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METHIONINE AND LYSINE SUPPLEMENTATIONS EITHER IN DIETS OR DRINKING WATER OF ONE-PHASE LOW DIETARY PROTEIN FEEDING SYSTEM FOR LAYING HENS

2- Effects on laying performance, feed utilization, egg quality and digestibility

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This work was conducted to study the effect of methionine and lysine supplementation to the level of 120% of requirements either in feed (F) or drinking water (W) for one-phase low protein diet on laying performance, feed utilization, egg quality and digestibility. A total number of 180 H&N females pullets of 19 weeks of age (previously divided into control (C), F treatment and W treatment during growing period) were classified into 9 experimental groups, 20 pullets for treatment, in 5 replicates, 4 birds each, as C/C, F/C, W/C, C/F, F/F, W/F, C/W, F/W and W/W groups. Control diet (C) during laying period contained 19, 18, 17 and 16% crude protein (CP) as strain requirements, while experimental diet F and W contained 15% crude protein (CP). All diets were iso-calorie and iso-nitrogenous. Results obtained could be summarized as follows:

- The lowest (P<0.05) final body weight obtained by F/F group (1.696 kg), while control group (C/C) attained highest (P< 0.05) final body weight (1.889 kg).
- Birds in W/F group recorded higher values in total egg number (105.6) and rate of egg production (75.26%) compared to the other experimental groups, while the heaviest egg mass recorded by control group (6.111 kg /hen) followed by W/F group (5.959 kg /hen). The lowest egg mass obtained by F/F group (4.844 kg/hen) followed by C/F group (4.852 kg/hen).
- The heaviest average egg weight recorded by control and W/C groups (58.0 gm) followed by C/W group (57.5 gm),

while the lightest average egg weight recorded by F/F group (55.8 gm) followed by F/W group (56.2 gm).

- The largest amount of feed intake recorded by W/F group (111.9 gm /bird /day) followed by C/C group (106.1 gm /bird /day), while the smallest amount recorded by F/F group (93.7 gm /bird /day) followed by C/F group (96.5 gm /bird /day).
- The best feed /egg conversion recorded by C/C and F/C groups (2.43), while the worst one recorded by C/F (2.75) followed by F/F group (2.73).
- The smallest ($P<0.05$) albumen weight, the highest shell thickness and percentage were recorded by W/F group. However, albumen percentage, yolk weight, yolk percentage, shell weight, Haugh units and yolk index were not affected by treatments through 19-38 weeks old.
- Groups of W/F recorded lower feed cost per dozen egg than the other experimental groups.
- The experimental treatments revealed no significant effects on nutrients digestibility, except those of ether extract where it was higher being 82.79% in W/C group, while the lowest one recorded by W/F group (71.10%).

Finally, it could be recommended to formulate a layer diet of lower crude protein content (15%) with lysine and methionine supplementation either in feed or drinking water during laying period. This will, in turns, alleviate the higher cost of feed and improve some of laying performance.

Keywords: Methionine, lysine, diet, drinking water, feed utilization, egg production, digestibility, economical efficiency, hen layers

The requirements for maximum egg production and egg weight are mainly controlled by fluctuations in nutrient content which finally affects performance. It is possible to use low-protein in laying hen diets supplemented with methionine, lysine and glycine without any need for animal feed (Goryachko *et al.,* 1985). In this respect, Roland (1980) reported that the protein content in layer diets can be reduced to as low as 11.5% in corn-soy diets containing 0.42% methionine + cystine and 0.52% lysine without adversely affecting egg production. Njoku *et al.* (1987) found that feed efficiency, egg production, egg weight and egg quality measurements did not significantly differ in low protein diet (13.05%) supplemented with 0.3% lysine in a tropical environment compared to the other treatments. Lopez and Leeson (1995) tested 16, 14, 12 or 10% CP supplemented with lysine and methionine and reported that egg shell deformation was not different up to 50 weeks of age. However, the smallest eggs produced by birds fed lower protein diets.

Although there were no significant decrease in each of egg production and egg weight when birds offered low protein diets supplemented with methionine and lysine, birds showed a significant decrease in feed consumption and feed conversion values (Lettner *et al.*, 1989; Harms and Russell, 1993 and Hashish and El-Ghamry, 1998).

Likopa *et al.* (1986) used feed mixture low in protein (14 or 12%) but containing high amounts of lysine and methionine. Control hens were fed on a diet containing 16% CP. Digestibility of protein was 67.6, 67.5 and 60.6% with the 16, 14 and 12% protein diets, respectively. Zander and Gruhn (1989) formulated a basal diet with lysine, methionine and cystine supplements of 60, 120 and 180 gm daily. They found that apparent digestibility of DM, CP, NFE, lysine and methionine plus cystine were 73, 78, 84, 80 and 77% and not influenced by feed intake.

