Vol. 14(2), pp. 22-30, April-June 2023
DOI: 10.5897/IJLP2022.0810
Article Number: E332CB870638
ISSN 2141-2448

http://www.academicjournals.org/IJLP

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International Journal of Livestock Production

Full Length Research Paper

Moist feeding in Muscovy duck (*Cairina moschata*) nutrition: Influence on growth performance and carcass characteristics

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Received 20 September 2022; Accepted 13 March, 2023

This study was aimed at investigating the influence of different proportion of water to dry meal, to give a moist feed form in feeding Muscovy duck (*Cairina moschata*) and assess the influence of these different feed forms on growth performance and carcass characteristics. A completely randomized design of fifty-four one to two weeks old ducklings weighing 64 to 67 g were randomly distributed into 3 treatments with three replicates each, was used for a study period of 8 weeks. Two standard starter and grower feeds were formulated for the study. Starter diet was fed for the first 4 weeks and grower for the final 4 weeks. The treatments based on water to dry feed ratios included a control treatment (TC: Dry feed), Moist 1 Treatment (M1T : 0.5 water : 1 dry feed) and Moist 2 Treatment (M2T : 0.75 water : 1 dry feed). Data was collected on growth performance (feed intake, weight gained, feed conversion ratio (FCR) and carcass characteristics. The results showed that feed intake, weight gain and FCR were higher (P≤0.5) for M2T than M1T and TC. M1T showed higher (P≤0.5) feed intake than TC and no differences (P>0.05) for weight gain and FCR. No significant differences (P>0.05) were found with the weights of different body parts (thigh, drumstick, breast, liver, heart, small intestine, gizzards and caeca) for all the treatments. In conclusion, providing moist feeds to Muscovy ducks compared to dry feed is more beneficial for growth performance.

Key words: Muscovy ducks, moist feed, growth performance, carcass characteristics.

INTRODUCTION

Duck is ranked second to chicken in poultry production in Cameroon although its production is on the lower side comparatively (Ekue et al., 2002). The prevalent species in Cameroon is the Muscovy duck *(Cairina moschata).* In the Western Highlands of Cameroon, ducks are mainly raised under an extensive system, where the birds

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scavenge for food, subsidized with kitchen waste.

Feed and nutritional considerations are the largest cost items for livestock and poultry production, accounting for 60 to 70% of the total cost of production (John et al., 2008). Feeding regimes and nutrients are major production factors for optimal poultry produced in confinements and commercialized farms (Solomon et al., 2007). Similar to the commercialization of chicken in Cameroon, ducks can be raised under semi-intensive and intensive systems of production. Nevertheless, their feeding regimes must be adjusted from scavenging, which is the common production system in Cameroon (Ekue et al., 2002), to more business oriented cost-effective feeding which will maximize profits. However, compared to other poultry kept in confinement, feed wastage would be relatively higher in ducks due to the shovel-shape of their bill (Farrell, 1986). This seems to suggest relative lower efficient feed and additional expenses for optimal production of meat and eggs by duck than with chickens.

It has also been observed that the form and structure of feeds have effects on the feeding behaviour and performance of livestock (Mai, 2007; Amerah et al., 2007; Ioannis, 2013) and suggests that traditional forms of feed (dry meal or mash) should be employed in feeding poultry including ducks and chickens for optimal performance and productivity. Difficulties of swallowing dry mash and high feed wastage in duck nutrition have been highlighted (Farrell, 1986; Eshaw, 2018). Furthermore, Eshaw, (2018) explained that when fed dry mash, ducks will swill a mouth full down the nearest water source to increase the level of moisture in the feed but also wasting a great amount of the feed and its nutrients in the water. In addition, he stated that dry mash forms sticky pastes with saliva and adheres to the papillae and other mouth structures bordering the outer margin of the tongue and upper and lower bill. When this dries off, it forms a cake. This caking interferes with the movement of the food mass to the tongue where it is normally rotated and coated with saliva and then propelled back to the esophagus for swallowing. This interference can cause disorder to the mouth, cause reduction in feed intake and increase feed wastage especially when the duck instinctively attempts to shake and/or wash off the adhering pasty-mash to its mouthparts. Though ducks are water animals and presumably should feed better on wet feeds as observed by several researchers (Yalda and Forbes, 1995, 1996; Yasar and Forbes, 2000; Forbes, 2003; Mai, 2007), the available commercial feed meal form for poultry in most parts of Cameroon is the dry mash form.

