

COMPARATIVE STUDY OF ASCORBIC ACID TREATMENT METHODS ON HATCHABILITY TRAITS AND GROWTH PERFORMANCE OF DUCKLINGS

By

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Abstract: A total number of 1200 fertile Muscovy duck eggs were used to investigate the effect of ascorbic acid (AA) treatment methods during incubation period on hatchability traits, blood hematology and some growth performance traits throughout two weeks after hatch as well as economic efficiency. The experimental treatments were as follows : control (non-treatment) and AA treatments by dipping (20 g /L) , spraying (30 g/L) and injection (3 mg / egg) methods .

The results indicated that hatchability and embryonic mortality percentages were significantly ($P \leq 0.01$) improved by AA dipping and spraying methods as compared to the control , while, they were insignificantly improved by the injection method through at the incubation period . The mean of hatched Muscovy duckling weight was not significantly affected by all AA treatment methods. White blood cells count and basophils percentage were significantly increased in the blood of one-day-old ducklings by AA spraying and injection as compared to the dipping and control methods, while, heterophils to lymphocyt ratio was significantly increased by all AA treatment methods. AA spraying method had the best values of these measurements as compared to other treatment methods. Body weight, body weight gain , feed consumption (g /duck.) and feed conversion (g feed / g BWG) were insignificantly affected by AA treatment methods, while duckling viability values were significantly ($P \leq 0.05$) improved due to AA treatment. Economic efficiency and net return were improved by AA spraying method during the incubation period followed by dipping and injection methods as compared to the control.

It could be concluded that, spraying fertile Muscovy duck eggs with AA solution (30 g/L) twice times daily during the last 3 weeks of incubation period, may be an alternative method to maximize the hatchability percentage ,immunity of hatched ducklings and economic efficiency of

hatching process as well as growth performance traits and viability through the first two weeks after hatch .

INTRODUCTION

Incubation conditions are the most important factors affecting the hatchability of duck eggs. As it is known, temperature, humidity, ventilation and turning during the incubation period markedly affect the hatchability of fertile eggs and chick quality. The most dramatic effect of these factors on hatchability is temperature. Temperature experienced by a developing embryo depends on three factors: incubator temperature, ability of heat to pass between the incubator and the embryo and the metabolic heat production of the embryo itself (*Meir and Ar, 1990* and *French, 1997*). Ascorbic acid is involved in a number of biochemical processes. It is necessary for biosynthesis of various vital compounds (i.e., collagen, carnitine, 1,25-dihydroxy vitamin D, adrenaline etc.) as well as for the regulation of diverse reactions (secretion of corticosterone, regulation of body temperature) and activation of the immune system (*McDowell, 1989* and *Kutlu, 2001*). Furthermore, ascorbic acid plays a critical role in Vit. D metabolism and it is required for the conversion of Vit. D into its metabolite form (calcitriol) which is essential for calcium regulation and the calcification process (*Sergeev et al., 1990* and *Bains, 1996*). Also, it is required for hydroxylation of proline residues necessary for the synthesis of procollagen, which is a precursor to bone formation. One of the basic biological functions of the egg shell for the domestic fowl chick is to allow for adequate movement of water vapor and respiratory gases. Ascorbic acid is a weak acid and the ability of diluted acid to interact with the egg shell cuticle was reported by *Burley and Vadehra (1989)* and *Shafey (2002)*. Biosynthesis of ascorbic acid during the first 6 weeks after hatching is not fully developed, since ascorbic acid supplementation should be applied during this period. Also, its synthesis is inadequate under stress conditions such as low or high environmental temperature, humidity, high productive rate, and parasite infestation (*McDowell, 1989* and *Kutlu, 2001*).

Therefore, the objective of this study was to determine the beneficial ascorbic acid treatment method of fertile Muscovy duck eggs during incubation period on hatchability, embryonic mortality and economic efficiency as well as duckling weights, blood hematology and growth performance of hatched ducklings during two weeks post hatching.

MATERIALS AND METHODS

This study was carried out at El-Serw Research Station, which belonging to Water Fowl Research Department, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt, during summer season, 2008. Eggs were obtained from a commercial strain of Muscovy duck breed which reared under standard husbandry conditions at the 8th month of age (first season) and fed on a standard breed diet formulated to cover or exceeds their requirements. The composition and calculated analysis of the diets are presented in Table (1).

