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Energy Utilization by Chickens Fed Various Levels of Balanced Methionine

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Hamedn Iran, Running Heads, Metabolisable Energy, Methionine, Broiler

Abstract: The present study investigated the effect of various methionine and metabolisable energy (ME) levels on carcass characteristics and visceral organs of broiler chickens. A total of 400 broiler chickens (Lohman) were allocated in completely random design by arrange of factorial 2×2 (4 replicates and 25 birds in each). The levels of 1.2 and 0.45 % methionine adjusted to 2800 and 3200 kcal/kg ME in starter and 0.9, 0.33% to 2800 and 3200 kcal/kg ME in grower periods, respectively. On 21 and 42 days of age two birds were slaughter and tested. The most parameters were differently affected by all treatments. The highest carcass percentage was obtained by low levels of methionine at 42 days of age (P<0.05). The significant increases of breast weights were observed by low levels of methionine at 21 days of age (P<0.05). The liver and heart weights were diversely affected by used dietary experiments at 21 and 42 days of ages (P>0.05). The results of current study have shown that different ME and methionine interactions can reflect in external (carcass traits) and internal (visceral organs) traits.

Key words: Methionine · Metabolizable Energy · Broiler Chicken

INTRODUCTION

Methionine is universally recognized as the first limited amino acid in broiler chickens diets based on corn and soybean meal. It is suggested that increased levels of methionine should be above the NRC [1] recommendations [2-5]. Sufficient intake of dietary methionine and cysteine is important for the synthesis of proteins [6]. It may be influence carcass characteristics and visceral organs. It is showed that methionine as lipotrophic agent is important diet protein regulation [7]. Beside the generation of decarboxylated S-adenosylmethionine, methionine is a donor of the methyl groups that participates in the methylation of DNA and proteins, the synthesis of spermidine and spermine and regulation of gene expression [8]. Also, methionine plays a role beyond a protein constituent [9].

Energy is one of the major factors which play the vital role in the feed intake and feed formulation in poultry industry [10]. Formulation of ration without energy couldn't be possible, since nutrients intake can be influence by different levels of energy in diets. Therefore, deficiency of nutrients may be occurring in poultry by more increasing of energy contents in diets. In contrast feed intake as well as nutrient utilization is increased by low levels of energy in diets [10, 11]. This phenomenon can affect carcass characteristics and breast weights [3]. The energy for adaptation comes from the three energy-yielding nutrients: carbohydrates, lipids and proteins. These nutrients are only available from feed and from nutrient reserves in the animal body. Lack of energy and amino acids hardly damages the performance and carcass characteristics [12]. The Choose of the proper level of energy and protein (amino acids) will optimize growth, carcass quality and feed efficiency. Although, the effects of energy and amino acids (methionine) separately investigated in broiler diets in some cases but their interactions is depended. Unfortunately scientific researches are scarce in this regarding. So it hypothesized that this interactions were determine final broiler response. Thus, to test this hypothesis the effects of different levels of methionine and metabolisable energy were evaluate on broiler internal parameters as carcass cuts (breast, thighs, backside, neck, wing) weights, visceral organs and relative organs of GIT of broiler chickens.

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Table 1: Ingredients and chemical composition of experimental diets

	Diets of starter				Diets of grower			
Ingredients%	1	2	3	4	1	2	3	4
Corn	49.04	38	49.04	38	44	36.5	44	36.5
Wheat barn	-	8	-	8	-	15	-	15
Soybean meal	18.52	29	19.27	30	29.8	25.3	30	25.5
Wheat	10	10	10	10	15	10	15	10
Corn gluten	15.3	5.5	15.3	5.5	2.2	2	202	2
Oil	2.76	1.14	2.5	0.82	5.8	3.04	5.82	2.98
Limestone	1.4	0.88	1.42	0.88	1.41	0.95	1.41	0.95
Dicalcium phosphate	1.8	1.63	1.78	1.62	1.21	1.1	1.21	1.09
Salt	0.45	0.36	0.45	0.36	0.32	0.24	0.32	0.24
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
Methionine	0.75	0.81	-	0.06	0.57	0.57	-	-
Lysine	0.3	-	0.27	-	-	-	-	-
Totall	100	100	100	100	100	100	100	100
Calculated								
ME.kcal/kg	3200	2800	3200	2800	3200	2800	3200	2800
Crude protein	23	23	23	23	20	20	20	20
Calcium	1	0.87	1	0.87	0.9	0.78	0.9	0.78
Available phosphorous	0.45	0.4	0.45	0.4	0.35	0.31	0.35	0.31
Methionine	1.2	1.2	0.45	0.45	0.9	0.9	0.33	0.33
Lysine	1.1	1.13	1.1	1.16	1	1	1	1
Methionine+Cystein	0.82	0.81	0.83	0.83	0.67	0.67	0.67	0.75

