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Effect of Dipping Eggs Time into Different Glucose Solutions on Hatchability and Subsequent Growth Performance of Hatched Domyati Ducklings

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ABSTRACT

This study amid to investigate the effect of dipping fertile Domyati duck eggs contained different glucose solutions (0.0, 5.0, 10.0 and 15.0%) and two dipping times (3 and 6 minutes) at the 24th day of incubation period on hatchability traits, duckling's quality and some blood parameters as well as subsequent growth performance of hatched ducklings and economic efficiency. A total number of 432 fertile eggs of Domyati duck at the 24th day of incubation period were distributed into eight experimental groups, each of three replicates in a factorial design (4 x 2). At the end of the 28th day of incubation period dead embryos, unhatched eggs, culled and healthy hatched ducklings were counted as well as hatched ducklings' length (cm) and weight (g) were recorded. Hatched ducklings of each experimental group were divided into three replicates and reared till 21 days of age to study the effect on subsequent growth performance and economic efficiency. Hatchability of fertile eggs was insignificantly improved by about 9.47 % of eggs dipped into 10.0% glucose solution as compared with those dipped into 0.0% glucose solution, while it was significantly decreased by dipping eggs into 15.0%glucose solution. Dead embryos (%) was insignificantly decreased by dipping eggs into 10.0%glucose solution than those dipped into 0.0% glucose solution only. Moreover, no significant changes in hatched weight, duckling's length (cm) and culled ducklings (%) due to dipping eggs into different glucose solutions. Dipping time of eggs had no significant effects on all studied hatching traits, while interaction between glucose solution and dipping time had significant effects on dead embryos, unhatched eggs and hatchability (%). Serum cholesterol level was significantly decreased in hatched ducklings produced from eggs dipped into 5.0 and 15.0% glucose solution comparing with those dipped into 0.0 and 10.0% glucose solutions at hatch. Dipping time of eggs had no significant effects on all studied blood parameters, while interaction between glucose solution and dipping time had significant effects on blood glucose and cholesterol. All studied growth performance traits were significantly affected due to dipping eggs into different glucose solutions, and the interaction between glucose solutions and dipping time except of FCR for hatched ducklings during the whole experimental period. Performance index recorded the best value of ducklings produced from eggs dipped into 10.0% glucose solution for 3 minutes (G5) than other interaction during the period of 1-21 days of age. No significant differences were recorded in relative weights of different carcass parts at hatch and 21 day of age except of liver at 21 day of age. Ducklings produced from eggs dipped into 10.0% glucose solution for 3 minutes (G5) recorded the best net return and economic efficiency than other interactions. It was concluded that dipping fertile Domyati duck eggs into 10.0% glucose solution for 3 minutes at the 24th day of incubation period could be used for improving hatchability, growth performance, net return and economic efficiency.

Keywords: Glucose solution, dipping time, hatchability, ducklings, growth performance, economic.

INTRODUCTION

The hatching process demands a readily available source of carbohydrates. Glucose and glycogen are preferentially utilized as energy sources over lipids and protein during chicken embryogenesis, especially during the last few days before hatch (Moran, 2007). Glucose ($C_6H_{12}O_6$) is a simple sugar (monosaccharide) and an important carbohydrate in biology (Clark and Sokoloff, 1999). It is the most important source of energy needed for development and growth of the chicken embryo (Starck and Rickelefs, 1998). Glucose injection into egg can be considered as a good solution for using better and easier than other sources of energy for the embryo therefore, this action causes to reduce the consumption of protein muscle as energy and increasing of newly- hatched chicks (Uni *et al.,* 2005). Glycogen stores decrease to a very low level at hatch and start rising when the newly hatched chick has access to oxygen so as to use fully the fat stored in the yolk sac and in the glycolytic muscles (Christensen *et al.,* 2001). Toward the end of incubation, the bird utilizes their energy reserves to meet the high demand for glucose which fuels hatching activities. The dipping method known is an *in ovo* feeding method to supply embryos with nutrient solutions to improve the performance of ducks production. Dipping eggs during the incubation period is one of the methods which used to improve hatchability percentage and chicks quality at hatch (Ghonim *et al.,* 2009), they concluded that it is considered the easiest method as compared to the injecting and spraying eggs methods.

Domyati ducks is one of Egyptian indigenous duck breeds; it reared for a diverse production situations such as meat and egg production. In addition to it has more favorable to the Egyptian consumers because they provide a medium carcass that is lower in fat than most large ducks and the meats taste like the emigrant duck bird Balboul (El-Shhat, 2002).

