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The Efficacy of using Herbal Methionine Instead of DL-Methionine in Broiler Diets: Study on Production Performance and Costs

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Key words: DL-methionine, herbal methionine, performance, carcass, production cost, broiler chickens

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Abstract: In order to evaluate using herbal methionine instead of synthetic methionine in feed for broiler chickens and its influence on performance indicators, carcass yield and production cost, an experiment was conducted with 500 Ross broiler chicks within 40 days. The birds were classified in 5 groups including lack of methionine dietary (control), diets containing 0.1 and 0.2% of herbal methionine, 4 repeats and each repetition 25 birds were selected randomly. At the end of starter, grower and finisher periods, indexes of weight gain, feed intake and feed conversion ratio have been investigated. Moreover, 2 birds of each iteration of the carcass in the main parts were tested in the fortieth day after weighing and slaughter. The cost of production and profit from each feeding group were also assessed with the numerical calculations at the end of each period. The results showed that herbal methionine has been ineffective or reducing significantly for the indexes of weight gain and feed intake in all periods. On the contrary, the level of synthetic methionine causes increase of weight and increase or equality in average feed consumption. In feed conversion ratio index, levels of herbal methionine have been identical or increasing in comparison with control group. In all periods, synthetic methionine has increased the indexes. Chicken breast weight did not change with different herbal methionine. This behavior was observed in synthetic methionine but synthetic methionine increases breast weight significantly in comparison to herbal methionine. Abdominal fat has also been reduced by both methionine source but this reduction was more in herbal methionine ($p<0.01$). The weight ratio of liver reduced for both methionine sources (identically) in comparison to control group. The results of studying production costs indicate that none of the herbal methionine consumption levels has the economic justification and the positive profit balance in comparison to synthetic methionine. This balance was even lower than the group lacking methionine. Accordingly, substitution of herbal methionine with synthetic methionine is not proper in fodder for broiler chickens.

INTRODUCTION

Poultry industry is one of the most productive branches of livestock that is important in terms of both economy and human health. Poultry has the lowest feed conversion ratio among all livestock and it has a high growth rate. It has economically rapid return on investment. Compared to cattle, poultry has a higher carcass yield. In addition to higher digestibility, its meat also has higher protein and less cholesterol. Moreover, the number of zoonotic disease in humans and poultry is much lower compared with livestock. The unique privilege of this meat product is its consistency with all religious and cultural beliefs of all nations. The cost of feed for poultry has been announced to be about 61-75% of the total cost of a poultry unit[1]. Much of this cost is associated with protein and essential amino acids needed to provide bird feed. Methionine is an essential amino acids for poultry; its main role is in the process of protein synthesis. This amino acid is very important because poultry is not able to synthesize methionine carbon skeleton within its body; therefore, this amino acid should be available in sufficient quantity in their diets to achieve optimal performance. On the other hand, methionine is the most limiting amino acid in most food ingredients used in diet. During an irreversible reaction with adenosine in ATP structure, methionine is compressed and it creates a combination called S-Adenosine Methionine. This combination participates in >100 important body reactions including the construction of adrenaline, DNA, RNA, carnitine and creatine as a key in free methyl group[2]. Besides, free methyl groups are active in most of the activities of the nervous, immune, kidney and heart system. Thus, providing required methionine for broiler chickens through food increases growth speed and improves their feed efficiency[3, 4]. It has been shown that the shortage of this amino acid in the diet leads to weakness in the growth of feathers[5]. For these reasons, poultry breeders must add much synthetic methionines to feed. This amino acid is not produced in Iran and much of this amino acid imports in Iran each year while it is very expensive; it requires a high exchange intensity.

Since, nutrition industry tries to decrease food costs, experts are in search of ways to reduce the costs related to the consumption of synthetic methionine[6]. Nowadays, consumers tend to consume poultry meat products derived from plants. It seems finding an alternative source for methionine is essential. Halder and Roy[7] reported in this regard that Herbomethionine (one of the sources of herbal methionine) is moe effective compared to synthetic methionine. Other investigations such as Hadinia *et al*.[8], Chattopadhyay *et al*.[9], Hadinia *et al*.[10, 11] and Kumari *et al*.[12] have reported the effective role of herbal methionine in broiler diets. According to this new source and other consumption ratios, studies try to replacements in terms of performance, carcass yield and the cost of broiler production. The main targets of this research is evaluating the effect of two types of methionine (synthetic and herbal) in carcass yield of broiler chickens, final production and feed costper kg of broiler meat.

