PRODUCTIVE PERFORMANCE OF BROILER CHICKS AS AFFECTED BY FEEDING DIFFERENT SOURCES OF METHIONINE

By

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Abstract: *This study was designed to evaluate three different synthetic sources of methionine : 1) DL- methionine (DL–M.) , 2) DL- methionine hydroxy analogue – calcium (MHA – Ca 65% and 75%), 3) DL- methionine hydroxy analogue – free acid (MHA– FA 65% and 75%) in which they were supplemented to broiler diets on an equimolar basis. Three hundred and sixty unsexed Hubbard broiler chicks at 7 days of age were divided into six treatments (60 chicks each), each treatment contained 6 replicates of 10 chicks.*

The results were summarized as follow :

Broilers fed diet supplemented with either MHA-Ca 65% or MHA-FA 65% had the highest live body weight (LBW) and live body weight gain (LBWG) values at 35, 42 and 49 days of age. However, birds fed the basal diet (control) had the lowest LBW and LBWG values at all ages studied. The highest feed intake (FI) values at the total period of experimental were obtained by broilers fed the diet containing MHA-Ca 65% (4311.63 g), whereas, the other birds fed the diet containing DL- M. had the lowest FI (4166.19g) during the same period. There were significant differences in feed conversion ratio (FCR) values during the periods 29-35 and 43-49 days of age. The previous results showed that the chicks fed the diets supplemented by MHA- Ca 65% had better FCR values than those fed the other diets during the period from 29 to 35 days of age. Whereas, the worst FCR values were obtained by feeding the control diet and the diet supplemented with MHA- FA 75% during the same period.

It could be seen from the total period (8-49 days of age) that the best crude protein conversion (CPC) or caloric conversion ratio (CCR) values were obtained when the diet was supplemented with DL-M, MHA-Ca 65% and MHA-FA 65% compared to other treatments.

The results showed that birds fed the MHA – Ca 65% supplemented diet resulted a significantly higher serum cholesterol value than the other treatments.

There was a significant difference in triglycerides in which the birds fed MHA–FA 65% had the higher triglycerides concentration. There were significant differences in total protein and albumin concentrations among treatments, but no significant differences in globulin concentration at the all periods studied. The GOT and GPT values of methionine supplemented diets were higher than that of the basal diet.

The present results indicated that broilers fed the diets containing DL–M. or MHA-Ca 65% showed better economical efficiency values than those fed the other diets.

INTRODUCTION

Methionine is considered to be the first limiting amino acid in corn-soy poultry diets, followed by lysine and arginine **(NRC, 1994 and Cheeke, 1999)**. Therefore, poultry diets must be supplemented with synthetic methionine. However, the use of feed ingredients rich in methionine, such as fish meal and corn gluten meal, are limited by cost and availability.

Requested use for methionine in poultry nutrition is as a feed supplement. For optimum health and performance, the animal diet must contain adequate quantities of all nutrients needed, including amino acids. A shortage of the limiting amino acid will constrain animal growth, reduce feed efficiency, and in extreme cases cause a nutritional deficiency. supplementation with synthetic amino acids improves feed efficiency, thus lowering feed costs per unit of weight gain or production (Pond et al., 1995).

Extensive literature have been published that document the efforts to optimize the balance of amino acids in poultry diets in order to lower costs, reduce need for animal or fish proteins, replace soy meal with less expensive or locally available plant proteins, and utilize plant proteins more efficiently (emmert et al., 2000 ;Neto et. al., 2000 and Waibel et al., 2000). Methionine is used as a urine acidifier because excretion of its sulfate anion lowers urine pH. Its sulfate anion may also displace phosphate from magnesium- ammonium phosphate hexahydrate. As a result, methionine is used to assist in dissolving and/or preventing uroliths, kidney stones, bladder stones, or urologic syndromes. Methionine is also used to assist in the treatment and/or prevention of hepatic lipidosis because of its need for body fat mobilization and transport (Lewis et al., 1987).

There are three commercial analogues of supplemental methionine used by manufacturers of poultry diets in Egypt : DL-Methionine (DL-M.), DL-Methionine hydroxy analogue calcium (MHA-Ca) and DL-Metnionine hydroxy analogue free acid (MHA-FA). Both DL-M. and MHA-Ca are in dry form, while MHA-FA is a liquid form.

Several experiments have been conducted with broiler chicks for the determination of the biological activity of methionine and its hydroxy analogues, however, complete agreement is lacking (Van Weerden et al., 1982 and Boebel and Baker, 1982).

The present study aimed to evaluate the effect of synthetic methionine sources: DL-M., MHA- Ca and MHA- FA in broiler diets on productive performance, carcass characteristics and some blood constituents. Economic efficiency of using such sources was also evaluated.

