The Productive and Physiological Performance of Broiler Chickens Affected by Adding Different Levels of Glycine in Low-Protein Diets

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ABSTRACT:

A total number of 300 broiler chicks were randomly divided into five groups as follows: T1 (control group), fed on a basal diet containing (23%, 21.5% and 19.5% CP) for starter, grower, and finisher phases respectively; T2, fed on a diet with low protein by 2% (21%, 19.5 %, and 17.5 % CP) without supplementation. T3 fed on T2 with (0.49, 0.074 and 0.07 %) digestible glycine. T4, fed on T2 with (0.98, 0.148 and 0.14 %) digestible glycine. T5 fed on T2 with (1.74, 0.222 and 0.21 %) digestible glycine in (Starter- Grower- Finisher phases), respectively. Results showed that body weight and weight gain which recorded by the control group were the highest values followed by groups (T5, T4, and T3) whereas the differences were not significant among them. The averages of feed intake, feed conversion ratio, and mortality ratio were not significantly affected by treatments. There were no significant effects for all treatments on total serum protein, triglycerides, uric acid, alanine aminotransferase and aspartate aminotransferase. Carcass traits showed no noticeable differences while, the abdominal fat weight was significantly increased in T5, T4, T1, and T3. chicks of T1 showed an increase ($P \leq 0.05$) in crypts depth as compared to the chicks of T2. As well as the differences between T1, T3, T4 and T5 were insignificant. Results also indicated that total bacteria, Lactobacillus, Sterptoococcus, and Coliforms counts were insignificantly. Based on the findings mentioned above, it could be recommended supplementation of glycine with low-protein diets without any adverse effects.

Keywords: glycine; protein; broiler; growth; blood.

INTRODUCTION:

In recent times the poultry sector exposure for price volatility which leads to higher feed prices, thus increasing costs for poultry producers and reducing profitability. Shortage of available quantities of soybeans led to an increase in their prices. As a result, it was necessary to limit the use of protein in poultry feed (Alexandratos and Bruinsma, 2012). Low protein requirement in diets causes an imbalance of amino acids, and during rapid growth, dispensable amino acids become indispensable. So Amino acid requirements for growing poultry have been studied and debated for many years (Owens and Pettigrew 2019). Also, broilers do not retain a significant portion of dietary nitrogen intake but are excreted into the environment. Therefore, reducing the crude protein content in diets can be a tool to reducing the nitrogen excretion and ammonia emission from broiler houses and thus protect the environment from pollution (Namroud, et al., 2008 and Hernández et al., 2013). Reducing the use of protein in poultry diets leads to a decrease in the proportion of soybeans and, accordingly, to a decrease in growth performance. When the crude protein content decreases, so do the levels of glycine and other nonessential amino acids (Dean et al., 2006). In order to reach the previous advantages of reducing the proportion of protein in poultry diets, there is an urgent need to counteract the negative effect, which is a decrease in growth. Therefore, the addition of some synthetic amino acids became a solution to the problem of low growth in broiler chickens. Many studies showed that glycine addition reducing the adverse effects of low crude protein diets for broiler chickens. (Hofmann et al., 2019; Hilliar et al., 2020 and He et al., 2021). Glycine considers as one of the dispensable amino acids and is considered as conditionally essential amino acid that needs to be supplemented in the diet during specific conditions (Satyanarayana and Chakrapani, 2013). Previous studies already compared the reduce crude protein level with the addition of dispensable amino acids and recorded the adverse effects of this addition under experimental conditions, but never compared them in different levels of indispensable amino acids like glycine under the experimental conditions.

In summary, the reduction of the dietary protein content has many of potential benefits such as, protein self-sufficiency by reducing protein levels consumed in feeds, and reduced environmental nitrogen pollution, provided that the productive performance is not

compromised. The objective of this study was to evaluate the effects of a reduction of 2% crude protein in the content of the Indian River broiler diets during the fattening period, with addition amino acids (like glycine), on growth performance, physiological measurements, carcass traits, intestinal microbial, histo-morphological examination, morphometric determinations, and economic efficiency of Indian River (IR) broiler chickens during a 42-day of age.

