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GROWTH PERFORMANCE, CARCASS CHARACTERISTICS AND SOME HAEMATOLOGICAL CONSTITUENTS OF JAPANESE QUAILS FED DIETS CONTAINING DIFFERENT LEVELS OF SUNFLOWER AND SESAME MEAL AS A REPLACEMENT OF SOYBEAN MEAL

Abdel-Hakim, N. F.*; A. A. Amer*; A. F. Abdel-Azeem* ; Akila S. Hamza* and A. F. Fahrghly*

*** Fac. Agric., Al-Azhar Univ., Naser City, Cairo, Egypt**

**** Regional Center for Food and Feed**

ABSTRACT

This study was conducted to investigate the effect of replacing soybean meal (SBM) by locally available oilseed meals i.e., sunflower seed meal (SFM) and sesame seed meal (SSM) at different substitution levels 25, 50 and 100% on an isonitrogenous and isocaloric basis. A total number of 315 mixed sex 7th days -old Japanese quails were randomly distributed into 7 treatment groups of 45 birds each, with three replicates containing 15 birds each. The experiment was carried out for 42 days (from7th to 48th days of age). Treatment 1 was fed a control diet (100% SBM), whereas treatment 2, 3,4,5,6 and 7 were fed diets containing 25, 50 and 100% of both SFM and SSM respectively. SBM was replaced with SFM and SSM on a weight basis. Experimental diets and fresh water were offered *ad* libitum along with the experimental period. Results revealed that substitution of SBM by SFM at 50% and 100% significantly ($p \leq 0.05$) increased live body weight, body weight gain, protein and energy efficiency ratios compared with quails fed other dietary treatment groups. While feed intake, protein and energy intakes were significantly ($p \leq 0.05$) higher for quails fed 100% SBM (control group) compared with quails fed SFM or SSM at different levels. However feed conversion ratio was the best for quails fed 100% and 50% SFM, followed by quails fed 100%SSM, 25%SFM, 50% SSM and control diet (100% SBM) respectively, while the worst FCR was observed for quails fed 25% SSM. The highest mortality rate was observed for quails fed 100% SSM, while the lowest values were recorded for quails fed 25% SFM. Carcass traits expressed as percentage of body weight were significantly ($p \leq 0.05$) affected by replacing SBM with SFM and SSM at different levels, where the percentage of total edible part were significantly ($p \leq 0.05$) higher for quails fed 50 % SFM, while the lowest values were shown for quails fed 25% SSM and 100% SBM (control group). However total inedible parts percentage were significantly ($p \leq 0.05$) higher for quails fed 100% SBM (control group), while the lowest values were recorded for quails fed 50% SFM. Concerning plasma parameters and carcass composition measured at the end of experimental period significant ($p \leq 0.05$) differences were observed among the experimental groups due to feeding Japanese quails on diets containing different levels of SFM and SSM or control group, except with ALT values, where insignificant differences were detected. Replacement of SBM by SFM or SSM at 25, 50 and 100% levels reduced feed costs/birds. In general, conclusion based on the present results it could be recommended that SFM or SSM can safely replace SBM up to 50 and100% without any adverse effects on growth performance or carcass traits of Japanese quail and using of SFM in quail diets as a plant protein alternative source was better than SSM.

Keywords: *(Japanese quail, sunflower meal, sesame meal, growth performance)*

INTRODUCTION

In Egypt, there is a serious problem of feed shortage for livestock especially in poultry field. Also there is a continuous increase in the prices of the traditional feed ingredients, especially soybean meal, owing to its universal use. This obliged the nutritionists to search for alternative cheap and good untraditional feedstuffs, such as sunflower meal and sesame meal. However the scarcity of feed ingredients is the main obstacle to the development of the poultry industry in Egypt and in many developing countries. Recently the possible threats from pathogenic bacteria and greater variability in protein quality in animal protein sources encourage using the vegetable protein in poultry diets *(Rama Rao et al. 2006)*. Plant protein sources i.e., sunflower seed meal (SFM)) and sesame seed meal (SSM) have the potential to be major feed ingredients for poultry in many countries not suitable for extensive soybean (SBM) cultivation. Sunflower *(Helianthus annuus)* is an oilseed cultivated worldwide for oil sources, due to its great capability of adaptation to different climatic and soil conditions *(Ra- vindran and Blair, 1992).* The by –product rendered by the oil industry, sunflower meal (SFM), is used as an alternative source of protein in livestock nutrition. It's crude protein (CP) content depends on dehulling and oil extraction process ranging from 29 to 45%, having an inverse relation to crude fiber (CF) content, which ranging from 14 to 32 % *(FEDNA, 1994).* Moreover the high fiber content and low lysine content limiting the use of SFM in poultry diets. On the other hand sesame (*Sesamum indicum*) meal (SSM) contains most of the essential amino acids at adequate amounts for the substitution of soybean meal (SBM) in practical diets, with the exception of lysine, for both growing broiler and laying hens *(Scott et al., 1982)*. SSM is widely grown for caculinary use in Asian and African countries, which produce nearly 95% *(FAO, 2004)* of world sesame seed. *Rajesh et al (2006)* reported that SFM can be safely included by replacing SBM up to 33 to 66% in broiler diets without and with enzyme mixture respectively to get a better performance. However *Rama Roa et al. (2008)* showed that the crude protein content of sunflower seed meal (SSM) was lower than that of SBM (296 and 448g/Kg), but methionine, cystine, calcium, phosphorus and ether extract were higher (7.2 and 5.7, 6.8 and 6.5, 12.7 and 0.3, 13.8 and 5.7, 57.7 and 9.5g/Kg, respectively). SSM contained lower concentration of lysine, threonine, isolucine, leucine and valine (6.2, 8.7, 8.9, 16.6 and 11.4g/Kg,) compared with those found in SBM (26.7, 17, 20.4, 36.4 and 21.3g/kg, respectively)**.**The same authors added that body weight gain of broiler chickens was not affected by feeding on diets containing sunflower seed meal (SSM) up to 0.67 % proportion of SBM in starter and finisher diets (360 and 310 g/Kg respectively). In other study by *Abdel-Hakim et al. (2009)* showed that replacing 50 or 100% of SBM protein by SFM, SSM and LSM revealed no significant effect on final body weight of broiler chickens. Also they indicated that carcass traits and mortality were not affected by replacing SBM protein by 50 or 100% of SFM and SSM. The present investigation was conducted with Japanese quails to study the effect of replacing SBM with graded levels of both SFM and SSM on growth performance, carcass traits, carcass composition, some hematological traits and economical efficiency of the experimental diets.

MATERIALS AND METHODS

This study was carried out at the Poultry Experimental Station, Faculty of Agriculture, Al-Azhar University, Naser City, Cairo, Egypt, in order to investigate the effect of replacing SBM with graded levels of both SFM and SSM at 25, 50 and 100% on growth performance, carcass characteristics, carcass composition and some hematological traits of Japanese quails. Also economic efficiency was calculated at the end of growing period. Chicks were raised together during the fist 7^{th} days of age to avoid any mortalities occurred during the first life of age. At the end of the 7^{th} days of age all chicks were individually weighed at start of experiment to the nearest gram to avoid the differences in weight at start of experiment and the average weight ranged between (16.93 to 18.04 ± 0.41 g). A total number of 315 chicks at 7^{th} days old were used in this study. The chicks were randomly distributed into 7 treatment groups containing 45 birds each. Each treatment was represented by 3 replicates each with 15 birds. The chicks were weighed at weekly intervals during the experimental growing period, and average live body weight was recorded. Body weight gain, feed intake, feed conversion ratio (g feed /g gain), protein intake, energy intake, protein and energy efficiency ratios and mortality rate were recorded. SBM was replaced by SFM and SSM at levels of 25, 50 and 100% (weight /weight). Diets composition and proximate chemical analysis were done before the start of experiment according to *AOAC (1994),* and shown in Table (1). Samples of raw material of SFM and SSM were taken for chemical composition and some amino acid analysis and the values are given in Table (2). All diets were isocaloric and isonitrogenous and contained the nutrient requirements of growing Japanese quails according to *NRC (1994).* Both diet and water were offered *ad libitum* along the experiment duration. At the end of experimental period (48^{th} days of age) samples of blood were taken from 10 birds (5 female and 5 males) for each treatment. Birds were fasted 24 hour prior to blood sampling. All samples were centrifuged at 3000 rpm for 15 minutes. Plasma was separated and stored in vials at -20 C^o until analysis. All tests were analyzed by using Spectrophotometer apparatus (Model 722 GRATING). The constituents of blood were determined e.g., total plasma protein according to *(*Henry, 1964), albumin *(*Doumas and Biggs*,* 1972*),* lipid *(*Zollner and Kirsch*, 1962),* triglycerides *(*Dryer*, 1970)*, cholesterol (Allain *et al.,* 1971), HDL (Warnick *et al.,* 1983), LDL (Assmann *et al.,* 1984) AST and ALT *(Reitman and Frankel, 1957).* Commercial kits (made in Egypt) by Diamond Company, Stanpio, Laboratory Pasteur Lab. Diagnostic and biodiaquastic Company were used for the blood analysis. The globulin values obtained by subtracting the values of albumin from the corresponding values of total protein. Also albumin/ globulin (A/G ratio) values were obtained by dividing the values of albumin on the values of globulins.