MATERIALS AND METHODS

The experimental work of the present study was carried out at EL-Takamoly Poultry Integrated project, Fayoum Governorate. Chemical analyses were performed in the laboratories of Poultry Production Department, Faculty of Agriculture, Fayoum.

Three hundred and sixty one – day old Hubbard broiler chicks were housed in wire batteries for the first week of age , in which they were fed ad libitum on a commercial starter - grower diets. At the seventh – day – old, chicks were wing banded , individually weighed and distributed into 36 replicates of 10 birds each . All replicates had nearly the same average body weight . They were randomly distributed into six dietary treatments. Each dietary treatment was fed to six replicates of 10 chicks each. The chicks were fed the experimental starter- grower diets from 8-35 days of age then fed on the experimental finisher diets from 36 to 49 days of age (table 1) .

The activity of 1 Kg DL – M. was equivalent to 1.1342 Kg of MHA-Ca and equivalent to 1.0067 Kg of alimet (MHA - FA) on a molar equivalent basis , as reported by the producers. The corn – soybean meal basal diets were calculated to be adequate in metabolizable energy , calcium , available phosphorous and most of essential amino acids according to Ministerial decree (1996).

Birds were individually weighed and feed consumption for each pen was weekly recorded . All birds were kept under similar managerial conditions. Artificial lighting was provided 24 hours daily during the experimental periods.

At the end of the experiment (49 day of age) plasma samples were assigned for determination of total protein, cholesterol, triglycerides, GOT, GPT and glucose by kits from Bio Merieux (France) according to the procedure outlined by the manufacture.

Analysis of variance was conducted on the data in accordance with procedures described by **Steel and Torrie (1980)** using general linear model procedure of **S.P.S.S program (1997)**. Significant differences among treatment means were determined using Duncan's multiple range test **(Duncan 1955)**.

The economical efficiency (the net revenue per unit feed cost) from input- output analysis.

RESULTS AND DISCUSSION

1-Effect of feeding different sources of methionine on broiler chicks performance

1-1. Live body weight (LBW):

Data presented in Tabie (2) show that, synthetic methionine sources significantly affected the LBW of the experimental birds ($P < 0.05$) at 35,42 and 49 days of age.

Broilers fed the diet supplemented with MHA-Ca 65% had the highest LBW values at 35, 42 and 49 days of age, followed by those fed the diet with MHA-FA 65% at the same ages. While birds fed the basal diet (control) had the lowest LBW values at the all ages studied.

Broiler chicks fed the MHA- FA 65% had lower body weight than those fed the MHA-Ca 65%, this result is in harmony with that obtained by **Huyghebaert (1993)**. On the other hand, the results showed that chicks fed MHA–Ca and MHA-FA were heavier than the chicks fed the control diet. These results are in harmony with those of **Bunchasak *et al.* (2006)**. Contrary to this result, **Sullivan and Bird (1957)** reported that MHA failed by a wide margin to support chicks performance equivalent to DL- M. when added to the diet on an equimolar basis. Also, **Calet and Melot (1961)** indicated that DL- M. and MHA supported equal performance when compared on an equimolar basis, however, when comparisons were made on an equal weight basis, MHA was always inferior to DL-M. Similar results were obtained by **Tipton *et al.*, 1965**. They stated that DL-M. consistently supported better performance than did MHA-Ca when used on an equimolar basis. They also added that similar results were obtained, but

the differences were even greater in favour of DL- M., when the two sources were compared on a weight for weight basis.

1-2. Live body weight gain (LBWG):

As shown in Table (3), the effect of feeding different sources of methionine significantly affected the LBWG values during the periods from 29 to 35, 43 to 49 and from 8 to 49 days of age (total experimental period).

During the pervious periods, the broilers fed the diet containing MHA-Ca 65% had higher LBWG values than the other groups. On the other hand, birds fed the control diet had lower LBWG values at starting and growing period and from 36 to 42 days of age, whereas, the birds fed the diet containing MHA-FA 75% had lower LBWG values during the periods from 43 to 49 and from 8 to 49 days of age.

This result may indicate that young broiler chicks at early stage of life are more susceptible to the deleterious effect of polymeric forms in MHA-FA **(Boebel and Baker, 1982)** then diminished with age of chicks. The results of **Dibner and Ivey (1992)** indicated that relative liver enzyme capacity to convert supplemental levels of MHA-FA or DL-M. and L-M. increases with the age of the broilers. Howéver, **Garlich (1985)** did not find any significant differences among the three sources (DL-M., L-M. and MHA-FA) in providing weight gain of broiler chicks. The auther concluded that when synthetic sources of methionine activity are used to meet the requirements for total sulfur amino acid in practical corn – soybean meal diets for producing 7-week old broilers, the chicks are capable for utilizing MHA-FA, DL-M. and L-M. with efficiency that is indistinguishable. Also, **Fayek *et al.* (1991)** reported that, there is no any significant difference between the two sources of methionine (DL and MHA- Ca) in LBWG while, they showed that, the addition of both sources of DL- M. and MHA Ca at 0.05% and 0.1% gave a progressive increase ($P<0.01$) of chick body weight gain.