The effects of wet feeding on pigs and poultry have been investigated (Liptrap and Hogberg, 1991; Heres et al., 2003; Niba, 2008; Niba et al., 2009a, b; Niba et al., 2013) and wet feeding has been observed to increase the feed intake and growth rate of chickens (Yalda and Forbes, 1995, 1996; Yasar and Forbes, 2000, 2003; Mai, 2007). Wet feeding has been reported to stimulate increased dry matter intake, growth rate and feed conversion efficiency of broilers (Yalda and Forbes, 1995; Awojobi and Meshioye, 2001; Awojobi et al., 2009). It has also been shown to improve broiler performance in the hot tropics as it reduces heat stress and improves feed intake (Dei and Bumbie, 2011). Restricting the excessively high intake of wet-based diets may increase the retention of feed and also improve daily weight gain and feed intake in broilers that might otherwise fail to consume sufficient quantities of dry mash and attain their genetic growth potential (Afsharmanesh et al., 2010, 2016).

According to several authors, there were significant improvements in the feed intake (FI), feed conversion ratio (FCR) and average daily gain (ADG) of broilers when fed on wet feed (Atapattu and Sudusinghe, 2013; Tabeidian et al., 2015; Afsharmanesh et al., 2016). In a study on pigs (Byung, 2000) stated that the improvement of growth rate is largely related to the increase in voluntary feed intake and feed wastage is reduced, thus improving feed efficiency.

Wet feeds also play a vital role in early foregut development in broilers (Mai, 2007). According to Mai (2007), the moistening capacity of the crop of chicks during the first weeks of life was a limiting factor for optimal functioning of the gut with standard solid diets as opposed to when moist feeds were fed. Research on current in-feed antibiotic replacement strategies has also rekindled interest in the use of wet feeding in animal production (Beal et al*.,* 2002; Brooks et al., 2003a, Brooks, 2008; Niba, 2008). Furthermore, Niba (2008) observed that fermented liquid feed technology could make vital contributions to African agriculture especially in semi-arid and hot areas. By implication therefore, wet feeding could improve the performance and productivity of ducks.

Wet feeding includes paste or liquid feeding which are slightly different in terms of the water to dry feed ratios. In other words, paste feeding is similar to liquid feeding, but water and feed are mixed at a ratio of 1.1 to l.5:1, forming a paste material (Liptrap and Hogberg, 1991). In case of liquid feeding, the ratio of added water to dry diet is higher than in paste feeding.

Nonetheless, there are dearth of information on the effect of the form of feeds and water to feed ratios of the diet for poultry husbandry in Cameroon, particularly in relation to feed efficiency, growth performance and carcass yield of ducks. This study was conducted to evaluate the influence of moist (paste) feed on the growth performance and carcass characteristics of Muscovy ducks in the Western Highlands of Cameroon.

MATERIALS AND METHODS

Study site and climate

The study was conducted at the Teaching and Research Unit of the National Polytechnic University Institute (NPUI) located in Mezam Division of the North West Region of Cameroon. The geographical

Table 1. Composition of starter and grower diets used in the study.