Table (1): Composition and determined analysis of the Japanese growing diets based on maize and soybean meal, sunflower seed meal and sesame seed meal

Ingredients	Control (100% SBM)	Substitution levels (%)					
		SSM			SFM		
		25.0	50.0	100.0	25.0	50.0	100.0
Ground yellow corn (8.5%)	55.00	56.50	53.70	49.40	55.00	53.0015.	48.00
Soybean meal (44%)	30.00	22.50	15.00	-	22.50	00	-
Sesame seed meal (35%)	-	07.50	15.00	30.00	-	-	-
Sunflower seed meal (37.6%)	-	-	-	-	07.50	15.00	30.00
Fish herring meal (62%)	09.00	10.90	12.00	15.20	10.10	11.50	13.80
Wheat bran (15.7%)	04.00	00.50	00.90	-	02.30	01.90	01.80
Sunflower oil	01.20	01.30	02.60	04.60	01.80	02.90	05.60
Sodium chloride (Na cl)	00.22	00.22	00.22	00.28	00.22	00.22	00.22
Pr-mix*	00.58	00.50	00.48	00.28	00.50	00.40	00.38
L-Lysine	-	00.08	00.10	0.30	00.08	00.08	00.20
Total (Kg)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Calculated diet composition							
CP%	24.08	24.08	24.00	24.11	24.03	24.10	24.20
ME Kcal/kg	2905	2903	2905	2904	2902	2900	2904
CF%	03.77	04.14	04.38	05.93	04.12	04.55	05.39
Ca%	00.80	00.98	01.13	01.54	00.95	00.95	01.13
Available phosphorous,%	00.42	00.54	00.59	00.71	00.51	00.58	00.69
EE%	02.86	03.80	03.78	06.38	02.85	02.83	02.69
Lysine%	01.30	01.36	01.30	01.32	01.32	01.35	01.37
Methionine %	00.50	00.50	00.54	00.63	00.46	00.50	00.56
Methionine+ systine %	00.81	0.86	00.92	01.05	00.86	00.88	00.92
Chemical diet composition:							
CP%	23.80	25.05	24.70	24.30	23.50	24.00	24.56
EE%	02.80	04.00	04.11	07.09	02.80	02.98	03.08
CF%	04.00	05.06	06.10	06.10	05.11	05.19	06.18

***Each 3 kilogram of mineral and vitamin pre-mix contains: Vit. A 12000000IU;Vit.D3 2200000IU; Vit. E 10000IU;VitK 2000 MG;Vit B1 1000 mg; VitB24000 mg; Vit B12 10mg;Vit B6 1500mg;Niacin 20000mg;Pantothenic acid 10000mg; Folic acid 1000mg;Biotin 50 mg; Cholin chloride 50000 mg; Copper 10000mg;Iodine 1000mg;Iron 3000mg;Zinc 5000mg;Manganmese5500; Mg and Selenium10mg.**

Table (2): Chemical composition and some amino acid contents of SFM and SSM compared with SBM

Items	SFM*	SSM**	SBM***
Moisture %	9.50	6.20	11.0[1]
CP%	37.60	35.0	44.0
EE%	0.71	12.70	0.80
CF%	13.43	15.76	7.00
Ca%	0.40	1.43	0.29
Total phosphorous %	1.25	0.93	0.81
Available phosphorous,%[2]	0.42	0.31	0.27
Gross energy K cal/kg	4500	4900	3450
Lysine %	1.35	1.06	2.69
Methionine%	0.81	1.0	0.62
Systine %	0.53	0.68	0.66

*** SFM=sunflower meal,**SSM=sesame meal, ***SBM=soybean meal**
1-According to analysis of NRC (1994)
2-Available phosphorous,%.= calculated as a basis of digestible forms usually account for only 30-40% of the total phosphorus

At the end of growing period in order to determine the carcass characteristics and carcass chemical composition, 6 quails from each treatment were randomly selected with equal numbers in terms of sex (3 females and 3 males), and a total of 42 quails were slaughtered for the 7th treatments. Samples of carcass were also taken to carry over the routine chemical composition according to standard methods of the Association of Official Analytical Chemists (A.O.A.C., 1994). At the end of experiment, the economical efficiency of the product was calculated from the input and output analysis based upon the differences in both growth rate and feeding cost as described by Bayoumi (1980). Data were subjected to analysis of variance using two way classifications (3 sources x 4 levels) using the General linear model of (SPSS, 2005, version 14.0), INC., Chicago, For Windows. Significant differences among means were determined by Duncan's multiple range tests *(Duncan's 1955)* at 5.0% level of significant. Arcsine of the square root of the some variable was used to convert all percentage values prior to analysis. All obtained data were analyzed by using the following Model:

$$X_{ijk} = M + \alpha_i + ß_j + (\alpha_i \times ß_j) + e_{ijk}$$

where,

M = General mean.

α_i = Effect of A factor (Sources).

ßj = Effect of B factor (Levels).

(α_i x **$ß_j$)** = Interaction between A and B.

e_{ijk}= Stander error for observations.

RESULTS AND DISCUSSION

Chemical composition and some amino acid of SFM and SSM compared with SBM

The data of chemical composition of SFM, SSM compared with SBM are illustrated in Table (2). Results revealed that SFM and SSM are rich in crude fiber, calcium, total phosphorus, gross energy and methionine content compared with SBM. However SSM contains higher levels and values of ether extract, crude fiber, calcium, gross energy, methionine, systine and gross energy compared with those present in SFM and SBM. On the other hand SBM contains higher level of CP percentage (44%) than those found in SFM (37.6%) and SSM (35%), although both SFM and SSM have moderate level of CP% compared to SBM. Generally, the chemical composition of both SFM and SSM may be considered as a preliminary indication to their feeding values as an alternative or new alternative ingredients plant protein sources in quail's diet, which can be used to resolving the shortage of SBM in Egypt. These results are partially in agreement with those obtained by Senkoylu *et al.* (1997) and Sayed (2002) who showed that SFM contains 33.2% CP, 3% EE, 24.97% CF, 4.06% ash and 34.77% NFE. The variation in the chemical composition of SFM might be due to the varity of the seeds, the processing method and or the degree of dehulling or decortications (Ra-vindran and Blair, 1992). Also Sohair *et al.* (2001) indicated that SFM contains 10.83, 32.03, 1.87, 23.60 and 9.25% for moisture, CP, EE, CF and ash respectively. Rama- Rao *et al.* (2006) indicated that SFM had higher concentration of calcium, phosphorous, methionine and cystine and lower energy content than SBM. In other study reported by Rama -Roa *et al.* (2008) showed that - crude protein content of SSM was lower than that of SBM (296 vs 448g/Kg, respectively), but methionine, cystine, Ca, P and ether extract were higher (7.2 vs 5.7, 6.8 vs 6.5, 12.7 vs 0.3, 13.8 vs 5.7, 57.7 vs 9.5g/Kg, respectively). SSM contained lower concentration of lysine, threonine, isolucine, leucine and valine (6.2, 8.7, 8.9, 16.6 and 11.4g/Kg, respectively), compared to SBM (26.7, 17, 20.4, 36.4 and 21.3g/kg, respectively).

