EFFECT OF SUNFLOWER MEAL REPLACEMENT FOR SOYABEAN MEAL WITH / WITHOUT ENZYME SUPPLEMENTATION ON GROWING AND LAYING PERFORMANCE OF JAPANESE QUAIL

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SUMMARY

A total number of 390 unsexed one week old Japanese quail chicks and 240 layer (160 female + 80 male) at 8 weeks of age were used to study the effect of substituting soyabean meal (SBM) by sunflower meal (SFM) at different rates on growing and laying Japanese quail performance with or without enzyme supplementation. Two factorial design experiments (5 x 2) were conducted. Each experiment included 10 treatment groups. Five experimental diets without enzyme supplementation were formulated in which, sunflower meal (SFM) replaced soyabean meal (SBM) at levels of 0, 25, 50, 75 and 100 %. Each level was fed with or without optizyme. During the growing (1-6 weeks of age) and laying periods (8-20 weeks of age), diets were isocaloric and isonitrogenous.

Results obtained colud be summarised as follows:

Experiment 1:

1. During the 6 weeks trial period, feeding graded levels of SFM replacing SBM up to 75 % (25.50 % SFM in the diet) did not exert any detrimental ($P < 0.50$) effect on body weight, body weight gain, feed intake and feed conversion. However, complete replacement of SBM with SFM in diets had detrimental effects on the same traits mentioned above. Increasing the dietary SFM resulted significant decrease in digestibility coefficients of DM, OM, CP and CF and feeding value expressed as ME, on the other hand increase in digestibility coefficient values of NFE. Chicks fed the diet contained 25 % SFM substitution of SBM resulted the best economical efficiency value as compared with other treatments or control.
2. Enzyme supplementation resulted improvements in growth performance, carcass traits, digestibility coefficient values of CP and economical efficiency.
3. The interaction effect between dietary SFM and optizyme levels on all growing performance and carcass traits were not significant, but showed significant effect on digestibility coefficients of DM, CP and EE and feeding values.
4. Chicks fed 25% SFM substituting for SBM with 0.50 g optizyme/kg feed recorded the best EEf.

Experiment 2:

1. During the 12 weeks trail (8-20 weeks of age), feeding grading levels of SFM substituting up to 100 % of SBM had no detrimental effects on performance or egg quality and increased economical efficiency when compared with control.
2. Also, enzyme supplementation resulted improvements in performance and egg quality.

In general, from nutritional point of view it can be concluded that, using SFM up to 75 % (25.5 % of the diet) and 100 % (25 % of the diet) substitution for SBM in growing and laying Japanese quail diets had no adverse effect on growth and laying performance. While from an economical point of view, SFM could substitute SBM up to the rate of 25% (8.5 % of the diet) and 100 % (25 % of the diet) in growing and laying Japanese quail. The supplementation of optizyme at a level of 0.50 g / kg feed is superior in promoting performance of growing and laying Japanese quail. Also, the same results were obtained by using optizyme (0.50g / kg feed) with 25 % and 100 % substitution in growing and laying Japanese quail diets. Such practice may be of high economic value without any adverse effects on the performance in growing and laying Japanese quail.

Keywords: *Japanese quail, soyabean meal, sunflower meal, enzyme supplementation, quail performance*

INTRODUCTION

Sunflower seed meal (SFM) is a by-product of sunflower oil extraction. It can be used as a feed ingredient to replace soyabean meal (SBM) in poultry diets. A major advantage of using SFM in poultry diets in addition to its lower price compared to SBM, is that it is free from toxic compounds and antinutritional factors which may affect the chick performance (Gheyasuddin *et al*., 1970). SFM could be used profitably up to 20 % of broiler diets with no negative effects on performance (Waldroup *et al.* 1970, Valdivie *et al.,* 1982 and El-Sherif *et al*., 1995). Higher inclusion rates of SFM (85-100 %) as a replacement for SBM were reported with laying hens (El-Sherif *et al.,* 1997 and El-Deek *et al.*, 1999 a and b). Zatari and Sell (1990) and Vieira *et al.*, (1992) recorded that high levels of SFM can be used successfuly in broiler chiks and laying hen diets if adequat levels of dietary lysine and metabolizable energy (ME) are provided. Vetesi *et al.*, (1999) found that body weight, feed conversion, slaughter value, egg production and hatchability of ducks and geese did not change significantly even at 100 % replacement of SBM with SFM.

The low concentration of lysine and high fiber content of SFM may restrict its higher inclusion rate in broiler diets, also the high levels of substitution for SBM in broiler and layer diets by SFM are limited because of its high fiber and low ME contents (Smith, 1968).

Enzymes which may not be produced with large amounts by the chicks are suggested to be added to the diets (Burnett, 1966 and Sullivan, 1987). There are accumulative evidences indicating that the anti-nutritional activity of cell wall non starch polysaccharides (NSP) had impairing effects on growth and feed /gain ratio of birds (Choct and Annison, 1992 and King *et al.*, 1997). However, current advantages in feed biotechnology could improve the utilization of high fibre containing feedstuffs for poultry diets (Makled, 1993 and Attia *et al.*, 1998). Attia *et al.*, (2001) reported that supplementing chick diets containing olive pulp with enzyme improved growth performance of boriler chicks.

The aim of the present experiment was to study the effect of varying proportion of SFM, substituting for SBM with or without enzyme supplementation on growing and laying Japanese quails performance.

MATERIALS AND METHODS

The present experiment was carried out at the Experimental Poultry Farm, Poultry Department, Faculty of Agriculture, Zagazig University, Egypt.

Two factorial design experiments (5 x 2) were conducted to study the effect of substituting SBM by SFM at different levels with or without enzyme supplementation on performance of growing and laying Japanese quails.

Experiment 1. Growing period (1-6 weeks of age):

A total number of 390 unsexed one week old quail chicks were randomly distributed into ten treatment groups of 39 chicks each with 3 replicates each of 13 chicks. Chicks of all experimental groups had nearly the same initial average weight. A (5x 2) factorial design experiment was conducted including five levels of SFM (0.0, 8.5, 17.0, 25.5, and 34.0 % which represents replacement rates of 0, 25, 50, 75 and 100 % of SBM in the basal diet and two levels of dietary enzyme (optizyme) supplementation (0 or 0.5 g/kg diet). Five experimental diets without enzyme supplementation were formulated in which SFM replaced SBM at levels 0 , 25, 50, 75 and 100% and the other 5 diets were the same, but having optizyme at the level of 0.5 g/kg diet.

Optizyme composed mainly of multienzyme systems containing protease, lipase, amylase, hemicellulase, cellulase, exylenase, B-glucanase, α-galactosanase, amylogluconase and pentosanase. The experimental diets were formulated based on the NRC (1994) requirements for quails and were almost isocaloric and isonitrogenous during the growing period (1-6 weeks of age) as shown in Table (1). Chicks were grown in brooders with raised wire floors and exposed to 24 hours of a constant light. Feed and water were supplied *ad-libitum* throughout the experimental period.

Individual body weight was recorded at one, three and six weeks of age, feed consumption and viability rate were recorded during the periods 1-3 , 3-6 and 1-6 weeks of age.

At 6 weeks of age three males from each treatment were randomly chosen having average body weight around the treatment mean, deprived overnight from feed, weighed then slaughtered and after complete bleeding feather was removad. The carcass traits studied were, giblets (liver, gizzard, and heart), carcass and dressed weights (dressed weight = carcass weight + giblets) / 100g pre-slaughter weight.

At the end of the experiment, four birds from each treatment were used to determine the digestibility coefficients of nutrients and to calculate the nutritive values of the experimental diets. Also, an indirect digestion trail was carried out to evaluate the digestibility coefficients and feeding values of SFM nutrients. Birds were housed in individual metabolism cages and fed the experimental diets for a period of three days to allow the birds to become adjusted to cages. Then the excreta was quantitavely collected for a 5 day period during which feed intake was also daily recorded.

Chemical analysis of SFM, experimental diets and excreta were carried out according to the official methods of A.O.A.C. 1990. Faecal nitrogen was determined according to the method outlined by Jakobsen *et al.*, (1960), while the urinary organic matter fraction was calculated according to Abou-Raya and Galal (1971). Nutritive values were calculated as total digestible nutrients (TDN) and metabolizable energy. Metabolizable energy was calculated as 4.2 Kcal /g TDN as suggested by Titus (1961).

Data were statistically analyzed on a (5 x 2) factorial design basis according to Snedecor and Cochran (1982). The following model was used :

$$Y_{ijk} = \mu + A_i + S_j + AS_{ij} + e_{ijk}$$

Where : Y_{ij} = observed trait, μ = the overall mean, A_i = effect of SFM substitution for SBM (i = 1 to 5), S_j = effect of enzyme supplementation (j = 1 and 2), AS_{ij} = the interaction between of SFM substitution for SBM and enzyme supplementation levels, e_{ijk} = random error. Differences among means within the same factor were tested by using Duncan's New Multiple Range test (Duncan, 1955).

Table (1): Composition and calculated analyses of growing and laying diets fed to Japanese quails.

Items	Grower diets (Experiment 1) SFM substitution % for SBM					Layer diets (Experiment 2) SFM substitution % for SBM				
	0 %	25 %	50 %	75 %	100%	0 %	25 %	50 %	75 %	100%
Ingredients (%)										
Yellow corn	56.71	53.10	49.50	46.00	42.10	60.05	57.57	55.26	52.55	49.80
Soybean meal (44%)	34.00	25.50	17.00	8.50	0.00	25.00	18.75	12.50	6.25	0.00
Sunflower meal (27.6%)	0.00	8.50	17.00	25.50	34.00	0.00	6.25	12.50	18.75	25.00
Corn gluten meal (60%)	6.30	8.70	11.20	13.63	16.20	5.70	7.40	9.15	11.10	12.90
Bone meal	2.35	2.40	2.50	2.57	2.70	3.30	3.35	3.41	3.50	3.55
Limestone	0.00	0.00	0.00	0.00	0.00	3.80	3.80	3.80	3.70	3.70
Vit. & Min. Premix [(1,2)]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
NaCl	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Dl-Methionine	0.06	0.05	0.03	0.00	0.00	0.05	0.03	0.01	0.00	0.00
L-Lysine Hcl	0.13	0.30	0.42	0.60	0.75	0.15	0.30	0.42	0.50	0.60
Cotton seed oil	0.00	1.00	1.90	2.75	3.80	1.50	2.10	2.50	3.20	4.00
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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Table (1): continued