MATERIALS AND METHODS

Experimental design, chicks and diets

A total number of 300 one-day-old Indian River (IR) commercial broiler chicks were randomly divided into five groups, each group containing 3 replicates (20 chicks/ replicate). Experimental treatments were T1 control) chicks fed a basal diet contained 23%, 21.5% and 19.5% CP for starter, grower, and finisher, respectively without any addition. T2) chicks fed on a diet with low protein 2% in all feeding periods (Starter 21% CP, Grower 19.5 % CP, and Finisher 17.5 % CP) without any supplementation. T3) chicks fed on a diet with low protein 2% with the addition of all requirements of digestible essential amino acids, and digestible glycine was added at levels of 0.49, 0.074 and 0.07 % in the starter, grower, and finisher periods, respectively. T4) fed on low protein diet by 2% with the addition of all requirements of digestible essential amino acids and digestible glycine was supplemented at levels of 0.98, 0.148 and 0.14 % in the starter, grower, and finisher periods, respectively. T5) fed on low protein 2% with the addition of all requirements of digestible essential amino acids and glycine was added at levels of 1.74, 0.222 and 0.21 in the starter, grower, and finisher periods, respectively. Diets were formulated to meet the nutrient requirements of broiler chickens according to the nutrition guide of IR strain 2019, as shown in Tables (1, 2 and 3). Chicks were raised in cages for 42 days and had ad libitum access to feed and water. Lighting was provided for 24 h in the first week, then the lighting was gradually decreased as the preceding of age until depend on the environmental condition. The experimental room temperature was gradually reduced from 32 to 21 °C until 42 days old and kept constant.

Growth performance evaluation

The chicks were weighed at the start of the experiment (one day old) at intervals to the nearest gram (±1.1gm) in each group. Then the weight was done every week and the average live body weight was recorded. Body weight gain, feed intake and feed conversion ratio (g feed /g gain) were recorded.

Sample collection

At 42 days of age, six chickens from each group were sacrificed by slaughter. Before slaughter, blood samples were withdrawn from the wing of the bird to separate serum by centrifuging for 15 min. at 3000 rpm and stored at -20 °C until use. After slaughter, carcass traits such as: carcass, liver, heart, gizzard, and abdominal fat were separated and weighed. Approximately 3 cm samples of ileum were collected for the determination of microbial count and morphometric determinations. Samples of the liver were taken to the determination of histo-morphological.

Analysis of serum

Serum total protein, total albumin, triglycerides, aspartate aminotransferase (AST), alanine aminotransferase (ALT) and uric acid concentration were determined by using commercially available kits and measuring the optical density by spectrophotometer (Model 722 GRATING), following the same steps as described by manufacturers. The suitable commercial kits were made in Egypt and were purchased from Diamond Company, Stanpio laboratory, Pasteur lab diagnostic and Biodiaquastic company.

Carcass characteristics determination

At the end of the experiment, birds were deprived of the feed for 12 hours and individually weighed. A slaughter test was performed on 48 birds including 3 bird males and 3 females from each group, whose body weight was closest to the group mean. The birds were weighed before slaughter then were allowed to bleed freely 2 min. and reweighed to calculate blood weight. Feathers were plucked manually. The birds were then weighed to obtain feather weight. The carcass was eviscerated by hand and individually reweighed after the removal of head, neck, shanks, viscera and giblets (liver, heart and gizzard) to obtain the dressing weight. Also, the abdominal fat was removed and weight individually.

Determination of ileum microbial count

After the ileum contents (1 gm) were aseptically collected. Total bacteria, Lactobacillus, Sterptoococcus and Coliforms counts of the intestine (Ileum) were performed

using pour plates technique described by Quinn et al., (1994). The bacterial counts were presented as Log10 colony forming units (CFU) per gm. of the cecal content.

Examination of ileum morphometric

The morphometric variables include villus height (from the tip of the villus to the villus – crypt junction) villus width (the width at half height) circular muscular layer, muscular mucosa layer and villus space. Villus volume was calculated as a cylinder from villus height and width at half height (Kisielinski, 2002).

