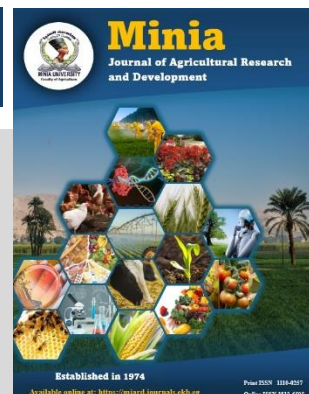




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Effect of Ovo Injection with Some Amino Acids on Hatchability and Productive Performance and Carcass Characteristics of Hatched Chicks

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ABSTRACT

This study was carried out to evaluate the effect of injected ovo with different sources of amino acids on hatchability, performance, and carcass characteristics of hatched chicks. A total 360 hatching eggs were randomly divided into six treatments with 60 eggs at each group. The sequence of treatment groups was as follows: Negative Control, Dry Punch Control, Positive Control, eggs were injected with 0.5 mL normal saline, Folic Acid (FA): eggs injected with 25 mg of folic acid, Threonine (THR): eggs was injected with 10 mg of threonine, and the combination of (FA + THR), eggs was injected with 12.5 mg of folic acid and 5 mg of threonine (FA + THR). Each treatment was divided equally into three replicates (20 chickens each). All chickens received a commercial broiler diet. At the end of the experiment (5 weeks) 3 birds from each group was randomly selected, weighted, and slaughtered for studying carcass characteristics. The obtained results showed ovo injection with folic acid, threonine or the combination of these two amino acids in the fertile eggs, had no significant effects on the fertility or hatchability of fetal eggs. Also, all parameters of growth performance and carcasses characteristics did not significantly affected. While, greatest numerically values of fertile eggs% and hatchability % were reported for folic acid and water injection groups. Body gain recorded the higher numerical value for birds received the combination of the two amino acids. Folic Acid group recorded highest feed intake.

Keywords: Ovo injection, hatchability, performance, carcass traits.

1. INTRODUCTION.

In modern poultry farming, the most important thing is to maintain a balance between growth and immunity, as broilers are mainly bred for higher growth rate rather than better immunity. During early growth, commercial chicks are susceptible to stress due to limited nutrient content in eggs during the later incubation period and also have delayed access to nutrients. nutrients in the diet during the first hours after hatching due to hatchery operating procedures (**Batal and Parsons 2002**).

Ovo injection is a technique utilized to adjust chicks during embryonic period. There are a vitality requesting movement hence this technique for arrangement of tall vitality for chick's bring forth, which is. In expansion, there is a fundamental development of the gastrointestinal tract amid the introductory days of chick age, taken after by skeletal and muscular improvement. There's not sufficient time for compensatory development as a result of the brief life expectancy of broilers, (**Kornasio et al. 2011**) hence, it is essential to fortify advantageous impacts on development execution of the broiler chickens amid the starting development to chick. Too, in ovo injection of a few supplements such as vitamins and minerals may offer assistance overcome any limitation of egg sustenance (**Selim et al. 2013**).

Pathogens can impair the immune function of chickens and thereby affect their growth performance. Therefore, it is very important to provide birds with a suitable starting point (**Kadam et al. 2008**). Nutritionally, the application of immunomodulatory nutrients such as carbohydrates, amino acids, vitamins and enzymes supports the synthesis of immune-mediated effectors that contribute to the clonal proliferation of lymphocytes are antigen-driven and mobilize bone marrow monocytes and allogenous cells (**Kogut and**

Klasing 2009). Dietary supplementation with amino acids such as folic acid, threonine (THR), methionine, arginine (ARG), glycine, serine and valine from early post-hatching ages has been shown to improve humoral immune responses in broilers (**Lee et al. 2003**). On the other hand, the use of amino acids in eggs can improve intestinal development, compensate for possible nutrient deficiencies in the early stages after hatching, and subsequently enhance immunity of broilers (**Kadam et al. 2008**).