Experimental design:

This trial was carried out to complete the study of the effects of ascorbic acid (AA) treatment during incubation period on hatchability traits and economic efficiency of hatching process, which carried out at summer 2007 and recommended that the beneficial effects were occurred by dipping hatching Muscovy duck eggs into AA by 20 g / liter at 14th day (one time) or spraying with AA 30 g / liter twice times daily during the last 3 weeks of incubation period (*Ghonim et al. 2008*).

So that, this trial was carried out to determine the beneficial AA treatment method during incubation period on hatchability traits, blood hematology and growth performance of hatched ducklings during the first two weeks after hatch as well as duckling viability.

A total number of 1200 fertile Muscovy duck eggs (77 – 78 g) at the 14th of incubation period were obtained and randomly assigned to four treatments, 300 eggs each, in 3 replicates of 100 eggs. Ascorbic acid (AA) solutions (35-37°C) were freshly prepared by dissolving in distilled water and protected from light. Experimental design was completely randomized and the treatments were, control (non-treatment), dipping into 20 g AA /liter for up to 2 minutes (one time), spraying with 30 g AA /liter by twice times daily (one time at morning and the other at night) by 200 ml solution / 1000 egg and injection with 3 mg AA / egg (one time). Dipping and injection treatment were at the 14th day, while, spraying treatment was during the last 3 weeks of incubation period (14 -35 day).

Hatchability traits:

Eggs were set in an Econom incubator and incubated at 37.6 °C and 65 % relative humidity. Eggs had been turned every 1 h until they transferred to the hatching compartment at day 31 of incubation. The hatching compartment was kept at 36.5 °C and 75 % relative humidity until

the end of hatching period .Then, hatched chicks and accumulative embryonic mortality (un-hatched eggs with live or dead embryos and dead hatched chicks) were counted. Hatched chicks were weighed, then, hatchability and embryonic mortality percentages were calculated.

Hematological parameters:

At hatch, blood samples from randomly selected three ducklings per treatment were collected and transferred to vial tubes containing EDTA as anticoagulant. Differential white blood cells (WBC) counts were performed by using standard avian guidelines introduced by **Ritchie *et al.* (1994)**. Total white blood cells were determined by the Unopett method (**Campbell, 1995**). Leucocyte cells (heterophils (H), lymphocytes (L), eosinophils, monocytes, and basophils) were counted in different microscopic fields in a total of 200 WBC by the same person , and the H: L ratios were calculated (**Gross and Siegel, 1986**).

Growth performance:

One hundred and eighty hatched Muscovy ducklings at one-day-old from each treatment were weighed and distributed into 3 replicates .Ducklings were reared under similar hygienic and managerial conditions from one-day-old up to 14 day of age .Ducklings were fed on starter diets which formulated to cover their requirements according to the strain recommended catalog as shown in Table (1). Wheat straw was used as a litter throughout the experimental period. Feed and fresh water were available all the time. Body weight (BW) of ducklings, feed consumption (FC) and dead duckling were recorded per each replicate. Body weight gain (BWG), feed conversion (FCR) and duckling viability (DV) was calculated through the experimental period.

Economic efficiency:

Economic efficiency and net return were calculated based on the prices of AA (19 LE/ 100 g) , fertile Muscovy duck egg (2.0 LE) and the hatched duckling (7.0 LE) prevailing during year 2008.

Statistical analysis:

Data obtained were statistically analyzed for the analysis of variance using the General linear Model of **SAS (1990)**, the used model was: $Y_{ij} = \mu + T_i + e_{ij}$ where, Y_{ij} = an observation, μ = Overall mean,

T_i = Effect of treatment (1, 2... 4), and e_{ij} = Random error.

The significant differences among treatments were determined by Duncan's multiple range test (*Duncan, 1955*).

RESULTS AND DISCUSSION -

Hatchability traits:

Results of Table (2) showed that hatchability percentage (HB %) was significantly ($P \leq 0.01$) improved by about 22.97 and 32.44 %, respectively of AA dipping and spraying methods, while, it was insignificantly improved by about 8.80 % of the injection method as compared to the control. AA spraying method had the higher value of HB % by 7.70 and 21.73% as compared to the AA dipping and injection methods, respectively. These results may be due to the AA spraying method had the higher effect on eggshell conductance which are essential for the exchange of respiratory gases during incubation.