Histo-morphological examination of ileum

At the end of the experiment (6 weeks of age), autopsy samples were taken from the liver and small intestine (illum) of six birds within each treatment and fixed in 10% formalin solution for 24 hours for the histo-morphological investigation. Washing was done in tap water then serial dilutions of alcohol (methyl, ethyl and absolute ethyl) were used for dehydration. Specimens were cleared in Xylene embedded in paraffin at 56OC in a hot air oven for twenty-four hours. Paraffin beeswax tissue blocks were prepared for sectioning at 5-10 microns thickness by slide microtome. The obtained tissue sections were collected on glass slides, deparaffinized then stained by hematoxylin, eosin and mounted in Canada balsam. The examination was done through the light electric microscope according to the method of Bancroft et al., (1996).

Economics of production

At the end of the experimental period (42 days) the European Efficiency Factor (EEF) was calculated, based on the age of broilers at sacrifices days, their average live weight (kg/head), viability (%) and feed conversion ratio (FCR) (kg feed/kg gain). European Production Efficiency Factors (EPEF) is given by the following equation according to Marcu et al., (2013).

EPEF = 100 ∗ [BW (Kg) ∗ viability (%)] / [Age (days) ∗ FCR]

Statistical analysis

Data analysis was performed using SPSS software program package (SPSS, 2001). All data were analyzed based on a completely randomized design using one-way ANOVA. Data were presented as means and standard error means. When the treatment effect was significant at P≤ 0.05. All statements of significance are based on testing at P ≤ 0.05. All traits percentage were analyzed by Chi square analysis. All obtained data were analyzed by using the following Model :

$Y_{ij} = \mu + \alpha_i + e_{ij}$

Where: Yij = The analyzed measurement (BW, WG, FCR or FI…..etc), μ = Overall mean,

αi = Effect of the treatment (i, =1,2,3,.…5)

eij = Random residual error.

RESULTS AND DISCUSSION

Results in Table (4) demonstrated the impact of low-protein diets with supplementation levels of synthetic glycine on productive performance parameters during the fatting period extended from (0-42) days. As presented in this table the mean of initial weights at the beginning of the experiment (one day of age) was insignificant among the experimental groups, which indicates the random distribution of individuals among treatment groups at the beginning of the experimental time. Results showed that body weight and weight gain which recorded by the control group were the highest values followed by groups (T5, T4 and T3) whereas the differences were not significant among them. While the T2 group showed the lowest value (P ≤ 0.05) for final body weight and weight gain and the differences between T2 and (T4, and T3) were insignificant.

The results in the same table showed that the averages of feed intake (FI) (g/bird), feed conversion ratio (FCR) and mortality ratio (MR) were not significantly affected by the treatments. The results showed that the lowest numerical value of FI, FCR and MR was recorded for the group T5 compared to other groups. The results confirm previous findings of (Corzo et al., 2005; Dean et al., 2006 and Ospina-Rojas et al., 2014), Promotes the idea that glycine (Gly) is a limiting growth factor in low-protein fed birds, thus emphasizing the higher glycine requirement in such low-protein diets (Dean et al., 2006) compared to the 12.5g/kg total Gly+Ser suggested by the (NRC, 1994). Besides its important role in formation of uric acid (Coon et al., 1975). This improvement resulting from the use of Gly in this study may be due to the role of glycine, as it involved in several metabolic functions, such as synthesis of hematopoiesis, bile acids, steroids and nucleic acids (Corzo et al., 2004). Glycine is also participating in methionine recycling, threonine catabolism and glutathione synthesis (Akinde, 2014). Also, glycine used as a donor for methyl groups and

is important for creatine biosynthesis (Baker, 2009).

Blood serum parameters:

The results showed in Table (5) that the analysis of variance values for total serum protein, triglycerides, uric acid, alanine aminotransferase and aspartate aminotransferase within the normal range and the differences between groups of T1 Co, T2, T3, T4 and T5 were insignificant. Whereas, T5 recorded the highest numerical values compared to other groups. Concerning to total serum albumin levels (g/dl), the T3, T4, T5, and the control group achieved the highest significant values compared to the T2 group, and the difference between T3 and T2 was insignificant. In general, the results of Gly supplement in the diets of T3, T4 and T5 with a CP decreases of 2%, the low albumin content on d 42 recovered to the standard level, indicating that the addition of Gly may increase amino acids intake, favoring albumin synthesis for birds (Wang et al., 2020). Concerning the uric acid (UA) the results observed an increase in serum UA content with Glycine addition, which could be because Glycine is along with other amino acids contributes to several crucial metabolic functions such as uric acid synthesis (Corzo et al., 2004; Awad et al., 2017 and Wang, et al., 2020).