The higher prices of some conventional feedstuffs, particularly soybean meal increased the total cost of poultry production, especially under the desert conditions. Hence, the formulation of lower protein diets supplemented with essential amino acids will contribute to alleviate the total feed cost of poultry nutrition. Therefore, the objective of the present work is to study the effect of adding free amino acids either in water or diet on laying performance and egg quality measurements. Economical evaluation and digestibility coefficients of the experimental diets were also taken into consideration.

MATERIALS AND METHODS

The study was carried out at the Poultry Experimental Station, Faculty of Agriculture, AL-Azhar University, Nasr City, Cairo in order to study the effect of methionine and lysine supplementation either in diet or drinking water for one-phase low protein diet on digestibility as well as egg production during layer period. A total number of 180 H&N pullets of 19^{th} week of age were distributed into nine groups, 20 pullets for treatment, in 5 replicates, 4 birds each and fed on one of laying treatment diets for each group. Hens kept on 16 hours light each day. Experimental treatments during growing and laying periods are shown in fig. (1). Formulation and calculated analysis of the experimental laying diets are shown in table (1). Nutrient requirements were determined according to catalogue of H&N layer hens.

Fig. (1). Design of experiment during growing and laying periods.

Growing: Stage I 0-5 wk CP%	Growing: Stage II 6-15 wk CP%	Growing: Stage III 16-18 wk CP%	Laying: Stage I 19-22 wk CP%	Laying: Stage II 23-26 wk CP%	Laying: Stage III 27-34 wk CP%	Laying: Stage IV (35-38 wk) CP%	
			19	18	17	16	C/C
	C		15	15	15	15	C/F
17	15	14	15	15	15	15	C/W
			19	18	17	16	F/C
	F		15	15	15	15	F/F
14	14	14	15	15	15	15	F/W
			19	18	17	16	W/C
	W		**15**	**15**	**15**	**15**	**W/F**
14	14	14	15	15	15	15	W/W

C Control
F Low protein diets supplemented by methionine and lysine in feed to the level of 120% of needs (F)
W Low protein diets supplemented by methionine and lysine in water to the level of 120% of needs (W)

Data of feed intake, feed conversion, egg production, egg weight, egg quality and mortality rate, age at first egg, age at 10% egg production, age at 50% egg production, age at the peak of production and final body weight were recorded.

Total egg number of hen was calculated as number of eggs divided by number of hens through the laying period. Total egg mass of hen was calculated as weight of egg on number of hens in each treatment.

Rate of egg production was calculated as $E \div (d \times b) \times 100$ (North, 1984)
where, E = egg number, d = number of days, b = No. of birds.

Egg Quality

Total number of 36 eggs from each treatment were used to evaluate egg quality measurements. Specific Gravity was estimated as mentioned by Hamilton (1978). Shape Index were estimated as the ratio of their maximum width to their length by using Vernier Calipers. Yolk Weight and Shell Weight (membrane-less shells) of each egg were recorded. Albumen Weight was calculated by subtracting yolk and shell weight from egg weigh. Yolk, shell and albumen percentage were calculated and their values were transferred to percentages angle according to Snedecor and Cochran, (1980) using the equation: Arcsin = $\sqrt{}$ percentage. Egg weight and albumen height were used to calculate the Haugh units for each individual egg according to Haugh (1937). The ratio of yolk height and diameter were used to determine yolk index, measuring its height by using tripod micrometer reading to the nearest 0.01 cm, while yolk diameter was measured by vernier calipers to nearest mm. Yolk Color was measured by Roche Color Fan. Shell Thickness was measured by using Ames Shell Thickness Gauge.

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

	Control diets				Experimental diets			
Ingredients%	Week	Week	week	week	week	week	week	week
	19-22	23-26	27-34	35-38	19-22	23-26	23-34	35-38
Corn yellow	58.00	61.60	64.90	68.50	69.43	69.55	69.64	69.88
Soybean meal	20.00	17.10	14.10	11.10	11.00	11.00	11.00	11.00
Concentrate a	10.00	10.00	10.00	10.00	8.00	8.00	8.00	8.00
Sunflower oil	2.65	2.00	1.50	0.90	0.90	0.90	0.90	0.90
Calcium carbo.	8.35	8.30	8.50	8.50	8.60	8.60	8.60	8.60
Di calcium pho.	-	-	-	-	0.40	0.40	0.40	0.40
DL-methionine	-	-	-	-	0.36	0.31	0.28	0.12
L-lysine	-	-	-	-	0.31	0.24	0.18	0.10
Vit. B mix b	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vit. AD3E c	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mineral mix. d	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
NaCl	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100
Calculated analysis								
CP %	19.0	18.0	17.0	16.0	15.0	15.0	15.0	15.0
ME (Kcal /kg)	2862	2861	2861	2861	2862	2862	2862	2862
Calcium %	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Av. Phosph. %	0.46	0.46	0.45	0.45	0.45	0.45	0.45	0.45
Met. + Cys. %	0.74	0.71	0.68	0.65	0.89	0.84	0.80	0.75
Lysine %	1.00	0.97	0.88	0.80	1.10	0.98	0.92	0.85

(a) Contains: CP 51%; ME 2400 Kcal /kg; Ca 8%; Av. p. 3.51%; Met. 1.69%; Lys. 3.19%.
(b) Each kg contains B1 20 gm ; B2 4.5 gm ; B6 3 gm ; B12 13 gm ; choline chlorid 100 gm
(c) Each kg contains vit. A 20,000 IU; vit. D3 2000 IU ; vit. E 400 IU; K2 1 gm
(d) Each kg contains Mn 40 gm ; Zn 45 gm ; Cu 3 gm ; Fe 30 gm ; I 0.3 gm ; Se o.1 gm.

