EFFECT OF SUBSTITUTING SOYBEAN MEAL BY NIGELLA SATIVA MEAL ON THE PERFORMANCE OF DIFFERENT LOCAL STRAINS OF LAYING HENS

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(Manuscript received 14 march 2007)

Abstract

This study was conducted to determine the effect of partially and completely replacing of soybean meal (SBM) protein with Nigella Sativa meal (NSM) protein on laying performance, economical efficiency as well as nutrient digestibilities of experimental diets .

A total of 360 hens and 40 cocks (28week of old)from Bandarah (BA), Gimmizah (GM), Dandarawi (DA) and Dokki-4 (DK-4) Egyption local strains (90 hens plus 10 cocks each strains) was used in this experiment. The experimental birds were divided into 5 equal groups (18hens +2 cocks each). Five experimental corn – soyabean meal layer diets were formulated from a layer basal diet by partially and completely replacing SBM protein with NSM protein at replacement ratios of 0 (control), 25, 50, 75, 100 %during the experimental peroid (20 weeks).

The results obtained were as follows:

Body weight and Body weight change were insignificantly different between diets containing NSM and control groups in all strains .

Egg number was significantly higher in diets containing NSM compared to the control groups in all strains.

Egg weight was insignificantly different between diets containing NSM and control groups in all strains, except diets containing 50% NSM that was significantly higher.

Feed intake was significantly higher in diets containing NSM compared to the control groups in all strains. Feed conversion ratio was significantly better in diets containing NSM compared to the control groups in all strains, except 100% that was similar to control groups.

INTRODUCTION

Nigella sativa meal, a by –product of oil extraction from Nigella sativa seeds which is produced in Egypt, is a source of protein and energy and has lower price compared to SBM. Thus, it can serve as a cheap plant protein source in poultry diets. Nigella sativa is one of the most important medicinal plants. Nowadays, there is an increased demand for using plants in therapy instead of using synthetic drugs which may have many adverse effects (Fluck *et al.,* 1976). Nassar (1997) reported that crushed Nigella Sativa L. seed supplementation in Balady chick diet increased their growth performance. The use of NSM for partial substitution with SBM has been investigated in growing Japanese quail diets by Zeweil (1996) who showed that the performance of growing Japanese quail chicks fed the diet containing NSM at 9 or 18% of dietary crude protein was statistically improved as compared to the control one. Quail given diets containing NSM at 28% of dietary crude protein was not different from that of the control, except feed conversion which was deteriorated. Feed intake, live body weight gain and feed conversion were decreased with increased NSM substitution at 38 or 48% of dietary crude protein. Recently, Abou El-Soud, (2000) found that Japanese quail chicks fed 2 % of whole crushed Nigella Sativa seeds had the highest live body weight at 21 and 42 day of age. The final live body weight, total live body weight gain, daily live body weight gain, total feed intake and feed conversion were the highest for quail received diet supplemented with 2 % whole crushed Nigella Sativa seeds. Abou-Egla *et al.* (2000) found that Japanese quail chicks fed NSM replacing 5 % of SBM gave the highest live body weight and live body weight gain values at 3 or 6 weeks of age. However, chicks fed NSM to replace 40 % of SBM gave the most inferior live body weight and live body weight gain values at the same ages. Chicks fed NSM instead of 5 or 10 % SBM protein were more efficient in converting feed to gain in the period of 0-3 weeks of age. Mortality rate tended to be lower in birds fed diets containing NSM instead of 10 % SBM protein, while, it was the highest in those fed NSM replacing 40 % of SBM protein. Other groups were intermediate in this respect. Zeweil (1996) found that Japanese quail chicks fed NSM at 7.5% of dietary crude protein had significantly increase egg production and egg mass as compared to the control birds fed the SBM. The productivity performance was not different between control birds and those fed NSM at 15, 22.5, 30 or 37.5% of dietary crude protein. Khodary *et al.* (1996), found that the feeding of Balady chickens on diet containing 1 and 2% freshly crushed Nigella Sativa L. seed for 65 successive days showed favourable effects on general health, live body weight, and resulted in significant increase in egg production and hatchability percentage. Meanwhile, 3% of Nigella Sativa seeds in the diet elicited a significant decrease in egg production and hatchability in hens.

