
High density lipoprotein (g/dl)	68.17±0.61 ^b	68.77±0.69 ^a	0.035
Low density lipoprotein (g/dl)	44.90±1.07	44.73±0.85	0.723
Triglyceride (g/dl)	96.31±1.17	95.83±0.58	0.685

^{a,b} = means with different superscripts on the same row differ statistically ($p<0.05$)

However, significant differences ($p < 0.05$) were observed in globulin and high-density lipoprotein concentrations. Globulin levels were greater in birds fed the pellet diet (15.53 ± 0.19) than those on the mash diet (14.30 ± 0.21) ($p = 0.009$). Similarly, high-density lipoprotein concentration was higher in the pellet-fed group (68.77 ± 0.69) compared to the mash-fed group (68.17 ± 0.61) ($p = 0.035$).

Discussion

Compared to birds fed a mash diet, those fed a pelleted diet in this trial showed increased feed intake, weight gain, and final body weight. This finding is consistent with the findings of Corzo *et al.* (2011), who found that when birds fed mash diets were compared to diets containing either 32% or 64% pellets, the birds consumed less feed and gained less weight. The study also supports the findings of Massuquetto *et al.* (2019), who highlighted that birds fed a pelleted feed had a higher FI (11%) than birds fed a mash diet, leading to a 17% increase in weight gain (WG) and a 6% improvement in feed conversion ratio (FCR). It also concurs with Dozier *et al.* (2010), who discovered that from 15 to 49 days of age, broiler chickens given premium pellets grew 4.7% faster, consumed 5.6% more feed, and had a 1% higher feed conversion ratio. The outcome, however, disagreed with the findings of Dozier *et al.* (2010), who discovered that broilers fed mash diets showed comparable body weight gain, feed conversion ratio, and breast meat weight to those fed mash form of feed.

According to McKinney and Teeter (2004), Ameral *et al.* (2007), and Abdollahi *et al.* (2013), broiler chickens fed with pellets perform better than mash because of their higher nutritional density, improved starch digestibility from chemical changes during pelleting, increased nutrient intake, altered feed form, decreased feed waste, and lower energy expenditure during feeding. It could also be because selective feeding is discouraged in pelleted diets due to the firm and consistent ingredients, which ensures improved feed intake and live weight gain. In contrast, selective feeding is encouraged in mash due to the loosely packed, unprocessed combination of grains, protein sources, minerals, and vitamins, which could result in an uneven nutrient intake and decreased live weight (Amerah *et al.*, 2007).

It is unclear whether the improved growth performance is the result of a higher feed intake capacity of pelleted diets (Latschaw, 2008), a decrease in energy expenditure related to feed consumption (Massuquetto *et al.*, 2019), an increase in productive energy due to less time spent feeding (McKinney and Teeter, 2004), or a combination of all these factors. However, it is known from experiments that birds do show preferences for particular feed particle sizes depending on the shape of their beaks and oral cavities (Ferguson-Lees and Christie, 2001; Grant and Grant, 2008). As a result, birds prefer pelleted diets with less or no fine particles over mash diets that contain fine particles.

Blood testing has been shown to be a useful tool for assessing the health of an animal (Muhammad *et al.*, 2000). Additionally, serum biochemical and hematological profiles can be used to accurately identify the health state of animals (Cetin *et al.*, 2009). Also, they demonstrate an animal's reactivity to its internal and external environment (Esonu *et al.*, 2001). According to research, genetic and environmental factors influenced the blood biochemical and haematological components of chickens (Attia *et al.* 2011, 2014).

As a result, feed is one environmental element that significantly affects the metabolism of lipids and cholesterol. The current findings corroborate those of Andi *et al.* (2011), who discovered that the variations in AST levels between birds fed pelleted and mash diets were negligible. The feed form had no effect on the biochemical and haematological components of the blood of broilers. On the other hand, Corzo *et al.* (2012) discovered that while feed form had no discernible effect on blood glucose, broilers fed a pelleted diet had considerably higher total protein than broilers fed a mash diet, and albumin levels were lower in broilers fed a mash diet than those fed a pellet diet. Furthermore, the results were incongruent with those of Atti *et al.* (2014), who demonstrated that the kind of feed had a substantial impact on blood haematological features.

The PCV found in this investigation was within the range reported by Banerjee (2005) and Adeyemo and Sani (2013), and it concurred with the figure published by Ilo *et al.* (2019). However, it disagreed with the report by Najib and Al-Aqil (2015), which provided a lower PCV value. The observed variation can be breed-related. The resultant haemoglobin (Hb) value in this study varied between 10.23 and 10.43 g/dl, which was not in agreement with the results of Adeyemo and Sani (2013) and Najib and Al-Aqil (2015), who reported lower Hb values independently. Furthermore, the outcome fell short of the range that Iheukwumere *et al.* (2008) reported. According to Banerjee (2005), these levels fell between the typical range of 7.00 and 13.00 (g/dl) for chicken's hemoglobin. A decrease in hemoglobin is a significant factor in anemia, which may likely result in a loss in the ability of the blood to carry oxygen since hemoglobin is necessary for cellular respiration, which is vital for metabolic activities. The range of RBC result ($\times 10^{12}/L$) is 4.25 to 4.37. The results were incongruent with those of Adeyemo and Sani (2013) and Ladokun *et al.* (2008), who reported significant differences. The values were lower than the range of 8 to 11 ($\times 10^6 /mm^3$) published by Simaraks *et al.* (2004), but they were still within the typical range of 2 to 4 ($\times 10^6 /mm^3$) reported by Jain (1986). The range of the MCHC result (%) is 33.72 to 34.54. The outcome of this results were in agreement with the range published by Adeyemo and Sani (2013). The variations might result from the sex of the bird (Addass *et al.*, 2012). The range of the WBC result is 9.20 to 11.07 ($\times 10^9 /L$) which disagreed with the findings of Adeyemo and Sani (2013), which indicated notable discrepancies.

Biochemical parameters play a crucial role in maintaining the appropriate osmotic pressure between the circulating fluid and the fluid in the tissue spaces, which facilitates the exchange of materials between cells and blood. As such, they are generally useful for monitoring the quality of proteins in feeds. Additionally, they support the preservation of normal blood pressure and pH as well as viscosity (Ladokun *et al.*, 2008). According to the findings of Ilo *et al.* (2019), not all of the biochemical markers examined in this study were influenced by the feed form. The outcome was also consistent with the findings of Albokhadaim *et al.* (2012) and Ladokun *et al.* (2008), which demonstrated non-significant variations in the biochemical parameters of broiler chickens given various feed formulations. In terms of numbers, the outcome deviated from the range that Caf e *et al.* (2012) indicated.

Conclusion

This study found that broiler chickens fed a pelleted diet had higher feed intake, greater body weight gain, and improved feed conversion ratio (FCR) compared to those fed a mash diet. However, no significant differences were observed in haematological and biochemical parameters between the two feed types, indicating that feed form does not substantially affect blood health markers.

Recommendations

Use pelleted diets to enhance feed intake, weight gain, and feed efficiency in broiler chickens. While feed form did not impact blood parameters in this study, further research is recommended to confirm these findings across different breeds and conditions.

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