Items	Grower diets (Experiment 1)					Layer diets (Experiment 2)				
	SFM substitution % for SBM					SFM substitution % for SBM				
	0 %	25 %	50 %	75 %	100%	0 %	25 %	50 %	75 %	100%
Calculated analyses [3]										
Crude protein %	24.05	24.03	24.00	24.01	24.05	20.03	20.01	20.00	20.04	20.01
ME (kcal / kg)	2901	2906	2904	2901	2907	2922	2918	2903	2907	2914
Crude Fiber %	3.81	5.18	6.56	7.93	9.30	3.22	4.23	5.25	6.26	7.26
Crude Fat %	2.58	2.53	2.48	2.44	2.39	2.62	2.59	2.57	2.53	2.49
Calcium %	0.81	0.82	0.84	0.85	0.88	2.51	2.52	2.53	2.52	2.53
Avail. Phosphorus %	0.45	0.45	0.45	0.45	0.46	0.55	0.55	0.55	0.55	0.55
Lysine %	1.33	1.35	1.32	1.35	1.35	1.08	1.12	1.14	1.12	1.10
Methionine + Cystine %	0.90	0.93	0.94	0.94	0.98	0.77	0.77	0.77	0.79	0.81
Cost / kg diet PT, (Local prices of 2003) [4]	116.9	114.9	111.9	109.4	107.5	108.1	106.4	103.9	101.9	100.4

(1) Grower Vit. & Min. Premix : Each 2.5 kg consists of Vit. A 12000.000 IU, Vit. D3 2000.000 IU, Vit. E 10 g, Vit. K3 2 g, Vit. B1 1000 mg, Vit. B2 4 g, Vit. B6 1.5 g, Vit. B12 10 mg, Pantothenic acid 10 g, Niacin 20 g, Folic acid 1000 mg, Biotin 50 mg, Cholin chloride 500g, Fe. 30 g, Mn. 40 g, Cu. 3 g, I 300 mg, Co. 200 mg, Si. 100 mg, Zn. 45 g.

(2) Layer Vit. & Min. Premix : Each 2.5 kg of vitamin and mineral premix (commercial source pfiezer co.) : Vit. A. 12.00 Miu, Vit. E. 15.00 Kiu, Vit. D3 4.00 Miu, Vit. B1 1.00g, Vit. B2 8.00g. Pantothenic acid 10.87g, Nicotinic acid 30.00g, Vit. B6 2.00g, Vit. B12 10.00 mg, Folic acid 1.00g, Biotin 150.00 mg, Copper 5.00g, Iron 15.00g, Manganese 70.00g, Iodine 0.50g, Selenium 0.15g, Zinc 60.00g, Antioxidant 10.00g.

(3) Calculated according to NRC (1994).

(4) Based upon each unit weight (kg) of yellow corn, soybean meal, Sunflower meal, corn gluten meal, Bone meal, Limestone, Vit. & Min. Premix, NaCl, Dl-Methionine, L-Lysine Hcl and cotton seed oil equals to 73.0, 175.0, 70.0, 180.0, 25.0, 20.0, 500.0, 10.0, 1600.0, 1400.0 and 300.0 PT, respectively..

Experiment 2. Laying period (8-20 weeks of age):

A total number of 160 hens and 80 cocks of Japanese quails at 8 weeks of age with nearly equal body weight and average egg production were randomly divided into 10 treatment groups (16 hens and 8 cocks in each group). Each group of birds was sub-divided into 8 replicates, each of 2 females and one male. Each replicate was housed in one cage. A (5 x 2) factorial treatment arrangement was performed including five levels of SFM (0.00, 6.25, 12.50, 18.75 and 25.00 %, with the previous replacement rates of SBM in experiment 1 i.e. 0, 25, 50, 75 and 100% of SBM in the control diet was replaced by SFM at the same rate) and two levels of optizyme (0 or 0.50 g / kg diet). The experimental diets included five experimental diets without enzyme supplementation and other five ones were the same but having optizyme at a level of 0.50 g / kg.

All experimental diets were nearly isocaloric and isonitrogenous and cover the requirements of quail chicks at the laying period as recommended by NRC (1994).

Birds were fed *ad-libitum* and the fresh water was available all the time during the experimental period. Artificial light source was used, giving a total of 16 hours of light per day throughout the experimental period.

The experimental period (8-20 weeks) was divided into three production phases (8-12, 12-16, and 16-20 weeks of age), these phases represented the productive performance of layer curve. For each replicate, egg number and egg weight were recorded daily and feed intake was calculated weekly. Egg mass was calculated by multiplying egg number by average egg weight. Feed conversion (g feed / g egg) was calculated after subtracting the male consumption (one third) from the total amount of the feed consumed. At the first and the third week of each experimental period, about 80 eggs from each treatment were collected and incubated. After hatching, chicks were counted and non-hatched eggs were broken to determine the percentages of fertility and hatchability. The hatchability was expressed as chicks hatched from fertile eggs.

Egg quality measurements (albumen%, yolk%, shell%, egg shape index%, yolk index% and shell thickness (mm)) were determined for every period at the second and the fourth week of each period, according to Shehata (2000). Two eggs were randomly taken from each replicate, being 96 eggs/treatments.

Statistical analysis for data of experiment 2, followed that used in experiment 1.

Finally, the economical efficiency (EEf.) of the product (growth rate or egg production) was calculated from the input and output analysis based upon the differences in both growth rat (Exp.1) or egg production (Exp.2) and feeding cost (Heady and Jensen, 1954).

RESULTS AND DISCUSSION

Chemical composition, digestion coefficients and nutritive values of SFM:

Sunflower meal used in this experiment contained 89.68 % dry matter, 30.80 % crude protein, 1.29 % ether extract, 26.15 % crude fiber, 35.72 nitrogen free extract, and 6.04 % ash, as shown in Table (2). These values are nearly similar to those reported by Kashani and Carlson (1988), El-Barbary (1997), Soliman (1997), Attia *et al.* (1998) and El-Deek *et al.* (1999 a), but disagree with those of Abbas *et al.* (1992), Villamide and Sanjuan (1998), Fouzder et al. (2000) and Sayed (2002). The variations in the chemical composition of SFM may be due to the differences betweem cultivars, climatic and soil conditions in different geographical locations (Karunajuwa *et al.*, 1989) and also due to the method of oil extraction and hull removal (Ravindran and Blair, 1992).

Table (2): Chemical composition, digestibility coefficients and feeding values of sunflower meal.

Item	Chemical composition % (DM basis)	Digestibility coefficient %
DM	89.68	50.89
OM	93.96	56.00
CP	30.80	74.69
EE	1.29	75.09
CF	26.15	26.05
NFE	35.72	65.82
Ash	6.04	-
Feeding value (as fed)		
TDN %		47.55
ME (Kcal/Kg)		1997

Results in Table (2) showed that digestibilty coefficients of nutrients in SFM were 50.89, 56.00, 74.69, 75.09, 26.05 and 65.82 % for DM, OM, CP, EE, CF and NFE, respectively. The feeding values of SFM in the present study were 47.55 % for TDN and 1997 Kcal ME/ kg.

Experiment 1. Growing period:

Growth performance:

Sunflower meal effect:

Results of growth performance of quail chicks during the experimental period showed that replacing SBM in the control diet with SFM up to 75 % (25.50 % SFM) did not exert any detrimental ($P < 0.05$) effect on body weight at 3 and 6 weeks of age and daily weight gain during all the experimental periods (1-3, 3-6 and 1-6 weeks of age) as shown in Table (3). Complete replacement of SBM with SFM in quail diets (34 % SFM) resulted in significant ($P < 0.05$) decrease in body weight at 3 weeks of age, while it had no significant effect on body weight at 6 weeks of age and daily weight gain at all experiment periods when compared with the control diet (0 % SFM).

It is worth noting that growth performance (body weight and daily weight gain) of quail chicks fed 25% dietary SFM was better than that of the control (0 % SFM) during all the experimental periods. From other poinet of view it is clear that no adverse effect was observed on live body weight and daily weight gain when crude fiber was increased from 3.81 % in the control diet (0 % SFM) to 7.93 % in the diet contained 75 % SFM substitution for SBM. Adverse effects were observed when crude fiber was increased to 9.30 % in the diet contained 100 % SFM substitution for SBM (34 % SFM in the diet). In this concern, Abbas (1992) found that chicks fed the diet containing 7 % crude fiber showed no significant differences in body weight and body weight gain. The adverse effects were observed at the level of 9 % in the diet. Increasing the dietary fiber contents may decrease the availability of amino acids (Nwokolo *et al.*, 1976; Onwudike, 1986) and almost decreased feed intake (Soliman *et al.*, 1996). According the previous results, it could be suggest that the replacement rate of SFM up to 75 % of SBM (25.50 % SFM in the diet) may be recommended in growing quail diets.

Data in Table (3) showed a decrease in daily feed intake with increasing the level of SBM substitution with SFM except at the 25% level of substitution. The differences in daily feed intake were significant ($p < 0.05$) between quails fed 50, 75 and 100% SFM and those fed 0 (control) and 25% SFM during 1-3 weeks of age. The reduction in feed intake for chicks fed SFM replaced 100% SBM may be due to the high fiber contents which can not be tolerated at early stages of quail age, also, diets containing higher levels of fiber occupied more space in the crop resulted in a less feed intake (Mayer and Cheeke, 1975).