Mandal *et al.* (2004) indicated that the chicks fed DL- M. had significantly higher LBWG than those fed on MHA-FA and the control diet at 0-3 weeks of age. They added that, during the overall growth period, (0-6 week) chicks fed DL- M. and MHA-FA grew better than those fed the control diet.

1-3. Feed intake (FI):

Results in Table (4) indicate that the different sources of methionine significantly affected FI values during all experimental periods, except during 22 to 28 and 36 to 42 days of age.

Highest FI values at periods from 8 - 14, 29 – 35, 43 - 49 and from 8 to 49 days of age were obtained with broilers fed diet containing MHA-Ca 65%, whereas, the other birds fed the diet containing DL- M. had lower FI during the same periods, except the period from 43-49 days of age.

These results indicated that supplemental methionine sources significantly affected FI of broiler chicks. These results agreed with those of **Rostango** and **Barbosa (1995)** and **Meirelles *et al.*(2003)** who reported that FI is affected by the supplemental methionine sources. On the other hand, **El-Daly and Mohamed (1999)** showed that methionine source had no significant effect upon FI.

1-4. Feed conversion ratio (FCR):

The data in Table (5) indicated significant differences in FCR values during the periods from 29 to 35 and from 43 to 49 days of age. On the other hand, there were no significant differences in FCR values during the other periods of age. The previous results showed that the chicks fed the diets supplemented either by MHA- Ca 65% or DL-M had better FCR values than those fed the other diets from 8 to 49 days of age.. Whereas, the worst FCR values were obtained by feeding the control diet and the diet supplemented with MHA- FA 75% during the period from 29 to 35 days of age.

These results agreed with those obtained by **Meirelles *et al.* (2003)** who reported that broilers fed MHA-Ca. had better FCR compared with those fed the MHA- FA diets. Also, **Van Weerden *et al.* (1982)** reported that MHA-Ca failed to support chicks performance (including feed conversion) as an equivalent to DL-M.

1-5.Crude protein conversion (CPC) and Caloric conversion ratio (CCR):

Results in Tables (6 and 7) indicated that no significant differences in CPC and CCR values during all experimental periods, except the period from 43 to 49 days of age, in which there were significant differences among treatments.

Generally, it could be seen from the overall period (8-49 days of age) that the best CPC or CCR values was obtained when the diet was supplemented either with DL-M, MHA-Ca 65% or MHA-FA 65% .

2- The effect of feeding different sources of methionine on plasma constituents:

2-1.Cholesterol:

The results presented in Table (8) showed that birds fed the MHA – Ca 65% supplemented diet resulted in a higher serum cholesterol value than the other treatments. No definite trend could be detected concerning source or the level of methionine supplementation upon plasma cholesterol content

2-2.Triglycerides:

There was a significant difference in triglycerides in which the birds fed MHA – FA 65% had higher triglycerides concentration than the other dietary treatments (Table 8). As previously mentioned concerning plasma cholesterol, the effect of feeding different sources or levels of Methionine had no definite trend on plasma triglycerides contents.

2-3.Glucose:

Non-significant differences were obtained by feeding the various experimental diets (Table 8). This result contrasted that obtained by **El-Daly and Mohamed (1999)** who indicated that glucose concentration was significantly affected by sources of supplemental methionine but not by the level of supplementation.

2-4. Total protein, albumin and globulin :

There were significant differences in plasma total protein and albumin concentrations, but no significant differences in globulin concentration was obtained as a result of feeding different dietary methionine sources and levels (Table 8). It could also be seen that MHA-FA 75% diet resulted in higher contents of plasma total protein, albumin and globulin values being 74.73, 46.97 and 27.75 (g/L), respectively.

2-5. GOT and GPT activities:

The GOT and GPT values of methionine supplemented diets were higher than that of the basal diet. However, no significant differences in both GOT and GPT values were detected among the different methionine levels and sources(Table 8) . **Chatto- padhyay *et al.* (2006)** found that no significant differences between birds fed DL- M. and herbal M. in GOT and GPT values.

3- Effect of feeding different sources of methionine on economical efficiency: (E. Ef.)

The present results indicated that broilers fed the diets containing DL–M. or MHA-Ca 65% recorded the best economical efficiency values compared with those fed the other dietary treatments (Table 9) .

From the economical point of view, the present results assured that the supplementation of synthetic sources of methionine could be used in broiler diets (such as MHA-Ca 75% and MHA-FA 75%) without any deleterious effect in economical efficiency as compared with, the unsupplemented Methionine basal diet.