MATERIALS AND METHODS

The experimental work of the present study was carried out at the Poultry Research Station, Seds, Beni Swiff, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Dokki, Egypt. An experiment was conducted to evaluate the nutritive value of NSM as a source of protein. The study also aimed to determine the best level of NSM that could be used without deleterious effect on the bird performance and its physiological status. A total of 360 hens and 40 cocks from Bandarah (BA), Gimmizah (GM), Dandarawi (DA) and Dokki-4 (DK-4) (90 hens plus 10 cocks each) strains of 28 wk old was used in this experiment. The birds of each strain were fasten overnight, individually wing-banded, weighed to the nearest 1 g and randomly divided in 5 equal groups (18 hens + 2 cocks each), so that, the average initial live body weight g (LBW) was insignificantly different in all groups. The groups were randomly re-housed in 5 suitable floor laying pens (3 m length x 2 m width) with chopped wheat straw litter and supplied with one automatic drinker and one manual feeder. Feed and water were offered *ad-libitum*. Therefore, twenty experimental groups were used in the experimental period. Five experimental layer diets were formulated from a corn-soybean meal basal diet by partially and / or completely replacing of soybean meal (SBM) protein with Nigella Sativa meal (NSM)protein at replacement ratios of 0 (control), 25, 50, 75 and 100 % (Table,1).

Diets were formulated to be iso-nitrogenous and iso-caloric being 16 % CP &2850 kcal. ME/kg diet. The experimental diets were supplemented with minerals and vitamins mixture, DL-methionine and L-lysine to cover the recommended nutrient requirements (NRC, 1984). The composition and chemical analysis of the experimental diets is presented in Table 1. Twenty experimental treatments were arranged factorials in a 4 strains x 5 levels of NSM. Within each strain, one of the five experimental groups was fed a control layer diet containing 0% NSM. The other four groups, however, received another layer diets that contained NSM protein instead of SBM at replacement ratios of , 25, 50, 75 or 100%, respectively. The following criteria were measured and/or calculated in the present study.

1. Body weight (BW): Individual live body weight values of the birds were used to calculate, average changes in body weights for every four weeks and at the end of the experimental period, by subtracting the initial weight of a certain period from the final weight of the same period, as follows:

$$BWC = W2 - W1$$

2-Egg number (EN): Eggs were daily collected and the average egg number (hen / day) was calculated per treatment, for each 4-wks period from 28 wks to 48wks of age, by the following formula:

EN = egg number produced / number of live hens

3. Egg weight (EW): Eggs were daily collected, individually recorded and weighed. For 1-wk, 4-wks 8-wks, 12-wks, 16-wks, and 20-wks periods, then the average egg weight per treatment was calculated by the following formula:

$$\text{EW / treatment} = \frac{\text{The sum of individual weight of the collected eggs / treatment}}{\text{Egg number}}$$

Also, for 1-wk, 4-wks,8-wks,12-wks,16-wks and 20-wks periods, the average egg weight per hen was obtained by the following formula:

$$EW / hen = \frac{\text{The sum of individual weight of the collected eggs / hen}}{\text{Egg number}}$$

4- Egg mass (EM): Egg mass was calculated for 1-wk, 4-wks 8-wks, 12-wks, 16-wks and 20-wk periods by using the following formula:

EM (gm) / hen = EN x average egg weight

5-. Feed intake (FI): Feed intake for each treatment was weekly calculated on a group basis by subtracting the residual feed from the offered one. Average daily and weekly feed intake per bird was then calculated using the following equations:

$$FI/bird/week = \frac{\text{FI / replicate/week}}{\text{No. of birds consumed feed daily during the week period}}$$

FI/bird/day = (FI/bird/week) / 7

6-. Feed conversion (FC): Feed conversion, was weekly calculated during the experimental period, for each treatment of the experimental birds by using the following formula:

$$FC = \frac{\text{FI (g) / hen during a certain period}}{\text{Egg mass (g) / hen during the same period}}$$

7-Crude protein conversion (CPC): Crude Protein conversion ratio was weekly calculated for each bird under each treatment of the experimental birds by using the following formula:

$$CPC = \frac{\text{CP intake (g) / bird during a certain period}}{\text{Egg mass (g) / bird during the same period}}$$

8- Economical efficiency (E.EF): Feeding cost was calculated on basis that the number of kg of FI from experimental diets per the number of kg of egg produced multiplied by the costs of the respective diets.

However, selling price (total revenue) was calculated by multiplying the number of kg of egg by 550 PT which represents the selling price of 1 kg egg commonly offered in the market in the period from January to May 2001. The economical efficiency (net return per unit feed cost) of egg production for the different experimental treatments was calculated using the following equations:

Total feed cost = a x b = c, Total revenue = d x e = f,

Net revenue = f – c = g and E.Ef. = g / c. Average FI (kg/hen/period) b = Price/kg feed (PT) Where: a =

c = Total feed cost (a x b d = Egg mass (kg/hen/period)

e = Price/kg egg (PT). f = Total revenue (d x e)

g = Net revenue (f – c)

EEF= Economical efficiency (g/c) REEF = Relative economical efficiency

It is worthy to note that, financial calculations were carried out according to the local market price of feed ingredients and additives dominated at the experimental time. The prices of ingredients in L.E per ton in 2001 were yellow corn, 550, SBM, 1100, NSM, 550, corn gluten meal, 1500, wheat bran, 520, vegetable oil, 2000, dicalcium phosphate, 1400, limestone, 40, premix, 8250, common salt, 210, DL-methionine, 16000, L-lysine, 12000. The veterinary services, housing and Labor costs were not included, as they were the same for all treatment groups.