Growth performance

Results of growth performance of Japanese quails including live body weight, body weight gain, feed intake, feed conversion ratio, protein intake, energy intake, protein efficiency ratio, energy efficiency ratio and mortality rate as affected by feeding control and diets containing different levels of SFM and SSM are given in Table (3).

Live Body weight (LBW) and body weight gain (BWG)

Averages of LBW at start of experiment (7^{th} days of age) ranged between 16.93 (±0.40g) to 18.04 (±0.27g) with insignificant differences. While at the end of the experimental period (48^{th} days of age) the analysis of variance showed that quails fed 50% and 100% SFM exhibited significantly ($p \leq 0.05$) heavier LBW, followed by quails fed 100% SSM, 25% SFM,50%SSM,100% SBM(control group), while quails fed 25% SSM recorded the lowest LBW. Regardless of levels quails fed SFM recorded the highest LBW compared with quails fed SBM or SSM respectively. The results of LBW as affected by dietary levels indicated that LBW was significantly ($p \leq 0.05$) higher for quails fed diet containing 100%, followed by those fed 50, 25 and 100%(control group) respectively. Concerning BWG the same trend was observed, where the quails fed 50 and 100% SFM recorded the highest ($p \leq 0.05$) values compared with quails fed other dietary treatments. However BWG was higher for quails fed SFM, followed by quails fed SSM and SBM respectively. Regarding the effect of different levels the data indicated that LBW was higher for quail's fed 100%, compared with other dietary treatment groups. It is interesting to note that replacing SBM by SFM at levels 50 or 100 % or SSM at 100% showed better LBW and BG compared with other substitution levels or 100% SBM (control group). The increase of LBW of quails fed SFM or SSM may be due to these ingredients having higher values of gross energy and SFM and SSM have higher levels of methionine compared with values present in SBM. These results are confirmed by Kazemi and Daghir (1971) who noticed that chicks fed diet containing SFM as plant protein source were significantly heavier in their weight than those fed diets containing SBM or cotton seed meal (CSM). Also *Kazemi* and Kratzer (1980) found that body weight gain of chicks fed SFM were significantly ($p \leq 0.05$) higher than those fed the other protein sources.

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Abdel-Salam *et al* (1985) reported that body weight of chicks fed on diets containing SSM was significantly lower than those of chicks fed SFM or diet containing SBM and corn gluten meal (CGM)***.*** Also Sayed (2002) illustrated that adding SFM at 10% to broiler diet recorded the best parameters of growth performance compared with broilers fed 5 and 15% SFM or those fed control group. On the other hand *Rama- Rao et al (2006)* found that replacement of SBM with SFM up to 67% in starter and 100% in finisher diet did not affect weight gain. Also Rama- Rao *et al. (2008*) found that body weight gain of broiler chickens was not affected, when fed diet containing of SSM up to 360 and 310 g/kg respectively. Abdel-Hakim *et al.* (2009) reported that replacing 50 or 100% of SBM protein with SFM protein revealed no significant effect on final body weight of broiler chickens, while final body weight decreased significantly in broiler fed diets containing SSM at 50 or 100% levels.

Feed intake (FI), protein intake (PI) and energy intake (EI)

The analysis of variance indicated that feed intake, protein intake and energy intake were significantly ($p \leq 0.05$) decreased as the levels of SFM and SSM in the diets of Japanese quails increased. The decreases of FI and consequently protein and energy intake due to the fact that SSM and SFM have higher content of crude fiber and high phytate content than that present in SBM *(Hossain and Jauncy(1989)*, which are responsible for the decrease of FI. Concerning the effect of sources the results indicated that quails fed SBM showed higher FI, PI and EI compared with those fed SFM and SSM respectively. The same trend was observed for the effect of graded levels, thus quails fed 100% (control) recorded the higher values of FI, PI and EI compared with quails fed 25, 50 and 100% respectively. These results are partially in agreement with those obtained by *Mamputu and Buhr (1995*) who showed that increasing of sunflower seed meal (SSM) levels in the diet of chickens from 30; 45 to 60 % as replacement of SBM dietary crude protein resulted in depression of feed intake. Also Tiwari *et al. (*2005*)* found that the use of SFM and Niger cake (NC) in quail diets as a replacement of SBM at 50, 60 and 70% levels causes a reduction in feed intake. While *Christaki et al. (*1994*)* reported that daily feed intake of growing Japanese quail was not significantly affected by feeding diet containing 35; 50 and 65 g/Kg of SFM. Also Tyagi *et al. (*2003*)* illustrated that feed intake of broiler was not altered at any level of SFM (0; 5 or 10 %) during both starter and finisher period. Also Rama- Rao *et al. (*2006*)* observed that feed intake was significantly higher for broiler fed diets replaced with SFM up to 67 to 100 % at 21 and 49 days of age. Abdel-Hakim *et al (*2009*))* indicated that broiler chickens fed diet supplemented with SFM at 100% recorded higher feed intake as compared with birds fed control (SBM) or other dietary treatments fed SSM and linseed meal (LSM). Moreover *El*-Sherif *et al. (*1997*)* showed that replacing of SBM with 10, 15 or 20% SFM had no significant effect on protein and energy intake of broiler chickens.

Feed conversion ratio (FCR), protein efficiency ratio (PER) and energy efficiency ratio (EER)

The results of FCR indicated that quails fed 100% and 50% SFM recorded the best FCR, while the worst values were observed for quails fed 25% SSM and 100% SBM(control group). Also quails fed SFM as dietary protein source showed the best FCR, followed by those fed SSM and SBM respectively. Regardless of sources quails fed diet containing 100% level recorded the best FCR compared with quails fed other dietary levels Concerning PER and EER results presented in Table (3) indicated that the higher ($p \leq 0.05$) values of both traits were observed for quails fed 100% and 50% SFM, while the lowest values were recorded for quails fed 100% SBM and 25% SSM respectively. The effect of sources indicated that quails fed SFM exhibited higher PER and EER than those recorded for quails fed SBM or SSM. Regardless of sources the quails fed 100% recorded the higher values compared with quails fed other dietary levels. These results are in accordance with the results obtained by Mohan *et al. (*1990*)* who found that quail fed diet containing different sources of SSM and SFM gave better feed efficiency as compared with birds fed control diet. Moreover Mandlekar *(*1992) found that feed efficiency of birds was significantly improved, when fed diet containing high level of SFM. While Mamputu and Buhr *(*1995*)* found that feed conversion ratio was decreased for chicks fed SSM at 30, 45 and 60% of SBM protein. *Rajesh et al. (2006)* reported that replacing SBM by SFM at 33 or 66% levels improved FCR of broiler chickens. While Rama-Rao *et al. (*2006*)* indicated that the replacement of SBM by SFM up to 67 % in starter and 100 % in finisher diets, depressed feed efficiency at 21 and 42 days of age respectively*.* Also Rama-Rao *et al. (*2008*)* indicated that feed efficiency was not affected by feeding broiler chickens on SSM up to 67%proportion of SBM in starter and finisher diets (360 and 310 g/Kg. respectively). Abdel-Hakim *et al.(*2009) indicated that the best feed conversion ratio was recorded for broiler chickens fed the control diet(SBM), followed by broilers fed diet containing SFM at 50% and 100% and SSM at 50% and 100 %. Concerning the effect of PER and EER El-Sherif *et al. (*1997*)* showed that replacing of SBM by 10, 15 or 20% SFM no significant effect on PER and EER of broiler chickens.

Mortality rate

Results of mortality rate occurred during the experimental period are given in the same Table. The analysis of variance indicated that the highest ($p \leq 0.05$) mortality rate was observed for quails fed 100% SSM (T4), followed by quails fed 25% SSM, 50% SSM, 50%SFM, 100% SFM and 100% SBM (control group) respectively, while the lowest mortality rate was recorded for quails fed 25% SFM. Regarding the effect of sources, quails fed SSM showed the higher mortality than those recorded for quails fed SFM and SBM. The effect of levels on mortality rate quails fed 100% showed the highest values, followed by those fed 50, 25 and 100%(control) respectively. These results are in agreement with those for *Arafa et al. (2001)* who reported that chicks fed diets containing SSM recorded higher mortality rate compared with chicks fed SBM. While *Tekeba et al. (2007)* observed that mortality rate of broiler chickens was not significantly affected, when fed diet containing 17.3% of SSM. *Abdel-Hakim et al. (2009)* showed that no effect of incorporation of plant protein sources i.e., SFM, SSM and LSM on mortality rate, when added in the diet of broiler chickens at 50 and 100% levels.