Growing feed cost (GFC) per hen was calculated as feed intake per hen during growing period × price of feed. Laying Feed Cost (LFC) per hen was calculated as feed intake per hen during laying period × price of feed. Total Feed Cost (TFC) per hen was calculated as: TFC = (GFC) + (LFC) . Feed cost per dozen egg was calculated as LFC / dozen egg per hen.

Digestion Trial

At the end of 38th week of age, three H&N female birds of each group were transferred to a battery where each bird was kept alone in order to evaluate the experimental diets. Urinary Organic Matter (UOM) was calculated according to Abou-Raya and Galal (1971), while, fecal nitrogen (UN) was determined by method of trichloro acetic acid (Jakobsen et al, 1960). Metabolizable energy (ME) and Productive energy were evaluated according to Titus and Fritz (1971). Chemical analysis of moisture, crude protein, crude fiber, ether extract and ash were determined as described in Association of Official Analytical Chemists (A. O. A. C., 1990).

Statistical Analysis

Analysis of variance was carried out according to Snedecor and Cochran (1980). When significant differences were found, means comparison were made by Duncan's multiple range test (SAS, 1988).

Two main effects were studied, effect of growing treatments and effect of laying treatments. So the linear model was as follows:

$$Yijk = \mu + G_i + L_j + (GL)_{ij} + e_{ijk}$$

where:

Y_{ijk} = The observation on the k^{th} bird in the i th experimental growing treatment and in the j^{th} experimental laying treatment

μ = An effect common to all birds.

G_i = Effect to all birds given i^{th} experimental growing treatment.

L_i = Effect to all birds given j^{th} experimental laying treatment.

$(GL)_{ij}$ = Effect particular to i^{th} growing treatment and j^{th} laying treatment.

e_{ijk} = A randomized error of all the unidentified factor that may affect the dependent variables and not included in the model.

RESULTS AND DISCUSSION

Effects on Body Weight and Laying Performance

Table (2) cleared that birds of group F/C and F/W matured sexually early, while birds of group W/C and W/W matured sexually later on. The differences among the experimental groups in age at first egg were clear with wide range of 9 days, dropped at 10% egg production to be 6 days, farther more these differences at 50% egg production was become 5 days only. This result agreed with the findings of Maurice *et al.* (1982) and Okazaki *et al.* (1995). The lowest final body weight was attained by F/F group (1.696 kg), while control group (C/C) attained highest final body weight (1.889 kg).

Disappearance of changes among averages live body weights of chicks during laying period until 38 weeks of age as affected by dietary protein regime and amino acid supplementation in present study may due to both positive effect of crystalline amino acids supplementation and negative effects of decreasing protein level in the diet on live body weights. However, Lopez and Leeson (1995) obtained smaller body weight gains of laying hens when protein in diet decreased, while Calderon and Jensen (1990) found that body weight of laying hens increased as dietary methionine and lysine increased.

Results of mortality rate during laying period were found to be 0.0% for control group and F/F group, while the other groups lost one bird for each group. Result of no mortality rate in C/C and F/F groups are in agreement with those found by Kociova *et al.* (1989) and Petersen (1993) who concluded that low protein supplemented diet had no effect on mortality.

Average egg number as affected by protein and amino acids program are presented in table (2). Best egg number was attain by W/F group (105.6 egg/hen), while control group C/C was better (104.5 egg/hen) than the other groups. Groups of C/F and F/F showed the lowest egg number per hen. This mean that birds grown on one- phase low protein supplemented with methionine and lysine in water laid more egg than the control or the other experimental groups. This result suggests physiological alterations in W/F birds or may due to the heavier body weight of these birds at 18 weeks of age. However, Proudfoot and Hulan (1986) found that reverse protein Juvenile dietary regime may support adult performance that equal or surpass the performance of birds reared on conventional dietary program. Cheng *et al.* (1991) found also that birds with heavier weight at 20 weeks of age had better laying performance than birds with lighter body weight.

The highest rate of egg production attained by W/F group (75.26%) followed by control group (74.56%) during 19-38 weeks of age, while the lowest attained by C/F (61.18%) and F/F (61.69%).

Total egg mass as shown in table (2) followed the same trend of egg production rate and egg number, but group W/F which laid eggs (105.6) more than control (104.5) attained egg mass (5.959 Kg/hen) slightly less than control (6.111 Kg/hen), that surely due to decrease egg weight of W/F group.