Folic acid and threonine are essential amino acids for broilers because they are not capable of producing threonine *de novo* (**Waguespack et al. 2010**). Therefore, these amino acids must be prepared exogenously to broilers. Supplementation of eggs with a mixture of amino acids has been reported to improve humoral and cell-mediated immunity (**Bhanja and Mandal 2005**). Kadam et al. (2008) revealed that yolk sac supplementation with 20–30 mg threonine in eggs improved antibody titers against sheep red blood cells (SRBCs) in broiler chickens. Recently, the expression of genes involved in humoral immunity, interleukin-6 and tumor necrosis factor was increased after broiler chickens were injected with folic acid, threonine or methionine and cysteine in eggs (**Bhanja et al. 2014**).

The objective of this experiment was to study the effects of egg injection of folic, threonine, and their combination on hatchability and growth performance and carcass traits and of growing chicks after hatching from injected eggs.

2. MATERIALS AND METHODS

2.1. Experimental Work.

This experiment was conducted out at the Farm of Animal and Poultry Production, Faculty of Agriculture, Minia University. It was planned to study the effect of injected fertile eggs of meat type breeders with either

folic acid, threonine acid, of both of folic and threonine acids at the levels of 25 mg, 10 mg or 12.5 and 5 mg respectively on some hatchability aspects and growth performance, and carcass characteristics of growing hatched chicks.

2.2. Hatching Eggs Treatments.

All 360 hatching eggs were randomly divided into six treatments group with 60 eggs at each group. Each treatment group was divided into three replicates with 20 eggs at each replicate. The sequence of treatment groups was as follows:

- Treatment (T1) Negative Control, in which no eggs were injected (NC).
- Treatment (T2) Dry Punch Control, in which shell and shell membranes were pricked without injecting any solution (DPC).
- Treatment (T3) Positive Control, in which eggs were injected with 0.5 mL normal saline (PC).
- Treatment (T4) Folic Acid group, in which eggs were injected with 0.5 mL normal saline containing 25 mg of folic acid (FA).
- Treatment (T5) Threonine group, in which eggs were injected with 0.5 mL normal saline containing 10 mg of threonine (THR).
- Treatment 6 (T6) Folic Acid with Threonine group, in which eggs were injected with 0.5 mL normal saline contain 12.5 mg of folic acid and 5 mg of threonine (FA + THR). The eggs were injected in the air sac.

2.3. In-Ovo Injection.

At the first day of incubation, the large ends of the freshly laid eggs were cleaned with ethyl alcohol (70%) and were penetrated by a pin, taking care not to injure the outer egg membrane. The solutions were injected into the air sac (0.5 mL/egg) at a depth of 12 mm (Akhlaghi et al., 2013), via a disposable syringe (1 ml syringe). The

punched eggs were sealed with melted paraffin wax.

2.4. General Management.

All eggs were set in an incubator at average temperature of 37.5°C, and relative humidity of 56.5%. The eggs were turned hourly. After 18 days of incubation, the eggs were transferred to a hatcher at an average temperature of 36.6°C, and a relative humidity of 61.2%. After hatching, all unhatched eggs were examined to calculate the embryonic mortality, which was classified as unfertile and early mortality (1-12 days) and late embryo mortality (13-21days).

2.5. Embryonic Mortality.

Total embryonic mortality was determined as amount of all dead embryos. Other calculated parameters consisted of fertility percentage, hatchability of total eggs and hatchability of fertile eggs.

2.6. Embryonic Mortality.

Fertility percentage was calculated as (number of fertile eggs divided by number of total eggs) multiply by 100 as follows:

$$\text{Fertility \%} = \frac{\text{number of fertile eggs}}{\text{number of total eggs}} * 100$$

Hatchability of total eggs calculated as (number of hatched chicks divided by number of total eggs) multiply by 100 as follows:

$$\text{Hatchability \%} = \frac{\text{number of hatched chicks}}{\text{number of total eggs}} * 100$$

Hatchability of fertile eggs calculated as (number of hatched chicks divided by number of fertile eggs) multiply by 100 as follows:

$$\begin{aligned} \text{Hatchability \% of Fertile eggs} \\ = \frac{\text{number of hatched chicks}}{\text{number of fertile eggs}} * 100 \end{aligned}$$

2.7. Grower Experiment.

After hatching, chickens were then transported to the farm of the Faculty of Agriculture Minia University. Each hatching chickens treatment according to the previous injection treatments was divided into three

replicates (20 chickens each). Each replicate was housed separately in several cages in open system house. Feed and water were available *ad libitum*.