The improvement of duck eggs hatchability is an important and critical input for the cost of hatched ducklings at one day of age. Nowadays, positive effects of *in ovo* feeding of embryos during incubation period with nutritive solutions may have increasing the hatchability, growth performance, marketing weights in order to reduce the total production cost to improve the total return, net return and economic efficiency. Information about the effects of *in ovo* feeding by glucose solution during few days' pre and post-hatch incubation for local duck eggs is lacking. Thus, the goal of this study was to evaluate the effect of dipping fertile Domyati duck eggs into different glucose solutions and dipping times at the 24th day of incubation period on hatching traits, duckling's quality and blood parameters as well as subsequent growth performance of hatched ducklings and economic efficiency.

MATERIALS AND METHODS

The present study was conducted at the Laboratory of Poultry Production Department, Faculty of Agriculture, Damietta University, Egypt, with Co-operation El-Serw Waterfowls Research Station, Animal Production Research Institute, Agricultural Research Center, Damietta, Egypt, from March to May, 2017. A total number of 432 Domyati duck eggs which contained life embryos at the 24th day of incubation period were distributed into eight experimental groups, each of three replicates in a factorial design (4 x 2), to investigate the effect of dipping eggs into different glucose solutions (0.0, 5.0, 10.0 and 15.0%) and two dipping times (3 and 6 minutes). The description of treatments were done as follows: G1: dipped into distilled water for 3 minutes, G2: dipped into distilled water for 6 minutes, G3: dipped into 5.0% glucose solution for 3 minutes, G4: dipped into 5.0% glucose solution for 6 minutes, G5: dipped into 10.0% glucose solution for 3 minutes, G6: dipped into 10.0% glucose solution for 6 minutes, G7: dipped into 15.0% glucose solution for 3 minutes and G8: dipped into 15.0% glucose solution for 6 minutes. The distilled water used for freshly preparing the dipping solutions at incubation temperature degree. Eggs were dipped into the experimental solutions, according to Meir and AR (1984). The treated eggs were transferred to the hatcher which maintaining at 97.3°F temperature and 82% relative humidity.

Data collection and estimated parameters:

At the end of 28th day of incubation embryo dead, unhatched eggs, healthy hatched ducklings and culled ducklings were counted, then hatchability and embryonic mortality were calculated as well as healthy hatched duckling's length (cm) and weight were measured. At hatch 3 ducklings were randomly taken and slaughtered from each treatment group to determine weights and relative weights of liver and pectoral muscle (mg/ g of live body weight) according to Haddad (1989). Blood samples were collected during slaughter at hatch in a separate two tubes. The first heparinized tube was immediately used for hematological estimation (Hb , RBC's, WBC's and hematocrit), while another non- heparinized blood tube was centrifuged (3500 rpm) for 15 minutes to obtain blood serum that stored at -20°C till analysis using commercial kits supplied by Egyptian company for biotechnology to determine glucose according to (Ellefson and Caraway, 1976). Triglycerides, cholesterol and high-density lipoprotein (HDL) were determined according to the method described by Young, (1995).

The hatched ducklings per each treatment were leg-banded, weighed individually and divided into equal three replicates. The hatched ducklings were brooded in well-ventilated pens and dry wheat chaff was used. The ducklings of each replicate were housed as 10 ducklings / m^2. All ducklings were reared under similar hygienic and managerial conditions. Fresh water and mash feed were offered *ad libitum* during the experimental period (21 day of age). The starter diet was formulated from plant origin according to Feed Composition Tables for Animals and Poultry Feedstuffs used in Egypt (2001), the composition and calculated analysis of this diet are presented in Table 1.

Hatched duckling's performance:

The ducklings were individually weighed at hatch and 21days of age (LBW). The body weight gain (BWG), feed consumption (FC), feed conversion ratio (g feed/g gain), and mortality were recorded for each replicate during the whole experimental period. Performance index (PI) of the ducklings was calculated (live body weight, Kg / feed conversion ratio * 100) according to North (1984).

Slaughter traits:

At the end of the experiment (21 days of age), a total number of 24 ducklings (3 from each treatment) were representing the average body weight of each treatment were fasted for 12 hrs. After slaughtering, complete bleeding and feathers were removed by hand. Carcass was eviscerated then feet, head and shanks were removed and the whole carcass weighed. Liver, thigh and breast's percentage were calculated in relation to respective live body weight.

Table 1. Composition and calculated analysis of the starter diet offered to the Domiaty duckings.

