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EFFECT OF SOME AMINO ACIDS INJECTION INTO HATCHING EGGS ON THE PERFORMANCE OF PRODUCING CHICKS.

El-Kaiaty, A.M.[1]; Fadia M. Nosseir[2]; Faten A.A. Ibrahim[1] and El-Sayed, O.A.[2]

1- Animal Production Dept., Faculty of Agriculture, Cairo University, Giza, Egypt.

2- Poultry production Dept. Animal Production Research institute, Agriculture Research Center, Ministry of Agriculture, Dokki, Giza.

ABSTRACT

A total of 990 fertile eggs (Commercial broiler Arbor Acres type) were used to study the effect of amino acid (AA) injection into hatching eggs on the productivity of producing chicks.

The eggs were taken from 52-56 weeks old hens and the average egg weight was 65 gm average. The eggs were assigned randomly to six equal groups, 165 eggs each. The first group was used as control (without any treatment), the second group was holed only (no injection), the third group was injected with 0.05 ml distilled water, the fourth group was injected with 0.05 ml distilled water contains 4.2 mg Arginine, the fifth group was injected with 0.05 ml distilled water contains 3.35 mg lysine and the sixth group was injected with 0.05 ml distilled water contains 1.5 mg histidine.

The injection of amino acids was completed with an automatic egg injection machine (INOVOJECT) at the 7th day of incubation time (embryonic development).

The obtained results were as following:

1) Amino acids injection at 7th day of incubation decreased hatchability.
2) The highest mortality rate was during the second week of incubation for injected groups comparing with other incubation periods.
3) No significant ($P<0.05$) differences were observed between treatments and controls at hatch, this due to selection the treated eggs with the same weight. At first week, control 1 (without treatment) has higher body weight than other groups, also, lysine and histidine treatments have decreased body weight ($P \leq 0.05$) than other treatment (arginine) and controls. Result showed the same trend during the second week of age.
4) During the 5th, 6th and 7th weeks of age, there was no significant ($P \leq 0.05$) difference in body weight between all of treatments and controls.
5) No significant differences ($P \leq 0.05$) in plasma constituents (glucose, total lipids, high-density lipoproteins (HDL), GOT, GPT and T_3) between all experimental groups.
6) Lysine and histidine amino acid increased plasma total protein and albumin but this increase was not significant.
7) Relative weights of lymphoid organs (% of body weight) at the 3rd and 6th weeks of age had no significant ($P \leq 0.05$) differences between all treatments and control. This may demonstrate that amino acids injection had no direct effects on relative weights of lymphoid organs between treatments and controls.

Keywords: Amino acid injection, hatching eggs, embryo, Productive performance, INOVOJECT.

INTRODUCTION

The chicks are affected by the nutrients in yolk remaining in the peritoneal cavity post-hatching (Romanoff, 1960). Because of fat and moisture, but not protein, are in excess (Al-Murrani, 1978), embryonic and post-embryonic growth may be improved by amino acid injection into the egg (Al-Murrani, 1982). Broiler chicks grow faster than layer chicks (Fujimura *et al.,* 1992). Since, protein and amino acids requirements for growth of broilers are greater than those of layers (NRC, 1994). The amino acids of albumen are transferred to the embryo at the same ratio, regardless of incubation time (Rupe and Farmer, 1955). Albumen is observed into the yolk sac (Freeman and Vince, 1974), and amino acids in yolk and albumin may be utilized at a constant ratio. Many investigators(Grau *et al.*, 1962, Romanoff, 1960, 1967, and Ohta, *et al.*, 1999) studied the effect of site of *In ovo* injection and time of injection on embryonic development and mortality. In broilers, egg size and protein content affect the growth of embryo (Al-Murrani, 1978). Al-Murrani (1982) demonstrated that injecting an amino acid mixture into growing embryos of broiler breeder eggs, resulted in higher chick body weight at hatch as compared with chick from control embryos.