Table (3): **Growth performance of Japanese quails (X ± SE) as affected by SFM and enzyme supplementation during the experimental period (1-6 weeks of age). (Exp.1)**

Items	SFM substitution % for SBM					Sig.	Enzyme (g / kg.)		Sig.
	0 %	25 %	50 %	75 %	100 %		0.00	0.50	
Live body weight (g) at:									
1 week	20.08±0.33	20.09±0.1	20.17±0.03	20.38±0.3	20.19±0.4	NS	20.12±0.1	20.18±0.1	NS
3 weeks	81.38±3.8^{a}	85.4±1.8^{a}	80.37±0.59^{ab}	80.3±0.3^{ab}	73.2±4.9^{b}	**	77.79±2.6^{b}	82.4±1.7^{a}	*
6 weeks	174.5±2.0^{ab}	180.8±5.4^{a}	170.85±7.93^{ab}	165.4±0.9^{b}	159.2±3.5^{b}	**	166.2±3.5^{b}	174.1±4.3^{a}	*
Daily weight gain (g) from:									
1-3 weeks	4.38±0.5^{ab}	4.67±0.2^{a}	4.30±0.08^{ab}	4.3±0.2^{ab}	3.79±0.8^{b}	**	4.1±0.97^{b}	4.4±0.57^{a}	*
3-6 weeks	4.43±0.19	4.54±0.33	4.30±0.80	4.07±0.06	4.10±0.16	NS	4.21±0.54	4.36±0.75	NS
1-6 weeks	4.4±0.1^{ab}	4.59±0.3^{a}	4.30±0.45^{ab}	4.2±0.1^{ab}	3.98±0.2^{b}	*	4.18±0.52	4.39±0.59	NS
Daily feed intake (g) from:									
1-3 weeks	12.99±0.7^{a}	13.2±0.8^{a}	12.02±0.26^{b}	12.0±0.3^{b}	11.4±0.1^{b}	**	12.19±1.8	12.5±1.97	NS
3-6 weeks	17.47±0.13	17.60±0.2	17.13±0.39	17.25±0.3	17.05±0.4	NS	17.18±0.7	17.41±0.4	NS
1-6 weeks	15.27±0.49	15.55±0.4	15.24±0.31	15.32±0.7	14.79±0.0	NS	15.08±0.4	15.38±0.8	NS
Feed conversion (g feed / g gain) from:									
1-3 weeks	2.97±0.17	2.97±0.08	2.87±0.01	2.82±0.06	3.06±0.60	NS	2.97±0.54	2.83±0.13	NS
3-6 weeks	3.97±0.16	3.93±0.20	4.09±0.79	4.25±0.12	4.21±0.19	NS	4.14±0.49	4.30±0.62	NS
1-6 weeks	3.47±0.05	3.40±0.12	3.57±0.31	3.69±0.01	3.74±0.22	NS	3.63±0.39	3.51±0.33	NS
Viability rate % from:									
1-3 weeks	100.00	100.00	100.00	100.00	98.78		100.00	99.56	
3-6 weeks	96.67	97.78	98.78	97.78	97.78		97.78	97.78	
1-6 weeks	96.67	97.78	98.78	97.78	96.67		97.78	97.34	
Economical efficiency:									
1-6 weeks	0.508	0.566	0.514	0.470	0.453		0.471	0.533	

Means in the same row within each classification bearing different letters are significantly ($P < 0.05$) different.

*** $P < 0.05$, ** $P < 0.01$ and NS = Not significant.**

The level of SFM substituted SBM in the control diet (25, 50, 75 or 100%) had no significant effect on fed conversion values of Japanese quails during all the experimental periods (Table 3). However, chicks fed on SFM replaced 100% of SBM in the control diet showed the poorest feed conversion values during all the experimental periods. This may be due to the reduction in body weight as a result of high crude fiber inclusion, in the high dietary fiber was also responsible for the poor crude fiber digestibility of broiler chicks fed diets containing 25 % SFM when compared with the control group (Vieira *et al.*, 1992).

Results of growth performance are in agreement with those obtained by Christaki *et al.*, (1994) who indicated that SFM can be used at levels up to 65 g / kg. in Japanese quail diets without any adverse effect on their general performance. Fouzder *et al.*, (2000) found that 100% replacement of SBM with dehulided full fat-sunflower seed meal (FFSSM) in Japanese quail diets did not affect (P < 0.05) body weight, feed conversion efficiency and survivability. Zatari and Sell (1990) found no adverse effect on the body weight gain of chicks fed 20 % SFM. Ibrahim and Geunbter (1991) fed SFM up to 30 % in broiler diets and reported similar body weight gain, feed intake and feed conversion efficiency. Musharaf (1991) incorporated SFM at 50, 100, 150 and 200 g/kg in broiler diets supplemented with lysine and methionine, and found an equivalent body weight gain and feed conversion to those with the control diet (SBM diet).

Enzyme effect:

Enzyme supplementation of the experimental diets significantly (P < 0.05) improved live body weight of quail chicks at 3 and 6 weeks of age (Table 3).

During 1-3 weeks of age, optizyme supplementation of the experimental diets significantly (P < 0.05) improved daily weight gain of chicks compared to those fed unsupplemented ones. While, during 3-6 and 1-6 weeks of age, daily weight gain was insignificantly improved.

Optizyme supplementation of the experimental diets rightly increased daily feed intake and almost improved feed conversion values during all experimental periods (1-3, 3-6 and 1-6 weeks of age), but with no significant differences for both growth performance traits (Table 3).

The improvement in growth performance due to enzyme supplementation may be attributed to increase in digestion and absorption of all nutrients and not simply to the starch alone (Bedford and Morgan, 1996). Also NSP may coat the nutrients contained in the feed. The addition of cell wall degrading enzymes may release nutrients coated by non starch polysaccharides (NSP) contained in the feed and favour their digestion (Classen, 1996 and Cowan *et al.*, 1996). It is well known that also enzymes decrease the viscosity of the digestive contents (Bedford, 1995), which may allow a better contact of nutrients with endogenous and absorptive mucosae cells and therefore a better use of the diet. Marquardt *et al.*, (1996) observed the enzymes caused a decrease in the water content of excreta, which will benefit a management productivity and quality of the end product. In addition, enzyme supplementation increases the rate of passage, which may improve feed intake (Brenes *et al.*, 1996) and decreases multiplication of anaerobes of genus Clostridium (Ward, 1995).

The present results are in good agreement with those obtained by Soliman *et al.*, (1996), Zeweil (1996) and Attia *et al.*, (2001). They found an improvement in broiler and quail chicks growth performance with enzyme supplementation of diets including high level of fiber. However, other investigators indicated that enzyme preparations failed to obtain a significant increase in live body weight and feed conversion of broiler (Mohamed and Hamza, 1991 and Ghazalah *et al.*, 1994).

Interaction effect:

The interaction effects between dietary SFM and optizyme levels on all growth performance traits were not significant (Table 4).

Viability rate varied between 96.67 and 100% for quail chicks fed diets with different replacement levels of SBM in the control diet by SFM or enzyme supplementation during all the experimental periods. It is clear that incorporation of SFM or enzyme supplementation in quail chick diets had little effect on viability rate of chicks.

Economical effeciency (EEf.):

The economical effeciency (EEf.) values of the groups fed 0, 25, 50, 50, 75 and 100 % SFM substitution for SBM were, 0.51, 0.57, 0.51, 0.47 and 0.45, respectively. It is worth noting that chicks fed the diet contained 25 % SFM substitution of SBM resulted in the best EEf. value as compared with other treatments or control.

It is clear that the EEf. of the groups fed on the optizyme supplemented diet were better than those fed the unsupplemented one (0.70 vs. 1.20). These results agree with Soliman *et al.*, (1996) who found that enzyme supplementation improved EEf.

Chicks fed 25 % SFM substitution for SBM with 0.50 g optizyme/kg feed had the best EEf. as shown in Table (4).

Carcass traits:

Sunflower meal effect:

All carcass traits studied except giblets percetage were significantly ($P< 0.01$) affected by feeding the SFM diets (Table 5). The variation in dressing and carcass percentages among different treatments is due to the significant effect on treatments of pre-slaughter weight. Also, dressing percentages were different among the experimental treatments, which could be attributed to the significant effect of treatments on both pre-slaughter weight and carcass weight. It is well known that there is a strong positive relationship between fasting body weight from one side and both carcass weight ($r = 0.92$) and dressing percentage($r = 0.27$) from another side (Krapoth, 1987). Also, Osman *et al.*, (1994) reported that, fasting body weight is strongly correlated with carcass weight ($r = 0.98$) and dressing percentage ($r = 0.18$). Results of SFM effect on carcass traits of quail chicks agreed with those obtained by Aboul Ela *et. al*, (2000) who found significant differences in percentages of carcass, dressing, giblets of broiler chicks due to SFM in the diet, but disagree with those obtained by Christaki *et al.*, (1994) and Fouzder *et al.*, (2000) who found that using SFM on the expense of SBM in Japanese quail diets, did not affect carcass characteristics. Also, Zhu *et al.*, (1983) and Soliman *et al.*, (1996) reported that SFM crude fiber content in the diet containing SFM of layer and broiler had no effect on dressing, heart, liver and gizzard percentages.

Enzyme effect:

All carcass traits studied except giblets were significantly ($P < 0.01$) improved in chicks fed diets supplemented with optizyme (Table 5). Zeweil (1996) and Attia *et al.*, (2001) reported that carcass characteristics in broiler and Japanese quail were not significantly affected by enzyme supplementation.

Interaction effect:

The interaction effect between SFM and enzyme supplementation showed insignificant effect on all carcass traits studied (Table 5).

Table (4): Growth performance of Japanese quail (X ± SE) as affected by interaction between SFM and enzyme supplementation during the experimental periods. (Exp. 1)

Items	SFM[1]	0 %		25 %		50 %		75 %		100 %		Sig.
	Enzyme	0.00	0.50	0.00	0.50	0.00	0.50	0.00	0.50	0.00	0.50	
Live body weight (g) at:												
1 week		19.8±0.5	20.4±0.8	20.0±0.9	20.2±0.9	20.2±1.0	20.1±0.8	20.1±0.9	20.6±0.9	20.6±0.9	19.8±0.7	NS
3 weeks		77.6±2.1	85.2±3.5	85.6±2.1	87.2±1.6	81.0±2.0	79.8±1.8	78.6±1.6	81.9±2.0	68.3±3.2	78.1±2.4	NS
6 weeks		173±4	176±4	176±5	186±5	163±4	179±5	165±5	166±5	156±4	163±5	NS
Daily weight gain (g) from:												
1-3 weeks		4.1±0.6	4.6±0.4	4.6±0.9	4.8±0.1	4.3±0.9	4.3±0.9	4.2±0.2	4.4±0.3	3.4±0.7	4.2±0.5	NS
3-6 weeks		4.5±0.5	4.3±0.8	4.4±0.8	4.7±1.2	3.9±1.5	4.7±0.3	4.1±0.6	4.0±0.4	4.2±1.4	4.0±0.5	NS
1-6 weeks		4.4±0.2	4.5±0.4	4.5±0.8	4.7±0.7	4.1±0.7	4.5±0.4	4.1±0.4	4.2±0.1	3.9±0.6	4.1±0.3	NS
Daily feed intake (g) from:												
1-3 weeks		12.6±1.6	13.4±0.2	12.8±1.5	13.5±0.5	12.3±0.6	12.2±0.9	11.9±0.4	12.2±0.8	11.4±0.7	11.5±0.2	NS
3-6 weeks		17.5±0.8	17.4±0.5	17.5±0.9	17.7±0.9	16.9±0.1	17.3±0.4	17.1±0.6	17.4±0.4	16.9±0.6	17.2±1.2	NS
1-6 weeks		15.0±0.9	15.5±0.5	15.3±0.8	15.8±0.5	15.1±0.3	15.4±0.4	15.2±0.4	15.5±1.1	14.8±1.1	14.8±1.9	NS
Feed conversion (g feed / g gain) from:												
1-3 weeks		3.1±0.3	2.9±0.2	2.8±0.5	2.8±0.1	2.9±0.5	2.9±0.4	2.9±0.2	2.8±0.3	3.6±0.6	2.8±0.3	NS
3-6 weeks		2.9±0.5	4.1±0.9	4.0±0.6	3.8±1.2	4.5±1.6	3.7±0.3	4.2±0.5	4.3±0.3	4.1±1.1	4.3±0.7^{ns}	NS
1-6 weeks		3.4±0.1	3.5±0.2	3.5±0.4	3.3±0.4	3.7±0.6	3.4±0.4	3.7±0.5	3.7±0.1	3.9±0.8	3.6±0.7^{ns}	NS
Viability rate % from:												
1-3 weeks		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	97.8	
3-6 weeks		95.6	97.8	97.8	97.8	100.0	97.8	97.8	97.8	97.8	97.7	
1-6 weeks		95.6	97.8	97.8	97.8	100.0	97.8	97.8	97.8	97.8	97.7	
Economical efficiency:												
1-6 weeks		0.51	0.51	0.53	0.61	0.44	0.59	0.47	0.47	0.41	0.50	