These findings suggest that the improvement of hatchability percentage due to the increasing of embryonic viability during incubation period where ascorbic acid may act as an anti-stress agent led to the reduction of corticosterone which has a negative impact in collagen synthesis and the metabolism of minerals and vitamin D (*Tullett, 1990; Roberson and Edwards, 1994; Kutlu, 2001 and Lohakare et al., 2005*). Also, the improvement of hatchability percentage may be due to the increasing in egg shell conductance where the ascorbic acid treatment changed the properties of cuticle. This change may be obtained from an interaction between the egg shell cuticle and AA in the dipping or spraying solutions which may have cause a thinner cuticle or some physical changes in their morphology (*Burley and Vadehra, 1989 and Shafey, 2002*). These results are in agreement with those obtained by *Zakaria and Al-Anezi (1996)* and *Ipek et al. (2004)* who found that the injection of incubated eggs with 3.0 mg/egg ascorbic acid at different times of incubation improved hatchability. Also, *Tag El-Din et al. (2004)* reported that the injection of Domayti duck eggs with 3.0 mg/egg ascorbic acid at 0 day of incubation period resulted in improving hatchability. *Shafey (2002)* reported that hatchability was significantly ($P \leq 0.05$) improved by dipping eggs into ascorbic acid solution 10 g / liter for up to 2 minutes before incubation. Moreover, *Ghonim et al. (2008)* reported that hatchability was significantly ($P \leq 0.01$) improved by dipping Muscovy duck eggs into ascorbic acid solution 20 g / liter for up to 2 minutes at 14 day of incubation period. Also, they found that hatchability was significantly ($P \leq 0.01$) improved by spraying Muscovy duck eggs with ascorbic acid solution 30 g / liter during the last three weeks of incubation period.

In general, all AA treatment methods of fertile eggs during incubation period had the lower embryonic mortality percentage than that of the control group. Embryonic mortality percentage was significantly ($P \leq 0.01$) decreased by about 44.15 and 62.36 %, respectively of AA dipping and spraying methods, while, it was insignificantly decreased by 16.92 % of the injection method as compared to the control (Table 2). AA spraying method resulted in a decreasing of EM % by 32.60 and 54.70 % as compared to the AA dipping and injection methods, respectively. These results may be due to the AA spraying method can improved biological functions of the eggshell to allow adequate movement of water vapor and respiratory gases. Also, it could have been increased the ability of AA as a weak acid to interact with the eggshell cuticle, which allow to the embryos to broken egg shell at hatch.

These results may be due that the chick embryos were subjected to stress caused by excessive production of heat during the latter stage of egg incubation (Tullett, 1990) but ascorbic acid may exert its effects by modulation of adrenal metabolism to inhibit synthesis of 21-hydroxylase and 11-beta hydroxylase enzymes which may produce less corticosterone and more mineralocorticoids. Ascorbic acid is essential to maintenance normal development of immune processes during physiological stress in the chicken (Pardue and Thaxton, 1986 ; Brake , 1989 , and Kutlu and Forbes , 1993). The present results are in agreement with those obtained by Zakaria and Al-Anezi (1996) , Ipek *et al.* (2004) and Tag El-Din *et al.* (2004) who found that the injection of incubated eggs with 3.0 mg/egg ascorbic acid decreased embryonic mortality .Also, Ghonim *et al.* (2008) who found that embryonic mortality was significantly ($P \leq 0.01$) decreased by dipping Muscovy duck eggs into 20 g AA /liter for up to 2 minutes at 14th day of incubation period or sprayed eggs with 30 g AA/liter twice times daily during the last three weeks of hatching process .

The differences between AA treatment methods during incubation period in loss egg weight and duckling weight were not significant. Duckling weights at hatch were almost equal (Table 2).

Hematological traits:

Results of the present experiment indicate that the different AA treatment methods during incubation period of duck eggs resulted in increase in the hemoglobin content ,white blood cells count , eosinophils, basophils and monocytes percentage at hatch (Table 3). White blood cells count were significantly high by about 47.21 and 33.34 % of one-day-old ducklings derived from AA spraying and injection methods, respectively .

