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Effect of early feeding or feed deprivation on growth performance of broiler chicks

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Abstract

The effect of fasting and early diet composition on productive performance of broiler chickens was investigated in this study. Total 300 day-old male broilers (Ross 308 breed) were randomly assigned to five feeding system including control (Group 1), fasted for 48 h (Group 2), feeding a diet containing 15% egg powder for 48 h (Group 3), feeding a diet containing 20% glucose syrup for 48 h (Group 4) and feeding a diet containing 15% egg powder and 20% glucose syrup for 48 h (Group 5). Body weights, feed intake and feed conversion ratio of broilers were measured at 7, 21 and 42 day. At 7-21 days of age, the chicks in group 5 had higher ($P<0.05$) weight gain than the other groups. In experimental period (1-42 days) group 5 had higher weight gain than group 1. Over 1-7 days, fasted birds showed decreased feed intake compared to the other treatments ($P<0.05$). At 21 to 42 days of age, chicks in group 1 consumed lower amounts of feed during study period, the chicks in group 5 had significantly higher ($P<0.05$) feed intake than group 1 and 2. In first week of age, feed conversion ratio reduced ($P<0.05$) in the chicks that had no access to feed. However, in the following weeks (7-21 d) chicks in group 2 indicated the highest FCR compared to all other groups ($P<0.05$). Serum glucose and triglyceride concentrations was determined to be the lowest in group 2, while, total, LDL and HDL cholesterol levels increased in this group ($P<0.05$). Statistically, hematological parameters did not have any difference among groups. The results suggest that diet composition affected chick performance in post-hatch period and feeding a semi-moist diet with high protein and suitable energy levels containing egg powder and glucose syrup for the first 48 hours post-hatch could improve growth performance of broiler chickens.

Keywords: Broiler; growth performance; early feeding; egg powder; glucose syrup

Introduction

The modern breeds of broiler chickens have been selected for fast growth. The magnitude of growth indicates that each day during the growing period is important to achieve the target growth. However, in commercial poultry operations, the chicks are held in the hatchery over two days period (21st and 22nd day of incubation). They are taken out of the incubator only when majority of chicks clear the shell. In some cases, the chicks have to be sexed, vaccinated and etc. which may extend the off-feed time. Indeed, in some cases it normally takes 24-48 hours to deliver the chicks to grow out facility and offered the first feed and water to newly hatched chicks. Thus, in practice, the post-hatch chickens often spend substantial time in the hatchery without access to feed and water, which causes poor viability and reduction in growth (Madsen et al., 2004).

Immediately after hatching the nutrient intake of chicks can greatly influence their subsequent performance characteristics. It has been determined that early access to feed and/or protein supplementation results in more rapid development of gastro-intestinal and muscular system (Noy and Sklan, 2001), immune system (Brink and Rhee, 2007) and faster utilization of yolk (Noy et al., 1996). In a study conducted by Noy and Sklan (1999) it has been observed that post-hatch deprivation of feed and water for 48 h reduced body weight of broilers by 7.8% over those fed immediately after hatch. Early feeding, either given access to feed

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and water to newly hatched birds or injected in ovo has been demonstrated to be beneficial (Kornasio et al. 2011). Suitable feed composition and optimal feed formulations specifically during the early days of broiler chickens are less known. The usual starter diets have complex and more digestible and simple feed components such as glucose syrup or egg powder may be more suitable for first days post-hatch. Thus, this study was carried out to compare the effect of different feeding programme and fasting over the first 48 hours immediately following hatch on performance, serum biochemistry and hematological parameters of broiler chickens.

Material and Methods

Animals and diets

A total number of 300 newly hatched (Ross 308) male broiler chicks were obtained from a commercial hatchery. The chicks were randomly assigned into five treatment groups with four replicates of 15 chicks each. The average of each group had approximately similar initial weight. The five groups were based on their diets. Control, feeding a corn-soybean meal based diet, fasted for 48 h, feeding a diet containing 15% egg powder for 48 h, feeding a diet containing 20% glucose syrup for 48 h, and feeding diet containing 15% egg powder and 20% glucose syrup for 48 h. All diets (Table 1) were semi-moist with a moisture content of 30%. After 48 hours, all chicks were fed with a commercial starter (up to 21 d) and grower (22-42 d) diets. The diets (Table 2) were formulated to meet nutrient requirements of NRC (1994). Body weight was determined at 7, 21 and 42 days of age. Food consumption and weight gain were recorded in different periods and food conversion ratio (food intake / weight gain) was calculated. Mortality was recorded as it occurred.

