EFFECT OF COMPLETE DIETARY REPLACEMENT OF SOYBEAN MEAL WITH SOME PLANT PROTEIN SOURCES ON LAYING HENS PERFORMANCE

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Abstract

A total of 180 Mamoura chickens (162- hens and 18 cocks) 24 weeks old were randomly devided into 6 triplicate groups (10 birds x 3 replicates x 6 treatments) each replicate contains one cock and nine hens. They were reared in conventional floor brooder houses under similar management conditions and fed on the experimental diets for 24 weeks experimental period. Six experimental diets were formulated in which the frist (T1) contained soybean meal (SBM) and yellow corn (YC) as the main sources of protein and energy, respectivly, and served as a control diet. In the other diets SBM in T1 was completely replaced by either cotton seed meal (CSM-T2) , corn glutin meal (CGM-T3), sesame seed meal (SSM-T4), molasses grown yeast (MGY-T5) or a mixture of them (MIX-T6). All diets, were adjusted to be iso-nitrogenous of about 16 % CP and iso-caloric of a bout 2800 Kcal ME/Kg. Laying hen performance, egg quality, fertility and hatchability were measured. A metabolism trial was also carried out to determine the nutrient digestibilities and metabolizabilities of the exprimental diets. Some blood constituents were also measured.

The obtained results showed significant differences among treatments in the averages of body weight, weight gain, egg production, egg mass and feed conversion, whereas, egg weight and feed intake values were not significantly different. The general descending ranking order of the performance data was T1 followed by T3, T6, T2, T5 and T4, respectively. Significant differences were also found in fertility, hatchability and embryonic mortality. The general statistical trend was such as that of the performance data. Once again, significant differences were detected between treatments in nutrient digestibilities and metabolizabilities, egg quality and some blood constituents. From the economic point of view, T1 recorded the best economic efficiency followed by T5, T6, T2, T3 and T4, respectively, in a descending ranking order. In conclusion, when the performance of laying hens are put into consideration, in addition to the economic efficiency, it appeared that the inclusion of MGY or CSM to completely replace of SBM in laying hen diets is economically effective. A combination of all plant protein sources as in MIX-diet (T6) could be occasionally used to solve a part of SBM shortage.

INTRODUCTION

Although soybean meal (SBM) is the most important source of protein in feeding livestocks, nevertheless, there are some other alternative plant protein sources such as cotton seed meal (CSM), corn glutin meal (CGM) , sesame seed meal (SSM) , linseed meal (LSM) , coconut meal, rapseed meal, sunflower meal, molasses grown yeast (MGY) and others. The nutritional values of such plant protein sources vary according to their contents of amino asids and whether or not they contain anti-nutritional factors.

In Egypt, it is still difficult to produce sufficient amounts of soybean, the common protein source, due to the very limited cultivable areas. On the other hand, the importation of SBM is very expensive due to the increase in its price from time to time owing to its universal use. This is the main reason in raising feed costs, and hence, the final product poultry, i. e. meat and egg .

The use of CSM in laying hen diets in Greece is illustrated in studies conducted by Tserbene *et al.* (1987), using Harco SL hens. The birds were given diets of 100 % SBM, 75% SBM and 25 % CSM, 35 % SBM and 65 % CSM or 100 % CSM. They found that mean body weight, weight gain, number of eggs/hen, total egg production, egg weight, hen mortality, shell quality, Hough unit and yolk colour were not affected by diet, but, they observed that feed intake and feed conversion ratio were influenced by the diet.

Castanon *et al.* (1990) reported that a proportion of 25 % CGM or less can be included in a layer diet without affecting egg production detrimentally. Mohamed (1992) reported that the poor quality CGM was corrected by supplementation with lysine at the level of 0.50 % thereby, was comparable to those of fish meal and SBM.

Cheva and Tangtaweewipat (1993) showed that SSM could substitute SBM at a level of 50 % in layer rations without any statistically adverse effect on egg production, feed intake, body weight gain, average egg weight or egg size. Mamputu and Buhr (1995) found that SSM is not suitable for a complete substitution for SBM in poultry diets.