In addition, the ducklings derived from AA dipping, spraying and injection treatment methods were characterized by high basophils percentage (23.3, 36.6 and 27.6 %, respectively) when compared with the control group. In AA spraying method, the heterophils – to- lymphocyte ratio was found to be significantly higher by 21.05 % than the control group. On the other hand, ducklings derived from AA treatment by dipping, spraying and injection methods did not differ significantly with regard to the percentage of heterophils, lymphocyte, eosinophils, monocytes cell as well as hemoglobin content in the blood ducklings. In general, AA spraying method had the best values of BWC, heterophils , basophils and H/L ratio compared than other methods, this could have been caused by the long -term effect of the AA spraying treatment method on incubated eggs .

These results can be due to a rise in heterophils percentage, and, it may be due to the decreases in vessel permeability which limits leucocytes infiltration and the increase passing of the heterophils from the bone marrow to blood circulation (Andreasen and Frank, 1999; Puvadolpirod and Thaxton, 2000; Aengwanich et al, 2003 and Lohakare et al.,2005). Moreover, AA was known to suppress corticosterone synthesis and /or release from adrenal cortex, which in turn play an important role in alleviating different stressor effects and hence increased the heterophils ratio. The current results agree with those of Özkan et al.(2004) who reported that the dietary ascorbic acid supplementation resulted in increase in heterophils, basophils and monocytes proportions and decrease in lymphocyte counts . Similar results were reported by Kontecka et al. (2006) who found that the blood of hatched ducklings from ducks fed on supplemented diets with ascorbic acid by 500 mg/ kg was high in hemoglobin, leukocytes and monocytes. Also, Yusuf et al. (2009) reported that the eosinophils, basophils and monocyte ratios were increased by feeding turkey on diet supplemented with 300 mg / kg ascorbic acid at 12 weeks of age in summer.

Growth performance traits:

Table (4) shows no significant differences of all studied growth performance traits with the exception of duckling viability which was significantly ($P \leq 0.05$) affected by AA treatment methods. Body weight (BW) and body weight gain (BWG) of ducklings during the first two weeks of age after hatch were insignificantly increased due to AA treatment method of fertile eggs during incubation period. BW was increased by 5.11, 6.55 and 0.74 % of AA treatments by dipping, spraying and injection methods as compared to the control, respectively. The corresponding values of BWG were 5.66, 7.08 and 0.63 %, respectively.

Feed consumption (FC) values (g/duckling) either at 1st and the 2nd week or as accumulative values were insignificantly increased of hatched ducklings due to all AA treatment methods during incubation period throughout the first two weeks of age after hatch. These increases by AA treatment dipping, spraying and injection methods as compared to the control group were, respectively, 7.79, 15.89 and 13.93% at the 1st week and were 5.55, 7.40 and 1.17% at the 2nd week. Meanwhile, these increases as accumulative values were 6.38, 10.55 and 5.65%, respectively (Table 3). It could be noticed that the sprayed method showed the highest increases of FC at the 1st and the 2nd week and as accumulative values. In contrast, the injection method showed the lowest increases at the 2nd week and as accumulative values. Feed conversion values (g feed / g BWG) were insignificantly decreased for hatched ducklings derived from all AA treatment methods throughout the first two weeks of age after hatch. It was insignificantly decreased by 0.60, 3.03 and 4.85% of AA treatment by dipping, spraying and injection methods as compared to the control group, respectively. This may be due to that hatched duckling from treated groups were consumed more amounts of feed and their BWG were approximately equal with the control group.

Duckling viability values were significantly ($P \leq 0.05$) improved by 3.46, 6.38 and 4.37% of AA treatment by dipping, spraying and injection methods as compared to the control group, respectively. This result may be due to the role of AA in the regulation of diverse reactions (secretion of corticosterone, regulation of body temperature, activation of the immune system) McDowell (1989) and Kutlu (2001) as well as to its anti-stress properties. Therefore, the addition of AA may be beneficial for alleviation of duckling stress.