Serum biochemistry

At the end of the experiment, after 12 h fasting, blood samples were collected puncturing the brachial vein at one week of age from 8 birds in each treatment and serums were obtained. Total protein, glucose, total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL) cholesterol and triglyceride parameters were analyzed in by commercial kits (Pars Azmoon Company; Tehran, Iran).

Hematological parameters

At one week of age, blood samples from 8 birds in each treatment were collected. The red blood cell (RBC) and white blood cell (WBC) counts were determined by a hemocytometer method. Hematocrit (HCT) and hemoglobin (Hb) were measured by microhematocrit and cyanmethemoglobin methods respectively (Kececi et al., 1998). The mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were computed complying with Campbell (1988) technique. Then heterophil to lymphocyte ratio was calculated and recorded (Gross and Siegel, 1983).

Statistical analysis

The data were subjected to analysis of variance procedures appropriate for a completely randomized design using the General Linear Model procedures of SAS Institute (2008). Mean values were compared using the Duncan multiple range test. Statements of statistical significance are based on $P<0.05$.

Results and Discussion

As displayed in Table 3, delayed access to feed for 48 hours resulted in lower weight gain in first 7 days of age compared to the other treatment groups ($P<0.05$). However, the chicks receiving the feeding diets containing egg powder, and both egg powder and glucose syrup resulted in higher weight gain than the control birds in first 7 days of age. At 7 to 21 days of age, the chicks fed a diet containing both egg powder and glucose syrup for 48 hours resulted to higher ($P<0.05$) weight gain than both the control and the other experimental groups (Table 3). There was no significant difference in weight gain between experimental groups from 21 to 42 days of age. However, during experimental period (1-42days), feeding diets contains egg powder or egg powder plus glucose syrup for 48 hours resulted in higher weight gain than control group (Table 3).

The finding of lower weight gain in fasted chicks during the first week of life is consistent with report of Batal and Parsons (2002). Lower weight gain in fasted groups could be attributed to lower feed intake and poor development of digestive tract. Most of the energy and nutrients consumed by birds younger than four weeks goes toward growth (Tabler, 2008). When feed consumption starts soon after hatch, the nutrients provided by feed are complementary to the yolk nutrients (Murakami et al., 1992). Initiation of feed consumption as close to hatch as possible is essential to support early muscle development, which may ultimately affect meat yield. Moreover, starvation or the absence of feed over the first 2-d post-hatch period retards growth and reduces ultimate meat yield. Furthermore, the reduction in ultimate meat yield observed after 48 hours of early post hatch starvation has been associated with a reduction in satellite cell proliferation (Halevy et al., 2000). Short-term reductions in satellite cell proliferation juvenile muscle, may occur in delayed post-hatch feeding,

Table 1: Composition and calculated nutrient content of experimental diets fed for 48 hours after hatch

Feed ingredients	Control	Egg powder	Glucose syrup	Egg + Glucose
Corn	550.5	526.0	438.0	230.0
Soybean meal	349.5	296.5	267.5	378.0
Fish meal	66.0	0.0	60.0	0.0
Egg powder	0.0	150.0	0.0	150.0
Glucose Syrup	0.0	0.0	200.0	200.0
Mono-calcium phosphate	10.0	11.5	9.0	11.5
CaCo3	9.0	10.5	8.0	10.5
Soybean oil	10.0	0.0	0.0	0.0
NaCl	0.0	0.0	2.5	3.0
Mineral premix	2.5	2.5	2.5	2.5
Vitamin premix	2.5	2.5	2.5	2.5
Calculated nutrients				
Metabolizable energy (kcal/kg)	2900	2700	3050	2700
Crude protein (g/kg)	230	240	183	250
Met (g/kg)	7.7	-	6.1	-
Lys (g/kg)	14.4	-	11.5	-
Ca (g/kg)	9.4	7.5	8.5	8.0
AP (g/kg)	5.2	3.5	4.5	3.5

Table 2: Composition and calculated nutrient content of starter and grower diets

Feed ingredients	Starter (up to 21d)	Grower (22 to 42 d)
Corn	535	583
Soybean meal	357	320
Fish meal	50	30
Mono-calcium phosphate	5.7	5.0
CaCo3	12.5	14.1
NaCl	3.5	3.0
Soybean oil	30	40
DL- methionin	0.8	0.1
Mineral premix[1]	2.5	2.5
Vitamin premix[2]	2.5	2.5
Calculated nutrients		
Metabolizable energy (MJ/kg)	12.55	12.97
Crude protein (g/kg)	215.6	193.7
Met (g/kg)	4.4	3.4
Met+Cys (g/kg)	8.4	7.0
Lys (g/kg)	13.2	11.5
Ca (g/kg)	9.3	8.7
AP[3] (g/kg)	4.2	3.4