Ingredients	%
Yellow corn	65.20
Soybean meal (44%)	21.50
Corn gluten meal (60%)	9.25
Limestone	1.30
Di-calcium phosphate	1. 90
Vit.& Min. Premix[1]	0.40
Salt (NaCl)	0.35
Dl–methionine (97%)	0.10
Total	100.00
Calculated analysis[2]:	
Crude protein (%)	20.03
ME (kcal/ kg)	3005
Calcium (%)	1.02
Av. Phosphorus (%)	0.48
Methionine (%)	0.52
Price (LE /Kg diet)[3]	7.00

[1] **Each 3 kg of the Vit. and Min. premix contains: Vitamin A, 10000000 IU, Vit. D 2 000000 IU, Vit E10 g, Vit. K 2 g, Thiamin 1 g, Riboflavin 5 g, Pyridoxine 1.5 g, Niacin 30 g, Vit. B12 10 mg, Pantothenic acid 10 g, Folic acid 1.5 g, Biotin 50 mg, Choline chloride 250 g, Manganese 60 g, Zinc 50 g, Iron 30 g, Copper 10 g, Iodine 1g, Selenium 0. 10 g, Cobalt 0.10g.andcarrierCaCo3to3000g.**

[2]**- According to Feed Composition Tables for animal and poultry feedstuffs used in Egypt (2001).**

[3]**-According to the price of different ingredients available in Egypt at the experimental time.**

Economic evaluation:

At the end of the study, economic efficiency was calculated according to input-output analysis (Heady and Jensen, 1954) in relation to prices of local market at the time of the study.

Statistical analysis:

Data obtained were statistically analyzed by two way analysis of variance using the General Liner Model of SAS (2002), the statistical model used was:

$$Y_{ijk} = \mu + G_i + T_j + (GT)_{ij} + e_{ijk}$$

Where: Y_{ijk}=trait measured, μ =Overall mean, G_i = Concentration glucose solution effect (i = 1, 2, 3 and 4), T_j = Dipping time effect (j = 1 and 2), $(GT)_{ij}$ =Interaction between concentration glucose solution and dipping time and e_{ijk} = Random error.

When significant differences among means were found, means were separated using Duncan's multiple range test (Duncan 1955).

RESULTS AND DISCUSSION

Hatchability traits:

Results in Table 2 shows that the dead embryos dead's (%) was significantly (P≤0.01) decreased by 56.03% of eggs dipped into 10.0% glucose solution than those dipped into 5.0 % glucose solution, while it was insignificantly decreased by 34.30 and 50.0% than those dipped into 0.0 and 15.0% glucose solution, respectively. On the other hand, it is evidently not significantly affected due to different eggs dipping time (DT). Regarding, the interaction between G and DT it was observed that eggs dipped into 10.0 % glucose solution for 3 and 6 minutes (G5 and G6) recorded the lowest dead embryos (%) while, eggs dipped into 5.0% glucose solution for 3 minutes (G3) and eggs dipped into 15.0%glucose solution for 6 minutes (G8) recorded the higher dead embryos (%) than other interactions.

Dipping eggs into 5.0% glucose resulted in a significant decrease (P≤0.05) in unhatched eggs (%) than those dipped into 15.0% glucose solution by 32.57% (Table 2). On the other hand, no significant differences were observed in unhatched eggs (%) due to dipping times (DT). It clearly that the better groups resulted from the interaction between G and DT were G3 and G4 , which recorded the lowest unhatched eggs (%), whereas, the worst groups were G7 and G8 as a result of the higher percentage of unhatched eggs than other interactions.

Table 2. Effect of dipping fertile duck eggs into different glucose solution and dipping times at the 24th day of incubation on the hatchability traits and duckling quality.

Mean effects		Hatchability traits				Duckling quality	
		Embryo dead's (%)	Piped and unhatched eggs (%)	Hatchability (%)	Weight at hatch (g)	Duckling length (cm)	Duckling culling (%)
Effect of glucose solution concentration (G), %							
0		15.80^{ab}	16.49^{ab}	67.71^{ab}	44.76	19.88	3.70
5		23.61^{a}	12.90^{b}	63.49^{ab}	43.52	19.72	1.85
10		10.38^{b}	16.83^{ab}	74.12^{a}	42.47	19.77	1.85
15		20.76^{ab}	19.13^{a}	60.12^{b}	43.32	19.87	1.85
SEM		5.86	3.53	6.20	2.82	0.21	0.18
Sig.		**	*	*	NS	NS	NS
Effect of dipping time (DT), minutes							
3		17.27	15.29	67.44	44.24	19.84	3.70
6		17.20	17.58	65.89	43.13	19.78	1.85
SEM		6.88	3.70	7.19	2.72	0.23	0.24
Sig.		NS	NS	NS	NS	NS	NS
Interaction effect (G x DT)							
0	3	15.98^{b}	14.80^{ab}	69.22^{ab}	45.90^{a}	19.58	3.70
	6	12.39^{bc}	18.98^{a}	68.63^{ab}	45.00^{a}	20.19	3.70
5	3	26.45^{a}	12.07^{b}	61.48^{ab}	45.00^{a}	19.88	3.70
	6	20.77^{ab}	13.72^{b}	65.51^{ab}	42.03^{b}	19.56	3.70
10	3	10.92^{c}	15.35^{ab}	73.73^{a}	43.77^{ab}	19.98	3.70
	6	9.84^{c}	18.32^{a}	74.51^{a}	41.17^{b}	19.55	1.85
15	3	15.73^{b}	18.94^{a}	65.33^{ab}	42.30^{b}	19.90	1.85
	6	25.78^{a}	19.31^{a}	54.90^{b}	44.33^{ab}	19.83	1.85
SEM		5.33	3.47	5.93	2.24	0.18	0.21
Sig.		*	*	*	*	NS	NS

