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Effect of Wet Feeding in Broiler on Growth Performance under Subtropical Summer Conditions

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Abstract

Broiler farmers experience increasing challenges, especially from heat stress due to climate change (e.g., global warming). This study aims to determine the effect of feeding wet feed in broiler chickens under subtropical summer conditions of Bhutan to mitigate heat stress in chickens. A total of 120 broiler chickens (Vencobb 400Y) were assigned randomly into two groups with three replications each: wet feed and dry feed groups and chickens were reared for six weeks. The average chicken's body temperature assigned in wet feed (41.39 ± 0.67 °C) was lower than those assigned in the dry feed group (42.07 ± 1.62 °C). A significant positive correlation between the chicken's body temperature and water consumption (r = .53, p < .01) indicates that as the chicken's body temperature increases the water intake is likely to increase. The chickens provided with wet feed weighed heavier (2445.71 ± 244.91 g) than those fed with dry feed (2148.86 ± 268.85 g) at six weeks of age (p < .05). Likewise, the chickens allocated to the wet feed group (233.18 kg) showed higher feed intake compared to the broiler chickens in the dry feed group (185.7 kg) at the end of the feeding trial. The dressing percentage was also observed higher in chickens fed with wet feed (84.53 ± 2.72%) than in those fed with dry feed (77.53 ± 4.65%) at p < .01. Furthermore, higher chicken mortality was observed in dry feed (11 chickens) than wet feed group (2 chickens) during the feeding trial. Moreover, chickens fed with wet feed were more profitable (Nu. 232.40 per chicken) than the chickens fed with dry feed (Nu. 117.43 per chicken). Therefore, a wet feeding strategy would be an effective strategy to mitigate heat stress in the subtropical summer conditions of Bhutan.

Keywords: broiler, climate change, heat stress, weight gain, wet feed

Introduction

Most Bhutanese people in the south (subtropical climate) heavily rely on chicken farming to support their livelihood. Chickens are kept for several reasons, such as, meat and eggs, manure, alarm clock, and sold and/or bartered to meet daily family requirements. The money earned from poultry farming is probably invested in other needs such as the purchase of clothes, school fees, and other necessities. Meat and eggs are considered cheap sources of animal protein, which is essential for human growth and development (Food and Agriculture Organization [FAO], 2013). Besides economic importance, chickens are also interwoven in the socio-cultural traditions and rituals of communities, for example, chickens

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are slaughtered to please the local deities to prevent misfortunes (Dorji *et al*., 2012; Penjor & Chhetri, 2019). The Bhutanese government launched several programs to increase the chicken meat and egg to eradicate poverty. Presently, the Bhutanese government claims that the country is self-sufficient in eggs. However, the country imported 1475 metric tons (MT) of chicken meat in 2016 and 1648 MT from India in 2020 (Department of Livestock, 2021), which indicates that the import of meat increased by 10% in four years. Although broiler farming is becoming more popular among Bhutanese farmers, the country heavily depends on the import of chicken meat from India probably due to small-scale production, management practices, and societal pressures.

Broiler farming has become more challenging in the last centuries (Syafwan *et al*., 2011) because the global temperature is expected to increase by 1.5 - > 6.0 °C in the 21st century (Nyoni *et al*., 2019). Chickens are more vulnerable to heat stress and the increasing temperature due to global warming would affect their performance and welfare (Bekele, 2021). When the ambient temperature exceeds beyond thermoneutral zone (TNZ), which ranges from 18 - 24 °C (Bhadauria *et al*., 2014), the chickens are under heat stress (Bilal *et al*., 2021). During heat stress, the growth performance of chicken is impaired as a result of reduced feed intake and also increases mortality (Yalcin *et al*., 1997; Garriga *et al*., 2006).

Boiler farming is concentrated in the southern region of Bhutan supporting the meat requirement of the country. However, broiler farming is becoming more difficult because the ambient temperature, for example, above 35 ºC was recorded in the summer of 2018 in Sarpang district, which is higher than the TNZ. Consequently, hundreds of broiler chickens died probably due to heat stress in Sarpang (Pokhrel, 2018), which is a substantial economic loss to broiler farmers. Several strategies are either suggested and/or implemented elsewhere to combat the heat stress in broilers, such as providing drinking water supplemented with vitamins (Daghir, 2009), inclusion of ventilation system in the shed (Rath *et al*., 2015), and feeding wet feeds to chickens (Smalling *et al*., 2019). Wet feeding is a simple and cost-effective strategy to reduce the cost of production in broiler farming because it enhances feed efficiency (Syafwan *et al*., 2011) and improves chicken's ability to tolerate high temperature (Saleh *et al*., 2021) and reduce mortality (Farghly, 2014). Several investigators have reported the positive effect of wet feeding on broiler chickens' performance (Balogun *et al*., 2013; Dijkslag *et al*., 2019; Smalling *et al.,* 2019). However, no empirical evidence has been collected nor studies conducted to study the effect of wet feeding as mitigation to combat heat stress. Therefore, this study aimed to evaluate the effect of wet feeding on broiler chickens in the subtropical summer conditions of Bhutan.