[1]supplemented (mg kg^{-1} of diet): Mn, 1200; Fe, 60; Zn, 120; Cu, 12; I, 1.2; Se, 0.24; [2] supplemented (mg or IU kg^{-1} of diet): Vit. A, 10800 IU; D_3, 2400 IU; E, 21.6 IU; K_3, 2.4 IU;B_1, 2.16; B_2, 7.9; B_3, 12; B_5, 3.6; B_9, 1.2; B_{12}, 0.015; Biotin, 0.12; choline chloride, 600; and adequate antioxidant
[3]AP: available phosphorus

ultimately reduce mature muscle size (Mozdziak et al., 1996).

Our results show that feeding a semisolid diet containing the egg powder and glucose syrup for 48 hours resulted in higher weight gain in broilers. This likely occurred for two reasons: first, the treatment diet was higher in protein and lower in energy than control and other treatments (Table 1) and second, the chicks in this group had the highest levels of feed intake (Table 3). Other studies also have shown that body weight gain during the first weeks increased with increasing protein levels (Sklan and Noy, 2003; Wijtten et al., 2004).

Sklan and Noy (2003) suggested that chicks might have a high protein requirement for the development of specific tissues in post-hatch period. For example, it has been reported that the small intestines grow rapidly in the post-hatch period (Sklan 2001). In the current study, increasing the energy source by feeding glucose syrup in a semi-solid diet did not result in higher post-hatch performance. This may have been due to immature development of digestive enzyme secretion.

In first week of age, no access to feed for 48 hours resulted in lower (P<0.05) feed intake and feeding a diet containing both egg powder and glucose syrup for 48 hours resulted in higher (P<0.05) feed intake than control (Table 3). Feed intake was not different for the experimental groups at 7 to 21 days of age. At 21 to 42 days of age, birds in control group consumed lower amounts of feed compared to the other treatments (Table 3). Over the entire experimental period, the chicks fed both egg powder and glucose syrup had significantly higher (P<0.05) feed intake than control and fasted chicks (Table 3). Higher feed intake in chicks fed with egg + glucose diet could be attributed to lower energy content and better amino acid balance in this diet. Other researchers also implied that feed intake was influenced by energy density of the feed (Plavnik et al., 1997; Noy and Sklan, 2002). Feed intake in post-hatch chicks might be regulated by environmental temperature as well. And chicks do not have a fully developed thermoregulatory system in the post-hatch period (Nichelmann and Tzschentke, 2002). However, in this experiment, birds were kept in a similar brooding system.

In first week of age, feed conversion ratio was lower (P<0.05) in the chicks that had no access to feed (Table 3). However, in the following weeks (7-21 d) fasted chicks showed the highest (P<0.05) FCR compared to all other treatments. Afterwards, no significant differences in feed conversion ratio occurred among the treatment groups. These findings are in agreement with results of Noy and Sklan (1999), Corless and Sell (1999) and Saki (2005).

According to Table 4 the highest glucose concentration was observed in birds fed glucose, while serum total, HDL and LDL cholesterol level increased in fasted birds (P<0.05). However, the lowest triglyceride concentration (P<0.05) occurred in chickens deprived of feed for the first 48 hours, compared to the other treatments. Hematological values and the blood indices calculated from the mean values of blood parameters are presented in Table 5. None of the parameters tested including WBC, RBC, Hb, hematocrit, MCV, MCH and heterophil to lymphocyte

Table 3: Effect of post-hatch diet and fasting on body weight gain, feed intake and feed conversion ratio (FCR) of broilers chickens at different ages