Chemical carcass composition

Results of chemical carcass composition as affected by dietary treatments are given in Table (4). It would appear that all carcass composition parameters are significantly ($p \leq 0.05$) affected by the dietary treatments or by sources and levels. The moisture content was significantly ($p \leq 0.05$) higher in bodies of quails fed 100% SFM compared with quails fed other dietary treatments, while the lowest values were observed for quails fed 50% SSM. However the moisture content as affected by dietary sources showed its higher content in bodies of quails fed SBM and SFM compared with those fed on SSM. Regardless of sources quails fed 100% (control) recorded higher values, followed by those fed on 100, 25 and 50% respectively. Concerning crude protein contents the obtained data indicated that quails fed diet containing 25% SFM recorded significantly ($p \leq 0.05$) higher values, followed by those fed 50%SFM,100%SSM, 100%SFM, 100% SBM, 50% SSM and 25% SSM respectively. The effect of sources on CP contents indicated that quails fed SFM have higher CP % in their meat compared with those fed SBM or SSM. Regardless of sources CP% was highest for quails fed 100% (control), followed by those fed 100%, 50% and 25% respectively. The results of EE% indicated that the highest ($p \leq 0.05$) levels were shown for quails fed 25% SSM, while the lowest level was observed for quails fed 100% SFM. The data of EE% as affected by source indicated that quails fed SSM have higher EE% in their meat compared with those fed SFM or SBM. The EE% recorded for the levels regardless of sources indicated that significantly ($p \leq 0.05$) higher values were recorded for quails fed 25% compared with quails fed other dietary levels. With respect of ash percentage the data indicated that quails fed 100% SFM recorded higher levels compared with quails fed the other dietary treatments, while the lowest values were recorded for quails fed 100% SSM. Regardless of levels ash percentage was higher for quails fed SFM, followed by those fed SBM and SSM respectively .The effect of levels indicated that quails fed 100% level recorded the highest value, followed by those fed 50, 25 and 100% (control). Regarding to NFE% the analysis of variance indicated that meat of quails fed 50 % and 100% SFM contained higher values than those recorded for quails fed other dietary treatments. Also quails fed SFM as a source had higher level than quails fed SBM or SM. The effect of levels indicated that quails fed on 50% showed the highest values compared with other dietary levels. Concerning the effect of sex on chemical carcass composition the data indicated that there were insignificant differences were observed for all carcass chemical composition, except with moisture contents, where females had higher levels than males (Table 4). These results are partially in agreement with those obtained by Abdel-Hakim *et al. (*2009*)* who showed that all carcass chemical composition of broiler chickens at 7th weeks of age were significantly($p \leq 0.05$) affected by feeding diets containing SFM, SSM and LSM at 50 and 100% levels. Where CP, ash and NFE% were higher for chickens fed LSM at 100% as compared with those fed SFM and SSM at 100% level. While DM and EE % decreased for chickens fed LSM at level 100%, when compared with broiler fed SFM 100% and SSM 100%.

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While Ibrahim *and* El-zubeir *(*1989*)* recorded that carcass moisture and ash content of broiler chickens were significantly decreased, when levels of SFM increased in the diet, while protein and ether extract were not affected. Also Christaki *et al. (*1994*)* found that moisture and protein content in the carcass were not affected by feeding quail on diet containing 35; 50 and 65 % of SFM, while significant differences were observed in fat and ash content. Further more El-Sherif *et al. (*1995*)* indicated that carcass compositions of broiler chickens was not affected, when fed diet supplemented with 75% extracted SFM as a replacement of SBM. Also El-Sherif *et al. (*1997*)* showed that replacing of SBM by 10, 15 or 20% of SFM was no significant effect on meat composition of broiler chickens.

Carcass characteristics

Results of carcass characteristics as percentage of final body weight are presented in Table (5). The obtained data revealed that the applied treatments, sources and levels released significant (p≤0.05) effect on liver, gizzard, heart, edible parts, dressing, total edible parts and total inedible parts percentage. Whereas the results of edible parts recorded significant (p≤0.05) higher values for quails fed 50% SSM, followed in a significant decreasing order by quails fed 25% SFM, 50%SFM, 100% SBM ,100 SFM,25%SSM and 100% SSM respectively. Regardless of levels quails fed SFM and SBM showed higher values compared with quails fed SSM. The effect of levels indicated that quails fed 50% recorded higher (p≤0.05) values compared with quails fed other dietary levels. The results of dressing percentage indicated that quails fed 50% and 100% SFM exhibited the highest values, while the lowest values were recorded for quails fed 100% SBM (control group). Regarding the effect of sources on dressing percentage the results indicated that quails fed SFM have higher values than those recorded for quails fed SSM and SBM respectively. Regardless of sources quails fed 100% level recorded the highest values, followed by quails fed 25, 50 and 100%(control) respectively. The values of total edible parts indicated that quails fed diet containing 50% SFM showed the highest (p≤0.05) value, followed by quails fed 25%SFM,100% SFM, 100%SSM, 50%SSM, 25%SSM and 100% SBM (control) respectively. Concerning the effect of sources on total edible parts, the results indicated that quails fed SFM recorded the best values, followed by quails fed SSM and SBM. The values of total edible parts as affected by dietary levels showed that quails fed 100% have higher values compared with quails fed other dietary levels. With respect of total inedible parts the analysis of variance showed that quails fed 100% SBM (control group) showed the highest values compared with quails fed other dietary treatments, while the lowest value was recorded for quails fed 50% SFM. Quails fed SBM as a dietary sources recorded higher values compared with those fed SFM or SBM. Also quails fed 100% (control) showed the higher total inedible parts, followed by quails fed 25, 50 and 100% (Table 5). From these results it is clear that SFM could replace SBM without any adverse effect on carcass traits of growing Japanese quails. These results are in accordance with the results reported by Rama - Rao *et al. (*2006) who found that the relative weights of gizzard and intestine increased with increasing levels of SFM in diet from 31.79%, 33, 67% to 100% levels .

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They concluded that SFM can replace up to two thirds of SBM corresponding to containing of 345 and 296g SFM per Kg for starter and finisher phases, respectively without adverse effect on carcass characteristics. Also Abdel-Hakim *et al. (*2009*)* found that SFM or SSM could replace SBM at levels 50 or 100% without any hazardous effects on total edible parts of broiler chickens. While Tyagi *et al. (*2003*)* found that carcass organs, except neck did not differ among groups of broiler chickens fed diet containing SFM at levels of 0; 5 and 10%. Also Rama-Roa *et al. (*2008*)* indicated that relative weights of giblet, liver and abdominal fat of broiler were not affected by including SSM up to 67% in replacement of SBM in starter and finisher broiler diets (360 and 310 g/Kg. respectively).

Blood plasma constituents

Table (6) shows the effect of replacement SBM by different levels of SFM and SSM on the blood plasma constituents of Japanese quails at the end of experimental period.