SEM : Standared error of means.
ab and c: means value in the same column followed by different letters are significantly different at P≤0.05 ;
NS= not significant; * = P≤ 0.05; ** = P≤ 0.01

Hatchability of fertile eggs (%) was significantly (P≤0.05) improved by 23.29% of eggs dipped into 10.0% glucose solution than those dipped into 15.0 % glucose solution, while it was insignificantly improved by 9.47 and 16.74% than those dipped into 0.0 and 5.0% glucose solution, respectively (Table 2). On the other hand, no significant differences were observed in hatchability due to the different dipping time (DT). Concerning the effect of the interaction between G and DT on hatchability, it could be observed that the best hatchability (%) was recorded for G5 and G6 groups, while the worst group was G8 which had the lowest hatchability (%) than other interactions. The improvement of hatchability may be due to the decrease of both dead embryos and unhatched eggs (%). The findings of the present study were similar to Ingram *et al;* (1997), Uni *et al;* (2005), Rizk and Ibrahim (2014) and Letsoalo, (2015) who found that *in ovo* injection of glucose solution increased hatchability rate. In contrary, Adriana *et al.* (2006) , Pedroso *et al.* (2006) and Leitao *et al*., (2008), found that hatchability was decreased when embryos received *in ovo* injection of glucose at day 16 of chicken egg incubation. Salmanzadeh (2012) and Ipek *et al.,* (2004) reported that *in ovo* glucose injection did not affect hatchability of broiler chicken eggs. The authors suggested that *in ovo* glucose feeding may have caused allergic reaction under the sac and stopped respiration of the developing embryo which ultimately led to death of the embryos.

Data in Table 2 showed that no significant differences in hatched ducklings weight due to dipping the fertile Domyati duck eggs at the 24th day of incubation period into different glucose solutions (G) or dipping times (DT), while the interaction between (G) and (DT) had significant (P≤0.05) effect in duckling's weight at hatch. Ducklings of groups G5 had heavier weights than other interactions. This result may be due to *in ovo* feeding by carbohydrates during incubation period resulted in an improve nutritional status and embryonic growth, resulting in increased weight at hatch due to surplus supply of glucose (Lourens *et al.,* 2006, Uni *et al.,* 2005; Zhai *et al.,* 2011, Shafey *et al.,*2012, and Letsoalo, 2015).

Duckling's length (cm) and culled ducklings (%) at hatch were not significantly affected due to neither dipping of fertile Domyati duck eggs into different glucose solutions (G), dipping times (DT) nor the interaction between them at the 24th day of incubation (Table 2). Nevertheless, Mukhtar *et al*., (2013) showed that the chick length is now considered to be the best method of evaluating visual quality in meat type chickens. Also, Christensen *et al*., (2000) found that from the factors are effect on chick length is better *in ovo* feeding of glucose solution.

Blood constituents:

Serum glucose and cholesterol levels were significantly affected due to dipping eggs into different glucose solutions and the interaction between G and DT at hatch (Table 3), while, the other studied serum constituents were not significantly affected. On the other hand, dipping time had no significant differences in all studied serum constituents. All studied blood hematological parameters (Hb, RBC's, WBC's and hematocrit) were not significantly affected due to treatment. These results are in the line with Rizk and Ibrahim (2014) who found that serum total lipids was not significantly affected in chicks produced from egg *in ovo* injected at 18th day of incubation by nutritive solutions. Christensen *et al.,* (2000) and Ebrahimnezhad *et al.,* (2011) reported that there was a positive relationship between broiler chick hatch-weight and blood glucose concentration. Also, Togun *et al.,* (2007) indicated that the *in ovo* feeding patterns had no any adverse effect on hematological parameters of hatched chicks.

Table 3. Effect of dipping fertile duck eggs into different glucose solution and dipping times at the 24th day of incubation period on blood parameters of ducklings at hatch