Average egg weight throughout the experimental period (19-38 weeks of age) laid by control and W/C groups were similar and significantly higher ($P<0.05$) than that laid by groups of W/F, F/W and W/W. The lowest egg weight was recorded by F/F group.

Feed Consumption and Feed Conversion

Average amount of feed consumed and feed conversion of hens during laying period (19-38 weeks old) as affected by protein treatments are shown in table (2). Clearly, birds in group F/F ate less feed than control group, excepting W/F group which consumed the largest amount of feed. However, this group recorded the highest values in total number of eggs, average rate of egg production and also a higher value in peak of egg production in comparing to the other experimental groups.

The result of increasing feed intake in group W/F was in agreement with those found by Sell and Johnson (1974) who reported that feed intake increased as lysine level increased. While the results of decreasing feed intake of other groups compared to control one were in agreement with those found by Skrivan (1988) and Wideman *et al.* (1994) who reported that feed intake decreased with low protein supplemented diet.

During 19-38 weeks of age control group and F/C group attained the best value(2.43) of feed conversion, while group C/F recorded the worst value (2.75) followed with ascending order by F/F group (2.73).

Egg Quality Measurements

Egg quality measurements as affected by the experimental groups are shown in table (3). Specific gravity, yolk weight, Haugh unit and yolk index was not significantly influenced by the experimental treatments. This result was previously confirmed by Kociova *et al.* (1989) and Okazaki *et al.* (1994) and disagreed with Mohamed (1994) who concluded that increasing CP level in laying rations improved significantly egg yolk percentage.

Shape index showed significantly ($P<0.05$) differences among treatments. Through 19-38 weeks old, shape index found to be 0.782, 0.800, 0.768, 0.782, 0.783, 0.786, 0.780, 0.784 and 0.782 for groups C/C, F/C, W/C, C/F, F/F, W/F, C/W, F/W and W/W, respectively.

Large number implies a more circular shape, while small number imply a more rectangular shape. However, group of F/C attained the highest shape index number (0.800), while group of W/C recorded the lowest one (0.768).

Through 19-38 weeks old, statistical evaluation indicated that differences among albumen weight means were significant ($P<0.05$). W/F group recorded the lowest albumen weight (37.04 gm), while F/W group attained the highest albumen weight (39.52). It can be easily seen the connection between albumen weight and egg weight since group of W/F recorded the lowest albumen weight and the lowest egg weight. Also group of F/W recorded the highest albumen weight and the highest egg weight. These results were in agreement with those of Lopez and Leeson (1995) who reported that the smaller eggs produced by birds fed the lower protein diet had less albumen and this may be due to being less protein. Mohamed (1994), on the other hand found no significant effects on albumen weights when he used different levels of protein.

TABLE (2). Effect of protein and amino acids feeding programs of H&N hens on laying house performance

Measurement	Treatments								
	C/C	F/C	W/C	C/F	F/F	W/F	C/W	F/W	W/W
Body weight at 18 weeks of age, kg	a 1.580	b 1.415	ab 1.504	ab 1.500	ab 1.466	ab 1.495	ab 1.522	ab 1.517	a 1.571
Final body weight at 38 week, kg	a 1.889	bc 1.731	abc 1.805	bc 1.732	c 1.696	ab 1.826	bc 1.771	bc 1.763	abc 1.777
Age at first egg production (day)	130	125	134	132	130	129	132	125	134
Age at 10 % egg production (day)	133	134	136	137	132	138	135	133	137
Age at 50 % egg production (day)	155	155	153	157	155	154	156	154	152
Age at peak of production (day)	242	200	228	228	235	200	221	221	256
Total number of egg / hen	104.5	98.4	94.7	85.7	86.4	105.6	91.6	94.1	96.8
Average rate of egg production (%)	74.56	69.98	67.58	61.18	61.69	75.26	65.37	67.15	68.94
Peak of egg production (%)	95	94	91	90	95	98	87	89	90
Egg mass kg / hen	6.111	5.737	5.539	4.852	4.692	5.959	5.267	5.269	5.455
Average egg weight (gm)	a 58.0	abc 57.4	a 58.0	cd 56.3	d 55.8	bcd 56.5	ab 57.5	d 56.2	bcd 56.5
Total feed intake (19-38 wk) kg/hen	14.850	13.941	14.734	13.343	12.809	15.732	13.905	13.488	14.619
Feed /egg conversion kg / kg	2.43	2.43	2.66	2.75	2.73	2.64	2.64	2.56	2.68
Mortality number	0	1	1	1	0	1	1	1	1
Mortality rate (%)	0	4.8	4.8	4.6	0	4.8	4.8	4.8	5.0

C = Control F = Supplement in feed W = Supplement in water

a, b…. Means in row with the same letter are not significantly different (P<0.05).