Ashraf (1983) reported that yeast (single-cell protein) was substituted for .0, 33, 66 or 100 % of dietary soya protein. No significant differences were found in egg production or hatchability, but slightly reduced fertility. Flors *et al.* (1993) concluded that MGY can be included in diets of broilers and layers up to 10 % without causing problemes for their performance.

The main purpose of this work is to study the possibility of using some selected plant protein sources (CSM, CGM, SSM and MGY) each alone or in combination to replace SBM in rations for laying hens, and the effect of such replacement on layer performance.

MATRIALS AND METHODS

The experimental work of the present study was carried out at EL-Serw Animal Production Research Farm, Animal Production Research Institute, ARC, Egypt.

A total of 180 Mamoura chickens (162 hens and 18 cocks) 24 weeks of age were randomly divided into 6 triplicate groups (10 birds X 3 replicates X 6 tretments), each replicate contains a cock and nine hens. They were reared in conventional floor brooder houses and fed on the experimental diets for 24 weeks experimental period. Six experimental diets were formulated (Table 1) in which the first contained mainly SBM and YC as sources of protein and energy, respectively, and served as control diet (T1) . In the other diets SBM in T1 was completely replaced by either CSM (T2) , CGM (T3) , SSM (T4) , MGY (T5) or a mixture from equal amounts of them (MIX,T6). All diets were adjusted nutritionally to be iso-nitrogenous of about 16 % CP and iso-caloric of about 2800 Kcal/Kg diet. Feed and water were offered *ad.lib.* and lighting durated for 16 h/daily. All birds were kept under strict hygienic control by veterinarian throughout the experiment.

Data on body weight (BW), weight gain (WG), egg production (EP), feed intake (FI), egg weight (EW), egg mass (EM) and feed conversion (FC) were recorded. An economic study was carried out to deduce the economic use of the experimental diets for egg production. At 32 weeks of age, a total of 108 eggs, i. e. 18 eggs from each treatment, was taken to determine some egg quality parameters as described in-details by Hussien (1998). At 44 weeks of age, a total of 648 eggs, i.e. 108 eggs from each treatment, was collected in order to evaluate fertility, hatchability and embryonic mortality at 18 and 21 days of incubation. At the end of the experiment, 6 metabolism trials were carried out using 3 cocks from each treatment to estimate nutrient digestibilities, metabolizabilities and feeding values of the experimental diets.

The chemical analysis of the experimental diets, excreta and the edible parts of fresh eggs were carried out according to A. O. A. C. (1980) , while, the method of Jakobsen *et al.* (1960) was used for separating fecal protein in excreta samples. Statistical analysis was carried out using the general model program of SAS (1990) .

RESULTS AND DISCUSSION

Laying hen performance results of laying hen performance are summarized in Table 2. All treatments commenced with hens of similar initial body weight at 24 weeks of age, while, at the end of the experimental period (at 48 weeks of age) the BW of hens was significantly influenced by dietary treatments. Birds of the control group (T1) significantly surpassed all groups and had the heaviest BW (2167g), while, the birds fed on diets containing either CGM (T3), MIX (T6), CSM (T2) or MGY (T5) achieved average BW of 1979, 1973, 1958 and 1942g, respectively, with no significant differences within them. Although the birds of SSM-diet (T4) had the lightest BW (1902 g), nevertheless, it did not significantly differ from those of T2 and T5. The same trend was observed with WG. Concerning EP, it was noticed that the control group (T1) significantly resulted in the highest rate of EP, while, no significant differences were observed among groups of hens of T2, T3 and T6 or among T2, T5 and T6. Inspite of the absence of significant differences between T5 and T4, the birds fed on SSM-diet (T4) gave the lowest EP value.

No significant differences were detected between all treatments in either EW or FI parameters. Also, no significant differences were observed in EM among T1, T3 and T6 and among T2, T3, T5, T6 and T4 which gave the lightest EM value.

Regarding FC, except the group of SBM-diet (T1) which recorded significantly ($P \leq 0.05$) the best value, all other treatments revealed insignificant differences resulting poorer values than the control group.

Fertility, hatchability and embryonic mortality data of fertility, hatchability and embryonic mortality on 18^{th} and 21^{st} days of incubation are presented in Table 3. With the exception of T1 which significantly ($P \leq 0.05$) recorded the highest fertility percentage, no significant differences were detected among all other treatments.

