Global Veterinaria 6 (5): 429-432, 2011
ISSN 1992-6197

The Effects of *In ovo* Administration of Glucose on Carcass Characterizes of Broiler Chickens

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Abstract: The present study was conducted to determine the effects of *in ovo* feeding of glucose on growth performances and carcass traits of broiler chickens. 720 fertile eggs were divided to five groups: 1) control group (no injection), 2) group including 0.5 ml deionized water (sham group), 3) group including 0.5 ml glucose 15% in deionized water, 4) group including 0.5 ml glucose 20% in deionized water and 5) group including 0.5 ml glucose 25% in deionized water with four replicates per treatment and 36 eggs per replicate. At the time of hatching, chicks were weighed and transferred to experimental house and reared for 42 days. Live weight was measured for each experimental unit at 1 and 42 days of age. On day 42, one chick from each replicate was killed for carcass analysis. In conclusion, group glucose 15%, 20 and 25% as compared with control and sham group had significantly higher the weight of newly-hatched chickens and final body weight ($p<0.01$). Also, chicks from *in ovo* feeding of glucose had improved weight carcass and breast than the control and sham group ($p<0.05$). But, glucose administrated *in ovo* did not have a statistically significant effect on legs, wings, neck, liver, heart and gizzard of broiler chicken.

Key words: Glucose · *In ovo* injection · Newly-hatched chick

INTRODUCTION

Glucose is a simple sugar (monosaccharide) and an important carbohydrate in biology. Cells use it as the primary source of energy [1]. Apart from the crucial role of glucose in the body; it is also used in the manufacture of a number of products. Nevertheless, the whole carbohydrate of egg doesn't exceed 1%. Despite the small amount of carbohydrate supply, glucose is the most important source of energy needed for the growth of embryo [2]. Therefore, the glucose naturally available in eggs may not be sufficient to meet the immediate metabolic demands of the embryo. Embryos prefer to use glucose rather than fatty acids for energy production because oxygen availability is limited before hatching and with the same amount of oxygen consumption, glucose oxidation provides more energy than lipid catabolism [3].

In ovo feeding is a practical means by which to safely introduce external nutrients into developing embryos. Nutrient *in ovo* injection may provide poultry companies with an alternative method to increasing weight of newly-hatched chick and growth performance [4].

A novel method of supplementing the *in ovo* nutriture of oviparous species, described as *in ovo* feeding within the US Patent (6592878) of Uni and Ferket [5], was demonstrated to be an effective way to administer exogenous nutrient to support the development of the embryos and neonates in broiler [6]. Our hypothesis was tested by providing glucose to the albumen of broiler embryos at 7 days of incubation by employing the *in ovo* injection method established before. The objective of the present study, therefore, was to evaluate the effect of glucose by the *in ovo* injection method during the incubation stage on growth performance and carcass traits of broiler chickens.

MATERIALS AND METHODS

Eggs used in the experimental were obtained from Cobb-500 broiler breeder strain at 28 weeks of age. All eggs were collected from the same breeder flock and weighed on a balance with 0.1 g precision and eggs with a weight of 60 ± 1 g were incubated at 37.8°C and %63 RH. 720 fertile eggs were divided to five groups: 1)

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control group (no injection), 2) group including 0.5 ml deionized water (sham group), 3) group including 0.5 ml glucose 15% in deionized water, 4) group including 0.5 ml glucose 20% in deionized water and 5) group including 0.5 ml glucose 25% in deionized water with four replicates per treatment and 36 eggs per replicate. The experimental design was a completely randomized design. At the time of hatching, chicks were weighed and transferred to experimental house and reared for growth performances study. Live weight was measured for each experimental unit at 1 and 42 days of age. Pure glucose was supplied from Merck Co) Item Catalog Number 108337.0250). On the 6th day of incubation, the eggs were candled and unfertilized eggs or those containing only dead embryos were discarded. On day 7 of incubation, eggs were removed from the incubator for 10 min to perform glucose injections. Then, the injection was carried out in the albumen of eggs. The control group was kept in the same environmental conditions during treatments. Chicks were reared up to 42 d of age and provided with a standard broiler ration [7]. Food and water were available *ad libitum*. At day 42, four birds from per treatment were randomly taken to carcass traits. Chicks were fasted for approximately 12 h and then individually weighed, slaughtered, feathered and eviscerated. Weight of cutting parts of carcass (breast, legs, wings and neck) and organs of birds (heart, liver and gizzard) were recorded. So, the percentage of carcass, cutting parts of carcass and organs of birds (% of live body weight) were calculated. Results were analyzed by ANOVA using the GLM procedure of SAS software Ver.9.1. Differences between treatments were compared by the Duncan's multiple range tests following ANOVA and values were considered statistically different at $P < 0.05$.

