

Influence of injecting a mixture of amino acids via mesenteric tissue and time of hatching on accumulative live performance of broiler

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Abstract

This experiment was conducted at the Al-Anwar Poultry Company's poultry farm in the Al-Muradiya area of Babylon Governorate for 35 days, from March 1, 2024, to April 5, 2024, to assess the ability of mesenteric injection with a mixture of amino acids to mitigate the effect of hatching windows on broiler performance. A total of three hundred sixty unsexed one day old chicks (ROSS 308) were used for this trail, they were distributed into 6 factorial treatments (2×3), the first main factor (360 chicks) was an hatching windows threshold (180 chicks hatch at 493 h and 180 chicks hatch after 493 h of incubation period), the second main factor was administration method with 120 chicks for each (via mesenteric injection with 0.5 ml of amino acids, mesenteric injection with 0.5 ml de-ionized H₂O, and none injected administration), 20 chicks were used for each replicate and 3 replicates for each treatment (60 chicks per treatment). Broiler performance parameters were assessed weekly and for accumulative period (1-21, 22-35 and 1-35 day of age); body weight (BWT), weight gain (WG), feed intake (FI), feed conversion ratio (FCR), mortality, and relative growth rate (RGR). The study results showed that removing chicks 493 hours before hatching had a significant effect on BWT on the 1 day, where chicks removed before 493 h recorded a higher BWT (45.85 g) compared with those removed after 493 h (45.41 g) FCR, which improved significantly in chicks removed before 493 h (1.455 g feed/g WG) compared with chicks removed after 493 h (1.542 g feed/g WG), and performance efficiency factor, where the before 493 h treatment achieved the highest value (420.64%) compared with the after 493 h treatment (377.14%). FI was also affected through the interaction between hatching time and injection type, as the group after 493 h without injection treatment recorded the highest FI (3305.47 g), whereas the group before 493 h amino acid injection treatment recorded one of the lowest values (3071.90 g). Therefore, the study concluded that mesenteric injection of amino acids was not a key factor in improving the productive performance of chicks under the conditions of this experiment, unlike hatching time, which had a more pronounced effect on the studied traits.

Keywords: Amino acids, Mesenteric injection, Hatching windows, Broiler performance.

Introduction

Hatching windows (HW) define as the time between first hatched chicks and the last which called 'take-off', this process happened between 461 h to 510 h of incubation period [1]. High variance of HW occurred due to different causes; breeder age, breeder feed, eggs weight, eggs characteristics, eggs storage, and finally incubation conditions [2]. The vast time between first and last hatched chicks

causes overwhelming to the hatchery employer because of different percentage of hatched chicks along the HW, additionally, the chick's quality were different, so, many hatcheries' strategies were taken to overcome this problem [3]. The weak performance and welfare occurred in early hatched chicks due to spending more than 30 h in hatchery condition (air temperature 37 C, RH of 80% and air polluted with down), this situation leads to lose about 10% of body

weight in comparison to 1-3% loss of body chicks weight hatched 2 h before take-off [4].

Electrolytic component of newly hatching chicks was altered after hatch due to long stay of hatching chicks in hatcher machines [5], Therefore, amino acids are essential for maintaining the physiological balance of each chick, playing a pivotal role in regulating the acid-base balance of body fluids [6], They also contribute to the maintenance of various cellular functions by influencing ion composition in cell membranes and supporting biochemical reactions within the body [7].

The mesenteric region supports intra-abdominal organs through a combination of vascular connection and peritoneon-fascial attachment [8], Ling et. al. [9] demonstrated that the yolk sac- Jejunum/Ileum complex is a highly active region of mesentery enclosing the vitelline duct, vitelline artery, umbilical vein, and yolk, and is contiguous with both Jejunum/Ileum, so, injection (i.e. amino acids) into mesenteric region could distribute throughout the mesentery in apposition with organs including the aorta and the pericardium and heart before being absorbed into their respective organs including heart, lung, and kidney [10].

According upon the previous facts, this experiment was conducted to assess the ability of mesenteric injection with mixture of amino acids to mitigate the effect of hatching windows on broiler performance.

Material and Methods

Experimental location:

The current experiment was conducted at the poultry farm belonging to Al-Anwar Poultry Company in the Al-Muradiya area of Babylon Governorate for a period of 35 days, from 1/3/2024 to 5/4/2024.