TABLE (3). TABLE (2). The variations in egg quality of H&N hens through 19-38 weeks old as affected by dietary protein and amino acids programs during growing and laying period

Treatments	Egg weight	Specific gravity	Shape index	Albumen weight		Yolk Weight		Shell Weight		Haugh Unit	Yolk index	Yolk color	Sell thickness m m
				gm	%	gm	%	gm	%				
C/C	a 57.56	a 1.0851	cb 0.782	ab 38.50	a 66.94	a 13.52	a 23.41	a 5.54	ab 9.66	a 91.5	a 0.491	b 5.7	ab 0.378
F/C	a 57.61	a 1.0846	a 0.800	ab 38.44	a 66.61	a 13.67	a 23.80	a 5.50	ab 9.59	a 94.6	a 0.490	ab 6.3	ab 0.375
W/C	a 57.34	a 1.0843	c 0.768	ab 38.56	a 67.27	a 13.36	a 23.27	a 5.42	b 9.46	a 91.9	a 0.489	ab 6.4	b 0.365
C/F	a 56.56	a 1.0862	bc 0.782	ab 37.78	a 66.81	a 13.28	a 23.42	a 5.50	ab 9.77	a 92.8	a 0.495	a 6.7	ab 0.380
F/F	a 56.54	a 1.0839	b 0.783	ab 37.94	a 67.08	a 13.20	a 23.31	a 5.40	ab 9.61	a 90.8	a 0.492	ab 6.5	b 0.373
W/F	a 55.98	a 1.0864	b 0.786	b 37.04	a 66.13	a 13.32	a 23.77	a 5.62	a 10.10	a 90.3	a 0.496	ab 6.4	a 0.393
C/W	a 57.38	a 1.0846	bc 0.780	ab 38.41	a 66.95	a 13.49	a 23.47	a 5.48	ab 9.58	a 94.5	a 0.503	a 6.8	b 0.372
F/W	a 58.68	a 1.0828	b 0.784	a 39.52	a 67.30	a 13.60	a 23.18	a 5.56	b 9.52	a 94.2	a 0.500	a 7.0	ab 0.374
W/W	a 57.09	a 1.0831	bc 0.782	ab 38.35	a 67.17	a 13.32	a 23.32	a 5.42	b 9.51	a 90.5	a 0.489	a 6.7	b 0.373

C = Control F = Supplement in feed W = Supplement in water

a, b…. Means in row with the same letter are not significantly different ($P<0.05$).

Yolk colour means significantly (P<0.05) influenced by the experimental treatments. Control group recorded the lowest yolk colour (5.7) while the highest yolk colour attained by F/W group (7.0) as shown in table (3). This mean that low protein diets supplemented with methionine and lysine either in feed or in drinking water resulted in a better yolk colour than the control group. This may be due to the decreasing of soybean meal in low protein diets (Table 1). However, North (1984) reported that certain ingredients like soybean meal reduced the density of yolk colour possibly related to decreasing absorbability of xanthophylls. In the same way Al-Bustany and Elwinger (1987) reported that yolk colour significantly affected by treatments.

Through 19-38 weeks old, analysis of variance indicated that differences among shell percentage and shell thickness (Table 3) were significant (P<0.05). In this connection W/F showed the highest values for the same traits compared to the other experimental groups. The result of increasing shell percentage of W/F group disagreed with Skrivan (1988) and Okazaki *et al.* (1994). The significant increase of shell thickness in the present study (Table 3) was previously confirmed by Mohamed (1994) who found that low protein diets supplemented with amino acids resulted in increasing shell thickness. On the other hand, Okazaki *et al.* (1994) reported that shell thickness were significantly decreased by low protein diet supplemented by methionine and lysine, while, Keshavarz and Jackson (1992) reported that shell thickness were not affected significantly by diets.

Digestibility of Experimental Diets

The average values of digestion coefficients in the experimental treatments including crude protein, crude fibres, NFE, organic matter and dry matter were not significant (Table 4). Also there were no real differences among metabolizable energy and productive energy. Digestibility of ether extract was the only one which significantly (P<0.05) influenced by the experimental treatments, where it was higher as 82.79% in W/C group and lower as 71.10% in W/F group. However, these results partially disagreed with the finding of Likopa *et al.* (1986) who reported that low protein diet supplemented with methionine and lysine resulted in decreasing protein digestibility. On the other hand, Gruhn and Zander (1989) did not found differences among digestibility of CP, but ther reported that digestibility of DM and NFE decreased with increasing CP intake.

Economic Evaluation

Results presented in table (5) showed that growing feed costs as affected by dietary protein programs were low in all tested treatments than control. The lowest growing feed costs was done in group F/F, F/C and F/W which received low protein level with methionine and lysine in feed. The lowest feed costs was noticed in group W/F (1.839 pound per dozen eggs/ hen) followed in ascending order by group F/C compared to control group. It must be reported that the lowest feed cost attained by W/F group (92.6) which revealed at the same time the highest egg production rate as well. These results agreed with the findings of Proudfoot and Hulan (1986), Kociova *et al.* (1989) and Mohamed (1994) who reported that feed costs were decreased when birds fed a low protein diet supplemented by methionine and lysine.