The aim of this study was to evaluate the effect of amino acids injection to embryo on hatchability traits and chick performance posthatching.

MATERIALS AND METHODS

This study was carried out at the Poultry Breeding Station, Department of Animal Production, Faculty of Agriculture, Cairo University, in cooperation with Animal Production Research Institute (APRI) and Cairo Poultry Company (CPC). A total of 990 fertile eggs (Arbor Acres) were used in this experiment. The eggs were divided randomly into six equal experimental groups, 165 eggs of each group. The first group was used as control (without any treatment), the second group was holed only (no injection), the third group was injected with 0.5 ml distilled water, the fourth group was injected 0.5 ml distilled water contains 4.2 mg Arginine, the fifth group was injected 0.5 ml distilled water contains 3.35 mg lysine and the sixth group was injected 0.5 ml distilled water contains 1.5 mg histidine amino acid.

Amino acids were injected into eggs according to the procedures described the INOVAJECT operator's manual supplied by Embrex. The INOVAJECT system works by a small diameter hollow punch pierces a little opening in the shell, a needle descends through this tube to a controlled depth (2.54 cm), a 0.05 ml of the amino acid solution is delivered per egg. Eggs were injected at the 7^{th} day of embryonic development as described by Ohta *et al.* (1999).

Egg-injection-Machine:

An automatic egg-injection machine (INOVAJECT) developed by Embrex, Inc., was used. Embrex provided the machine and expertise to operate the machine in the hatcheries participating in the field trails.

The INOVAJECT gently injects compounds in precisely calibrated volumes without causing trauma to the developing embryo.

The machine is sanitized before used by sanitizing solutions, in addition, a sanitizing solution cleans the injection needles between injections, as well as the interior and exterior of the shell-piercing tube, to prevent contamination with extraneous agents.

Chicks:

All eggs were incubated in the hatchery. At hatch-day, chicks were removed from hatcher, culled, counted, wing banded and weighed. Hatchability (%) and culling rate were calculated.

All chicks were transferred at hatch-day to the Poultry Breeding Station, Animal Production Department, Faculty of Agriculture, Cairo University. A total of 500 chicks (50 chicks from each treatment) were taken randomly and each treatment takes a serial number (wing banded). All chicks were reared in floor in one chamber under the same managerial conditions and feds the basal diet.

At the beginning of the 2^{nd} week of age, chicks were distributed into 6 partitions (by using plastic barriers).

Chicks were exposed to continuous light and fed starter diet containing 23% crude protein and 3000 k cal ME/kg diet until the 5^{th} week of age. At the 6^{th} week of age, there was an addition of one kg oil/50 kg diet. Feed and water were provided *ad-libitum*.

Studied Traits:

a) Growth Performance:

Individual body weight was calculated weekly.

b) Lymphoid organs weights:

To study the lymphoid organs weights, 5 chicks/group at 3 and 6 weeks of age were randomly taken, weighed and slaughtered. The thymus, spleen and bursa were separated, weighed and proportionated to the live body weigh.

b) Blood parameters:

Five chicks from each treatment were randomly taken for blood samples at 3, 4, 5 and 7 week of age to measure triiodothyrnine (T3), total protein, albumin, Asparate amintransferase (AST/GOT) and Alanine aminotranferase (ALAT/GPT) activity, High density lipoprotein (HDL), low density lipoprotein (LDL), total lipids and glucose.

Statistical analysis:

Data of this study were statistically analyzed by using the general linear models (GLM) adapted to micro-computer of statistical analysis system (SAS) software package (2001).

The comparison of embryonic mortality, hatchability and chick viability data were done by chi-square test. Statements of significance are based on ($P<0.05$).

RESULTS AND DISCUSSION

a) Hatchability %:

Data for hatchability are shown in Table (1). It can be observed that the treatments decreased the hatchability percentage, even eggs were holed only or injected with distilled water injection. Amino acids injection decreased hatchability than control. Ohta and Kidd (2001) found the same result, that amino acids injection decreased ($P \leq 0.05$) hatchability.

