**Effect of ascorbic acid injection for incubation eggs of broiler breeders on hatchability and productivity of chicks**

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**Abstract**

A total number of 500 fertile eggs were used in this study collected from Arbor Acres and Ross parental flocks to investigate the effect of injecting incubated eggs with Ascorbic acid (vitamin C) on the productive performance of the hatched chicks. Eggs of each strain were randomly equally divided into five groups (each of 100 eggs). Eggs of the 1sr, 2nd and 3rd groups were injected with 3, 6 and 9 mg of, respectively. The 4th group was used as a shim (eggs drilled only), while the 5th group was considered as control. Results obtained could be summarized as follows; Ross strain significantly decreased embryonic mortality and correspondingly increased hatchability percentage. Treatments applied had highly significant effect on embryonic mortality and hatchability. Ross strain significant increased body weight, weight gain and growth rate during the all periods of estimation when compared with those of Arbor Acres strain. The highest averages of body weight and weight gain were observed in chicks hatched from eggs injected with 6 and 9mg ascorbic acid (vitamin C) when compared with other treatments applied and control group. Birds of Arbor Acres showed the better feed conversion values at all periods of estimation compared with Ross strain. The best feed conversion values at the period from (0-6) weeks of age were found in chicks hatched from eggs injected with 3 or 9mg ascorbic acid (2.11 and 2.11g feed/g gain, respectively). Chicks hatched from eggs of Ross strain showed the highest economic efficiency at (0-6) week (143.53%) when compared with Arbor Acres strain (142.65%), respectively. Chicks hatched from eggs injected with ascorbic acid at a level of 3or 6mg showed the highest economic efficiency values at (0- 6) week (170.35 and 155, 94%, respectively) when compared withdifferent treatments applied. It could be concluded that, Ross strain and injection incubated eggs with 3 and 6 mg ascorbic acid seemed to be adequate to a chive the favorable results and is being recommended from the economic point of view.

*Key words;* Ascorbic acid injecting, hatchability, embryonic mortality, growth performance, broiler chicks

**1. Introduction**

Function of ascorbic acid (vitamin C) is related to its reversible oxidation and reduction characteristics further to its effect of as an anti-stress agent on productive performance parameters of birds such as growth and reproductive traits, the most important of them are fertility and hatchability. Ascorbic acid is synthesized by the embryo **(Surai *et al.*, 1996 and Wilson, 1990)** and the accumulation of this water soluble antioxidant by the developing tissues will be independent of the dietary intakeby the breeding hen. Incubated eggsand their embryos may be subjected to stress caused by excessive production of metabolic heat during the latter part of egg incubation **(Tullet, 1990),** producing some internal environmental stress for embryo, which may be not suitable for the embryo to hatch successfully. So, In-ovum injection of ascorbic acid as an anti-stress agent may be beneficial. Injecting ascorbic acid into chicken eggs has a favorable impact on hatchability results, embryo weight at different incubation days and consequently on chick body weight after hatching as well as on the reduction of embryo death during incubation **(Zakaria and Al-Anezi, 1996; Zakaria and Al-Latif, 1998 and Zakaria *et al*., 1998).** In addition, **Selim *et al.*, (2012)** concluded that, in-ova injection of saline solution with or without ascorbic acid decreased hatchability percentage (68%) in comparison with control (74%).The same other concluded that, In-ova injection of vitamin E (53.23g) or ascorbic acid (52.20g) significantly increased (P <0.05) body weights of ducklings at hatch compared to the control (45.95g).

According to all these facts, this study aimed to determine the effect of injecting incubated eggs of both Ross and Arbor Acres parental flocks with ascorbic acid (vitamin C) on hatchability and productive performance of hatched chicks.

