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Original research article

Effects of wet feeding and early feed restriction on blood parameters and growth performance of broiler chickens

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ABSTRACT

The aim of the study was to investigate the effects of early feed restriction (FR) with wet feeding on size of small intestine, blood lipids and performance parameters in broilers from d 1 to 42. A total of 160 one-day-old male broiler chickens were randomly allocated to 4 treatments with 4 pens per treatment and 10 chickens per pen, in a fully randomized 2×2 factorial arrangement, two feeding arrangement; providing feed *ad libitum* (Full Fed) or FR by 50% between days 6 to 12, and feed in either wet or dry form (wet form, 1.2 g water per 1 g dry feed). Body weight and feed intake of broiler chickens were determined at d 0, 21, and 42, and feed conversion ratio (FCR) was calculated. At d 42, two birds per replicate were euthanised for determination of carcass weight, organ weight and length, and also for blood parameters, which included high density lipoprotein (HDL), low density lipoprotein (LDL), total cholesterol and triglycerides (TG). The broilers fed wet form irrespective of FR throughout had superior body weight gain and carcass weight compared with birds fed dry diets at d 22 and 42 ($P < 0.05$). The wet form with FR significantly showed lower FCR compared with the wet form and *ad libitum* at d 1 to 21 ($P < 0.05$). The broilers fed wet form had significantly increased HDL, LDL, and total cholesterol and decreased TG ($P < 0.05$). In conclusion, wet form can improve performance growth and blood parameters, and the FR birds were able to attain normal market body weight at d 42, which suggests that growth compensation occurred.

1. Introduction

The advantages of wet feeding in broilers were recently reviewed by Yasar and Forbes (2000) and wet feeding was suggested by Scott (2002), Scott and Silversides (2003) and Afsharmanesh et al. (2006) as being a valuable tool in increasing our understanding of the limitations in feed intake by broilers fed cereal-based diets. Yasar and Forbes (2000) showed consistent benefits to broiler chickens of feeding conventional feeds mixed with 1.3 parts of water by weight per part of air-dry food. This effect may be due to changes in the physical properties of the feed, and to allowing more rapid penetration of digestive juices, rather than through improved palatability or pre-digestion between wetting and consumption. In general, broilers more readily accept feed in wet form than dry form (Mikkelsen and Jensen, 2001). Wet feed can improve daily weight gain and feed intake but can have a variable effect on feed conversion ratio (FCR) (Afsharmanesh et al., 2006; Scott and Silversides, 2003), because Scott (2002) suggested that adding water to the diet before feeding the hydrated diet allowed digestion to begin immediately and the bird to eat more and grow more quickly, therefore it can be concluded that broilers cannot eat enough dry feed to attain their genetic potential for growth. Fermented wet feed can reduce gastric pH and the number of coliform bacteria in the gastrointestinal tract of broilers (Afsharmanesh et al., 2010). However, for cereal-based diets, wet feeding resulted in a disproportionally larger increase in feed intake relative to growth rate, and may resulting in a significant increase in FCR (Yasar and Forbes, 2000). Washburn (1991) demonstrated that slowing the rate of passage of a diet increased nutrient retention.

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Akinola et al. (2015) reported a markedly higher body weight gain for chickens fed wet diets. 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 tropic as it reduces heat stress and improve feed intake (Dei and Bumbie, 2011). Restricting the excessively high intake of wet-based diets may increase the retention of nutrients.

Physical FR is one of the common procedure was used in controlling feed intake in poultry. Physical FR supply a calculated amount of feed per bird, which is often just enough to meet maintenance requirements (Plavnik and Hurwitz, 1989). Quantitative FR has been observed to reduce mortality and culling (Yu and Robinson, 1992), improve feed conversion ratio (Deaton, 1995; Lee and Lesson, 2001) and allow a complete recovery of body weight if the degree of restriction was not too severe and slaughter ages were extended beyond 6 weeks (Plavnik and Hurwitz, 1988; Deaton, 1995). Plavnik and Hurwitz (1989) reported that broilers subjected to a short period (7 to 14 d) of severe early FR (before 21 d) could show complete catch up in body weight following refeeding. Some studies shows that feed restriction (FR) for short periods during the early growth phases show improvement of feed efficiency and reach a weight equal to that of birds fed ad libitum (Hornick et al., 2000; Pinheiro et al., 2004).

However, the aims of this study were to investigate three items as follows: 1) Examine the phenomenon of compensatory growth due to short-term FR with wet feeding method; 2) Determine if feeding wet diets with early FR can be manipulated to overcome the marked loss in FCR of wet-fed cereal-based diets; 3) Effects of limiting feed intake from d 6 to 12 with wet feeding method on growth performance in restricted-ad lib fed broilers.