BIO-AMINO FORT INJ Solution (BS):

The BIO-AMINO FORT INJ solution, an aseptic injection solution, was used to replenish essential amino acids and minerals in the chicks. A mixture of amino acids consisting of L-Methionine, L-Tryptophan, L-Cysteine HCl, L-Threonine, L-Isoleucine, L-Phenylalanine, L-Valine, L-Lysine HCl, and L-Leucine. This solution was manufactured by Bio-Pharmachemic in Vietnam and is specifically designed for injection into the mesenteric region of newly hatched chicks. It is administered using a 1 ml medical syringe, commonly used for insulin injections.

Experimental Design:

A total of three hundred sixty unsexed one day old chicks (ROSS 308) (45 ± 1.5 g) were used for this trail, they were distributed into 6 factorial treatments (2×3), the first main factor (360 chicks) was an hatching windows threshold (180 chicks hatch at 493 h and 180 chicks hatch after 493 h of incubation period), the second main factor was administration method with 120 chicks for each (via mesenteric injection with 0.5 ml of amino acids, mesenteric injection with 0.5 ml de-ionized H₂O, and none injected administration), 20 chicks were used for each replicate and 3 replicates for each treatment (60 chicks per treatment). Feed and water were free access (ad libitum), illumination and other directions of broiler

rearing were used according to ROSS 308 guide [11].

Performance Traits:

Broiler performance parameters were assessed weekly and for accumulative period (1-21, 22-35 and 1-35 day of age); BWT, WG, FI, FCR, mortality percentage, and RGR [12]. The diets used in the experiment was illustrated in table (1), and had an optimum requirement as nutrition specification of breeding company [11].

Statistical Analysis:

To assess the significant effect of main factors and its interactions on selected parameters, firstly, every percentage data was transfer to arc sine, then all transformed data were analysed using Two-Way ANOVA analysis. The analysis was applied by using General Linear Model (GLM) procedure of statistical software package SAS version 9.1 [13], P-values less than 0.05, 0.01 and 0.001 were considered to be significant for the main effect, results were presented as mean/SEM (pooled).

Table 1. The diets used in the experiment

Ingredients	Experimental diets (%)		
	Starter (1-10 days)	Grower (11-21 days)	Finisher (22-35 days)
Corn	52.8	58.65	62.4
Wheat	10	10	10
Soybean (48% protein)	29.8	24	20.5
Protein concentrate	5	5	5
Sunflower oil	0.3	0.3	0.3
Limestone	1.14	1.21	1.22
Dicalcium phosphate	0.5	0.35	0.2
Methionine	0.17	0.17	0.13
Lysine	0.19	0.22	0.15
Salt (NaCl)	0.1	0.1	0.1
Total	100	100	100
Calculated Chemical Composition**			
Crud protein (%)	21.94	19.66	18.29
ME (Kcal/kg feed)	2940	2995	3035
Lysine (%)	1.39	1.26	1.11
Crude fibre (%)	2.73	2.64	2.58
Calcium (%)	0.9	0.88	0.83
Meth + Cyc (%)	1.03	0.97	0.9
Available phosphor	0.44	0.41	0.38

*The protein concentrate utilized in the present study was of the Brocon type, originating from the Netherlands. Each kilogram of the concentrate provides 40% crude protein, 5% crude fat, 2.20% crude fiber, 5% calcium, 4.68% available phosphorus, 3.85% lysine, 4.12% methionine + cystine, 0.42% tryptophan, 2017 kcal/kg of metabolizable energy, and 1.70% threonine. Moreover, it contains a balanced mixture of vitamins and trace minerals formulated to meet the nutritional requirements of poultry for these essential elements.

