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EFFECT OF SUBSTITUTING SOYBEAN MEAL BY NIGELLA SATIVA MEAL ON GROWTH PERFORMANCE, CARCASS CHARACTERISTICS, BLOOD CONSTITUENTS AND SENSORY EVALUATION FOR BROILER CHICKS.

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ABSTRACT

Four isocaloric isonitrogenous starter (3093 kcal ME/kg; 22.03 %CP) and finisher (3205 kcal ME/kg; 18.50 %CP) broiler diets in which SBM protein was partially substituted by NSM protein at 0 (control), 10, 20 and 30 % levels were formulated and offered to the experimental broiler chicks.

A total number of 576 unsexed one-week old Arbor-Acres broiler chicks were assigned randomly to 4 dietary equal groups of 12 equal replicates each . Chick groups were offered the starter diets in which SBM protein was replaced by NSM protein at 0,10,20 and 30%.At the beginning of finishing period, a total number of 120 chicks were randomly chosen from each experimental group and divided into 4 equal sub-groups, each in 3 equal replicates and fed NSM finisher diet .Therefore, there were 4 and 16 experimental groups in the starting and finishing periods, respectively.

From the nutritional and economical point of view, it could be concluded that substituting NSM crude protein up to 30 % for SBM crude protein in both starter and finisher diets of broiler chicks improved their growth performance and the nutrients digestibility coefficients of the experimental diets without any detrimental or harmful effect on the carcass characteristics and blood constituents for broiler chicks . Since poultry production depends mainly on the economical return, feeding broiler chicks on diets containing NSM crude protein at level of 10 or 20 % instead of SBM protein to 4-wk of age and up to 30 % instead of SBM protein to 7-wk of age gave the best economical efficiency.

INTRODUCTION

Poultry production in developing countries is hampered by shortage of feedstuffs. Many of traditional conventional feed ingredients used in formulating poultry diets such as soybean meal are becoming extremely expensive. Therefore, the search for alternative protein sources has become an urgent matter.

Nigella Sativa meal, a by-product of oil-extraction from Nigella Sativa seeds which is produced in Egypt, is rich in protein and energy and has lower price compared to SBM. Many attempts has been made to cut feeding cost down to the minimum levels by replacing the costly feedstuffs, especially SBM, by relatively less expensive plant protein sources such as NSM.

The use of NSM as a partial substitution for SBM has been investigated in growing Japanese quail diets by Zeweil (1996) who showed that growing performance of Japanese quail chicks fed diet containing NSM at 9 or 18% of dietary CP was significantly ($p<0.01$) improved and live body weight gain (LBWG) was significantly ($p<0.01$) the highest compared to the control one. While feed intake (FI), LBWG and feed conversion (FC) of quail chicks were decreased with increasing NSM substitution up to 38 or 48% of dietary CP. Moreover, Ghazalah and Ibrahim (1996) observed that feeding black seed oil to Muscovy ducks did not significantly affect live body weight

(LBW) for most ages compared to the control group. They also added that black seed oil is capable for inhibiting mold growth and aflatoxin production that could reduce the rate of growth and accordingly lead to a higher utilization efficiency of nutrients in the feed. Osman and El-Barody (1999) found that Nigella Sativa seeds had insignificant effect on average LBW or viability rate of broiler chicks at all age intervals. While, the high levels of Nigella Sativa seeds (0.8 % and 1.0 %) significantly reduced FI and improved FC at 4 and 6 weeks of age

Recently, Abou El-Soud, (2000) found that Japanese quail chicks fed 2 % of whole crushed Nigella Sativa seeds had the highest LBW at 21 and 42 day of age, and those fed 1 % of Nigella Sativa oil had the highest LBW at 35 day of age. Abou-Egla *et al.*, (2000) found that Japanese quail chicks fed 5 % or 10 % NSM substituted for SBM gave the highest LBW, LBWG and FC values either at 3 or 6 weeks of age. While, chicks fed 40 % NSM as a partial substitution for SBM gave the most inferior LBW and LBWG values at the same ages. They added that mortality 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.

Many trials have been done to investigate the possibility of introducing Nigella Sativa seeds or its derivatives to poultry for better performance. Khalifah (1995) found that supplementing broiler diets with black seed oil improved dressing percentage and had no effect on liver, heart, gizzard, pancreas, spleen and bursa percentages compared to black seeds oil free- diets. Ghazalah and Ibrahim (1996) found that the administration of black seed oil to Muscovi ducks increased carcass protein content, decreased carcass fat content and did not affect blood, feather and dressing weight percentages compared to those fed the control diet, however it reduced fat pad as well as the total fat content of the body. Hedaya (1995) found that the injection of black seed extract to male rats decreased the serum glucose and cholesterol levels, but it increased the total serum protein and globulin levels. Meanwhile, the values of serum albumin and urea were not significantly altered. Nearly, similar results were obtained by Mandour *et al.*, (1995) and El-Gazzar (1997) for serum protein. Ghazalah and Ibrahim (1996) found that using black seed oil in diets of Muscovi ducks decreased total lipids and cholesterol content of blood serum than control group. Mandour *et al.* (1998) reported that feeding broiler chickens with Nigella Sativa seeds for 30 days at level of 1% decreased serum cholesterol level, while the serum uric acid was significantly decreased at 2%, in addition, the low levels of Nigella Sativa seeds increased the values of thyroxin (T4), Ca and Zn, while the high levels of 8% decreased them.

On the other hand, Zeweil (1996) found that digestibility coefficients of OM and EE were significantly decreased as growing Japanese quail chicks received the highest level of NSM in the diet (38 and 48% of dietary CP) than those fed the other experimental diets. The digestibility coefficients of NFE and CP showed a significant decrease for the highest level of NSM (38 %), however, the differences among treatments in digestibility coefficient of CP were not significant. He also found that digestibility coefficient of CF revealed insignificant differences among the experimental diets, and the highest ME values were recorded for groups fed either control diet or 9, 18 and 28% NSM of dietary crude protein, while the lowest values were recorded for groups fed 38 or 48% NSM of dietary CP. Abou-Egla *et al.* (2000) found that Japanese quail chicks fed 5 % NSM instead of SBM did not show any significant effect on digestibility of EE, CF and NFE. While they were more efficient in digestion of CP than the control group by 3.7 %.

From the economical point of view, Zeweil (1996) found that the economical efficiency of Japanese quail fed diets containing 9, 18 or 28 % NSM of dietary CP were higher than those fed the control group. Using Nigella Sativa seeds, Soltan (1999) observed the possibility of increasing economical efficiency for Japanese quail chicks by feeding 1 % NSM as a partial substitution for SBM. However, Ghazalah and Ibrahim (1996) found that the administration of black seed oil to Muscovi ducks did not affect the economical efficiency of the diets. Also, Osman and El-Barody (1999) found that Nigella Sativa seeds had insignificant effect on feed cost / kg gain.

The aim of this experiment is to evaluate the nutritive value of NSM and to study the effect of using it as a partial substitution for SBM in broiler diets on growth performance, carcass characteristics , some blood constituents , sensory evaluation , nutrients digestibility economical efficiency of broiler chicks.

MATERIALS AND METHODS

The experimental work of the present study was carried out at El-Takamoly Poultry Project, Fayoum Governorate, Egypt. The chemical analysis was performed in the laboratories of the same project and Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Dokki, Egypt.

A total number of 576 unsexed one week-old Arbor-Acres broiler strain chicks which were fed a commercial corn-soybean meal diet containing 23 % CP and 3000 kcal ME/kg diet for the first 7 days posthatching to minimize the influences of protein in the yolk of the newly hatched chicks, then fasted overnight, individually wing-banded and weighed to the nearest 0.1 g. and were randomly distributed into 4 equal groups of nearly similar means of LBW (114±0.39g) each in 12 equal replicates. The four experimental groups were reared in 4 galvanized wire cage batteries of three tires each. At the end of the starting period, a total number of 120 chicks were randomly chosen from each experimental group and divided into 4 equal sub-groups, each in 3 equal replicates. Therefore, sixteen experimental groups were used in the finishing period.

Diets were fed using two-phase feeding system and formulated to be iso-caloric iso-nitrogenous being 3093 kcal. ME/kg & 22.03 % CP for the starter diets and 3205 kcal & 18.50 % CP. ME/kg for the finisher diets. The experimental starter and finisher diets were contained 0 (control), 10, 20 and 30 % NSM as a partial substitution for SBM protein and were supplemented with minerals and vitamins mixture, DL-methionine and L-lysine to cover the recommended requirements (NRC, 1994). The composition and calculated chemical analysis of the experimental diets is presented in Table (1).

Table 1: The composition and chemical analysis of the experimental starter and finisher diets.

Item,%	Starter (1 – 4 wks)				Finisher (5 – 7 wks)			
	% NSM CP from SBM CP				% NSM CP from SBM CP			
	0%	10%	20%	30%	30%	10%	20%	30%
Yellow Corn, ground	55.49	55.11	54.55	54.28	60.94	60.49	60.05	59.51
Corn gluten meal(62% CP)	6.70	6.70	6.75	6.75	0.25	0.30	0.35	0.40
Soybean meal(44% CP)	30.00	27.00	24.00	21.00	30.00	27.00	24.00	21.00
Nigella Sativa meal(31.8% CP)	0.00	4.15	8.30	12.50	0.00	4.15	8.30	12.50
Dicalcium phosphate	1.70	1.70	1.75	1.60	1.50	1.50	1.45	1.45
Limestone	1.40	1.40	1.40	1.45	1.00	1.00	1.00	1.00
Common salt	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Vegetable oil	3.60	2.80	2.12	1.25	5.50	4.75	4.00	3.25
Premix*	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
DL-Methionine	0.17	0.15	0.13	0.12	0.11	0.10	0.09	0.08
L-Lysine	0.24	0.29	0.30	0.35	0.00	0.01	0.06	0.11
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Determined values (%)								
Moisture	9.36	9.34	9.30	9.27	8.77	8.71	8.70	8.67
CP	22.01	22.08	22.06	21.98	18.55	18.50	18.49	18.47
CF	3.46	3.60	3.88	4.04	3.48	3.70	4.00	4.26
EE	6.20	5.70	5.43	4.99	8.16	7.72	7.36	7.01
Ash	6.25	6.33	6.54	6.61	6.00	6.15	6.22	6.30
NFE	52.72	52.95	52.79	53.11	55.04	55.22	55.23	55.29

Table 1: (Cont.)