TABLE (4). Digestion coefficients of nutrients and energy values of diets as affected by dietary protein and amino acids programs during laying periods.

Items	Treatments								
	C/C	F/C	W/C	C/F	F/F	W/F	C/W	F/W	W/W
CP %	92.06 a	89.56 a	92.39 a	90.62 a	91.03 a	90.48 a	90.95 a	90.08 a	90.89 a
EE %	84.58 a	79.68 ab	82.79 a	77.88 ab	81.04 ab	71.10 b	77.40 ab	78.29 ab	79.44 ab
CF %	24.99 a	22.75 a	22.21 a	24.12 a	25.45 a	24.74 a	21.77 a	22.02 a	21.82 a
NFE %	81.53 a	78.19 a	81.69 a	80.55 a	80.97 a	79.02 a	79.41 a	79.67 a	80.87 a
OM %	81.69 a	78.52 a	81.44 a	80.33 a	80.87 a	77.81 a	79.69 a	79.75 a	80.80 a
DM %	76.91 a	72.91 a	76.43 a	72.84 a	75.82 a	73.20 a	73.72 a	76.62 a	76.29 a
ME kcal/kg	2944 a	2828 a	2950 a	2899 a	2923 a	2840 a	2846 a	2846 a	2885 a
PE kcal/kg	2093 a	2010 a	2093 a	2095 a	2075 a	2016 a	2020 a	2022 a	2050 a

a, b,... Means in row with the same letter are not significantly different ($P<0.05$).

TABLE (5). Economic evaluation of egg production of H&N hens as affected by dietary protein and amino acids programs during growing and laying periods.

Measurements	Treatments								
	C/C	F/C	W/C	C/F	F/F	W/F	C/W	F/W	W/W
Growing feed cost, LE/hen	6.739	6.029	6.341	6.539	5.855	6.614	6.604	6.076	6.635
Relative feed cost , LE /hen	100	89.5	94.1	97.0	86.9	98.1	98.0	90.2	98.5
Laying feed cost, LE / hen	17.307	15.299	16.751	15.631	14.506	16.185	15.564	16.514	16.343
Total feed cost, LE/hen	24.046	21.328	23.092	22.170	20.364	22.799	22.168	22.590	22.978
Egg production, dozen / hen*	8.708	8.200	7.892	7.142	7.200	8.800	7.633	7.842	8.067
Feed cost / dozen egg / hen	1.987	1.866	2.123	2.189	2.015	1.839	2.039	2.106	2.026
Relative feed cost / dozen egg / hen	100	93.9	106.8	110.2	101.4	92.6	102.6	106.0	102.0

C = Control F = Supplement in feed W = Supplement in water

*Calculated using egg mass and average egg weight and divided by 12.

CONCLUSION

From the nutritional viewpoint, it could be recommended to formulate a layer diet of lower crude protein content (15%) with lysine and methionine supplementation either in feed or drinking water during laying period without detrimental effects on laying performance. The lower protein diets will be of economic value, particularly under the desert and newly reclaimed areas in an attempt to alleviate the higher feeding cost of poultry diets in those regions.

REFERENCES

Abou-Raya, A. K. and A. G. H. Galal (1971). Evaluation of poultry feeds in digestion trials with reference to some factors involved. *U. A. R.* J. Anim. Prod., 11 (1) : 207-221.

AL-Bustany, Z. and K. Elwinger (1987). Comparison between barley / fish meal-and maize / soybean meal-based diets with various lysine and protein levels fed to different strains of laying hens. *Acta Agriculturae Scandinavica*, 37 (1): 41-49.

A.O.A.C. Association of Official Analytical Chemists (1990). In "*Official methods of analysis*".13th ed., pub. by the A.O.A.C. Benjamin Franklin Station, Washington D. C., U.S.A.

Calderon, V. M. and L. S. Jensen (1990). The requirement for sulfur amino acid by laying hens as influenced by the protein concentration. *Poultry Science*, 69(6): 934-944.

Cheng, T. K.; A. Peguri; M. L. Hamre and C. N. Coon (1991). Effect of rearing regimens on pullet growth and subsequent laying performance. *Poultry Science*, 70 (4): 907-916.

Goryachko, N. T.; T. E. Gushcha; I. V. Vydritskaya and L. S. Potapovich (1985). Used of crystalline amino acids in feeding laying hens. *Pitaniya Sel'skokhozyaistvennykh Zhivotny-kh.*, 31: 102-106.

Gruhn, K. and R. Zander (1989). Investigations on the influence of graded levels of soyabean oilmeal on the apparent digestibility of crude nutrients and amino acids in colostomized laying hens. *Archives of Animal Nutrition*, 39 : 112, 123- 130.

Hamilton, R.M.G. (1978). The effect of dietary protein level on productive performance and egg quality of four strains of white Leghorn hens. *Poultry Science*, 57: 1355-1364.

