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The Effects of In-Ovo Injection of Glucose on Hatchability, Hatching Weight and Subsequent Performance of Newly-Hatched Chicks

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ABSTRACT

This experiment was conducted to determine the effects of an *in-ovo* injection of glucose on hatchability, weight and subsequent performances of newly-hatched chickens. The 720 fertile eggs used in this experiment were obtained from a Cobb-500 broiler breeder flock of 28 weeks of age. Treatments were the following: 1) control group (withou- injection), 2) group injected with 0.5 ml deionized water (sham group), 3) group injected with 0.5 ml glucose 15% in deionized water, 4) group injected with 0.5 ml glucose 20% in deionized water and 5) group injected with 0.5 ml glucose 25% in deionized water. There werh four replicates per treatment and 36 eggs per replicate. The experimental design was a completely randomized design. Upon hatch, hatchability and weight of newly-hatched chicks were measured, and 20 chicks per replicate were transferred to an experimental house and reared for 42 days. Live weight and feed intakeswere measured for each experimental unit at 21 and 42 days of age and then weight gai, and feed conversion ratio were calculated. The results of the study indicate that group that received glucose at 15%, 20% and 25% had significantly higher hatching weight as compared with the control and the sham groups,tbut,eggs injected *in ovo* had significantly lower hatchability than the controls ($p < 0.01$). Also, there were no significant treatment effects on feed intake between 0 and 21 days post-hatch. Chicks that received *in-ovo* injection of glucose haddbetter feed intake, weight gain and feed conversion ratio compared with chicks hatched from the control and the sham groups. The obtained Data suggest that *in-ovo* injection may increase weight and improve the performancs of newly-hatched chickens.

INTRODUCTION

The injection oN nutrients *in ovo* may provide poultry companies with an alternative method to increase hatchability and the weight of newly-hatched chick (Ohta *et al.*, 2001). Glucose is the main energy source of living organisms (Stryer, 1995). Ingram *et al.* (1997b) investigated the effect of *in-ovo* injection of different levels glucose in broiler eggs prior to transfer to the hatcher on the hatchabilit,, chick weight, and subsequent body weight, and reported that glucose significantly improved performancs. Accelerated embryo development and improved nutritional status afforded by *in-ovo* feeding improved hatching weight, growth rate (Al-Murrani, 1982; Ohta *et al.*, 1999; Bhanja *et al.*, 2004). Also, the rapid development of digestive organs during the final days of incubation implies that a large amount of energy is required to maintain the normal development of the embryo. However, limited glucose supply in latm incubation of poultry embryos induces gluconeogenesis from amino acids produced by the

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degradation of protein of the breast muscle (Hamer & Dickson, 1989), which ultimately results in decreased protein deposition in breast muscle and organ weight decline (Vieira & Moran, 1999). Therefore, the final days of incubation and the first few days after hatching are a critical period for the survival and development of embryos at the end of incubation and neonates in poultry because of considerable energy catabolism.

Glucose storage as glycogen was demonstrated to be a very important energy resource for maintaining normal metabolism and body growth duringrpre- and post-hatching days (Christensen *et al.*, 2000). Itnwas demonstrated that *in-ovo* injectioneis an available tool to supply nutrient to embryos in previous research studies (Uni *et al.*, 2005),sproviding a new insight into the nutritional manipulation of poultry embryos. We hypothesize that the exogenous supply of glucose by the method of *in-ovo* injection is likely to alleviate the crisis of energy supply in broiler embryos, and to improve hatchability, weight and subsequent performancs of newly-hatched chickens.