Calculated values	Starter (1 – 4 wks)				Finisher (5 – 7 wks)			
	% NSM CP from SBM CP				% NSM CP from SBM CP			
	0%	10%	20%	30%	0%	10%	20%	30%
ME, kcal/kg	3094.00	3091.00	3095.00	3092.00	3204.00	3205.00	3207.00	3207.00
Ca. %	1.00	1.01	1.02	1.01	0.81	0.81	0.80	0.81
Avail. P %	0.45	0.46	0.47	0.45	0.41	0.41	0.41	0.41
Lys. %	1.20	1.20	1.17	1.17	0.97	0.94	0.94	0.94
Meth. %	0.55	0.54	0.53	0.52	0.41	0.41	0.40	0.40
Cyst. %	0.37	0.38	0.39	0.40	0.31	0.32	0.33	0.34
Meth.+Cyst. %	0.92	0.92	0.92	0.92	0.72	0.73	0.73	0.74
Cost (PT/kg)**	92.44	89.04	86.71	83.81	86.00	83.05	80.51	78.01
Relative cost***	100.00	96.32	93.80	90.66	100.00	96.57	93.62	90.71

*The premix (Rovimix for broiler "La Roche") was added as 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 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.

Chicks in all experimental treatments were kept as possible under similar managerial and hygienic conditions. The experimental diets were weekly mixed and offered on an ad libitum basis. Fresh clean water was freely available and artificial lighting was provided continuously at night during the whole experimental period. Droppings were collected and removed twice a week.

Feed intake for each treatment was recorded weekly. Average live body weight (LBW) per chick in each treatment was recorded at 4 and 7 weeks of age. Average live body weight gain (LBWG), feed conversion (FC), crude protein conversion ratio (CPC), caloric efficiency ratio (CER) and mortality rate (MR) were calculated during the starting and finishing periods. Relative growth rate (RGR) was calculated during the same periods according to Brody (1949) as follows:

RGR = [(W2 – W1) / 0.5 (W1 + W2)] x 100.

Where:

W1 = Body weight at certain age, and

W2 = Body weight after certain period.

Performance index (PI) during the starting and finishing periods was also calculated according to North (1981) as in the following equation:

PI = [LBW (kg) / FC] x 100

The economical efficiency ($E.E_f.$) of meat 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 $E.E_f.$ = g / c.

Where:

a = Average FI (kg/bird)

b = Price/kg feed (PT)

d = Average LBWG (kg/bird)

e = Selling price of kg gain (PT).

At the end of the experimental period, a slaughter test was performed on 48 birds including 3 birds for each treatment group (1 bird for each replicate) whose body weight was closest to the replicate mean. The selected birds were deprived of feed for 12 hours, then individually weighed and slaughtered by the customary Islamic way. Traits of the subjective meat quality were recorded by organoleptic evaluation of roasted samples of forequarter (FQ) and hindquarter (HQ) meat according to the method reported by Molander (1960). A test panel consisting of ten panelists judged the meat samples for color, tenderness, juiciness, chewiness, flavor, odour and acceptance with grades of very good (9-8), good (7-6), fair (5-4) and poor (3-2).

At the end of the starting and finishing periods, individual blood samples of about 3 ml, from randomly 12 birds of each treatment group were withdrawn via the wing vein puncture by a nonheparinized syringe and permitted to a clot to obtain serum. Sera were individually separated by centrifugation at 3000 r.p.m. for 15 min., transferred into a clean ependorf vials and stored in a deep freezer at approximately– 20± 1°C until required analysis. Frozen Sera were thawed and colorimetrically assayed for total protein (g/dl), albumin (g/dl), cholesterol, triglycerides, Ca and P by Atomic Absorption Spectrophotometer (model, GBC906 AA) using commercial kits (Stambio, San Antonio, Texas, USA). Globulin (g/dl) values were obtained by subtracting albumin values from the corresponding total protein values. Also, albumin and globulin (A/G) ratio was calculated. All values were expressed as mg/100 ml.

Chemical analysis of the experimental diets and NSM was carried out in triplicate samples to determine moisture, CP, EE, CF and ash contents according to the standard methods outlined by A.O.A.C. (1980). NFF was calculated by difference. Metabolizable energy (ME) of experimental diets was calculated considering the ME values of different feed ingredients (NRC, 1994). The ME value of the NSM was calculated according to the equation of Carpenter and Clegg (1956) as follows :

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

Faecal nitrogen was determined by Jakobsen *et al.* (1960).

Data obtained were statistically analyzed according to Steel and Torrie (1980) including analysis of variance. Also, SPSS computer program for MS Windows (1993) was used. The differences among treatments means were tested using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition and amino acid content of NSM:

The results of chemical composition and amino acid content of NSM are shown in Table 2. It was observed that NSM contains 5.18 % Moisture, 31.80 % CP, 11.25 % EE, 12.00 % CF, 32.92 % NFE, 6.85 % ash, 0.61 % methionine and 1.05 % lysine. From the previous results, it could be concluded that NSM contains reasonable amount of CP but less than that of SBM. Moreover, the data indicated that SBM had higher lysine content than NSM (2.69 vs. 1.05 %). However, SBM and NSM had similar methionine content (0.62 vs. 0.61 %). Accordingly, the NSM diets must be supplemented with essential amino acids especially lysine. In this respect, Babayan *et al.* (1978) reported that the Nigella Sativa L. seeds showed a composition of 21.0 % protein containing 15 amino acids, nine of those were found to be essential amino acids. Also, Khalifah (1995) indicated that NSM contained most of the essential amino acids.

Table 2: Proximate composition of NSM and SBM.

Item	NSM*	SBM**
Moisture %	5.18	11.00
CP %	31.80	44.00
EE %	11.25	0.80
CF %	12.00	7.00
Ash %	6.85	6.82
NFE %	32.92	30.38
ME(kcal/kg)	3552***	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 ME (kcal/kg) = 35.3 x CP % + 79.5 x EE % + 40.6 x NFE % + 199**

Live body weight (LBW): -

At the end of the starting period, Table 3 shows that chicks fed diets containing NSM had significantly higher LBW than those fed 0 % NSM which had the lightest one. It could be seen that no significant response was obtained for increasing NSM level from 10 to 20 %, while, increasing NSM from 20 to 30 % significantly decreased LBW of chicks. At the end of the finishing period, chicks fed diets containing NSM showed similar LBW to those fed diet containing 0/0 % NSM except for chicks fed diet containing 10/0, 10/10, 10/20, 20/0 and 20/10 % NSM which had significantly higher LBW compared to those fed 0/0 % NSM as shown in Table 4. The same trend was noticed at the overall period (Table 5).

Table 3: Growth performance of broiler chicks fed the experimental diets during starting period.

Treat.	Level of SBM CP % replacement by NSM			
Starter	0 %	10 %	20 %	30 %
LBW,g	839.13 ± 6.89^{c}	873.16 ± 8.57^{ab}	889.22 ± 7.65^{a}	865.56 ± 7.27^{b}
LBWG,g	724.94 ± 6.78^{c}	758.97 ± 8.40^{ab}	774.97 ± 7.41^{a}	751.37 ± 7.13^{b}
FI,g	1308.93 ± 2.62^{b}	1312.51 ± 4.95^{b}	1348.50 ± 5.24^{a}	1348.05 ± 2.50^{a}
FC g feed/g gain	1.83 ± 0.02^{a}	1.76 ± 0.02^{b}	1.76 ± 0.02^{b}	1.82 ± 0.02^{a}
CPC g protein intake/g gain	0.40 ± 0.004^{a}	0.39 ± 0.004^{b}	0.39 ± 0.003^{b}	0.40 ± 0.004^{a}
CER Cal-intake/g gain	5.67 ± 0.05^{a}	5.45 ± 0.06^{b}	5.45 ± 0.05^{b}	5.63 ± 0.05^{a}
RGR %	151.83 ± 0.39^{b}	153.34 ± 0.44^{a}	154.20 ± 0.38^{a}	153.11 ± 0.39^{a}
PI %	46.96 ± 0.80^{c}	51.11 ± 1.00^{ab}	51.57 ± 0.86^{a}	48.74 ± 0.85^{bc}
MR %	0.00	1.39	1.39	0.00

a, b, c : means in the same row having different letters are significantly different at $p \leq 0.05$.

Live body weight gain (LBWG): -

At the starting period (1-4 wk), Table 3 shows that chicks fed diets containing NSM had significantly heavier LBWG than those fed diet containing 0 % NSM which had the smallest one. It could be noticed that increasing NSM from 20 % to 30 % significantly decreased LBWG of chicks. At the finishing period (5-7 wk), chicks fed diets containing NSM showed similar LBWG to those fed diet containing 0/0 % NSM (Table 4) except for chicks fed diet containing 10/0, 10/10 and 20/10 % NSM which had significantly heavier LBWG than those fed 0/0 % NSM. On the other han, chicks fed diet containing 30/10, 30/20 or 30/30 % NSM showed significantly lighter LBWG compared to those fed 0/0 % NSM. At the overall period (1-7 wk), chicks fed diets containing NSM showed similar LBWG to those fed diet containing 0/0 % NSM as shown in Table 5 except for chicks fed diet containing 10/0 or 10/10 % NSM which had significantly an increase in LBWG compared to those fed 0/0 % NSM.

Feed intake (FI): -

At the starting period (1-4 wk), chicks fed diets containing 20 % and 30 % NSM had significantly more FI than those fed NSM-free diet (Table 3); while chicks fed diet containing 10 % NSM had nearly similar FI to those fed the control diet (0 % NSM). At the finishing period (5-7 wk), chicks fed NSM-contained diets had significantly lower FI than those fed NSM-free diet NSM except for chicks fed diet containing 20/0 and 30/0 % NSM which had nearly similar FI to those fed diet containing 0/0 % NSM as shown in Table 4. At the overall period (1-7 wk), Table 5 shows that chicks fed NSM-contained diets had similar FI to those fed NSM-free diet except for chicks fed diet containing 0/10, 0/20, 0/30, 10/10, 10/20 and 10/30 % NSM which had significantly (p?0.05) lower FI than those fed the control diet (0/0 % NSM).