The results obtained from the present study suggested that MHA-Ca and MHA-FA are acceptable sources of methionine for broiler chicks in which they maintained better growth performance and economical efficiency as compared with the unsupplemented Methionine basal diet.

Table (1): Composition and calculated analysis of the experimental diets.

Ingredient (%)	Starting and growing period (8 – 35 days)						Finishing period (36 - 49 days)					
	Basal (control)	DL-M	MHA-Ca 65%	MHA-Ca 75%	MHA-FA 65%	MHA-FA 75%	Basal (control)	DL-M	MHA-Ca 65%	MHA-Ca 75%	MHA-FA 65%	MHA-FA 75%
Yellow corn	61.00	61.00	61.000	61.000	61.000	61.000	66.00	66.00	66.000	66.000	66.000	66.000
Soybean meal (44%)	30.10	30.10	30.100	30.100	30.100	30.100	26.00	26.00	26.000	26.000	26.000	26.000
Corn gluten meal (60%)	4.30	4.30	4.300	4.300	4.300	4.300	0.40	0.40	0.400	0.400	0.400	0.400
Wheat bran	-	-	-	-	-	-	2.50	2.50	2.500	2.500	2.500	2.500
Corn oil	1.00	1.00	1.000	1.000	1.000	1.000	2.00	2.00	2.000	2.000	2.000	2.000
Di - calcium phosphate	1.80	1.80	1.800	1.800	1,800	1.800	1.70	1.65	1.623	1.634	1.623	1.634
Limestone	1.20	1.15	1.123	1.134	1.123	1.134	0.80	0.80	0.800	0.800	0.800	0.800
Salt (Nacl)	0.30	0.30	0.300	0.300	0.300	0.300	0.30	0.30	0.300	0.300	0.300	0.300
Vit. Min. Premix *	0.30	0.30	0.300	0.300	0.300	0.300	0.30	0.30	0.300	0.300	0.300	0.300
DL- Methionine	0.00	0.05	0.077	0.066	0.077	0.066	0.00	0.05	0.077	0.066	0.077	0.066
Total	*100.00*	*100.00*	*100.000*	*100.000*	*100.000*	*100.000*	*100.00*	*100.00*	*100.000*	*100.000*	*100.000*	*100.000*
Cost / kg diet (P.T) **	132.82	133.53	133.94	133.73	133.86	133.66	124.47	125.41	125.76	125.57	125.68	125.51
Relative Cost ***	100.00	100.53	100.84	100.69	100.78	100.63	100	100.76	101.04	100.88	100.97	100.84

* Each 3.0 kg of Vit and Min. Premix manufactured by Agri-Vet Company Egypt contains: Vit. A, 12000000 IU; Vit. D3, 2000000 IU; Vit E, 10g; Vit K3, 2.0g; Vit B1, 1.0g; Vit B2, 5g; Vit B6, 1.5g; Vit B12, 10mg; choline chloride, 250g ; biotin 50mg; folic acid, 1g; nicotinic acid, 30g; Ca pantothenate, 10g ; Zn, 50g; Cu, 10g; Fe, 30g; Co, 100mg; Se, 100mg; I, 1g; Mn, 60g and anti-oxidant, 10g; and completed to 3.0Kg by Calcium Carbonate.

** According to market prices of 2005.

*** According to the price of the control diet = 100

Table (1): Contin.

Calculated analysis****	Starting and growing period (8 – 35 days)						Finishing period (36 – 49 days)					
	Basal (control)	DL-M.	MHA-Ca 65%	MHA-Ca 75%	MHA-FA 65%	MHA-FA 75%	Basal (control)	DL-M.	MHA-Ca 65%	MHA-Ca 75%	MHA-FA 65%	MHA-FA 75%
CP, %	21.19	21.22	21.24	21.23	21.24	21.23	17.15	17.18	17.19	17.19	17.19	17.19
EE, %	2.67	2.67	2.67	2.67	2.67	2.67	2.80	2.80	2.80	2.80	2.80	2.80
CF, %	3.59	3.59	3.59	3.59	3.59	3.59	3.63	3.63	3.63	3.63	3.63	3.63
Ca, %	1.08	1.06	1.05	1.06	1.05	1.06	0.89	0.88	0.87	0.87	0.87	0.87
P. available, %	0.52	0.52	0.52	0.52	0.52	0.52	0.49	0.48	0.48	0.48	0.48	0.48
Lys., %	1.07	1.07	1.07	1.07	1.07	1.07	0.94	0.94	0.94	0.94	0.94	0.94
Meth., %	0.40	0.45	0.48	0.46	0.48	0.46	0.31	0.36	0.39	0.39	0.38	0.38
Meth. + cys., %	0.75	0.80	0.82	0.81	0.82	0.81	0.60	0.65	0.68	0.68	0.68	0.67
ME./ kcal/kg diet	2965	2965	2965	2965	2965	2965	3018	3018	3018	3018	3018	3018

**** According to Ministerial decree, 1996.

Table (2): The effect of feeding different sources of methionine on broilers live body weight (LBW, g).