**The chemical composition of the diet was determined in accordance with the NRC (1994) standards.

Results and Discussion

Table (2) shows a significant effect of the interaction between the two experimental factors on the BWT trait at one day old. The treatments of removing chicks before 493 hours with mesenteric injection of water and control, and mesenteric amino acids, and the two treatments of removing chicks after 493 hours with mesenteric water and control, which gave the highest averages of (45.94, 45.82, 45.79, 45.69, and 45.66 g) respectively, were significantly superior compared to the treatment of removing chicks after 493 hours with mesenteric amino acids, which gave the lowest averages of (44.79 g). The table also shows that the type of injection factor at its levels did not significantly affect the BWT trait at one day old. The significant improvement observed earlier may be attributed to a significant difference in the chick hatching rate before and after 493 hours. It has had a considerable effect on the BWT of day-old birds, with the pre-hatching treatment of up to 493 hours being the treatment group with the highest mean BWT (45.85 g), with an estimated percentage increase of 0.95%. This could also be attributed to chicks hatching up to 493 hours consuming lesser amounts of yolk sac content, hence preserving nutrients and energy, which results in higher hatching BWT. The late hatching of chicks means that they will have spent a longer time feeding on the yolk sac content, causing a relative reduction in BWT [14].

According to several studies, delayed feed and water consumption upon

hatch causes poor growth performance of chicks, negatively influences the development of digestive system, immune system, and the utilization of yolk sacs [15], [16], [17]. Conversely, Yehia et al. [18] observed higher BWT in the day-old chicks supplemented with amino acid. In a similar study conducted by Deines et al. [19], it was found that chicks hatched earlier were those exhibiting low hatching weight. Similarly, Saleh et al. [20] noted no significant difference in BWT of day-old broiler chickens (Cobb 500) receiving moderate and high levels of amino acids supplementation. Likewise, Gamboa et al [21], and Alimuddin et al [22] noted no significant effect on BWT at one-day old age of birds.

Moreover, there were no significant effects in the other two major variables of the experiment, namely, time of hatching and type of injection, as well as their interaction on BWT at 35 days, WG, mortality percentage, and RGR, based on the findings of the analysis of variance (ANOVA) presented in Table (2). In the absence of significant differences between the two variables, it can be argued that the early variations observed were insufficient to produce lasting effects on subsequent productive performance, which is largely influenced by feed efficiency and diet quality during the post-hatch period[23]. These findings are corroborated by the experiment conducted by Wandita et al[24] who did not notice any considerable difference in BWT of the chicks when amino acids were added to their feed. This conclusion contradicts the findings of the experiment performed by Dorra et al. [25]

whereby the maximum body live weight at 803 grams and 2957 grams for each chicken was achieved at 21 days old when there were additional amino acids lysine, methionine, threonine, and valine at 14.7 g/kg, 6.8 g/kg, 9.9 g/kg, and 10.4 g/kg respectively. Similarly, the findings in the experiment by Saleh et al. [20] were of 35 days old chickens offered a low protein feed supplemented with adequate quantities of methionine, lysine, and threonine in terms of live BWT, WG, and mortality rate (%).

As shown in the table (2), the effect of the injection factor at its various levels, and their interactions, did not show any significant differences in FCR or overall performance efficiency. However, a significant effect of the chick removal time was observed in both FCR and overall performance efficiency. The removal of the chicks before 493 hours treatment gave a significantly improved average conversion rate of feed (1.455 g of feed per g of WG). Also, the removal of the chicks before 493 hours treatment produced the best results regarding performance efficiency with the highest average (420.64%) as compared to the lowest average of (377.14%) for the removal of chicks after 493 hours treatment. This can be explained by the fact that early removal of chicks from the hatchery reduces the period of water and feed deprivation after hatching. This helps activate the digestive system and improve nutrient utilization more quickly, thereby positively impacting feed conversion efficiency and production performance. Conversely, delaying the removal of chicks depletes some yolk sac reserves and exposes them to stress, thereby negatively affecting growth efficiency and performance. These results

are in agreement with those obtained in Deines et al. [19] experiment, where it was observed that earlier hatched chicks show improved FI and performance efficiency. According to Dişa et al [26], the treatment of removing the chicks from the hatchery also impacts productive performance because it determines the physiological condition of the chicks in the early phase of rearing and its effects can be seen through the FI and performance, but these effects disappeared by 41 days of age. For FI, an important interaction effect was observed between the two experimental factors.