The decreasing hatchability may be related to the site of injection as reported by (Ohta and Kidd, 2001) who found that the injection by 27-ga 19-mm needle decreased hatchability (70%) significantly ($P \leq 0.05$) than 13-mm needle (88.0%) or-control (88.0%). Also, Ohta *et al.* (1999) showed that amino acids solution injected in air cells of eggs has been shown to decrease hatchability. Windowing of eggs resulted in hatchability of percentage 55% and this was significantly lower than the unwindwed control eggs (Ohta and Kidd, 2001).

Total mortality increased with amino acids injection according the Chi Square probability (Table 1).

Table (1): Percentage of some hatchability and mortality at hatch day.

Treatment	Hatchability % Total eggs	Hatchability % fertile eggs	Total Mortality %	Mortality		
				Early (First wk.)	Middle (Second wk)	Late (third wk)
Control 1 (No treatment)	79.39	80.86	19.14	4.94	1.85	4.94
Control 2 (holed only)	68.48	76.87	23.13	10.88	1.36	7.48
Control 3 (distilled water)	67.27	72.08	27.92	3.25	0.65	13.64
Histedine	63.64	68.18	31.82	8.44	1.95	10.39
Arginine	61.82	67.11	32.89	3.29	5.92	13.16
Lysin	57.58	62.91	37.09	5.96	7.28	13.25
Pr > Chi. Sq.	0.324	0.516	0.057	0.256	0.002	0.543

b) Growth performance:

Data for body weight at hatch day, 1, 2, 3, 4, 5, 6 and 7^{th} week (marketing) posthatch are shown in Tables (2 and 3).

No significant ($P<0.05$) differences in body weight were observed between treatments and controls at hatch. This may be due to selection the treated eggs with the same weight. Ohta *et al.* (2004) found the same results, where they reported that there was no significant difference in the body weight of hatched chicks. At the first week, control 1 (without treatment) has higher body weight than the other groups. Also, lysine and histidine treatments decreased body weight significantly ($P \leq 0.05$) than the other treatment (arginine) and controls.

Table (2): Means ±S.E. of body weight (g) of Arbor Acres chicks as affected by egg injection with amino acids.

Treatments (Amino acid injection)	Age (weeks)			
	Hatch weight*	First week	Second week	Third week
Control 1 (no injection)	41.67 ±0.32 a	148.38 ±2.26 a	292.74 ±5.26 a	405.26 ±10.14 b
Control 2 (holed only)	41.55 ±0.32 a	146.00 ±2.20 ab	284.84 ±5.26 ab	404.77 ±9.43 b
Control 3 (distilled water)	41.03 ±0.32 a	140.00 ±2.23 bcd	275.41 ±5.33 abcd	388.78 ±9.31 bc
Histidine	41.75 ±0.32 a	139.82 ±2.23 cd	267.02 ±5.33 cd	377.40 ±9.84 bc
Arginine	41.85 ±0.32 a	142.32 ±2.23 abcd	280.55 ±5.26 abc	392.76 ±9.70 bc
Lysine	41.72 ±0.33 a	139.84 ±2.23 cd	265.00 ±5.26 cd	460.33 ±9.99 a

a, b,.... etc means within the same column with different letters are significantly different ($P < 0.05$).

* Hatch weight = chick weight at hatch/mean of egg weight before setting.

Table (3): Means ±S.E. of body weight (gm) of Arbor Acres chicks as affected by egg injection with amino acids.