	Age (d)	Control	Fasted	E48	G48	EG48	SEM
Body weight gain (g/d/bird)	1-7	12.84^{b}	9.72^{c}	14.4^{ab}	12.72^{b}	15.36^{a}	0.22
	7-21	28.4^{b}	26.04^{b}	31.4^{ab}	28.4^{b}	38.04^{a}	0.53
	21-42	78.1	81.6	84.7	81.5	81.7	0.55
	1-42	48.6^{c}	49.4^{c}	52.8^{a}	50.3^{b}	53.5^{a}	0.34
Feed intake (g/d/bird)	1-7	15.7^{b}	6.72^{c}	20.8^{a}	16.8^{ab}	20.9^{a}	0.56
	7-21	35.2	45.36	46.5	39.7	46.5	1.09
	21-42	140.5^{b}	146.4^{a}	146.1^{a}	142.5^{ab}	147.6^{a}	2.36
	1-42	84.6	89.4	90.1	87.4	92.9	1.54
FCR (g feed/g gain)	1-7	1.22^{b}	0.69^{c}	1.45^{a}	1.32^{ab}	1.36^{a}	0.032
	7-21	1.23^{c}	1.74^{a}	1.48^{bc}	1.39^{b}	1.21^{c}	0.061
	21-42	1.79	1.79	1.72	1.74	1.8	0.019
	1-42	1.74	1.8	1.70	1.73	1.73	0.016

E48: diet containing 15% egg powder that fed for 48 h; and G48: diet containing 20% glucose syrup that fed for 48 h; EG48: diet containing 15% egg powder and 20% glucose syrup that fed for 48h; $^{a\text{-}b}$ Means in a row with no common superscripts differ significantly (P<0.05)

Table 4: Effect of post-hatch diet and fasting on serum metabolites of broiler chickens

Parameters	Control	Fasted	E48	G48	EG48	SEM
Glucose (mg/dL)	222.62^{ab}	91.75^{c}	137.62^{bc}	299.12^{a}	150.62^{bc}	40.46
Total cholesterol (mg/dL)	149.1^{b}	260.4^{a}	155.6^{b}	150.1^{b}	151.3^{b}	30.47
Total triglycerides (mg/dL)	167.36^{b}	67.37^{c}	184.27^{a}	140.35^{b}	117.77^{b}	16.14
HDL (mg/dL)	189^{b}	254.25^{a}	209^{b}	197.5^{b}	191.25^{b}	7.51
LDL (mg/dL)	135.95^{b}	377.5^{a}	127.35^{b}	119.65^{b}	153.35^{b}	25.9
Total protein (g/dL)	3	3.31	3.09	2.77	3.16	0.10

E48: diet containing 15% egg powder that fed for 48 h; and G48: diet containing 20% glucose syrup that fed for 48 h; EG48: diet containing 15% egg powder and 20% glucose syrup that fed for 48 h; $^{a\text{-}b}$ Mean values in a row with no common superscripts differ significantly (P<0.05)

Table 5: Effect of post-hatch diet and fasting on hematological parameters of broiler chickens

Parameters	Control	Fasted	E48	G48	EG48	SEM
WBC ($\times 10^3$/ µl)	10.9	10.1	12.6	10.3	8.1	2.13
RBC ($\times 10^6$/ µl)	1.84	1.78	1.48	1.68	1.61	0.060
Hemoglobin (g/100 mL)	11.52	11.7	9.57	10.87	10.72	0.390
Hematocrit (%)	22.8	21.87	19.85	20.70	21.15	0.707
MCV (fl)	123.37	124.02	133.87	122.65	130.85	1.796
MCH (pg)	62.22	66.15	64.90	64.37	66.33	0.895
Heterophil (%)	29.75	32.5	30	28.25	31.75	0.802
Lymphocyte (%)	63.5	61	63	65.5	59.75	1.11
H/L ratio	0.46	0.53	0.47	0.43	0.53	0.23

E48: diet containing 15% egg powder that fed for 48 h; and G48: diet containing 20% glucose syrup that fed for 48 h; EG48: diet containing 15% egg powder and 20% glucose syrup that fed for 48 h

ratio were not significantly influenced by experimental diets.

Blood serum metabolites and hematological parameters have often been associated with health indices and are of diagnostic significance in routine clinical evaluation of the state of health (Toghyani et al., 2010). Furthermore these parameters have been shown to be major indices of physiological, pathological and nutritional status of an organism and changes in the constituent compounds of blood (Toghyani et al., 2011). According to the current findings, feeding a semi-moist diet, high in protein and energy within the first 48 hours post-hatch can increase blood glucose and triglyceride, resulting in better body reserves which proved to influence positively growth performance of birds at a later stage of growth. This is while feed deprivation negatively influenced serum metabolites which resulted in poorer productive traits of birds. It seems that there are no reports concerning the impact of early feed delivery on serum biochemical and hematological parameters of broiler chickens.

Conclusion

The results of this study indicate that early delivery of first feed and diet composition can influence post-hatch growth performance of broiler chickens. Feeding a semi-moist diet with high protein and suitable energy levels containing egg powder and glucose syrup for 48 hours post-hatch is beneficial for post-hatch growth and considerable performance benefits.

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