Mean effects		Some blood metabolites				Blood hematological traits			
		Glucose (mg/dl)	Trigly. (mg/dl)	Chole. (mg/dl)	HDL (mg/dl)	HB (g/dl)	(RBC's) $\times10^6$ul	WBC ($x10^3/mm^3$)	Hematocrit (HCT), %
Effect of glucose solution concentration (G), %									
0		206.56^a	192.11	174.78^a	66.42	10.24	6.17	26.22	0.49
5		179.50^b	222.33	154.00^b	60.39	11.92	5.82	28.00	0.35
10		192.17^{ab}	202.00	171.33^a	71.84	12.92	5.75	24.00	0.43
15		196.17^a	227.67	134.83^c	65.25	10.18	6.40	22.50	0.53
SEM		12.92	7.21	5.59	4.01	1.19	0.81	1.68	0.06
Sig.		*	NS	**	NS	NS	NS	NS	NS
Effect of dipping time (DT), minutes									
3		190.92	203.92	170.67	68.27	11.90	5.98	27.58	0.46
6		197.83	230.75	165.08	62.59	10.91	5.39	23.00	0.45
SEM		15.60	89.22	64.59	6.05	0.75	1.63	1.24	0.08
Sig.		NS	NS	NS	NS	NS	NS	NS	NS
Interaction effect (G x DT)									
0	3	210.33^a	210.33	156.00^b	68.67	11.43	5.80	23.33	0.46
	6	209.00^a	224.33	146.67^c	60.35	12.77	6.07	20.00	0.55
5	3	150.67^c	283.00	150.00^{bc}	69.21	11.27	6.57	28.00	0.34
	6	208.33^a	161.67	158.00^b	66.73	12.57	6.47	28.00	0.37
10	3	201.67^{ab}	200.33	181.00^a	61.08	10.93	6.03	22.33	0.46
	6	182.67^b	203.67	174.67^a	63.97	12.90	6.27	25.67	0.40
15	3	201.00^{ab}	229.33	153.33^{bc}	69.04	11.00	6.67	26.67	0.53
	6	191.33^{ab}	226.00	166.33^{ab}	66.28	10.37	6.13	28.33	0.53
SEM		8.72	5.42	5.09	5.86	1.09	0.18	1.73	0.07
Sig.		**	NS	*	NS	NS	NS	NS	NS

SEM : Standared error of means.

ab and c: means value in the same column followed by different letters are significantly different at $P\leq0.05$;

NS= not significant; * = $P\leq 0.05$; ** = $P\leq 0.01$

Subsequent growth performance of hatched ducklings:

Data in Table 4 showed that LBW at 21 day of age was significantly ($P\leq0.05$) improved by 12.89, 12.36% for ducklings produced from eggs dipped into 15.0% glucose solution than those produced from eggs dipped into 0.0 and 5.0 % glucose solution, respectively, while it was insignificantly increased by 10.29% as compared with those produced from eggs dipped into 10.0% glucose solution at 21 day of age. On the other hand, no significant differences were observed in LBW due to different dipping time at 21 day of age. Interaction between different glucose solutions (G) and dipping time (DT) had significant effect on LBW at 21 day of age; the ducklings produced from eggs dipped into 10.0% glucose solution for 3 minutes (G5) had significant ($P\leq0.01$) heavier LBW than the all of the other interaction groups. This may be due to *In ovo* glucose feeding possibly, accelerated maturation of the gastrointestinal tract which increased feed intake, digestibility and nutrient absorption (Sunny, 2008 and Murakami *et al.,* 2007) resulting in increased live body weight of the chickens. Also, Amitav *et al*. (2007) reported that *in ovo* injection with glucose in turkey eggs had significantly higher body weight at 6 weeks of age.

Body weight gain (BWG) was significantly ($P\leq0.05$) increased by about 15.42 and 14.36% for ducklings produced from eggs dipped into 10.0 % glucose than those produced from eggs dipped into 0.0 and 5.0% glucose solutions, respectively during 1-21 day of age (Table 4). The ducklings BWG were not significantly affected due to different dipping time. Interaction between G and DT had significant effect on BWG at the period of 1-21 day of age; the ducklings produced from eggs dipped into 10.0% glucose solution for 3 minutes (G5) recorded an improvement in BWG than other interactions during 1-21 days of age. This result are in the line with Chen *et al.* (2009) who reported that *in ovo* injection of carbohydrates improved duckling weight gain in the early days of post-hatch. Also, Salmanzadeh (2012) stated that broiler chicks hatched from eggs injected with glucose had better weight gain throughout the experimental rearing period.

Data in Table 4 clearly indicated that FC amount per duckling was significantly ($P\leq0.05$) increased by15.55 and 13.28% for ducklings produced from eggs dipped into 10.0% glucose solution than those produced from eggs dipped into 0.0 and 5.0 % glucose solution, respectively during 1-21 day of age. On the other hand, dipping time had no significant effects on FC amount.Regarding, the interaction between G and DT it had significant effect on FC during 1-21 day of age, it was evidently that ducklings in G5 had significantly higher FC amount while, the lower FC amount was recorded for ducklings in G1. Similar results were observed in feed consumption of broiler chickens that hatched from eggs injected with glucose (Salmanzadeh, 2012; Salmanzadeh *et al.*, 2011; Sunny, 2008; Bhanja, 2008; Amitav *et al*., 2007; Murakami *et al.,* 2007and Wilson, 1991). The authors attributed the increased of feed consumption may be to increase embryo nutritional status after *in ovo* glucose injection. However, Leitao *et al.*, (2008) observed no increasing of feed consumption of chickens hatched from eggs injected with glucose.