Economic efficiency:

Calculations were carried out according to the prices of AA and fertile Muscovy duck eggs and ducklings prevailing during year 2008 as listed in Table (5). Treatment of fertile Muscovy duck eggs with AA by different methods during incubation period resulted in an obvious improvement of net return by about 38.23, 55.49 and 15.06% for AA dipping, spraying and injection methods as compared to the control, respectively. The economic efficiency was 1.31, 1.72, 2.00 and 1.51 for the control, dipping, spraying and injection treatment methods, respectively. AA spraying method had the best values of net return and economic efficiency as compared to other treatment methods. The improvement of EE may be due to the increase of hatchability percentage and decreasing in

embryonic mortality as well as increasing the duckling price. These results are in agreement with those obtained by *Ghonim et al. (2008)* who reported that economic efficiency and net return were improved by dipping (20 g AA/liter) or spraying (30 g AA/liter) fertile Muscovy duck eggs with ascorbic acid solution at the 14th of incubation period.

CONCLUSION

The obtained results generally showed that the spraying method of Muscovy duck eggs by 30 g AA/ L twice times daily during the last 3 weeks of incubation period may be alternative method to maximize the hatchability percentage, net return and economic efficiency. Also, it could be to increase the ducklings viability and immunity during the first two weeks after hatch without adverse effects.

Table (1): Composition and calculated analysis of the basal diets throughout the experimental periods.

Ingredients %	Starter	Breeder
Yellow corn	65.00	66.00
Soya bean meal (44 %)	30.45	21.50
Wheat bran	0.65	2.70
Dicalcium phosphate	1.80	1.50
Limestone	1.40	7.60
Vit & Min. premix *	0.30	0.30
Salt (NaCl)	0.30	0.30
DL. Methionin	0.10	0.10
Total	100.0	100.0
<u>Calculated analysis **</u>		
Crude protein %	19.12	15.50
ME (Kcal / kg)	2865	2724
Calcium (%)	1.029	3.410
Available phosphorus (%)	0.42	0.45

*Starter premix ,each 3 kg of the Vit. and Min. premix manufactured by Agri-Vit Company, Egypt contains: Vitamin A 10 MIU; 2 MIU Vit. D₃; 10 g Vit E ; 2 g Vit. K ; 1 g Vit. B1 ; 5 g Vit.B2; 1.5 g Vit.B6 ; 30 g Niacin ; 10 mg Vit.B₁₂ ; 10 g Pantothenic acid ; 1.5 g Folic acid; 50 mg Biotin; 250 g Choline chloride ; 60 g Manganese ; 50 g Zinc ; 30 g Iron ; 10 g Copper ; 1g Iodine ; 0.1 g Selenium ; 0.1 g Cobalt and carrier CaCO₃ to 3000 g..

*Layer premix ,each 3kg of Vit. and Min. premix contains: Vit. A 100 MIU;2 MIU Vit.D₃;10 g Vit.E; 1 g Vit.K₃; 1 g Vit B1; 5 g Vit B2 ;10 mg Vit.B₁₂ ; 1.5 g Vit B6; 30 g Niacin ;10 g Pantothenic acid ;1g Folic acid;50 mg Biotin ; 300 g Choline chloride; 50 g Zinc; 4 g Copper; 0.3 g Iodine ; 30 g Iron; 0.1 g Selenium ;60g Manganese ;0.1 g Cobalt; and carrier CaCO₃ to 3000 g .

** According to NRC (1994)

Table (2): Effect of ascorbic acid treatment methods during incubation period on loss of egg weight , hatchability , embryonic mortality percentages and duckling weight at hatch.

Traits	Treatments				Sig.
	Control	Dipping	Spraying	Injection	
Egg weight (g)	73.0±1.0	72.3±1.3	72.4±0.9	72.5±1.0	NS
Loss of egg weight %	7.94±0.53	7.93±0.43	7.50±0.24	7.58±0.41	NS
Hatchability %	65.78 ±1.90 ^b	80.89 ±3.47 ^a	87.12 ±3.57 ^a	71.57 ±2.11 ^b	0.01
Embryonic mortality %	34.22 ±1.90 ^a	19.11 ±3.47 ^b	12.88 ±3.57 ^b	28.43 ±2.11 ^a	0.01
Duckling weight at hatch (g)	47.03 ±0.95	47.13 ±0.79	47.92 ±1.63	47.83 ±1.09	NS

a,b,c,d :means in the same row bearing different superscript are significantly different ($P \leq 0.05$).

Table (3): Effect of ascorbic acid treatment methods during incubation period on blood hemoglobin, white blood cells count ($\times 10^3/\text{dl}$) and differential counts (%) at hatching.