Carcass characteristics:

Table (6) offered the results of supplementation different levels of synthetic glycine on carcass characteristics of growing broiler (IR) at 6 weeks old. The analysis of variance indicated that the weights (g) of the dressing, liver, gizzard and heart were not significantly affected by all treatments. However, significant changes in abdominal fat weight were found. The abdominal fat weight of T5 group recorded the highest significant value, followed by decreasing order T4, T1, and T3 groups while, the lowest value recorded byT2 group,

The present study displayed that dietary CP reduction by 2% lowered the body mass of birds on 42 days old, implying that the carcass traits became inferior to those of birds fed the normal-CP diet when dietary CP level is decreased by 2%. This was basically consistent with previous studies made by (Awad et al., 2017 and Belloir et al., 2017).

The present study displayed that lowering dietary crude protein by 2% reduced body mass of birds at 42 days old, which means that carcass traits became lower in rank carcass traits became lower in rank compared to birds fed the normal crude protein levels. This was mainly consistent with previous studies by (Awad et al., 2017 and Belloir et al., 2017.(

In particular, the glycine enrichment for broiler fed diet with a 2% reduction of CP led to abdominal fat similar compared to broiler fed to the normal diet. This could be because of the ideal form of amino acids in this low crude protein diet supported by glycine, which leads to increased energy required for nitrogen deposition, thus leaving less energy to be deposited in the abdomen (Smith et al., 1999). When Gly supplemented in low crude protein diet by 2%, the birds had a similar body mass yield (BMY) for those who fed on the normal diet of crude protein. This may reflect importance Gly in maintaining BMY of birds. It may be due to perhaps because of the role of Gly as a precursor for synthesis of creatine (Ngo et al., 1977), which Main energy source of muscle and can improve the use of nutrient in muscle growth (Allen, 2012). Beside of, Gly is contributing with other AA in the synthesis of bile acids which increased fats digestion (Corzo et al., 2004).

Microbial population:

The results in Table (7) presented that total bacterium, Lactobacillus, Sterptoococcus, and Coliforms counts in the Ileum of the intestine were insignificantly ($P \leq 0.05$) between all groups.

It is conceivable that the protein/amino acids act as energy or nitrogen sources for other microbial clans who change the intestinal environment in a way favorable to the reproduction of microbes (Dahiya et al., 2005). It may be done through saving positive selection pressure on those gut microbes that can ferment amino acids for carbon and nitrogen directly. Also, high glycine diets may affect the host in a way that makes the gut environment is made more favorable for microbes (Titball et al., 1999 and Dahiya et al., 2005). The way the glycine affects the intestinal bacteria gatherings of the fattening broiler is unclear. Some strict anaerobic bacteria have a unique mechanism for energy conservation and catalyze using glycine as substrate using the internal Stickland reaction in which glycine acts as an electron donor during oxidation by a glycine cleavage system or as an electron acceptor which is reduced by glycine reductase. The glycine reductase system is present in many clostridia (Clostridium sticklandii, Clostridium difficile, and

Eubacterium acidaminophilum) and catalyzes the reductive deamination of glycine to acetyl phosphate and ammonia (Costilow, 1977 and Andreesen, 1994).

Morphometric determinations of the ileum:

The effects of supplementation levels of glycine in low-protein diets on intestine histomorphology are given in Table (8). The obtained results stated that the chicks fed T1 showed increased (P≤ 0.05) crypt depth (μm) compared with the chicks of T2 which recorded the lowest value. As well as the differences in the treatments: control group, T3, T4 and T5 were insignificant. However, villi length and villi width (μm) were not affected by supplementation different levels of glycine in low-protein diets compared with the control group. Whereas villi length and width were increased numerically by increased glycine levels in the diet. The achieved results suggest that the changes in crypt depth, villi length and villi width, could be because the Glycine may improve intestinal structure and function by increasing intestinal epithelial cells. It is expected that an increase in villus length is paralleled by an increase in the digestive and absorptive function of the intestine (Pluske et al., 1996), which is reflected in the increase in weight. These results agreed with (Macelline et al., 2020 and Deng et al., 2023).