Results in Table 4 showed no significant differences in ducklings FCR due to dipping eggs into different glucose solution, dipping time and their interaction during the overall experimental period. These results are disagree with Bhanja *et al.* (2008) and Salmanzadeh (2012) who showed that broiler chicks hatched from eggs injected with glucose had improved feed conversion ratio throughout the experimental rearing period.

Performance index (%) was significantly ($P\leq0.05$) increased by13.37% for ducklings produced from eggs dipped into 15.0% glucose solution than those produced from eggs dipped into 5.0% glucose solution, while it was insignificantly higher when compared with those produced from eggs dipped into 0.0 or 10.0% glucose during the period of 1-21 days of age (Table 4). On the other hand, dipping time (DT) had no significant effect on PI. Interaction between G and DT had significant effect on PI at the period of 1-21 day of age, the ducklings produced from G5 which overabundance significant ($P\leq0.01$) PI during the period of 1-21 days of age than other interactions but the worst PI of ducklings was recorded for G6. These results are in agreement with Ingram *et al;* (1997) who investigated the effect of *in ovo* injection of different levels glucose in broiler breeder eggs prior to transfer to the hatcher significantly improved performance of produced chicken. However, Leitao *et al.* (2008) concluded that the *in ovo* injection of glucose had no effect on the broiler chicken performance.

Table 4. Effect of dipping fertile duck eggs into different glucose solution and dipping times at the 24th day of incubation period on subsequent growth performance of ducklings during rearing period.

Mean effects		LBW, (g) at 21 day	BWG, (g) 0-21 day	FC, (g) 0-21 day	FCR, (g feed/g gain) 0-21 day	PI, (%) 0-21 day
Effect of glucose solution concentration (G), %						
0		362.09^{b}	317.36^{b}	947.34^{b}	3.00	12.07^{ab}
5		363.80^{b}	320.30^{b}	966.28^{b}	3.08	11.82^{b}
10		370.63^{ab}	366.30^{a}	1094.62^{a}	3.04	12.19^{ab}
15		408.77^{a}	327.32^{ab}	995.33^{ab}	3.05	13.40^{a}
SEM		31.05	30.97	67.90	0.29	2.34
Sig.		*	*	*	NS	*
Effect of dipping time (DT), minutes						
3		384.33	340.10	994.86	2.97	12.94
6		374.52	331.40	1019.07	3.11	12.04
SEM		31.93	31.89	73.79	0.28	2.83
Sig.		NS	NS	NS	NS	NS
Interaction effect (G x DT)						
0	3	343.03^{c}	297.13^{b}	925.40^{b}	3.12	10.99^{c}
	6	405.97^{ab}	361.00^{ab}	1017.83^{ab}	2.82	14.40^{b}
5	3	353.03^{c}	308.03^{b}	935.13^{ab}	3.12	11.32^{c}
	6	374.57^{b}	332.57^{b}	997.43^{ab}	3.03	12.35^{bc}
10	3	456.60^{a}	412.83^{a}	1124.53^{a}	2.72	16.79^{a}
	6	360.93^{bc}	319.77^{b}	1064.70^{ab}	3.36	10.73^{c}
15	3	384.67^{bc}	342.37^{b}	994.37^{ab}	2.90	13.26^{bc}
	6	356.60^{bc}	312.27^{b}	996.30^{ab}	3.20	11.13^{c}
SEM		21.11	20.97	65.56	0.24	1.98
Sig.		**	*	*	NS	**

SEM : Standared error of means.

ab and c: means value in the same column followed by different letters are significantly different at $P\leq0.05$;

NS= not significant; * = $P\leq 0.05$; ** = $P\leq 0.01$

Weights of some body parts:

Results in Table 5 observed that no significant differences in relative weights of duckling liver and pectoral muscle (mg / g of live body weight) at hatch due to neither different glucose solutions, dipping times nor the interaction between them.

Dipping eggs into 10.0 % glucose solution resulted in a significant increase in relative weight of duckling liver (%) by about 32.17 and 22.33% as compared with those produced from eggs dipped into 0.0 and 5.0% glucose solution, respectively. While, it is no significantly affected due to dipping time on relative liver weight. The groups of ducklings produced from G5 and G6 had higher relative weight of liver than other interactions. This result are in the line with Uni *et al;* (2005) who found that *in ovo* injection of carbohydrate solution increased pectoral muscle size of chickens up to 25 days post-hatch. Relative weights of breast, thigh and liver (%) of chicks at 21 days of age were significantly affected by *in ovo* glucose injection (Salmanzadeh 2012, Rizk and Ibrahim 2014 and Letsoalo, (2015). While, Pilarski *et al*. (2005) observed that *in ovo* injection of oligosaccharides did not improve broiler carcass and breast meat weights.