Ingredient	Starter Mash (Kg)	Grower Mash (Kg)
Corn	56	60
Soyabean	16	14
Groundnut cake	4	4
Fish meal	4	4
Bone meal	4	6
Concentrate	8	4
Rice bran	4	4
Oil	4	4
Total (Kg)	100	100
Calculated composition		
Crude protein (%DM)	22	19
Calcium (%)	1	1
Phosphorus (%)	0.7	0.8
Crude fibre (%)	5	5
Ash (%)	7	7
ME (Kcal/Kg DM)	2950	3050

Source: Authors

coordinates of the area of the research are 6° 3'0" North, 10° 14'0" East of and is about 1350 m above sea level (Google Map 2022 Imagery). Agro-ecologically, the study site is in the Western Highlands of Cameroon. The area has a subtropical type climate with average temperatures ranging from 21.6 to 27ºC and an annual rainfall of 2125 mm (Kamguia et al., 2007). A bimodal rainfall type; with two seasons, rainy season from mid-March to mid-November and dry season from mid-November to mid-March.

Trial management

A total of 54 numbers of one to two week old ducklings weighing 64 to 67 g obtained from farmers in the environs of Mezam were used in the study. The ducklings were allotted to a completely randomized design of three treatments (T_1, T_2 and T_3) with each treatment replicated 3 times (R_1, R_2 and R_3) and 6 ducks per replicate. The number of ducks per replicate was within the range used by other researchers in previous studies in poultry of 5, 6 and 14 (Solomon et al., 2007; Mai, 2007; Ashkan et al., 2014) respectively. At the start of the experiment, the ducklings were individually weighed and randomly distributed to the 3 replicate per treatment irrespective of the sex. The experiment lasted for 8 weeks from May to July, 2021.

The ducklings were housed throughout the study based on the FAO recommendation of ≤ 10 birds per 3 m^2 of floor space (TECA, 2010). Prior to the start of the study, the birds were kept for an adaptation period of one week for observation and familiarisation with the experimental diets. The birds were kept under a deep litter management system and each unit was provided with drinkers and feeders as well as external heat provided until ducklings developed feathers. All management practices were in accordance with the ethical regulations for raising poultry by the Ministry of Livestock, Fisheries and Animal Industries of Cameroon were observed.

A starter diet was provided to the ducklings until 4 weeks of age and a grower mash until the end of the experiment (8 weeks of age) (Table 1). The feed and water were provided *ad libitum* to the birds. Experimental diets were formulated according to the recommendation of NRC (1994)

Following the composition of the dry diet, water was added to vary the moisture contents according to the treatments shown in Table 2. The moist diets were freshly prepared each feeding time by homogenously mixing the dry diet of same particle size with portable water in clean deep feeder trays and fed to the birds within 30 min, following the 30 min feed soaking-time. (Mai, 2007; Saleh et al., 2021)

The weight of the feed before distributing to the birds and left overs before the next feeding of the birds were recorded daily. The health status of the birds were monitored daily during the adaptation and study periods and dead birds were properly disposed according to prescribed regulations by the Ministry of Livestock and Fisheries, Cameroon.

Data collection and statistical analysis

Influence of moist feeding on growth performance

The following parameters were determined: Feed intake, body weight, weight gain, feed conversion ratio and mortality as previously described (Liu et al., 2019; Awojobi et al*.,* 2009).

Daily feed Intake was determined by calculating the daily difference between pre-weighed feed allocations to each replicate and weight of the left-over feeds. The weekly feed intake was the sum of the daily feed intake (Weighed feed - Unconsumed feed = Feed Intake (FI)). For moist feed, no correction was made for evaporation of water from the moist diet due to the fact that most of the water had evaporated at the time of weighing.

Body weight (BW) was recorded on a weekly basis. Each duckling was weighed in each replicate group before feeding in the morning. The weekly total weight per replica group was divided by the number of ducklings to give the average weekly weight:

$$\text{Average weekly weight /duckling} = \frac{\text{Total weekly weights}}{\text{Number of ducklings}}$$

Table 2. Proportion of water to dry feed of experimental diets used in the study.

Treatment	Water: Feed ratio (wt/wt)	Texture
Control	0:1	Dry
Moist 1	0.5:1	Crumbled
Moist 2	0.75:1	Paste-like

Source: Authors

Table 3. Weekly feed intake (g) of ducks fed moisturized diets.