Treatments (Amino acid injection)	Age (weeks)			
	4	5	6	7
Control 1 (no injection)	669.98 ±19.01 b	944.23 ±34.49 a	1253.53 ±41.96 a	1277.73 ±39.64 a
Control 2 (holed only)	621.26 ±19.29 bc	864.40 ±35.17 a	1161.53 ±40.71 a	1186.84 ±38.38 a
Control 3 (distilled water)	639.44 ±20.07 bc	926.72 ±32.65 a	1255.97 ±42.63 a	1279.55 ±40.32 a
Histidine	602.05 ±19.54 c	877.44 ±30.16 a	1132.41 ±40.71 a	1161.94 ±38.38 a
Lysine	727.70 ±20.97 a	963.64 ±30.61 a	1179.61 ±44.86 a	1209.58 ±42.58 a
Arginine	637.48 ±19.04 bc	888.40 ±39.32 a	1185.44 ±40.71 a	1208.78 ±38.38 a

a, b,.... etc means within the same column with different letters are significantly different ($P < 0.05$)

All-Murrani (1978 and 1982) demonstrated that providing supplemental amino acids to the developing embryo with an amino acid pattern identical to that already available in the egg results in higher body weight of chicks at hatch and up to 56 day of age. These results agree with that reported by Ohta *et al.* (1999) who concluded that eggs injection with amino acids resulted in a higher hatched chick weight and this may be due to compensate or covered the shortage of amino acids in eggs (Al-Murrani, 1982 and Ohta *et al.*, 2001)

At the third week of age lysine treatment increased body weight significantly ($P \leq 0.05$) than other treatments and control. The same trend was observed also during the fourth week of age. Ohta *et al.* (2004) found that amino acids content of egg might be sufficient for hatching but insufficient for maximum growth of broiler embryos.

During the 5^{th}, 6^{th} and 7^{th} week of age, there was no significant ($P \leq 0.05$) difference in body weight between all treatments and controls.

c) Plasma constituents:

Data for plasma constituents (total protein, albumin, total lipids, high density lipoproteins (HDL), T_3, GOT, GPT and glucose are shown in Tables (4 to 11).

It can be observed that no significant differences ($P \leq 0.05$) between treatments and controls for plasma constituents except total protein and albumin which increased in injected groups compared with controls. On the other hand. Ohta *et al.* (2004) reported that there was no significant difference in plasma amino acids between the groups of hatched chicks.

Plasma amino acids concentration increased with the age of embryo (Ohta *et al.*, 2004). The energy source for hatching eggs is glucose generated from amino acids (John *et al.*, 1988).

Table (4): Means ±S.E. of total protein (g/dl) of Arbor Acres chicks as affected by egg injection with amino acids.

Treatments	Age (weeks).			
(Amino acid injection)	3	4	5	7
Control 1 (no injection)	2.570 ±0.468	2.058 ±0.571	3.018 ±0.439	4.836 ±0.874
Control 2 (holed only)	2.618 ±0.468	2.933 ±0.571	2.715 ±0.439	3.964 ±0.874
Control 3 (distilled water)	2.545 ±0.468	3.351 ±0.571	2.424 ±0.439	3.697 ±0.874
Arginine	2.400 ±0.468	3.249 ±0.571	2.654 ±0.439	3.370 ±0.874
Lysine	1.612 ±0.468	2.994 ±0.571	3.539 ±0.439	5.733 ±0.874
Histidine	2.267 ±0.468	3.942 ±0.571	3.103 ±0.439	3.600 ±0.874

Table (5): Means ±S.E. of albumin (g/dl) of Arbor Acres chicks as affected by egg injection with amino acids.

Treatments (Amino acid injection)	Age (weeks)			
	3	4	5	7
Control 1 (no injection)	1.027 ±0.108	1.007 ±0.252	0.967 ±0.100	1.740 ±0.119
Control 2 (holed only)	1.107 ±0.108	1.013 ±0.252	1.020 ±0.100	1.627 0.119
Control 3 (distilled water)	0.867 ±0.108	1.073 ±0.252	0.967 ±0.100	1.660 0.119
Arginine	0.833 ±0.108	1.213 ±0.252	0.993 ±0.100	1.387 0.119
Lysine	0.993 ±0.108	1.133 ±0.252	1.227 ±0.100	1.727 0.119
Histidine	0.953 ±0.108	1.533 ±0.252	1.220 ±0.100	1.560 0.119

Table (6): Means ±S.E. of total lipid (g/dl) of Arbor Acres chicks as affected by egg injection with amino acids.