9-Statistical Analysis. Data from both experiment were analyzed with the (SAS Institute,1990)

RESULTS AND DISCUSSION

1- Chemical composition and amino acids content of NSM

The results of chemical composition and amino acids content of NSM are shown in Table 2. It was observed that NSM contains 5.49% moisture, 30.60 % CP, 16.26 % EE, 8.22 % CF, 33.38 % NFE, 6.05 % ash, 0.61 % methionine and 1.05 % lysine.Based on these results, it could be concluded that NSM contains reasonable amount of CP but less than that of SBM. Moreover, the data indicated that NSM had lower lysine content than SBM (1.05 vs. 2.69 %). However, NSM, and SBM had similar methionine content (0.61 vs. 0.62 %).Accordingly, the NSM, diets must be supplemented with the essential amino acids lysine and methionine. In this respect, Khalifah (1995) indicated that NSM contained most of the essential amino acids.

2-. Effect of substituting SBM by NSM on laying performance

2-1. Body weight (BW)

- At 28 weeks of age (Table 3), the initial BW of 28 week-old hens, within each strain, for all NSM levels was similar. Regardless of NSM level, GM hens had significantly the highest initial BW followed by BA, DK-4, and DA, hens,. At 48weeks of age, it was observed that NSM level had no significant effect on BW of hens. With regard to hen strain, it was noticed that NSM level did not exert any significant effect on BW of hens. with-respect to hen strain, it was noticed the same trend as previously mentioned at 28-weeks of age . Concerning the interaction between NSM level and hen strain, the results revealed that different hen strains fed NSM containing diets did not significantly differ in BW as compared to the corresponding control groups.

2-2. Body weight change (BWC)

During the period from 28 to 48 weeks of age (Table 3), it was observed that hens fed NSM-containing diets did not differ significantly in BWC than those fed NSM-free diets. Regardless of NSM level, hen strain did not show any significant response in BWC due to feeding NSM-containing diets. Regarding the interaction between NSM level and hen strain, the results revealed that different hen strains fed NSM-containing diets did not significantly differ in BWC as compared to the corresponding control groups . The non – significant differences in BW and BWC among NSM levels during the tested periods in the current study indicated that NSM protein is a good quality protien that provided enough and adequate nutrients for normai development.

2-3. Egg number (EN)

In respect to the overall experimental period (Table 4), it was noticed that hens fed diet containing NSM had significantly higher EN than those fed diet containing 0 % NSM. Regardless of NSM level, it was noticed DA hens gave the highest EN, followed by, DK-4, GM hens and then BA hens that gave the lowest one . Concerning the interaction between NSM level and hen strain, the results revealed that BA, GM, DA and DK-4 hens fed NSM-containing diets had significantly higher EN than the corresponding control groups. There were two exceptions, the first one was for DA hens fed 100 % NSM had similar EN to the corresponding control group while the second one was for DK-4 hens fed 75 % NSM had similar EN to the corresponding control group and those fed 100% NSM that had significantly lower EN than the corresponding control group. The improvement in the final EN of hens fed NSM-containing diets during the overall experimental period may be due to the antimicrobial effect of the black seeds Soltan,(1999) and the high amount of unsaturated fatty acids in the black seeds which are very essential to the poultry (Ustun *et al.,* 1990).

2-4. Egg weight (EW)

In respect to the overall experimental period (Table 4), it was noticed that hens fed diet containing NSM showed similar EW to those fed diet containing 0 % NSM except for hens fed diet containing 50 % NSM that had significantly higher EW than those fed diet containing 0 % NSM. Regardless of NSM level, it was noticed that BA hens gave the highest EW,followed by GM, DK-4 hens, and then DA hens that gave the lowest one . . Concerning the interaction between NSM level and hen strain, the results revealed that different hen strains fed NSM- containing diets did not significantly differ in EW as compared to the corresponding control groups except for BA hens fed 50%NSM and Gimmizah (GM) hens fed 25 or 05%NSM that had significantly higher EW than the corresponding control group.

2-5. Egg mass (EM)

In respect to the overall experimental period (Table 4), it was noticed that hens fed diet containing NSM had significantly higher EM than those fed diet containing 0 % NSM. Regardless of NSM level, it was noticed that DK-4 hens gave the highest EM, followed by DA, GM hens and then BA hens that gave the lowest one. Concerning the interaction between NSM level and hen strain, the results revealed that BA and GM hens fed NSM-containing diets had significantly higher EM than the corresponding control groups. However, DA and DK-4 hens fed NSM-containing diets did not significantly differ in EM as compared to the corresponding control group except for DA fed 50 or 75 % NSM and DK-4 hens fed 50 % NSM that had significantly higher EM than the corresponding control groups. The high EM related to NSM containing diets during the overall experimental period may be related to the high EN .