Duration (weeks)	Feed Intake (g) of ducks according Treatment		
	Dry (0 water : 1 feed)	Moist 1 (0.50 water : 1 feed)	Moist 2 (0.75 water : 1 feed)
1	780±105.83^{a}	1100±50^{ab}	1200±50^{b}
2	1043.3±75.06^{a}	1343.3±40.41^{b}	1450±43.59^{b}
3	1150±50^{a}	1506.7±60.28^{b}	1576.7±30.55^{b}
4	1366.7±102.75^{a}	1700±80.47^{b}	1770±60.83^{b}
5	2728.7±117.30^{a}	3206.7±155.91^{b}	3460±145.69^{b}
6	3398.7±121.00^{a}	3830±39.69^{b}	3861.7±129.45^{b}
7	3663.3±56.19^{a}	3728.3±72.86^{a}	4053.3±78.16^{b}
8	3825±8.66^{a}	3868.3±37.86^{a}	4198.3±2.89^{b}

Values in the table are means ± SD of triplicate results (n=6). Means of the same row having different superscripts are significantly different (p≤0.05).
Source: Authors

Body weight gain (BWG) was calculated as the difference between the average weight of the ducks per replicate group at the end of the week and their average weight at the start of the week for instance average body weight week 2 (BW2) minus average body weight week 1 (BW1).

BWG = BW2 - BW1

Feed conversion ratio (FCR) was calculated as the ratio of feed consumed over weight gained within a period as follows:

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Total Feed Consumption}}{\text{Weight Gain}}$$

Influence of moist feeding on carcass characteristics

At the end of the study, 2 ducks (01 Male and 01 Female) with live weights similar or closest to the mean weight of the ducklings in the replicate groups were fasted overnight and slaughtered for carcass and internal organ weight measurements. Thus a total of 18 ducks, corresponding to 02 per replicate group of 3 replicates per treatment for the 3 treatments, were used for carcass yield characteristics. Following tagging and obtaining of the live weights, the selected birds were slaughtered, manually plucked and eviscerated. The eviscerated ducks were dressed- (excluding their heads and legs), weighed and primal parts (including the breast, thigh and drumstick, gizzard, liver, heart) separated as described by Kleczek et al. (2010) and weighed using a KangRui KR-B09 electronic scale, sensitive to 0.001 g. The difference of the weights of the full and empty segments of the gut (small and large intestines, gizzard and caeca) was used to calculate the weight of the digesta.

Mortality rates were recorded as percentages of the total birds per treatment. The average body weight gain (BWG) and feed intake were adjusted with the mortality when calculating for FCR.

Data collected on growth performance (feed intake, weight gained, feed conversion ratio (FCR) and carcass characteristics were computed and subjected to a one way analysis of variance (ANOVA) as described by Steel and Torrie (1980) using the statistical software Stat Graphics Version XVII.II., Significant means were separated using the Duncan's multiple range test at 5% level of significance.

Ethical consideration

Risk assessment was done to reduce hazard to researcher, aids, study animals and environment. The study birds were humanely handled and manipulated to avoid suffering on them. To boost their health and development, the experimental birds were treated to multi-vitamin (U-VITA EXTRA). This had no effect on the experiment objective as all the animals were treated the same. The scientific committee of the Department of Animal Production Technology, COLTECH approved and validated the work while appropriate permission was obtained to use the facilities of the National Polytechnic University Institute (NPUI).

RESULTS

Influence of moist feeding on feed intake of ducklings

The weekly feed intake (FI) of ducklings (Table 3) was significantly higher for Moist 2 and Moist 1 feed than the control diet, except for weeks 7 and 8 where there were no significant differences ($p>0.05$), between Moist 1 and

Table 4. Mean weekly live weights (g) of ducks.