Total plasma protein, albumin, globulin and A/ G ratio

The analysis of variance indicate that quails fed 50 and 100% SFM recorded significantly ($p \leq 0.05$) higher values of total plasma protein, albumin and globulin compared with quails fed other experimental diets, while the control group recoded the lowest ($p \leq 0.05$) values. The values of A/G ratio indicated that quails fed 25% and 100% SSM showed the highest values, followed by quails fed 50%SSM, 100% SBM (control), 25%SFM, 50%SFM and 100% SFM respectively. Concerning the effect of sources the results indicate that quails fed SFM exhibited the highest values of total protein, albumin and globulin, followed by those fed SSM and SBM respectively. The highest A/G ratio was observed for quails fed SSM than quails fed SBM or SFM. Regarding the effect of levels the obtained data indicated that quails fed diet containing 100% recorded the highest values of total protein and albumin than those observed for quails fed other dietary levels. Results of the same Table show that total globulin was higher for quails fed 100, 50 and 25% levels than quails fed 100% (control). Insignificant differences were observed for A/G ratio due to dietary levels. No effect of sex on total protein, albumin and globulin contents in blood plasma. While A/G ratio was higher for males compared with females. These results agree with those obtained by. *Rama-Rao et al. (*2006*)* indicated that serum protein concentration progressively decreased with increasing SFM level in broiler diets from 33, 67 to 100%.The concentration of total protein was lowest for chicks fed diet containing 100% SFM than other levels. Diarra and Usman *(*2008*)* showed that serum protein, albumin and globulin were not affected in blood of chickens, when fed diet containing SSM at 12.5% level. However Abdel-Hakim *et al. (*2009*)* reported that there were significant differences were observed for blood plasma parameters measured at 7^{th} weeks of age due to adding of SFM, SSM and LSM in broiler diet at levels 50 and 100%.Where the total protein and globulin were higher for chickens fed 100% SFM, 100% SSM and 50% LSM

Total plasma lipids, triglycerides, cholesterol, high density lipoprotein (HDL) and low density lipoprotein (LDL)

The results of total plasma lipids, triglycerides, cholesterol and HDL indicated that quails fed 100% SBM (control group) recorded the highest

($p \leq 0.05$) values compared with quails fed diet containing different levels of SFM and SSM. While the reverse trend were observed for LDL, where quails fed 100%SBM (control diet) showed the lowest values compared with quails fed diets containing SFM and SSM at 25, 50 and 100% levels respectively (Table 6). Concerning the effect of sources the data indicated that quails fed SBM recorded higher values of lipids, triglycerides, cholesterol, HDL compared with quails fed SSM or SFM. While LDL was higher for quails fed SSM and SFM compared with quails fed SBM diet. Regardless of sources quails fed 100 %(control) recorded the highest ($p \leq 0.05$) values compared with quails fed other dietary levels. Values of LDL were higher for quails fed diet containing 25, 50 and 100% than values recorded for quails fed 100% (control). The decrease of cholesterol in blood of quails fed high levels of SFM may be due to fact that SFM has higher fiber content, which acting to decreases lipid in blood and increases execration of lipids in the faeces *(*Rama- *Rao et al.,* 2004*)*. Concerning the effect of sex on these parameters the statistical evaluation indicates that males showed significantly higher values for these traits compared with their females. Rama -Rao *et al. (2004)* observed that serum cholesterol concentration decreased in chickens, when fed diet containing different levels of SFM. Also Shrivastav and Johri *(*2005*)* found that serum cholesterol concentration decreased with the increase of sunflower oil meal in diets of laying quail from 7.5, 15, and 22.5 to 30% by weight of SBM. Furthermore Rama -Rao *et al. (*2006*)* found that cholesterol and triglycerides concentration decreased progressively in the blood of broiler chickens with increasing SFM in diets up to 67% in starter and 100% in finisher diets.

Aspartate transaminase (AST) and Alanine transaminase (ALT)

The data of AST and ALT values are also given in Table (6). The obtained data indicated that quails fed control diet (100% SBM) recorded significantly ($p \leq 0.05$) higher values of AST compared with quails fed other dietary experimental groups. The results indicate that quails fed SBM as a source showed the highest AST values, followed by quails fed SSM and SFM. Regardless of sources quails fed 100% (control) recorded the highest values compared with quails fed other dietary levels. Insignificant differences were recorded for ALT due to interaction or due to sources and levels. Concerning the effect of sex on both parameters results indicated that males has higher values of AST than females, while adverse trends were detected for ALT, where the females has higher values of ALT than those recoded for males.

Economical efficiency

Results of the economical efficiency of the experimental diets are presented in Table (7). The data indicated that quails fed 50 and 100% SFM recorded lower feed cost and higher economical efficiency compared with quails fed other experimental diets or control diet. However the lowest economical efficiency was recorded by diet containing 25% SSM as well as the diet containing SBM. *Valdivie et al. (1982*) indicated that the cost of feed required producing 1 ton of chickens live weight was lower, when fed diet containing sunflower oil meal compared with birds fed on control diet.

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El-Deek *et al. (*1999*)* found that the use of SFM in chickens and pullet diets to replace SBM decreases feed costs and improved net revenue. Sayed *(*2002*)* showed that broiler chickens fed diet containing SFM and LSM as plant protein sources at 5,10 and 15% levels recorded higher economical efficiency as compared with birds fed the control diet. *Rajesh et al. (2006)* reported that replacing SBM by SFM at 33 or 66% levels improved economic traits of broiler chickens. While Mandal *et al. (*2006*)* reported that the containing of sunflower seed meal (SSM) in maize- sorghum based diets did not alter the feed cost for gain and production statistically but were numerically lower in all the diets of broiler chickens.

In general conclusion based on the former results it could be recommended that SFM or SSM can be safely included by replacing SBM up to 50 and100% without any adverse effects on growth performance or carcass traits of Japanese quail but using SFM in quail diets as a plant protein alternative source was better than of SSM.

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الأداء الانتاجى وصفات الذبيحة وبعض مكونات الدم للسمان اليابانى والمغذى على علائق تحتوى على مستويات مختلفة من كسب دوار الشمس وكسب السمسم كأستبدال من كسب فول الصويا

نبيل فهمى عبدالحكيم*، عبدالهادى عامر عامر*، عبدالعظيم فهمى عبدالعظيم*، عقيلة صالح حمزة و على فتحى فرغلى***
*** كلية الزراعة - جامعة الازهر**
**** قسم الانتاج الحيوانى، والمعمل المركزى للاغذية والاعلاف**

اجريت هذة التجربة لبحث تأثير استبدال كسب فول الصويا بالاكساب الزيتية المحلية والمتوفرة مثل كسب دوار الشمس وكسب السمسم عند مستويات مختلفة 25،50،100% فى العلائق المتساوية البروتين والطاقة.إستخدم عدد 315 كتكوت سمان عمر 7 ايام حيث قسم هذا العدد عشوائيا الى 7 معاملات تجريبية واحتوت كل معاملة على عدد 45 كتكوتا وكل معاملة مثلت بثلاث مكررات واحتوت كل مكررة على 15 كتكوتا. واستمرت فترة التجربة 42 يوما (من 7 الى 48 يوما). المعاملة الاولى غذيت على غذاء الكنترول والمحتوى على 100 % كسب فول الصويا، بينما غذيت المعاملات 1،2،3،4،5،،6،7 على مستويات مختلفة 25،50،100 % من كل من كسب دوار الشمس وكسب السمسم على التوالى.إستبدل كسب فول الصويا بهذة الأكساب على أساس الوزن.وتم تقديم الماء والغذاء بحرية طوال فترة التجربة.
أشارت النتائج الى أن استبدال كسب فول الصويا بكسب دوار الشمس عند مستوى 50، 100 % نتج عنة زيادة معنوية فى كل من وزن الجسم، وزن الجسم المكتسب، وكفاءة إستخدام البروتين والطاقة بالمقارنة بباقى المجاميع التجريبية.بينما لوحظ ان الغذاء المأكول ،البروتين والطاقة المستهلكة كانت أعلى معنويا فى السمان والمغذى 100% كسب فول الصويا (مجموعة الكنترول) بالمقارنة بالسمان المغذى على كسب دوار الشمس أو السمسم عند المستويات المختلفة. كانت نسبة تحويل الغذاء أحسن فى السمان المغذى على علائق تحتوى 100% ، 50% كسب دوار الشمس تبعة المعاملات المغذاة على 100% كسب السمسم، 25% كسب دوار الشمس،50% كسب السمسم ثم مجموعة الكنترول(100% كسب فول الصويا). بينما وجد أن أسوء قيمة لمعامل التحويل الغذائى للسمان المغذى على 25% كسب السمسم. كانت أكبر نسبة للوفيات ملاحظة للمجموعة المغذاة على 25% كسب السمسم بينما أقل قيمة للسمان المغذى على 25% كسب دوار الشمس. تأثرت صفات الذبيحة معنويا عند إستبدال كسب فول الصويا بكل من كسب دوار الشمس وكسب السمسم عند المستويات المختلفة حيث لوحظ أن نسبة الأجزاء المأكولة كانت أعلى معنويا فى السمان المغذى على

50% كسب دوار الشمس بينما أقل قيمة لوحظت فى السمان المغذى على 25% كسب السمسم والمجموعة الكنترول(100% كسب فول الصويا). وكانت نسبة الأجزاء الغير المأكولة أعلى معنويا فى السمان المغذى على 100% كسب فول الصويا بينما أقل قيمة لوحظت للسمان المغذى على 50% كسب دوار الشمس. فيما يتعلق بمكونات الدم والتركيب الكيماوى للذبيحة والمقاسة فى نهاية فترة التجربة وجدت إختلافات معنوية نتيجة التغذية على كسب دوار الشمس أو كسب السمسم عند المستويات المختلفة فيما عدا قيمة ALT حيث لم تلاحظ اختلافات معنوية بين المجاميع التجريبية. إستبدال كسب فول الصويا بكسب دوار الشمس أو كسب السمسم عند 25،50،100% يخفض من تكلفة الغذاء للطيور.