[1] Vitamin mix provided the follwing (per kg of diet): Vitamin - A, 7.2 gr;Vitamin - D: 7 gr: Vitamin - E. 14.4 gr: Vitamin k_3, 1.6 gr: ribo flavine, 0.72 gr: Pantothenic acid, 12 gr: [2]Trace mineral mix provides the following (per kg of diet): manganese (Mn $SO_4.H_2O$), Zinc 64 gr: (Zinc Zno), 44 gr: iron ($FeSO_4.7H_2O$), 100gr: copper (Cu $SO_4.5H_2O$), 16gr: iodine (ethylene diamine dihydroiodide), 0.64gr: cobalt, 0.2gr: Selenium (%1), 8gr

MATERIALS AND METHODS

Birds and Diets: A total of 400-day-old broiler chickens (Lohman) were used in this study. Birds were randomly allocated to 4 experimental diets, 4 replications and 25 chickens in each. This study was arranged in completely random design by factorial 2×2 management. Experimental rations were consist of 2 levels of energy (2800 and 3200 kg/kcal) and methionine 1.2 and 0.45 % (at 1-21 days) and 0.9 and 0.33 % (at 22-42 days) (Table 1) during the starter and grower period, respectively. The experimental periods were starter 1- 21 days and grower 22- 42 days of age.

Carcass and Organelles Traits: On 21 and 42 days of age, final body weights were measured then 4 birds from each pen were randomly selected and tagged then birds were fasted without limitation of water access for 8 h. So birds were weighted after removal of feather, head, legs and abdominal fat contents. Proventriculus, liver, heart and abdominal fat dissected and calculated as the percentage weights. The breast, thighs, backside, wings and neck were calculated as the percentage of fasted live body weights.

Statistical Analysis: The all data were check for normal test by Kolmogrov Smirrnov test. Experimental data subjected to one way-ANOVA using the GLM procedure of SAS [13]. Significant differences were compared by Duncan's multiple range test (P<0.05).

RESULTS AND DISCUSSION

Carcass Characteristics: The effect of dietary treatments on the carcass characteristics of broiler chicks at 21 and 42 days of age are shown in Table 2 and 3, respectively. No significant differences were observed by methionine levels on parameters (carcass, thighs, backside, neck and wing weights) at 21 days of age (P>0.05). The low level of methionine caused the highest breast weights percentage at 21 day of age. No significant differences were observed by energy levels on parameters (carcass, backside and neck weights) at 21 days of age (P>0.05). Also, neck and wing weights were significantly decreased by low level of energy (P>0.05). No significant differences were found in mentioned parameters (carcass, backside and neck weights) but thighs and wings weights were differently affected. Except carcass weights, no significant differences were found between methionine levels in

Table 2: Effect of different levels of methionine and energy on carcass characteristics of broiler chicken (21 days of age) (% of *Carcass Weight)