Materials and Method

Study area and experimental design

The study was conducted in Kafley village, Dekiling block under the Sarpang district of Bhutan. The farm is located at a latitude of 26° 52' N and a longitude of 90°16' E. The average temperature in summer is 35.5 ^{o}C and the average rainfall is 7220 mm per annum.

One hundred and twenty unsexed day-old chicks of Vencobb 400Y were purchased and fed with broiler starter for 14 days (i.e. chicks were not assigned to treatment). All the chicks were provided with a unique ID. On day 15, all chicks were weighed, and using a completely randomized trial they were randomly assigned into two groups: dry feed and wet feed group with three replications (n = 20 each). The wet feed was freshly prepared (before feeding the chickens) by mixing clean and fresh water in dry feed in a ratio of 1:1.3 (feed: water) (Yalda & Forbes, 1995; Dei & Bumbie, 2011). The commercial feeds (chick starter, grower, and finisher feeds) were purchased from the nearest feed agent. Three drinkers and three feeders were placed in each compartment to avoid overcrowding. The heights of drinkers and feeders were adjusted regularly to the shoulder level of the chicken to minimize water and feed wastage. Chickens were fed twice a day (8.00 hrs; 16:00 hrs). Also, clean fresh water was provided (8:00 hrs; 12:00 hrs; 16:00 hrs). Both feeders and drinkers were cleaned twice a day using tap water. The feeding trial was carried out for 42 days (harvesting age).

A typical poultry shed measuring 10 m x 8 m x 3 m (length x breadth x height) owned by a farmer was used for feeding trial. Before the trial, the shed was disinfected thoroughly using a mixture of potassium permanganate and calcium hydroxide. The shed was partitioned into six compartments to accommodate 20 chickens (1 m^2 per chicken) using wire mesh, green nets, bamboo, and wood. The shed floor was covered with sawdust (2 cm deep). An old newspaper was laid over the sawdust to prevent the chicks from consuming and also to keep the floor dry. Also, sawdust was turned twice a week and was changed once every two weeks to keep the floor dry. An aluminum ring (45 cm height) was placed in the center of the shed where an electric brooder of 300 volts was installed. All chicks were vaccinated against Marek's, infectious bursal, and Newcastle disease.

Data collection

All chickens were weighed by using a digital weighing balance every week before feeding them (5:00 hrs). The amount of feed consumed by chickens daily was estimated by subtracting leftovers from the total feed provided. Likewise, water intake by chicken was also measured daily by subtracting water left in the drinkers from the total water provided. Moreover, a digital clinical thermometer was inserted 3 cm into a chicken's cloaca to measure the body temperature of a chicken thrice a day (6:00 hrs; 12:00 hrs; 18:00 hrs) (Yahav & Hurwitz, 1996) and all chickens' body temperature were recorded. Likewise, temperature and humidity in a shed were recorded thrice a day using an automatic data logger. The average daily shed temperature in a shed was 28.48 ± 1.36 °C at 6:00 hrs, 32.46 ± 2.20 °C at 12:00 hrs, and 30.92 ± 1.87 °C at 18:00 hrs, which was above TNZ (Rath *et al.,* 2015; Babinszky *et al.,* 2011). The average relative humidity in a shed (6:00 hrs, 38.37 ± 13.56%; 12:00 hr, 33.23 ± 5.03%; 18:00 hr, 35.14 ± 14.41%) was much lower than the optimum relative humidity requirement of 75.5% for broiler farming (Borges *et al*., 2003). The mortality of chicken was also recorded daily.

The feed conversion ratio (FCR) was estimated as the ratio of feed intake by a chicken to the weight gained by a chicken. The average weekly weight gain was calculated by taking the weight gained by a chicken from the last weight and dividing the weight by the feeding period. At the end of the experiment period (six weeks of age), five chickens were selected randomly from each replication for slaughtering and determining the dressing percentage. The chickens were slaughtered using the neck dislocation method. The eviscerated (carcass) weight was measured using digital weight balance after defeathering and evisceration. The dressing percentage of a chicken was calculated by dividing the live weight of a chicken by carcass weight and by multiplying it by 100. Moreover, cost-benefit was also performed to check whether there was a benefit of feeding wet feed to chickens.