وعموما نستخلص من هذة الدراسة وبناءا على النتائج المتحصل عليه أنة يمكن استبدال كسب فول الصويا بكسب دوار الشمس أو كسب السمسم حتى مستوى 50،100% بدون أى تاثير عكسى على الأداء الانتاجى للنمو أو صفات الذبيحة للسمان اليابانى ولكن إستخدام كسب دوار الشمس كان أفضل من كسب السمسم.

قام بتحكيم البحث

أ.د / محمد محمد الشناوي	**كلية الزراعة – جامعة المنصورة**
أ.د / فهمي الحسيني عبد السلام	**مركز البحوث الزراعية**

Table (3): Effect of replacing SBM by different levels of SFM and SSM on growth performance and mortality rate of Japanese quail (Means's ±SE).

Items / Effects	Body weight at 7 days	Body weight at 48 days	Body gain 7-48 days	Feed intake g/bird/ period	Feed conversion ratio	Protein intake g/bird/ period	Energy intake Kcal/bird/ period	Protein efficiency ratio	Energy efficiency ratio	Mortality rate %
Interaction among: SBMXSMXSFM*										
T1 (100% SBM control)	18.04±0.27	178.16±0.17f	160.12±0.05e	543±0.25a	3.39±0.006b	130.75±0.44a	1577.42±6.7a	1.22±0.005e	10.15±0.08e	6.66±0.35d
T2 (25%SSM)	17.99±0.39	171.04±0.42g	153.05±0.03g	541±0.30b	3.53±0.003a	130.27±0.64b	1570.52±7.7b	1.18±0.003f	9.75±0.05f	8.66±0.33b
T3 (50%SSM)	17.82±0.31	192.99±0.23e	175.17±0.02d	525±0.26c	2.99±0.004c	126.08±0.48c	1525.13±6.9c	1.39±0.002d	11.48±0.06d	7.66±0.34c
T4 (100% SSM)	17.02±0.40	203.75±0.40c	186.73±0.08b	519±0.30d	2.78±0.002e	125.13±0.64d	1507.18±5.7d	1.49±0.004b	12.39±0.05b	12.0±0.57a
T5 (25% SFM)	16.94±0.42	193.28±0.47d	176.34±0.04c	517±0.47e	2.93±0.003d	124.24±0.54e	1500.32±8.6e	1.42±0.001c	11.75±0.03c	5.60±0.30e
T6 (50% SFM)	17.30±0.63	206.50±0.42a	189.20±0.06a	509±0.30f	2.69±0.007f	122.67±0.74f	1476.10±4.7f	1.54±0.003a	12.82±0.02a	6.66±0.31d
T7 (100 SFM)	16.93±0.40	206.03±0.49b	189.10±0.07a	506±0.25g	2.68±0.005f	122.45±0.63g	1469.42±5.6g	1.54±0.002a	12.87±0.02a	6.66±0.29d
Overall mean	17.44±0.41	193.11±2.0	175.67±2.07	522±2.10	2.99±0.06	125.63±0.61	1514.42±7.61	1.40±0.03	11.62±0.05	7.69±0.30
Significant effect	NS	*	*	*	*	*	*	*	*	*
Sources:										
SBM	18.04±0.27	178.16±0.17c	160.12±0.05c	543±0.25a	3.39±0.006a	130.75±0.44a	1577.42±6.7a	1.23±0.005c	10.15±0.08c	6.66±0.35b
SFM	17.61±0.22	201.93±1.4a	184.32±1.4a	510±0.20c	2.77±0.004c	123.12±0.69b	1481.95±4.8c	1.50±0.003a	12.48±0.18a	6.30±0.29c
SSM	17.06±0.28	189.25±3.2b	172.19±3.3b	528±0.29b	3.06±0.002b	126.6±0.55c	1527.83±6.6b	1.36±0.004b	11.24±0.37b	9.43±0.33a
Overall mean	17.44±0.41	193.11±2.0	175.67±2.07	522±2.10	2.99±0.06	125.63±0.61	1514.42±7.61	1.40±0.03	11.62±0.05	7.69±0.30
Significant effect	NS	*	*	*	*	*	*	*	*	*
Levels (%):										
100 (control)	18.04±0.27	178.16±0.17d	160.12±0.06d	543±0.25a	3.39±0.006a	130.75±0.44a	1577.42± 6.7a	1.23±0.005d	10.15±0.08d	6.66±0.35d
25	17.46±0.29	182.16±3.3c	164.70±3.3c	530±3.06b	3.21±0.005b	126.41±0.50b	1525.26±11.7b	1.30±0.003c	10.82±0.42c	7.13±0.70c
50	17.56±0.35	199.02±2.0b	182.19±2.1b	516±2.44c	2.84±0.005c	124.38±0.77c	1501.09±11.2c	1.46±0.002b	12.09±0.50b	7.15±0.77b
100	16.98±0.16	204.41±0.35a	187.43±0.35a	512±1.99d	2.73±0.002d	123.79±0.61d	1488.30±8.5d	1.52±0.007a	12.59±0.11a	9.33±0.61a
Overall mean	17.44±0.41	193.11±2.0	175.67±2.07	522±2.10	2.99±0.06	125.63±0.61	1514.42±7.61	1.40±0.03	11.62±0.05	7.69±0.30
Significant effect	NS	*	*	*	*	*	*	*	*	*

[a,b,c….] Means in the same column have the different superscript are significantly different at ($p \leq 0.05$).
***SBM=Soybean meal, SSM=Sesame meal, SFM=Sunflower meal.**

Table (4): Effect of replacing SBM by different levels of SFM and SSM on body chemical composition (on dray matter basis %) of Japanese quail at the end of experimental period (Means ±SE).