Economics of production:

The statistical evaluation of results in Table (9) exhibited that the (EPEF) was not affected significantly by the addition of Gly for all treatments compared to the T1 group. The results showed that the T5 group had the highest value, followed in descending order by T1, T3, T4 and T2 group, respectively. These results agree with the study of (Badawi et al., 2019 and Attia et al., 2022). From the previous results it could be concluded that using diets with low-protein 2% with adding different levels of digestible glycine (0.49, 0.074 and 0.07 %), (0.98, 0.148 and 0.14 %), and (1.74, 0.222 and 0.21 %) in starter, grower and finisher periods, respectively from 1-42 days of age in IR broiler chicken diets can be applied without any reverse effect. Also, it improved the growth performance and realized the best economic production without adverse effects on body functions under the Egyptian condition (in the summer season).

CONCLUSION:

It could be concluded that using diets with low-protein 2% with adding different levels of digestible glycine (0.49, 0.074 and 0.07 %), (0.98, 0.148 and 0.14 %), and (1.74, 0.222 and 0.21 %) in starter, grower and finisher periods, respectively from 1-42 days of age in IR broiler chickens. Also, improved the growth performance and realized the best economic production without adverse effects on body functions under the Egyptian condition. In addition, this method also promotes a reduction in nitrogen excretion and ammonia emissions from the litter. Therefore, more studies are needed in order to better elucidate the levels of glycine requirements.

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Table 1: Ingredient and nutritional composition of the experimental diets (T1 to T5) fed to Indian River broiler chicks from 1 to 10 d of age (Starter phase):

Item	T1 (control)	T2	T3	T4	T5
Ingredient, %					
Ground yellow corn 7.5%	51.100	59.190	58.900	58.801	61.200
Soybean meal 46%	35.000	33.223	32.600	32.600	29.100
Corn gluten meal 60%	3.660	0.000	0.000	0.000	0.000
Sunflower oil	2.720	2.440	3.000	2.630	2.664
Monocalcium phosphate	1.620	1.600	1.741	1.760	1.750
Limestone	1.515	1.550	1.320	1.280	1.500
Premix*	0.300	0.300	0.300	0.300	0.300
Sodium Chloride (NaCl)	0.300	0.300	0.300	0.300	0.300
DL-methionine 99%	0.335	0.420	0.426	0.426	0.446
L-lysine 78%	0.242	0.312	0.318	0.318	0.408
L -Threonine 98.5%	0.147	0.280	0.229	0.229	0.260
L -Valine 98.5%	0.009	0.120	0.120	0.120	0.180
L -Arginine	0.000	0.160	0.155	0.155	0.265
L -Isoleucine 98.5%	0.000	0.105	0.101	0.101	0.157
L -glycine 97%	0.000	0.000	0.490	0.980	1.470
Total (Kg)	100	100	100	100	100
Calculated analysis					
Crude protein%	23.000	20.947	21.169	21.733	21.297
ME. Kcal/Kg feed	2987	2983	3013	2986	3014
C/P ratio	-	-	-	-	-
Calcium%	0.963	0.967	0.974	0.961	0.964
Nonphytate phosphorus %	0.497	0.488	0.516	0.520	0.510

*Each 3 Kilo gram contain: 12000000 IU Vit. A; 2000000 IU Vit. D_3; 10000mg Vit. E; 2000mg Vit. K_3; 1000mg Vit. B_1; 5000mg Vit. B_2; 1500mg Vit. B_6; 10 mg Vit. B_{12}; 30000 mg Nicotinic acid; 1000mg Folic acid; 10000 mg Vit. Pantothenic acid; 50 mg Vit. Biotin; 50000 mg Zn; 60000 mg Mn; 30000 mg Fe; 10000 mg Cu; 1000 mg I; 100 mg Se and Co 100 mg.