Research methodology: This research is conducted in the research field of Agriculture College at Azad University of Varamin located at Qale Sin village from January 30, 2014 to March 11, 2014 for 6 weeks (during the the poultry farming period) in order to study the efficacy of using herbal methionine instead of DL-methionine in broiler diets with respect to production performance and costs. 500 day-old broiler chicks (Ross 308 breeder) were classified in 5 groups including lack of methionine dietary (control), diets containing 0.1 and 0.2% of herbal methionine, 4 repeats and each repetition 25 birds were selected randomly within 40 days. With respect to the requirements of Ross 308 breeder, food used for chicks were founded based on three periods of starter or pre-feeding (1-10 days), grower or mid-feeding (11-24 days), finisher or post-feeding (25-42 days). The food is prepared in form of mash and it is available for birds in free food. Diet formulation was performed by Amino Feed Software based on the food requirements of Ross 308 breeder. Different diets have been formulated and considered for each growing period. Experimental groups were divided as follows:

- Control (without methionine)
- Diet containing 0.1% synthetic methionine
- Diet containing 0.1% herbal methionine
- Diet containing 0.2% herbal methionine
- Diet containing 0.2% synthetic methionine

MATERIALS AND METHODS

To perform the test, 4 kg herbal methionine with the brand of Argano Organic made in India was prepare. At the end of day 41, 2 birds from each replicate were randomly selected to examine the carcass; then they were slaughtered after weighting. The birds were kept hungry for 8 h to discharge the digestive system before slaughtering. About 500 day-old broiler chicks (Ross 308 breeder) were classified in 5 groups, 4 repeats and each repetition 25 birds were selected randomly within 40 days. Diet formulation was performed by Amino Feed Software based on the food requirements of Ross 308 breeder. Different diets have been formulated and considered for each growing period. Research data were written in Excel randomly; then, they were analyzed statistically by MSTAT-C Software. Averages were compared through Duncan test at the 0.05 level. The statistical model used for analysis of data is as following:

Yij = μ+ai+eij
Yij = Observed value
μ = Mean
ai = The effect of methionine type
eij = Effectiveness of experimental error

RESULTS AND DISCUSSION

Research findings

Weighting gainmean: The weight gainmean in the starter, grower and finisher periods, and the total period (1-10, 11-24, 25-40 and 1-40) as well as statistical comparison of the experimental groups are in Table 1. The results of Table 1 indicate that the synthetic methionine increases the weight of broiler chickens significantly in the starter, grower and total periods (p<0.01). Despite increasing effect of both levels of methionine for the weight gain index in the finisher period, only 0.% 2 of the index was increased significantly (p<0.05) in these growing periods, the results of herbal methionine was similar to control group (no methionine).

Feed consumption mean: The food consumption mean in the starter, grower and finisher periods and the total period are mentioned in Table 2 after statistical analysis. The results in the index of feed consumption of boiler chickens different experimental groups based on growing period indicate that level of 0.1% synthetic methionine increases consumed feed increasingly ()<0.05). Another consumption level of synthetic methionine (0.%) and levels of herbal methionine have not changed comparing to control group; they were identical statistically. The results in grower period showed that level of 0.2% synthetic methionine is increasing and 0.1% of methionine is reducer of consumption food (p<0.01). levels of 0.1% synthetic methionine, 02.% herbal methionine and control group are identical statistically. The results of feed consumption for the total period reveal significant increase by 0.2% level of synthetic methionine (p<0.01); no difference was observed for other experimental groups (Table 2).