Regarding the hatchability of fertile eggs, there were significant differences among dietary treatments, also, T1 recorded the highest value followed by those of T6, T3, T5, T4 and T2, respectively.

The embryonic mortality of the incubated eggs on 18^{th} day of incubation showed that T2 and T4 recorded significantly the highest rates, and those of T1 recorded the lowest rate, while results of T3, T5 and T6 recorded intermediate values.

On the 21^{st} day of incubation, also T2 and T4 recorded significantly higher embryonic mortality rate than all other treatments in which there were no significant differences among them.

Nutrient digestibility and metabolizability as shown in Table 4, no significant differences were observed among the dietary treatments in DM balance, metabolizability of ash and dry matter retention. There were significant differences in nitrogen and EE retention, and digestion coefficient of CP. SBM-diet gave the highest values of N-retention and utilization of EE and digestibility of CP, but, it did not significantly differ from nutrient metabolizability and digestibility values achieved with CGM-diet (T3) or MIX-diet (T6), followed by those obtained with diets containing CSM (T2), MGY (T5) and SSM (T4) in a descending ranking order, respectively; taking in consideration that the lowest values were obtained with SSM-diet. Also, there were significant differences in metabolizability of NFE and in digestibility of OM since the group of T1 (SBM-diet) exhibited the best values followed by those of T3 (CGM) , T6 (MIX),T4 (SSM),T2 (CSM) and T5 (MGY) ,respectively.

Egg quality data of egg weight, shell weight, yolk weight, egg shape index, Haugh unit, shell thickness and specific gravity among all dietary treatments (Table 5) revealed no significant differences. On the other hand, yolk colour of eggs from the hens fed on CGM-diet (T3) recorded significantly the highest score followed by those from hens fed on diets containing either MIX (T6) , CSM (T2) ,MGY (T5) or SBM (T1) with no significant differences among them, while the lowest score of yolk colour was attained with eggs produced from hens fed on SSM-diet. Concerning the chemical composition of the edible parts of eggs (Table 6) , also, no significant differences were detected among all dietary treatments.

Blood constituents With the exception of some significant differences which were observed in blood hemoglobin and plasma calcium and phosphorus (Table7) there were no significant differences among all dietary treatments in levels of total plasma protein, total lipids, plasma glucose, cholesterol and hematocrit values. However, there was such a trend in plasma cholestrol with MGY and SSM treatments. These treatments reduced the values by 17.94 and 11.90 % as compared to the control.

Economic efficiency data on the economic efficiency (Table 8) revealed that the control diet group (T1) exhibited the best economic efficiency value, but, it did not significantly differ from those achieved by MGY-diet group (T5) , MIX-diet group (T6) or CSM-diet group (T2). The significant poorest value of economic efficiency was found with SSM-diet group (T4), which was not significantly different from that of CGM-diet group (T3).

In conclusion, it is well known that from the nutritional point of view, there is no "best" diet formula in terms of ingredients that are used. Ingredients should, therefore, be selected on the basis of availability, price and the quality of nutrients they contain. Even though the present findings revealed that SBM-diet had a superiority to CSM, CGM, SSM, MGY and MIX diets with respect to the performance of Mamoura laying hens for egg production and feed conversion. It did not differe from those containg MGY, MIX or even CSM from the economic point of view. The results found herein are in line with those of Tserbene *et al.* (1987) for CSM, Hammond (1944) for CGM, Mamputu and Buhr (1995) for SSM and Ashraf (1983) for MGY.

Continuos efforts should be made, however, to pay much care to adjust all facts of the diet formula, and to improve the formulation of diets in order to make most efficient use of CSM, CGM, SSM, MGY or their mixture (MIX) as available resources to replace SBM in laying hen diets.

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Table 1. composition and chemical analysis of the experimental diets of different energy sources.