(1) SFM substitution % for SBM, NS = Not significant

Table (5): Some carcass traits, g /100g pre-slaughter weight, X± SE, of growing Japanese quails as affected by SFM and enzyme supplementation and their interaction at 6 weeds of age. (Exp. 1)

Item		Pre-slaughter wt. (g)	Dressing %	Carcass %	Giblets %
SFM substitution % for SBM					
0 %		173.65±2.55^{abd}	78.49±0.58^{ab}	73.38±0.24^{ac}	5.12±0.00
25 %		177.91±6.68^{a}	79.70±0.40^{a}	74.41±0.11^{a}	5.30±0.61
50 %		172.49±6.68^{bd}	78.76±1.23^{a}	73.65±1.04^{ac}	5.12±0.83
75 %		168.96±7.75^{b}	77.20±1.16^{b}	71.95±0.67^{b}	5.26±0.18
100 %		161.28±2.69^{c}	78.25±1.78^{ab}	72.87±1.18^{bc}	5.38±0.58
Significance		**	**	**	NS
Enzyme (E) g / kg.					
0.00		167.89±13.04^{b}	78.05±2.73^{b}	72.59±0.53^{b}	5.45±0.50^{a}
0.50		173.81±15.65^{a}	78.91±1.54^{a}	73.90±0.37^{a}	5.01±0.42^{b}
Significance		**	**	**	**
Interaction (SFM x E)					
SFM	Enzyme				
0 %	0.00	172.37±3.18	78.20±0.50	73.09±0.38	5.12±0.12
	0.50	174.92±6.03	78.78±1.35	73.66±1.09	5.12±0.50
25 %	0.00	174.57±6.88	78.90±2.07	74.30±1.74	5.60±0.32
	0.50	181.25±1.28	79.50±1.47	74.51±1.38	4.99±0.10
50 %	0.00	167.25±3.34	78.14±1.03	72.61±0.93	5.53±0.51
	0.50	177.45±1.65	79.37±0.61	74.68±0.56	4.70±0.50
75 %	0.00	164.08±2.15	78.63±0.94	71.28±1.12	5.35±0.74
	0.50	172.83±6.61	77.78±1.64	72.61±1.90	5.17±0.43
100 %	0.00	159.93±3.42	77.36±2.00	71.69±1.73	5.67±0.27
	0.50	162.62±6.37	79.19±1.05	74.05±1.31	5.09±0.31
Significance		NS	NS	NS	NS

Means in the same column within each classification bearing different letters are significantly ($P < 0.05$) different.

** $P < 0.01$ and NS = Not significant

Digestibility coefficients:

Sunflower meal effect:

The digestibility coefficients of the different nutrients and feeding values of the experimental diets are shown in Table (6). Increasing the dietary SFM resulted insignificant ($P < 0.05$ or $P < 0.01$) decrease in digestibility coefficients of (DM, OM, CP, and CF) and feeding value expressed as ME. On the other hand it increased the digestibility coefficient values of NFE. The reduction in digestibility of nutrients with increasing the dietary SFM level may be due to the increase in dietary crude fiber level with increasing SFM replaced SBM. The decrease of apparent protein digestibility with increasing in fiber contents might be which increase the endogenous losses apparent digestibility (Josson and Carre, 1989). Also, the higher fiber contents caused a strong barrier to the penetration of digestive enzymes. This latest point can explain the negative relationship between fiber dietary and digestibility of crude protein and fat. The results presented here support the hypothesis suggested by Omar (2003) that, as the dietary fiber increased the digestibility of nutrients were decreased. However Soliman *et al.*, (1996) observed no significant differences in the digestibility coefficients of OM, CP, EE and CF of broiler chicks fed diets containing 15 and 25 % SFM in the starter and finisher diets, respectively.

Enzyme effect:

Optizyme supplementation significantly ($P < 0.01$) decreased the digestibility coefficients of DM, OM, EE and NFE as shown in Table (6). On the other hand there is an increase ($P < 0.01$) in digestibility coefficient value of CP was obtained. The enzyme supplement may have increased the apparent digestibility of nutrients by decreasing digesta viscosity and thereby enhancing nutrient digestion and absorption (Friesen *et al.*, 1992). The solubilization and disruption of feed indosperm cell walls by enzyme supplementation propably was primarily responsible for the observed improvements in digestibility and production results (Petterson and Aman, 1989).

The present results agree with those obtained by Samai *et al.*, (1992) and Soliman *et al.*, (1996) who found that digestibility of nutrients in small gut, was improved by enzyme supplementation.

Interaction effect:

The interaction between SFM levels and enzyme supplementation showed significant effects on digestibility coefficients of DM, CP and EE and TDN and ME values. This was achieved by the much greater response to enzyme treatment in birds fed SFM diets compared with those free from enzyme.

Experiment 2. Laying period:

Productive performance:

Sunflower meal effect:

The data in Table (7) showed that egg number was not significantly influenced by SFM percentages during 8-12 and 16-20 weeks of age. However, egg number significantly ($P < 0.05$ or $P < 0.01$) increased in hen fed diets containing SFM during the periods of 12-16 and 8-20 weeks of age. It is worthy noting that egg number at 8-12 weeks of age increased by 3.79, 2.53 and 5.06% in hens fed the diets contained 50, 75 and 100 % SFM substitution for SBM, respectively when compared with those fed on the diet without SFM. The corresponding figures during the whole experimental period (8-20 weeks of age) were 2.94, 2.94 and 2.94 %, respectively. The present results agree with those obtained by El-Barbary, (1997) who found that SFM up to 30 % in the laying hen diets increased egg laying rate. Also, Soliman (1997) and El-Deek *et al.*, (1999 b) reported that replacing SFM protein up

Table (6): Digestion coefficients and feeding values (X± SE) of experimental diets as affected by dietary SFM ration, enzyme and their interaction. (Exp. 1)

Items		Digestion coefficients %						Feeding values	
		DM	OM	CP	EE	CF	NFE	TDN %	ME kcal/kg.
SFM substitution % for SBM									
0 %		77.6±0.3^{a}	80.1±0.3^{a}	82.9±0.2^{a}	78.1±0.1	22.9±0.9^{a}	85.2±0.7^{b}	70.3±0.4	2945±17^{a}
25 %		75.7±0.1^{b}	78.5±0.2^{b}	83.4±0.4^{a}	76.2±1.9	22.3±0.0^{ba}	84.0±0.3^{c}	70.0±0.5	2926±9^{ab}
50 %		75.0±0.2^{b}	77.9±0.1^{b}	81.5±1.6^{b}	76.1±0.1	21.8±0.2^{b}	85.2±1.1^{b}	70.0±0.2	2938±8^{ab}
75 %		73.4±1.4^{c}	76.4±1.2^{c}	80.2±0.1^{c}	75.3±1.2	20.5±0.2^{c}	85.1±1.8^{bc}	68.8±1.1	2887±45^{b}
100 %		74.1±0.5^{c}	76.9±0.8^{c}	78.8±0.6^{d}	75.8±1.0	20.4±0.5^{c}	88.7±1.3^{a}	69.2±0.8	2907±33^{b}
Significance		**	**	**	NS	**	*	NS	*
Enzyme (g / kg.)									
0.00		75.2±0.6^{a}	78.4±0.5^{a}	80.8±0.9^{b}	76.9±0.3^{a}	21.4±0.5	86.7±0.9^{a}	69.9±0.1	2936±5
0.50		74.7±0.9^{b}	77.5±0.8^{b}	81.9±0.9^{a}	75.8±1.0^{b}	21.7±0.5	84.6±0.7^{b}	69.4±0.6	2911±23
Significance		**	**	**	**	NS	**	NS	NS
Interaction (SFM x Enzyme)									
SFM	Enzyme								
0 %	0.00	77.9±0.1^{a}	80.4±0.1	82.7±0.1^{b}	77.0±0.2^{ab}	22.6±0.2	85.9±0.1	69.9±0.1^{ab}	2937±6^{ab}
	0.50	77.3±0.1^{a}	79.7±0.1	83.1±0.6^{a}	78.3±0.7^{a}	23.1±0.2	84.5±0.1	70.8±0.3^{a}	2971±14^{a}
25%	0.00	75.6±0.9^{bd}	78.3±0.9	83.0±0.1^{a}	78.0±0.2^{ab}	22.3±0.3	84.3±0.9	69.5±5.5^{bc}	2917±23^{bc}
	0.50	75.8±0.1^{b}	78.6±0.2	83.2±0.0^{a}	74.3±0.5^{c}	22.4±0.2	83.8±0.3	70.4±2.0^{ab}	2936±24^{ab}
50 %	0.00	75.2±0.2^{cd}	78.0±0.3	80.0±0.1^{c}	76.2±1.1^{bd}	22.4±0.2	86.3±0.4	70.2±1.0^{a}	2946±43^{ac}
	0.50	74.9±0.2^{c}	77.7±0.2	83.1±0.2^{a}	76.0±1.0^{b}	22.0±0.2	84.0±0.2	69.8±0.7^{a}	2930±28^{a}
75 %	0.00	74.7±0.5^{c}	77.6±0.5	80.3±0.4^{c}	76.5±0.8^{b}	20.7±0.7	86.9±0.5	69.8±1.3^{a}	2932±55^{a}
	0.50	72.0±0.1^{e}	75.2±0.3	80.2±0.2^{c}	74.2±0.4^{c}	20.3±0.1	83.2±0.2	67.7±1.0^{d}	2843±41^{d}
100 %	0.00	74.6±0.4^{c}	77.5±0.6	78.1±0.5^{c}	76.8±0.6^{ab}	19.9±0.8	90.0±0.9	70.0±1.9^{a}	2940±79^{ad}
	0.50	73.5±0.5^{g}	76.4±0.5	79.4±0.4^{d}	74.7±0.9^{cd}	20.9±0.9	87.5±0.4	68.4±1.6^{c}	2874±67^{cd}
Significance		**	NS	*	**	NS	NS	*	**