Itemss / Effects	Moisture%	DM%	CP%	EE%	Ash%	NFE%
Interaction among:						
Sbmxsmxsfm*						
T1 (100% SBM control)*	68.94±0.98b	31.06±0.07e	65.98±0.16c	28.32±0.05d	4.82±0.01d	0.88±0.005d
T2 (25% SSM)	67.64±0.42c	32.36±0.05d	63.85±0.14f	30.80±0.06a	4.77±0.02e	0.58±0.003f
T3 (50%SSM)	66.83±0.73d	33.17±0.02a	65.37±0.13e	29.07±0.04c	4.81±0.07d	0.75±0.004e
T4 (100% SSM)	67.56±0.66c	32.44±0.07c	65.96±0.11c	29.13±0.01b	4.53±0.05f	0.38±0.004g
T5 (25% SFM)	69.04±0.47b	30.96±0.04f	66.75±0.13a	27.17±0.02e	4.96±0.03c	1.12±0.002c
T6 (50% SFM)	67.08±0.92cd	32.92±0.03 b	66.14±0.11b	26.42±0.01f	5.80±0.01b	1.64±0.01a
T7 (100 SFM)	69.79±0.42a	30.21±0.01g	65.83±0.67d	26.07±0.03g	6.93±0.02a	1.17±0.03b
Overall mean	68.13±0.18	31.67±0.06	65.69±0.13	28.14±0.04	5.23±0.03	0.94±0.006
Significant effect	*	*	*	*	*	*
Sources:						
SBM	68.94±0.98a	31.06±0.06 c	65.98±0.16b	28.32±0.05b	4.82±0.01b	0.88±0.005b
SFM	68.64±0.28a	31.36±0.07 b	66.24±0.14a	26.55±0.03c	5.89±0.04a	1.32±0.009a
SM	67.34±0.22b	32.66±0.03a	65.06±0.12c	29.66±0.05a	4.71±0.03c	0.57±0.003c
Overall mean	68.13±0.18	31.67±0.06	65.69±0.13	28.14±0.24	5.23±0.03	0.94±0.006
Significant effect	*	*	*	*	*	*
Levels (%):						
100(control)	68.94±0.98a	31.06±0.6d	65.98±0.16a	28.32±0.05b	4.82±0.01d	0.88±0.005b
25	68.34±0.21b	31.66±0.01b	65.30±0.13d	28.98±0.04a	4.87±0.05c	0.85±0.008c
50	66.95±0.37c	33.05±0.04a	65.75±0.12c	27.75±0.02c	5.31±0.05b	1.19±0.03a
100	68.68±0.46ab	31.32±0.03c	65.90±0.11b	27.60±0.06d	5.73±0.06a	0.77±0.004d
Overall mean	68.13±0.18	31.67±0.06	65.69±0.13	28.14±0.04	5.23±0.03	0.94±0.006
Significant effect	*	*	*	*	*	*
sex						
Males	67.91±0.28b	32.09±0.05	65.70±0.13	28.14±0.05	5.23±0.03	0.94±0.008
Females	68.34±0.23a	31.66±0.06	65.69±0.12	28.13±0.04	5.24±0.04	0.94±0.008
Overall mean	68.13±0.18	31.67±0.06	65.69±0.13	28.14±0.04	5.23±0.03	0.94±0.006
Significant effect	*	NS	NS	NS	NS	NS

[a,b,c….] **Means in the same column have the different superscript are significantly different at (p≤0.05).**

- **SFM=sunflower meal, SM=sesame meal, SBM=soybean meal**

Table (5): Effect of replacing SBM by different levels of SFM and SSM on relative carcass characteristics of Japanese quail. at the end of experimental period(Means ±SE).

Effects	Carcass characteristics relative to body weight %							
	Live body weight	**Liver**	**Gizzard**	**Heart**	**Edible parts**	**Dressing**	**Total edible parts**	**Total inedible parts[1]**
Interaction among SBMxSFMxSSM								
T1 (100% SBM control)	183.33±0.67d	2.45±0.09cd	1.73±0.02c	0.95±0.002b	5.13±0.06c	64.87±6.14g	70.02±7.92g	29.98±0.21a
T2 (25% SSM)	183.71±0.76d	2.17±0.03e	1.52±0.06f	0.88±0.003d	4.57±0.03e	66.25±4.28e	70.82±3.65f	29.18±0.22b
T3 (50% SSM)	192.65±0.70c	2.80±0.03a	1.71±0.02d	0.93±0.002c	5.44±0.01a	65.73±4.28f	71.16±4.01e	28.83±0.33c
T4 (100% SSM)	195.53±0.69b	1.73±0.06f	1.75±0.02b	0.95±0.002b	4.43±0.04f	67.39±4.22d	71.82±7.92d	28.18±0.37d
T5 (25% SFM)	195.96±0.49b	2.73±.03b	1.74±0.02b	0.82±0.003e	5.29±0.05b	67.43±2.58c	72.81±2.24b	27.19±0.31f
T6 (50% SFM)	195.01±0.44b	2.32±0.06d	1.86±0.03a	0.96±0.003a	5.14±0.03c	67.93±4.28a	73.07±3.65a	26.93±0.34g
T7 (100 % SFM)	211.85±0.32a	2.48±0.03c	1.60±0.02e	0.88±0.002d	4.96±.02d	67.81±4.22b	72.77±4.28c	27.23±0.21e
Overall mean	193.92±0.43	2.39±0.05	1.70±0.02	0.91±0.007	4.99±0.05	66.77±0.17	71.78±0.17	28.22±0.28
Significant effect	*	*	*	*	*	*	*	*
Sources								
SBM	183.39±0.67c	2.45±0.09b	1.73±0.02a	0.95±0.002a	5.12±0.06a	64.87±6.14c	70.02±7.92c	29.98±0.21a
SFM	200.67±0.38a	2.53±0.04a	1.74±0.03a	0.88±0.001c	5.13±0.04a	67.73±3.55a	72.88±3.55a	27.12±0.39c
SSM	190.67±0.42b	2.23±0.11c	1.65±0.02b	0.92±0.006b	4.81±0.1b	66.45±3.36b	71.26±3.66b	28.73±0.23b
Overall mean	193.92±0.43	2.39±0.05	1.70±0.02	0.91±0.007	4.99±0.05	66.77±0.17	71.78±0.17	28.22±0.28
Significant effect	*	*	*	*	*	*	*	*
Levels (%):								
100(control)	183.39±0.67d	2.46±0.09b	1.73±0.02b	0.95±0.002a	5.12±0.06b	64.87±6.14d	70.02±7.92d	29.98±0.21a
25	189.84±0.44c	2.45±0.08b	1.63±0.03d	0.85±0.008c	4.93±0.11c	66.84±3.15b	71.81±2.30c	28.19±0.57b
50	193.89±0.34b	2.59±0.07a	1.78±0.02a	0.94±0.005a	5.28±0.04a	66.82±3.33c	72.12±3.28b	27.88±0.51c
100	203.28±0.34a	2.11±0.11c	1.67±0.02c	0.91±0.001b	4.69±0.08d	67.60±3.66a	72.29±3.14a	27.71±0.29d
Overall mean	193.92±0.43	2.39±0.05	1.70±0.02	0.91±0.007	4.99±0.05	66.77±0.17	71.78±0.17	28.22±0.28
Significant effect	*	*	*	*	*	*	*	*
sex								
Male	193.99±0.46	2.38±0.07	1.70±0.03	0.91±0.001	4.99±0.07	66.77±3.34	71.79±3.71	28.22±0.40
Female	193.84±0.44	2.40±0.08	1.70±0.02	0.90±0.002	4.99±0.08	63.75±2.34	71.77±3.64	28.22±0.40
Overall mean	193.92±0.43	2.39±0.05	1.70±0.02	0.91±0.007	4.99±0.05	66.77±0.17	71.78±017	28.22±0.28
Significant effect	*	NS	NS	NS	NS	NS	NS	NS

[a,b,c….]Means in the same column have the different superscript are significantly different at ($p \leq 0.05$).
***SBM=Soybean meal, SSM=Sesame meal, SFM=Sunflower meal.**
1-Total inedible parts including blood, feather, head, neck, wing, legs and intestine

1-Accodring to the price of different ingredients available in Egypt at 2009

Items	Treatments						
	T1 100% SBM (control)	T2 25%SSM	T3 50% SSM	T4 100%SSM	T5 25%SFM	T6 50%SFM	T7 100% SFM
Initial body weight g/bird.	180.04±0.27	17.99±0.39	17.82±.39	17.02±0.31	16.94±0.42	17.30±0.63	16.93±0.40
Final body weight g/bird.	178.16±0.17f	171.04±0.42g	192.99±0.23e	203.75±0.40c	193.28±0.47d	206.50±0.42a	206.03±0.49a
Total amount of feed intake/g/bird/period.	543±0.25a	541±0.30b	525±0.26c	519±0.30d	517±0.47e	509±0.30f	506±0.25g
Feed cost(PT)/chick[1]	0.90	0.89	0.87	0.85	0.85	0.84	0.84
Price of chick at 1 day of age (PT) [2].	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Total cost (PT)/chick	1.40	1.39	1.37	1.35	1.35	1.34	1.34
Total revenue (PT)/chick[3]	2.67	2.57	2.9	3.06	2.90	3.09	3.09
Net revenue(PT)/chick	1.27	1.18	1.53	1.71	1.55	1.75	1.75
Relative economic efficiency%	90.71	84.89	111.68	26.67	114.82	130.60	130.60
Control [5]	100	93.58	123.12	139.65	126.58	143.98	143.98

2-Fixed cost
3-Price of 1 kg live weight=15 LE.
4-Net revenue per unit total cost
5-Assuming that the relative economical efficiency of control group equals 100%.