Treatments (Amino cid injection)	Age (weeks)			
	3	4	5	7
Control 1 (no injection)	0.870 ±0.130	0.388 ±0.095	1.037 ±0.091	0.764 ±0.083
Control 2 (holed only)	0.827 ±0.130	0.670 ±0.095	0.950 ±0.091	0.612 ±0.083
Control 3 (distilled water)	0.707 ±0.130	0.391 ±0.095	1.018 ±0.091	0.546 ±0.083
Arginine	0.684 ±0.130	0.371 ±0.095	0.945 ±0.091	0.617 ±0.083
Lysine	0.644 ±0.130	0.582 ±0.095	0.839 ±0.091	0.636 ±0.083
Histidine	0.676 ±0.130	0.587 ±0.095	0.797 ±0.091	0.769 ±0.083

Table (7): Means ±S.E. of HDL (mg/dl) of Arbor Acres chick as affected by egg injection with amino acids.

Treatments (Amino acid injection)	Age (weeks)			
	3	4	5	7
Control 1 (no injection)	45.01 ±8.05	36.15 ±6.52	50.49 ±3.40	59.31 ±5.11
Control 2 (holed only)	64.46 ±8.05	36.52 ±6.52	43.75 ±3.40	55.39 ±5.11
Control 3 (distilled water)	55.02 ±8.05	34.80 ±6.52	44.41 ±3.40	49.88 ±5.11
Arginine	47.18 ±8.05	42.28 ±6.52	44.85 ±3.40	43.75 ±5.11
Lysine	55.64 ±8.05	36.15 ±6.52	50.00 ±3.40	45.64 ±5.11
Histidine	56.37 ±8.05	36.89 ±6.52	40.69 ±3.40	53.31 ±5.11

Table (8): Means ±S.E. of triiodothyronine T3 (nmol/L) of Arbor Acres chicken as affected by egg injection with amino acids.

Treatments (Amino acid injection)	Age (weeks)		
	4	5	7
Control 1 (no injection)	4.443 ±0.972	2.740 ±0.441	2.680 ±0.504
Control 2 (holed only)	3.177 ±0.972	3.027 ±0.441	1.867 ±0.504
Control 3 (distilled water)	3.050 ±0.972	1.993 ±0.441	3.087 ±0.504
Arginine	3.270 ±0.972	2.643 ±0.441	2.287 ±0.504
Lysine	3.533 ±0.972	3.487 ±0.441	1.390 ±0.504
Histidine	3.593 ±0.972	3.113 ±0.441	3.097 ±0.504

Table (9): Means ±S.E. of GOT (U/L) of Arbor Acres chicks as affected by egg injection with amino acids.

Treatments (Amino acid injection)	Age (weeks)			
	3	4	5	7
Control 1(no injection)	37.00 ±0.42	31.67 ±1.74	37.00 ±0.00	37.00 ±0.00
Control 2 (holed only)	37.00 ±0.42	37.00 ±1.74	37.00 ±0.00	37.00 ±0.00
Control 3 (distilled water)	37.00 ±0.42	35.67 ±1.74	37.00 ±0.00	37.00 ±0.00
Arginine	37.00 ±0.42	35.67 ±1.74	37.00 ±0.00	37.00 ±0.00
Lysine	37.00 ±0.42	34.33 ±1.74	37.00 ±0.00	37.00 ±0.00
Histidine	37.00 ±0.42	37.00 ±1.74	37.00 ±0.00	37.00 ±0.00

Table (10): Means ±S.E. of GPT (U/L) of Arbor Acres chicken as affected by egg injection with amino acids.