Treatments	T_1	T_2	T_3	T_4	T_5	T_6
	SBM	CSM	CGM	SSM	MGY	MIX
Ingredients:						
Yellow corn	86.00	66.00	64.50	58.80	65.50	65.60
Soybean meal (44 %)	16.47	----	----	----	----	----
Cottonseedmeal (41 %)	----	17.30	----	----	----	4.25
Corn gluten meal (62 %)	----	----	9.00	----	----	2.80
Sesamseed meal (30 %)	----	----	----	25.70	----	5.88
M.G.Yeast (40 %)	----	----	----	----	18.89	4.40
Fish mea (72 %)	3.00	3.00	3.00	3.00	3.00	3.00
Weat bran	2.50	3.55	13.20	2.00	1.92	3.91
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50
Ground limestone	7.00	7.00	7.00	7.00	7.00	7.00
Vit .& Min. Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Common Salt	0.25	0.25	0.25	0.25	0.25	0.25
DL-Mcthionine	0.03	0.05	----	----	0.04	----
L-Lysinc	----	0.10	0.30	0.30	----	0.12
Corn oil	----	----	----	1.20	0.65	----
Total	100	100	100	100	100	100
Determined analysis% :						
Dry matter (DM)	89.03	89.18	88.36	88.89	88.33	88.43
Crude protein (CP)	16.36	16.09	16.45	16.45	16.00	16.14
Ether extract (EE)	3.18	3.40	3.00	3.00	3.35	3.20
Crude fiber (CF)	4.28	5.00	4.10	4.22	4.06	4.20
N-free extract (NfE)	48.75	49.27	48.69	50.51	49.70	48.82
Ash	16.46	15.42	16.12	14.78	15.22	16.07
Gross nergy, Kcal/g DM	3.950	3.947	3.934	3.882	3.955	3.984
Calculated values:						
Crude protein %	16.11	16.15	16.16	16.02	16.11	16.03
ME, Kcal/Kg	2802	2802	2804	2809	2810	2810
C/P ratio	174.00	174.00	174.00	175.00	174.00	175.00
Ether extract %	3.09	3.01	3.37	3.80	3.97	3.62
Crude fiber %	3.00	4.21	3.01	4.02	2.12	3.19
Ca %	3.54	3.52	3.51	3.62	3.60	3.64
Total P %	0.69	0.76	0.74	0.90	0.88	0.80
Lysine %	0.83	0.75	0.79	0.85	1.06	0.79
Methionine %	0.34	0.34	0.39	0.40	0.39	0.36
Methionine + Cystine	0.60	0.58	0.64	0.62	0.63	0.60

Each 2.5 kg of Vit & Min. mixture contains: Vit. A 12000,000IU, Vit. D_3 2000,000IU, Vit. E 10,000mg, Vit. K_3 2000mg, Vit. B_1 1000mg, Vit. B_2 4000mg, Vit. B_6 1500mg, Vit. B_{12} 10mg, Pantothenic acid 10,000mg, Nicotinic acid 20,000 mg, Folic acid 1000mg, Biotin 50mg, Choline chloride 500,000mg, Copper 10,000mg Iodine 1000mg, Manganese 55,000mg, Iron 30,000mg, Zinc 55,000mg and Selenium 100mg.

Table 2 . Performance of Mamoura laying hens fed the experimental diets of different protein sources.*

