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Study of Effects Difference Levels of Crude Protein and Amino Acid of Diet on Intestinal Morphological and Blood Biological Parameters of Poultry

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ABSTRACT: A total of 720 Arian chicks were used in this study to determine the effects of diets formulation based on different expression systems of amino acids of feeds and requirements on performance, intestinal Morphological and blood biological parameters. Four diets were arranged in a 2 × 2 factorial design with 2 systems of amino acids of feeds (TAAf & DAAf) and 2 methods of amino acids requirement (TAAr & DAAr) from 1 to 42 days of age. Each treatment was replicated six times with each replicate consisting of 15 males and 15 females. The results showed that when the feed formulation was based on DAAf and DAAr the BW, BWG, total CP, Albumin, globulin, villi length increased. It is concluded that use of DAAf and DAAr methods to feed formulation could improve the productive and physiological performance in broilers.

Key word: Intestinal Morphological, Blood Biological Parameters, Amino Acids

INTRODUCTION

Farming sustainably means growing crops and livestock in ways that meet three objectives simultaneously: Economic profit, Social benefits to the farm family and the community Environmental conservation. It is a system of agriculture that will maintain its productivity over the long run. Sustainable farming could be Organic farming, biodynamic, perm culture, agro ecological systems and low input. The goal of sustainable agriculture is to minimize adverse impacts to the immediate and off-farm environments while providing a sustained level of production and profit. Sustainable agriculture is influenced by environmental climate, soil types and the various crops, types of farm practices employed and Nutritional systems. Total energy and amino acids content in diet are not fully utilized by birds. Their availability depend on the species of bird, feed intake, anti-nutritional factors, feed processing, systems of feeding, etc. It has been suggested that proper nutrients is supplied through regulation of diets based on digestible amino acid (DAA) method compared to total amino acid (TAA). Formulation of diets based on these patterns, provide different levels of energy and protein for broilers so make different productive and metabolic responses. Diets formulation in poultry industry are mainly done based on productive parameters such as growth rate, rate of egg production, feed intake and feed conversion ratio, so does not consider the physiological responses.

Shown that blood indices are reflect of physiological responses resulting from internal (strain, sex, age, etc.) and external factors (feeding, rearing conditions, welfare, etc.). Blood parameters as metabolic intermediates provide information on metabolism and health of animals. Through checking the changes in blood parameters can be observed and interpreted effects of diets and feeding systems on body. Total protein, glucose and triglyceride as most common indicators for the detection body homeostasis and energy metabolism, can provide useful information for assessing the physiological condition. Enzymatic digestion capacity needs to match the diet switch by: (a) having a fixed high constitutive level of the pancreatic and intestinal enzyme pool needed for to breakdown all foodstuffs or, (b) changing the level of enzymes activity in a positive relationship with the substrate that is being digested. Pancreatic secretion is mainly excreted in response to volume of incoming chymouse to duodenum and its composition is partially influenced by the type of feed. While the intestinal enzyme secretion is largely regulated through contact stimulating and local neural reflexes. Therefore dietary factors through effect on level of feed intake or provide different amounts of nutrients for poultry, can alter the secretion of digestive enzymes. The purpose of this study was to determine the effects of diet formulation patterns (TAAf, DAAf and TAAr and DAAr) on performance, morphological characteristics of intestinal and serum biological parameters of broiler chicks.