Table 1: The weight gain mean of broiler chickens (gram per bird) in different experimental groups

	Age (Days)			
Experimental groups	1-10	11-24	25-40	1-40
Control (No methionine)	230^{BC}	1158^{b}	1984	3372^{b}
DL-Methionine 0.1%	260^{A}	1157^{b}	1996	3413^{b}
DL-Methionine 0.2%	252^{AB}	1218^{a}	2049	4519^{a}
Herbal Methionine 0.1%	241^{ABC}	1113^{c}	2022	3376^{b}
Herbal Methionine 0.2%	223^{C}	1159^{b}	2063	3445^{ab}
SEM	7.89	12.58	19.3	39.77
Significance	0.027	<0.000	0.052	0.006

$^{a.b}$: Means with dissimilar letter has significant difference statistically in each column (p<0.01); $^{A.B}$: Means with dissimilar letter has significant difference statistically in each column (p<0.05); SEM: Standard Error of Mean

Table 2: The feed consumption mean of broiler chickens (gram per bird) in different experimental groups

	Age (Days)			
Experimental groups	1-10	11-24	25-40	1-40
Control (No methionine)	230^{BC}	1158^{b}	1984	3372^{b}
DL-Methionine 0.1%	260^{A}	1157^{b}	1996	3413^{b}
DL-Methionine 0.2%	252^{AB}	1218^{a}	2049	4519^{a}
Herbal Methionine 0.1%	241^{ABC}	1113^{c}	2022	3376^{b}
Herbal Methionine 0.2%	223^{C}	1159^{b}	2063	3445^{ab}
SEM	7.89	12.58	19.3	39.77
Significance	0.027	<0.000	0.052	0.006

$^{a.b}$: Means with dissimilar letter has significant difference statistically in each column (p<0.01); $^{A.B}$: Means with dissimilar letter has significant difference statistically in each column (p<0.05); SEM: Standard Error of Mean

Table 3: The feed conversion ratio mean of broiler chickens (gram per bird) in different experimental groups

	Age (Days)			
Experimental groups	1-10	11-24	25-40	1-40
Control (No methionine)	1.22^{AB}	2.11^{ab}	$2.99A^{BC}$	2.40^{b}
DL-Methionine 0.1%	1.15^{B}	1.81^{C}	2.84^{BC}	2.19^{C}
DL-Methionine 0.2%	1.13^{B}	1.87^{c}	2.67^{C}	2.14^{c}
Herbal Methionine 0.1%	223^{C}	2.05^{b}	$3.22A^{B}$	2.48^{b}
Herbal Methionine 0.2%	1.27^{A}	2.25^{a}	3.49^{A}	2.67^{a}
SEM	0.04	0.06	0.16	0.06
Significance	0.024	<0.000	0.022	<0.000

$^{a.b}$: Means with dissimilar letter has significant difference statistically in each column (p<0.01); $^{A.B}$: Means with dissimilar letter has significant difference statistically in each column (p<0.05); SEM: Standard Error of Mean

Feed conversion ratio: The mean of feed conversion ratio in thestarter, grower and finisher periods and the total period are presented in Table 3.

According to results that show Table 3, consumption levels of herbal methionine do increase feed conversion ratio identically comparing to groups treated with synthetic methionine (both levels are identical (p<0.05). There is no significant statistical difference between both methionine sources in this period comparing to control group. In the grower period for synthetic methionine consumption levels reduce feed conversion ration significantly (p<0.01). There is no difference between experimental groups (herbal methionine and control group). The results of final period show no statistical difference between the groups of methionine sources and control group but among the receivers of methionine, level of 0.2% of synthetic methionine reduces and level of 0.2% of herbal methionine increases feed conversion ratio significantly (p<0.05). According to the results of total period in the discussed index, synthetic methionine (both levels identically) reduces feed conversion ratio significantly and level of 0.0% herbal methionine increases feed conversion ratio (p<0.01).

Table 4: Weighted mean of carcass parts of broiler chickens (gram per bird) in different experimental groups

	Age (Days)				
Experimental groups	Breast	Thighs	Abdominal fat	Liver	Heart
Control (No methionine)	26.36[AB]	24.82	1.18[a]	3.03[a]	0.76
DL-Methionine 0.1%	29.25[A]	25.10	0.97[c]	2.35[b]	0.64
DL-Methionine 0.2%	28.84[A]	24.38	0.92[c]	2.65[b]	0.65
Herbal Methionine 0.1%	26.94[AB]	24.52	1.15[ab]	2.70[b]	0.75
Herbal Methionine 0.2%	25.73[B]	25.13	1.08[b]	2.47[b]	0.81
SEM	0.86	0.51	0.02	0.12	0.40
Significance	0.046	-	<0.000	0.013	0.55