**2. Material and methods**

This study was carried out at the hatchery of Al-Quds Poultry Company (Mansoura city) and Poultry Research Farm belonging to the department of Animal production, Faculty of Agriculture, Benha University. A total number of (1000) fertile eggs from Arbor Acres and Ross parental strains were obtained from Cairo Company for broiler production. Eggs were randomly equally divided into five groups for each strain (each of 100 eggs). Eggs of the 1st, 2nd and 3rd groups were injected with 3, 6 and 9mg of ascorbic acid (vitamin C), respectively. The 4th group was used as a shim (eggs drilled only), while the 5th group was considered as control (untreated eggs). Eggs at the 14th day of incubation were placed on an egg flat air cell upwards. The area over the air cell (blunt end of the egg) was wiped with 70% ethanol. A small hole of 2 mm was gently drilled with needle through the egg shell along the center axis at the top of the egg. The needle was strongly heated and cooled by small piece of cotton wetted with alcohol. Eggs were candled to determine that air cell is in the normal position. An amount of 0.l ml of solution that includes the doses of ascorbic acid were injected through the hole made in egg shell over the inner egg shell membrane using a syringe with a needle of 3-4 mm length. The puncture was then sealed with a small drop of sterilized melt paraffin wax. The eggs were incubated in Petersen incubator type (576) and hatcher type (192), Incubator, hatcher and eggs were fumigated directly before setting eggs for 30 min by formaldehyde gas. Eggs were incubated at constant temperature of 99.7° F (37.6ºc) with relative humidity of 52% during the first 18 days of incubation period. Eggs were turned automatically through an angle of 90° every hour until the 18th day of the incubation period. Ventilation channels were opened and closed automatically according to temperature fluctuation. Ventilators limits were between 0.5 to 3.0 ventilation units (v.u) until the 18th day of incubation period and were 1.5 to 4.0 (v.u) at the last three days of incubation. Incubator were calibrated, set and monitored with the same reference thermometer and monitored twice daily to insure proper operation. Incubated eggs from each incubator were transferred to a single hatchery at the 18th day of incubation. The relative humidity increased in each hatchery during the peak of the hatching process. Incubated eggs were individually candled using a hand candling ultraviolet lamp at 7, 14, 18th days of incubation period to determine the infertile eggs and embryonic mortality. A total number of 500 chicks (50 chicks from each group) were randomly chosen from different groups of incubated eggs then weighed at hatch, wing banded and vaccinated against Newcastle and Gumboro diseases, Pullorum free and kept under similar standard hygienic and environmental conditions. Floor gas heating brooders were used for brooding chicks. Wheat straw was used as a litter in the brooding house. The litter depth was 10 cm and the wetting litter was continually changed by a fresh one. Chicks were fed ad-libitum on commercial starting and growing ration (Table, 1) with composition and nutritive value **According to NRC, 1994.**

**Table (1): The composition and calculated analyses of experimental starter and grower diets:**

|  |  |  |
| --- | --- | --- |
| **Ingredients %** | **Starter (0-4) wks** | **Grower (4-6) wks** |
| Yellow corn | 61.00 | 66.00 |
| Soybean meal (44% CP) | 35.50 | 26.00 |
| Corn gluten meal (60% CP) | 0.00 | 1.00 |
| Vegetable oil | 0.00 | 3.00 |
| Di.calcium phosphate | 1.70 | 1.70 |
| Calcium carbonate | 1.10 | 1.20 |
| Sodium chloride | 0.30 | 0.30 |
| Vit.and M.n.permix\* | 0.30 | 030 |
| DL.Methionine 99% | 0.10 | 0.16 |
| L.Lysine hydrochloride 78% | 0.00 | 0.04 |
| Total | 100 | 100 |

**Calculated analysis %\*\***

|  |  |  |
| --- | --- | --- |
| ME.( Kcal Kg) | 2839 | 3135 |
| Crude protein | 20.86 | 17.81 |
| Crude fat | 2.67 | 5.80 |
| Crude fiber | 2.73 | 2.49 |
| Calcium | 0.93 | 0.95 |
| Available P | 0.43 | 0.42 |
| Methionine | 0.46 | 0.47 |
| Methionine+Cystine | 0.83 | 0.79 |
| Lysine | 1.21 | 0.99 |

\*Each 3.0 Kg of the Vit. and Min . premix contains :

Vit . A, 12000000 IU ; Vit . D3 , 2000000 IU ; Vit. E , 10g ; Vit. K3 , 2.0g ; Vit.B1 .1.0g ; Vit. B2, 5g ; Vit. B6 ;1.5 g ; Vit.B12,10mg ; choline choloride , 250 g ; Biotn, 50mg ; folic acid ,1 g ; nicotinic acid , 30 g ; Ca Pantothenate , 10 g; Zn , 50 g ; Cu , 10g ; Fe , 30g ; Co,100 mg ; Se, 100mg ; I ,1g ; Mn , 60g and anti – oxidant , 10g and complete to 3.0 Kg by calcium carbonate.

Embryonic mortality was classified according to the time of incubation at which it occurred into early (1-6 days), mid (7-14 days) and late (15-18 days).

**Hatchability (%) = (hatched chicks / fertile eggs) x l00**

Chicks were individually weighed to the nearest (g) at hatch, and then at the 4th and 6th week of birds age. Weight gain and rate of growth were individually calculated according to the following formula suggested by **Broody, (1949).**

**Weight gain = W2-W1**

Where; W1 and W2 are individual body weight at the two successive periods.