Table 2: Ingredient and nutritional composition of the experimental diets (T1 to T5) fed to Indian River broiler chicks from 11 to 22 d of age (Grower phase):

Item	T1 (control)	T2	T3	T4	T5
Ingredient, %					
Ground yellow corn 7.5%	54.75	60.678	60.625	60.248	61.800
Soybean meal 46%	35.35	31.000	31.000	30.800	29.700
Corn gluten meal 60%	1.30	0.000	0.000	0.000	0.000
Sunflower oil	4.715	4.000	4.040	4.500	3.684
Monocalcium phosphate	1.390	1.400	1.400	1.400	1.528
Limestone	1.40	1.400	1.400	1.400	1.370
Premix*	0.30	0.300	0.300	0.300	0.300
Sodium Chloride (NaCl)	0.30	0.300	0.300	0.300	0.300
DL-methionine 99%	0.300	0.362	0.360	0.350	0.370
L-lysine 78%	0.115	0.210	0.228	0.220	0.260
L -Threonine 98.5%	0.080	0.150	0.151	0.151	0.176
L -Valine 98.5%	0.00	0.060	0.056	0.057	0.080
L -Arginine	0.00	0.070	0.000	0.060	0.120
L -Isoleucine 98.5%	0.00	0.050	0.046	0.046	0.070
L -glycine 97%	0.000	0.00	0.074	0.148	0.222
Total (Kg)	100	100	100	100	100
Calculated analysis					
Crude protein%	21.490	19.549	19.501	19.575	19.494
ME. Kcal/Kg feed	3087	3096	3097	3121	3088
C/P ratio	-	-	-	-	-
Calcium%	0.884	0.873	0.872	0.871	0.876
Nonphytate phosphorus. %	0.447	0.441	0.441	0.440	0.465

*Each 3 Kilo gram contain: 12000000 IU vit. A; 2000000 IU vit. D_3; 10000mg vit. E; 2000mg vit. K_3; 1000mg vit. B_1; 5000mg vit. B_2; 1500mg vit. B_6; 10 mg vit. B_{12}; 30000 mg Nicotinic acid; 1000mg Folic acid; 10000 mg vit. Pantothenic acid; 50 mg vit. Biotin; 50000 mg Zn; 60000 mg Mn; 30000 mg Fe; 10000 mg Cu; 1000 mg I; 100 mg Se and Co 100 mg.

Table 3: Ingredient and nutritional composition of the experimental diets (T1 to T5) fed to Indian River broiler chicks from 23 to 42 d of age (Finisher phase):

Item	T1 (control)	T2	T3	T4	T5
Ingredient, %					
Ground yellow corn 7.5%	58.66	63.199	65.015	65.600	65.700
Soybean meal 46%	32.184	27.300	26.210	25.600	25.500
Corn gluten meal 60%	0.00	0.000	0.000	0.000	0.000
Sunflower oil	5.600	5.500	4.740	4.612	4.527
Monocalcium phosphate	1.290	1.360	1.360	1.360	1.360
Limestone	1.250	1.250	1.250	1.250	1.250
Premix*	0.30	0.300	0.300	0.300	0.300
Sodium Chloride (NaCl)	0.30	0.300	0.300	0.300	0.300
DL-methionine 99%	0.276	0.321	0.320	0.329	0.329
L-lysine 78%	0.080	0.200	0.230	0.239	0.240
L -Threonine 98.5%	0.060	0.130	0.120	0.120	0.130
L -Valine 98.5%	0.00	0.009	0.030	0.050	0.050
L -Arginine	0.00	0.050	0.031	0.072	0.092
L -Isoleucine 98.5%	0.00	0.050	0.040	0.060	0.060
L -glycine 97%	0.000	0.000	0.070	0.140	0.210
Total (Kg)	100	100	100	100	100
Calculated analysis					
Crude protein%	19.485	17.933	17.596	17.544	17.614
ME. Kcal/Kg feed	3171	3222	3197	3200	3199
C/P ratio	-	-	-	-	-
Calcium%	0.802	0.798	0.795	0.793	0.792
Nonphytate phosphorus. %	0.420	0.425	0.424	0.422	0.422

*Each 3 Kilo gram contain: 12000000 IU vit. A; 2000000 IU vit. D_3; 10000mg vit. E; 2000mg vit. K_3; 1000mg vit. B_1; 5000mg vit. B_2; 1500mg vit. B_6; 10 mg vit. B_{12}; 30000 mg Nicotinic acid; 1000mg Folic acid; 10000 mg vit. Pantothenic acid; 50 mg vit. Biotin; 50000 mg Zn; 60000 mg Mn; 30000 mg Fe; 10000 mg Cu; 1000 mg I; 100 mg Se and Co 100 mg.