MATERIALS AND METHODS

This experiment was conducted at Islamic Azad Universit.Hhatchery farm during the summer of 2010. The 720 fertile eggs used in this experiment were obtained from a Cobb-500 broiler breeder flock of 28 weeks of age. All eggs were collected from the same breeder flock and weighed on a scale with 0.1 g precision.sEggsfweighed 60 ± 1 g and were incubated at 37.8°CC and 63% RH relativeyhumidity). Then, the eggs were divided into five groups; 1) control group (without injection), 2) group injected with 0.5 ml deionized water (sham group), 3) group injected with 0.5 ml glucose 15% in deionized water, 4) group injected with 0.5 ml glucose 20% in deionized water and 5) group injected with 0.5 ml glucose 25% in deionized water. There werh four replicates per treatment and 36 eggs per replicate. Pure glucose was supplied by Merck Company (Item Catalog Number 108337.0250). Onyday 6 of incubation, eggs were candled, and unfertilized eggs or those containing dead embryos were discarded. On day 7 of incubation, eggs were removed from the incubator for 10 min to perform glucose injections that were carried out in the albumen of eggs. The control group was kept in the same environmental conditions during treatments. Upon hatch, 20 chicks per replicate were weighed and transferred to an experimental house for subsequent performance study. Chicks were reared up to 42 d of age and were supplied with a standard broiler feed (National Research Council, 1994). Food and water were available *a- libitum*. Body weight and feed intake were measured at 21 and 42 days of age and then feed conversion ratio was calculated. Treatments were analyzed by ANOVA using the general linear models procedure of SAS software package (SAS institute, 2001). When differences among means were found, means were compared by Duncan's multiple range tests.

RESULTS

Hatching weight was significantly higher when glucose was received as compared to the control and sham groups.yOn the other hand, *in-ovo* glucose administration significantly decreased hatchability ($p < 0.01$) (Table 1). As shown in Table 2, *in-ovo* injection of glucose did notnsignificantly influence the feed intake of broiler chickens during the period of 1-21 day of age., bu feed intake was significantly higher in chicks hatched from eggs injected with glucosenboth during the period 21-42 days and total rearing period (1-42 days of age) compared with the control and the sham groups ($p < 0.01$). Chicks from eggs injected witf glucose had better weight gain and feed conversion ratioothan chicks hatched from the control and sham groupn throughout the experimental rearing period (Table 3 and Table 4).

Table 1 - Effect of *in ovo* injection of glucose on chick weight and hatchability of newly-hatched chickens.

Groups	Chick weight (g)	Hatchability (%)
Control	39.22[b]	86.32[a]
Sham	39.27[b]	70.27[bc]
Glucose (15%)	40.24[a]	67.50[c]
Glucose (20%)	40.16[a]	72.52[bc]
Glucose (25%)	40.26[a]	74.02[b]
p - value	0.0001	0.0001
SEM	0.11	1.72

Table 2 - Effect of *in-ovo* injection of glucose on the feed intake of broiler chickens during different periods.

Groups	1-21 days of age (g)	21-42 days of age (g)	1-42 days of age (g)
Control	744	3218[b]	3962[b]
Sham	750	3227[b]	3976[b]

Glucose (15%)	754	3260[a]	4013[a]
Glucose (20%)	759	3256[a]	4016[a]
Glucose (25%)	755	3270[a]	4025[a]
p - value	0.470	0.0001	0.0001
SEM	6.03	5.42	6.70

Table 3 - Effect of *in-ovo* injection of glucose on the body weight of broiler chickens during different periods.

Groups	1-21 days of age (g)	21-42 days of age (g)	1-42 days of age (g)
Control	549[b]	1522[b]	2071[b]
Sham	540[b]	1519[b]	2059[b]
Glucose (15%)	567[a]	1564[a]	2131[a]
Glucose (20%)	564[a]	1575[a]	2139[a]
Glucose (25%)	571[a]	1570[a]	2141[a]
p - value	0.0007	0.0001	0.0001
SEM	4.02	4.45	5.20

Table 4 - Effect of *in-ovo* injection of glucose on the feed conversion ratio of broiler chickens during different periods.