2.7.1. Chickens Diet.

Chickens received a commercial broiler starter diet with 3025 kcal of ME/kg and 23% Crude Protein (CP) from first to 14th day. At the age of 14 to 28 days, the chickens were fed a grower diet with 3150 kcal of ME/kg and 21% CP. From 28 days to 35 days of age, the chickens were fed a finisher diet containing 3200 kcal of ME/kg and 19% CP. Starter feed was provided as crumbles, and subsequent feeds were provided as pellets.

2.7.2. Body Weight (gm).

At one day of age and weekly, chicks in every replicate weighed until the end of the study period (35 days of age), respectively. Chicks' weights distributed by the number of survived birds in each replicate (gm/bird).

2.7.3. Body Gain (gm).

Body gain calculated through the 1 to 3, 3 to 5, and 1 to 5 weeks of age by subtracting the initial BW from the final BW within each period and divided by the number of survived chicks in each replicate (gm/bird).

2.7.4. Feed intake (gm).

The feed consumption in each replicate at entire whole perimental periods 1 to 3, 3 to 5, and 1 to 5 weeks of age were recorded. Averages feed intake (gm/bird) during each period were calculated as follow: feed intake for each replicate (gm)/ the number of live chicks in the same replicate.

2.7.5. Feed conversion ratio (gm feed/gm weight gain).

Feed conversion ratio (FCR) was calculated as follows:

Feed conversion ratio

$$= \frac{\text{Avarage feed intake/ bird/period}}{\text{Avarage body gain/ bird/ period}}$$

2.8. Slaughter Traits.

At 35 days of chickens age, 2 birds from each group randomly selected,

weighted and sacrificed after 12 hours of fasting. After bleeding, chicks were scalded, feather picked by hand and eviscerated. Different organs (Liver, Heart, Spleen, Fabricius, and Gizzard) were removed, weighed and expressed as percentage of live body weight.

3. RESULTS AND DISCUSSION

3.1. Effects of Ovo Injected Treatments on Egg Fertility.

The effect of in ovo injected with folic acid (FA) and Threonine (Thre.) their combination into air sac at day one of incubation on Apparent fertility% (AF) Hatchability of fertile eggs% (AH) and Hatchability of total eggs% (AHT) at hatch are shown in table (1). According to the results, no significant effects were detected due to in ovo injection in Arbor Acres broiler parent eggs by folic acid, Threonine and their combination on the previous items. The results showed that the ovo injection with either 25 mg FA or 10 mg Thre. presented a numerically higher Apparent fertility (%) values than other treatments fertile eggs. Regarding to fertility and hatchability of total eggs% at hatch, the greatest numerically enhance was observed for folic acid and water ovo injection compared with other treatment groups.

The improvement in apparent fertility% due to ovo injection with folic acid (FA) and Threonine (Thre.) or hatchability of fertile eggs% and hatchability of total eggs% (AHT) due to the nutritional importance of FA lies in its vital role in one carbon metabolism; these include amino acid synthesis such as synthesis of serine and glycine (Bailey, 2007), the latter is critical for synthesis and repair DNA, for all cell replication, including normal foetal development (Stover, 2010). In addition, Threonine (Thre.) might be explained the critical rule of threonine supplementation, in ovo, yields

for the early growth trajectory (**Abo Ghanima et al., 2023; Ahmad et al., 2019**).

Injecting 20 to 30 milligrams of threonine into the yolk sac in ovo improves post-hatching growth. Moreover, This improvement in hatchability rate might be explained according to some scientific basics during embryonic development where during this period high metabolic rates can cause chain reaction leads to thousands of events which resulted in production of reactive oxygen species (ROS) (**Halliwell, 1994**). Free radicals are extremely reactive where they react with a normal compound, other free radicals are generated. Peroxidation of polyunsaturated fatty acids leads to loss of plasma membrane functions. Moreover, deoxyribonucleic acid damage may cause inhibition of proteins directly such as enzymes and indirectly cause mutation or cell death and as a result carcinogenesis (**Vasudevan and Sreekumari, 2001**). The decline in hatchability in untreated treatments may be duo to sometimes attributed to damage to the internal environment of the egg, particularly when injections occur early in embryonic development, or if the injected volume is too high, leading to excessive embryo hydration (**Zhai et al., 2011**)