Table 4: Effect of supplementation different levels of glycine in low protein diets on productive performance of IR broiler chickens at 42 days of age (Means):

Item	T1 (Co[1])	T2	T3	T4	T5	Pooled - SEM[2]	*p*-value
Initial weight one day old (IW) (g)	37.50	37.36	37.60	37.43	37.70	0.098	0.880
Final Body weight (FBW) (g)	2507.33 [a]	2228.33 [b]	2391.67 [ab]	2410.00 [ab]	2465.00 [a]	28.76	0.002
Weight gain (WG) (g)	2469.83 [a]	2190.96 [b]	2354.06 [ab]	2372.56 [ab]	2427.30 [a]	28.73	0.002
Feed intake (g)/bird. (FI)	4269.88	4379.23	4222.71	4334.77	4184.24	42.51	0.654
Feed conversion ratio (FCR)	1.73	2.00	1.79	1.83	1.72	0.034	0.350
Mortality ratio (MR)	1.33	0.66	1.33	1.00	0.66	0.195	0.737

[1] Co (without supplementation),

[2]SEM: standard error of the mean.

[a,b] : Means of the same raw have the different superscript were significantly different *($P \leq 0.05$).*

Table 5: Effect of supplementation different levels of glycine in low protein diets on blood serum parameters of IR broiler chickens at 42 days of age (Means):

Item	T1(Co[1])	T2	T3	T4	T5	Pooled-SEM[2]	*p*-value
Total protein (g/dL)	4.95	4.30	4.67	5.14	5.23	0.126	0.119
Total albumin (g/dL)	2.01[a]	1.13 [b]	1.89 [ab]	2.05 [a]	2.22 [a]	0.109	0.007
Triglycerides (mg/dL)	62.66	54.66	60.50	68.83	76.66	3.443	0.323
Uric acid (mg/dL)	1.53	1.52	1.64	1.80	1.96	0.061	0.099
Alanine aminotransferase (U/L)	31.16	30.00	32.16	29.00	34.00	1.475	0.867
Aspartate aminotransferase (U/L)	13.16	13.83	14.66	14.33	15.16	0.598	0.876

[1] Co (without supplementation),

[2]SEM: standard error of the mean.

[a,b] : Means of the same raw have the different superscript were significantly different *($P \leq 0.05$).*

Table 6: Effect of supplementation different levels of glycine in low protein diets on carcass characteristics of IR broiler chickens at 42 days of age (Means):

Item	T1 (Co[1])	T2	T3	T4	T5	Pooled-SEM[2]	*p*-value
Dressing [3] weight (g)	1813.50	1656.00	1734.50	1743.33	1788.50	25.829	0.374
Liver weight (g)	41.07	39.99	39.91	41.72	39.53	1.068	0.970
Gizzard weight (g)	28.01	25.92	26.75	28.77	27.22	0.906	0.897
Heart weight (g)	13.89	12.13	10.66	11.74	12.28	0.578	0.547
Abdominal fat weight (g)	26.07 [ab]	17.77 [b]	25.66 [ab]	28.72 [ab]	31.91 [a]	1.410	0.014

[1] Co (without supplementation),

[2] SEM: standard error of the mean.

[3] Head, giblets, feet and eviscerate were not included.

[a,b] : Means of the same raw have the different superscript were significantly different *(P ≤ 0.05).*

Table 7: Effect of supplementation different levels of glycine in low protein diets on contents of microbiota count (log_{10} cfu/g) in the Ileum part of the intestine of IR broilers at 42 days of age (Means):

Item	T1 (Co[1])	T2	T3	T4	T5	Pooled-SEM[2]	*p*-value
Total bacteria count	18.03	16.74	16.95	17.14	17.54	0.373	0.872
Lactobacillus count	4.25	3.72	3.95	4.10	4.13	0.168	0.916
Sterptoococcus count	4.19	3.54	3.43	3.63	3.96	0.279	0.934
Coliforms count	3.15	3.48	3.27	3.20	3.16	0.193	0.989

[1] Co (without supplementation),

[2]SEM: standard error of the mean.