The interaction treatment of the time of chick removal after 493 hours with the control was significantly superior, recording the highest averages of (3305.47 g) compared to the other interaction treatments. This was followed by a group of treatments that were both significantly superior to the other treatments and whose averages were ranked from highest to lowest: the treatment of time of chick removal before 493 hours with mesentery of water and the control; the treatment of time of chick removal after 493 hours with mesentery of water; and finally, the treatments of time of chick removal after 493 hours with mesentery of amino acids and the treatment of time of chick removal before 493 hours with mesentery of amino acids. It was noted that there were no significant differences between the interaction treatment of time of chick removal before 493 hours with the control and the interaction treatment of time of chick removal after 493 hours with a mesenteric injection of amino acids. Averages of (3181.05 and 3085.86 g) were recorded, respectively. Previous studies have shown that chicks hatching at

different times within the hatching window exhibit physiological differences [16], [27]. Other studies have also found that chicks may differ behaviorally in terms of feeding. Regarding the effect of defecation time after 493 hours, studies, including Dişa et al. [26], have shown that defecation time significantly affects FI in the first few days, with higher consumption observed compared to other treatments during the first seven days. However, this effect disappeared by 41 days of age. Wandita et

al[24] also demonstrated that feeding diets high in protein and amino acids leads to decreased FI in chicks, which aligns with our findings, as amino acid injections did not significantly affect FI compared to defecation time. However, the study by Boyner et al [15] differed from the results of the statistical data, as no significant effect of the time of hatching of chicks on FI was observed during all periods of the experiment.

Table 2. influence of injecting a mixture of amino acids via mesenteric tissue and time of hatching on accumulative live performance of broiler (35 days).

treatments ⁽¹⁾	BWT(g)		WG (g/bird)	FI (g feed/bir d)	FCR		Mortality (%)	RGR (%)	PEF (%)
	1 day	35 days			(g feed/g weight gain)				
Hatching time major factor									
Before 493 h	45.85 a	2169.46	2123.61	3153.05	1.455	b	1.50	191.70	420.64 a
After 493 h	45.41 b	2077.68	2032.26	3199.17	1.542	a	2.50	191.42	377.14 b
Probability	0.0373	0.0922	0.0938	0.3267	0.0195		0.5057	0.1991	0.0416
Type of injection major factor									
Without	45.74	2146.93	2101.18	3243.26 a	1.513		2.50	191.63	397.55
Water	45.82	2140.68	2094.86	3183.80 ab	1.490		0.83	191.59	408.98
Amino acid	45.29	2075.31	2030.01	3078.88 b	1.486		2.50	191.43	390.59
Probability	0.0977	0.4775	0.4826	0.0305	0.7625		0.5920	0.7094	0.7627
Interaction of hatching time with injection type									
Before 493 h	Without	45.82 a	2193.94	2148.12	3181.05 ab	1.452	2.50	191.79	422.34

After 493 h	Water	45.94 a	2195.88	2149.93	3196.84 ab	1.457	0.00	191.78	431.18
	Amino acid	45.79 a	2110.40	2064.61	3071.90 b	1.457	1.66	191.49	407.82
	Without	45.66 a	2099.92	2054.25	3305.47 a	1.575	2.50	191.47	372.75
	Water	45.69 a	2085.49	2039.79	3170.75 ab	1.524	1.66	191.40	386.77
	Amino acid	44.79 b	2040.22	1995.42	3085.86 b	1.516	3.33	191.37	373.36
	Probability	0.05	0.4612	0.4671	0.05	0.2084	0.8586	0.7284	0.3857
Total mean	45.63	2123.56	2077.93	3176.10	1.498	2.00	191.56	398.88	
SEM ⁽²⁾	0.1162	25.3333	25.3157	26.6364	0.0179	0.6688	0.0968	9.8691	

1- Experimental Design: The hatching window (prior to 493 hours and after 493 hours) was considered the first factor, whereas the injection treatment (control, mesenteric water, mesenteric amino acids) was regarded as the second factor.

2- SEM: Values are presented as the Standard Error of the Mean.

3- Statistical Significance: Distinct letters within the same column denote statistically significant differences among treatment means at the 0.05 and 0.01 probability levels.

Conclusion

The study concluded that the most significant factor affecting the studied traits was the hatching time compared to the type of mesenteric injection. Its significant effect was most pronounced in BWT at one day old, FCR, and FCN through its interaction with the injection type. While mesenteric injection of amino acids did not show a clear significant effect on most of the studied productive traits, the effect of amino acids was indirect, through its interaction with hatching time, on feed consumption (FCN). Therefore, mesenteric injection of amino acids was not a primary factor in improving the productive performance of chicks under the conditions of this experiment, unlike hatching time, which had a more pronounced effect on the studied traits.

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