Treatment	Starting and growing period, days					Finishing period, days	
	8	14	21	28	35	42	49
Control	112.71±1.78	267.79±5.76	532.45±10.25	906.22±14.78	1249.91±18.93^{C}	1628.90±24.35^{B}	2087.43±28.23^{C}
DL - M.	112.80±1.48	273.84±6.12	546.91±12.08	921.45±18.08	1278.04±23.62^{BC}	1703.50±33.10^{AB}	2160.80±37.42^{ABC}
MHA-Ca 65%	113.14±1.88	279.41±5.42	563.80±10.77	940.51±14.94	1341.69±19.24^{A}	1749.75±26.17^{A}	2233.02±36.23^{A}
MHA-Ca 75%	113.36±1.65	279.52±4.75	551.50±11.54	924.74±14.34	1304.97±16.10^{ABC}	1696.55±23.40^{AB}	2119.09±29.55^{BC}
MHA-FA 65%	113.09±1.55	277.17±5.08	555.40±9.48	941.98±14.53	1319.33±17.52^{AB}	1742.86±25.86^{A}	2205.29±37.08^{AB}
MHA-FA 75%	112.97±1.99	273.81±6.22	554.69±11.03	931.86±14.55	1292.63±21.46^{ABC}	1696.78±33.17^{AB}	2087.95±41.57^{C}
Overall mean of the M. groups	113.07±0.75	276.75±2.42	554.46±4.79	932.11±7.92	1307.33±11.04	1717.89±15.72	2161.23±66.43

¹Mean + standard error of the mean

A,B and C: Values in the same column with different superscripts are significantly different at $P < 0.05$.

Table (3) : The effect of feeding different sources of methionine on broilers live body weight gain (LBWG, g).

Treatment	Starting and growing period, days				Finishing period, days		Total period,days
	8 – 14	15-21	22 – 28	29 – 35	36 – 42	43 – 49	8-49
Control	154.88±4.72	264.66±6.50	373.28±8.56	343.69±10.63^{C}	378.98±14.54	459.53±14.00^{AB}	1975.52±28.20$^{}$
DL-M.	161.04±5.07	273.07±7.24	374.94±9.16	356.59±11.70^{BC}	425.46±17.11	457.30±13.15^{AB}	2048.00±36.71^{BC}
MHA-Ca 65%	166.27±4.02	284.39±7.26	376.71±7.06	401.19±10.39^{A}	408.05±17.67	483.27±21.41^{A}	2119.88±35.51^{A}
MHA-Ca 75%	166.16±3.90	271.98±8.72	373.24±10.36	380.22±7.91^{AB}	391.59±14.91	422.53±16.44^{BC}	2005.72±29.21^{BC}
MHA-FA 65%	164.09±4.06	278.22±5.62	386.59±7.70	377.34±11.26^{AB}	423.53±16.85	462.43±20.48^{AB}	2092.21±37.03^{AB}
MHA-FA 75%	160.85±4.79	280.88±6.43	377.17±7.60	360.76±13.42^{BC}	404.15±18.28	391.17±19.17^{C}	1974.98±41.10^{C}
Overall mean of the M. groups	163.7±1.96	277.71±3.18	377.73±4.90	375.22±7.21	410.56±12.0	443.34±62.98	2048.16±64.41

¹Mean + standard error of the mean.
A,B and C. Values in the same column with different superscripts are significantly different at P < 0.05.

Table (4) : The effect of feeding different sources of methionine on broilers feed intake (FI, g.).

Treatment	Starting and growing period, days			Finishing period, days		Total period, days	
	8 – 14	15-21	22 – 28	29 – 35	36 – 42	43 – 49	8 - 49
Control	264.13±.87^{CD}	436.49±3.09^{D}	699.43±1.5	813.86±4.06^{C}	998.55±0.95	991.02±1.95^{A}	4205.51±7.27^{C}
DL-M.	261.57±.94^{D}	446.85±3.12^{CD}	698.12±0.94	786.90±5.93^{D}	1000.80±0.71	970.87±2.20^{B}	4166.19±9.76^{D}
MHA-Ca 65%	276.27±1.29^{A}	477.13±2.41^{B}	701.35±1.03	864.92±3.09^{A}	1005.42±1.03	993.32±1.31^{A}	4311.63±5.51^{A}
MHA-Ca 75%	271.16±1.55^{B}	470.09±3.46^{BC}	700.07±0.84	836.55±4.02^{B}	995.89±0.95	994.57±1.58^{A}	4272.37±7.23^{B}
MHA-FA 65%	267.59±1.76^{BC}	539.37±24.89^{A}	698.95±1.06	828.38±2.05^{B}	1006.23±0.87	959.00±2.41^{C}	4294.34±26.22^{AB}
MHA-FA 75%	266.12±2.11^{C}	456.87±2.87^{BCD}	701.84±0.91	831.92±2.69^{B}	997.61±1.01	932.85±1.32^{D}	4187.75±4.55^{CD}
Overall mean of the M. groups	268.54±5.44	478.06±0.0	699.95±3.2	829.73±2.12	1000.75± 0.94	970.12±1.6	4246.46±6.33

¹Mean + standard error of the mean.
A,B, C and D. Values in the same column with different superscripts are significantly different at P < 0.05.