Performance Criteria	Treatments					
	T1	T2	T3	T4	T5	T6
	SBM	CSM	CGM	SSM	MGY	MIX
Initial body weight, g	1806 ± 3	1807 ± 8	1800 ± 8	1796 ± 10	1800 ± 5	1799 ± 5
Final body weight, g	2167 ± 21^{a}	1958 ± 8^{bc}	1979 ± 7^{b}	1902 ± 26^{c}	1942 ± 12^{bc}	1973 ± 9^{b}
Body weight gain, g	361 ± 18^{a}	151 ± 15^{bc}	179 ± 15^{b}	106 ± 31^{c}	142 ± 17^{bc}	174 ± 7^{bc}
Egg production (eggs/ bird)	114.5 ± 2.0^{a}	99.5 ± 2.0^{bc}	104.8 ± 2.3^{b}	89.8 ± 2.3^{d}	95.5 ± 2.0^{cd}	102.6 ± 2.0^{bc}
Egg production % (hen/day)	68.1 ± 1.2^{a}	59.2 ± 1.2^{bc}	62.4 ± 1.4^{b}	53.4 ± 1.3^{d}	56.8 ± 1.2^{cd}	$61.1 \pm 1.2b^{c}$
Average egg weight, g	51.2 ± 0.7	49.6 ± 1.7	50.1 ± 1.8	48.8 ± 1.3	49.4 ± 1.8	50.0 ± 1.7
Average egg mass , kg	5.862 ± 0.1^{a}	4.930 ± 0.3^{b}	5.254 ± 0.3^{ab}	4.383 ± 0.2^{b}	4.718 ± 0.3^{b}	5.126 ± 0.3^{ab}
Feed intake, kg/brid	16.698 ± 0.7	15.819 ± 0.7	16.498 ± 0.7	14.329 ± 0.7	15.189 ± 0.7	16.571 ± 0.7
Daily feed intake,g/brid	99.390 ± 0.4	94.160 ± 0.4	98.200 ± 0.4	85.290 ± 0.4	90.410 ± 0.4	96.730 ± 0.4
Feed conversion*	2.848 ± 0.1^{b}	$3.209 \pm .02^{a}$	$3.140 \pm .05^{a}$	$3.269 \pm .03^{a}$	$3.219 \pm .03^{a}$	$3.170 \pm .02^{a}$

* a - d :Means within the same row with different superscripts are significantly different ($p \leq 0.05$).

* Feed conversion = kg feed/k eggs.

Table 3 . Fertility and hatchability of eggs produced from Mamoura laying hens fed the experimental diets of different protein sources.*

Experimental Diets	Fertility %	Hatchability %
T_1 (SBM)	94.44 ± 1.6^{a}	83.29 ± 1.22^{a}
T_2 (CSM)	84.26 ± 0.93^{b}	68.14 ± 0.98^{d}
T_3 (CGM)	84.26 ± 1.85^{b}	79.12 ± 0.93^{b}
T4 (SSM)	86.11 ± 1.61^{b}	72.06 ± 0.69^{c}
T_5 (MGY)	84.26 ± 2.45^{b}	78.03 ± 0.76^{b}
T_6 (MIX)	85.18 ± 1.85^{b}	79.31 ± 1.37^{b}

* a – d: means within the same column with different superscripts are significantly different ($p \leq 0.05$)

Table 4. Nutrient metabolizability and digestibilty of mamoura cocks fed on the experimental diets of different energy sources.*

Item	Treatments					
	T1	T2	T3	T4	T5	T6
	control	25 % SG	50 % SG	75 % SG	100 % SG	25 % CRM
Body weight, g	2950 ± 105	2860 ± 64	2320 ± 191	2680 ± 234	2690 ± 73	3170 ± 145
Daily DM balance :						
Feed intake DM/bird/day, g	163.67 ± 1.8	160.00 ± 3.5	161.33 ± 2.8	159.33 ± 1.5	158.33 ± 1.9	161.67 ± 2.6
Excreta DM/bird/day, g	55.78 ± 1.5	54.27 ± 2.0	54.56 ± 1.9	53.08 ± 1.4	52.58 ± 1.5	54.19 ± 1.8
DM ratio	0.341 ± 0.006	0.339 ± 0.005	0.338 ± 0.006	0.333 ± 0.006	0.332 ± 0.006	0.335 ± 0.006
Utilization (metabolizability) %:						
Ash retention	69.32 ± 5.6	50.59 ± 5.3	55.63 ± 5.8	65.78 ± 5.8	66.23 ± 5.9	52.28 ± 5.7
N- retention.	48.63 ± 0.7[a]	48.69 ± 0.7[a]	47.68 ± 0.7[a]	44.79 ± 0.7[b]	44.79 ± 0.7[b]	48.68 ± 0.7[a]
Ether extract (EE)	89.55 ± 0.5[a]	89.56 ± 0.5[a]	88.30 ± 0.7[a]	85.45 ± 0.7[b]	85.44 ± 0.7[b]	89.20 ± 0.7[a]
N-free extract (NFE)	79.90 ± 0.5	79.90 ± 0.6	78.93 ± 0.6	77.89 ± 0.6	77.89 ± 0.6	79.90 ± 0.6
Dry matter (DM)	65.93 ± 0.6	66.10 ± 0.5	66.20 ± 0.6	66.70 ± 0.6	66.80 ± 0.6	66.50 ± 0.6
Digestion coefficient %:						
Crude protein (CP)	89.31 ± 0.7[a]	89.29 ± 0.7[a]	88.31 ± 0.7[a]	85.31 ± 0.7[b]	85.35 ± 0.7[b]	89.32 ± 0.7[a]
Crude fiber (CP)	19035 ± 0.4[a]	19.31 ± 0.5[a]	18.19 ± 0.5[a]	15.10 ± 0.6[b]	15.14 ± 0.6[b]	19.29 ± 0.4[a]
Organic matter (OM)	73.55 ± 0.6[a]	73.52 ± 0.6[a]	72.47 ± 0.6[ab]	60.71 ± 0.6[bc]	70.70 ± 0.6[bc]	73.52 ± 0.6[a]
Energy :						
ME, kcal/kg (as fed)	2777±13	2773±8	2780±26	2765±22	2756±10	2786±39
Energy utilization %	78.98±0.38	79.72±0.22	79.30±0.73	79.63±0.62	79.99±0.29	79.91±1.12