Table 5. Effect of dipping fertile duck eggs into different glucose solution and dipping times at the 24th day of incubation period on relative weights of duckling liver and pectoral muscle (mg/g) at hatch and 21 day of age.

Mean effects		At hatching			At 21 days of age			
		Duckling at hatched weight,(g)	Liver (mg / g)	Pectoral muscle (mg / g))	LBW, (g) at 21 day	Liver (%)	Thigh (%)	Breast (%)
Effect of glucose solution concentration (G), %								
0		44.76	23.03	7.29	362.09^{b}	2.86^{b}	33.40	26.61
5		43.52	23.60	8.12	363.80^{b}	3.09^{b}	32.96	25.57
10		42.47	25.67	7.18	370.63^{ab}	3.78^{a}	34.30	27.24
15		43.32	24.84	6.92	408.77^{a}	3.01^{b}	33.10	25.94
SEM		2.82	2.94	1.67	31.05	0.51	2.48	2.07
Sig.		NS	NS	NS	*	*	NS	NS
Effect of dipping time (DT), minutes								
3		44.24	24.40a	7.55	384.33	3.29	33.80	25.89
6		43.13	25.24a	7.02	374.52	3.08	32.88	27.05
SEM		2.72	2.56	1.80	31.93	0.61	2.30	2.56
Sig.		NS	NS	NS	NS	NS	NS	NS
Interaction effect (G x DT)								
0	3	45.90^{a}	25.79	7.24	343.03^{c}	3.13^{ab}	34.04	25.99
	6	45.00^{a}	23.56	6.56	405.97^{ab}	2.57^{b}	31.96	28.28
5	3	45.00^{a}	22.64	6.58	353.03^{c}	2.99^{ab}	33.75	24.60
	6	42.03^{b}	24.56	6.96	374.57^{b}	3.20^{ab}	32.16	26.54
10	3	43.77^{ab}	26.05	7.29	456.60^{a}	3.89^{a}	35.15	27.62
	6	41.17^{b}	25.28	7.07	360.93^{bc}	3.66^{a}	33.44	26.85
15	3	42.30^{b}	23.12	7.25	384.67^{bc}	3.15^{ab}	32.24	25.34
	6	44.33^{ab}	25.55	6.59	356.60^{bc}	2.87^{ab}	33.96	26.54
SEM		2.24	2.42	1.71	21.11	0.52	2.19	2.22
Sig.		*	NS	NS	**	*	NS	NS

SEM : Standared error of means.
a and b: means value in the same column followed by different letters are significantly different at $P\leq 0.05$;
NS= not significant; * = $P\leq 0.05$ ** = $P\leq 0.01$

Economic evaluation:

In Table 6, at 21 days of age the ducklings produced from eggs dipped in 15% glucose was the best concentration than the other groups. It was surpassed the ducklings produced from eggs dipped in 0.0% glucose by 44.65 and 37.89 %, respectively in respect of net return and economic efficiency. On the other hand, economic efficiency was increased for ducklings produced from dipping eggs for 3 minutes than those dipped into 6 minutes by 31.12%. Regarding, the interaction between G and DT, the highest economic efficiency value of ducklings which produced from eggs dipped into 10.0% glucose solution for 3 minutes (G5) that increased the net return and economic efficiency. The increasing of net return and economic efficiency may be due to improve the performance index at marketing (Table 4) thus increasing of the total return, net return and economic efficiency.

Table 6. Effect of dipping fertile duck eggs into different glucose solution, dipping times and their interaction at the 24th day of incubation period on economic evaluation on the basis of selling ducklings at 21 days of age

Mean effects		Feed consump. (g)	Feed cost (EGP.)[1]	Total production costs (EGP.)[2]	Live body weight (g)[3]	Total return (EGP.)[4]	Net return (EGP.)[5]	Economic efficiency (%)[6]
Effect of glucose solution concentration (G), %								
0		947.34	6.63	11.05	362.09	13.76	2.71	24.49
5		966.28	6.76	11.27	363.80	13.82	2.55	22.63
10		1094.62	7.66	12.77	370.63	14.08	1.31	10.28
15		995.33	6.97	11.61	408.77	15.53	3.92	33.77
Effect of dipping time (DT), minutes								
3		994.86	6.96	11.61	384.33	14.60	3.00	25.83
6		1019.07	7.13	11.89	374.52	14.23	2.34	19.70
Interaction effect (G x DT)								
0	3	925.40	6.48	10.80	343.03	13.04	2.24	20.74
	6	1017.83	7.12	11.87	405.97	15.43	3.55	29.91
5	3	935.13	6.55	10.91	353.03	13.42	2.51	22.96
	6	997.43	6.98	11.64	374.57	14.23	2.60	22.32
10	3	1124.53	7.87	13.12	456.60	17.35	4.23	32.25
	6	1064.70	7.45	12.42	360.93	13.72	1.29	10.42
15	3	994.37	6.96	11.60	384.67	14.62	3.02	26.00
	6	996.30	6.97	11.62	356.60	13.55	1.93	16.58