Feed conversion (FC), Crude protein conversion (CPC) and Caloric efficiency ratio (CER):-

The average FC, CPC and CER for chicks during starting, finishing and whole periods are presented in Tables 3, 4 and 5; respectively.

At the starting period (1-4 wk), chicks fed diets containing NSM had significantly better FC, CPC and CER than those fed diet containing 0 % NSM except for chicks fed diet containing 30 % NSM which had similar FC, CPC and CER to those fed diet containing 0/0 % NSM. At the finishing period (5-7 wk), chicks fed diets containing NSM had similar FC, CPC and CER to those fed diet containing 0/0 % NSM except for chicks fed diet containing 10/0, 10/10, 10/20 or 10/30 % NSM which had significantly better FC, CPC and CER than those fed diet containing 0/0 % NSM. At the overall period (1-7 wk), chicks fed diets containing NSM had similar FC, CPC and CER to those fed diet containing 0/0 % NSM except for chicks fed diet containing 10/0, 10/10, 10/20 or 10/30 % NSM which had significantly better FC, CPC and CER than those fed diet containing 0/0 % NSM.

Relative growth rate, performance index and mortality rate (RGR, PI & MR): -

At the starting period (Table 3); the average RGR of chicks fed diets containing NSM was significantly higher than those fed diet containing 0 % NSM which had the lowest one. With respect to PI, it was observed that chicks fed diet containing NSM had significantly higher PI than those fed diet containing 0 % NSM except for chicks fed diets containing 30% NSM which had similar PI to those fed diet containing 0 % NSM. Mortality rate data clearly showed that, chicks fed diet containing NSM had higher MR (1.39 %) than those fed diet containing 0 % NSM except for chicks fed diets containing 30 % NSM which had numerically similar MR to those fed diet containing 0 % NSM.

At the finishing period, the average RGR of chicks fed diets containing NSM was nearly similar to those fed diet containing 0/0 % NSM as shown in Table 4, except for chicks fed diet containing 30/10, 30/20 or 30/30 % NSM which had significantly lower RGR than those fed diet containing 0/0 % NSM. With regard to PI, it was noticed that chicks fed diet containing NSM had similar PI to those fed diet containing 0/0 % NSM except for chicks fed diets containing 10/0, 10/10, 10/20, 10/30, 20/0 or 20/10 % NSM which had significantly higher PI than those fed diet containing 0/0 % NSM. Regarding MR data, it was observed that chicks fed diet containing 0/10 or 0/20 and those fed diet containing 30/0 or 30/30 % NSM had the highest MR followed by chicks fed diet containing 10/10, 10/20, 20/0, 20/10, 20/30 and those fed diet containing 30/10 % NSM. However, chicks fed diets containing 0/0, 0/30, 10/0 ,10/30, 20/20 and those fed diet containing 30/20 % NSM had no MR.

Table 4 : Growth performance of broiler chicks fed the experimental diets during the finishing period.

Treat.	Level of SBM CP % replacement by NSM															
Starter	0 %				10 %				20 %				30 %			
Finisher	0 %	10 %	20 %	30 %	0 %	10 %	20 %	30 %	0 %	10 %	20 %	30 %	0 %	10 %	20 %	30 %
LBW,g	2069.50 ± 13.87^{cde}	2088.21 ± 17.75^{cd}	2079.07 ± 24.62^{cd}	2030.33 ± 17.64^{de}	2171.97 ± 23.07^{ab}	2170.38 ± 24.42^{ab}	2156.66 ± 25.87^{ab}	2132.03 ± 20.79^{abc}	2175.52 ± 18.54^{a}	2174.72 ± 25.24^{a}	2119.10 ± 19.52^{abc}	2109.66 ± 16.19^{bc}	2086.57 ± 12.71^{cd}	2026.24 ± 17.23^{de}	2028.60 ± 17.15^{de}	2009.29 ± 17.27^{e}
LBWG,g	1205.70 ± 14.88^{cde}	1218.50 ± 14.75^{abcde}	1216.32 ± 18.90^{bcde}	1166.57 ± 13.48^{efg}	1275.83 ± 21.30^{a}	1277.52 ± 24.00^{a}	1262.07 ± 21.31^{abc}	1239.87 ± 22.28^{abcd}	1262.97 ± 20.99^{abc}	1271.79 ± 22.34^{ab}	1212.00 ± 19.40^{cde}	1204.34 ± 14.56^{cde}	1192.50 ± 14.18^{def}	1137.55 ± 16.85^{fg}	1138.70 ± 17.36^{fg}	1125.29 ± 14.06^{g}
FI,g	2533.25 ± 5.31^{a}	2445.95 ± 10.46^{ef}	2439.14 ± 5.12^{f}	2439.31 ± 6.39^{f}	2498.25 ± 4.87^{b}	2468.60 ± 5.85^{cd}	2464.81 ± 2.94^{cd}	2455.76 ± 1.01^{e}	2534.23 ± 0.12^{a}	2504.71 ± 3.99^{cd}	2465.12 ± 3.89^{cd}	2460.93 ± 2.27^{d}	2538.57 ± 1.10^{a}	2476.81 ± 4.58^{c}	2478.75 ± 3.55^{c}	2466.62 ± 1.56^{cd}
FC g feed/g gain	2.11 ± 0.03^{bcd}	2.02 ± 0.03^{de}	2.02 ± 0.03^{de}	2.10 ± 0.02^{bcd}	1.97 ± 0.04e	1.95 ± 0.04^{e}	1.97 ± 0.03^{e}	2.00 ± 0.04^{e}	2.02 ± 0.03^{de}	1.99 ± 0.03^{e}	2.05 ± 0.03^{cde}	2.05 ± 0.03^{cde}	2.14 ± 0.03^{abc}	2.19 ± 0.03^{abc}	2.19 ± 0.03^{abc}	2.20 ± 0.03^{abc}
CPCg protein intake/g gain	0.39 ± 0.01^{abcd}	0.37 ± 0.01^{def}	0.37 ± 0.01^{def}	0.39 ± 0.01^{bcde}	0.36 ± 0.01^{f}	0.36 ± 0.01^{f}	0.36 ± 0.01^{f}	0.37 ± 0.01^{ef}	0.37 ± 0.01^{def}	0.37 ± 0.01^{f}	0.38 ± 0.01^{cdef}	0.38 ± 0.01^{cdef}	0.39 ± 0.01^{abc}	0.40 ± 0.01^{ab}	0.41 ± 0.01^{ab}	0.41 ± 0.01^{a}
CER Cal-intake/g gain	6.75 ± 0.09^{abcd}	6.45 ± 0.09^{def}	6.46 ± 0.09^{def}	6.72 ± 0.08^{bcde}	6.32 ± 0.11^{f}	6.25 ± 0.13^{f}	6.30 ± 0.11^{f}	6.40 ± 0.11^{ef}	6.47 ± 0.11^{def}	6.36 ± 0.11^{f}	6.56 ± 0.10^{cdef}	6.57 ± 0.08^{cdef}	6.84 ± 0.08^{abc}	7.01 ± 0.01^{ab}	7.01 ± 0.11^{ab}	7.04 ± 0.09^{a}
RGR%	82.30 ± 1.08^{a}	82.46 ± 0.95^{a}	82.72 ± 0.93^{a}	80.70 ± 0.88^{abc}	83.35 ± 1.41^{a}	83.52 ± 1.48^{a}	82.83 ± 1.25^{a}	82.12 ± 1.47^{a}	81.91 ± 1.40^{ab}	82.68 ± 1.22^{a}	80.19 ± 1.27^{abc}	80.05 ± 1.15^{abc}	80.64 ± 1.21^{abc}	78.15 ± 1.16^{bc}	78.11 ± 1.16^{bc}	77.88 ± 0.96^{c}
PI%	98.72 ± 1.86^{de}	104.28 ± 1.95^{bcd}	104.09 ± 2.71^{bcd}	97.31 ± 1.80^{de}	111.37 ± 2.84^{ab}	112.86 ± 3.18^{a}	110.90 ± 2.96^{abc}	108.04 ± 2.84^{abc}	108.72 ± 2.55^{abc}	110.86 ± 2.97^{abc}	104.45 ± 2.34^{bcd}	103.38 ± 1.78^{cd}	98.00 ± 1.28^{de}	93.23 ± 1.91^{e}	93.43 ± 2.03^{e}	91.86 ± 1.80^{e}
MR%	0.00	6.67	6.67	0.00	0.00	3.33	3.33	0.00	3.33	3.33	0.00	3.33	6.67	3.33	0.00	6.67

a, b, c,...., g: means in the same row having different letters are significantly different at $p \leq 0.05$.

Table 5 : Growth performance of broiler chicks fed the experimental diets during the overall period.