* a – b: Means within the same row with different superscripts are significantly different ($p \leq 0.05$).

Table 5. Egg components and some egg quality measurements of egg produced by Mamoura laying hens fed the experimental diets of different protein sources.*

Measurements	Treatments					
	T1	T2	T3	T4	T5	T6
	SBM	CSM	CGM	SSM	MGY	MIX
Egg weight, g	53.11 ± 1.6	51.01 ± 0.6	51.80 ± 0.3	51.03 ± 0.5	51.53 ± 0.9	51.24 ± 1.1
Shell weight, g	5.84 ± 0.49	5.73 ± 0.05	5.77 ± 0.05	5.49 ± 0.02	5.81 ± 0.10	5.79 ± 0.15
Shell weight %	10.97 ± 0.46	11.24 ± 0.12	11.14 ± 0.14	11.35 ± 0.13	11.28 ± 0.04	11.29 ± 0.07
Yolk weight, g	15.86 ± 0.35	15.08 ± 0.08	15.87 ± 0.08	15.67 ± 0.13	15.84 ± 0.36	16.16 ± 0.25
Yolk weight %	29.90 ± 0.92	29.56 ± 0.41	30.64 ± 0.28	30.71 ± 0.33	30.72 ± 0.19	31.54 ± 0.16
Albume weight, g	31.41 ± 1.28	30.21 ± 0.59	30.17 ± 0.37	29.57 ± 0.50	29.89 ± 0.43	29.29 ± 0.66
Albumen weight %	59.13 ± 0.99	59.20 ± 0.52	58.22 ± 0.41	57.94 ± 0.40	58.00 ± 0.22	57.17 ± 0.12
Egg shape index	0.782 ± 0.007	0.772 ± 0.004	0.772 ± 0.003	0.760 ± 0.008	0.767 ± 0.01	0.769 ± 0.004
Haugh units	90.18 ± 0.46	90.30 ± 0.85	90.76 ± 0.39	91.03 ± 0.89	90.98 ± 0.73	89.60 ± 0.71
Shell thickness, mm	0.388 ± 0.008	0.385 ± 0.010	0.375 ± 0.011	0.365 ± 0.005	0.388 ± 0.010	0.371 ± 0.011
Specific gravity	1.099 ± 0.009	1.100 ± 0.002	1.096 ± 0.001	1.094 ± 0.002	1.098 ± 0.001	1.096 ± 0.001
Egg yolk colur	6.89 ± 0.39^{b}	7.00 ± 0.17^{b}	9.87 ± 0.59^{a}	4.67 ± 0.26^{c}	7.00 ± 0.09^{b}	7.11 ± 0.15^{b}

* a - c :Means within the same row with different superscripts are significantly different ($p \leq 0.05$).

Table 6. Chemical composition of eggs produced by Mamoura laying hens fed the experimental diets of different protein sources.