2-6. Feed intake (FI)

In respect to the overall experimental period (Table5), it was noticed that hens fed diet containing NSM had significantly higher FI than those fed diet containing 0 % NSM except for hens fed diet containing 25 and 50 % NSM that had significantly lower FI than those fed diet containing 0 % NSM. With respect to hen strain, it was noticed that DK-4 gave the highest FI, followed by DA, BA and then GM hens that gave the lowest one. Regarding the interaction between NSM level and hen strain, the results showed that BA and GM hens fed NSM-containing diets had significantly lower FI than the corresponding control groups. There were two exceptions, the first one was for BA fed 100 % NSM had similar FI to the corresponding control group. The second one was for GM hens fed 75 or 100 % NSM had significantly higher FI than the corresponding control group. However, DA and DK-4 hens fed NSM-containing diets had significantly higher FI than the corresponding control groups. The increased final FI of hens fed NSM-containing diets indicated that NSM may improve the palatability of feed. However, Osman and El-Barody (1999) stated that increasing Nigella Sativa seeds had no significant effect on FI of broiler chicks.Differences in FI observed among different strains agree with those reported by Osman *et al.* (1992) who reported that different breeds had different feed intake.Also, the higher overall FI of GM than those of BA and DA observed in the current study agree with the results of

El-Dakroury and Mahmoud (1982) who found that GM birds consume more feed than BA birds

2-7. Feed conversion (FC)

In respect to the overall experimental period (Table5), it was noticed that hens fed NSM-containing diets had significantly better FC than those fed NSM-free diet except for hens fed diet containing 100 % NSM that had insignificantly different FC to control hens. Regardless of NSM level, it was noticed that both DA and DK-4 hens had significantly better FC than BA and GM hens. Concerning the interaction between NSM level and hen strain, the results revealed that BA and GM hens fed NSM-containing diets had significantly better FC than the corresponding control groups. However, DA and DK-4 hens fed NSM-containing diets did not significantly differ in FC than the corresponding control groups except for DA hens fed 50 or 100 % NSM that had significantly poorer FC than the corresponding control group.The better FC value observed in the present study agree in general with the studies of Khalifah (1995) who concluded that NSM-containing diet was beneficial in improving FC of broiler chicks. Similar results were reported by Abou-Egla *et al.* (2000) with Japanese quail. The explanation for the improvement in FC resulted from adding NSM to the diet could be attributed to the suppression of harmful intestinal microflora which interfere with the absorption of nutrients (such as minerals, vitamins, amino acids and fats).Differences in FC observed among different strains agree with those observed by Osman *et al.* (1992) who stated that FC differed significantly among different breeds.

2-8. Crude protein conversion (CPC)

In respect to the overall experimental period (Table 8), it was noticed that hens fed diet containing NSM had significantly better CPC than those fed NSM-free diet. Regardless of NSM level, it was noticed that both DA and DK-4 hens had significant better CPC than BA and GM hens. Concerning the interaction between NSM level and hen strain, the results revealed that BA and GM hens fed NSM-containing diets had significant better CPC than the corresponding control groups. On the other hand, DA and DK-4 hens fed NSM-containing diets did not significantly differ in CPC as compared to the corresponding control groups. The improvements in CPC obtained in the current study strongly suggest that NSM enhanced the utilization of dietary protein and energy, respectively. In general, the CPC results of layer hens in the present study showed similar trend to the FC results

3. Effect of substituting SBM by NSM on economical efficiency of laying hens

The results of EEF of the whole experimental period showed that the use of NSM in laying diets resulted in lower feed cost than diet containing 0 % NSM. Therefore, feeding hens on diets containing NSM showed higher EE_f as compared to those fed diet containing 0 % NSM.

Table 1. Composition of the experimental layer diets.