Duration (Weeks)	Weight of ducks (g) according to Treatment		
	Dry (0 water : 1 feed)	Moist 1 (0.50 water : 1 feed)	Moist 2 (0.75 water : 1 feed)
0 (start of trial)	65.00±1.00^{a}	66.00±1.00^{a}	65.00±1.00^{a}
1	96.67±1.53^{a}	115.23±1.66^{b}	121.2±1.31^{c}
2	129.33±1.26^{a}	160.53±0.46^{b}	190.33±0.58^{c}
3	179.83±4.54^{a}	207.07±3.00^{b}	265.67±1.70^{c}
4	245.17±18.09^{a}	285.17±5.98^{b}	371.47±2.20^{c}
5	383.67±3.21^{a}	437.33±14.19^{b}	553.90±1.65^{c}
6	469.83±12.91^{a}	525.171±14.5^{b}	673.00±2.65^{c}
7	577.00±20.66^{a}	631.33±28.739^{b}	793.33±10.41^{c}
8	669.67±24.51^{a}	748.77±31.78^{b}	898.33±10.41^{c}

Values in the table are means ± SD of triplicate results (n=6). Means of the same row having different superscripts are significantly different (p≤0.05).
Source: Authors

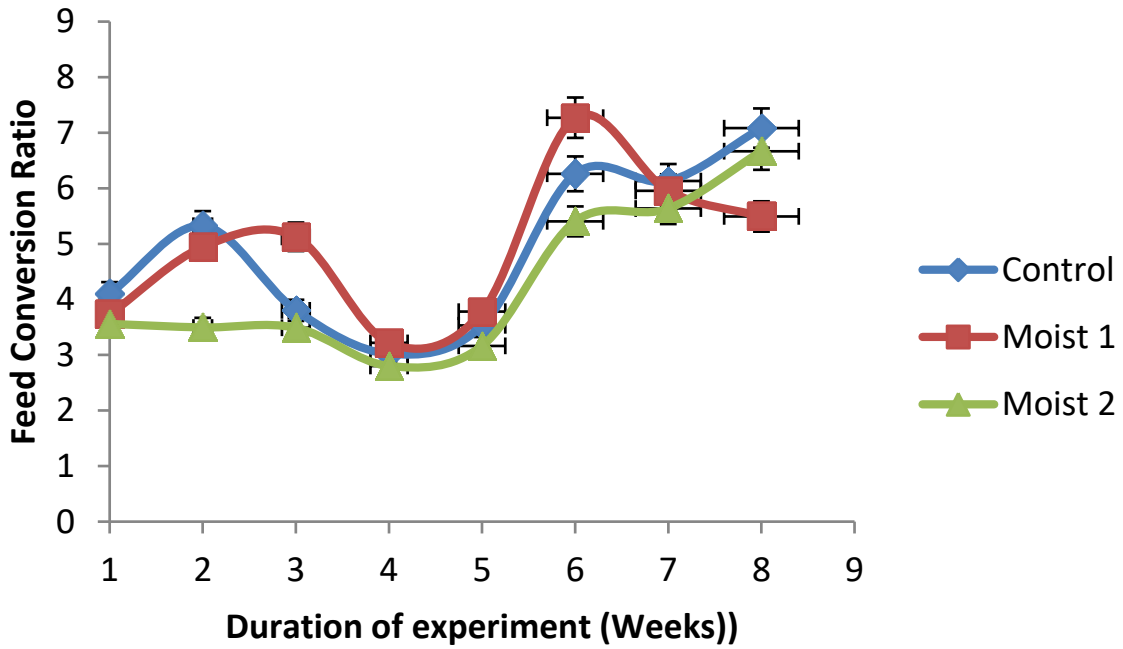

Figure 1. Feed conversion ratio for all treatments.
Source: Authors

control (Dry feed) diet. Moist 2 showed significant difference (p≤0.05) in feed intake in the 7th and 8th week compared to Dry and Moist 1, respectively.

Influence of moist feeding on live weight of ducklings

Table 4 indicates that ducks fed Moist 2 diet showed significantly higher (p≤0.05) weekly live weight than those fed Moist 1 and dry feed, throughout the experiment. Meanwhile, moist 1 feed showed significantly higher (p≤0.5) weekly weights than dry feed.