Component	Treatments					
	T1	T2	T3	T4	T5	T6
	SBM	CSM	CGM	SSM	MGY	MIX
Dry matter %	26.48 ± 0.13	26.41 ± 0.01	26.55 ± 0.07	26.41 ± 0.02	26.14 ± 0.20	26.28 ± 0.12
Moisture %	73.52 ± 0.13	73.59 ± 0.01	73.45 ± 0.07	73.59 ± 0.02	73.86 ± 0.20	73.72 ± 0.12
CP %	12.94 ± 0.02	12.65 ± 0.07	12.69± 0.07	12.82 ± 0.18	12.85 ± 0.05	12.73 ± 0.07
EE %	10.60 ± 0.12	10.87 ± 0.17	11.07 ± 0.07	10.80 ± 0.10	10.53 ± 0.18	10.70 ± 0.26
Ash %	1.23 ± 0.04	1.24 ± 0.05	1.17 ± 0.01	1.17 ± 0.03	1.15 ± 0.08	1.24 ± 0.09
NFE %	1.71 ± 0.04	1.66 ± 0.09	1.62 ± 0.07	1.62 ± 0.10	1.61 ± 0.07	1.61 ± 0.02

Table 7. Blood constituents in Mamoura laying hens fed the experimental diets of different protein sources.*

Measurements	Treatments					
	T1	T2	T3	T4	T5	T6
	SBM	CSM	CGM	SSM	MGY	MIX
Total protein, g/100 ml	4.50 ± 0.21	4.48 ± 0.12	4.74 ± 0.09	4.67 ± 0.17	4.75 ± 0.03	4.55 ± 0.19
Blood hemoglobin, g/100 ml	11.11 ± 6^{a}	10.12 ± 4^{ab}	9.95 ± 4^{ab}	8.85 ± 2^{b}	8.85 ± 3^{b}	11.21 ± 6^{a}
Total lipids, g/100 ml	1.35 ± 0.12	1.23 ± 0.08	1.27 ± 0.06	1.36 ± 0.04	1.25 ± 0.11	1.46 ± 0.08
Plasma glucose, mg/100 ml	292.7 ± 38	288.8 ± 25	290.9 ± 20	248.7 ± 22	265.1 ± 19	252.5 ± 37
Plasma cholestrol, mg/100 ml	133.57 ± 3	133.77 ± 9	136.42 ± 7	109.6 ± 7	117.68 ± 9	128.11 ± 8
Plasma calcium, mg/100 ml	1504 ± 0.1^{a}	15.4 ± 0.3^{a}	14.08 ± 0.5^{b}	15.52 ± 0.1^{a}	15.48 ± 0.2^{a}	15.67 ± 0.1^{a}
Plasma phosphorus, mg/100 ml	5.55 ± 0.2^{b}	5.77 ± 0.4^{b}	5.58 ± 0.1^{b}	6.93 ± 0.2^{a}	5.71 ± 0.4^{b}	7.67 ± 0.3^{a}
Hematocrit value %	28.67 ± 0.9	30.67 ± 1.5	29.67 ± 2.4	32.33 ± 1.3	31.33 ± 0.9	32.00 ± 2.0

* a – b: Means within the same row with different superscripts are significantly different ($p \leq 0.05$).

Table 8 . Economic efficiency of Mamoura laying hens fed the experimental diets of different protein sources. *

Measurements**	Treatments					
	T1	T2	T3	T4	T5	T6
	SBM	CSM	CGM	SSM	MGY	MIX
Average FI, Kg/bird	16.70	15.82	16.50	14.33	15.19	16.25
Price/Kg feed, (L. E.)[1]	0.65	0.64	0.67	0.72	0.63	0.64
Total feed cost, (L. E.)[2]	10.86	10.12	11.06	10.32	9.57	10.40
No. of eggs produced	115	99	105	90	95	105
Price of one egg, (L.E.)[3]	0.15	0.15	0.15	0.15	0.15	0.15
Total revenue, (L. E.)	17.25	14.85	15.75	13.50	14.25	15.45
Net revenue, (L. E.)	6.39	4.73	4.69	3.18	4.68	5.05
Economic efficiency (EEF)	0.588^{a}	0.467^{b}	0.424^{bc}	0.308^{c}	0.489^{ab}	0.486^{ab}
Relative EEF[4]	100	79.42	72.11	52.38	83.16	82.65

* a - c :Means within the same row with different superscripts are significantly different ($p \leq 0.05$).