Feed consumed by all chicks was weekly recorded for each treatment. It was then averaged and expressed in gram per chicks at the periods from (0-4), (4-6) and (0-6) weeks of chicks' age. Feed conversion (F.C) was calculated according to the following formula:

**Feed consumption (g)**

**F.C = ————————**

**Weight gain (g)**

The economic efficiency (E.E) was calculated according to the following equation:

**EE = [(A-B) / B] x 100**

Where; **A** is the selling price of the obtained gain which mounted 12 L.E for each kg live weight and **B** is the feeding cost of this gain and the price of the injected material.

Analysis of variance was calculated using SAS procedure guide (SAS 2004) using the following linear model:

Xijk  = µ + Si + Lj + SLij + eijk

Where:

Xijk  =the kth observation

µ = overall mean

Si = effect of ith strain

Lj = effect of the jth level of vitamin C

SLij= effect of the interaction between ith strain and jth level of vitamin C.

Eijk = the experimental error

**3. Results and discussion**

**1. Embryonic mortality and hatchability:**

Inspection of data presented in table (2) showed that the embryonic mortality and hatchability percentage were significant affected by broiler strain. Fertile incubated eggs of Arbor Acres strain had significantly increased in embryonic mortality rate during the all periods of estimation when compared with those of Ross strain and, correspondingly percentage of hatchability was increased (93.56%) for Ross strain when compared with Arbor Acres strain (89.43%).These results agreed with those obtained by **Full *et al*, (2005**) they found that, significant differences in embryonic mortality between Fayoumi and Dandarawi strain. **Abudabos, (2010)** found that, fertility of an egg and embryonic mortality during the hatching process are known to be different for different strain and these characteristics are very important in determining hatchability.

Regardless of Broiler strain, it was clearly evidence that eggs injecting with ascorbic acid showed the lower embryonic mortality rate and higher hatchability percentage compared with control groups. Concerning to the doses of ascorbic acid injecting into hatching eggs, it was found that eggs injected with 9 mg ascorbic acid (vitamin C) had significantly increased late embryonic mortality rate during the period from 19-21 days of incubation period (3.40 %) which, correspondingly decreased percentage of hatchability (91.25%). However, incubated eggs injected with 6mg ascorbic acid significantly decreased late embryonic mortality during the same period of incubation period (1.05%) and correspondingly improved percentage of hatchability (93. 33%) when compared with different treatments applied (Table, 2). **Bains, (1996)** who found that supplementing ascorbic acid to regulate metabolic temperature reduced mortality and improved hatchability. Also, **Zakaria and Al-Anezi, (1996)** reported that, injecting ascorbic acid at 11th and 15th days of incubation improved hatchability. However, no significant difference was observed in mortality rate between ascorbic acid injection at a level of 3mg and saline injection of 0.1 ml on hatchability (86. 66 and 5.00%, respectively).

It was clearly evidence (Table, 2) that eggs drilled only (a shim) significantly decreased late embryonic mortality (2.30%) and, correspondingly improved percentage of hatchability (90.70%), when compared with control. This result obtained go in a quite agreement with those obtained by **Meir and Ar, (1996)** who found that drilling a hole into the air cell of goose eggs (during the second half of the incubation period) increase hatchability. However, **Rolon and Buhr, (1992)** reported that drilling a hole of mm through the eggs shell above the air cell at the first day of incubation significantly decreased hatchability.

Data presented in table (2) showed that the interaction between strain and treatments applied had had insignificant effect on hatchability percentage. However, it had highly significant effect on embryonic mortality rate at all periods of estimation. The best hatchability percentage was found in fertile incubated eggs of Ross strain injecting with either 3 or 6 mg ascorbic acid average 95.5 %and 95.5%, respectively.

Results obtained in this study concluded that there was advantage attributable to treating fertile incubated eggs with ascorbic compared to other treatments applied, treating eggs with a dose of 6gm during the latter part of incubation period has the lowest mortality rate and corresponding improving of hatchability percentage that may be attributed to the role of ascorbic acid in reducing stress effect and hence, reduced late embryonic mortality and improve percentage of hatchability. On the other hand, the effect of high doses of ascorbic acid (9 mg) per egg reduce the hatchability that may attributed to the toxic action of the high concentration of ascorbic acid on the pancreatic beta cells **(Meglasson and Hazelwood, 1982),** death of resting cells, and reversal of differentiation **(Lyengar and Lal, 1982).** Also, the high level of ascorbic acid led to severe body hemorrhages during the latter part of incubation increased late embryonic mortality and sharply reduced percentage of hatchability **(Zakaria and Al-Anezi, (1996).**