These results agreement with published results by **Kadam et al., (2008)**

they demonstrated that, no significant difference was observed in the hatchability rates between the injected groups and the uninjected control group when threonine was injected into broiler breeder eggs at concentrations of 10, 20, 30, or 40 milligrams dissolved in sterile saline into the yolk sac on the fourteenth day of incubation. Also, **Kermanshahi et al., (2016)** who optional that threonine, administered appropriately, does not negatively affect the embryonic viability leading up to hatch. In a study on Japanese quail, similar findings were reported; the hatchability of eggs injected with a low volume of threonine solution (0.05 milliliters) under the air sac was comparable to the non-injected control group.

In addition, **Kermanshahi et al., (2016)** found a positive retention of hatchability was noted when 0.05 milliliters of threonine solution was injected under the air sac in Japanese quail. **Li et al., (2016)** and **Liu et al., (2016)** speculated an improved in hatchability rate when 100 or 150 micrograms of folic acid injected into the yolk sac on the eleventh day of embryonic development compared to the control group.

Table (1): Effect of in ovo injection on embryonic mortality and hatchability

Items	Treatments						SE	Significant
	Control	Sham	Water	Folic acid	Threonine	FA & Thre.		
AF (%)	88.33	86.67	90	90	91.67	91.67		NS
AH (%)	77.00	65.79	80.43	80.43	75.53	71.93		NS
AHT (%)	67.98	57.02	72.37	72.37	69.21	65.79		NS

3.2. Effect of Ovo Injected Treatments on Chicks Post Hatch Performance

3.2.1. Body Weight and Body Gain

The effect of in ovo injected with folic acid (FA), Threonine (Thre.), and their combination at the levels of 25 mg, 10 mg,

or 12.5 and 5 mg respectively into air sac at day one of incubation on body weight and body gain are shown in tables (2 & 3). The data revealed that there is no significant effects on either body weight or body weight gain during all experimental periods due to

all ovo injection treatments and control. In general, by 3 weeks and 5 weeks of age, the Sham treatment group consistently maintained the highest body weight (1012.4 gm at 3 weeks and 2507.3 gm at 5 weeks). The Folic Acid group remained numerically the lowest at 5 weeks of age, recording 2278.3 gm. Regarding to body gain, numerically the Sham group achieved the highest gain during the early 1-3 weeks period (341.3 gm) and also recorded the highest total body gain for the overall 1-5 weeks period (1836.3 gm).

Notably, the Threonine treatment group registered the highest gain during the later 3-5 weeks period (1545.2 gm), while the Folic Acid group consistently recorded the lowest body gain across all measured periods, including the 1-3 weeks period (264.8gm), 3-5 weeks period (1360.2 gm), and the 1-5 weeks period (1625 gm).

The finding that the Sham group frequently demonstrated the highest body weight (at 3 and 5 weeks) and highest overall body gain (1-5 weeks), while the nutrient-injected groups (Folic Acid, Threonine, and FA & Thre.) often performed worse than the Sham or Control treatments, stands in striking opposition to the growth-enhancing results consistently reported in the literature review for in ovo nutrient delivery. Folic acid, which is critical for single-carbon transfer in amino and nucleic acid synthesis and metabolism, is widely supported as a beneficial nutrient for developing embryos. **Ismail et al. (2019)** reported that injecting folic acid positively contributes to broiler body weight and body weight gain, specifically finding that doses of 75 micrograms and 150 micrograms per egg led to a significant increase in live body weight by 7 days of age compared to controls. Furthermore, chicks receiving

these dosages achieved the highest significant body weight gain values at 7 days of age. **Nouri et al. (2017)** also confirmed that injecting 120 micrograms of folic acid significantly improved body weight gain in birds by 21 days post-hatch. Similarly, the literature strongly emphasizes the efficacy of in ovo threonine supplementation for growth enhancement.