Data analysis

Data collected were entered into MS Excel, which then imported to International Business Machines' Statistical Package for Social Sciences version 26 for further analyses. An independent sample *t-test* was used to compare the mean body weight, FCR, weekly weight gain, and body temperature. A Pearson correlation was used to estimate the relationship between chicken's body temperature and water consumption. The difference was considered significant when $p < .05$.

Results and Discussion

Chicken body temperature

The average daily body temperature of chickens fed with wet feed (41.39 ± 0.67 ^{o}C) was slightly lower than that of chickens fed with dry feed (42.07 ± 1.62 ^{o}C). Also, the body temperature of chickens fed with wet feed was within the ideal range of 40.6 - 41.7 °C (Chen *et al.,* 2009), which probably indicates that chickens fed with wet feed during hot climate maintain body temperature (Syafwan *et al.,* 2011). When the body temperature of chickens varies from an ideal temperature this negatively impacts chicken's growth and health as a result of heat stress (Yahav & Hurwitz, 1996).

Feed and water intake

At the end of the feeding trial, the total feed consumption was higher in those chickens fed with wet feed (233.18 kg) than those fed with dry feed (185.7 kg) (Figure 1 shows the daily feed and water intake). The high feed intake by chickens assigned in wet feed was in agreement with the finding of Yalda and Forbes (1995) who reported the higher feed intake when chickens were fed wet feed in hot climates. Chickens fed with wet feed assist them to tolerate high temperatures because it brings a cooling effect to chickens (Shariatmadari & Forbes, 2005; Saleh *et al.,* 2021). Moreover, wet feeding may also increase feed intake because the feed becomes soft and are easily digested which gets absorbed quickly in the gut, allowing for faster digestion (Scott, 2002).

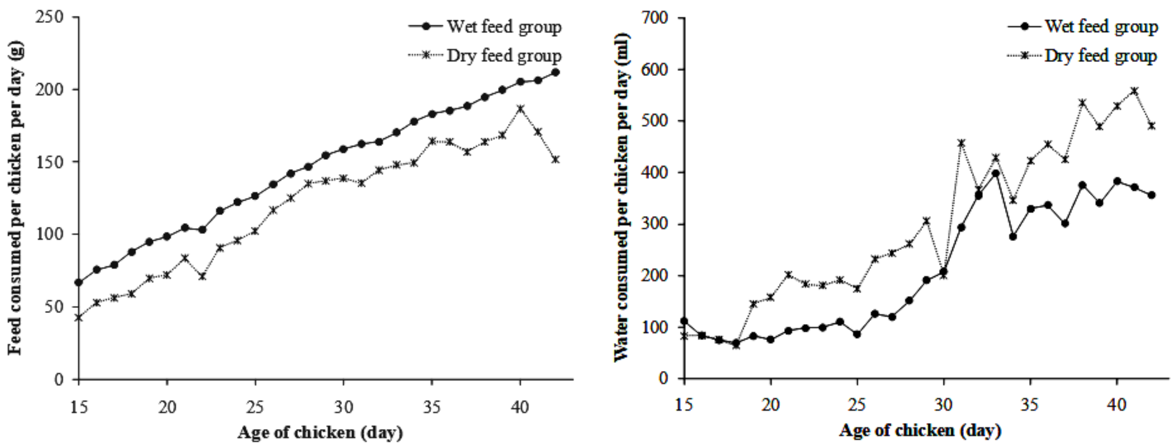

Figure 1: Average feed and water consumption per chicken per day

However, the total water consumed by chickens fed with dry feed (453.3 l) was higher than that of wet feed (343.9 l) during the entire feeding trial. The high body temperature of chickens fed with dry feed (42.07 ± 1.62 ^{o}C), which is beyond an ideal body temperature for chicken stimulates them to consume more water to maintain body temperature (Alleman & Leclercq, 1997). The high water consumption by those chickens fed with dry feed than the wet feed was in agreement with the previous report by Balogun *et al*. (2013) and Dijkslag *et al*. (2019). Moreover, a positive correlation between chicken's body temperature and their water consumption (r = .53, p < .01) also confirms the present findings that when the chicken's body temperature increases water consumption by chicken is likely to increase.