MATERIALS AND METHODS

Experimental Design: This study was carried out at Animal Science Research Institute of Iran. A total of 720 one-day-old broiler chicks were randomly allocated to 4 groups with 6 replicates containing 30 bird (15 males + 15 females). The experimental diets were formulated with 2 methods of amino acids of diets (Total and digestible amino acid) and 2 methods of amino acid requirement expression (Total and digestible amino acid). Formulation and composition of experimental diets are given in Table 1. Productive and serum biological parameters determination: Body weight (BW) and feed consumption were obtained weekly then daily feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR) were calculated from these data. At end of the sixth week, 6 birds from each treatment were selected randomly and used for blood sampling. To serum separation, the blood samples centrifuged at 3000 rpm for 15 minutes. The serum preserved at -20°C until use. Total protein, Albumin, Globulin, urea and uric acid were measured in serum by Pars'Azmoon standard kit based on colorimetric analysis. Statistical analysis: Measurements of performance, serum biological parameters and morphological characteristics of intestinal were subjected to analysis of variance for completely randomized 2×2 factorial design that including 2 dietary expression patterns of feed amino acid requirement (TAAf and TAAf) and 2 amino acid requirement patterns (TAAr and DAAr), using ANOVA-General linear method (Minitab reference manual release 9.1). Significant differences between treatment means were identified by Duncan's multiple range, with 5% probably.

Table 1: Composition of experimental diets.

	Starter(1-21 day old)				Grower(22-42 day old)			
	TAAf		DAAf		TAAf		DAAf	
Ingredients (%)	**TAAr**	**DAAr**	**TAAr**	**DAAr**	**TAAr**	**DAAr**	**TAAr**	**DAAr**
Corn	54.34	54.80	54.56	54.37	56.47	56.85	57.86	58.55
Soybean meal	37.55	36.78	37.34	36.20	33.27	32.54	32.49	31.53
Wheat	-	-	-	-	2.50	2.50	4.00	4.00
Wheat meal	-	-	2.21	2.96	-	-	-	-
Fish meal	1.75	2.36	1.25	2.05	0.75	1.25	0.85	1.55
Vegetable oil	2.94	2.80	1.12	1.10	3.86	3.74	1.25	1.00
DL-Methionine	0.24	0.16	0.25	0.17	0.13	0.15	0.13	0.13
L-Lysine	0.12	0.14	0.13	0.15	0.12	0.13	0.12	0.11
Oyster shell	0.89	0.90	0.92	0.93	0.90	0.91	0.97	0.98
DCP	1.35	1.25	1.39	1.25	1.22	1.13	1.43	1.25
Salt	0.32	0.31	0.33	0.32	0.28	0.30	0.40	0.40
Vitamin mix [1]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mineral mix [2]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calculated composition of diets (%)								
AMEn (kcal/kg)	3050	3050	3050	3050	3150	3150	3150	3150
Crude Protein	21	19.5	22.5	21	19	17.5	20.5	19
Methionine	0.46	0.40	0.46	0.40	0.38	0.33	0.38	0.33
Methionine + Cystine	0.85	0.73	0.85	0.73	0.81	0.70	0.81	0.70
Lysine	1.25	1.07	1.25	1.07	1.15	1.00	1.15	1.00
Threonine	0.79	0.67	0.79	0.67	0.74	0.64	0.74	0.64
Tryptophan	0.21	0.18	0.21	0.18	0.17	0.15	0.17	0.15
Arginine	1.31	1.12	1.31	1.12	1.15	1.00	1.15	1.00
Valine	0.76	0.65	0.76	0.65	0.55	0.48	0.55	0.48
Leucine	1.21	1.04	1.21	1.04	0.87	0.76	0.87	0.76
Isoleucine	0.68	0.58	0.68	0.58	0.52	0.45	0.52	0.45
Calcium	1.00	1.00	1.00	1.00	0.90	0.90	0.90	0.90
Avail. Phosphorus	0.50	0.50	0.50	0.50	0.45	0.45	0.45	0.45
DCAB [3](meq/kg)	250	205	250	250	225	225	225	225

[1]Vitamin mix provided the following (per kg of diet): thiamin-mononitrate, 2.4 mg; nicotinic acid, 44 mg; riboflavin, 4.4 mg; D-Ca pantothenate, 12 mg; vitamin B12 (cobalamin), 12.0 mg; pyridoxine HCL, 4.7 mg; D-biotin, 0.11 mg; folic acid, 5.5 mg; menadione sodium bisulfate complex, 3.34 mg; choline chloride, 220 mg; cholecalciferol, 27.5 mg; transretinyl acetate, 1892 mg; all-rac α tocopheryl acetate, 11 mg; ethoxyquin, 125 mg.