Treat.	Level of SBM CP % replacement by NSM															
Starter	0 %				10 %				20 %				30 %			
Finisher	0 %	10 %	20 %	30 %	0 %	10 %	20 %	30 %	0 %	10 %	20 %	30 %	0 %	10 %	20 %	30 %
LBW,g	2069.50 ± 13.87^{cde}	2088.21 ± 17.75^{cd}	2079.07 ± 24.62^{cd}	2030.33 ± 17.64^{de}	2171.97 ± 23.07^{ab}	2170.38 ± 24.42^{ab}	2156.66 ± 25.87^{ab}	2132.03 ± 20.79^{abc}	2175.52 ± 18.54^{a}	2174.72 ± 25.24^{a}	2119.10 ± 19.52^{abc}	2109.66 ± 16.19^{bc}	2086.57 ± 12.71^{cd}	2026.24 ± 17.23^{de}	2028.60 ± 17.15^{de}	2009.29 ± 17.27^{e}
LBWG,g	1930.60 ± 27.67^{bc}	1943.61 ± 12.61^{abc}	1942.72 ± 22.89^{abc}	1891.47 ± 6.74^{c}	2034.13 ± 34.57^{a}	2034.89 ± 29.85^{a}	2023.13 ± 45.42^{ab}	1998.17 ± 0.32^{ab}	2017.51 ± 31.11^{ab}	2023.27 ± 58.47^{ab}	1967.50 ± 44.25^{abc}	1961.46 ± 23.57^{abc}	1943.40 ± 8.18^{abc}	1887.34 ± 36.72^{c}	1890.07 ± 16.25^{c}	1875.95 ± 17.94^{c}
FI,g	3842.18 ± 20.21^{ab}	3752.61 ± 38.22^{e}	3749.39 ± 18.52^{e}	3748.24 ± 24.32^{e}	3810.76 ± 18.54^{bcd}	3780.05 ± 21.90^{cde}	3777.89 ± 11.02^{cde}	3768.27 ± 3.84^{de}	3882.71 ± 0.47^{a}	3852.19 ± 15.17^{ab}	3813.62 ± 17.81^{bcd}	3809.51 ± 8.36^{bcd}	3886.39 ± 3.60^{a}	3823.81 ± 17.33^{bcd}	3826.80 ± 13.51^{bc}	3814.60 ± 5.54^{bcd}
FC g feed/g gain	1.99 ± 0.04^{abc}	1.93 ± 0.02^{bcde}	1.93 ± 0.01^{cde}	1.98 ± 0.01^{abcd}	1.87 ± 0.04^{e}	1.86 ± 0.03^{e}	1.87 ± 0.04^{e}	1.89 ± 0.003^{de}	1.93 ± 0.03^{cde}	1.91 ± 0.05^{cde}	1.94 ± 0.04^{abcde}	1.94 ± 0.02^{abcde}	2.00 ± 0.01^{abc}	2.03 ± 0.03^{a}	2.02 ± 0.01^{ab}	2.03 ± 0.02^{a}
CPC g protein intake/ g gain	0.39 ± 0.01^{abc}	0.38 ± 0.003^{abcde}	0.38 ± 0.003^{abcde}	0.39 ± 0.00^{abcd}	0.37 ± 0.01^{de}	0.37 ± 0.01^{e}	0.37 ± 0.01^{de}	0.37 ± 0.00^{de}	0.38 ± 0.01^{bcde}	0.38 ± 0.01^{cde}	0.38 ± 0.01^{abcde}	0.38 ± 0.01^{abcde}	0.39 ± 0.003^{abc}	0.40 ± 0.01^{a}	0.40 ± 0.003^{abc}	0.40 ± 0.01^{ab}
CER Cal-intake/ g gain	6.30 ± 0.12^{abc}	6.11 ± 0.06^{bcd}	6.11 ± 0.05^{bcd}	6.27 ± 0.02^{abc}	5.93 ± 0.12^{d}	5.88 ± 0.10^{d}	5.92 ± 0.13^{d}	5.97 ± 0.01^{d}	6.10 ± 0.09^{bcd}	6.03 ± 0.15^{cd}	6.14 ± 0.12^{abcd}	6.15 ± 0.07^{abcd}	6.34 ± 0.02^{ab}	6.42 ± 0.01^{a}	6.41 ± 0.04^{a}	6.44 ± 0.07^{a}
RGR%	179.08 ± 0.27^{abc}	179.27 ± 0.13^{abc}	179.19 ± 0.22^{abc}	178.70 ± 0.08^{bc}	180.01 ± 0.34^{a}	179.99 ± 0.25^{a}	179.89 ± 0.41^{a}	179.66 ± 0.01^{a}	180.04 ± 0.28^{a}	179.97 ± 0.57^{a}	179.53 ± 0.41^{ab}	179.47 ± 0.19^{ab}	179.24 ± 0.09^{abc}	178.63 ± 0.36^{bc}	178.68 ± 0.16^{bc}	178.47 ± 0.22^{c}
PI%	104.06 ± 3.42^{bcd}	108.20 ± 1.56^{abcd}	107.81 ± 1.97^{abcd}	102.46 ± 0.22^{cd}	116.04 ± 4.42^{a}	116.84 ± 3.55^{a}	115.75 ± 4.98^{a}	113.06 ± 0.11^{abc}	113.05 ± 3.44^{abc}	114.14 ± 6.11^{ab}	109.40 ± 4.32^{abcd}	108.72 ± 2.37^{abcd}	104.33 ± 0.80^{bcd}	99.98 ± 3.38^{d}	100.20 ± 1.42^{d}	98.77 ± 2.16^{d}
MR%	0.00	1.15	1.15	0.00	1.15	1.72	1.72	1.15	1.72	1.72	1.15	1.72	1.15	0.57	0.00	1.15

a, b, c,...., e: means in the same row having different letters are significantly different at $p \leq 0.05$.

At the overall period, Table 5 shows that the average PI of chicks fed diets containing NSM was similar to those fed diet containing 0/0 % NSM except for chicks fed diets containing 10/0, 10/10 or 10/20 % NSM which had significantly higher PI than those fed diet containing 0/0 % NSM. The highest MR was obtained with chicks fed diet containing 10/10, 10/20, 20/0, 20/10 or 20/30 % NSM followed by chicks fed diet containing 10/30, 20/20, 0/10, 0/20, 10/0, 10/30 and those fed diet containing 30/30 or 30/10 % NSM. However, chicks fed diets containing 0/0 or 0/30 and those fed diet containing 30/20 % NSM had no MR.

The present results of growth performance tend to support the previous findings of many investigators, who reported that NSM could be used as a feed ingredient in broiler diets. The higher LBW related to chicks fed NSM-containing diets in the present study is in full agreement with Khalifa (1995) who reported that NSM gave an increase in LBW of broilers. Similar findings were reported by Zeweil (1996) and Abou-Egla *et al*, (2000). They found that average LBW of Japanese quail was increased when diets contained NSM.

The improvement in the final LBW of chicks fed NSM-containing diets may be due to the antimicrobial effect of the black seeds (Rathee *et al*., 1982; Hanafy and Hatem, 1991 and 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). The improvement in the final LBWG of chicks fed NSM-containing diets tend to support the suggestion that feeding NSM significantly increased LBWG of chicks (Khalifa, 1995; Zeweil, 1996; Nassar, 1997 and Abou-Egla *et al*, 2000). On the other hand, Osman and El-Barody (1999) found that Nigella Sativa seeds did not significantly affect LBWG. The decreased in final FI of chicks fed NSM-containing diets is in harmony with the findings of Osman and El-Barody (1999) who reported that the high levels of Nigella Sativa seeds significantly reduced FI.

The better FC 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) who found that the NSM significantly improved FC of 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 mineral, vitamins, amino acids and fats) and the increase in LBWG without any significant effect on FI. The improvements in CPC and CER obtained in the current study strongly suggest that NSM enhanced the utilization of dietary protein and energy, respectively. In general, the CPC and CER results of broiler chicks in the present study showed similar trend to the FC results.

The improvement observed in RGR at 4 wk from NSM-containing diets tend to support the suggestion of Ghazalah and Ibrahim (1996) who suggested that black seed oils is capable of inhibiting mold growth and aflatoxin production which could be reduce the rate of growth and accordingly lead to a higher utilization efficiency of nutrients in the feed. The failure of NSM to cause a response in RGR at 7 wk might be attributable to the viability of chicks and relatively higher hygienic conditions during the finisher period and thus NSM was less effective in stimulating growth.

The improvement observed in PI may be related to the increase in LBW and improvement in FC. The low MR % obtained at 4 and 7-wk in the present study may be related to the proper management practices during the starting and the entire experimental period. Similar results were observed by Zeweil (1996) who commented that there was insignificant difference in mortality rate between the groups fed NSM as compared to the control group. These results are also in accordance with those of Osman and El-Barody (1999) who indicated that Nigella Sativa seeds had no significant influence on chick mortality. On the other hand, no elucidation could be provided to explain the trend oMR % during the finishing period.

Effect of substituting SBM by NSM on carcass traits of broiler chicks: -

The results obtained for the experimental broiler carcass traits in terms of carcass yield and composition are shown in Table 6. Generally, it can be noticed that abdominal fat, bursa, heart, liver, spleen, gizzard, giblets and dressing % for chicks fed diets containing NSM did not significantly different from those fed diet containing 0/0 % NSM except for chicks fed diets containing 30/0, 30/10, 30/20 or 30/30 % NSM which had significantly lower spleen % than those fed diet containing 0/0 % NSM

The previous results indicated that the differences in blood and feather % might due to the slaughter procedure. The failure of NSM containing diets to affect carcass traits including bursa, heart, liver, gizzard and parts of the digestive tract weight percentages in the current study is in agreement with Khalifah (1995) who reported that chicks fed NSM at 1, 2 or 3 % had no significant differences in bursa, heart, liver and gizzard weight percentages. Similar results were also reported by (Ghazalah and Ibrahim, 1996; Nassar, 1997). In contrast of these results, Houghton *et al.*, (1995) explained the case of enlargement for bursa of fabricius to the improvement in immune response shown in birds receiving NSM derivatives. Further study is required to investigate the effects of NSM on hormonal and mineral concentrations.

The results of sensory evaluation for cooked FQ and HQ carcass meat in terms of darkness of color, tenderness, juiciness, chewiness, flavor by mouth (taste), odour and overall acceptance are illustrated in Table 7 and Table 8. Generally, it could be judging that chicks fed diet containing 0/0, 0/10 or 0/20 % NSM had the least darkness of color as compared to the other treatments. Judges also could easily discriminated and distinguished the differences in tenderness and juiciness of meat samples, reporting that the meat samples of chicks fed diet containing either 10/10, 10/20 or 10/30 % NSM were the most tender and juicy as compared to the other treatments. The same trend was noticed with judging of chewiness, flavor and general acceptance. The results related to meat tenderness of the present study are consistent with those reported by Abd El-Ghani (1986) who reported that tenderness of thigh meat was higher than of breast meat.

Table 6: Some slaughter parameters of broiler chicks fed the experimental diets at 7 wk of age.