Table (5) : The effect of feeding different sources of methionine on broilers feed conversion ratio (FCR).

Treatment	Starting and growing period, days				Finishing period, days		Total period , days
	8 - 14	15-21	22 – 28	29 – 35	36 – 42	43 – 49	8 – 49
Control	1.71±.07	1.65±.04	1.87±.07	2.37±.09^{A}	2.63±.13	2.16±.07^{B}	2.13±.03
DL-M.	1.62±.06	1.64±.06	1.86±.08	2.21±.11^{AB}	2.35±.16	2.12±.06^{B}	2.03±.04
MHA-Ca 65%	1.66±.05	1.67±.05	1.86±.03	2.16±.06^{B}	2.46±.58	2.05±.19^{B}	2.03±.03
MHA-Ca 75%	1.63±.05	1.73±.68	1.88±.04	2.20±.04^{AB}	2.54±.26	2.35±.21^{AB}	2.13±.03
MHA-FA 65%	1.63±.05	1.94±.10	1.81±.04	2.19±.11^{AB}	2.38±1.68	2.07±.15^{B}	2.05±.03
MHA-FA 75%	1.65±.06	1.63±.04	1.86±.04	2.31±.19^{A}	2.47±.41	3.38±.60^{A}	2.12±.04
Overall mean of the M. groups	1.64±.02	1.72±.14	1.85±.03	2.22±.05	2.44±.37	2.20±.18	2.10±.12

1Mean + standard error of the mean.

A and B: Values in the same column with different superscripts are significantly different at $P < 0.05$.

Table (6): The effect of feeding different sources of methionine on crude protein conversion values(CPC).

Treat.	Starting and growing period,days				Finishing period, days		Total period, days
	8-14	15-21	22-28	29-35	36-42	43-49	8-49
Control	0.36±0.012	0.35±0.060	0.40±0.012	0.50±0.025	0.45±0.318	0.37±0.050^{B}	0.41±0.008
DL-M.	0.34±0.012	0.35±0.061	0.40±0.012	0.47±0.025	0.40±0.323	0.36±0.051^{B}	0.39±0.008
MHA-Ca 65%	0.35±0.012	0.36±0.060	0.40±0.012	0.46±0.025	0.42±0.315	0.35±0.049^{B}	0.39±0.008
MHA-Ca 75%	0.35±.012	0.37±0.060	0.40±0.012	0.47±0.025	0.44±0.318	0.40±0.050^{B}	0.41±0.008
MHA-FA 65%	0.36±0.012	0.41±0.060	0.39±0.012	0.47±0.025	0.41±0.318	0.36±0.050^{B}	0.39±0.008
MHA-FA 75%	0.35±0.012	0.35±0.060	0.40±0.012	0.49±0.025	0.42±0.315	0.41±0.049^{A}	0.41±0.008
Overall mean of the M. groups	0.35± 0.01	0.37± 0.044	0.40± 0.1	0.47± 0.02	0.42± 0.032	0.32± 0.047	0.40± 0.007

Table (7) : The effect of feeding different sources of methionine on calorie conversion ratio (CCR).

Treat.	Starting and growing period,days				Finishing period, days		Total period, days
	8-14	15-21	22-28	29-35	36-42	43-49	8-49
Control	5.06±0.170	4.85±0.844	5.55±0.162	7.02±0.346	7.95±5.58	6.51 ± 0.873^{B}	6.37±0.117
DL-M.	4.81±0.173	4.85±0.858	5.52±0.165	6.54±0352	4.01±5.68	6.41 ± 0.888^{B}	6.08±0.119
MHA-Ca 65%	4.93±0.169	4.97±0.836	5.52±0.161	6.39±0.343	7.44±5.54	6.20 ± 0.865^{B}	6.08±0.16
MHA-Ca 75%	4.84±0.170	5.12±0.844	5.56±0.162	6.52±0.346	7.68±5.58	7.1 ± 0.873^{B}	6.37±0.117
MHA-FA 65%	4.84±0.170	5.75±0.844	5.36±0.162	6.51±0.346	7.17±5.58	6.26 ± 0.873^{B}	6.14±0.177
MHA-FA 75%	4.9±0.169	4.82±0.836	5.51±0.161	6.84±0.343	7.45±5.54	7.2 ± 0.865^{A}	6.34±0.116
Overall mean of the M. groups	4.9± 0.163	5.1± 0. 821	5.49± 0. 16	6.56± 0.323	7.35± 0.559	6.63± 0. 872	6.20± 0.117

1. Mean ± standerd error of the mean

A and B: Values in the same column with different superscripts are significantly different at $P \leq 0.05$

Table (8) : The effect of feeding different sources of methionine on plasma constituents.