Traits	Treatments				Sig.
	Control	Dipping	Spraying	Injection	
Hemoglobin	12.75 ±0.36	14.63±0.80	13.65±0.90	14.25±1.00	NS
White blood cells	30.50±2.92 ^b	31.83±4.91 ^b	44.90±3.16 ^a	40.67±4.33 ^a	0.05
Heterophils	25.33±1.45	27.80±1.53	28.03±0.76	27.33±0.88	NS
Lymphocyt	65.92±1.45	62.04±2.13	61.33±2.40	62.21±2.73	NS
Eosinophils	3.87±0.41	4.27±0.38	4.28±0.11	4.32±0.22	NS
Basophils	3.00±0.15 ^b	3.70±0.15 ^{ab}	4.10±0.25 ^a	3.83±0.12 ^a	0.01
Monocytes	1.88±0.14	2.19±0.19	2.26±0.10	2.31±0.09	Ns
H : L	0.38±0.01 ^b	0.45±0.01 ^a	0.46±0.01 ^a	0.44±0.02 ^a	0.01

a,b. :means in the same row bearing different superscript are significantly different ($P \leq 0.05$).

Ascorbic acid, egg dipping, hatchability, mortality, growth, blood, ducks

Table (4): Effect of ascorbic acid treatment methods during incubation period on some growth performance traits at the first two weeks of age after hatch .

Items	Treatments				Sig
	Control	Dipping	Spraying	Injection	
Body weight .g at the 14 th day of age (g)	458.3 ±7.3	481.7 ±4.4	488.3.0 ±7.2	461.7 ±6.8	NS
Body weight gain .g (0- 2 wks)	411.3 ±8.2	434.6 ±3.9	440.4 ±8.8	413.9 ±5.1	NS
Feed consumption .g at the 1 st week	251.7 ±11.7	271.3 ±22.4	291.7 ±19.2	285.0 ±26.0	NS
Feed consumption .g at the 2 nd week	426.7 ±20.5	450.4 ±16.1	458.3 ±13.6	431.7 ±15.9	NS
Accumulative feed consumption, g at the 2 wks of age	678.4 ±31.8	721.7 ±30.6	750.0 ±5.8	716.7 ±41.9	NS
Feed conversion during 2 wks	1.65 ±0.05	1.66 ±0.08	1.70 ±0.02	1.73 ±0.09	NS
Duckling viability*	89.79 ±1.09 ^f	92.90 ±0.83 ^b	95.52 ±0.93 ^a	93.71 ±0.87 ^b	0.05

a,b,c,d :means in the same row bearing different superscript are significantly different (P ≤ 0.05).

*duckling viability = number of live duckling at 14 day after hatch / total number of duckling at start rearing period.

Table (5): Effect of ascorbic acid treatment methods during incubation on economical efficiency.

Items	Treatment			
	Control	Dipping	Spraying	Injection
No. of fertile eggs	300	300	300	300
Total price of eggs LE	600	600	600	600
Total price of AA LE	-	14.5	11.80	0.60
Total cost LE	600	614.5	611.80	600.60
No.of hatched ducklings	198	243	262	215
Total price of hatched ducklings LE	1386	1701	1834	1505
Net return LE	786	1086.5	1222.2	904.40
EEF	1.310	1.719	1.998	1.506
REEF	100	138.23	155.49	115.06

L.E = Egyptian pound ,

1-Local price of one egg = 2.0 LE.

2-Cost of 100 gm ascorbic acid (93%) =19.0 LE. .

3- Total cost = total price of eggs LE + total price of AA LE

4-Local price of one hatched Muscovy duckling =7.0 LE.

5- EEF = economic efficiency = (Net return LE / Total cost LE).

6- REEF = Net return % of control = net return of each group / net return of control

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الملخص العربي

دراسة مقارنة لطرق المعاملة بفيتامين جـ على صفات التفريخ وأداء النمو
لكتاكيت البيط الفاقسة