Level of SBM CP% replacement by NSM		Blood%	Feather%	Head%	Neck%	Legs%	Small intestine%	Ceca%	Rectum%
Starter	Finisher								
0%	0%	3.44 ± 0.02^{a}	5.85 ± 0.16^{a}	2.53 ± 0.04^{a}	4.30 ± 0.13^{a}	3.94 ± 0.07^{a}	3.28 ± 0.06^{a}	0.65 ± 0.03^{a}	0.15 ± 0.01^{a}
	10%	3.24 ± 0.03^{b}	5.71 ± 0.37^{ab}	2.41 ± 0.14^{a}	4.29 ± 0.09^{a}	3.90 ± 0.09^{a}	3.28 ± 0.05^{a}	0.61 ± 0.03^{a}	0.15 ± 0.01^{a}
	20%	3.22 ± 0.03^{b}	5.59 ± 0.37^{abc}	2.37 ± 0.03^{a}	4.24 ± 0.07^{a}	3.89 ± 0.05^{a}	3.27 ± 0.03^{a}	0.60 ± 0.05^{a}	0.14 ± 0.02^{a}
	30%	3.22 ± 0.11^{b}	5.59 ± 0.06^{abc}	2.31 ± 0.08^{a}	4.23 ± 0.06^{a}	3.89 ± 0.07^{a}	3.24 ± 0.02^{a}	0.59 ± 0.05^{a}	0.14 ± 0.01^{a}
10%	0%	3.23 ± 0.08^{b}	5.41 ± 0.08^{abc}	2.53 ± 0.05^{a}	4.20 ± 0.22^{a}	3.93 ± 0.03^{a}	3.28 ± 0.08^{a}	0.66 ± 0.11^{a}	0.16 ± 0.01^{a}
	10%	3.18 ± 0.07^{b}	5.33 ± 0.16^{abc}	2.52 ± 0.08^{a}	4.20 ± 0.08^{a}	3.93 ± 0.02^{a}	3.27 ± 0.02^{a}	0.62 ± 0.09^{a}	0.15 ± 0.003^{a}
	20%	2.92 ± 0.04^{de}	5.13 ± 0.03^{c}	2.42 ± 0.08^{a}	4.18 ± 0.07^{a}	3.92 ± 0.09^{a}	3.23 ± 0.03^{a}	0.60 ± 0.04^{a}	0.14 ± 0.01^{a}
	30%	2.85 ± 0.03^{e}	5.10 ± 0.05^{c}	2.40 ± 0.13^{a}	4.18 ± 0.16^{a}	3.91 ± 0.14^{a}	3.23 ± 0.01^{a}	0.63 ± 0.10^{a}	0.14 ± 0.003^{a}
20%	0%	3.22 ± 0.05^{b}	5.42 ± 0.17^{abc}	2.54 ± 0.04^{a}	3.91 ± 0.05^{a}	3.85 ± 0.08^{a}	3.24 ± 0.12^{a}	0.62 ± 0.02^{a}	0.15 ± 0.02^{a}
	10%	3.16 ± 0.03^{b}	5.41 ± 0.12^{abc}	2.50 ± 0.01^{a}	4.05 ± 0.20^{a}	3.84 ± 0.04^{a}	3.18 ± 0.02^{a}	0.62 ± 0.01^{a}	0.15 ± 0.02^{a}
	20%	3.14 ± 0.07^{bc}	5.87 ± 0.08^{a}	2.50 ± 0.11^{a}	4.04 ± 0.25^{a}	3.84 ± 0.06^{a}	3.18 ± 0.05^{a}	0.62 ± 0.04^{a}	0.14 ± 0.01^{a}
	30%	3.06 ± 0.04^{bcd}	5.42 ± 0.14^{abc}	2.48 ± 0.09^{a}	4.04 ± 0.06^{a}	3.82 ± 0.10^{a}	3.15 ± 0.05^{a}	0.62 ± 0.01^{a}	0.13 ± 0.03^{a}
30%	0%	3.19 ± 0.05^{b}	5.44 ± 0.08^{abc}	2.49 ± 0.07^{a}	3.99 ± 0.06^{a}	3.76 ± 0.05^{a}	3.19 ± 0.11^{a}	0.61 ± 0.02^{a}	0.16 ± 0.02^{a}
	10%	3.12 ± 0.07^{bc}	5.22 ± 0.16^{bc}	2.47 ± 0.05^{a}	4.11 ± 0.04^{a}	3.75 ± 0.03^{a}	3.19 ± 0.05^{a}	0.61 ± 0.04^{a}	0.14 ± 0.01^{a}
	20%	3.09 ± 0.03^{bcd}	5.18 ± 0.04^{bc}	2.44 ± 0.03^{a}	4.00 ± 0.04^{a}	3.74 ± 0.16^{a}	3.18 ± 0.03^{a}	0.60 ± 0.02^{a}	0.13 ± 0.01^{a}
	30%	2.97 ± 0.02^{cde}	5.18 ± 0.09^{bc}	2.41 ± 0.14^{a}	3.99 ± 0.03^{a}	3.74 ± 0.06^{a}	3.16 ± 0.01^{a}	0.58 ± 0.01^{a}	0.14 ± 0.01^{a}

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

Table 6: (Cont.)

Level of SBM CP% replacement by NSM		Abdominal fat%	Bursa%	Heart%	Liver%	Spleen%	Gizzard%	Giblets%	Dressing%
Starter	Finisher								
0%	0%	2.26 ± 0.03^{a}	0.13 ± 0.01^{a}	0.48 ± 0.02^{a}	2.20 ± 0.10^{a}	0.23 ± 0.02^{ab}	1.44 ± 0.01^{a}	4.35 ± 0.12^{abc}	68.92 ± 1.05^{a}
	·10%	2.23 ± 0.03^{a}	0.13 ± 0.01^{a}	0.48 ± 0.02^{a}	2.23 ± 0.05^{a}	0.23 ± 0.01^{a}	1.44 ± 0.02^{a}	4.38 ± 0.10^{ab}	69.94 ± 0.28^{a}
	20%	2.19 ± 0.03^{a}	0.15 ± 0.01^{a}	0.49 ± 0.02^{a}	2.24 ± 0.04^{a}	0.23 ± 0.01^{a}	1.45 ± 0.02^{a}	4.41 ± 0.06^{ab}	70.52 ± 0.49^{a}
	30%	2.18 ± 0.02^{a}	0.14 ± 0.01^{a}	0.49 ± 0.02^{a}	2.24 ± 0.01^{a}	0.23 ± 0.04^{a}	1.46 ± 0.03^{a}	4.43 ± 0.13^{a}	70.20 ± 0.78^{a}
10%	0%	2.28 ± 0.01^{a}	0.13 ± 0.01^{a}	0.45 ± 0.03^{a}	1.93 ± 0.06^{b}	0.19 ± 0.01^{abc}	1.47 ± 0.01^{a}	4.04 ± 0.07^{c}	70.42 ± 0.51^{a}
	10%	2.27 ± 0.02^{a}	0.13 ± 0.03^{a}	0.45 ± 0.02^{a}	1.97 ± 0.03^{ab}	0.19 ± 0.01^{abc}	1.47 ± 0.01^{a}	4.08 ± 0.03^{bc}	69.58 ± 1.78^{a}
	20%	2.26 ± 0.10^{a}	0.14 ± 0.02^{a}	0.47 ± 0.01^{a}	2.04 ± 0.04^{ab}	0.19 ± 0.01^{abc}	1.47 ± 0.01^{a}	4.17 ± 0.06^{abc}	70.06 ± 0.27^{a}
	30%	2.25 ± 0.05^{a}	0.15 ± 0.02^{a}	0.47 ± 0.01^{a}	2.01 ± 0.17^{ab}	0.21 ± 0.01^{abc}	1.48 ± 0.01^{a}	4.17 ± 0.19^{abc}	68.77 ± 0.41^{a}
20%	0%	2.27 ± 0.02^{a}	0.13 ± 0.02^{a}	0.44 ± 0.02^{a}	2.01 ± 0.01^{a}	0.18 ± 0.01^{b}	1.46 ± 0.03^{a}	4.09 ± 0.04^{bc}	68.57 ± 0.86^{a}
	10%	2.23 ± 0.01^{a}	0.15 ± 0.01^{a}	0.44 ± 0.01^{a}	2.07 ± 0.14^{ab}	0.19 ± 0.01^{abc}	1.47 ± 0.02^{a}	4.17 ± 0.15^{abc}	68.82 ± 1.03^{a}
	20%	2.23 ± 0.02^{a}	0.15 ± 0.01^{a}	0.45 ± 0.03^{a}	2.06 ± 0.05^{a}	0.19 ± 0.01^{abc}	1.47 ± 0.02^{a}	4.17 ± 3.46^{abc}	68.39 ± 0.79^{a}
	30%	2.22 ± 0.11^{a}	0.16 ± 0.01^{a}	0.46 ± 0.02^{a}	2.09 ± 0.04^{a}	0.20 ± 0.01^{abc}	1.48 ± 1.53^{a}	4.23 ± 0.06^{abc}	70.38 ± 1.82^{a}
30%	0%	2.25 ± 0.02^{a}	0.16 ± 0.01^{a}	0.46 ± 0.02^{a}	2.10 ± 0.01^{a}	0.16 ± 0.01^{c}	1.45 ± 0.02^{a}	4.16 ± 0.06^{abc}	70.84 ± 0.19^{a}
	10%	2.00 ± 0.06^{a}	0.16 ± 0.02^{a}	0.47 ± 0.02^{a}	2.10 ± 0.13^{ab}	0.16 ± 0.01^{c}	1.45 ± 0.01^{a}	4.19 ± 0.17^{abc}	70.12 ± 0.31^{a}
	20%	2.00 ± 0.01^{a}	0.16 ± 0.01^{a}	0.47 ± 0.02^{a}	2.12 ± 0.04^{a}	0.16 ± 0.01^{c}	1.46 ± 0.02^{a}	4.21 ± 0.07^{abc}	69.91 ± 0.05^{a}
	·30%	1.98 ± 0.04^{a}	0.16 ± 0.01^{a}	0.47 ± 0.02^{a}	2.16 ± 0.03^{a}	0.18 ± 0.01^{b}	1.46 ± 0.01^{a}	4.26 ± 0.05^{abc}	69.49 ± 0.42^{a}

a, b, c: means in the same column having different letters are significantly different at $p \leq 0.05$.

Table 7: Sensory evaluation of cooked FQ carcass meat of broiler chicks fed the experimental diets at 7 wk of age.