RESULTS AND DISCUSSION

Weight of newly-hatched chickens and final body weight of chickens in the group that received glucose injection was higher than control and sham group ($P<0.01$) (Table 1). As shown in Table 2, Chicks from *in ovo* injection of glucose had improved percentage of carcass and breast than the control and sham group ($P<0.05$). Also, glucose administrated *in ovo* did not have a statistically significant effect on legs, wings and neck of broiler chicken. But, percentage of legs, wings and neck had numerically higher in chicks hatched from eggs injected with glucose than control and sham group. *In ovo* injection of glucose hadn't any significant effect on liver, heart and gizzard of broiler chickens in 42 day of age (Table 3).

Table 1: Effect of *in ovo* feeding of glucose on weight of newly-hatched chickens and Final body weight of broiler chickens

Groups	Weight of newly-hatched chickens (g)	Final body weight (g)
Control	39.22^{b}	2070.9^{b}
Group sham	39.27^{b}	2058.7^{b}
Glucose (15%)	40.24^{a}	2130.9^{a}
Glucose (20%)	40.16^{a}	2139.1^{a}
Glucose (25%)	40.26^{a}	2140.8^{a}
P-Value	0.0001	0.0001
SEM	0.11	5.20

Table 2: Effect of *in ovo* feeding of glucose on percentage of carcass and cutting parts of carcass (as percentage of live weight) of broiler chickens

Groups	Carcass (%)	Breast (%)	Leg (%)	Wing (%)	Neck (%)
Control	67.39^{b}	25.68^{b}	29.85	5.160	6.680
Group sham	67.34^{b}	25.73^{b}	29.71	5.060	6.830
Glucose (15%)	68.27^{ab}	26.01^{ab}	30.16	5.170	6.920
Glucose (20%)	68.87^{a}	26.49^{a}	30.11	5.220	7.040
Glucose (25%)	68.51^{a}	26.18^{ab}	30.25	5.160	6.910
P-Value	0.022	0.028	0.168	0.915	0.732
SEM	0.344	0.173	0.166	0.120	0.185

Table 3: Effect of *in ovo* feeding of glucose on organs of broiler chickens (as percentage of live weight)

Groups	Liver (%)	Heart (%)	Gizzard (%)
Control	2.060	0.489	0.790
Group sham	2.110	0.490	0.800
Glucose (15%)	2.140	0.480	0.740
Glucose (20%)	2.100	0.483	0.770
Glucose (25%)	2.070	0.481	0.760
P-Value	0.086	0.192	0.232
SEM	0.966	0.003	0.019

Leitao *et al.* [8] concluded that, *in ovo* injection of glucose hadn't any affect on the growth rate of chickens. In addition, Pilarski *et al.* [9] stated that, oligosacharides administrated *in ovo* at a dose of 1.763 mg/egg did not have a statistically significant effect on the weight of the carcass and breast muscle of broiler chicken. On the contrary, in the present study, injection of glucose in the albumin had improved weight of newly-hatched chickens, Final body weight, weight carcass and breast as compared with control and sham group. Also, Ingram *et al.* [10] investigated the effect of *in ovo* injection of glucose in varying levels to broiler breeder eggs on the chick weight and subsequent body weight and reported that, glucose significantly improved body weight. It has previously been shown that, the *in ovo* injection of a mixture of carbohydrates dissolved in saline [sucrose (a monosaccharide), maltose (a disaccharide) and dextrin (a polysaccharide)] on d 17 or 17.5 of incubation improved embryonic development and subsequently increased total chick body weight at hatch [6, 11, 12]. Amitav *et al.* [13] demonstrated that, *in ovo* injection of glucose in eggs of small white turkey had significantly higher body weight through out the experimental period and at 6 weeks of age there was difference of 76-78 g in body weight between glucose injected groups and control group. Uni *et al.* [11] showed that, weight of newly-hatched chickens from *in ovo* injection of carbohydrate in eggs of broiler breeder was 5 to 6% heavier than the control group and these body weight differences continued until the end of the experiment. Our results further demonstrated that *in ovo* feeding of glucose at 7 day of incubation can improve the energy status of late-term broiler embryos and improve early growth to enhance the genetic potential for late embryonic, early post-hatch growth,percentage of carcass and breast. Thus, the glucose level available to the late-term embryo for hatching and post-hatch survival is dependent upon the glycogen reserve and gluconeogenesis, which is induced when glucose intake is insufficient to meet the metabolic glucose demands [14]. The late-term embryo and neonatal chick depend on gluconeogenesis from amino acids [15], resulting in the depletion of muscle protein reserves and reduced early growth and development [16]. To reduce the use of liver glycogen reserves and the depletion of muscle protein we hypothesized that *in ovo* feeding of glucose into the embryonic albumen prior to hatch would support the energy status of the hatchling by elevating the glycogen reserves, moderating the use of muscle proteins and thus contributing to enhance post-hatch performance.

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