Table (6): Effect of replacing SBM by different levels of SFM and SSM on blood plasma constituents of Japanese quail at the end of experimental period (Means's ±SE).

Items / Effects	Total plasma protein (mg/d)	Total plasma albumin (mg/d)	Total plasma globulin (mg/d)	A/G ratio	Total plasma lipids (mg/d)	Total plasma Triglycerides (mg/d)	Total plasma cholesterol (mg/d)	Total Plasma HDL (mg/d)	Total plasma LDL (mg/d)	AST (U/ml)[1]	ALT (U/ml)[2]
Interaction among: SBMXSMXSFM*											
T1 (100% SBM control)	4.29±0.08d	2.15±0.03d	2.14±0.07e	1.01±0.04ab	857.41±22.93a	108.28±3.54a	209.14±5.02a	66.40±2.21a	67.63±8.82b	89.16±9.34a	27.83±2.83
T2 (25% SSM)	5.22±0.18bc	2.75±0.15bc	2.47±0.15d	1.14±0.11a	659.68±55.31b	80.43±3.13b	142.84±6.49b	53.23±1.13b	109.39±9.17a	32.16±2.16b	25.0±0.0
T3 (50%SSM)	5.03±0.12c	2.62±0.11c	2.41±0.10d	1.03±0.07ab	722.43±47.02b	78.33±3.57bc	150.68±3.91b	50.86±1.98b	105.72±9.04a	36.50±2.90b	25.0±0.0
T4 (100% SSM)	5.54±0.10ab	2.94±0.07ab	2.59±0.04cd	1.13±0.02a	631.81±44.84b	69.75±3.33c	151.99±5.75b	48.51±2.11bc	106.74±13.02a	34.33±2.74b	25.0±0.0
T5 (25% SFM)	5.61±0.15a	3.03±0.05a	2.84±0.10bc	0.98±0.08ab	593.15±61.08b	67.65±3.57c	146.45±5.11b	44.29±1.35cd	113.26±14.10a	34.33±2.74b	27.83±2.83
T6 (50% SFM)	5.69±0.10a	3.02±0.05a	3.02±0.05ab	0.88±0.04b	690.11±34.59b	73.02±4.02bc	147.26±4.47b	42.39±1.04d	103.68±5.35a	30.0±0.0b	27.83±2.83
T7 (100 SFM)	5.83±0.13a	3.12±0.02a	3.12±0.02a	0.86±0.02b	656.52±34.39b	67.59±3.74c	131.82±6.47b	42.34±1.17d	103.27±5.82a	34.33±2.74b	23.16±1.83
Overall mean	5.32±0.08	2.80±0.05	2.65±0.06	1.0±0.02	687.30±19.88	77.86±2.41	154.74±4.03	49.72±1.35	11.38±4.07	41.54±3.38	25.95±0.74
Significant effect	*	*	*	*	*	*	*	*	*	*	NS
Sources:											
SBM	4.29±0.08c	2.15±0.03c	2.14±0.07c	1.01±0.04ab	875.57±22.93a	108.28±3.54a	209.14±5.02a	66.40±2.21a	67.63±8.82b	89.16±9.34a	27.83±2.83
SFM	5.71±0.07a	3.06±0.02a	2.99±0.04a	0.91±0.03b	646.59±26.34b	69.42±2.14b	142.84±3.24b	43.0±2.91c	106.74±5.18a	32.88±1.31b	26.27±1.47
SM	5.26±0.09b	2.77±0.07b	2.49±0.06b	1.10±0.04a	671.31±28.25b	76.17±2.13b	148.50±3.13b	50.87±1.08b	107.28±5.74a	34.33±1.48b	25.0±0.0
Overall mean	5.32±0.08	2.80±0.05	2.65±0.06	1.0±0.02	687.30±19.88	77.86±2.41	154.74±4.03	49.72±1.35	101.38±4.07	41.54±3.38	25.95±0.74
Significant effect	*	*	*	*	*	*	*	*	*	*	NS
Levels(%):											
100	4.29±0.08c	2.15±0.03c	2.14±0.07b	1.01±0.04	857.41±22.93a	108.28±3.54a	209.14±5.02a	66.40±2.21a	67.63±8.82b	89.16±9.34a	27.83±2.83
25	5.42±0.12ab	2.89±0.08ab	2.65±0.10a	1.06±0.07	626.41±40.54b	74.04±2.97b	144.65±3.97b	48.76±1.58b	111.32±8.04a	33.25±1.69b	26.41±1.41
50	5.36±0.12b	2.82±0.08b	2.71±0.10a	0.95±0.04	706.27±28.25b	75.67±2.68b	148.97±2.87b	46.62±1.66b	104.70±5.02a	33.25±1.69b	26.41±1.41
100	5.68±0.09a	3.05±0.04a	2.86±0.08a	0.99±0.04	644.16±27.20b	68.67±2.41b	143.40±4.87b	45.43±1.48b	105.0±6.82a	34.33±1.84b	24.08±0.91
Overall mean	5.32±0.08	2.80±0.05	2.65±0.06	1.0±0.02	687.30±19.88	77.86±2.41	154.74±4.03	49.72±1.35	101.38±4.07	41.54±3.38	25.95±0.74
Significant effect	*	*	*	N	*	*	*	*	*	*	NS
Sex											
Female	5.30±0.12	2.79±0.07b	2.66±0.08	0.99±0.04b	665.75±32.37b	75.07±3.49b	153.97±6.09b	48.85±2.22b	100.10±5.55b	36.76±3.6b	27.42±1.33a
Male	5.33±0.13	2.81±0.08a	2.65±0.08	1.02±0.03a	708.85±22.92a	80.65±3.31a	155.50±5.42a	50.58±1.57a	102.66±6.09a	44.33±5.75a	24.47±0.52b
Overall mean	5.32±0.08	2.80±0.05	2.65±0.06	1.0±0.02	687.30±19.88	77.86±2.41	154.74±4.03	49.72±1.35	101.38±4.07	41.54±3.38	25.95±0.74
Significant effect	NS	NS	NS	*	*	*	*	*	*	*	*

[a,b,c….] Means in the same column have the different superscript are significantly different at (p≤0.05).
***SBM=Soybean meal, SSM=Sesame meal, SFM=Sunflower meal.**
1-ALT= Aspartate transaminase
2-AST= Alanine transaminase

Table (7): The economical efficiency of the experimental diets.

Items	Treatments						
	T1 100% SBM (control)	**T2 25%SSM**	**T3 50% SSM**	**T4 100%SSM**	**T5 25%SFM**	**T6 50%SFM**	**T7 100% SFM**
Initial body weight g/bird.	18.04±0.27	17.99±0.39	17.82±0.39	17.02±0.31	16.94±0.42	17.30±0.63	16.93±0.40
Final body weight g/bird.	178.16±7.30c	171.04±2.9d	192.99±5.9ab	203.75±7.9ab	193.28±13.50b	206.50±6.6a	206.03±74a
Total amount of feed intake/g/bird/period.	541±2.57a	435±2.60b	525±2.33c	5.19±3.57d	513±0.50d	509±2.57c	506±2.59c
Feed cost(PT)/chick[1]	90	89	87	85	85	84	84
Price of chick at 1 day of age (PT) [2].	50	50	50	50	50	50	50
Cost of husbandry [3]	50	50	50	50	50	50	50
Total cost (PT) chick	190	189	187	185	185	184	184
Sale price of one bird (PT)[4]	600	600	600	600	600	600	600
Net revenue (PT) / bird	410	411	413	415	415	416	416
Relative economic efficiency 5	215.79	217.46	220.86	224.32	224.32	226.09	226.09
% control [6]	100	100.77	102.35	103.95	103.95	104.77	104.77

1-Accodring to the price of the different ingredients available in Egypt at 2009
2-Fixed cost
3-Price of 1 husbundry comprise of drugs , light and labor.
4-Price of one bird = 600 PT
5- Net revenue per unit total cost
6-Assuming that the relative economical efficiency of control group equals 100%.