Influence of moist feeding on feed conversion ratio of ducklings

Feed conversion ratios as shown in Figure 1, was generally highest as the birds matured, with fluctuating situations for most part of all the treatments. This could be attributed to adaptability to the diets (week 1 to 3) as well as their response to diet change from starter to grower in the 5th week of the study. Moist 2 diets showed a steadier decline in FCR and presented the lowest FCR values up to week 7. Meanwhile moist 1 and dry feed had higher FCR, overall.

Table 5. Weights of body parts (g) as affected by treatment and sex of birds.

Treatment	Dry (0 water: 1 feed)		Moist 1 (0.5 water: 1 feed)		Moist 2 (0.75 water: 1 feed)	
Sex/ body parts	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Live weight	745.00±99.67^{ab}	656.67±46.46^{a}	736.70±63.31^{ab}	670.00 18.03^{a}	843.30±107.51^{b}	693.3010.41^{a}
Dressing weights	380.00±85.44^{ab}	331.70±20.21^{a}	381.70±33.29^{ab}	337.00±12.58^{a}	458.30±70.06^{b}	363.30±2.89^{a}
Thigh and drumstick	63.33±12.58^{a}	58.33±5.77^{a}	61.70±2.89^{a}	58.30±2.89^{a}	70.00±8.66^{a}	60.00±5.00^{a}
Breast	58.33±10.4^{ab}	41.67±2.89^{a}	58.30±7.64^{ab}	46.70±7.64^{ab}	70.00±10.0^{b}	56.70±2.89^{ab}
Liver	21.67±2.89^{a}	23.33±2.89^{a}	20.00±0.00^{a}	21.7±5.77^{a}	25.00±5.00^{a}	21.7±2.89^{a}
Heart	5.00±0.00^{a}	5.00±0.00^{a}	6.7±2.89^{a}	5.00±0.00^{a}	6.7±2.89^{a}	5.00±0.00^{a}
Small/large intestine	73.33±14.43^{a}	70.00±10.00^{a}	75.00±13.23^{a}	70.00±5.00^{a}	80.00±8.66^{a}	66.70±2.89^{a}
Gizzards	35.00±5.00^{a}	36.67±5.77^{a}	41.7±7.64^{a}	35.00±5.00^{a}	41.67±5.77^{a}	36.67±2.89^{a}
Caeca	13.33±7.6^{b}	10.00±5.0^{ab}	5.00±0.00^{a}	5.00±0.00^{a}	8.33±2.89^{ab}	6.67±2.89^{ab}

Values in the table are means ± SD of triplicate results (n=6). Means of the same row having different superscripts are significantly different (p≤0.05).
Source: Authors

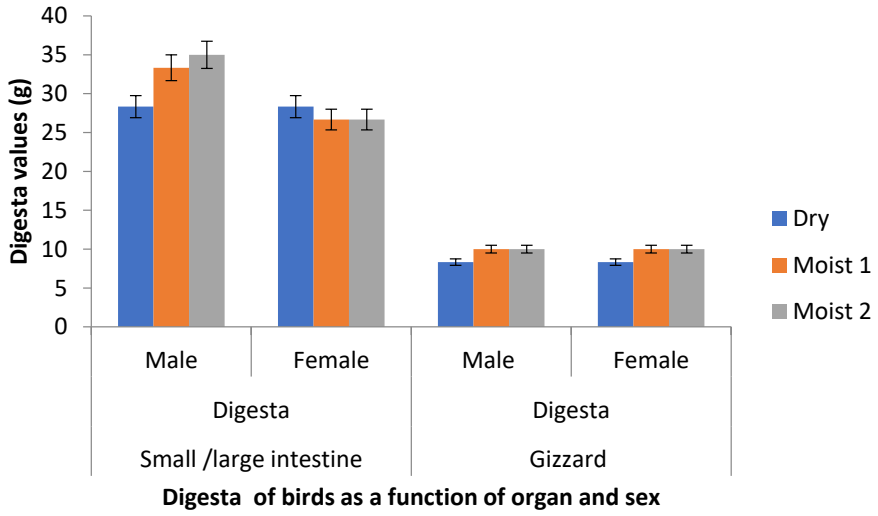

Figure 2. Mean weights (g) of small intestine and gizzard digesta of ducks by sex.
Source: Authors