Harms, R. H. and G. B. Russell (1993). Optimizing egg mass with amino acid supplementation of a low-protein diet. *Poultry Science*, 72 (10): 1882-1896.

Hashish, Samia M. and A. A. El-Ghamry (1998). Substitution of yellow corn by sorghum in layer ration and the effect of methionine and Kemzyme supplementation on hen performance and egg quality. *Egypt. Poult. Sci.* , 18 (11): 241-253.

Haugh, R.M.A. (1937): The haugh units for measuring egg quality. *Poultry Magazine*, 43: 552.

Jakobsen, P. E.; K. Grtov and S. H. Nilson (1960). Frdjeli-gheds frogmed fierbae. Digestibility trail with poultry. *Bereting fra forsogslaboratoriet, Kobenhaven*, 56: 1

Keshavarz, K. and M. E. Jackson (1992). Performance of growing pullets and laying hens fed low-protein, amino acid supplemented diets. *Poultry Science*, 71: 905-918.

Kociova, Z.; S. Koci and T. Werthemer (1989). Supplementary DL-methionine in the diet of layers during their low-protein phase of nutrition. Hydinarstvo, Vedecke Pr-ace Vyskummeho Ustavu chovu a SL'achtenia Hydiny v Ivanke pri Dunaji, 24: 5-11.

Lettner, F.; F. Preining and W. Wetscherek (1989). Use of methionine in the ration for laying hens. *Bodenkultur*, 40(3): 243-250.

Likopa, M.; I. Vitinya and A. Erte (1986). Levels of amino acids and calcium in low-protein feed mixtures for hens. *Ptitsevodstvo*, 8: 22-24.

Lopez, G. and S. Leeson (1995). Response of broiler breeders to low-protein diets. 1. Adult breeder performance. *Poultry Science*, 74 (4): 685-695.

Maurice, D. V.; B. L. Hughes; J. E. Jones and J. M. Weber (1982). The effect of reverse protein and low protein feeding regimens in the rearing period on pullet growth, subsequent performance, and liver and abdomi-nal fat at end of lay. *Poultry Science*, 61: 2421-2429. (Cited in Proudfoot and Hulan, 1986)

Mohamed, O. M. A. (1994). Effect of supplementing plant protein ration with DL-methionine and lysine on performance of laying hens. *M.Sc. Thesis*, Fac. Agric., Al-Azhar Univ., Cairo, Egypt.

Njoku, P. C.; C. A. Odukwe; S. O. Ogunsola and A. O. Aduku (1987). The lysine requirement of 16-month old laying exotic chickens fed low protein practical diets in a tropical environment. *Journal of Animal Production Research,* 7(2): 167-175.

North, M. (1984). In "*Commercial Chicken Production Manual*". 3rd Edition, the AVI publishing company, INC. West port connecticut.

Okazaki, Y.; A. Fukasawa; S. Adachi; R. Ohishi and T. Ishibashi (1995). Effect of phase feeding of amino acid on performance of laying hens during laying period. *Japanese Poultry Science*, 32(1): 12-25.

Okazaki, Y.; A. Fukasawa; S. Adachi; R. Ohishi and T. Ish-ibashi (1994). Amino acid requirements and timing for shift of diets for effective phase feeding of laying hens. *Japanese Poultry Science*, 31(1): 28-37.

Petersen, V. E. (1993). Requirement for high-producing hens for lysine and methionine combined with reduced protein content in diets. *Forskningsrapport fra Statens Hus- dybr-ugsforsong*. No. 6, 19 pp.

Proudfoot, F. G. and H. W. Hulan (1986). Effect of modified conventional and reverse protein rearing dietary regimens on the performance of Leghorn hens. *Poultry Science*, 65: 2090-2097.

Roland, D. A. SR. (1980). Egg shell quality. 1. Effect of dietary manipulations of protein, amino acids, Energy, and calcium in aged hens on egg weight, shell weight, shell quality and egg production. *Poultry Science*, 59: 2038-2046.

SAS (1988). SAS/State User's guide 6-03 ed., SAS institute inc., Cary NC., USA.

Sell, J. L. and R. L. Johnson (1974). Low protein rations based on wheat and soybean meal or corn and soy-bean meal for laying hens. *Poultry Science,* 53: 43- 49.

Skrivan, M. (1988). Performance of hybrid layers on low-protein diet supplemented with methionine. *Veterinaria*. 24(5): 399-405.

Snedecor, G.W. and W.G. Cochran (1980). In "*Statistical methods*", Iowa State Univ. Press, Iowa, U.S.A.

Titus, H. W. and J. C. Fritz (1971). In "*The Scientific feeding of chickens*". The interstate primeter and publisher INC. Danville, Illonis, USA.

Wideman, R. F.; B. C. Ford; J. J. Dobner; W. W. Robey and A. G. Yersin (1994). Responses of laying hens to diets containing up to 2 %

DL-methionine or equimolar (2.25%) 2-hydroxy-4-(methylthio) butanoic acid. *Poultry Science*, 73 (2): 259-267.