		Traits					
Diets		Carcass	Breast	Thighs	Backside	Neck	Wing
Methionine							
1		75.34^{a}	17.76^{b}	19.83^{a}	15.70^{a}	3.89^{a}	7.16^{a}
2		74.07^{a}	18.24^{a}	19.79^{a}	15.27^{a}	4.00^{a}	7.23^{a}
P-value		0.3220	0.5023^{a}	0.8435	0.5538	0.5815	0.7791
SEM[1]		0.87	0.49	0.15	0.42	0.14	0.14
Energy							
1		74.48^{a}	17.27^{a}	18.94^{b}	15.38^{a}	4.06^{a}	$6,97^{b}$
2		74.95^{a}	$18.\ 7^{2a}$	20.68^{a}	15.57^{a}	3.83^{a}	7.43^{a}
P-value		0.7051	0.0577^{a}	0.001	0.7226	0.2485	0.0456
SEM		0.85	0.49	0.15	15.96	0.14	0.14
P-interaction		0.1383	0.3398	0.0154	0.6201	0.0957	0.4679
Diets Composition							
M	E						
1	1	76.09^{a}	17.38^{a}	19.28^{b}	15.35^{a}	3.83^{a}	7.01^{ab}
1	2	74.61^{a}	18.14^{a}	20.39^{a}	15.91^{a}	3.95^{a}	7.30^{ab}
2	1	72.86^{a}	17.18^{a}	18.61^{a}	15.32^{a}	4.29^{a}	6.92^{b}
2	2	75.29^{a}	19.30^{a}	20.97^{a}	15.23^{a}	3.71^{a}	7.50^{a}
P		0.3210	0.1744	0.0001	0.8468	0.2224	0.2026
SEM		1.25	0.69	0.22	0.56	0.19	0.18
CV%		4.8	11.4	5.8	7.7	8.2	9.3

a-c value in columns with no common superscript differ significantly ($P<0.05$). [1]Standard error of the mean. Higher level of each factor is represented with number 1(methionin and energy in starter and grower respectively=1.2%, 0.9% and 3200 kcal/kg) and lower level is represented with number 2 (energy in starter and grower respectively= 0.45%, 0.33% and 2800 kcal/kg)

Table 3: Effect of different levels of methionine and energy on carcass characteristics of broiler chicken (42 days of age) (% of *Carcass Weight)

		Traits					
Diets		Carcass	Breast	Thighs	Backside	Neck	Wing
Methionine							
1		71.99^{b}	23.64^{a}	25.50^{a}	15.00^{a}	4.10^{a}	6.89^{a}
2		77.14^{a}	25.17^{a}	24.84^{a}	14.21^{a}	3.58^{a}	6.48^{a}
P-value		0.0376	0.3515	0.4374	0.1477	0.1548	0.1063
SEM[1]		1.58	0.72	0.94	0.38	0.24	0.17
Energy							
1		73.12^{a}	25.15^{a}	26.10^{a}	15.31^{a}	4.23^{a}	6.78^{a}
2		76.01^{a}	23.75^{a}	24.28^{a}	14.93^{a}	3.45^{b}	6.49^{a}
P-value		0.2149	0.0949	0.1256	0.311	0.438	0.1203
SEM		1.56	0.72	0.94	0.538	0.24	0.17
P-interaction		0.8738	0.0923	0.861	0.8937	0.5399	0.7252
Diets Composition							
M	E						
1	1	70.38^{a}	25.15^{a}	26.44^{a}	15.62^{a}	4.38^{a}	6.95^{a}
1	2	73.62^{a}	22.32^{a}	24.69^{a}	14.37^{a}	3.82^{a}	6.66^{a}
2	1	75.88^{a}	25.16^{a}	25.81^{a}	14.87^{a}	4.07^{a}	6.64^{a}
2	2	78.41^{a}	25.17^{a}	23.88^{a}	13.47^{a}	3.08^{a}	6.33^{a}
P		0.1187	0.1048	0.3978	0.0873	0.101	0.1919
SEM		2.20	1.00	1.30	0.53	0.34	0.24
CV%		5.7	9.4	6.1	7.7	10.9	9.4

a-c value in columns with no common superscript differ significantly ($P<0.05$). [1]Standard error of the mean. Higher level of each factor is represented with number 1(methionin and energy in starter and grower respectively=1.2%, 0.9% and 3200 kcal/kg) and lower level is represented with number 2 (energy in starter and grower respectively= 0.45%, 0.33% and 2800kcal/kg) measured parameters (thighs, backside, neck and wing weights) at 42 days of age (P>0.05). The low level of methionine caused the highest carcass weights at 42 day of age. No significant differences were found between methionine levels in all measured parameters. Also, no significant differences were achieved by methionine× energy interactions in all measured parameters.