**Table (2) Least –square means and standard error (X ± S.E) for embryonic mortality of incubated eggs of different experimental groups as affected by studied factors.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait of embryonic mortality (%) during** | | | | | | **Items** |
| **Hatchability (%)** | **Total Mortality**  **%** | **During hatching**  **(19-21 day)** | **Late mortality**  **(15-18day)** | **Mid mortality**  **(7-14day** | **Early**  **(1-6 day)** |
|  |  |  |  |  |  | **Strain(S)** |
| 78.41±0.04a | 21.51±0.87a | 2.64±0.22a | 4.43±0.25a | 4.24±0.24 a | 10.18±0.2a | Arbor Acres (A) |
| 92.02±0.04b | 6.63±0.87b | 0.29±0.22b | 1.70 ±0.25b | 1.25±0.24b | 3.37±0.2b | Ross (R) |
|  |  |  |  |  |  | **Treatments injection(T)** |
| 87.54±0.07b | 10.96±1.38b | 1.32±0.35a | 1.90±0.40c | 0.37±0.39c | 7.37±0.40b | Vitamin C 3mg |
| 90.81±0.07a | 8.43±1.38b | 1.07±0.35a | 1.25±0.40c | 1.25±0.39c | 4.85±0.40b | Vitamin C 6mg |
| 83.99±0.07c | 15.61±1.38a | 1.28±0.35a | 4.41±0.40b | 3.30±0.39b | 6.61±0.40b | Vitamin C 9mg |
| 82.60±0.07d | 16.64±1.38a | 1.80±0.35a | 2.71±0.40b | 3.79±0.39b | 8.33±0.40a | A shim (As) |
| 81.87±0.07e | 18.70±1.38a | 1.85±0.35a | 4.07±0.40a | 5.04±0.39a | 6.73±0.40b | Control (cont.) |
|  |  |  |  |  |  | **Interaction(S x T)** |
| 81.61±0.11g | 17.59±1.96bc | 2.29±0.49a | 3.44±0.57b | 0.38±0.55dc | 11.48±0.5b | Ax3mg |
| 86.02±0.11f | 13.95±1.96dc | 2.143±0.4a | 2.14±0.57bc | 2.14±0.55b | 7.52±0.57d | Ax6mg |
| 77.77±0.11h | 22.19±1.96ba | 2.213±0.4a | 6.66±0.57a | 4.43±0.55a | 8.88±0.57dc | Ax9mg |
| 73.91±0.11i | 26.06±1.96a | 3.25±0.49a | 3.25±0.57b | 6.51±0.55a | 13.03±0.5a | A x As |
| 72.22±0.11j | 27.75±1.96ba | 3.32±0.49a | 6.66±0.57a | 7.77±0.55d | 9.99±0.57bc | A x Cont. |
| 93.48±0.11b | 4.34±1.96ef | 0.36±0.49b | 0.36±0.57c | 0.36±0.55d | 3.25±0.57fe | Rx3mg |
| 95.60±0.11a | 2.92±1.96f | 0.01±0.49b | 0.36±0.57c | 0.36±0.55dc | 2.19±0.57f | Rx6mg |
| 90.21±0.11d | 9.03±1.96fe | 0.36±0.49b | 2.16±0.57bc | 2.16±0.55dc | 4.34±0.57e | Rx9mg |
| 91.30±0.11c | 7.23±1.96ef | 0.36±0.49b | 2.166±0.57bc | 1.08±0.55d | 3.62±0.57fe | R x As |
| 89.530.11e | 9.66±1.96de | 0.38 ±0.49b | 3.48±0.57b | 2.32±0.55c | 3.48±0.57fe | R x Cont. |

Mean having similar letters in each column are not significantly different.

**2. Body weight:**

Data concerning body weight (Table, 3) showed that the average of body weight gradually increased by advancing age with different rates among the experimental groups.in addition,

Chicks hatched from eggs of Ross strain had higher average body weight (46.31, 1120.51 and 2095.80g at hatch, 4th and 6th week of age, respectively), when compared with those recorded by Arbor Acres strain that averages body weight (42.77, 969.54 and 1917.34 g at hatch, 4th and 6th week of age, respectively). These results agree with those obtained by **Makram *et al.,* (2010)** who found that, the Cobb and Avian broiler chicks had significantly heaviest marketing body weight compared to remaining strains ,but the difference did not statistically significant .

Treatments applied had highly significant effect on body weight at hatch, 4th and 6th week of bird's age. It is clearly obvious that chicks hatched from eggs injected with the level of ascorbic acid (vitamin C) had significantly higher body weight body weight at all periods of estimation compared with either eggs drilled only (A shim) or control group( untreated eggs). The highest body weight at hatch (45.46g) resulted from eggs treated with level of 9 mg ascorbic acid. While, chicks hatched form eggs injected with 6mg had higher body weight (1117.28 and 2074.78) at the 4th and 6th week of age, compared with other levels applied and control groups. On the other hand, there was no significant difference in body weight between both chicks hatched from eggs drilled only (A shim) and control group (untreated eggs) at all periods of estimation (table, 5). Partial agreement exists between obtained result and results of **Zakaria and Al-Anezi, (1996)** who found that, injected ascorbic acid at a dose of 3mg during egg incubation improved body weight. The interaction effect between the broiler strain and the level of ascorbic acid injecting showed highly significant on body weight at the 4th and 6th week of bird's age. The highest averages body weight was observed in the interaction between Ross strain and injected fertile incubated eggs with ascorbic acid (vitamin C) 6mg at the all period of estimation (Table, 3)