Zander, R. and K. Gruhn (1989). The influence of the level of feed intake on the apparent digestibility of crude nutrients and amino acid in broiler brhens. *Archiv fur Geflugelkunde,* 53(5): 207-209.

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التدعيم بالميثيونين والليسين في العليقة أو ماء الشرب لنظام التغذية على مستوى واحد من البروتين المنخفض في الدجاج البياض
٢- التأثير على معدل إنتاج البيض، الاستفادة الغذائية، صفات البيضة ومعاملات الهضم في الدجاج البياض

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أجريت هذه التجربة لدراسة تأثير الدعم بالميثايونين والليسين إلى مستوى ١٢٠% من الاحتياجات في العليقة (F) أو ماء الشرب (W) لنظام التغذية على مستوى واحد منخفض من البروتين في الدجاج البياض وتأثير ذلك على معدل إنتاج البيض، الاستفادة الغذائية، صفات البيضة ومعاملات هضم المركبات الغذائية. استخدم في هذا البحث عدد ١٨٠ دجاجة بياضة عمر ١٩ أسبوع من سلالة H & N حيث قسمت إلى ٩ مجموعات تجريبية، اشتملت كل مجموعة على ٢٠ طائر وزعت في ٥ مكررات واشتملت كل مكررة على ٤ طيور وكانت المجموعات هي: C/C, F/C, W/C, C/F, F/F, W/F, C/W, F/W, W/W. احتوت عليقة المقارنة أثناء الإنتاج على ١٩، ١٨، ١٧، ١٦% بروتين حسب احتياجات السلالة خلال مراحل الإنتاج المختلفة، بينما احتوت عليقة (F) أو عليقة (W) على مستوى واحد من البروتين هو ١٥% مع الدعم بالميثايونين والليسين إلى ١٢٠% من الاحتياجات في العليقه أو ماء الشرب. كما تساوت جميع العلائق فى محتواها من الطاقة الممثلة (٢٨٦٢ ك كالورى / كجم).

- حققت مجموعة F/F أقل وزن نهائي (١,٦٩٦ كجم) بينما حققت مجموعة C/C أثقل وزن نهائي (١,٨٨٩ كجم) وكان الفارق معنوياً.
- سجلت طيور مجموعة W/F عدد بيض (١٠٥,٦بيضة/ طائر) وأيضا معدل إنتاج بيض (٧٥,٢٦%) أفضل من المجاميع التجريبية الأخرى، بينما سجلت أعلى كتلة بيض (كجم بيض/ دجاجة) بواسطة مجموعة الكنترول (٦,١١١) يتلوها مجموعة W/F (٥,٩٥٩) بينما أقل كتلة بيض سجلت بواسطة مجموعة F/F (٤,٨٤٤) يليها مجموعة C/F (٤,٨٥٢).
- سجل أعلى متوسط وزن بيضة (٥٨جم) بواسطة مجموعةC/C يليها مجموعة W/C (٥٧,٥ جم) بينما أقل متوسط وزن بيضة سجل بواسطة مجموعة F/F (٥٥,٨ جم) يتلوها مجموعة F/W (٥٦,٢ جم).
- استهلكت مجموعة W/F أكبر كمية من العلف (١١١,٩ جم/ طائر/ يوم) يتلوها مجموعةC/C (١٠٦,١جم/ طائر/ يوم) بينما استهلكت مجموعة F/F أقل كمية من العلف (٩٣,٧ جم/ طائر/ يوم) يتلوها مجموعة C/F (٩٦,٥ جم/ طائر/ يوم).
- سجلت مجموعتى F/C, C/C أفضل معدل تحويل (غذاء/ بيض) وكان ٢,٤٣ وأسوء معدل تحويل سُجل بواسطة مجموعة C/F (٢,٧٥) يتلوها مجموعة F/F (٢,٧٣).
- سجل أقل وزن ألبيومين بواسطة مجموعة W/F (٣٧,٠٤ جم) وهى ذات المجوعة التى سجلت أعلى نسبة وسمك لقشرة البيضة وعلى أية حال لم تؤثر المعاملات معنويا على نسبة الألبيومين ، وزن الصفار ، نسبة الصفار ، وزن القشرة ، وحدات هيو ومعامل الصفار.

- كانت تكلفة التغذية لإنتاج دستة بيض أقل في مجموعة W/F بالمقارنة ببقيـة المجـاميع الأخرى.
- لم تؤثر المعاملات الغذائية معنويا على معاملات الهضم باستثناء معامل هضم الدهن والذي سجل أعلى قيمة له في مجموعة الكنترول وأقل قيمة في مجموعة W/F .

مما سبق فانه يوصى بعمل توليفة علفية للدجاج البياض منخفضة في نسـبة البـروتين (١٥%) مع اضافة كل من الليسين والميثيونين إلى العليقة أو مياه الشرب الأمر الذي يقلـل مـن تكلفة العليقة وحسن أيضا من بعض صفات البيض.