Treatment	Cholesterol (mmol/L)	Triglyceride s (mmol/L)	Glucose (mmol/L)	Total protein (g/L)	Albumin (g/L)	Globulin (g/L)	GOT (U/L)	GPT (U/L)
Control	$2.76\pm.21^{AB}$	$0.48\pm.03^{B}$	5.30±15	60.88 ± 5.39^{AB}	38.22 ± 1.36^{BC}	22.66±4.26	209.75±21.39	11.55±1.56
DL-M.	$2.71\pm.09^{AB}$	$0.41\pm.03^{B}$	5.41±.12	59.78 ± 6.16^{AB}	43.44 ± 1.60^{AB}	16.34±5.89	229.83±21.39	13.17±1.56
MHA-Ca 65%	$3.14\pm.26^{A}$	$0.43\pm.03^{B}$	4.86±.22	56.70 ± 3.37^{AB}	36.08 ± 3.47^{C}	20.63±4.93	243.83±21.39	12.83±1.56
MHA-Ca 75%	$2.35\pm.10^{B}$	$0.44\pm.02^{B}$	5.81±.56	50.33 ± 3.78^{B}	40.89 ± 2.77^{ABC}	19.44±1.91	233.33±21.39	16.50±1.56
MHA-FA 65%	$2.75\pm.12^{AB}$	$0.60\pm.01^{A}$	5.08±.28	67.25 ± 10.18^{AB}	44.18 ± 1.50^{AB}	23.07±9.99	277.17±21.39	14.85±1.56
MHA-FA 75%	$2.97\pm.24^{AB}$	$0.52\pm.07^{AB}$	5.65±.20	74.73 ± 2.63^{A}	46.97 ± 1.89^{A}	27.75±3.86	250.17±21.39	13.07±1.56
Overall mean of the M. groups	2.78±0.09	0.48±0.02	5.36±0.15	61.76±2.91	42.31±1.20	19.45±2.73	246.87±8..37	14.08± 0.66

1 Mean ± standard error of the mean.

A,B and C: Values in the same column with different superscripts are significantly different at $P \leq 0.05$.

Table (9): Effect of feeding different sources of methionine on economical efficiency (E.Ef.) of broiler chicks during the experimental period.

Item	Basal diet	Different sources and levels of methionine				
		DL- M.	MHA-Ca 65%	MHA-Ca 75%	MHA-FA 65%	MHA- FA 75%
Average LBW (Kg/ bird)- A	2.088	2.161	2.233	2.119	2.205	2.087
Price of Kg LBW - B	7.500	7.500	7.500	7.500	7.500	7.500
Average feed intake kg/ bird: Starting & growing period – C	2.215	2.195	2.318	2.278	2.335	2.255
Cost/kg diet Starter & grower -D*	1.328	1.335	1.339	1.337	1.339	1.337
Feed cost /starting and growing(CxD)=E	2.941	2.931	3.104	3.045	3.127	3.015
Average feed intake kg/ bird : Finishing period- F	1.991	1.971	1.993	1.995	1.959	1.933
Cost/kg diet Finishing period = G	1.245	1.254	1.258	1.256	1.257	1.255
feed cost Finishing period (FxG)=H	2.479	2.472	2.508	2.505	2.462	2.426
Total feed cost (E+H)=I	5.420	5.403	5.612	5.551	5.589	5.441
Total Revenue A x B = J	15.66	16.21	16.75	15.89	16.54	15.66
Net revenue J- I = K	10.24	10.81	11.14	10.34	10.95	10.22
Economical efficiency K/I=L	1.89	2.00	1.98	1.86	1.96	1.88
Relative E. Ef. **	100	105.82	104.76	98.41	103.70	99.47

* According to market prices at time of experiment ** Assuming that the control equals 100.

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الملخص العربي

الأداء الإنتاجي لكتاكيت التسمين وتأثره بالتغذية على مصادر مختلفة من المثيونين

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صممت التجربة لتقيم ثلاث مصادر تجارية للمثيونين وهم دل – مثيونين، مثيونين هيدروكسي أنالوج كالسيوم (بودرة) والمثيونين هيدروكسي أنالوج (أحماض حرة) وقد أضيف المصدرين الأخرين عند مستويين ٦٥%، ٧٥% وذلك باستخدام علائق نباتية (ذرة – صويا). أستخدم عدد ٣٦٠ كتكوت غير مجنس من نوع هابرد عمر ٧ يوم ، قسمت الكتاكيت الى ٦ معاملات (٦٠ كتكوت / معاملة) ، كل معاملة اشتملت على ٦ مكررات وكل مكرر به ١٠ كتاكيت.