Level of SBM CP% replacement by NSM		Color	Tenderness	Juiciness	Chewiness	Flavor	Odour	Acceptance
Starter	Finisher							
0%	0%	8.50±0.17^{a}	7.80±0.20^{f}	7.80±0.20^{f}	7.80±0.20^{f}	6.80±0.20^{f}	8.20±0.13^{a}	7.80±0.20^{f}
	10%	8.50±0.17^{a}	8.00±015^{ef}	8.00±015^{ef}	8.00±015^{ef}	7.00±015^{ef}	8.20±.013^{a}	8.00±015^{ef}
	20%	8.50±0.17^{a}	8.10±0.18^{def}	8.10±0.18^{def}	8.10±0.18^{def}	7.10±0.18^{def}	8.10±0.18^{a}	8.10±0.18^{def}
	30%	7.70±0.15^{bc}	8.20±0.13^{cdef}	8.20±0.13^{cdef}	8.20±0.13^{cdef}	7.20±0.13^{cdef}	8.00±0.21^{a}	8.20±0.13^{cdef}
10%	0%	7.70±0.15^{bc}	8.70±0.15^{bc}	8.70±0.15^{bc}	8.70±0.15^{bc}	7.70±0.15^{bc}	8.20±0.20^{a}	8.70±0.15^{bc}
	10%	7.80±0.13^{b}	9.50±0.17^{a}	9.50±0.17^{a}	9.50±0.17^{a}	8.50±0.17^{a}	8.00±0.21^{a}	9.50±0.17^{a}
	20%	7.60±0.16^{bcd}	9.50±0.17^{a}	9.50±0.17^{a}	9.50±0.17^{a}	8.50±0.17^{a}	8.00±0.21^{a}	9.50±0.17^{a}
	30%	7.30±0.26^{bcdef}	9.50±0.17^{a}	9.50±0.17^{a}	9.50±0.17^{a}	8.50±0.17^{a}	8.00±0.21^{a}	9.50±0.17^{a}
20%	0%	7.40±0.16^{bcde}	8.70±0.15^{bc}	8.70±0.15^{bc}	8.70±0.15^{bc}	7.70±0.15^{bc}	8.00±0.21^{a}	8.70±0.15^{bc}
	10%	7.60±0.16^{bcd}	8.80±0.13^{b}	8.80±0.13^{b}	8.80±0.13^{b}	7.80±0.13^{b}	8.00±0.21^{a}	8.80±0.13^{b}
	20%	7.60±0.16^{bcd}	8.60±0.16^{bcd}	8.60±0.16^{bcd}	8.60±0.16^{bcd}	7.60±0.16^{bcd}	8.00±0.21^{a}	8.60±0.16^{bcd}
	30%	7.10±0.23^{def}	8.30±0.26^{bcdef}	8.30±0.26^{bcdef}	8.30±0.26^{bcdef}	7.30±0.26^{bcdef}	8.10±0.18^{a}	8.30±0.26^{bcdef}
30%	0%	7.20±0.13^{cdef}	8.40±0.16^{bcde}	8.40±0.16^{bcde}	8.40±0.16^{bcde}	7.40±0.16^{bcde}	8.00±.21^{a}	8.40±0.16^{bcde}
	10%	7.10±0.18^{def}	8.60±0.16^{bcd}	8.60±0.16^{bcd}	8.60±0.16^{bcd}	7.60±0.16^{bcd}	8.00±.21^{a}	8.60±0.16^{bcd}
	20%	7.00±0.15^{ef}	8.60±0.16^{bcd}	8.60±0.16^{bcd}	8.60±0.16^{bcd}	7.60±0.16^{bcd}	8.00±.21^{a}	8.60±0.16^{bcd}
	30%	6.80±0.20^{f}	8.10±0.23^{def}	8.10±0.23^{def}	8.10±0.23^{def}	7.10±0.23^{def}	7.80±0.13^{a}	8.10±0.23^{def}

a, b, c,...., f: means in the same column having different letters are significantly different at $p \leq 0.05$.

Table 8: Sensory evaluation of cooked HQ carcass meat of broiler chicks fed the experimental diets at 7 wk of age.

Level of SBM CP% replacement by NSM		Color	Tenderness	Juiciness	Chewiness	Flavor	Odour	Acceptance
Starter	Finisher							
0%	0%	7.50±0.17[a]	6.80±0.20[f]	6.80±0.20[f]	6.80±0.20[f]	5.80±0.20[f]	8.20±0.13[a]	6.80±0.20[f]
	10%	7.50±0.17[a]	7.00±015[ef]	7.00±015[ef]	7.00±015[ef]	6.00±015[ef]	8.20±.013[a]	7.00±015[ef]
	20%	7.50±0.17[a]	7.10±0.18[def]	7.10±0.18[def]	7.10±0.18[def]	6.10±0.18[def]	8.10±0.18[a]	7.10±0.18[def]
	30%	6.70±0.15[bc]	7.20±0.13[cdef]	7.20±0.13[cdef]	7.20±0.13[cdef]	6.20±0.13[cdef]	8.00±0.21[a]	7.20±0.13[cdef]
10%	0%	6.70±0.15[bc]	7.70±0.15[bc]	7.70±0.15[bc]	7.70±0.15[bc]	6.70±0.15[bc]	8.20±0.20[a]	7.70±0.15[bc]
	10%	6.80±0.13[b]	8.50±0.17[a]	8.50±0.17[a]	8.50±0.17[a]	7.50±0.17[a]	8.00±0.21[a]	8.50±0.17[a]
	20%	6.60±0.16[bcd]	8.50±0.17[a]	8.50±0.17[a]	8.50±0.17[a]	7.50±0.17[a]	8.00±0.21[a]	8.50±0.17[a]
	30%	6.30±0.26[bcdef]	8.50±0.17[a]	8.50±0.17[a]	8.50±0.17[a]	7.50±0.17[a]	8.00±0.21[a]	8.50±0.17[a]
20%	0%	6.40±0.16[bcde]	7.70±0.15[bc]	7.70±0.15[bc]	7.70±0.15[bc]	6.70±0.15[bc]	8.00±0.21[a]	7.70±0.15[bc]
	10%	6.60±0.16[bcd]	7.80±0.13[b]	7.80±0.13[b]	7.80±0.13[b]	6.80±0.13[b]	8.00±0.21[a]	7.80±0.13[b]
	20%	6.60±0.16[bcd]	7.60±0.16[bcd]	7.60±0.16[bcd]	7.60±0.16[bcd]	6.60±0.16[bcd]	8.00±0.21[a]	7.60±0.16[bcd]
	30%	6.10±0.23[def]	7.30±0.26[bcdef]	7.30±0.26[bcdef]	7.30±0.26[bcdef]	6.30±0.26[bcdef]	8.10±0.18[a]	7.30±0.26[bcdef]
30%	0%	6.20±0.13[cdef]	7.40±0.16[bcde]	7.40±0.16[bcde]	7.40±0.16[bcde]	6.40±0.16[bcde]	8.00±0.21[a]	7.40±0.16[bcde]
	10%	6.10±0.18[def]	7.60±0.16[bcd]	7.60±0.16[bcd]	7.60±0.16[bcd]	6.60±0.16[bcd]	8.00±0.21[a]	7.60±0.16[bcd]
	20%	6.00±0.15[ef]	7.60±0.16[bcd]	7.60±0.16[bcd]	7.60±0.16[bcd]	6.60±0.16[bcd]	8.00±0.21[a]	7.60±0.16[bcd]
	30%	5.80±0.20[f]	7.10±0.23[def]	7.10±0.23[def]	7.10±0.23[def]	6.10±0.23[def]	7.80±0.13[a]	7.10±0.23[def]

a, b, c,...., f: means in the same column having different letters are significantly different at $p \leq 0.05$.

Table(9) and Table (10) shows some blood serum constituents of broiler chicks at 4 and 7 wk, respectively. Generally, it can be noticed that chicks fed diets containing NSM had significantly higher TP, Alb, Glo, Ca and P values while had significantly lower TG and Choles values than those fed diet free of NSM.

Table 9: Some blood serum constituents of broiler chicks fed the experimental diets at 4 wk of age

Level of SBM CP% replacement by NSM	TP g/dl	Alb. g/dl	Glo. g/dl	A/G ratio	TG mg/dl	Cho. mg/dl	Ca mg/dl	P mg/dl
0	4.27 ±0.003[b]	2.09 ±0.003[c]	2.18 ±0.003[c]	0.96 ±0.003[c]	80.34 ±0.004[a]	100.04 ±0.01[a]	6.65 ±0.003[d]	8.09± 0.004[d]
10	4.28 ±0.004[b]	2.14 ±0.004[b]	2.14 ±0.006[d]	0.99 ±0.004[b]	80.32 ±0.003[b]	100.03 ±0.01[a]	6.74 ±0.004[c]	8.26± 0.003[c]
20	4.56 ±0.003[a]	2.31 ±0.003[a]	2.25 ±0.004[a]	1.03 ±0.003[a]	80.11 ±0.003[c]	99.18 ±0.23[b]	6.81 ±0.003[b]	8.45 ±0.003[b]
30	4.28 ±0.003[b]	2.08 ±0.003[d]	2.20 ±0.003[b]	0.95 ±0.002[d]	80.12 ±0.003[c]	99.60 ±0.23[b]	6.99 ±0.01[a]	8.64 ±0.004[a]

a, b, c, d: means in the same column having different letters are significantly different at $p \leq 0.05$.

The previous data indicated that the increase in 4-wk serum protein fractions (TP, Alb., Glo. and A/G ratio) related to the 20 % NSM may be due to the increase which may have occurred in the level of metabolic processes (Abdel-Malak *et al.*, 1995). Furthermore, The increase in serum Glo. concentration may reflect an increase in Glo. synthesis of chicks receiving the 20 or 30 % NSM in order to enhance the resistance of chicks against different stress factors.

The low level of serum Cho. obtained with NSM-containing diets may be due to the presence of unsaturated fatty acids in NSM which stimulate the Choles. excretion into the intestine and oxidation of Cho. into bile acid. This notation is in agreemrnt with those reported by Mandour *et al.*, (1998) who reported that feeding chickens with Nigella Sativa seeds decreased serum Choles. level. Ghazalah and Ibrahim (1996) reached similar conclusion. They found that using black seed oil in diets of Muscovi ducks decreased Cho. content of blood serum. Similar to the last observation, Hedaya (1995) showed that the injection of black seed extract to male rats decreases the serum Cho. level.