Means in the same column within each classification bearing different letters are significantly ($P < 0.05$) different. * $P < 0.05$, ** $P < 0.01$ and NS = Not significant

Table (7): Productive performance of Japanese quails (X ± SE) as affected by SFM and enzyme supplementation during the experimental period (8-20 weeks of age). (Exp. 2)

Items	SFM substitution for SBM					Sig.	Enzyme (g / kg.)		Sig.
	0 %	25 %	50 %	75 %	100 %		0.00	0.50	
Egg number from:									
8-12 weeks	19.0±0.0	19.0±0.0	18.8±0.0	18.8±0.0	18.8±0.0	NS	19.0±0.0	18.8±0.0	NS
12-16 weeks	22.1±0.0^{b}	22.1±0.0^{b}	23.0±0.0^{b}	22.7±0.0^{b}	23.2±0.0^{a}	**	22.4±0.0	22.7±0.1	NS
16-20 weeks	16.2±0.0	16.5±0.0	16.8±0.0	16.8±0.0	17.1±0.0	NS	16.8±0.0	16.8±0.0	NS
8-20 weeks	57.1±0.0^{b}	58.0±0.0^{ab}	58.8±0.0^{a}	58.8±0.0^{a}	58.8±0.0^{a}	*	58.0±0.0	58.0±0.0	NS
Egg weight (g) from:									
8-12 weeks	11.3±0.1	11.3±0.3	11.1±0.2	11.3±0.0	11.4±0.2	NS	11.3±0.2	11.3±0.4	NS
12-16 weeks	11.8±0.2^{ab}	11.8±0.1^{ab}	11.7±0.0^{b}	11.8±0.1^{a}	11.9±0.1^{a}	**	11.8±0.2	11.8±0.2	NS
16-20 weeks	11.9±0.1^{ab}	12.0±0.1^{ab}	11.9±0.1^{b}	12.1±0.0^{ab}	12.1±0.1^{a}	*	12.0±0.2	12.0.±0.2	NS
8-20 weeks	11.7±0.1^{b}	11.7±0.2^{b}	11.6±0.1^{b}	11.7±0.1^{ab}	11.8±0.1^{a}	**	11.7±0.3	11.7±0.3	NS
Egg mass from:									
8-12 weeks	215±0.2	214±0.2	209±0.6	213±0.3	214±0.3	NS	216±0.3	211±0.5	NS
12-16 weeks	261±0.0	262±0.1	269±1.0	269±0.0	277±0.3	NS	264±0.5	268±1.2	NS
16-20 weeks	194±0.3^{bc}	198±0.3^{b}	199±0.2^{ab}	203±0.1^{ac}	207±0.1^{a}	*	202±0.5	201±0.2	NS
8-20 weeks	666±0.2^{b}	677±0.1^{b}	680±0.2^{ab}	689±0.1^{ab}	696±0.1^{a}	**	678±0.4	677±0.4	NS
Feed conversion (g feed / g egg) from:									
8-12 weeks	3.2±0.1	3.2±0.1	3.2±0.2	3.1±0.1	3.1±0.1	NS	3.1±0.2	3.2±0.2	NS
12-16 weeks	3.0±0.0^{a}	2.9±0.1^{ac}	2.8±0.0^{bc}	2.8±0.0^{bc}	2.7±0.1^{b}	**	2.9±0.2	2.8±0.2	NS
16-20 weeks	3.7±0.1^{a}	3.7±0.1^{a}	3.6±0.1^{ab}	3.5±0.2^{ab}	3.4±0.1^{b}	**	3.6±0.3	3.6±0.3	NS
8-20 weeks	3.3±0.1^{a}	3.2±0.0^{ac}	3.2±0.1^{ac}	3.1±0.0^{bc}	3.0±0.0^{a}	**	3.2±0.2	3.2±0.2	NS
Viability %:	100.00	100.00	100.00	100.00	100.00		100.00	100.00	
Economical efficiency:									
8-20 weeks	1.42	1.51	1.59	1.61	1.66		1.56	1.55	

Means in the same row within each classification bearing different letters are significantly ($P < 0.05$) different.

*$P < 0.05$, ** $P < 0.01$ and NS = Not significant.

to 100% of SBM protein had no negative effect on egg production percentage of broiler breeder hens and laying hens.

Results in Table (7) indicated that SFM replacement up to 100 % SBM significantly ($P < 0.05$ and $P < 0.01$) improved egg weight during all experimental periods except 8-12 weeks of age in which egg weight insignificantly increased by 1.24, 1.10, 1.51 and 1.54 % in hens fed the diets containing 100 % SFM substitution for SBM as compared with the control diet during the periods of 8-12, 12-16, 16-20 and 8-20 weeks of age, respectively. This particular effect on egg size may be related to the higher body weights obtained with the same treatments. The present results are in agreement with those reported by El-Barbary (1997) who reported that feeding 20 % and 30 % SFM during laying period increased egg weight when compared to the control diet (0.00 % SFM). El- Deek *et al.*, (1999 b) indicated that SFM fed to laying hens during 1-26 weeks of age had no adverse effect on egg weight. Fouzder et al., (2000) found that increased levels of substitution of SBM by dehulled SFM in the diets of quails exerted no effect on egg weight.

Sunflower meal substitution for SBM significantly ($P <0.05$ or $P < 0.01$) increased egg mass during 16-20 weeks of age and the whole experimental period (8-20 weeks of age). This increase was to the extent of 6.93, 6.90 and 4.80 % when compared with the control diet in hens fed diets contained 100 % SFM substitution for SBM. These results agree with Soliman (1997) who found that replacing SFM up to 60 % of SBM increased egg mass significantly.

Results in Table (7) showed that feed conversion values (feed / egg mass ratio) significantly ($P < 0.01$) improved when SFM was substituted by SBM during all periods except 8-12 weeks of age. This improvement was to the extent of 6.37, 2.17 and 2.85 % (for 75 % SFM substitution for SBM) and 8.76, 7.08 and 6.46 % (for 100 % SFM substitution for SBM) during the periods of 12-16, 16-20 and 8-20 weeks of age, respectively. These results agree with those obtained by Soliman (1997), El-Barbary (1997) and El-Deek *et al.*, (1999 b) who found that SFM in the laying hens diets improved feed efficiency.

Therfore, regarding to the resulte of laying production performance, SFM protien could substitute SBM in Japanese quail layer diets up to the rate of 100 % (25 % of the diet).

Enzyme effect:

Table (7) showed that there was no significant effect due to enzyme supplementation on laying productive performance studied (egg number, egg weight, egg mass and feed conversion, (g feed / egg) as compared with those fed unsupplemented diets. These results agree with Hataba *et al.*, (1994), Attia *et al.*, (1997), Igbasan and Geunbter (1997) and Shehata (2000) who reported insignificant improved in laying productive performance of due to enzyme supplementation.

Interaction effect:

During the whole experimental period all interactions due to level of SFM substituting for SBM or optizyme supplementation insignificant affected (egg number, egg weight, egg mass and feed conversion) as shown in Table (8). The present results agree with Soliman (1997) who found that the interaction between SFM and enzyme supplementation did not significantly affect egg weight, egg mass, However El-Deek *et al.*, (1999 b) indicated also a significant interaction between optizyme by SFM on the feed / egg mass ratio during 21-44 weeks of age.

It is worthy noting that viability percentage was 100 % during the whole

Table (8): Productive performance of Japanese quail (X ± SE) as affected by interaction between SFM and enzyme during the experimental periods (8-20 weeks of age). (Exp. 2)

Items SFM[(1)]	0 %		25 %		50 %		75 %		100 %		Sig.
Enzyme	0.00	0.50	0.00	0.50	0.00	0.50	0.00	0.50	0.00	0.50	
Live body weight (g) at:											
8 weeks (Initial)	168.9±0.9	169.0±0.8	169.3±1.0	168.8±1.2	169.0±0.7	169.2±0.9	169.0±1.9	169.3±1.5	169.7±1.4	169.5±0.9	NS
12 weeks	187.8±2.9	187.6±2.5	188.2±6.7	188.1±3.0	188.2±5.7	188.3±2.3	188.5±3.9	188.6±3.2	189.0±1.4	189.5±3.7	NS
16 weeks	200.9±5.5	201.2±2.5	202.5±3.1	203.0±3.2	202.1±3.2	202.8±4.8	202.8±6.1	202.1±4.0	201.8±4.1	202.4±3.0	N.S
20 weeks	212.3±4.1	214.6±3.1	215.7±2.6	215.6±3.4	214.8±8.5	216.0±3.3	215.5±3.7	215.2±4.3	214.4±4.5	214.2±3.6	NS
Egg number from:											
8-12 weeks	18.8±0.1^{abc}	19.0±0.1^{adg}	19.0±0.1^{ace}	19.0±0.1^{af}	19.3±0.1^{ac}	18.2±0.1^{bd}	19.0±0.1^{af}	18.2±0.1^{befg}	18.5±0.1^{befg}	18.8±0.1^{cfg}	*
12-16 weeks	22.1±0.1	21.84±0.10	21.84±0.03	22.4±0.1	22.68±0.7	23.2±0.1	22.7±0.1	22.7±0.9	23.0±0.8	23.2±0.1	NS
16-20 weeks	16.0±0.1	16.52±0.10	16.52±0.12	16.2±0.1	17.08±0.1	16.5±0.1	16.8±0.1	16.8±0.1	17.4±0.1	17.1±0.1	NS
8-20 weeks	56.3±0.1	57.1±0.1	58.0±0.1	58.0±0.1	58.8±0.1	58.0±0.1	58.8±0.1	58.0±0.1	58.8±0.1	58.8±0.1	NS
Egg weight (g) from:											
8-12 weeks	11.2±0.9	11.4±0.8	11.4±0.8	11.1±1.6	11.2±1.1	11.1±0.9	11.3±1.0	11.3±0.8	11.4±0.8	11.5±0.6	NS
12-16 weeks	11.7±0.3^{a}	11.8±0.3^{cdi}	11.9±0.2^{cde}	11.8±0.2^{afhi}	11.7±0.2^{afg}	11.7±0.2^{af}	11.8±0.2^{cdgh}	11.9±0.6^{beh}	11.9±0.3^{bcdh}	12.0±0.3^{bc}	**
16-20 weeks	11.9±0.4	12.0±0.6	12.02±1.06	11.9±0.5	11.9±0.5	11.8±0.8	12.1±0.2	12.0±0.9	12.2±0.6	12.1±0.3	NS
8-20 weeks	11.6±0.3	11.7±0.4	11.8±0.4	11.6±0.6	11.6±0.5	11.5±0.4	11.7±0.4	11.8±0.6	11.8±0.3	11.9±0.2	NS
Egg mass from:											
8-12 weeks	210.5±1.6^{ab}	216.1±1.5^{a}	217.4±0.7^{a}	211.3±1.7^{a}	217.0±0.8^{a}	201.1±0.9^{b}	215.2±0.5^{a}	206.2±0.6^{ab}	209.8±1.1^{ab}	215.7±0.8^{a}	*
12-16 weeks	258.4±1.1	258.2±1.1	259.5±0.4	263.7±1.2	265.4±0.8	271.7±1.6	267.6±1.7	269.2±0.9	272.5±0.8	278.4±0.8	NS
16-20 weeks	189.9±1.3	197.7±0.7	198.6±1.3	199.1±1.5	203.4±1.2	195.3±1.2	202.8±1.2	22.3±0.9	210.9±0.6	206.5±1.0	NS
8-20 weeks	652.3±0.9	668.3±0.7	682.2±0.7	671.2±1.1	682.7±0.3	667.7±0.7	687.4±0.7	681.0±0.3	693.3±0.4	697.4±0.7	NS
Feed conversion (g feed / g egg) from:											
8-12 weeks	3.3±0.7^{ab}	3.2±0.7^{abc}	3.1±0.3^{ac}	3.2±0.8^{abc}	3.1±0.3^{ac}	3.3±0.4^{b}	3.1±0.2^{c}	3.2±0.2^{abc}	3.1±0.4^{ac}	3.0±0.3^{c}	*
12-16 weeks	3.0±0.4	3.0±0.4	2.9±0.1	2.8±0.4	2.8±0.2	2.8±0.4	2.8±0.5	2.8±0.3	2.8±0.2	2.7±0.2	NS
16-20 weeks	3.7±0.7	3.6±0.4	2.6±0.6	3.7±0.8	3.5±0.6	3.6±1.0	3.6±0.6	3.4±0.9	3.4±0.3	3.5±0.5	NS
8-20 weeks	3.3±0.4	3.2±0.3	3.2±0.3	3.2±0.5	3.1±0.1	3.2±0.3	3.1±0.2	3.1±0.1	3.1±0.2	3.0±0.3	NS
Viability %:	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
Economical efficiency:											
8-20 weeks	1.41	1.42	1.52	1.50	1.62	1.56	1.61	1.60	1.63	1.68	