Treatments (Amino acid injection)	Age (weeks)			
	3	4	5	7
Control 1(no injection)	31.33 ±1.77	32.67 ±1.18	24.33 ±1.33	36.00 ±3.12
Control 2 (holed only)	34.00 ±1.77	34.33 ±1.18	28.33 ±1.33	30.00 ±3.12
Control 3 (distilled water)	32.67 ±1.77	34.33 ±1.18	28.33 ±1.33	31.33 ±3.12
Arginine	32.67 ±1.77	34.33 ±1.18	28.33 ±1.33	25.67 ±3.12
Lysine	29.67 ±1.77	36.00 ±1.18	24.33 ±1.33	27.00 ±3.12
Histidine	34.33 ±1.77	36.00 ±1.18	28.33 ±1.33	30.00 ±3.12

Table (11): Means ±S.E. of glucose (mg/dl) of Arbor Acres chicks as affected by egg injection with amino acids.

Treatments (Amino acid injection)	Age (weeks)			
	3	4	5	7
Control 1(no injection)	233.52 ±18.95	267.49 ±43.07	210.80 ±14.32	181.93 ±15.91
Control 2 (holed only)	186.80 ±18.95	274.47 ±43.07	219.37 ±14.32	207.95 ±15.91
Control 3 (distilled water)	255.05 ±18.95	255.79 ±43.07	20[illegible].53 ±14.32	188.82 ±15.91
Arginine	198.80 ±18.95	197.07 ±43.07	179.30 ±14.32	183.58 ±15.91
Lysine	220.10 ±18.95	228.79 ±43.07	201.20 ±14.32	204.07 ±15.91
Histidine	192.88 ±18.95	178.70 ±43.07	206.30 ±14.32	189.95 ±15.91

d) Lymphoid organs weight:

Relative weights of lymphoid organs (% of body weight) at 3rd and 6th weeks of age are shown in Tables (12 and 13). There were no significant ($P \leq 0.05$) differences between all treatments and control. This may demonstrate that amino acids injection had no direct effect on relative weight of lymphoid organs weight.

Table (12): Means ±S.E. of relative weight lymphoid organs of Arbor Acres chicks (at 3rd weeks of age) as affected by egg injection with amino acids.

Treatments (Amino acid injection)	Lymphoid organs weight (% to body weight)		
	Bursa	Spleen	Thymus
Control 1(no injection)	0.260 ±0.025	0.118 ±0.015	0.296 ±0.04
Control 2 (holed only)	0.272 ±0.029	0.097 ±0.017	0.268 ±0.045
Control 3 (distilled water)	0.268 ±0.029	0.112 ±0.017	0.316 ±0.045
Arginine	0.226 ±0.029	0.131 ±0.017	0.295 ±0.045
Lysine	0.206 ±0.029	0.0117 ±0.017	0.243 ±0.045
Histidine	0.296 ±0.029	0.111 ±0.017	0.295 ±0.045

Table (13): Means ±S.E. of relative weight lymphoid organs of Arbor Acres chicks (at 6th weeks of age) as affected by egg injection with amino acids.

Treatments (Amino acid injection)	Lymphoid organs weight (% to body weight)		
	Bursa	Spleen	Thymus
Control 1(no injection)	0.033 ±0.008	0.125 ±0.021	0.123 ±0.029
Control 2 (holed only)	0.057 ±0.011	0.173 ±0.030	0.167 ±0.040
Control 3 (distilled water)	0.052 ±0.009	0.154 ±0.023	0.156 ±0.031
Arginine	0.043 ±0.010	0.173 ±0.026	0.158 ±0.035
Lysine	0.009 ±0.029	0.168 ±0.023	0.164 ±0.031
Histidine	0.011 ±0.029	0.110 ±0.030	0.130 ±0.040

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تأثير حقن بيض التفريخ ببعض الأحماض الأمينية على أداء كتاكيت الدجاج

أحمد محمد القياتى[1] ، فادية محمود نصير[2] ، فاتن عبد الفتاح أحمد إبراهيم[1] و أسامة عبدالله السيد[2]

[1] قسم الإنتاج الحيوانى، كلية الزراعة ، جامعة القاهرة ، الجيزة ، مصر.