[a,b]: Means with dissimilar letter has significant difference statistically in each column (p<0.01); [A,B]: Means with dissimilar letter has significant difference statistically in each column (p<0.05); SEM: Standard Error of Mean

Table 5: Comparison of influences of synthetic and herbal sources in the cost of feed in the starter period

Experimental groups	Feed price per kg (Tomans)	Consumed feed (kg)	Cost of feed (Tomans kg)$^{-1}$
Control (No methionine)	1394	1.158	1614
DL-Methionine 0.1%	1409	1.156	1630
DL-Methionine 0.2%	1422	1.218	1735
Herbal Methionine 0.1%	1409	1.113	15.68
Herbal Methionine 0.2%	1424	1.159	1651

1: feed price per kg × consumed feed

Table 6: Comparison of influences of synthetic and herbal sources in the cost of feed in the grower period

Experimental groups	Feed price per kg (Tomans)	Consumed feed (kg)	Cost of feed (Tomans kg)$^{-1}$
Control (No methionine)	1394	1.158	1614
DL-Methionine 0.1%	1409	1.156	1630
DL-Methionine 0.2%	1422	1.218	1735
Herbal Methionine 0.1%	1409	1.113	15.68
Herbal Methionine 0.2%	1424	1.159	1651

1: feed price per kg × consumed feed

Table 7: Comparison of influences of synthetic and herbal sources in the cost of feed in the final period

Experimental groups	Feed price per kg (Tomans)	Consumed feed (kg)	Cost of feed (Tomans kg)$^{-1}$
Control (No methionine)	1326	1.984	2631
DL-Methionine 0.1%	1341	1.996	2676
DL-Methionine 0.2%	1356	2.049	2778
Herbal Methionine 0.1%	1341	2.022	2712
Herbal Methionine 0.2%	1356	2.063	2797

1: feed price per kg × consumed feed

Carcass yield

Weighted mean of carcass parts: The results of average weight ratio of primal cuts such as breasts, thighs, abdominal fat, liver and heart are presented in Table 4 after statistical analysis.

The results of average weight ratio of breast represent similarity of consumption levels in both sources of methionine comparing to control group. Among the receivers of methionine, groups treated by synthetic methionine was increaser of average weight ratio in comparison to groups treated by herbal methionine (p<0.05). The results of average weight ratio of abdominal fat indicate that both consumption levels of synthetic methionine reduce the level of abdominal fat. 0.2% of herbal methionine has also decreased the level of abdominal fat with a significant difference to synthetic methionine level (p<0.01). A part of the results revealed that all methionine levels of both sources reduces average weight ratio of liver (p<0.01). Moreover, levels and sources of methionine have no effect in the average weight ratio of heart and tights.

Economic efficiency, cost of production and profitability

Feed costs: Table 5-8 present the cost of consumed feed for each grower period.

According to the cost of feed calculations in the starter period, the minimum and maximum costs of produced feed are associated with the groups of 0.2% herbal methionine and 0.1% of synthetic methionine. According to these calculations, it is concluded that the cost of prepared feed with synthetic methionine in starter period is more than other feeds.

According to the cost of feed calculations in the grower period, 0.01% level of herbal methionine has the lowest and 0.2 level of synthetic methionine has the highest cost of feed. In this grower period, no differential reduction in the cost of herbal methionine feed is observed comparing to synthetic methionine as if it increases 0.2% level of herbal methionine feed cost comparing to the diet with 0.1%.

The cost of consumed feed in the final period indicates that 0.2 level of herbal methionine is the highest feed cost and feed lacking methionine (control) has le lowest cost of feed. In addition, not only herbal methionine has not been reducer of feed cost but also it has been increaser (even comparing to synthetic levels).

Total feed costs show that 0.2% level of synthetic methionine and 0.2% of herbal methionine have the highest costs; the combination lacking methionine (control) has the lowest cost. Accordingly, there is small difference among the receiver paire groups of methionine from synthetic and herbal sources.