Growth performance and feed conversion ratio

The weekly weight gained was higher for those chickens fed with wet feed than those with dry feed at p < .05 (Figure 2). The finding was consistent with previous studies (Scott, 2002; Forbes, 2003) that reported chickens fed with wet feed gained more body weight than the chickens receiving dry feed probably because of increased feed intake (wet feed) in hot climates. At the end of the trial, the average body weight of chickens fed with wet feed weighed higher (2445.71 ± 32.16 g) than those chickens fed with dry feed (2148 ± 35.61 g) ($t_{(113)} = 6.19$, $p < .01$). Likewise, the eviscerated weight was heavier in wet feed (2198.80 ± 48.82 g) than those fed with dry feed group (1717.00 ± 58.15 g) ($t_{(28)} = 6.35$, $p < .01$). Similarly, the dressing percentage was also higher in broiler chickens fed with wet feed (84.53 ± 0.70 %) compared with those fed with dry feed (77.53 ± 1.20 %) ($t_{(28)} = 5.04$, $p < .01$) and these results were in agreement with earlier investigator (Awojobi *et al.*, 2009).

Moreover, the slightly higher FCR in chickens fed with wet feed (1.87 ± 0.02 g) compared to those chickens fed with dry feed (1.79 ± 0.04 g) was in agreement with Scott (2002) findings. However, no difference between the two groups was observed for FCR ($t_{(113)} = 1.53$, $p > .05$). The average FCR in present study was higher than those reported in other studies of 1.37 - 1.52 (Quintana-Ospina *et al.*, 2023) which probably is affected by different breeds of broiler chickens, health status (diseases, handling) and management (feed, temperature, ventilation, lighting) (RossTechNote, 2011).

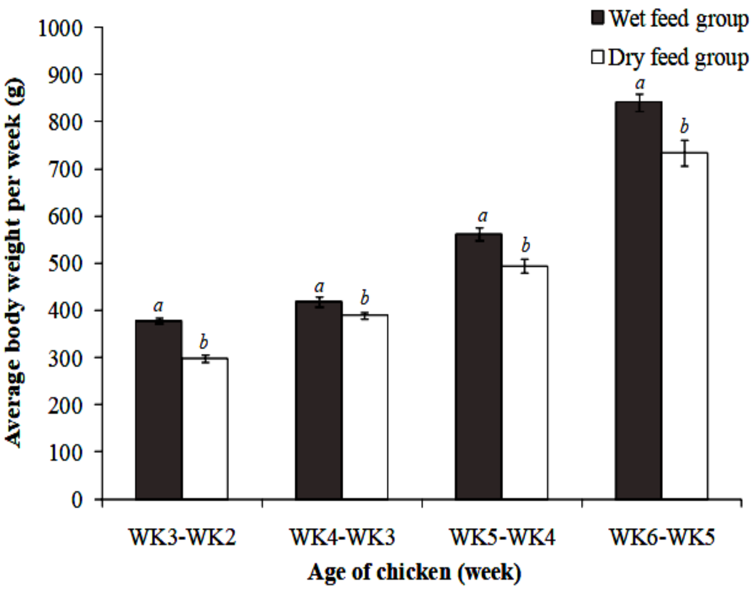

Figure 2: Weekly body weight gain of broiler chickens in two groups (average ± standard error). Means of bars with different letters within each week are significantly different ($p < .05$).

Cost benefits

A high number of broiler chicken mortality was observed in the dry feed group (11 chickens) while a few were in the wet feed group (2 chickens) during the entire feeding trial. The broiler chickens fed with wet feed were more profitable (Nu. 232.40 per chicken) than those

Table 1: Cost benefits of rearing broiler chickens in different feed feeding groups

Parameter	Wet feed (Nu)	Dry Feed (Nu)
Fixed cost		
Total cost of day-old chicks	4500	4500
Variable cost		
Feed	7906.86	5216.06
Electric bulbs and bills	481	481
Others (transportation, hire labour, rental and others)	4240	4240
Total cost	**17127.86**	**14437.06**
Revenue		
Sale of chicken meat after dressing*	30607.2	20191.2
Total benefit	13479.34 (n = 58)	5754.14 (n = 49)
Benefit per chicken	232.4	117.43

*Nu. 240 per kg (2022)

chickens fed with dry feed (Nu. 117.43 per chicken) as shown in Table 1. This study suggested that introducing wet feeding during hot climates (i.e. subtropical summer conditions) would benefit broiler farmers because it improves feed digestibility, reduces mortality and heat stress, which is associated with animal health and welfare (Bilal *et al*., 2023), and is more profitable.

Conclusion

The broiler chickens fed with wet feed have better growth and also maintain body temperature than those fed with dry feed. In addition, chickens fed with wet feed showed enhanced feed intake, better body weight gain, and thus a higher dressing percentage than the one fed with dry feed. The cost-benefit result also indicated that the chickens fed with wet feed were more profitable than those fed with dry feed under hot subtropical summer conditions. From this study, it may be concluded that the wet feeding can be used as a strategy to mitigate heat stress in chickens in subtropical summer conditions of Bhutan.

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