Kadam et al. (2008) speculated that injecting threonine has significant potential for improving broiler body weight and body weight gain, observing that optimal doses (20 to 30 milligrams per egg) led to significantly higher live body weight gain compared to untreated controls, resulting in treated chicks being 29 to 79 grams heavier by 28 days of age. **Tahmasebi and Toghyani (2015)** reinforced this, reporting that injecting 25 milligrams of threonine significantly increased body weight across all phases, with threonine-injected birds weighing 2569.4 grams by 42 days, significantly more than the 2155.6 grams of un-injected controls. The effectiveness of threonine is biologically supported by its crucial role as a precursor for glycine synthesis and its influence on the functional development of the gastrointestinal tract, leading to higher protein synthesis. Even at higher doses, **Alabi et al. (2020)** demonstrated that 45 milligrams of threonine resulted in the highest average daily weight gain at the second week post-hatch. These consistent findings across multiple studies showing significant, positive effects of both Folic Acid and Threonine on early and long-term body weight and gain, sharply contrast with the initial data where the Folic Acid group recorded the lowest weights at 1 and 5 weeks and the lowest overall body gain.

Table (2): Effect of on ovo injection on body weight (gm/bird) of growing chicks.

Items	Age (weeks)	Treatments						SE	Significant
		Control	Sham	Water	Folic Acid	Threonine	FA & Thre.		
Body weight (gm)	1	660.5	671.1	671.6	653.3	683.8	683	15.34	NS
	3	928.3	1012.4	906.1	918.1	905.3	967.3	35.10	NS
	5	2430	2507.3	2452.2	2278.3	2450.6	2360.7	85.75	NS

Table (3): Effect of in ovo injection on body gain (gm/bird) of growing checks.

Items	Age (weeks)	Treatments						SE	Significant
		Control	Sham	Water	Folic Acid	Threonine	FA & Thre.		
Body Gain (gm)	1-3	267.7	341.3	234.4	264.8	221.6	284.3	33.57	NS
	3-5	1501.7	1494.9	1494.9	1360.2	1545.2	1393.5	68.36	NS
	1-5	1769.5	1836.3	1780.5	1625	1766.8	1677.7	84.08	NS

3.2.2. Feed Intake and Feed Conversion

The effect of in ovo injected with folic acid (FA), Threonine (Thre.), and their combination at the levels of 25 mg, 10 mg, or 12.5 and 5 mg respectively into air sac at day one of incubation on feed intake (FI) and feed conversion (FCR) of hatched chicks during the 1-5 weeks duration is shown in tables (4 & 5). Generally, the data revealed that there is no significant effects either in feed intake or feed conversion ratio during all experimental period. Regarding total feed intake from 1-5 weeks, the Sham treatment group recorded the highest consumption at 4912.4 gm per bird. The control group consumed 3395.3 gm. Among the specific amino acid treatments, the Folic Acid group consumed 3995.9 gm, followed by the combination group (FA & Threonine) at 3825.4 gm, while the Threonine-only group recorded 3423.3 gm, which is only slightly higher than the control group. The lowest recorded intake was observed in the water injection group (3217.2 gm).

For the corresponding total feed conversion ratio (1-5 weeks), efficiency varied numerically, suggesting differences in nutrient utilization. The water group showed

the most efficient conversion ratio (lowest ratio) at 1.81, closely followed by the control group (1.92) and the Threonine group (1.94). Conversely, the Sham treatment resulted in the least efficient feed conversion ratio at 2.67. Both the Folic Acid treatment (2.47) and the combination treatment (FA & Threonine) (2.29) showed substantially less efficient conversion ratios compared to the control group for the overall 1-5 weeks duration.

The numerical results showed only marginal increases in feed intake (FI) and reduced feed conversion ratio (FCR) efficiency for the Folic Acid (FA) and combination treatments across 1-5 weeks, stand in contrast to numerous positive findings reported in the literature. Specifically, regarding Threonine, the results (3423.3 gm FI over 1-5 weeks) do not align with reports indicating significant enhancement. For instance, **Kadam et al. (2008)** found that chicks receiving various levels of Threonine injections exhibited significantly higher feed intake between 14 and 21 days post-hatching, with the 20 mg dose yielding the statistically highest consumption. This increase in consumption