Influence of moist feeding on live and carcass weights/body parts by sex

Table 5 shows weights of body parts (g) as affected by treatment and sex of birds. There is a significant difference (p≤0.05) for the live and dressed weights of males of moist 2 treatments compared to females in all treatments but the result showed no significant difference of males of moist 2 treatment with males of other treatments. Although not significantly different (P>0.05), males in all treatments showed higher mean live and mean dressing weights than females.

No significant difference (P>0.5) was found in the weights of the different body parts (thigh and drumstick, breast, liver, heart, small intestine, gizzards and caeca) for all treatments.

Influence of moist feeding on digesta (gut contents)

Weights of digesta from Figure 2 were generally higher for the moist 2 and moist 1 diet than the control.

Diseases and mortality

Four ducklings died within the first 3 weeks of the study, corresponding to 3 (16.7%) from the control treatment (dry feed) and 1 (5.6%) from the moist 1 (0.5 water: 1 feed). The ducklings in this experiment died suddenly with no visible symptoms of any disease.

DISCUSSION

The result on feed intake (FI) (Table 3) revealed that the

moister the feed, the higher the feed intake by Muscovy ducks. This result is in line with the results of Jensen and Mikkelsen (2001) who observed that in general, broilers more readily accept feed in wet form than dry form. Scott (2002) also confirmed this finding. He advanced that adding water to the diet before feeding allowed digestion to begin immediately and the bird to eat more and grow quickly. He concluded that broilers cannot eat enough dry feed to attain their genetic potential for growth. This results further supports several studies on chicken that wet feeding increases the feed intake and growth rate of chickens (Yalda and Forbes, 1995, 1996; Forbes, 2003; Mai, 2007). Similarly, it has been reported that wet feeding stimulates increased dry matter intake, growth rate and feed conversion efficiency of broilers (Yalda and Forbes, 1995, Awojobi and Meshioye, 2001, Awojobi et al., 2009).

The results of live weight gains of birds show best performances for moist 2 followed by moist 1 diets and lastly by the control (Table 4). This results support earlier researcher's investigations on chickens: Akinola et al. (2015) who reported a markedly higher body weight gain for chickens fed wet diets. The improved performance with wet feeding which is attributed to higher dry matter intake has also been reported by Yasar and Forbes (2000); as growth stimulation by Forbes (2003); improved nutrient digestibility and utilization; increased feed conversion efficiency (Yalda and Forbes, 1995, Awojobi and Meshioye, 2001, Awojobi et al., 2009), and increased palatability and increased rate of digesta passage through the gastrointestinal tract (Yalda and Forbes, 1996).

Consistent with the results, Farghly (2012) reported that the body weight of Japanese quails that were fed wet feed was significantly ($P < 0.05$) higher than that of quail that were fed dry feed.

Meanwhile, the results on the feed conversion ratio (Figure 1), though not consistent in trend, still presented moist 2 as having the best FCR, followed by the control and then moist 1. With a higher feed intake and live weight for moist 1 compared to the control (dry diet) one would have expected the FCR of moist 1 to have been better than the control. This could have been as a result of wasted feed calculated as feed consumed in relation to the weight gained. The FI of the ducks was not maximized as it was observed that the pasty or sticky nature of the food affected their feed consumption as well as feed wasted from the washing-off of the paste that stock on their bills and mouthparts in water. This is in confirmation with Yasar and Forbes (2000) who using cereal-based diets reported that wet feeding resulted in a disproportionally larger increase in feed intake relative to growth rate, resulting in a significant increase ($p \leq 0.05$) in feed conversion ratio, demonstrating that slowing the rate of passage of a diet increased nutrient retention.