[2] قسم إنتاج الدواجن، معهد بحوث الإنتاج الحيوانى، مركز البحوث الزراعية، الدقى، الجيزةز

تم استخدام ٩٩٠ بيضة مخصبة (دجاج تسمين تجارى من نوع اربور ايكرز) لدراسة حقن بيض التفريخ ببعض الأحماض الأمينية وتأثير ذلك على أداء الكتاكيت الناتجة.

أخذ البيض من قطيع أمهات عمر ٥٢-٥٦ أسبوع متوسط وزن البيضة ٦٥ جرام. قسم البيض عشوائيا إلى ٦ مجاميع متساوية (كل مجموعة ١٦٥ بيضة) حيث كانت المجاميع كالآتى:

- المجموعة الأولى استخدمت كمجموعة مقارنة حيث لم يتم حقن البيض مطلقا.
- المجموعة الثانية تم فيها ثقب البيضة فقط بدون الحقن بأى شئ وفى نفس مكان حقن المجموعات الأخرى.
- المجموعة الثالثة تم حقن البيض بـــ ٠,٥ مللى ماء مقطر.
- المجموعة الرابعة تم حقن البيض بـــ ٠,٥ مللى ماء مقطر يحتوى على ٤,٢ ملجم حمض أمينى أرجنين.
- المجموعة الخامسة تم حقن البيض بـــ ٠,٥ مللى ماء مقطر يحتوى على ٣,٣٥ ملجم حمض أمينى ليسين.
- المجموعة السادسة تم حقن البيض بـــ ٠,٥ مللى ماء مقطر يحتوى على ١,٥ ملجم حمض أمينى هيستدين.
- تمت عملية حقن البيض بالأحماض الأمينية باستخدام ماكينة حقن خاصة (نوع مبركس) وذلك عند اليوم السابع من التطور الجنينى (من بداية التفريخ).

وتلخصت النتائج المتحصل عليها فى الآتى:

١) الحقن بالأحماض الأمينية عند اليوم السابع من بداية التفريخ أدى لانخفاض نسبة الفقس.

٢) كانت أعلى نسبة نفوق خلال الأسبوع الثانى من بداية التفريخ وذلك للمعاملات المحقونة بالأحماض الأمينية.

٣) لم تكن هناك فروقاً معنوية بين المعاملات فى وزن الكتاكيت عند الفقس. بينما كانت معاملة الكنترول أعلى فى وزن الكتاكيت عند الأسبوع الأول والثانى بعد الفقس.

٤) لم تكن هناك فروقاً معنوية بين المعاملات فى وزن الكتاكيت خلال الأسابيع ٥ ، ٦ ، ٧ من عمر الكتاكيت.

٥) لم تكن هناك فروقاً معنوية بين المعاملات بالنسبة لمكونات البلازما (الجلوكوز ، البروتين الكلى ، الليبوبروتين عالى الكثافة HDL ، اسبارات امينوترانسفيريز (AST/GOT) ، الانين امينوترانسفيريز (ALAT/GPT) ، الترای ايودوثريونين (T_3) خلال فترة التسمين.

٦) بالنسبة لوزن الأعضاء الليمفاوية عند الأسبوع الثالث والسادس من عمر الكتاكيت فلم تكن هناك فروقا معنوية فى الوزن النسبى للأعضاء الليمفاوية (بالنسبة لوزن الجسم) فيما بين كل المعاملات.

مما سبق يتضح أن حقن بيض التفريخ عند اليوم الـــ ٧ من بداية التفريخ بالأحماض الأمينية: أرجنين، ليسين، هيستدين أدى لخفض نسبة الفقس ولكن لم يكن له تأثير على الأداء الإنتاجى والقياسات فيما بعد الفقس (فترة التسمين).