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استخدم في هذه الدراسة ١٢٠٠ بيضة تفريخ مخصبة للبط المسكوفى لتحديد أنسب
معاملة بفيتامين جـ خلال فترة التفريخ على نسبة الفقس والتفوق الجنيني ووزن الكتاكيت الفاقسة
وبعض مكونات الدم وبعض مقاييس النمو والحيوية خلال أول أسبوعين من الفقس هذا بالإضافة
الى تقدير الكفاءة الاقتصادية لهذه المعاملات . وكانت المعاملات الأربعة كالتالى : الأولى هى
بيض غير معاملة (كنترول) والثانية تم فيها غمر البيض فى محلول ٢٠ جم/لتر فيتامين جـ مرة
واحدة عند ١٤ يوم من التفريخ والثالثة تم فيها رش البيض بمحلول ٣٠ جم/لتر فيتامين جـ خلال

الثلاث أسابيع الأخيرة من التفريخ بمعدل مرتين يوميا والرابعة تم فيها حقن البيض بفيتامين ج بمعدل ٣ مجم فيتامين ج/ بيضة عند عمر ١٤ يوم من التفريخ وتم عد الكتاكيت الفاقسة السليمة والناقطة ، تم حساب نسبة الفقس والنفوق الجنيني ، وتم أخذ عينات دم للكتاكيت عند الفقس لعد كريات الدم البيضاء ونسب مكوناتها ، وتم تقسيم عدد ١٨٠ كتكوت ناتجة من كل معاملة إلى ثلاث مكررات وتم تربيتهم لمدة أول أسبوعين بعد الفقس وتم تسجيل وزن الجسم والعليفة المستهلكة والنفوق لحساب بعض مقاييس النمو وكذلك حساب الكفاءة الاقتصادية .

ويمكن تلخيص أهم النتائج المتحصل عليها كالتالي :

تحسنت نسبة الفقس معنويا للمجموعات المرشوشة والمغمورة بمحاليل فيتامين ج بينما كان التحسن غير معنوي في المجموعة المحقونة ، كان مقدار التحسن في نسبة الفقس للمجموعات المرشوشة والمغمورة والمحقونة بمحاليل فيتامين ج هو ٣٢.٤٤ ، ٢٢.٩٧ ، ٨.٨٠ % على التوالي مقارنة بمجموعة الكنترول .

انخفضت نسبة النفوق الجنيني معنويا للمجموعات المرشوشة والمغمورة بمحاليل فيتامين ج بينما كان الانخفاض غير معنوي في المجموعة المحقونة، كان مقدار الانخفاض في نسبة النفوق الجنيني للمجموعات المرشوشة والمغمورة والمحقونة بمحاليل فيتامين ج هو ٦٢.٣٦ ، ٤٤.١٥ ، ١٦.٩٢ % على التوالي مقارنة بمجموعة الكنترول . لم يتأثر وزن الكتاكيت الفاقسة معنويا بالمعاملة بفيتامين ج سواء بالغمر أو الرش أو الحقن .

ازدادت عدد كريات الدم البيضاء في دم الكتاكيت معنويا للمجموعات المرشوشة والمغمورة بينما ازدادت نسبة H/L معنويا لكل المجموعات المعاملة بفيتامين ج مقارنة بالكنترول وكانت المجموعة المرشوشة هي الأفضل في تلك القياسات.

لم يتأثر وزن الجسم ومعدل الزيادة في وزن الجسم والطف المستهلك ومعدل التحويل الغذائي خلال أول أسبوعين بعد الفقس بالمعاملات المختلفة مقارنة بالكنترول . بينما تحسنت حيوية الكتاكيت الفاقسة بالمعاملات معنويا مقارنة بالكنترول وبلغ مقدار التحسن للمجموعات المرشوشة والمغمورة والمحقونة بمحاليل فيتامين ج ٦.٨٢ ، ٣.٤٦ ، ٤.٣٧ % على التوالي . تحسنت الكفاءة الاقتصادية وصافي العائد بالمعاملة بالرش بفيتامين ج ثم تلتها المعاملة بالغمر خلال فترة التفريخ .

من النتائج السابقة يمكن الاستنتاج بأنه يمكن رش بيض التفريخ للبط المسكوفي بمحلول فيتامين ج بمعدل ٣٠ جرام لكل لتر مرتين يوميا في الثلاث أسابيع الأخيرة من فترة التفريخ حيث أدت هذه الطريقة الى تحسين نسبة الفقس وتقليل النفوق الجنيني وتحسين حيوية ومناعة الكتاكيت الفاقسة خلال أول أسبوعين بعد الفقس وكذلك تحسين صافي العائد والكفاءة الاقتصادية خلال عملية التفريخ .