is considered a function of live body weight in birds maintained on similar diets. Similarly, **Tahmasebi and Toghyani (2015)** reported that injecting 25 milligrams of Threonine per egg demonstrated a considerable increase in daily feed Intake across the growing, finishing, and the entire rearing phases when compared to sham or control groups. **Tahmasebi and Toghyani (2015)** hypothesized that this enhancement is due to Threonine's critical role as an essential component of mucin and gastric enzymes, which supports the functional development of the gastrointestinal tract. For Folic Acid, the numerically higher FI (3995.9 gm) resulted in this work is supported by the mechanism described by **Abd El-Azeem et al. (2014)**, which links enhanced feed intake to the beneficial impact Folic Acid exerts on cellular functions and protein biosynthesis, optimizing the balance between various amino acids. Furthermore, **Nouri et al. (2017)** demonstrated that feed intake increased significantly in birds that received Folic Acid compared to the control group across the entire duration of their study. **Ismail et al. (2019)** confirmed that Folic Acid administration through in ovo injection positively influences feed intake, with effective outcomes often dependent on the specific dosage and whether it is administered alone or in combination with other substances.

Concerning feed conversion, the reduced efficiency observed for Folic Acid (FCR 2.47) and the combination treatment (FCR 2.29) in the results contrasts sharply with much of the reviewed literature. While **Tahmasebi and Toghyani (2015)** noted

conflicting results, where the overall FCR for the collective 1-42 days period was not significantly influenced by Threonine treatments alone in some research, they also reported that 45 milligrams of Threonine led to a better feed conversion ratio during the second week post-hatch. Earlier, **Kadam et al. (2008)** reported that the efficiency of nutrient utilization (FCR) until seven days after hatching was notably improved (a lower numerical value) in chicks receiving 10, 20, or 40 milligrams of Threonine. However, **Alabi et al. (2020)** also showed variability, reporting that a 30 mg dose, despite promoting growth, resulted in a significant feed conversion Ratio during the second and fifth weeks in one investigation. For Folic Acid, the lack of improved FCR in resulted in this work is conflicted by **Nouri et al. (2017)**, who found that the overall FCR generally improved (a lower numerical value) in birds receiving Folic Acid injections during the later growth phase (21–42 days) and over the collective experimental period.

Nouri et al. (2017) specifically found that the administration of 40 and 80 micrograms of Folic Acid resulted in significantly improved feed conversion ratios compared to the untreated control group across the entire 1-42 days period. When Folic Acid was administered in combination, **Ismail et al. (2019)** reported that combinations involving folic acid and ascorbic acid resulted in a significant numerical decrease in the feed conversion ratio at twenty-eight days of age.

Table (4): Effect of in ovo injection on feed intake (gm/bird) of growing checks.

Items	Age (weeks)	Treatments						SE	Significant
		Control	Sham	Water	Folic Acid	Threonine	FA & Thre.		
Feed Intake (gm)	1-3	1071.9	1319.9	1025.5	1148.9	1027.2	1120	47.30	NS
	3-5	2323.3	3592.4	2191.8	2847	2396.1	2705.4	141.15	NS
	1-5	3395.3	4912.4	3217.2	3995.9	3423.3	3825.4	149.12	NS

Table (5): Effect of in ovo injection on feed conversion ratio of growing checks.

Items	Age (weeks)	Treatments						SE	Significant
		Control	Sham	Water	Folic Acid	Threonine	FA & Thre.		
Feed Conversion	1-3	4.03	3.87	4.38	4.62	4.77	4.31	0.58	NS
	3-5	1.56	2.40	1.42	2.10	1.55	1.94	0.11	NS
	1-5	1.92	2.67	1.81	2.47	1.94	2.29	0.11	NS

3.3. Carcass Characteristic

The effect of in ovo injected with folic acid (FA), Threonine (Thre.), and their combination at the levels of 25 mg, 10 mg, or 12.5 and 5 mg respectively into air sac at day one of incubation on carcass characteristics of hatched chicks is shown in tables (6 & 7) Including absolute weight of live body, carcass, and different organs of bird in table (6) and weight percentage of carcass and organs to live weight table (7). The results showed that there is no significant influences on all carcass characteristics examined among all treatments at the end of the experiment.

The results revealed that live body weight recorded for birds had the Sham (2551.7 gm) and Threonine (2538.7 gm) groups achieved the highest weights, exceeding the Control group (2476.7 gm). The lowest live weights were observed in the Folic Acid (2335 gm) and Water (2360 gm) treatment groups. For Carcass weight, the Control group led with 1906.7 gm, followed by the Threonine (1860 gm) and Sham (1855 gm) treatments. When measured as a percentage of live body weight, the Control group also had the

highest numerically Carcass percentage (76.99%). Examination of internal organ weights revealed key differences between treatments. The liver weight was maximized in the Sham group (75.13 gm), significantly greater than the Control (55.56 gm), and the Sham group also had the highest relative liver weight (2.94). Heart weights were highest in the Threonine (12.56 gm) and Folic Acid (12.26 gm) groups, compared to 11.13 gm for the Control group.