[(1)] SFM substitution % for SBM

Means in the same row within each classification bearing different letters are significantly (P < 0.05) different.

*** P < 0.05, ** P < 0.01 and NS = Not significant.**

experimental period. Similar results were reported by El-Deek *et al.*, (1999 b).

Reproductive performance:

Results in Table (9) showed that fertility and hatchability during all the experimental periods were not significantly affected by SFM substitution for SBM up to the rate of 100%, enzyme supplementation and the interaction between SFM and enzyme supplementation. Therefore, in regard to fertility and hatchability, SFM could substitute SBM in Japanese quail layer diets up to the rate of 100 % without deleterious effect on reproductive performance. Brake (1992) and Shehata (2000) found no adverse effect for kemzyme addition on fertility of broiler breeder eggs. Vetesi *et al.*, (1999) reported that replacing SBM with SFM had no significant effect on egg production or hatchability of ducks or geese even at 100 % replacement.

Egg quality:

Sunflower meal effect:

Results obtained in Table (10) showed that albumin, yolk and shell as percentages were significantly ($P < 0.01$) affected by SFM level in quail hen diets. Albumin increased with increasing SFM level from 50 % up to 100 % replaced by SBM in the diets. It is clear that quail hens fed 50 % SFM replaced by SBM had the significantly ($P < 0.01$) lower yolk percentage when compared with the other treatment groups. El-Barbary (1997) reported that replacement of SBM by SFM in layer diets resulted in a significant increase in egg yolk weight percentage.

It is worth noting that eggs from hens fed on 25 and 50 % SFM replaced for SBM had significantly ($P < 0.01$) higher egg shell weight percentages compared with the other treatments. El-Deek *et al.*, (1999 b) found that replacing SFM protein up to 100 % of SBM protein had deleterious effects on egg shell weight percentages. Shape index was not significantly affected by SFM substitution for SBM up to 100 % in the hen diets (Table 10). Generally, yolk index was significantly ($P < 0.01$) increased in hen fed SFM diets.

Also, shell thickness significantly increased in hen fed diets contained SFM when compared with those diet free from SFM. El-Deek *et al.*, (1999 b) found no impairing effect of SFM on egg shell thickness, since group fed 100 % SFM had similar shell thickness, with the control group. These results indicated that SFM protein could be utilized up to 100 % of SBM in the quail hen diets without adverse effect on egg quality.

Enzyme effect:

Results in Table (10) showed that all egg quality traits were not significantly affected by optizyme supplementation in Japanese quail laying diets. Similarly, El-Full *et al.*, (2000) and Shehata (2000) found the same results with kemzyme supplementation.

Interaction effect:

The interaction between SFM and enzyme supplementation showed insignificant effects on all egg quality traits except shape index and yolk index (Table 10). Similarly El-Deek *et al.*, (1999 b) showed the same trend.

Economical efficiency (EEf.):

The economical efficiency values of the groups fed 0, 25, 50, 75 and 100 %SFM substituted for SBM were 1.42, 1.51, 1.59, 1.61 and 1.66, respectively (Table 7). It is worth noting that SFM substitution for SBM up to 100 % provided EEf. higher than that of the control SBM diet.

It is observed that the best EEf. value during the whole experimental period was recorded for birds fed 100 % SFM substitution for SBM with 0.50 g optizyme / kg diet (Table 8).

Table (9): Reproductive performance (X ± SE) of Japanese quail as affected by SFM and enzyme and their interaction during the experimental periods (8-20 weeks of age). (Exp. 2)

Item		Fertility %				Hatchability %			
		8-12 Weeks	12-16 Weeks	16-20 Weeks	8-20 Weeks	8-12 Weeks	12-16 Weeks	16-20 Weeks	8-20 Weeks
SFM substitution % for SBM									
0 %		75.67±1.40	85.75±0.29	84.86±2.56	81.68±1.71	68.09±0.40	79.94±0.14	79.99±1.57	75.34±1.32
25 %		75.02±1.38	86.36±0.25	85.75±0.29	82.72±0.61	68.73±0.96	79.95±0.11	81.00±1.25	76.66±0.63
50 %		74.88±0.67	86.79±0.29	86.36±0.25	81.78±0.48	67.94±0.49	80.90±1.01	78.98±0.89	75.78±0.37
75 %		76.06±1.37	83.87±1.87	86.79±0.29	81.08±1.65	68.95±0.77	78.60±072	78.39±1.80	74.96±1.18
100 %		75.18±0.04	84.70±0.75	83.87±1.87	80.83±1.05	69.51±0.17	80.20±1.40	79.92±1.38	76.33±0.65
Significance		NS	NS	NS	NS	NS	NS	NS	NS
Enzyme g / kg.									
0.00		74.87±0.96	85.09±3.53	84.23±2.70	81.27±1.81	68.49±1.47	79.58±1.82	78.95±2.36	75.40±1.89
0.50		75.85±1.55	85.78±1.84	84.73±5.02	81.95±2.29	68.79±1.70	80.25±2.10	80.33±2.18	76.23±1.28
Significance		NS	NS	NS	NS	NS	NS	NS	NS
Interaction (SFM x E)									
SFM	**Enzyme**								
0 %	0.00	74.97±8.88	85.06±1.60	83.58±7.57	80.82±6.16	67.89±7.36	79.87±0.78	79.15±7.23	74.68±5.70
	0.50	76.37±7.27	85.89±2.02	86.14±1.53	82.53±2.79	68.29±9.30	80.01±1.88	80.72±0.46	76.00±3.31
25 %	0.00	74.33±10.38	86.23±1.67	86.14±4.46	82.41±5.27	68.25±8.09	79.89±0.22	80.37±6.71	76.34±4.81
	0.50	75.71±10.94	86.48±0.85	86.82±7.33	83.02±5.72	69.21±9.83	80.00±0.47	81.62±8.18	76.97±6.07
50 %	0.00	74.54±9.54	86.93±1.75	83.44±1.43	81.54±2.28	68.18±10.77	80.39±2.64	78.53±1.49	75.59±2.37
	0.50	75.21±11.28	86.64±0.85	84.72±1.99	82.02±4.79	67.69±9.30	80.40±0.43	79.42±0.69	75.96±3.23
75 %	0.00	75.37±9.68	82.93±1.58	83.28±0.56	80.25±3.01	68.56±10.80	78.24±0.66	77.49±3.92	74.37±3.08
	0.50	76.74±8.22	84.80±2.16	84.96±1.50	81.90±2.86	69.33±8.14	78.96±2.09	79.29±3.32	75.55±3.44
100 %	0.00	75.16±8.66	84.32±2.78	84.71±4.58	81.35±5.81	69.59±12.10	79.50±2.90	79.23±2.41	76.00±6.27
	0.50	75.20±12.10	85.07±2.70	81.02±9.39	80.30±2.25	69.42±11.17	81.00±3.65	80.61±0.69	76.65±4.81
Significance		NS	NS	NS	NS	NS	NS	NS	NS

Means in the same column within each classification bearing different letters are significantly ($P < 0.05$) different.
N.S = Not significant.