The results of carcass weights are in agreement with Sarabmeetkaur *et al*. [14] who documented that addition of low levels of methionine induced carcass weights. Also, it is shown that the high levels of methionine increased carcass weights [15]. This findings is opposite of current study. But, Hickling *et al*. [16] reported that addition of methionine had no effects on broiler carcass weights up to 3 weeks of age. Regarding this results it must be noted that levels of protein and other components of diets are important and can influence obtained results.

The results of breast weights are similar to Bunchasak *et al*. [17] and Li and Li [18] who shown that various levels of methionine as well as energy had no effects on breast weights. Moreover, Yalcin *et al*. [19] concluded that methionine above NRC [1] level had no effects on breast weights.

Saleh *et al*. [20] reported that with increase of energy levels thighs percentage didn't affected. Also, Vieira *et al*. [21] showed that sulfur amino acids usage had no effects on thighs weights. Jianlin *et al*. [22] noted that high levels of methionine affect thighs weights, which are in agreement with this study at 21 days of age. It seems that the high levels of methionine (above NRC) are useful to thighs weights.

It must be noted that little information is available regarding weights of carcass components (backside, neck and wing weights). The backside, neck and wing are organelles that muscular of them is limited and not expected that energy and protein affect them. So, it may lead to no significant differences in this regards.

Organelles Characteristics: The effect of dietary treatments on the organelles traits of broiler chickens at 21 and 42 days of age are presented in Table 4 and 5, respectively. No significant differences were observed by methionine and energy levels on parameters (proventriculus, pancreas and abdominal fat weights) at 21 days of age (P>0.05) but liver and heart significantly were affected in this respect. The interaction results were significant between heart and proventriculus weights at

Table 4: Effect of different levels of methionine and energy on organelles traits of broiler chicken (21 days of age) (% of *Live Weight)

Diets		Traits				
		Proventriculus	Pancreas	Liver	Heart	Abdominal fat
Methionine						
1		1.31^{a}	0.55^{a}	3.73^{a}	0.76^{a}	0.84^{a}
2		0.94^{a}	0.54^{a}	3.37^{b}	0.69^{b}	0.83^{a}
P-value		0.1952	0.7528	0.009	0.0453	0.9444
SEM[1]		0.04	0.03	0.05	0.03	0.07
Energy						
1		1.03^{a}	0.56^{a}	3.70^{a}	0.68^{b}	0.96^{a}
2		0.93^{a}	0.53^{a}	3.39^{b}	0.77^{a}	0.72^{a}
P-value		0.0676	0.486	0.0026	0.21	0.0284
SEM		0.04	0.03	0.06	0.02	0.069
P-interaction		0.3582	0.5791	0.2214	0.4276	0.6273
Diets Composition						
M	E					
1	1	1.04^{a}	0.55^{a}	3.83^{a}	0.73^{ab}	0.99^{a}
1	2	0.98^{ab}	0.55^{a}	3.63^{a}	0.79^{a}	0.70^{a}
2	1	1.02^{ab}	0.57^{a}	3.58^{a}	0.63^{b}	0.94^{a}
2	2	0.87^{b}	0.51^{a}	3.16^{b}	0.74^{a}	0.74^{a}
P		0.1318	0.8342	0.337	0.0246	0.1466
SEM		0.06	0.05	0.08	0.03	0.09
CV%		12.8	19.6	11.5	11	7.37

a-c value in columns with no common superscript differ significantly (P<0.05). [1]Standard error of the mean. Higher level of each factor is represented with number 1(methionin and energy in starter and grower respectively=1.2%, 0.9% and 3200 kcal/kg) and lower level is represented with number 2 (energy in starter and grower respectively= 0.45%, 0.33% and 2800kcal/kg)