Groups	1-21 days of age (g)	21-42 days of age (g)	1-42 days of age (g)
Control	1.35[b]	2.11[a]	1.91[b]
Sham	1.38[a]	2.12[a]	1.93[a]
Glucose (15%)	1.32[bc]	2.08[b]	1.88[c]
Glucose (20%)	1.33[bc]	2.06[b]	1.87[c]
Glucose (25%)	1.33[c]	2.08[b]	1.88[c]
p - value	0.0026	0.0001	0.0001
SEM	0.01	0.006	0.004

DISCUSSION

Ipek *et al.* (2004), investigating the effect of *in-ovo* injection of different levels glucose in broiler breeder eggs on hatchability, reported that eggs injected with 0.5 ml of deionized sterile water containing 5, 10 and 15 mg of glucose did not differ significantly. On the other hand, in the present study, the injection of glucose in the albumen reduced hatchability, Another study also showed that the injection of glucose in the albumen reduced the hatching percentage of newly-hatched chicks compared with the control group (Bhanja *et al.*, 2008). Also, Pedroso *et al.* (2006) observed that, when chick embryos received an *in-ovo* injection of glucose at 16 days of incubation, hatchability decreased.

The observed reduced hatchability possibly results from the injection in the albumen, that may have caused an allergic reaction under the air sac that stopped the respiration of the developing embryo, causing its death. Previous studies showed that on *in-ovo* administration of hormones such as corticosteroids on embryonic day 7 resulted in 35% decline of hatchability (Heiblum *et al*. 2001). All reviewed studies relative to *in-ovo* manipulation, including the present study, especially in early embryonic life, were not successful in terms of hatchability (Kocamis *et al*. 1998; Kocamis *et al*. 1999; Lamosova *el al*. 2003; Heiblum *et al*. 2001).

Accelerated embryo development and improved nutritional status afforded by *in-ovo* feeding improved hatching weight and growth rate (Al-Murrani, 1982; Ohta *et al.*, 1999; Bhanja *et al.*, 2004). Chen *et al.* (2009) stated that the *in-ovo* injection of carbohydrates improved duck weight gain in the early days of post-hatch. In the present study, the weight of newly-hatched chickens was significantly higher when glucose was injected *in-ovo* compared with that of the control and sham groups. Previous studies demonstrated that the weight of newly-hatched chickens is an important predictor of market weight in chickens. Although this correlation between hatching weight and market weight may differ among strains, the effect of hatch weight on market weight apparently increases as broiler breeding companies continue to select for ever-increasing growth rates (Wilson, 1991; Vieira & Moran, 1999a, b; Havenstein *et al.*, 2003). Wilson (1991) indicated that each 1 g of increase in body weight at hatch resulted in 8 to 13 g increase in body weight at market age. In this study, we showed that an one g of increase in body weight at hatch due to *in-ovo* injection of glucose resulted in 60 to 63 g of increase in body weight on day 42. Amitav *et al.* (2007) demonstrated that the *in-ovo* injection of glucose in the eggs of small white turkeys had significantly higher body weight throughout the experimental period and, at 6 weeks of age, there was a difference of 76-78 g in body weight between the glucose-injected groups and the control group. In the present study, results were consistent with the report of Amitav *et al.* (2007) on broiler body weight. This additional energy source probably supported the late development of the embryo, resulting in a significant increase in the weight of newly-hatched chickens and their subsequent performance. Leitao *et al.* (2008) concluded that, the *in-ovo* injection of glucose had no

effect on the chicken performance. However, in the present experiment, chicks hatched from eggs injected with glucose presented better weight gain and feed conversion ratio compared with those hatched from eggs of the control and sham groups throughout the experimental rearing period. Bhanja *et al.* (2008) also showed that the feed conversion ratio during early post-hatch period was better in the glucose-injected group than the control group. Nevertheless, age, strain, egg size or flock broiler breeder conditions may influence the performance of broilers. Therefore, it can be suggested that the effect of glucose should be examined considering those factors.

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