[2] Trace mineral mix provided the following (per kg of diet): manganese ($MnSO_4$-H_2O), 60 mg; iron ($FeSO_4$-$7H_2O$), 30 mg; zinc (ZnO), 50 mg; copper ($CuSO_4$-$5H_2O$), 5 mg; iodine (ethylene diamine dihydroiodide), 0.15 mg; selenium ($NaSeO_3$), 0.3 mg

[3] Dietary cation-anion balance.

RESULTS AND DISCUSSION

The results of productive, serum biological parameters and morphological characteristics of intestinal represented in table 2, 3 and 4 respectively. The final BW, BWG and FI were affected significantly by both diet formulation methods ($P<0.05$). The diets that regulated based on DAA patterns have greater final BW, BWG and FI. The FCR decreased significantly when used the DAA pattern to diet regulation compared to TAA.

There were significant interactions between diet formulation methods on FI but not on BW, BWG and FCR. Higher FI observed in treatment that fed diet regulated based on DAAf × DAAr pattern (P<0.05).

Studies have shown that broilers are capable of adaptation to diets containing low-energy, if they have enough time to match with these diets, can reach to optimal weight. In the present experiment, any negative effect on growth was observed during using the TMEn method (lower energy diets), even the growth rate was significantly increased in comparison to AMEn. The broiler soften adjust their feed in take to get the enough energy, it is known that this adjusting is more accurate during the consuming low-energy diets. In the present study increasing of growth rate during use TMEn system may be due to increasing feed intake. The results of FI in this study were agreement with results of Dozier *et al* and Kamran *et al*, they found that FI decreased during consuming the high-energy diets. In various reports, such as Smith and Pesti stated that reducing energy of diet will cause increasing FI to access more energy. Khaksar and Golian reported that diet regulation based on DAA pattern, significantly increased body weight and use of TAA pattern leads to reduced feed intake. These results are similar to the results of the present study. Although Maiorka *et al* reported that diet formulation based on total amino acid has no effect on feed intake and weight gain. Similar to this trial, Zaghari reported that diet formulation based on DAA method compared to TAA can be accurately supply the amino acid requirements and improved FCR of broilers.

When used the DAAf method to diet formulation, total CP, Albumin, globulin levels of serum increased but uric acid level did not effected (P<0.05). Amino acid requirement patterns had significant effect on villi length and ratio of villi length to crypt dept but not on villi width and crypt depth. There were significant interactions between diet formulation methods on crypt dept and ratio of villi length to crypt dept but no ton villi length and villi width.

Increasing feed intake stimulates physiological processes that causes more accessible to nutrients. It is known that increasing feed consumption increase the activity of pancreatic amylase, lipase, trypsin and intestinal maltase and sucrose. So rising of enzyme activity will increase serum metabolic such as glucose, triglyceride and total protein. In the present study, formulation diets accordingly to TMEn and DAA increased FI so enzyme activity and metabolic parameters of serum. Although Malheiros has announced that blood glucose levels is not affected by diet composition, this situation was attributed to the strong regulation of carbohydrate metabolism. There is a direct correlation between dietary protein and total protein of serum. The concentration of total protein in serum, reflecting the level of dietary amino acids and can be used in the estimation of the essential amino acid requirements. In agreement with result obtained by Liukkonen, more protein provided through the circulatory system to birds when their diet regulation based on DAA pattern, this is an indication of the optimal digestion and metabolism of dietary protein. This pattern provide a more accurate estimation of amino acid requirements of broilers compared to TAA pattern. Researchers have reported that digestibility of dietary protein has an inverse relation with Proteolytic enzymes activity while the relative balance of dietary amino acids improves the efficiency of proteolytic enzymes activity.