However, when viewed as a percentage, the Folic Acid group had the highest relative Heart weight (0.53%). The smallest Gizzard weight was associated with the Sham injection (18.00 gm), contrasting with the Control which had the highest weight (24.78 gm). Regarding the Fabricius weight was highest in the Sham group (4.49 gm) and lowest in the FA & Thre. (2.46 gm). Total Edible organ weight was highest for the Sham group (103.53 gm) compared to the Control (91.47 gm).

The results suggests that the Threonine treatment resulted in live body and carcass weights among the highest recorded, comparable to the Sham group. However, this finding often contrasts with industry

research, which frequently notes that potential benefits of Threonine injection, while often enhancing initial muscle development immediately post-hatch, are rarely maintained until completion of the rearing phase.

Tahmasebi and Toghyani (2015) specifically investigated the impact of 25 milligrams of Threonine in ovo, finding a significant increase in carcass yield at day 11, yet confirming this advantageous effect was not retained, resulting in no observable impact on total carcass weight by day 42. They concluded that such early advantages rarely translate into statistically significant commercial improvements at market maturity. Similarly, **Alabi et al. (2020)** suggested that Threonine injection yields mixed results and that standard carcass characteristics, including dressed yield and primal cuts, were not significantly

influenced by the amino acid administration at 42 days post hatch.

Nouri et al. (2017) found that the subsequent effect of egg injection with folic acid indicates a general lack of significant influence on carcass characteristics by the time of slaughter. Their detailed investigation of various folic acid doses detected no significant difference in total carcass weight, breast weight, leg weight, or abdominal fat at 42 days when compared to the control group. Result of this work indicated slightly heavier heart weights for both the Threonine and Folic Acid treatments compared to the control, the literature generally suggests that the relative weights of internal organs, including the liver and heart, often remain unaffected by singular or combined amino acids (**Tahmasebi and Toghyani, 2015**).

Table (6): Effect of in ovo injection on some carcass characteristic (gm/bird).

Item weight (gm)	Treatments						SE	Significance
	Control	Sham	Water	Folic Acid	Threonine	FA & Thre.		
Live body	2476.7	2551.7	2360	2335	2538.7	2390	98.01	NS
Carcass	1906.7	1855	1713.3	1733.3	1860	1793.3	79.98	NS
Liver	55.56	75.13	62.86	62.44	60.60	61.88	8.78	NS
Heart	11.13	10.40	10.21	12.26	12.56	10.82	0.89	NS
Spleen	4.89	4.66	5.01	5.19	3.69	3.98	0.90	NS
Gizzard	24.78	18.00	20.26	23.53	23.66	19.15	2.05	NS
Fabricius	3.59	4.49	3.85	3.49	2.94	2.46	0.74	NS
Edible	91.47	103.53	93.33	98.23	96.82	91.85	9.40	NS

Table (7): Effect of in ovo injection on weight percentage (%) of some carcass characteristic.

Item weight %	Treatments						SE	Significance
	Control	Sham	Water	Folic Acid	Threonine	FA & Thre.		
Carcass	76.99	72.70	72.60	74.23	73.27	75.03	0.86	NS
Liver	2.24	2.94	2.66	2.67	2.39	2.59	0.34	NS
Heart	0.45	0.41	0.43	0.53	0.49	0.45	0.03	NS
Spleen	0.20	0.18	0.21	0.22	0.15	0.17	0.03	NS
Gizzard	1.00	0.71	0.86	1.01	0.93	0.80	0.07	NS
Fabricius	0.14	0.18	0.16	0.15	0.12	0.10	0.74	NS
Edible	3.69	4.06	3.95	4.21	3.81	3.84	0.35	NS

4. CONCLUSION.

Based on the performed experimental work it could be concluded that, ovo injection with folic acid, threonine or the combination of these two amino acids in the fertile eggs, had no significant effects on the fertility or hatchability of fetal eggs. Also, all parameters of growth performance and some blood biochemical aspects studied on hatched birds from the previous injection treatments did not significantly affected. While, Body gain was recorded for combination amino acids. in addition, the Threonine group achieved the highest serum Glucose, and the Folic Acid group exhibited the lowest Cholesterol concentration.