The price of each kilogram of feed: After calculation of feed costs in different growing periods, the price of each kilograms feed is estimated; the estimations are presented in Table 9.

The calculations related to the cost per kg of feed show that the cheapest feed is the diet lacking methionine and diet with 0.2% synthetic methionine is the most expensive one. Comparison of paired prices from each level indicates that difference is insignificant with 1-2 Tomans difference; it can be ignored.

The cost of production and profitability: Feed cost for producing one kilogram of meat and its production profit have been calculated in Table 10.

According to the calculations in above, the maximum amount of feed cost for production of one kilogram of meat is marked by 0.2% herbal methionine; then, 0.1% of this source is in the next rank. The minimum feed cost for production of one kg of meat belongs to the diet containing synthetic methionine (even lower than diet lacking methionine). In terms of profitability, calculation balance shows the higher profit of diets with synthetic methionine in comparison to diets containing herbal

Table 8: Comparison of influences of synthetic and herbal sources in the cost of feed different periods per each bird

Experimental groups	Feed cost of starter period	Feed cost of grower period	Feed cost of final period	Feed cost of total period
Control (No methionine)	334	1614	2631	4579
DL-Methionine 0.1%	382	1630	2676	4687
DL-Methionine 0.2%	375	1735	2778	4888
Herbal Methionine 0.1%	354	1568	2712	4634
Herbal Methionine 0.2%	331	1651	2797	4779

Table 9: Comparison of synthetic and herbal sources in terms of the price of one kilogram feed for broiler chickens

Experimental groups	Feed cost in the total period (Tomans kg^{-1})	The amount of consumed feed (kg)	Total feed cost in the period[1]
Control (No methionine)	4579	3.372	1358
DL-Methionine 0.1%	2687	3.412	1374
DL-Methionine 0.2%	4888	3.519	1389
Herbal Methionine 0.1%	4634	3.376	1373
Herbal Methionine 0.2%	4779	3.445	1387

1: Feed cost in the total period/consumed feed in the period

Table 10: Comparison of synthetic and herbal sources in termsof production cost for one kilogram of meat and financial profit of boiler chickens

Experimental groups	Price of 1 kg feed (Tomans)	Feed conversion ratio	Feed cost for production of 1 kg live chicks (Toman)1	Profit after reduction of feed cost for production of 1 kg live chicks (Tomans)2	Profit after reduction of feed cost for each bird (Tomans)3
Control (No methionine)	1358	2.40	32.64	1236	6535
DL-Methionine 0.1%	1374	2.19	2983	1517	7296
DL-Methionine 0.2%	1389	2.14	2973	1527	7643
Herbal Methionine 0.1%	1373	2.48	3407	1093	6345
Herbal Methionine 0.2%	1387	2.67	3714	786	6034

1: Price of one kilogram feed× Feed conversion ratio; 2: The price of one kilogram live chicks - feed cost for production of one kilogram live chicks; 3: (live chick's weight× The price of one kilogram live chick)-(consumed feed × Price of one kilogram feed)

methionine and lacking methionine. Profitability balance also indicates that diets lacking methionine is more profitable comparing to diets containing herbal methionine.

CONCLUSION

According to the results of this study the following statements can be mentioned. The use of herbal methionines from the levels 0.1 and 0.2% as an alternative has not appropriate and optimum effect on performance indexes and carcass yield of broiler chickens; it may have a negative role comparing to synthetic methionine (even negative role in the performance comparing to diet lacking methionine. The use of herbal methionines from the levels 0.1 and 0.2% as an alternative to synthetic methionine reduces the price of 1 kg feed comparing to the levels of synthetic methionine in a small amount. The amount of feed cost for production of 1 kg weight increase and optimal profit of growing boiler chicken is improper (Comparing to both synthetic methionine and diet lacking methionine. The use of synthetic methionine levels (0.1 and 0.2%) improves indexes of performance and carcass yield significantly. With respect to the more expensive feed, the feed containing this amino acid is very economic based on investigations and calculations. It is suggested for further studies to study the effect of herbal methionine levels on the intestinal morphology and immune system. In addition, it is suggested for careful comparison of these two materials (synthetic and herbal methionine) to employ 5-7% levels of two sources. The results can be compared to this research.

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