Item, %	% NSM CP instead of SBM CP				
	0%	25%	50%	75%	100%
Ground yellow corn	58.61	57.50	58.10	52.54	46.23
Soybean meal (44 CP%)	18.00	13.50	9.00	4.50	0.00
Nigella Sativa meal (30.6 CP%)	0.00	6.47	12.94	19.41	25.88
Corn gluten meal (62 CP %)	3.00	3.00	3.25	3.05	2.75
Wheat bran	8.00	8.50	7.25	11.00	16.00
Vegetable oil	3.00	1.63	0.00	0.00	0.0
Ground limestone	6.40	6.40	6.40	6.40	6.60
Dicalcium phosphate	2.25	2.25	2.25	2.25	1.70
Common salt (NaCl)	0.30	0.30	0.30	0.30	0.30
Premix*	0.30	0.30	0.30	0.30	0.30
Dl-Methionine	0.06	0.05	0.04	0.03	0.02
L-lysine	0.08	0.10	0.17	0.22	0.22
Total	100.00	100.00	100.00	100.00	100.00
Determined values (%)					
Moisture	7.02	6.97	7.13	7.21	7.00
Ash	8.10	8.14	8.07	7.96	8.11
CP	16.02	16.00	16.01	16.00	16.07
CF	3.47	3.72	3.81	4.32	4.94
EE	3.63	3.41	3.50	3.69	4.12
NFE	61.76	61.76	61.48	60.82	59.76
Calculated values:					
ME, Kcal/kg	2844.44	2846.92	2870.36	2879.15	2875.33
Ca %	3.01	3.02	3.02	3.03	3.00
P, avail %	0.61	0.62	0.62	0.66	0.62
Lys. %	0.75	0.72	0.71	0.70	0.66
Met. %	0.30	0.30	0.30	0.30	0.30
Cyst. %	0.26	0.27	0.29	0.30	0.33
Met. + Cyst. %	0.56	0.57	0.59	0.60	0.63
Cost (PT/kg) **	74.56	70.16	66.24	63.88	60.25
Relative cost ***	100	94.10	88.84	85.68	80.81

*The premix (Vit. & Min.) was added at a rate of 3 kg per ton of diet and supplied the following (as mg or I.U. per kg of diet): Vit. A 12000 I.U., Vit. D3 2000 I.U., Vit. E 40 mg, Vit. K3 4 mg, Vit. B1 3 mg, Vit. B2 6 mg, Vit. B6 4 mg, Vit. B12 0.03 mg, Niacin 30 mg, Biotin 0.08 mg, Pantothenic acid 12 mg, Folic acid 1.5 mg, Choline chloride 700 mg, Mn 80 mg, Cu 10 mg, Se 0.2 mg, I 40 mg, Fe 40 mg, Zn 70 mg and Co 0.25mg.

** According to market prices of the year 2001.

*** Assuming NSM-free diet equals 100.

From the economical point of view, the results assured that the better EE_f related to NSM-containing diets might be attributed to the lower cost of NSM as compared to SBM. The former observation is in harmony with those outlined by Zeweil

(1996) who pointed out that the EE of the diets containing 9, 18, and 28 % NSM of dietary CP was higher than that of the control diet. Also, Osman and El-Barody (1999) found that Nigella Sativa seeds in broiler diets had insignificant effect on feed cost / kg gain.In accordance with the present observation, it is advisable to use NSM up to 100 % to replace SBM protein in the four local breeds laying hen diets. Such practice helps in decreasing the financial pressure on the small farmer and seems to be advantageous in improving the economical profit without any adverse effects on the utilized productive performance parameters.

Table 2. Proximate composition of Nigella Sativa meal (NSM) and soybean meal (SBM).

Item	NSM*	SBM**
Moisture %	5.49	11.00
CP %	30.60	44.00
EE %	16.26	0.80
CF %	8.22	7.00
Ash %	6.05	6.82
NFE %	33.38	30.38
ME (kcal/kg) ***	3927	2230
Ca %	0.27	0.29
Avail P %	0.29	0.27
Methionine %	0.61	0.62
Lysine %	1.05	2.69

*Analyzed by Central Lab. for Food and Feed (CLFF) Agri., Res., Center, Giza, Egypt.

**According to NRC (1994).

*** Calculated according to Carpenter and Clegg equation (1956)

ME (kcal/kg) = 35.3 x CP % + 79.5 x EE % + 40.6 x NFE % + 199.

Table .3 Body weight and body weight change (g/hen) of laying hens fed the experimental diets at 28 and 48 weeks of age.