[1] EGP.= Egyptian pound. [2] Assuming that the feed cost as 60 % of the total production cost according to (Singh *et al*; 2015).
[3] The local market price of 1 kg live body weight of duckling at 21 days of age was 38 EGP. at the experimental time.
[4]Total return (EGP.) = Live body weight * price of one kg at selling which was 50 EGP.
[5]Net return (EGP.) = Total return (EGP.) - Total production costs (EGP.).
[6]Economic efficiency (%)= Net return (EGP.) / Total production cost(EGP.)*100.

CONCLUSION

In conclusion, *in ovo* dipping fertile Domyati duck eggs at the 24^{th} day of incubation period into 10.0% glucose solution for 3 minutes could be used for improving hatchability percentage, subsequent growth performance of hatched ducklings, net return and economic efficiency.

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تأثير مدة غمر بيض البط فى محاليل مختلفة من الجلوكوز على صفات التفريخ وأداء النمو اللاحق للكتاكيت الفاقسة للبط الدمياطى

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تهدف هذه الدراسة إلى بحث تأثير غمر بيض التفريخ للبط الدمياطى فى محاليل ذات تركيزات مختلفة من الجلوكوز لمدد مختلفة على صفات التفريخ وجودة الكتاكيت وبعض مكونات الدم عند الفقس و أداء النمو وصفات الذبيحة وكذلك الكفاءة الاقتصادية. أستخدم عدد 432 بيضة مخصبة عند اليوم 24 يوم من فترة التفريخ فى تصميم تجريبى عاملى 4 X2 حيث تم توزيع البيض على ثمانية معاملات متساوية بواقع 54 بيضه لكل معامله و كانت العوامل هى : تركيز محلول الجلوكوز (0 و 5 و 10 و 15 %) و مدة غمر البيض (3 دقائق و 6 دقائق). وعند الفقس تم تربية الكتاكيت الناتجة من كل معاملة لمدة 21 يوم حيث تم تسجيل الوزن الحي للكتاكيت الناتجة وكذلك العليقة المستهلكة وحساب معدل الزيادة في الوزن الحي و معدل التحويل الغذائي و دليل كفاءة النمو خلال فترة التجربة . وتم إجراء اختبار ذبح في يوم الفقس وفى نهاية فترة التجربة لأخذ بعض قياسات الذبيحة وكذلك تم اخذ عينات الدم خلال الذبح لتقدير بعض مكونات سيرم الدم. ويمكن تلخيص أهم النتائج المتحصل عليها في النقاط الآتية :- لوحظ تحسن معنوي في نسبة الفقس بمقدار 9.47 % نتيجة الغمر فى محلول الجلوكوز 10 % بالمقارنة بالمجموعة المغمورة فى الماء المقطر(صفر% جلوكوز) . كما إنخفضت نسبة الأجنة الميتة بالغمر فى محلول 10% جلوكوز مقارنة بالمحاليل الأخرى. لم يتأثر وزن الكتاكيت عند الفقس وطول الكتاكيت بالغمر فى محاليل الجلوكوز المختلفة. إنخفض مستوى الكوليسترول معنويا غى دم الكتاكيت الناتجة من غمر البيض فى محاليل تحتوى 5.0 ، 15.0% جلوكزز بالمقارنة بتلك المغمورة فى الماء المقطرومحلول 10.0% جلوكوز عند الفقس. لم تتأثر صفات الدم المدروسة معنويا بمدة غمر البيض بينما التداخل بين محاليل الجلوكوز ومدة الغمر كان له تأثير معنوى على محتوى الدم من الجلوكوز والكوليسترول فقط. تأثرت جميع صفات النمو المدروسة معنويا بالغمر فى محاليل الجلوكوز المختلفة وتداخلها مع مدة الغمرفيما عدا معدل التحويل الغذائى خلال فترة النمو(1-21 يوم من العمر). سجلت الكتاكيت الناتجة من غمر البيض فى محلول يحتوى 10.0% جلوكوز أفضل القيم لدليل كفاءة النمو والكفاءة الإقتصادية بالمقارنة بالمعاملات الأخرى. تشير النتائج إلى إمكانية تحسين نسبة الفقس وخفض النفوق الجنينى وتحسين أداء النمواللاحق للكتاكيت الفاقسة وكذلك الكفاءة الاقتصادية و ذلك بغمر بيض البط فى محلول يحتوى 10.0 % جلوكوزلمدة 3 دقائق عند اليوم الرابع والعشرون من فترة التفريخ للبط الدمياطى .