1 L.E. = One pound, Egyptian currency = 100 Piasters.

2 According to prices of the ingredients available in Egypt at the experimental time (1998).

3 According to the local price at the experimental time (1998).

4 Assuming that the relative EEF of the control diet (T1) equals 100.

تأثير الاحلال الكامل لكسب فول الصويا ببعض مصادر البروتين النباتى فى العلائق على الأداء الإنتاجى للدجاج البياض

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أستخدم فى هذه الدراسة عدد ١٨٠ طائر معمورة (١٦٢ دجاجة بياضة + ١٨ ديكاً) عمر ٢٤ أسبوعاً، قسمت عشوائيا إلى ٦ مجموعات ثلاثية (١٠ طيور x ٣ مكررات x ٦ معاملات) ، كل مكرر يحتوى على ديك وتسع دجاجات . ربيت الطيور فى حظائر مناسبة تربية أرضية تحت ظروف رعاية واحدة وغذيت على علائق التجربة لمدة ٢٤ أسبوعاً فترة تجريبية . وتم تركيب عدد ٦ علائق تجريبية أحتوت الاولى منها (م١) على كسب فول صويا وذرة صفراء كمصادر رئيسيةللبروتين والطاقة على التوالى وأستخدمت كعليقة مقارنة (كنترول) . فى العلائق الأخرى ثم إحلال كسب فول الصويا بالكامل بكل من كسب قطن مقشور (م٢) ، جلوتين أذرة صفراء (م٣) ، كسب سمسم (م٤) ، خميرة مولاس (م٥) وأخيرا مخلوط من هذه المواد (م٦) . وضبطت هذه العلائق غذائيا لتصبح متساوية فى محتوى البروتين (١٦ % بروتين خام) والطاقة (٢٨٠٠ كيلو كالورى طاقة ممثلة/كجم) .

أخذت قياسات الاداء الانتاجى وجودة البيض والخصوبة والفقس .فى نهاية التجربة أجريت تجربة هضم على الديوك لتقدير معاملات الهضم والتمثيل الغذائى لعلائق التجربة كما أخذت بعض قياسات الدم .

أوضحت النتائج المتحصل عليها وجود فروق معنوية بين المعاملات فى متوسط وزن الجسم والوزن المكتسب وإنتاج البيض وكتلة البيض والكفاءة التحويلية بينما لم يتأثر معنويا وزن البيضة وإستهلاك العلف . وكان الترتيب التنازلى بصفة عامة لجميع هذه المقاييس م١ (الكنترول) تلاها م٣ (الجلوتين) ثم م٦ (المخلوط) ثم م٢ (كسب القطن) ثم م٥ (خميرة المولاس) وأخيرا م٤ (كسب السمسم) الذى أعطى أقل القيم .

أوضحت نتائج التفريخ وجود فروق معنوية بين المعاملات فى نسب الخصوبة والفقس والاجنة النافقة ، وأخذت نتائج التحليل الاحصائى نفس إتجاه نتائج الاداء الانتاجى . أيضا ظهرت فروقاً معنوية بين المعاملات فى النسب الهضمية والتمثيل الغذائى وكذلك جودة البيض وبعض قياسات الدم .

من وجهة النظر الاقتصادية فإن مجموعة المقارنة (م١) سجلت أفضل كفاءة إقتصـــادية تلاها م٥ ، م٦ ، م٢ ، م٣ وأخيرا م٤ على التوالى فى ترتيب تنازلى .

وعموما فإنه يمكن الاستنتاج _ من هذا البحث _ أنه عند الوضـــع فـــى الاعتبـــار الاداء الانتاجى مع الكفاءة الاقتصادية يتضح لنا أن خميرة المولاس (م٥) أو كسب القطن المقشـــور (م٢) يمكن إحلال أى منهما محل كسب فول الصويا بصورة عملية للحصول على منتج نهائى أرخص . وتتضح فائدة ذلك أكثر فى حالة نقص كسب فول الصويا ، كما يمكن إستخدام مخلوط من كسب القطن وجلوتين الذرة وكسب السمسم وخميرة المولاس بدلا من كسب فول الصويا .