Table (10): Egg quality (X ± SE) of Japanese quail as affected by SFM and enzyme and their interaction during the experimental periods (8-20 weeks of age). (Exp. 2)

Item		Albumen %	Yolk %	Shell %	Egg shape index %	Yolk index %	Shell thickness (mm)
SFM substitution % for SBM							
0 %		52.39±0.39^{ab}	28.66±0.05^{a}	18.96±0.34^{ab}	70.84±1.03	52.30±0.33^{b}	0.23±0.01^{b}
25 %		51.76±0.32^{b}	28.91±0.35^{a}	19.35±0.64^{a}	70.97±1.61	51.45±0.85^{c}	0.24±0.00^{a}
50 %		52.49±0.54^{a}	27.90±0.08^{b}	19.66±0.71^{a}	70.87±2.03	52.44±0.52^{ab}	0.24±0.00^{a}
75 %		52.73±0.75^{a}	29.06±0.02^{a}	18.22±0.76^{b}	70.94±0.20	51.69±1.12^{c}	0.24±0.00^{a}
100 %		52.43±0.12^{ab}	28.98±0.10^{a}	18.60±0.02^{ab}	70.76±1.36	52.28±0.04^{ac}	0.24±0.00^{a}
Significance		**	**	**	NS	**	*
Enzyme g / kg.							
0.00		52.34±0.71	28.74±1.06	18.93±0.72	70.82±1.84	52.02±1.30	0.24±0.01
0.50		52.37±1.22	28.66±1.09	18.98±1.94	70.93±1.63	52.04±1.30	0.24±0.01
Significance		NS	NS	NS	NS	NS	NS
Interaction (SFM x E)							
SFM	**Enzyme**						
0 %	0.00	52.19±2.14	25.68±2.26	19.13±4.09	71.35±1.82^{ab}	52.13±1.08^{acd}	0.24±0.00
	0.50	52.58±2.03	28.63±1.93	18.79±3.09	70.32±1.53^{cd}	52.46±0.97^{ac}	0.24±0.01
25 %	0.00	51.92±1.28	29.08±3.04	19.03±2.47	71.77±1.13^{ac}	51.87±1.90^{ad}	0.24±0.00
	0.50	51.60±2.90	28.73±1.64	19.67±2.80	70.16±1.66^{cf}	51.02±2.41^{b}	0.24±0.00
50 %	0.00	52.76±1.77	27.94±0.76	19.30±1.77	69.85±5.26^{c}	52.70±3.95^{ac}	0.24±0.00
	0.50	52.22±1.67	27.86±1.52	20.01±2.90	71.88±1.84^{a}	52.18±1.14^{ac}	0.24±0.00
75 %	0.00	52.35±2.52	29.05±2.38	18.60±3.64	71.04±1.51^{bde}	51.13±1.36^{bd}	0.24±0.00
	0.50	53.10±1.87	29.07±1.45	17.84±3.04	70.84±1.97^{bfg}	52.25±1.33^{ac}	0.24±0.00
100 %	0.00	52.49±1.30	28.93±0.81	18.59±1.80	70.08±1.01^{cf}	52.26±1.49^{ac}	0.24±0.00
	0.50	52.37±2.24	29.03±1.01	18.61±2.87	71.44±1.26^{acg}	52.30±1.42^{ac}	0.24±0.00
Significance		NS	NS	NS	**	**	**

Means in the same column within each classification bearing different letters are significantly ($P < 0.05$) different.

* $P < 0.05$, ** $P < 0.01$ and NS = Not significant.

In general, from nutritional point of view it can be concluded that, using SFM up to 75 % (25.5 % of the diet) and 100 % (25 % of the diet) substitution for SBM in growing and laying Japanese quail diets had no adverse effect on growth and laying performance. While from an economical point of view, SFM could substitute SBM up to the rate of 25% (8.5 % of the diet) and 100 % (25 % of the diet) in growing and laying Japanese quail. The supplementation of optizyme at a level of 0.50 g / kg feed is superior in promoting performance of growing and laying Japanese quail. Also, the same results were obtained by using optizyme (0.50g / kg feed) with 25 % and 100 % substitution in growing and laying Japanese quail diets. Such practice may be of high economic value without any adverse effects on the performance in growing and laying Japanese quail.

REFERENCES

Abbas, A.M. (1992). Effect of dietary fiber on broiler performance. J. Agric. Sci. Mansoura Univ., 17(10): 3165-3173.

Aboul Ela, S.S; A.I. Attia ; M.M. Soliman and M. El-Tawil (2000). Sunflower meal as a substitute for soybean meal in broiler rations. Conf. Of Social and Agricultural Development of Sinai. pp 31, El-Arish, Egypt.

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

Association of Official Analytical Chemists, AOAC (1990). Official Methods of Analysis. 14th Ed. Published by AOAC, Washington, DC, USA.

Attia, Y.A.; A.I. Abd El-Ghani, E.H. El-Ganzory and S.B. Abd El-Hady (1997). Responses of Dandarah local breed to some pro-nutrient additions. Egypt. Poult. Sci., 16: 137-153.

Attia, Y.A.; A.A. El-Deek and M. Osman (1998). Evaluation of sunflower meal as a feedstuff in diets for ducks. Arch. Fur. Geflugelkude. 62: 6, 273-282.

Attia, A.I.; A. El-Anowar ; M.M. Soliman (2001). Effect of olive pulp supplemented with or without optizyme on growth performance and carcass characteristics of broiler chicks. The 8th Scientific Conf. on Animal Nutrion, pp. 967, Sharm El-Sheikh, Egypt.

Bedford, M.R. (1995). Mechanism of action and potential environmental benefits from the use of feed enzymes. Animal Feed Sci. and Technol., 53: 145-155.

Bedford, M.R. and A.J. Morgan (1996). The use of enzyme in poultry diets. World's Poult. Sci., 52: 61-68.

Brake, J. (1992). Effect of an enzyme product (Kemzyme) in a corn-soy diet on broiler breeders. Poult. Sci., 71: (Suppl.1), 24.

Brenes, A.; R. Lazaro ; M. Garcia and G.G. Mateos (1996). Utilizacion practica de complejos enzimaticos en aviculture. In : Rebdler, P.G., Mateos, G.G and de Blas, C. (eds) XII Curso de Especializacion FEDNA. FEDNA, Madrid, pp. 135-157.

Burnett, G.S. (1966). Studies on viscosity as the probable factor involved in the improvement of certain barleys for chickens by enzyme supplementation. Br. Poult. Sci., 7: 55-75.

Choct, M. and G. Annison (1992). Anti-nutritive effect of wheat pentosans in broiler chickens : Roles of viscosity and microflora. Br. Poult. Sci., 33: 821-834.

Christaki, E.V.; P. Florou-Paneri ; A.L. Tserveni-Gousi and A.V. Spais (1994). Effect of sunflower seed meal on the performance and carcass characteristics of growing Japanese quails. Anim. Feed Sci. and Technol., 48: 169-74.

Classen, H.L. (1996). Cereal grain starch and exogenous enzymes in poultry diets. Anim. Feed Sci. and Technol., 60:21-27.

Cowan, W.D.; A. Korsbak ; T. Hastrup and P.B. Rasmussen (1996). Influence of added microbial enzymes on energy and protein availability of selected feed ingredients. Anim. Feed Sci. and Technol., 60: 311-319.

Duncan, D.B. (1955). Multiple Range and Multiple F Tests. Biometrics, 11: 1-42.

El-Barbary, A. (1997). Effect of sunflower seed meal (Helianthus annuus) as feed replacement for layer ration on some physiological parameters and reproductive performance. M. Sc. Thesis, Faculty of Agric., Alexandria University.

El-Deek, A.A.; M.A. Abaza ; Mona Osman ; Y.A. Attia and A.M. Khalaf, (1999, a). Inclusion of sunflower meal and commercial enzyme to egg type strain ration during growth period 1- Effects on growth performance, mortality rate, blood parameters and economic returns. Egypt. Poult. Sci. J. 19(III): 429-447.

El-Deek, A.A.; Mona Osman ; M.A. Abaza ; Y.A. Attia and A.M. Khalaf, (1999b). Inclusion of sunflower meal and commercial enzyme to egg type strain ration during growth period 2- Effects on sexual maturity laying performance, internal egg and shell qualities and economic returns. Egypt. Poult. Sci., 19(III): 549-567.

El-Full, E.A.; N.E.A. Asker ; M.M.M. Ali ; H.M. Abdel Wahed and E.M. Omar (2000). The use of rice bran in broiler and layer diets with reference to enzyme in broiler and layer diets with reference to enzyme supplementation. Egypt. Poult. Sci., 20 (III): 517-543.

El- Sherif, K.; T. Gippert and D. Gerendai (1995). Effect of different levels of expeller sunflower seed meal in broiler diets. Allatenyesztez - es- Takarmanyozas. 44:5, 427-435. (Cited in El-Deek et al., 1999 a)

El- Sherif, K.; T. Gippert and D. Gerendai (1997). Effect of feeding sunflower meal supplemented with energy and amino acids on laying hen performance. Allatenyesztez -es- Takarmanyozas. 46:1, 87-94. (Cited in El-Deek et al., 1999 b)

Fouzder, S.K.; N.R.M.Z. Khan ; M.A.R. Howlider and M.L. Ali (2000). Substituting dehulled full-fat sunflower seed-meal for soybean-meal in Japanese quail diets. Indian J. Anim. Sci., 7(9): 961-964.

Friesen,O.D.; W. Gventer ; R.R. Marquardt and B.A. Rotter (1992). The effect of enzyme supplementation on the apparent metabolizable energy and nutrient digestibilities of wheat, barly, oats and rye for the young broiler chick. Poult. Sci., 71: 1710-1721.

Ghazalah, A.A; O.M. El-Husseiny ; H.M. Fayek and S. El-Wafa (1994). Influence of enzyme preparations and growth promoters on broiler performance. pp. 140-165. 2nd Scientific Conf. on Poultry, September 1994, Kafr El-Sheikh, Egypt.

Gheyasuddin, S.; C.M. Carter and K.F. Mattil (1970). Effect of several variables on the extractability of sunflower seed proteins. J. Food Sci., 35: 453-456.

Hataba, N.A.; S.A. Ibrahim ; A.I. El-Faham and M.A. El-Sheikh (1994). Utilization of the enzyme preparation "kemzyme" in layer rations. pp. 124-138. 2nd Scientific Conf. On Poultry, September 1994, Kafr El-Sheikh, Egypt.

Heady, E.O. and H.R. Jensen (1954). Farm Management Economics. Prentic- Hall, Inc. Englewood Cliffs, N.J.

Ibrahim, M.A. and E.A. Geunbter (1991). Higher fiber sunflower seed meal in broiler chick diets. Anim. Feed Sci. and Technol., 33(3-4): 343-347.

Igbasan, F.A. and W. Geunbter (1997). The influence of micromization, dehulling, and enzyme supplementation on the nutritional value of peas for laying hens. Poult. Sci. 76: 331-337.

Jakobsen, D.E.; S.K. Gertovey and H. Nielson (1960). Digestibility trials with poultry. 322 Bertning fra forsg slabooratoriel udgbet of statens. Husdyrbugsudvaly – Kobengaven.

Josson , W.M. and B. Carre (1989). Influence of fibre on digestibility of poultry feeds. In: Recent Develpoments in Poultry Nutrition.pp. 78-93. Eds cole, D. J. And W., Jaresign, Butterworths, London.

Karunajuwa, H.; S.H. Tham and S. Abu-Serewa (1989). Sunflower seed-meal, sunflower oil and full-fat sunflower seeds-hulls and darnels for laying hens. Anim. Feed Sci. and Technol., 26: 45-54.

Kashani, A. and C.W. Carlson (1988). Use of sunflower seeds grower diets for pullets and subsequent performance as affected by aureomycin and pelleting. Poult. Sci., 67: 445-51.