5. REFERENCES

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تأثير حقن البويضات ببعض الأحماض الأمينية على نسبة الفقس والأداء الإنتاجي وخصائص الذبيحة للكتاكيت الفاقسة

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اجريت هذه التجربة لدراسة تأثير حقن بيض التفريخ الخاص بقطيع أمهات دجاج اللحم إما بحمض الفوليك، أو بحمض الثريونين، أو بكليهما معاً، بمستويات 25 ملجم، 10 ملجم، أو 12.5 و 5 ملجم على التوالي، وذلك على بعض صفات الفقس، وأداء النمو، ومواصفات الذبيحة للكتاكيت الناتجة. تم توزيع عدد 360 بيضة تفريخ عشوائياً إلى ست مجموعات تجريبية، احتوت كل مجموعة على 60 بيضة. كما قُسمت كل مجموعة تجريبية إلى ثلاث مكررات، بكل منها 20 بيضة. وتم ترتيب المجموعات التجريبية على النحو التالي:

المعاملة الأولى: (T1) الشاهد السلبي (NC) لم يتم حقن البويضات. **المعاملة الثانية:** (T2) شاهد الثقب الجاف (DPC) تم ثقب القشرة والأغشية دون حقن أي محلول. **المعاملة الثالثة:** (T3) الشاهد الإيجابي (PC) تم حقن البيض بـ 0.5 مل من محلول ملحي عادي. **المعاملة الرابعة:** (T4) مجموعة حمض الفوليك (FA) تم حقن البيض بـ 0.5 مل من محلول ملحي يحتوي على 25 ملغم من حمض الفوليك. **المعاملة الخامسة:** (T5) مجموعة الثريونين (THR) تم حقن البيض بـ 0.5 مل من محلول ملحي يحتوي على 10 ملغم من حمض الثريونين. **المعاملة السادسة:** (T6) مجموعة الحمضين معاً (FA + THR) تم حقن البيض بـ 0.5 مل من محلول ملحي يحتوي على 12.5 ملغم من حمض الفوليك و 5 ملغم من الثريونين.

تم إجراء الحقن في الغرفة الهوائية للبيضة، ثم وُضعت جميع البويضات في الحاضنة للتفريخ. بعد الفقس، تم تحديد إجمالي الوفيات الجنينية من خلال حساب عدد الأجنة النافقة. كما تم حساب كل من نسبة الخصوبة، ونسبة الفقس من إجمالي البيض، ونسبة الفقس من البيض المخصب. بعد الفقس، نُقلت جميع الكتاكيت إلى المزرعة، ووزعت وفقاً لمعاملات الحقن السابقة إلى ست مجموعات (كل مجموعة بثلاث مكررات، 20 كتكوتاً لكل مكررة). تغذت الكتاكيت على علائق بادئ ونامي تجارية. خلال الفترتين (1-3 أسابيع) و(3-5 أسابيع) على التوالي.

ويمكن تلخيص نتائج هذه الدراسة على النحو الآتي:

1. لم تكن هناك فروق معنوية في جميع القياسات المدروسة إلا ان المجموعات المعاملة بحمض الفوليك أو الثريونين سجلت أعلى تحسن عددي في نسبة الخصوبة والفقس مقارنة ببقية المعاملات.
 2. سجلت مجموعة حمض الفوليك أعلى استهلاك للعلف، تلتها المعاملة المزدوجة (حمض الفوليك + الثريونين).
 3. أظهرت مجموعة الحقن بالماء أفضل كفاءة تحويل غذائي.
 4. كانت مجموعة حمض الفوليك الأعلى عددياً في وزن القلب النسبي، بينما سجلت مجموعة الـ Sham أعلى نسبة للوزن الكلي.
- ويمكن أن نخلص إلى أن حقن البيض المخصب للأمهات دجاج اللحم بكل من حامض الفوليك أو الثريونين قد يحسن عددياً من بعض الصفات الانتاجية للكتاكيت الفاقسة.