2. Material and methods

2.1. Birds and treatments

One hundred and sixty 1-day-old male broiler chickens (Ross 308) were housed in floor pens covered with wood shavings and were fed experimental treatments from d 1 to 42. At d 1, chickens were individually weighed and assigned to 16 floor pens (100 cm × 120 cm, 10 birds per pen) in an environmentally controlled room with 23-h light and 1-h dark cycle. Room temperature was maintained at 32°C during the first week and gradually decreased to 24°C by the end of the third week. Experimental procedures were approved by the Kerman University Animal Ethics Committee and complied with the animal welfare guidelines at the Veterinary Control and Research Institute of Kerman, Iran.

The starter (d 1 to 21) and finisher (d 22 to 42) basal diets were based on corn-wheat and soybean meal (Table 1). The four dietary treatments tested were based on a 2 × 2 factorial arrangement, two feeding arrangement (full fed, *ad libitum*; FR, restricted to 50% of *ad libitum* from d 6 to 12), and feed in either wet or dry form (wet form, 1.2 g water per 1 g dry feed). Each treatment was fed to four replicate cages of ten chickens each.

The experimental treatments were as follows:

Treatment 1, *ad libitum* + dry form;
Treatment 2, *ad libitum* + wet form;
Treatment 3, FR + dry form;
Treatment 4, FR + wet form.

Birds in the full-fed groups (Treatments 1, 2) consumed diet (Table 1) on an *ad libitum* basis throughout the experimental period of d 1 to 42. In the other two treatments (3 and 4), birds were limited in quantity of feed through physical FR. Feed intake of FR chickens during the period d 6 to 12 was restricted to 50% of the voluntary feed intake of their full-fed counterparts in Treatments 1, 2. This amount was calculated by averaging the daily feed intake for all four replicates of the control birds and then providing 50% of this as the feed allocation for the FR birds for the following days.

Table 1
Ingredient composition and calculated values of the basal diets (as fed basis).

Item	Starter diet (d 1 to 21)	Grower diet (d 22 to 42)
Ingredients, %		
Corn	45.85	43.74
Wheat	8.00	18.84
Soybean meal, 48%	37.40	29.06
Soybean oil	4.64	4.50
Limestone	1.70	1.74
Dicalcium phosphate[1]	1.20	1.00
NaCl	0.29	0.29
Vitamin-mineral premix[2]	0.75	0.75
D, L-Methionine	0.17	0.09
Calculated analysis, %		
Dry matter	92	91
AME_n, kcal/kg	3,076	3,140
Crude protein	22.00	20.20
Calcium	1.00	0.94
Available phosphorus	0.45	0.40
Methionine + cysteine	0.90	0.73
Total lysine	1.25	1.11
Arginine	1.51	1.32
Arginine:lysine	1.21	1.19

AMEn = nitrogen corrected apparent metabolizable energy.
[1] Contained 23% Ca and 20% P.
[2] Supplied per kilogram of diet: vitamin A, 8,800 IU (retinyl palmitate); vitamin D_3, 3,300 IU; vitamin E, 11.0 IU (dl-α-tocopheryl acetate); riboflavin, 9.0 mg; biotin, 0.25 mg; thiamin, 4 mg; pantothenic acid, 11.0 mg; vitamin B_{12}, 13 μg; niacin, 26 mg; choline, 900 mg; vitamin K, 1.5 mg; folic acid, 1.5 mg; ethoxyquin, 125 mg; manganese, 55 mg; zinc, 50 mg; copper, 5 mg; iron, 30 mg; selenium, 0.1 mg.

Dry diets were ground with a hammer mill (P-241 DTF Pulverator, Jacobson Machine Works, Minneapolis, MN) with 3-mm screen, to give grind sizes classified as fine meal. The basal diets were isonitrogenic at 225.0 and 200.0 g/kg crude protein and isocaloric at 12.9 and 13.2 nitrogen corrected apparent metabolizable energy (AMEn) MJ/kg in starter and grower phases, respectively. The diets met or exceeded the nutrient requirements of chickens (National Research Council, 1994). Provision of each of the two wet-diets was as described by Scott (2002). Briefly, an ample allotment of daily dry feed was mixed by hand with 1.2 parts water (this amount of water was sufficient to give the consistency of sloppy porridge), allowed to stabilize for 15 min and then divided into plastic-lined feeders identical to those used for feeding dry diets. The wet feed and feeder were weighed, presented to the broilers for a 24 h period and reweighed, with the difference used to determine intake expressed on a dry weight basis. Any feed remaining after 24 h was discarded. No correction was made for evaporation of water from the wet diet.

2.2. Performance and digestive tract measurements

Daily feed intake for each pen was recorded. The average body weight gain (BWG) and feed intake was adjusted for mortality to d 22 and 42 and was used to calculate FCR. When the broilers were 42 days of age, 8 birds per treatment (two birds closest to the mean weight of each replicate pen) were randomly selected, BW was recorded and the birds were euthanised by cervical dislocation. The gastrointestinal tract and organs were carefully excised. The empty weight and length of duodenum, proximal ileum (from the pancreatic loop to Meckel's diverticulum), and distal ileum (from Meckel's diverticulum to the ileocaecal junction) were recorded.