The increase in serum Ca and P concentrations shown herein may be in coordination with those of Mandour *et al.*, (1998) who demonstrated that the low levels of Nigella Sativa seeds increased Ca value, but the level (8%) decreased it. These alterations in Ca and P concentrations can be attributed to the NSM itself in its role of absorption of minerals (Mandour *et al.*, 1998).

Economical efficiency (EE_f):

Economical evaluation parameters for substituting SBM by NSM in broiler diets in terms of feeding cost of the experimental diets, net revenue and economical efficiency (EE_f) of meat production are listed in Table 11.

Table 10: Some blood serum constituents of broiler chicks fed the experimental diets at 7 wk of age

Level of SBM CP% replacement by NSM: Starter	Finisher	TP g/dl	Alb. g/dl	Glo. g/dl	A/G ratio	TG mg/dl	Cho. mg/dl	Ca mg/dl	P mg/dl
0%	0%	4.31±0.01^{g}	2.50±0.01^{g}	1.81±0.003^{g}	1.38±0.002^{ab}	90.43±0.01^{a}	100.31±0.01^{a}	6.83±0.01^{h}	8.56±0.01^{fg}
	10%	4.39±0.01^{e}	2.55±0.01^{abcd}	1.84±0.01^{f}	1.39±0.01^{a}	90.41±0.003^{ab}	100.29±0.01^{ab}	6.85±0.01^{gh}	8.58±0.01^{ef}
	20%	4.44±0.01^{bc}	2.57±0.01^{a}	1.87±0.01^{de}	1.37±0.01^{ab}	90.39±0.003^{c}	100.28±0.01^{b}	6.87±0.01^{def}	8.60±0.01^{de}
	30%	4.36±0.01^{f}	2.48±0.01^{h}	1.88±0.01^{cd}	1.32±0.01^{ef}	90.37±0.01^{d}	100.25±0.01^{c}	6.90±0.01^{bcd}	8.62±0.01^{bcd}
10%	0%	4.38±0.01^{e}	2.53±0.01^{def}	1.85±0.01^{ef}	1.37±0.003^{bc}	90.40±0.01^{bc}	100.26±0.003^{c}	6.84±0.01^{gh}	8.56±0.01^{gh}
	10%	4.41±0.01^{d}	2.55±0.01^{abcd}	1.86±0.01^{de}	1.37±0.002^{ab}	90.37±0.01^{d}	100.25±0.003^{c}	6.85±0.01^{gh}	8.58±0.01^{fg}
	20%	4.43±0.01^{cd}	2.560.01^{abcd}	1.87±0.01^{de}	1.37±0.01^{ab}	90.34±0.01^{e}	100.21±0.01^{d}	6.87±0.01^{def}	8.61±0.01^{d}
	30%	4.41±0.01^{d}	2.51±0.01^{fg}	1.90±0.01^{bc}	1.32±0.01^{ef}	90.32±0.01^{f}	100.18±0.01^{e}	6.90±0.01^{abc}	8.63±0.01^{abc}
20%	0%	4.43±0.01^{cd}	2.56±0.01^{abc}	1.87±0.01^{de}	1.37±0.01^{ab}	90.35±0.003^{e}	100.21±0.003^{d}	6.86±8.82^{efg}	8.51±8.82^{i}
	10%	4.43±0.01^{cd}	2.53±0.00^{def}	1.90±0.01^{bc}	1.33±0.004^{de}	90.32±0.01^{f}	100.20±0.003^{de}	6.88±8.82^{cde}	8.56±8.82^{fg}
	20%	4.46±0.01^{a}	2.55±0.01^{bcd}	1.92±0.01^{ab}	1.33±0.004^{de}	90.30±0.003^{fg}	100.16±0.01^{f}	6.91±1.16^{abc}	8.58±6.67^{ef}
	30%	4.43±0.01^{cd}	2.51±0.01^{g}	1.92±0.01^{a}	1.30±0.002^{f}	90.28±0.01^{h}	100.12±0.01^{hi}	6.92±8.82^{ab}	8.65±8.82^{a}
30%	0%	4.44±0.01^{bc}	2.54±0.01^{cde}	1.91±0.01^{bc}	1.34±0.01^{de}	90.30±0.01^{fg}	100.15±0.01^{fg}	6.86±0.003^{efg}	8.54±0.01^{h}
	10%	4.46±0.01^{ab}	2.55±0.01^{abc}	1.91±0.01^{ab}	1.34±0.01^{de}	90.29±0.01^{gh}	100.14±0.01^{gh}	6.89±0.01^{cde}	8.58±0.01^{fg}
	20%	4.47±0.01^{a}	2.56±0.01^{ab}	1.90±0.01^{ab}	1.34±0.01^{cd}	90.27±0.003^{hi}	100.11±0.003^{i}	6.91±0.01^{abc}	8.61±0.003^{cd}
	30%	4:42±0.01^{cd}	2.52±0.01^{efg}	1.88±0.01^{bc}	1.35±0.002^{de}	90.26±0.003^{i}	99.98±0.01^{j}	6.93±0.01^{a}	8.64±0.003^{ab}

a, b, c,...., j: means in the same column having different letters are significantly different at $p \leq 0.05$.

Table 11: Input-output analysis and economical efficiency ratio of experimental treatments during the whole period.

Level of SBM CP% replacement by NSM		Feed intake (kg/bird) (a)		Price/kg feed (PT) (b)*		Total feed cost /bird (PT) (c) =a x b	Total gain (kg/bird)	Selling price /bird (PT) (Total Revenue) (d)**	Net revenue /bird (PT) (e) =d-c	Economical efficiency (EEr) (e/c)***	Relative economical efficiency %
Starter	Finisher	Starter	Finisher	Starter	Finisher						
0%	0%	1.31	2.54	92.44	86.00	339.54	1.93	887.80	548.26	1.61	100.0
	10%		2.45		83.05	324.57	1.95	897.20	572.43	1.76	109.3
	20%		2.44		80.51	317.54	1.94	892.40	574.86	1.81	112.4
	30%		2.44		78.01	311.44	1.89	869.40	557.96	1.79	111.2
10%	0%	1.31	2.50	89.04	86.00	331.64	2.03	933.80	602.16	1.82	113.0
	10%		2.47		83.05	321.78	2.03	933.80	612.02	1.90	118.0
	20%		2.46		80.51	314.70	2.02	929.20	614.50	1.95	121.1
	30%		2.46		78.01	308.55	2.00	920.00	611.45	1.98	123.0
20%	0%	1.35	2.53	86.71	86.00	334.64	2.02	929.20	594.56	1.78	110.6
	10%		2.50		83.05	324.68	2.02	929.20	604.52	1.86	115.5
	20%		2.46		80.51	315.11	1.97	906.20	591.09	1.88	116.8
	30%		2.46		78.01	308.96	1.96	901.60	592.64	1.92	119.3
30%	0%	1.35	2.54	83.81	86.00	331.58	1.95	897.00	565.42	1.71	106.2
	10%		2.48		83.05	319.11	1.89	869.94	550.83	1.73	107.5
	20%		2.48		80.51	312.81	1.89	869.94	557.13	1.78	110.6
	30%		2.47		78.01	305.83	1.88	864.80	558.97	1.83	113.7

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

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

*** Net revenue per unit feed cost.

5The results of EE_f of 7-wk-old chicks showed that the use of NSM in broiler diets resulted in lower feed cost than diet containing 0/0 % NSM. Moreover, feeding chicks on diets containing NSM showed higher EE_f as compared to those fed diet containing 0/0 % NSM except for chicks fed diet containing 30/0, and 30/10 % NSM which had similar EE_f to those fed diet containing 0/0 % NSM. 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 price 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_f of the diets containing 9, 18, and 28 % NSM of dietary CP was higher than that of the control diet. On the contrary, the present results are not in line with those of Ghazalah and Ibrahim (1996) who indicated that the administration of black seed oil to Muscovi ducks did not affect the EE_f of the diets. Also, Osman and El-Barody (1999) found that Nigella Sativa seeds had insignificant effect on feed cost / kg gain.

Digestibility Trial: -

Data of nutrients digestibility coefficients for starting diets (Table 12), showed that the digestibility coefficients of OM for diets containing NSM were significantly higher than those containing 0% NSM which had the lowest one. The digestibility coefficients of CP for diets containing NSM were significantly higher than those containing 0% NSM except diet containing 30% NSM which had similar value to those containing 0 % NSM. The highest digestibility coefficient value of CP was recorded for diet containing 20 % NSM followed by those containing 10 % NSM. Digestibility coefficients of CF for the experimental diets did not significantly different from each other. The obtained results also revealed that diets containing NSM had significantly higher digestibility coefficients for EE than those containing 0 % NSM. The highest value was recorded for diet containing 20 % NSM followed by those containing 30 % NSM, while 10 % NSM diet gave similar value to that of the control diet (0 % NSM)

Table 12 : Digestibility coefficients of OM, CP, CF and EE %of the experimental starter and finisher diets.

Item	Level of SBM CP% replacement by NSM							
	Starter diet				Finisher diet			
	0%	10%	20%	30%	0%	10%	20%	30%
O-M %	87.22 $\pm0.003^c$	87.41 $\pm0.006^b$	87.46 $\pm0.003^a$	87.46 $\pm0.003^a$	87.33 $\pm0.003^{bc}$	87.34 $\pm0.003^b$	87.39 $\pm0.003^a$	87.32 $\pm0.01^c$
CP %	89.13 $\pm0.003^c$	89.23 $\pm0.003^b$	89.31 $\pm0.003^a$	89.12 $\pm0.003^c$	88.62 $\pm0.003^c$	88.63 $\pm0.003^{bc}$	88.70 $\pm0.003^a$	88.64 $\pm0.003^b$
CF %	66.52 $\pm0.003^a$	66.52 $\pm0.003^a$	66.53 $\pm0.003^a$	66.53 $\pm0.006^a$	68.32 $\pm0.009^a$	68.32 $\pm0.006^a$	68.32 $\pm0.003^a$	68.321 $\pm0.003^a$
EE %	83.76 $\pm0.006^c$	83.77±0. 003^c	83.88 $\pm0.006^a$	83.85 $\pm0.003^b$	84.14 $\pm0.003^{bc}$	84.15 $\pm0.003^b$	84.21 $\pm0.003^a$	84.13 $\pm0.003^c$

a, b, c: means in the same raw having different letters are significantly different at $p \leq 0.05$.