However the results show that there was a negative correlation between feed intake and lipase activity and triglyceride level of serum. The oil content of diets that formulated based on AMEn were more than TMEn, for this reason the lipase activity and triglyceride of serum in these treatments were more than treatments that fed diets regulated based on TMEn pattern. These results were agreement with Hulan and Imandy, they found that broilers are able to adjust their amylase and lipase activity in relation to diet composition. So it can be said that enzymatic activity and consequently metabolic parameters of serum affected by both amount of feed intake and dietary composition.

Table 2. Effects of feed formulation methods on productive parameters of broiler chicks

Main Effects[1]	BW (g)	BWG (g/bird/day)	FI (g/bird/day)	FCR
TAAf	2163	50.2	101.3	2.00
DAAf	2170	50.7	102.1	2.01
p. value	0.842	0.842	0.609	0.810
TAAr	2126[b]	49.6	99.8[b]	2.01
DAAr	2207[a]	51.6	103.6[a]	2.00
p. value	0.027	0.585	0.017	0.910
Interaction Effects				
TAAf × TAAr	2145	50.1	110.7[b]	2.01
TAAf × DAAr	2181	50.9	101.9[b]	2.00
DAAr × TAAf	2107	49.2	98.9[b]	2.01
DAAr × DAAr	2333	52.2	105.2[a]	2.02
p. value	0.217	0.095	0.01	0.996
SEM	47.82	0.57	2.52	0.02

Means within Colum with different superscripts are significantly different (p<0.05)

Table 3: Effects of feed formulation methods on serum biological parameters of broiler chicks

Main Effects[1]	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Uric Acid (mg/dl)
TAAf	3.38[b]	1.64[b]	1.74[b]	4.66
DAAf	3.85[a]	2.02[a]	1.83[a]	5.31
p. value	0.0001	0.0001	0.186	0.672
TAAr	3.68	1.88	1.81	5.09
DAAr	3.54	1.79	1.75	4.88
p. value	0.107	0.080	0.186	0.672
Interaction Effects				
TAAf × TAAr	3.45	1.70	1.75	4.83
TAAf × DAAr	3.31	1.59	1.72	4.49
DAAr × TAAf	3.92	2.07	1.86	5.35
DAAr × DAAr	3.77	1.98	1.79	5.28
p. value	0.948	0.519	0.629	0.788
SEM	0.15	0.13	0.03	0.20

Means within Colum with different superscripts are significantly different ($p<0.05$)

Table 4: Effects of feed formulation methods on morphological characteristics of intestinal of broiler chicks.

Main Effects[1]	Villi length (µm)	Villi width (µm)	Crypt depth (µm)	Villi length to Crypt depth
TAAf	1731	136	216	8.18
DAAf	1704	141	223	7.84
p. value	0.368	0.142	0.429	0.321
TAAr	1671[b]	139	225	7.8[b]
DAAr	1764[a]	137	214	8.53[a]
p. value	0.004	0.646	0.214	0.005
Interaction Effects				
TAAf × TAAr	1690	134	211[b]	8.03[a]
TAAf × DAAr	1772	138	221[ab]	8.33[a]
DAAr × TAAf	1651	144	239[a]	6.93[b]
DAAr × DAAr	1757	137	207[b]	8.74[a]
p. value	0.687	0.091	0.025	0.035
SEM	41.2	3.22	8.63	0.43

Means within Colum with different superscripts are significantly different ($p<0.05$)

CONCLUSIONS

The results showed that digestible amino acid pattern for feed (DAAf) and digestible amino acid requirements of broiler chick s more accurate than total amino acid pattern (TAAf and TAAr). Diets formulation based on these models, improved enzymatic activity, serum metabolic parameters and consequently performance. It is suggested that to improve physiological, performance and consequently economic efficiency of broiler chick use the DAA pattern to diet formulation.

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