Table (3): Least–square means and standard error (X±S.E) for body weight of incubation eggs of different experimental groups as affected by studied factors

|  |  |  |  |
| --- | --- | --- | --- |
| **Items** | **Body weight ( g) at** | | |
| **Hatch** | **4WK** | **6WK** |
| **Strain (S)** |  |  |  |
| Arbor Acres(A) | 42.77± 0.19b | 969.54± 8.90b | 1917.34± 10.17b |
| Ross (R) | 46.31± 0.19a | 1120.51± 8.90a | 2095.80± 10.17a |
| **Treatments injection(T)** |  |  |  |
| Vitamin C 3mg | 44.03± 0.30b | 1029.50± 14.07b | 2030.85 ±16.08a |
| Vitamin C 6mg | 44.57± 0.30b | 1117.28± 14.07a | 2074.78 ± 16.08a |
| Vitamin C 9mg | 45.46± 0.30a | 1115.50± 14.07a | 2073.35 ± 16.08a |
| A shim ( AS) | 44.60± 0.30b | 999.0± 14.07bc | 1941.64± 16.08b |
| Control (cont.) | 44.03 ± 0.30b | 963.78± 14.07c | 1912.21 ± 16.08b |
| **Interaction (S x T)** |  |  |  |
| Ax3mg | 41.92± 0.42d | 921.28± 19.90c | 1929.71±22.75def |
| Ax6mg | 42.92± 0.42cd | 1064.71±19.90b | 1960.42±22.75cd |
| Ax9mg | 43.57± 0.42c | 1051.85± 19.90b | 1939.57± 22.75de |
| A x As | 43.07± 0.42cd | 931.28± 19.90c | 1868.57± 22.75d |
| A x Cont. | 42.35± 0.42cd | 878.57± 19.90c | 1888.42± 22.75ef |
| Rx3mg | 46.14± 0.42ab | 1137.71± 19.90a | 2132.0± 22.75b |
| Rx6mg | 46.21± 0.42ab | 1169.85± 19.90a | 2189.14± 22.75ab |
| Rx9mg | 47.35± 0.42a | 1179.28± 19.90a | 2207.14± 22.75a |
| R x As | 46.14± 042ab | 1066.71± 19.90b | 2014.71± 22.75c |
| R x Cont. | 45.71± 0.42b | 1049.0± 19.90b | 1936.0± 22.75def |

Mean having similar letters in each column are not significantly different.

**3. Body weight gain:**

Data presented in table (4) showed that broiler strain had highly significant effect on body weight gain during all periods of estimation. It was found that chicks hatched from eggs of Ross strain had significantly higher body weight gain at (0-4) weeks was 1074.25g compared to Arbor Acres strain averaged 926.64g. Also, during the period from (0-6) a week of age was 2049.54g for Ross strain when compared with those of Arbor Acres strain 1873.87g at the same period. Highly significant effect was found on body weight gain at all periods of estimation due to treatments applied.

Inspecting data presented in table (4) showed that, chicks hatched from eggs injected with ascorbic acid at a level of 6 mg had significantly higher body weight gain during the period from (0-4) weeks of age (1072.89g). Also, the higher body weight gain during the period from (0-6) weeks of age was found in chicks hatched from eggs injected with 6 and 9mg ascorbic acid (2029.67 and 2027.89g, respectively) when compared with other treatments applied and control group.These results disagree with those obtained by **Hassan *et al.,(*2011) and Celik and Ozturkcan (2003)** showed that, the body weight gain was significantly enhanced by vitamin supplemented (L-carnitine, ascorbic acid or both) under high temperature conditions, whereas L-carnitine or L-carnitine + ascorbic acid supplementations significantly reduced the growth performance in broilers under normal ambient temperature.

The interaction effect had highly significant value on body weight gain at all periods of estimation. The higher body weight gain observed in chicks hatched from Ross strain and injected with either 9mg (2159.78g) or 6mg ascorbic acid (vitamin c) (2143.21g), respectively when compared with different interactions.