Table 5: Effect of different levels of methionine and energy on organelles traits of broiler chicken (42 days of age) (% of *Live Weight)

Diets		Traits				
		Proventriculus	Pancreas	Liver	Heart	Abdominal fat
Methionine						
1		0.55[a]	0.26[a]	2.52[a]	0.68[a]	2.41[a]
2		0.58[a]	0.27[a]	2.69[b]	0.61[a]	2.83[a]
P-value		0.5162	0.4833	0.3099	0.5187	0.8731
SEM1		0.04	0.01	0.11	0.03	0.12
Energy						
1		0.59[a]	0.27[a]	2.47[a]	0.76[a]	2.96[a]
2		0.53[a]	0.26[a]	2.73[a]	0.73[a]	1.82[b]
P-value		0.3225	0.4605	0.1274	0.5175	0.0001
SEM		0.03	0.01	0.11	0.02	0.12
P-interaction		0.9147	0.1726	0.7093	0.5175	0.4599
Diets Composition						
M	E					
1	1	0.58[a]	0.25[a]	2.38[a]	0.76[a]	2.92[a]
1	2	0.50[a]	0.26[a]	2.68[a]	0.74[a]	1.91[b]
2	1	0.61[a]	0.29[a]	2.59[a]	0.77[a]	3.07[a]
2	2	0.56[a]	0.24[a]	2.79[a]	0.75[a]	1.75[b]
P		0.6864	0.3889	0.3134	0.398	0.001
SEM		0.045	0.02	0.15	0.04	0.18
CV%		14.6	12	13.3	10	15.9

a-c value in columns with no common superscript differ significantly ($P<0.05$). [1]Standard error of the mean. Higher level of each factor is represented with number 1(methionin and energy in starter and grower respectively=1.2%, 0.9% and 3200 kcal/kg) and lower level is represented with number 2 (energy in starter and grower respectively= 0.45%, 0.33% and 2800kcal/kg)

this age. Treatment with high level of methionine and low level of ME induced a significant increase in proventriculus weights at 21 day of age ($P<0.05$). Also, the high levels of methionine and ME caused a significant increase in liver weighs at 21 day of age ($P<0.05$). Except liver weights, other parameters (proventriculus, pancreas, heart and abdominal fat weights) were not influence by methionine levels at 42 days of age. Except abdominal fat weights, other parameters (liver, proventriculus, pancreas, heart and weights) were not influence by energy levels at 42 days of age. The interactions results showed that abdominal fat weights were influence by treatments but no significant differences were observed between other parameters in this regards.

Stas and Potter [23] and Gordon and Sizer [24] reported that addition of methionine to broiler diets lead to lower abdominal fat. It said that this phenomenon may be due to lipolisis activity of methionine. Generally, it appears that higher abdominal fats were shown by methionine levels above NRC [1] recommendations for broiler chickens. On the other hand, Fox *et al*. [25] stated that the use of energy enriched diets cause increase abdominal fat which is in agreement with current study.

Diets effects on heart are agreement with Swain and Johri [26] which showed that that levels of methionine and energy had no effects on heart. Because of limitation in available data regarding heart and proventriculus weights no properly explanation can done in this regards.

Danicke *et al*. [27] observed no significant effects on pancreas by addition of various levels of methionine in diets. Furthermore, this finding was confirmed by Takahashi *et al*. [28] which are in concurrence with this study.

Vieira *et al*. [21] noted that various levels of sulfur amino acids in broiler diets lead to higher liver weights. It must be noted that after amino acid absorption from intestine, body metabolism increase and level of liver activity increase. This action not only can lead to higher liver activity but also increase liver weights. In contrast, Wiseman [29] was found that different levels of energy had no effects on liver weights.

CONCLUSION

The amino acid (methionine) and metabolisable energy interactions differently alter carcass trait and visceral organs. These changes can attribute to their effects on energy and protein access in metabolism of body. Furthermore, the abdominal fat of broiler has a considerable reduction by methionine usage in diets and can use to production lean broiler. Further research is necessary to clear exact mechanism of these interactions on in carcass and visceral organelles.

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