Level of SBM CP% replacement by NSM	Strain				Overall mean
	Bandarah	Gimmizah	Dandarawi	Dokki-4	
Body weight at 28 wks.					
0	1620.00±8.99^{b}	1771.94±11.37^{a}	1154.00±16.46^{d}	1484.65±13.93^{c}	1507.65±28.17^{A}
25	1626.11±11.53^{b}	1748.41±16.30^{a}	1154.94±15.90^{d}	1498.83±18.21^{c}	1507.08±27.54^{A}
50	1632.24±8.93^{b}	1747.56±19.27^{a}	1145.44±16.60^{d}	1473.50±11.35^{c}	1499.68±27.93^{A}
75	1626.27±18.11^{b}	1769.00±21.73^{a}	1142.29±14.17^{d}	1478.89±14.42^{c}	1504.12±28.83^{A}
100	1621.22±8.47^{b}	1769.33±18.05^{a}	1142.41±14.89^{d}	1481.78±10.43^{c}	1503.69±28.23^{A}
Overall mean	1625.17±5.19^{C}	1761.25±7.83^{B}	1147.82±6.86^{E}	1483.53±6.16^{D}	
Body weight at 48 wks.					
0	1647.44±7.71^{c}	1777.94±12.41^{ab}	1184.00±11.82^{e}	1488.71±13.74^{d}	1524.52±27.27^{A}
25	1631.78±5.57^{c}	1759.53±21.25^{b}	1169.61±11.89^{e}	1509.39±20.95^{d}	1517.58±27.36^{A}
50	1646.53±6.40^{c}	1759.78±16.79^{b}	1149.31±17.64^{e}	1486.61±10.94^{d}	1510.56±28.21^{A}
75	1632.56±4.71^{c}	1792.00±15.63^{ab}	1172.88±11.67^{e}	1488.94±10.77^{d}	1521.60±7.57^{A}
100	1624.89±9.62^{c}	1806.78±20.35^{a}	1169.18±7.53^{e}	1497.17±12.54^{d}	1524.50±28.34^{A}
Overall mean	1636.64±3.22^{C}	1779.21±7.89^{B}	1168.10±5.53^{E}	1494.16±6.31^{D}	
Body weight change at 29-48 wks.					
0	27.44±13.01^{a}	6.00±5.73^{a}	30.00±14.82^{a}	4.06±5.47^{a}	16.88±5.44^{A}
25	5.67±13.41^{a}	11.12±16.12^{a}	14.67±14.77^{a}	10.56±13.26^{a}	10.50±7.05^{A}
50	14.29±11.69^{a}	12.22±6.35^{a}	3.87±17.06^{a}	13.11±10.04^{a}	10.88±5.68^{A}
75	6.29±17.80^{a}	23.00±20.44^{a}	30.59±13.35^{a}	10.05±18.13^{a}	17.48±7.77^{A}
100	3.67±8.79^{a}	37.45±11.61^{a}	26.77±15.52^{a}	15.39±7.35a	20.82±5.66^{A}
Overall mean	11.47±5.90^{B}	17.96±5.91^{B}	21.18±6.69^{B}	10.63±4.09^{B}	

a, b, c,...., e: means in the same raw and column per each item having different letters are significantly different at $p \leq 0.05$.

A: means in the last column having similar letters are notsignificantly different

B, C, D, E: means in the last raw having different letters are significantly different at $p \leq 0.05$.

Table 4. Egg number, egg weight and egg mass (g) of laying hens fed the experimental diets at 29-48 weeks of age.

Level of SBM CP% replacement by NSM	Strain				Overall mean
	Bandarah	Gimmizah	Dandarawi	Dokki-4	
Egg number (29-48) wks.					
0	53.61±0.28^{i}	59.06±0.21^{h}	71.60±0.41^{de}	73.33±0.60^{cd}	64.40±0.10^{C}
25	61.05±0.85^{gh}	71.64±0.92^{de}	74.67±0.65^{bc}	76.17±0.49^{b}	70.88±0.81^{A}
50	59.83±0.80^{h}	69.16±1.05^{e}	79.31±0.66^{a}	76.17±0.53^{b}	71.12±0.98^{A}
75	63.11±0.67^{g}	65.78±1.38^{f}	80.45±0.43^{a}	73.71±0.56^{cd}	70.76±0.91^{A}
100	59.56±0.69^{h}	63.11±0.68^{g}	69.41±0.61^{e}	70.67±0.41^{e}	65.69±0.62^{B}
Overall mean	59.43±0.52^{I}	65.75±0.67^{H}	75.09±0.52^{F}	74.01±0.32^{G}	
Egg weight (29-48) wks.					
0	45.91±0.24^{ab}	42.78±1.76^{d}	39.68±0.08^{gh}	40.94±0.15^{defg}	42.33±0.52^{B}
25	45.95±0.27^{ab}	45.21±0.25^{b}	39.81±0.08^{fgh}	40.66±0.12^{efgh}	42.91±0.35^{AB}
50	46.89±0.34^{a}	44.83±0.15^{bc}	39.64±0.17^{h}	41.44±0.17^{de}	43.20±0.35^{A}
75	45.90±0.30^{ab}	43.75±0.17^{c}	39.53±0.07^{h}	41.17±0.15^{def}	42.59±0.31^{AB}
100	46.12±0.25^{ab}	43.76±0.18^{c}	39.35±0.08^{h}	41.30±.18^{def}	42.63±0.31^{AB}
Overall mean	46.16±0.13^{D}	44.07±0.37^{E}	39.60±0.05^{G}	41.10±0.08^{F}	
Egg mass (29-48) wks.					
0	2461.13±62.09^{j}	2526.35±112.25^{j}	2841.09±16.80^{ghi}	3001.84±25.57^{cdef}	2707.60±43.17^{C}
25	2805.25±46.36^{hi}	3238.70±46.56^{a}	2972.46±26.19^{defg}	3096.77±19.65^{bcd}	3028.30±25.95^{A}
50	2805.55±43.43^{hi}	3100.58±44.65^{abcd}	3143.85±28.56^{abc}	3156.79±22.67^{ab}	3051.69±25.16^{A}
75	2897.00±36.04^{defgh}	2878.01±54.96^{fghi}	3180.19±15.45^{ab}	3034.79±25.81^{bcde}	2997.50±22.55^{A}
100	2747.15±36.71^{i}	2761.82±27.56^{i}	2731.01±23.24^{i}	2918.39±20.78^{defg}	2789.59±16.19^{B}
Overall mean	2743.22±25.75^{G}	2901.09±39.88^{F}	2973.72±20.60^{E}	3041.72±13.60^{D}	