**Table (4) Least –square means and standard error (X ± S.E) for body weight gain of incubation eggs of different experimental groups as affected by studied factors.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Items** | **Body weight gain (g) during** | | |
| **0-4 WK** | **4-6WK** | **0-6WK** |
| **Strain (S)** |  |  |  |
| Arbor Acres (A) | 926.64 ± 8.85 b | 947.22 ± 5.82 b | 1873.87 ± 10.12 b |
| Ross (R) | 1074.25 ± 8.85 a | 975.28 ± 5.82 a | 2049.54 ± 10.12 a |
| **Treatments** **injection (T)** |  |  |  |
| Vitamin C 3mg | 985.46 ± 14.0 b | 1000.64 ± 9.21 a | 1986.10 ± 16.01 a |
| Vitamin C 6mg | 1072.89 ± 14.0 a | 956.78 ± 9.21 b | 2029.67 ± 16.01 a |
| Vitamin C 9mg | 1070.10 ± 14.0 a | 957.78 ± 9.21 b | 2027.89 ± 16.01 a |
| A shim(As) | 954.39 ± 14.0 a c | 942.64 ± 9.21 b | 1897.03 ± 16.01 b |
| Control (cont.) | 919.39 ± 14.0 c | 948.42 ± 9.21 b | 1867.82 ± 16.01 b |
| **Interaction (S x T)** |  |  |  |
| Ax3mg | 879.35 ± 19.81 c | 1007.0 ± 13.02 a | 1886.35 ± 22.64def |
| Ax6mg | 1021.85 ± 19.81 b | 894.28 ± 13.02 c | 1916.14 ± 22.64 d c |
| Ax9mg | 1008.28 ± 19.81 b | 887.71 ± 13.02 c | 1896.0 ± 22.64 d e |
| A x As | 888.21 ± 19.81 c | 937.28 ± 13.02 b | 1825.50 ± 22.64 f |
| A x Cont. | 835.50 ± 19.81 c | 1009.85± 13.02 a | 1845.35 ± 22.64 e f |
| Rx3mg | 1091.57 ± 19.81 a | 994.28 ± 13.02 a | 2085.85 ± 22.64 b |
| Rx6mg | 1123.92 ± 19.81 a | 1019.28± 13.02 a | 2143.21 ± 22.64 a b |
| Rx9mg | 1131.92 ± 19.81 a | 1027.85± 13.02 a | 2159.78 ± 22.64 a |
| R x As | 1020.57 ± 19.81 b | 948.00 ± 13.02 b | 1968.57± 22.64 c |
| R x Cont. | 1003.28 ± 19.81 b | 887.00 ± 13.02 c | 1890.28 ± 22.64 def |

Mean having similar letters in each column are not significantly different

**4. Feed consumption;**

Data concerning feed consumed (Table, 5) showed gradual increase in the average of feed consumed per chick by the advancing age. This was quite true in all experimental groups which may be attributed to the increasing demand of various nutrients by advancing age.

Chicks hatched from eggs of Ross strain showed the highest insignificant average of feed consumption per chick during the period from (0-6) weeks of age (3373.1g/chick). While, the lowest average of feed consumption at the same period was found in chicks hatched from eggs of Arbor Acres strain (3199.1g/ bird). Similar results were observed during the periods from (4-6) weeks of chicks age. These results disagree with those obtained by **Samak, (2001)** who found that, average feed consumption was significantly higher in Bandara pullets (121.47 g ∕bird) following by Mamourah (118.45g∕bird) and Gimmizah (114.18g/bird).

Chicks hatched from eggs injected with 9 mg ascorbic acid showed the highest insignificant average of feed consumption per chick during the period from (0-6) weeks (3382.28g/bird).While, the lowest averages of feed consumption were found in chicks hatched from eggs injected with 3 or 6 mg ascorbic acid (3172.03 and 3181.96g /bird, respectively). These results agree with those obtained by **Hegab, (2001)** who stated that chicks hatched from eggs injected with 3 mg ascorbic acid showed the lowest average of feed consumption per chick at the period from (0-8) weeks of age ( 4726.81 g / bird).

The interaction effect had insignificant effect on feed consumption at all periods of estimation. It was clearly evidence that chicks hatched from eggs of Arbor Acres and injected with 6 or 3 mg ascorbic acid had the lowest insignificant averages of feed consumption (2963.73 and 2970.46 g/ bird, respectively) during the period from (0-6 ) weeks .