وتتلخص النتائج المتحصل عليها فيما يلي:

١- لم يكن هناك أي استجابة معنوية على وزن الجسم نتيجة لإضافة المصادر المخلقة للمثيونين عند أعمار ١٤، ٢١، ٢٨ يوم . بينما أظهرت المجموعة التي غذيت على مثيونين هيدروكسي أنالوج كالسيوم ٦٥% أعلى وزن حي عند عمر ٤٩ يوم.

٢- لم يكن هناك فروق معنوية بين المعاملات المختلفة خلال الفترات من عمر ٨-١٤، ١٥- ٢١، ٢٢-٢٨ ، ٣٦-٤٢ يوم من العمر بينما خلال الفترات ٢٩-٣٥، ٤٣- ٤٩ والفترة الكلية ٨-٤٩ يوم أظهرت المجموعة المغذاه على مثيونين هيدروكسي أنالوج كالسيوم ٦٥% أعلى معدل زيادة في وزن الجسم عن غيرها من المجموعات الأخرى

٣- أظهرت المجموعة التي تغذت على عليقة مضاف لها مثيونين هيدروكسي أنالوج كالسيوم ٦٥% أعلى كمية غذاء مأكول خلال الفترات ٨-١٥،١٤ -٢١، ٢٩- ٣٥ والفترة الكلية ٨-٤٩ يوم من العمر بينما المجموعة التي غذيت على دل – مثيونين كانت الأقل فى كمية الغذاء المأكول خلال نفس الفترات.

٤- هناك فروق معنوية بين المعاملات المختلفة خلال الفترات من عمر ٢٩-٣٥، ٤٣- ٤٩ يوم من العمر حيث أظهرت المجموعة التي غذيت على عليقة مضاف لها مثيونين هيدروكسي أنالوج كالسيوم ٦٥% أفضل معدل تحويل غذائي خلال هذه الفترة من العمر، بينما أظهرت المجموعة التي تغذت على علائق تحتوى على مثيونين هيدروكسي أنالوج (أحماض حرة) ٧٥% أسوأ معدل تحويل غذاء خلال نفس الفترة من العمر.

٥-لم يكن هناك أي تأثير معنوي على معدل تحويل البروتين أو معدل تحويل الطاقة خلال الفترات المختلفة من العمر فيما عدا الأسبوع الأخير من العمر حيث أظهرت النتائج أن المجموعات المغذاة على علائق تحتوى على دل – مثيونين ، مثيونين هيدروكسي أنالوج كالسيوم ٦٥% ،وكذلك ، مثيونين هيدروكسي أنالوج (أحماض حرة) ٦٥% أفضل نتائج.

٦- كان هناك فروق معنوية بين المعاملات المختلفة في مستوى الكوليسترول والجليسريدات الثلاثية بالدم حيث أظهرت المجموعة المغذاة على العليقة المضاف إليها مثيونين هيدروكسي أنالوج كالسيوم ٦٥% أعلى مستوى لكوليسترول الدم بينما أظهرت الطيور التي تغذت على عليقة مضاف لها مثيونين هيدروكسي أنالوج أحماض حرة ٦٥% أعلى مستوى من الجليسريدات الثلاثية .

٧- أيضا كان هناك فروق معنوية بين المعاملات المختلفة بالنسبة لمستوى كل من البروتين الكلي والالبيومين بينما لم يكن هناك أي فروق معنوية في مستوى الجلوبيولين بين المصادر المختلفة للمثيونين، ولقد أظهرت الطيور المغذاة على علائق مضاف لها مثيونين هيدروكسي أنالوج (أحماض حرة) ٧٥% أعلى مستوى في كل من البروتين الكلي والألبيومين والجلوبيولين.

٨- بالنسبة لانزيمات الكبد (GPT,GOT) ، أظهرت النتائج عدم وجود فروق معنوية بين المعاملات المختلفة حيث أظهرت الطيور التي تغذت على عليقة مضاف لها مثيونين هيدروكسي أنالوج أحماض حرة ٦٥% أعلى مستوى لل GOT بينما أظهرت المجموعة المغذاة على العليقة المضاف إليها مثيونين هيدروكسي أنالوج كالسيوم ٧٥% أعلى مستوى من GPT.

٩- أوضحت النتائج أن إضافة كل من دل – مثيونين أوالمثيونين هيدروكسي أنالوج كالسيوم ٦٥% الى علائق كتاكيت التسمين يحقق أفضل كفاءة اقتصادية مقارنة بباقى المعاملات.