a, b, c,...., h: means in the same raw and column per each item having different letters are significantly different at $p \leq 0.05$.
A, B,C: means in the last column having different letters are significantly different at $p \leq 0.05$.
D, E, F, G: means in the last raw having different letters are significantly different at $p \leq 0.05$.

Table 5. Feed intake, feed convertion and crud protein convertion (g/hen) of laying hens fed the experimental diets at 29-48 weeks of age.

Level of SBM CP% replacement by NSM	Strain				Overall mean
	Bandarah	Gimmizah	Dandarawi	Dokki-4	
Feed intake (29-48) wks.					
0	16583.03±12.24^{b}	15615.51±22.58^{f}	14456.53±39.98^{n}	15013.33±33.80^{j}	15417.10±97.73^{B}
25	15578.29±30.92^{g}	14121.40±42.19^{o}	14991.54±75.53^{i}	15769.33±108.44^{d}	15115.14±82.68^{C}
50	13703.36±5.73^{p}	14772.24±32.85^{k}	16833.44±26.56^{a}	15963.46±34.29^{c}	15318.12±125.24^{C}
75	14616.38±26.84^{m}	16609.52±96.91^{b}	16190.58±32.56^{c}	15443.37±63.55^{h}	15714.96±94.01^{A}
100	16578.86±69.30^{b}	15855.36±46.87^{e}	14606.86±105.29^{l}	15339.45±8.17^{h}	15595.13±87.79^{A}
Overall mean	15411.98±105.27^{F}	15394.81±89.59^{G}	15415.79±99.74^{F}	15505.79±54.29^{E}	
Feed convertion (29-48) wks.					
0	6.74±0.18^{a}	6.18±0.45^{a}	5.09±0.03^{fg}	5.00±0.05^{fg}	5.75±0.16^{A}
25	5.55±0.10^{cd}	4.36±0.07^{h}	5.04±0.05^{fg}	5.09±0.05^{ef}	5.01±0.06^{C}
50	4.88±0.08^{gh}	4.76±0.07^{gh}	5.35±0.05^{de}	5.06±0.03^{fg}	5.01±0.04^{C}
75	5.05±0.06^{fg}	5.77±0.13^{bc}	5.09±0.03^{fg}	5.09±0.05^{fg}	5.25±0.05^{B}
100	6.03±0.09^{b}	5.74±0.06^{bc}	5.71±0.06^{de}	5.26±0.04^{ef}	5.69±0.05^{A}
Overall mean	5.65±0.09^{D}	5.36±0.13^{E}	5.26±0.03^{F}	5.10±0.02^{F}	
Crud protein convertion (29-48) wks.					
0	1.08±0.03a	0.99±0.07a	0.82±0.01fgh	0.80±0.01gh	0.92±0.03A
25	0.89±0.02cde	0.70±0.01i	0.81±0.01fgh	0.81±0.01fgh	0.80±0.01C
50	0.78±0.01hi	0.76±0.01hi	0.86±0.01def	0.81±0.01fgh	0.80±0.01C
75	0.81±0.01fgh	0.92±0.02bc	0.81±0.00fgh	0.81±0.01fgh	0.84±0.01C
100	0.97±0.01b	0.92±0.01bcd	0.86±0.01def	0.84±0.01efg	0.90±0.01B
Overall mean	0.91±0.01D	0.86±0.02E	0.83±0.00F	0.81±0.00F	

a, b, c,...., k: means in the same raw and column per each item having different letters are significantly different at $p \leq 0.05$.
A, B, C: means in the last column having different letters are significantly different at $p \leq 0.05$.
D, E, F, G: means in the last raw having different letters are significantly different at $p \leq 0.05$.

Table 6. Input-output analysis and economical efficiency ratio of experimental treatments during the experimental period.