**Table (5) Least –square means and standard error (X ± S.E) for feed consumption of different experimental groups as affected by studied factors.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Items** | **Feed consumption(g/bird) during** | | |
| **0-4 WK** | **4-6 WK** | **0-6 WK** |
| **Strain(S)** |  |  |  |
| Arbor Acres (A) | 1176.1± 5.70 | 2148.4 ± 18.34 | 3199.1 ± 84.14 |
| Ross (R) | 1174.4 ± 5.70 | 2162.7 ± 18.34 | 3373.1 ± 84.14 |
| **Treatments injection (T)** |  |  |  |
| Vit.c 3mg | 1177.70 ± 9.01 | 2147.75 ± 29.01 | 3172.03 ± 133.04 |
| Vit.c 6mg | 1180.15 ± 9.01 | 2147.74 ± 29.01 | 3181.96 ± 133.04 |
| Vit.c 9mg | 1174.10 ± 9.01 | 2174.51 ± 29.01 | 3382.28 ± 133.04 |
| A sham(As) | 1171.40 ± 9.01 | 2152.15 ± 29.01 | 3350.70 ± 133.04 |
| Control(Cont.) | 1173.05 ± 9.01 | 2156.15 ± 29.01 | 3363.75 ± 133.04 |
| **Interaction** **(S x T)** |  |  |  |
| Ax3mg | 1170.00 ± 12.74 | 2145.50 ± 41.02 | 2970.46 ± 188.15 |
| Ax6mg | 1180.00 ± 12.74 | 2150.30 ± 41.02 | 2963.73 ± 188.15 |
| Ax9mg | 1182.40 ± 12.74 | 2155.30 ± 41.02 | 3371.96 ± 188.15 |
| A x AS | 1172.40 ± 12.74 | 2150.60 ± 41.02 | 3338.66 ± 188.15 |
| A x Cont | 1175.70 ± 12.74 | 2140.60 ± 41.02 | 3351.13 ± 188.15 |
| Rx3mg | 1185.40 ± 12.74 | 2140.00 ± 41.02 | 3373.60 ± 188.15 |
| Rx6mg | 1180.30 ± 12.74 | 2144.70 ± 41.02 | 3360.20 ± 188.15 |
| Rx9mg | 1165.80 ± 12.74 | 2193.73 ± 41.02 | 3392.60 ± 188.15 |
| R x As | 1170.40 ± 12.74 | 2155.70 ± 41.02 | 3362.73 ± 188.15 |
| R x Cont | 1170.40 ± 12.74 | 2171.50 ± 41.02 | 3376.36 ± 188.15 |

Mean having similar letters in each column are not significantly different.

**5. Feed conversion:**

Results obtained in table (6) showed that Arbor Acres chicks had the better feed conversion values at all periods of estimation when compared with Ross chicks.

Broiler strain had highly significant effect (p<0.001) on average feed conversion during the period from (0-6) wks. of birds age only. These results agree with those obtained by **Samak,(2001)** who found that, feed efficiency was significantly (p<0.001) different among the three strains of chickens along the pullets age .Gimmizah pullets had significantly high (0.27 gm egg ∕ gm feed) feed efficiency following by Mamourah (0.26) and Bandara ones (0.25) .

Treatments applied showed significant effect (P< 0.05) on feed conversion at the period from (0-6) wks. of bird's age only. Chicks hatched from eggs injected with 6mg ascorbic acid showed the poorest value of feed conversion during the period from (0-6) wks. (2.35g feed/g gain). While, the best feed conversion values at the period from (0-6) weeks of age were found in chicks hatched from eggs injected with 3 or 9mg ascorbic acid (2.11 and 2.11g feed/g gain, respectively). This result agree with those obtained by **Njoku, (1986); McForlane and Curtis, (1988); Robertson** **and** **Edwards, (1994) and Hassan *et al*., (2011)** who reported that, supplementation of ascorbic acid improved feed conversion.

The interaction between Ross strain and each of a sham and control group had the best averages of feed conversion (2.09 and 2.10g feed/g gain, respectively) during the period from (0-6) weeks of bird's age.