King, D.; D. Ragland and O. Adeola (1997). Apparent and true metabolizable energy values of feedstuffs for ducks. Poult. Sci. 76: 1418-1423.

Krapoth, G.H. (1987). Untersuchungen zur sohlacht koeperbevertung und flishbeschaffenheit bei Broilorn. Ph. D. Thesis, Kiel Univ., Germany.

Makled, N. (1993). Enzymes as poultry fed supplement. 4[th] Symp. Anim. Poult. Fish Nut., El-Fayoum. Egypt: 5-9.

Marquardt, R.R.; A. Brenes ; Z. Zhang and D. Boros (1996). Use of enzyme to improve nutrient availability in poultry feedstuff. Anim. Feed Sci. and Technol. 60: 321-330.

Mayer, R.O. and P.R. Cheeke (1975). Utilization of alfalfa meal and protein concentrate by rates. J. Anim. Sci., 40: 500-508.

Mohamed, N.A.and A.S. Hamza (1991). Using enzyme preparation in corn-soybean meal broiler rations. Egypt. J. Anim. Prod., 28: 245.

Musharaf, N.A. (1991). Effect of graded levels of sunflower seed meal in broiler diets. Anim. Feed Sci. and Technol., 33(1-2); 129-137.

National Research Council, NRC (1994). Nutrient Requirements of Poultry 9[th] ed. National Academy of Sci. Washington, D,C., USA.

Nwokolo, E.N.; D.B. Bragg, and W.D. Kitts (1976). The availability of amino acids from palm kernel, soybean, cotton seed and rape seed meal for the growing chick. Poult. Sci., 55: 2300-2304.

Omar, A. (2003). Effect of some dietary physical and chemical properties on the growth and digestion in broiler chicks. Ph. D. Thesis, Poult. Dept., Fac. of Agric., Zgazig University, Egypt.

Onwudike, O.C. (1986). The effects of dietary sand on the usage of diets containing brower's dried grains by growing chicks. Poult. Sci., 65; 1129-1136.

Osman, A.M.A.; A. Gh. Galal and A.A. Saleh (1994). Comparative studies among some broiler hybrids for carcass traits and meat quality under different feeding systems. Minia J. Agric. Res. & Dev., 16(2): 447-470.

Petterson, D. and P. Aman, (1989). Enzyme supplementation of a poultry diet containing rye and wheat. Br. J. Nut., 62: 139-149.

Ravindran, A. and R. Blair (1992). Feed resources for poultry production in Asia and Pacific. II. Plant protein sources. World's Poult. Sci. J., 48: 205-231.

Samai, A.M.; J.M. Groopp and R.T.B. Doris (1992). Nutrient digestibility of 30 % rye seed broiler diet as influenced by carbohydrate splitting enzymes. Egypt. Poult. Sci., 12: 399-415.

Sayed, M.A. (2002). Chemical and biological evaluation of sunflower meal and linseed meal in poultry diets with reference to effect on broiler performance. Egypt. Poult. Sci. J. 22: 953-969.

Shehata, M.M. (2000). Using some aquatic plants in feeding chicks. Ph. D. Thesis, Fac. of Agric. Zagazig University, Egypt.

Smith, K.J. (1968). A review of the nutritional value of sunflower meal. Feedstuffs (USA), 40: 20-22.

Snedecor, C.W. and W.C. Cochran (1982). Statistical Methods. 7th ed. Iowa State Coll Press Ames IA.

Soliman, A.A. (1997). Evaluation of the productivity and performance of broiler breeder hens fed practical or vegetable diets containing high levels of barley and sunflower meal with multi-enzymes supplement during the pre-laying and laying periods. Ph. D. Thesis, Fac., of Agric., Alex. Univ.

Soliman, A.Z.; I. Hassan ; S. Abou-Elwafa and A.G. Abdellah (1996). Utilization of high fiber sunflower meal with/without commercial enzymes of stabilized rumen extract in broiler diets. Egypt. Poult. Sci., 16(1): 51-67.

Sullivan, T.M. (1987). Evaluation of sorghum varieties in poultry diet. Feed facts. Published by Grain Sorghum Producers Association, April, 15, Vol. 4, No. 2.

Titus, H.W. (1961). The Scientific Feeding of Chickens. 5th Ed. Danvil, Illinois, U.S.A

Valdivie, M.L.; O. Sardinas and G.A. Garcia (1982). The utilization of 20 % sunflower seed meal in broiler diets. Cuban J. Agric., Sci., 16: 167-171.

Vetesi, M.; M. Mezes and L. Kiss (1999). Using sunflower meal in waterfowl diets. Nutr. Abs. & Rev., 68: 8, 726.

Vieira, S.L.; A.M. Penz ; Jr.,m. A.M. Leboute and J. Corteline (1992). Anti-nutritional evaluation of a high fiber sunflower meal. J. Appl. Poult. Res., 1: 382-388.

Villamide, M.S. and L.D. Sanjuan (1998). Effect of chemical composition of sunflower seed meal on its true metabolizable energy and amino acid digestibility. Poult. Sci., 77: 1884-1892.

Waldroup, P.W.; C.M. Hillard and R.J. Mitchell (1970). Sunflower meal as a protein supplement for broiler diets. Feedstuffs, 41:42.

Ward, N.E. (1995). Enzyme use in viscous inducing cereal diets examined. Feedstuffs, 67(49), 1-4.

Zatari, I.M. and J.L. Sell (1990). Sunflower meal as a compound of fat-supplemented diets for broiler chickens. Poult. Sci., 69: 1503-1507.

Zeweil, H.S. (1996). Enzyme supplements to diets of growing Japanese quail. Egypt. Poult. Sci., 16: 535-557.

Zhu, Y.Q.; J.L. Ding and Y.P. Zhou (1983). High-fiber sunflower oil meal as a replacement for soybean in layer diets. Chinese J. Anim. Sci. (C.F. Nutr. Abs. & Rev. Ser. B, 19.).

تأثير إحلال كسب بذور عباد الشمس لكسب بذور فول الصويا مع أو بدون إضافة الأنزيم على الأداء الإنتاجي للنمو وإنتاج البيض في السمان الياباني

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استخدم في هذا البحث ٣٩٠ كتكوت سمان ياباني غير مجنس عمر أسبوع ٢٤٠، (١٦٠ أنثى+٨٠ ذكر) من الأمهات والأباء لدراسة تأثير إحلال كسب بذور عباد الشمس محل كسب بذور فول الصويا بمستويات مختلفة مع أو بدون إضافة الإنزيم. وقد صمم لذلك تجربتان عامليتان (٥x ٢) اشتملت كل واحدة على ١٠ معاملات، كونت خمس علائق تجريبية بدون إضافة الإنزيم حل فيها كسب بذور عباد الشمس محل كسب بذور فول الصويا بمستويات (صفر، ٢٥، ٥٠، ٧٥، ١٠٠ %) أما العلائق الخمس الأخرى أضيفَ إليها أنزيم الأوبتيزيم (Optizyme) بمعدل ٠,٥ جم/كجم علف. خلال فترة النمو (١-٦ أسابيع) وإنتاج البيض (٨-٢٠ أسبوع) العلائق التجريبية كانت متساوية في الطاقة والبروتين.

وفيما يلي ملخصاً لأهم ما توصلت إليه هذه الدراسة من نتائج:

أولاً: التجربة الأولى:

١- التغذية على مستويات متدرجة من كسب بذور عباد الشمس لتحل محل كسب بذور فول الصويا حتى ٧٥ % ليس لها أي تأثيرات ضارة على وزن الجسم والزيادة فيه والغذاء المأكول ومعدل التحويل الغذائي. أما الاستبدال الكلى لكسب بذور عباد الشمس محل كسب بذور فول الصويا كان له تأثيرات ضارة على نفس الصفات المذكورة.

٢- تأثرت صفات اللحم المدروسة ما عدا الأحشاء المأكوله (giblets) معنوياً بكسب بذور عباد الشمس بمستوياته التجريبية المختلفة.

٣- تأثرت جميع معاملات الهضم والقيم الغذائية فيما عدا مستخلص الأثير بزيادة نسبة الإحلال لكسب عباد الشمس محل كسب فول الصويا.

٤- سجلت الكتاكيت التي غُذيت على غذاء يحتوى على ٢٥ % كسب بذور عباد الشمس أعلى كفاءة اقتصادية بمقارنتها بالكنترول الخالي من هذا الكسب.

٥- أدت إضافة الأنزيم لعلائق كسب بذور عباد الشمس إلى تحسن في أداء النمو وتجارب اللحم ومعامل هضم البروتين والكفاءة الاقتصادية.

٦- تأثيرات التداخل بين مستويات إحلال كسب بذور عباد الشمس والأنزيم على كل صفات النمو واللحم المدروسة كانت غير معنوية، مع وجود تأثيرات معنوية على معاملات الهضم (المادة الجافة، البروتين، مستخلص الأثير) والقيم الغذائية.

ثانيا: التجربة الثانية:

١- التغذية على مستويات متدرجة من كسب بذور عباد الشمس لتحل محل كسب بذور فول الصويا حتى ١٠٠ % خلال ١٢ أسبوع (٨-٢٠ أسبوع) ليس لها أي تأثيرات ضارة على الأداء الإنتاجي والتناسلي وجودة البيض، كما انه أدى إلى زيادة الكفاءة الاقتصادية .

٢- أدت إضافة الأنزيم إلى تحسن في كل الصفات المذكورة.

بصفةٍ عامة يُستخلص من نتائج التجربة من الوجهة الغذائية أنه يمكن استخدام نسبة إحلال ٧٥ % و ١٠٠ % من كسب فول الصويا بكسب عباد الشمس في أعلاف النمو وإنتاج البيض في السمان الياباني بدون أي تأثير ضار على الطيور من حيث الصفات الإنتاجية ومع ذلك من المنظور الاقتصادي يمكن أحلال ٢٥ % و ١٠٠ % من كسب فول الصويا وبما يقابله من كسب عباد الشمس في أعلاف النمو وإنتاج البيض للسمان الياباني مع الحصول على أفضل أداء إنتاجي للطيور.

- إضافة أنزيم (Optizyme) بمعدل ٠,٥ جم/كجم عليقة يكون جيد للحصول على أعلى أداء إنتاجي للسمان الياباني النامي والبياض .
- أيضاً استخدام الأنزيم (٠,٥ جم/كجم عليقة) مع استخدام نسبة إحلال ٢٥ % و ١٠٠ % من كسب فول الصويا بكسب بذور عباد الشمس في أعلاف النمو وإنتاج البيض للسمان الياباني لتحقيق أعلى كفاءة اقتصادية بدون التأثير على الأداء الإنتاجي للسمان الياباني النامي والبياض .