Table 8: Effect of supplementation different levels of glycine in low protein diets on the intestinal (Ileum) histo-morphological parameters of IR broiler chickens at 42 days of age (Means):

Item	T1 (Co[1])	T2	T3	T4	T5	Pooled - SEM[2]	*p*-value
Crypts depth (μm)	66.04 [a]	42.02 [b]	58.13 [ab]	59.50 [ab]	60.00 [ab]	2.49	0.014
Villi length (μm)	549.86	413.60	429.01	538.05	545.74	20.43	0.052
Villi width (μm)	143.13	100.99	129.04	155.53	145.70	8.89	0.361

[1] Co (without supplementation),

[2]SEM: standard error of the mean.

[a,b] : Means of the same raw have the different superscript were significantly different *(P ≤ 0.05).*

Table 9: Effect of supplementation different levels of glycine in low protein diets on (EPEF[1]) of IR broiler chickens at 42 days of age (Means):

Item	T1 (Co[2])	T2	T3	T4	T5	Pooled-SEM[3]	*p*-value
Final Body weight (FBW) (Kg)	2.50 [a]	2.22 [b]	2.39 [ab]	2.41 [ab]	2.46 [a]	0.028	0.002
Feed conversion ratio (FCR)	1.73	2.00	1.79	1.83	1.72	0.034	0.350
Viability %	98.66	99.33	98.66	99.00	99.33	0.195	0.737
EPEF	328.26 [a]	243.11[b]	319.03 [a]	313.75 [a]	328.57 [a]	7.98	0.000

[1]EPEF (European Production Efficiency Factor)

[2] Co (without supplementation),

[3]SEM: standard error of the mean.

[a,b] : Means of the same raw have the different superscript were significantly different *(P ≤ 0.05).*

الأداء الإنتاجي والفسيولوجى لدجاج اللحم المتأثر بإضافة مستويات مختلفة من الجلايسين في العلائق منخفضة البروتين

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الملخص العربي:

تم دراسة العلائق منخفضة البروتين مع إضافة الجلايسين على الأداء الإنتاجى لكتاكيت التسمين (IR) إستخدم 300 كتكوت غير مجنس فى خمس مجموعات. مجموعة الكنترول إحتوت على بروتين خام (23٪ للبادئ - 21.5٪ للنامي - 19.5٪ للناهي). المجموعة الثانية تغذت على عليقة منخفضة البروتين بنسبة 2٪ (البادئ 21٪ - النامي 19.5٪ - الناهي 17.5) بدون إضافات. المجموعة الثالثة تغذت على العليقة الثانية مع إضافة إحتياجات الأحماض الأمينية الأساسية القابلة للهضم مع الجلايسين بمستويات (البادئ 0.49٪ - النامي 0.074٪ - الناهي 0.07%). المجموعة الرابعة غذيت على العليقة الثانية مع الجلايسين بمستويات (البادئ 0.98٪ - النامي 0.148٪ - الناهي 0.14%). المجموعة الخامسة غذيت على العليقة الثانية مع الجلايسين بمستويات (البادئ 1.74٪ - النامي 0.222٪ - الناهي 0.21%). سجلت نتائج الكنترول أعلى قيم للوزن تلاها (T5 و T4 و T3) وكانت الفروق بينهم غير معنوية. ولم يتأثر إستهلاك العلف و تحويل العلف والنفوق معنوياً بالمعاملات. كانت قيم قياسات الدم ضمن المستوى الطبيعي ولم تتأثر معنويا. لا يوجد فروق معنوية بين المجموعات لوزن الذبيحة فارغة والكبد والقونصة والقلب،بينما زاد وزن دهون البطن معنويا لـ T5. كانت الفروق في مجموعات T1 و T3 و T4 و T5 غير معنوية لطول وعرض الحملات. وكانت أعداد البكتيريا الكلية ، Lactobacillus، Sterptoococcus ، و Coliforms غير معنوية. معامل كفاءة الإنتاج الأوروبي زاد بشكل ملحوظ لجميع المعاملات بإستثناء T2. ويستخلص أنة يمكن تقليل نسبة البروتين 2٪ مع إضافة الجلايسين بنسب (البادئ 0.49٪ - النامي 0.074٪ - الناهي 0.07%) أو (البادئ 0.98٪ - النامي 0.148٪ - الناهي 0.14%) أو (البادئ 1.74٪ - النامي 0.222٪ - الناهي 0.21%) خلال فترة التسمين.

الكلمات الاسترشادية : الجلايسن، البروتين ، دجاج التسمين، النمو، الدم.