In another development, wet feed can improve daily weight gain, feed intake and can have variable effects on feed conversion ratio (FCR) (Afsharmanesh et al., 2016; Scott and Silversides, 2003).

However, other authors did not report noticeable changes in the WG and FCR of broilers, Muscovy ducks and geese as a result of wet feeding compared to dry feeding (Akinola et al., 2015; Emadinia et al., 2014; Farghly et al., 2018; Liu et al., 2019; Sale et al., 2013). They proposed that the further processing of wet feeds or supplement inclusion is needed to ensure that beneficial effects on growth performance are attained.

The results of the influence of moist feeding on live and carcass weights/cody parts of birds (Table 5) showed no significant difference in the three treatments. However, the result revealed sexual dimorphism characteristics within treatments, where the male ducks had higher carcass weights and body parts, respectively, than females. Sola-Ojo et al. (2011) observed these characteristics of sexual dimorphism of birds. The result of their study showed that males had significantly ($P<0.05$) higher values than females in slaughtered weight, dressed weight, feather weight, weight of scales and claws. Bogosavljevie-Boskovic et al. (2006) also observed that heavier carcasses at slaughter (on the 56^{th} day of fattening) were recorded in the male broilers compared to the female ones, the differences being statistically significant ($P \leq 0.01$). These ties with the results of Etta and Kogbara (2020) who concluded that sexual dimorphism was exhibited in all morphometric traits in favor of the male with BW as the highest dimorphic trait.

Farghly et al. (2018) also observed that the carcass characteristics of Muscovy ducks fed wet feed were also not influenced by the diet. Similarly, Liu et al. (2019) demonstrated that wet feeding does not significantly affect dressed weight, breast meat, leg meat, liver, heart and abdominal fat percentages in geese. Likewise, Akinola et al. (2015) reported that the percentages of the cut-up parts and relative organ weight of broilers did not differ when fed on dry, wet or fermented wet feeds.

The results on the digesta (gut contents) for small/large intestines and gizzards (Figure 2) showed that digesta was generally higher for moist 2 and moist 1 feeds than dry or control diet. This demonstrates that digesta was more retained in these portions of the gut of ducks that fed on moist feed. This is in accordance with Yasar and Forbes (1999), who stipulated that an additional beneficial effect of wet feeding is decreased viscosity of gut contents. Furthermore, wetting feed increases a more rapid penetration of digestive juices, rendering the feed more digestible (Yasar and Forbes, 2001). This allows the actual digestibility of the feed to approach more closely to the potential digestibility that would be achieved if the feed retention time remained longer in the GI tract (Yasar and Forbes, 2001).

Considering that all treatment birds were placed under similar management systems, the deaths of four birds in this study could be attributed to digestion defects through

delayed development of the foregut or the difficulty to digest dryer diets due to feed compaction. Mai (2007) observed that the moistening capacity of the crop of chicks during the first weeks of life was a limiting factor for optimal functioning of the gut with standard solid diets as opposed to when moist feeds was fed. She added that wet feeding helped maintain gut health at a very young age in broiler chickens. The highest mortality in this study was from the control treatment, (16.7%) followed by moist 1 treatment (5.6%) respectively in the early weeks of the study, is in line with the observation of Mai (2007) that the moistening capacity of the crop of chicks during the first weeks of life was a limiting factor for optimal functioning of the gut.

Conclusion

From this study, it can be concluded that, the moister the feed, the better the growth performance: increased feed intake, increased body weight gain, improved FCR and improved carcass characteristics. Therefore, providing moist feeds to Muscovy ducks compared to dry feed is more beneficial in terms of growth performance. From the findings of this study, it can be observed that duck producers use moist feed with a water to dry feed ratio of 0.75:1 for optimum growth performance and carcass yield.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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