**Table (6) Least –square means and standard error (X ± S.E) for feed conversion of different experimental groups as effected by studied factors.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Items** | **Feed conversion (g feed/g gain), during** | | |
| **0-4 WK** | **4-6 WK** | **0-6 WK** |
| **Strain (S)** |  |  |  |
| Arbor Acres (A) | 1.23 ± 0.03 | 2.22 ± 0.05 | 2.11 ± 0.09 a |
| Ross (R) | 1.25 ± 0.03 | 2.27 ± 0.05 | 2.26 ± 0.09b |
| **Treatments injection(T)** |  |  |  |
| Vit.C .3mg | 1.91 ± 0.09 | 2.23 ± 0.05 | 2.11 ± 0.04 a |
| Vit.C .6mg | 1.22 ± 0.09 | 2.28 ± 0.05 | 2.35 ± 0.04 a b |
| Vit.C .9mg | 1.20 ± 0.09 | 2.27 ± 0.05 | 2.11 ± 0.04 a b |
| A sham(As) | 1.81 ± 0.09 | 2.20 ± 0.05 | 2.17 ± 0.04 b |
| Control(Cont.) | 1.20 ± 0.09 | 2.15 ± 0.05 | 2.13 ± 0.04 a b |
| **Interaction** **(S x T)** |  |  |  |
| Ax3mg | 1.16 ± 0.12 | 2.12 ± 0.07 b | 2.21 ± 0.06a |
| Ax6mg | 1.20 ± 0.12 | 2.41 ± 0.07 b | 2.21 ± 0.06 b |
| Ax9mg | 1.30 ± 0.12 | 2.33 ± 0.07 a | 2.37 ± 0.06 b |
| A x AS | 1.15 ± 0.12 | 2.14 ± 0.07 a | 2.25 ± 0.06 b |
| A x Cont. | 1.13 ± 0.12 | 2.18 ± 0.07 a b | 2.20 ± 0.06 a b |
| R x 3mg | 1.18 ± 0.12 | 2.15 ± 0.07 a | 2.22 ± 0.06a |
| R x 6mg | 1.20 ± 0.12 | 2.43 ± 0.07 b | 2.21 ± 0.06 a b |
| R x 9mg | 1.31 ± 0.12 | 2.19 ± 0.07 b | 2.24 ± 0.06 b |
| R x As | 1.16 ± 0.12 | 2.20 ± 0.07 b | 2.09 ± 0.06 b |
| R x Cont. | 1.15 ± 0.12 | 2.11 ± 0.07 a b | 2.10 ± 0.06 a b |

Mean having similar letters in each Colum are not significantly different.

**6. Economic efficiency:**

Data listed in table (7) showed that broiler strain had insignificant effect on economic efficiency (EE). This may be attributed to the insignificant difference found in the feeding cost since the selling price is constant.

Chicks hatched from eggs of Ross strain showed the highest economic efficiency at (0-6) week (143.53%) when compared with Arbor Acres strain (142.65%), respectively. Treatments applied had highly significant effect (P<0.01) on economic efficiency during the period from 0-6 wks. In addition, chicks hatched from eggs injected with ascorbic acid at a level of either 3 or 6 mg ascorbic acid showed the highest economic efficiency values at (0-6) weeks (170.35 and 155.94%, respectively) when compared withdifferent treatments applied. However, Chicks hatched from eggsof control group had the lowest average of economic efficiency (108.52%)when compared with different treatments applied. These results agree with those obtained by **Ghonim *et al.,* (2008)**who reported that, economic efficiency and net return were improved by dipping (20 g ascorbic acid/liter) or spraying (30g ascorbic acid/liter) fertile Muscovy duck eggs with ascorbic acid solution at the 14th day of incubation period. **Ghonim *et al.,* (2009)** found that, the improvement of economic efficiency (EE) may be due to the increase of hatchability percentage and decreasing in embryonic mortality as well as increasing the duckling price.He also added that, economic efficiency and net return were improved by ascorbic acid spraying method during the incubation period followed by dipping and injection methods as comparedto the control.

The interaction between Ross x Control and Arbor Acres x control had the lowest averages of economic efficiency (108.03 and 109.01%, respectively) when compared with different treatments applied. However, the interaction between (Arbor x 3mg ascorbic acid) and (Ross x 3mg ascorbic acid) had the highest averages of economic efficiency level (174.79% and 165.91%), respectively.

Table (15) Least –square means and standard error (X ± S.E) for economic efficiency of different experimental groups as affected by studied factors.

|  |  |
| --- | --- |
| **Economic efficiency(%)during** | **Items** |
| **0-6 WK** |
|  | **Strain(S)** |
| 142.65 ± 7.99 | Arbor Acres(A) |
| 143.53 ± 7.99 | Ross (R) |
|  | **Treatments injection(T)** |
| 170.35 ± 12.64a | Vit.C 3mg |
| 155.94 ± 12.64 a | Vit.C 6mg |
| 150.37 ± 12.64 a | Vit.C 9mg |
| 130.27 ± 12.64 a b | A sham(As) |
| 108.52 ± 12.64 b | Control (cont.) |
|  | **Interaction** **(SxT)** |
| 174.74 ± 17.88a | Ax3mg |
| 160.07 ± 17.88a b | Ax6mg |
| 158.03 ± 17.88a b | Ax9mg |
| 115.76 ± 17.88a b | A x As |
| 109.01 ± 17.88b | A x Cont. |
| 165.91 ± 17.88a b | Rx3mg |
| 151.81 ± 17.88a b | Rx6mg |
| 142.72 ± 17.88a b | Rx9mg |
| 144.78 ± 17.88a b | R x As |
| 108.03 ± 17.88b | R x Cont. |

Mean having similar letters in each column are not significantly different.

**4. Conclusion**

It could be concluded that, Ross strain and injection incubated eggs with 3 and 6 mg ascorbic acid seemed to be adequate to a chive the favorable results and is being recommended from the economic point of view.

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