Level of SBM CP% replacement by NSM		Feed intake (kg/hen)	Price/kg feed (PT)	Total feed cost/hen (LE)	Egg mass (kg/hen)	Selling price/kg egg (LE)	Total revenue	Net revenue/bird (LE)	Economical efficiency (EE_f)	Relative economical efficiency (REE_f) (%)
Strain	NSM	(a)	(b)*	(c) =a x b	(d)	(e)**	(g) =d x e	(h) = g-c	(i) = h/c***	
Bandarah	0	16.58	74.56	12.36	2.46	5.42	13.33	0.97	0.08	100.00
	25	15.58	70.16	10.93	2.81	5.42	15.23	4.30	0.39	500.66
	50	13.70	66.24	9.07	2.81	5.42	15.23	6.16	0.68	863.40
	75	14.62	63.88	9.34	2.90	5.42	15.72	6.38	0.68	869.41
	100	16.58	60.25	9.99	2.75	5.42	14.91	4.92	0.49	626.37
Gimmizah	0	15.62	74.56	11.65	2.53	5.42	13.71	2.07	0.18	100.00
	25	14.12	70.16	9.91	3.24	5.42	17.56	7.65	0.77	435.48
	50	14.77	66.24	9.78	3.10	5.42	16.80	7.02	0.72	404.32
	75	16.61	63.88	10.61	2.88	5.42	15.61	5.00	0.47	265.55
	100	15.86	60.25	9.56	2.76	5.42	14.96	5.40	0.57	318.72
Dandarawi	0	14.46	74.56	10.78	2.84	5.42	15.39	4.61	0.43	100.00
	25	14.99	70.16	10.52	2.97	5.42	16.10	5.58	0.53	124.06
	50	16.83	66.24	11.15	3.14	5.42	17.02	5.87	0.53	123.12
	75	16.19	63.88	10.34	3.18	5.42	17.24	6.89	0.67	155.83
	100	14.61	60.25	8.80	2.73	5.42	14.80	5.99	0.68	159.20
Dokki-4	0	15.01	74.56	11.19	3.00	5.42	16.26	5.07	0.45	100.00
	25	15.77	70.16	11.06	3.10	5.42	16.80	5.74	0.52	114.51
	50	15.96	66.24	10.57	3.16	5.42	17.13	6.56	0.62	136.91
	75	15.44	63.88	9.86	3.03	5.42	16.42	6.56	0.67	146.85
	100	15.34	60.25	9.24	2.92	5.42	15.83	6.58	0.71	157.29

* According to the local market price of feed ingredients at the experimental time in ARE.

** According to the local market price of eggs at the experimental time in ARE.

***Net revenue per unit feed cost.

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تأثير استبدال كسب فول الصويا بكسب حبة البركة على أداء سلالات محلية مختلفة من الدجاج البياض

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صممت هذه الدراسة لتحديد تأثير الاستبدال الجزئي والكلى لبروتين كسب فول الصويا ببروتين كسب حبة البركة وتأثير ذلك على مظاهر الأداء للدجاج البياض والكفاءة الاقتصادية.

استخدام في هذه الدراسة عدد ٣٦٠ دجاجة و٤٠ ديك (عمر ٢٨ أسبوع) من سلالة البندرة والجميزة والدندراوى ودقى٤ (٩٠ دجاجة + ١٠ ديوك من كل سلالة). قسمت الطيور إلى خمسة مجموعات متساوية (١٨ دجاجة +٢ ديك). تم تكوين خمس علائق بياض نباتية باستبدال الجزئي والكلى لبروتين كسب فول الصويا ببروتين كسب حبة البركة بنسب صفر (كنترول) ٢٥، ٥٠، ٧٥، ١٠٠% خلال فترة التجربة (٢٠ أسبوع).

وكانت نتائج الدراسة كما يلي :

١- وزن الجسم والتغير في وزن الجسم لم يختلف معنويا بين الطيور المغذاة على علائق محتوية على كسب حبة البركة بالمقارنة بعلائق الكنترول وذلك في جميع السلالات .

٢- ارتفع عدد البيض معنويا للطيور التي غذيت على علائق محتوية على كسب حبة البركة بالمقارنة بعلائق الكنترول

٣- لم يختلف وزن البيض معنويا بين الطيور المغذاة على كسب حبة البركة بالمقارنة بعلائق الكنترول وتبين أن الطيور المغذاة على العلائق المحتوية على ٥٠% كسب حبة البركة زاد وزن البيض فيها معنويا.

٤- ازداد العلف المأكول معنويا للطيور المغذاة على العلائق محتوية على كسب حبة البركة بالمقارنة بعلائق الكنترول ، وتحسن معامل التحويل الغذائي معنويا للطيور المغذاة على علائق محتوية على كسب حبة البركة بالمقارنة بعلائق الكنترول باستثناء الطيور المغذاة على العلائق المحتوية على ١٠٠% كسب حب البركة حيث لم يختلف معامل تحويلها الغذائي عن تلك المغذاة على علائق الكنترول .