Data of nutrients digestibility coefficients for finishing diets (Table 12) showed that the digestibility coefficients of OM CP and EE for diets containing NSM were nearly similar to those containing 0% NSM except for diet containing 20 % NSM which had significantly higher digestibility coefficient value than those containing 0 % NSM. With regard to digestibility coefficient of CF, no significant differences were obtained among all the experimental diets.

The data indicated that the remarkable increase in nutrients digestibility by NSM may be due to its inhibiting effect on the mold growth and accordingly lead to a higher utilization efficiency of nutrients in the feed. This explanation seems reasonable because NSM may contain active materials shown to possess antimicrobial effect. Therefore, it may eliminate harmful bacteria which produce toxins that reduce chick growth, stimulate the growth of beneficial micro-organisms which synthesize either identified or unidentified nutrients, reduce the growth of micro-organisms which compete with host for the supplies of nutrients and increase the absorptive capacity of the intestine. However, the failure of NSM to cause a CF digestibility response might be attributable to the low CF content of the experimental diets. The obtained results of CF digestibility disagree with the findings of Abou-Egla *et al.* (2000) who found that Japanese quail chicks fed NSM replacing of SBM did not show any significant effect on EE and CF digestibilities.

In accordance with the present observation, it is advisable to use NSM up to 30 % to replace a part of SBM protein in broiler chick die. Such practice helped in decreasing the financial pressure on the farmer and seemed to be advantageous in improving the economical profitability without any adverse effects on broiler chicks.

REFERENCES

Abd El-Ghani, A.I. (1986). Studies on meat production in poultry. Ph. D. Thesis, Fac. Agric., Cairo Univ., Egypt.

Abdel-Malak, N.Y.; M.S. Abdel-Malak; G.M. El-Gendi and F. Emily (1995). Effect of feeding different levels of herbal feed additive on performance in relation to some metabolic functions. Egypt. Poult. Sci., 15:111-139.

Abou-Egla, E.; G.K. Salwa; A.E. Abou-Zeid and H.S. Zeweil (2000). Nigella Sativa seed oil meal as a non-traditional source of plant protein in Japanese quail diets. Egypt. Poult. Sci., 21 (I): 107-125

Abou El-Soud, S.B. (2000). Studies on some biological and immunological aspects in Japanese quail fed diets containing some Nigella Sativa seeds preparations. Egypt. Poult. Sci., 20 (IV): 757-776.

A.O.A.C. (1980). Official Methods of Analysis Association of Official Analytical Chemists, 15 th Edition, Washington, D.C., USA.

Babayan, V.K.; D. Koottungal and G.A. Halaby (1978). Proximate analysis, fatty acid and amino acid composition of Nigella Sativa L. seeds.J. Food Sci., 43: 1314-1315

Brody, S. (1949). Bioenergetics and growth. Reinhold corporation, New York, U.S.A. (1945).

Carpenter, K.J. and K.M. Clegg (1956). The metabolizable energy of poultry feedingstuffs in relation to their chemical composition. J. Sci. Food Agr, 7: 45-51.

Duncan, D.B. (1955). Multiple range and multiple F tests. Biometrics, 11: 1-42.

El-Gazaar, U.M.B. (1997) .Biochemical studies on vit. E deficiency in rats. Thesis Ph.D. Fac. Vet. Med. Alex. Univ.

Ghazalah, A.A. and F.A.A. Ibrahim (1996). The possibility of using some edible and aromatic oils in the nutrition of Muscovy ducks. Egypt Poult. Sci., 16:305-328

Hanafy, M.S. and M.E. Hatem (1991). Studies on the antimicrobial activity of Nigella Sativa seed (black cumin). J. Ethno-pharmacol., 34: 275-278.

Hedaya, S. (1995). Effect of Nigella Sativa seeds (Black seeds) extract on some. hematological and biochemical parameters in rats. Alex. J. Vet. Sci., 11 (2): 95-99.

Houghton, P.J.; R. Zarka; B.L. Heras and J.R.S. Hoult (1995). Planta Medica 33-36.

Jakobsen, P.E.; Kirston Gertoveg and H. Nielson (1960). Digestibility trials with poultry. 322 bereting fra forsgslaboratoriet, Udgivet of Statens. Husdyrbugsudvalg-Kobenhavn.

Khalifah, M.M.M. (1995). Nigella seed oil meal as a protein supplement in broiler diets. M. Sci. Thesis Fac. of Agric, Alexandria Univ.

Mandour, A.A.; K. Mahmoud; E. Assa Abou El-Wafa El-Agamy and R. Ommyma (1995). Effect of aflatoxin and Nigella Sativa seeds on serum proteins and its electrophoretic patterns in white pekin ducklings. 1st Egyptain-Hungarian poultry conference. 17-19 Sep. Alex. Egypt.

Mandour, A.A.; K.M. Ashry and S.A. Hedaya (1998). Biochemical profile of serum constituents of broiler chicken supplemented with different levels of Nigella Sativa (Black seed) with special reference to its effects on hormonal and mineral concentrations. Egypt. Poult. Sci., 18 (II): 429-439.

Molander, A.L. (1960). Discernment of primary test substances and probable ability.to judge food. Iowa State University Press, Ames, Iowa, U.S.A.

Nassar, H.M. (1997). Pharmacological and toxicological studies on Nigella Sativa. Ph.D. Thesis Vet. Med. Sci., Fac.Vet. Med., Alex. Univ.

National Research Council, N. R. C. (1994). Nutrient Requirements of Poultry 9th ed, National Academy of Science,. Washinton, D.C., U.S.A.

North, M.O. (1981). Commercial Chicken Production Manual, 2 nd Edition. AVI Publishing Company INC, USA.

Osman, A.M.A. and M.A.A. El-Barody (1999). Growth performance and immune response of broiler chicks as affected by diet density and Nigella Sativa seeds supplementation. Egypt. Poult. Sci., 19 (III): 619-634.

Rathee, P.S.; S.H. Mishra and R. Kaushal (1982). Antimicrobial activity of essential oil, fixed oil and unsaponifiable matter of Nigella Sativa L. Indian J. Pharmac. Sci., 44: 8-10.

Soltan, M.A. (1999). Effect of diets containing Nigella Sativa (black seeds) and or ox bile on growth and reproductive performance of Japanese quail. Alex. J. Vet. Sci., 15(3): 655-669.

SPSS (1993). SPSS Statistical software Package for the social sciences. 2 nd ed. HA33-N48. McGrow-Hill, Inc., USA.

Steel, R.G.D. and J.H. Torrie (1980). Principles and procedures of statistics: A Biometrical 2 nd ed. McGraw-Hill Book Co., Inc., New York, USA.

Ustun, G.; L. Kent; N. Cekin and H. Civele Koglu (1990). Investigation of the technological properties of Nigella Sativa L., (black cumin) seed oil. JAOCS, 67(12): 958-960.

Zeweil, H.S. (1996). Evaluation of substituting Nigella seed oil meal forsoybean meal on the performance of growing and laying Japanese Quails. Egypt. Poult. Sci., 16: 451-477.

تأثير استبدال كسب فول الصويا بكسب حبة البركة على أداء النمو وصفات الذبيحة ومكونات الدم واختبار التذوق لكتاكيت التسمين

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كونت أربعة علائق تسمين متساوية الطاقة والبروتين في كل من البادئ (٣٠٩٣ كيلو كالورى/كجم ،٢٢,٠٣٪ بروتين خام) والناهي (٣٢٠٥ كيلو كالورى/كجم ، ١٨,٥٪ بروتين خام) والتي استبدل فيها بروتين كسب فول الصويا ببروتين كسب حبة البركة بمستويات صفر (مقارنة) ، ١٠ ، ٢٠ ، ٣٠٪ حيث غذيت فى فترة البادئ والناهي.

استخدم في هذه التجربة عدد ٥٧٦ كتكوت تسمين غير مجنس عمر أسبوع من نوع أربورايكرز حيث وزعت عشوائيا على أربعة مجموعات تجريبية متساوية تحتوى كل منها على ١٢ مكرر متساوية في فترة البادئ حيث غذيت مجموعات الكتاكيت على العلائق البادئة والتي استبدل فيها بروتين كسب فول الصويا جزئيا ببروتين كسب حبة البركة بنسب صفر ، ١٠٪ ، ٢٠٪ ، ٣٠ ٪. وفى بداية فترة الناهي أختير عدد ١٢٠ كتكوت عشوائيا من كل مجموعة تجريبية .قسمت إلى أربعة مجموعات فرعية كل مجموعة في ٣ مكررات متساوية حيث غذيت على العلائق الناهية المحتوية على كسب حبة البركة وبذلك كان هناك أربعة مجموعات تجريبية في فترة البادئ وستة عشر مجموعة في فترة الناهي.

ومن الناحية الغذائية و الاقتصادية يمكن أن نستخلص أن استبدال بروتين كسب فول الصويا ببروتين كسب حبة البركة حتى ٣٠ ٪ في علائق البادئ والناهي لكتاكيت التسمين حسن أداء النمو ومعاملات الهضم للعناصر الغذائية فى العلائق التجريبية دون أى تأثيرات عكسية أو ضارة على صفات الذبيحة ومكونات الدم لبدارى التسمين . وحيث أن إنتاج الدواجن يعتمد بصفة رئيسية على العائد الاقتصادي فأن تغذية كتاكيت التسمين على علائق تحتوى بروتين كسب حبة البركة بمستويات١٠ أو ٢٠ ٪ حتى عمر أربعة أسابيع وحتى ٣٠ ٪ إلى عمر سبعة أسابيع بدلا من بروتين كسب فول الصويا أعطت أفضل كفاءة اقتصادية.