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PARTIAL SUBSTITUTION OF SOYBEAN MEAL BY LINSEED MEAL OR SESAME MEAL IN GROWING RABBIT'S DIET

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SUMMARY

In a feeding trial lasted 56 days 27 male New Zealand White rabbits aged 5-6 weeks with an average body weight 665 ± 0.87 g were divided randomly into three equal experimental groups to investigate the effect of replacing 50% of soybean meal crude protein (CP) by linseed or sesame meal on growth performance, nutrients digestibilities and carcass characteristics of growing rabbits. The results showed that, there was no significant effect of dietary CP substitution on daily feed intake. Sesame meal group showed significant (P<0.05) increase of DM, EE and NFE digestibilities than other groups. However, OM, CP, CF digestibilities did not differ among experimental groups. Total digestible nutrients was significantly higher (P<0.05) for sesame diet, while digestible crude protein had comparable values among groups. Final body weight gain, total body weight gain and average daily gain were significantly (P<0.05) increased with diets containing linseed or sesame meal, also feed conversion ratio significantly (P<0.05) improved for rabbits fed LSM or SM containing diets compared with SBM diet. Dressing percentages significantly (P<0.05) increased with diets containing either linseed or sesame meal. Slaughter weight, carcass weight, dressing percentages and total meat weight were significantly (P<0.05) increased for rabbits fed linseed and sesame meal diets compared with those fed soybean meal, while the other parameters of carcass characteristics and eye muscle chemical analysis were not significantly (P>0.05) affected. Plasma total protein for rabbits fed sesame diet and albumin values for rabbits fed linseed and sesame diets were significantly (P<0.05) higher compared to that fed soybean meal, however, the other blood plasma components were not significantly different. From these results, it could be concluded that replacement 50% of CP from soybean meal by linseed meal or sesame meal in rabbit diets as a good alternative source of protein led to improve all digestion coefficients and nutritive values also, caused significantly (P<0.05) increasing in total body weight gain and average daily gain of growing rabbits.

Keywords: Soybean meal, Linseed meal, Sesame meal, rabbits, growth performance, digestibility, carcass characteristics..

INTRODUCTION

The annual increase of human population all over the world requires continues supply of food from either plant or animal sources. In Egypt there is a gab between human requirements and production of animal protein. Rabbits meat could be one of the promising animal protein source to cover this gab. Feed is the most important cost item for

livestock production which represents about 70% of the production costs (Borhami and Yacout, 2001).

Soybean meal (SBM) is considered the main source of protein in rabbit nutrition. It has lower fiber content than linseed meal (Bechai, 2001). A Study made by El-Reweny (1999) noted that SBM has the highest protein quality and has slightly more TDN than cotton seed meal (CSM), Linseed meal (LSM) and sesame meal (SM). On the other hand, the classification of ARC (1984) ranked SBM in class (A).

Linseed meal (LSM) is one of most popular protein sources in most countries. Ahmed, (1996) and Hussin (1998) reported that, in Egypt, LSM is considered as the third important plant protein source in animal feeding. Its popularity is not due to its richness in protein, but even more to palatability and it slightly laxative effect. On the other hand, LSM has fair level of calcium, rich in phosphorus and B-complex vitamins (Goll, 1975). The protein content of LSM and SM are lower than SBM. However, on a comparable protein basis LSM is equal in the feeding value to either SBM or CSM (Matsushima, 1979).

Sesame meal (SM) is the residue after pressing the oil from the seed, it is an excellent source of protein 47.1% to 52.9% (Mamputu and Buhr 1995 and Kaneko *et al.*, 2002) and has an amino acid composition similar to that of soybean meal 47.7% CP (Mamputu and. Buhr 1995). The SM could partially replace soybean meal in the diet as a source of plant protein for ducklings (Dey *et al.*, 1982).

Sesame (*Sesamum indicum L*) is a drought-tolerant crop adapted to many soil types (Ram *et al.*, 1990). Full-fat sesame seed contains 22% crude protein and the meal after oil extraction about 44% crude proteins (Peace Corps, 1990; Mamputu and Buhr, 1991). The amino acid composition of the protein is similar to that of soyabean meal with the exception of lower lysine (Mamputu and Buhr, 1991) and higher methionine in sesame (Olomu, 1995; Dipasa, 2003). The seed contains 50-60% oil compared to 20% in soyabean (Kato *et al.*, 1998; Ahmed 2005). The fibre content of the seed ranges from 2.7 to 6.7% (Beckstrom-Sternberg and Duke 1994). However, the seed contains up to 50 µg/g phytic acid (PA) which reduces the biological availability of zinc, calcium, magnesium and iron (Nahm 2007). Diarra *et al.* (2007) reported that soaking is one of the most effective methods of lowering the phytic acid (PA) content of the seed.

The aim of this experiment was to study the effect of replacing 50% of soybean meal crude protein (CP) by linseed or sesame meal on rabbit performance, digestibility coefficients, blood constituents and carcass characteristics.

MATERIALS AND METHODS

This work was carried out at El-Kheir and El-Baraka farm for rabbit production at Sakkara, Giza and the chemical analyses were undertaken at laboratories of Animal Production Department, National Research Centre, Dokki, Giza, Egypt.

A total number of 27 male New Zealand White rabbits aged 5-6 weeks with an average body weight of 665 ± 0.87 g, were divided randomly into three equal groups (9 animals in each). The basal experimental diet was formulated and pelleted to cover the nutrient requirements of rabbits according to NRC (1977). The feeding period was extended for 56 days, and the experimental diets were classified as control diet (SBM)

contained soybean meal, while linseed meal and sesame meal replaced 50% of soybean meal crude protein (CP) (LSM and SM diets), respectively.

Rabbits individually housed in galvanized wire cages. Stainless steel nipples for drinking and feeders allowing to record individual feed intake for each rabbit, were supplied for each cage (30 x 35 x 40 cm). Feed and water were offered *ad-libitum.* Rabbits of all groups were kept under the same managerial conditions and were individually weighed, and feed consumption was individually recorded weekly during the experimental period.

At the end of the experimental period three rabbits from each group were used in digestibility trials over period of 7 days to determine the nutrient digestibility coefficients of the tested diets. Feces were daily collected quantitatively. Feed intake of experimental rations and weight of feces were daily recorded. Representative samples of 10% of total fresh weight of feces was sprayed with solution of 10% sulfuric acid and 10% formaldehyde and oven dried at 60°C for 48 hrs and composite samples of dried feces were ground and stored for later chemical analysis.

At the end of the experimental period, three representative rabbits from each treatment were randomly chosen and fasted for 12 hours before slaughtering according to Blasco *et al.* (1993) to determine the carcass measurement.

Animals were slaughtered according to the Islamic rules. Animals were weighed just before slaughter, slaughter fasted weight was recorded. External offal's included Fur, head, ears and feet were weighed. Edible offal's (Giblets) included liver; kidneys and heart were removed and individually weighed. Hot carcass weight was recorded. The eye muscle lean samples were taken and dried at 60 C° for 24 hrs. The air-dried samples were analyzed for CP, EE, and ash according to the A.O.A.C. (2000) methods.

Blood samples were taken during slaughtering process in heparinized test tubes and centrifuged at 3000 rpm for 15 minutes, the plasma were collected and preserved in a deep freezer at -18°C until the time of analysis. Various blood plasma chemical parameters were calorimetrically determined using commercial kits, following the same steps as described by manufactures. Plasma total protein was determined according to Armstrong and Carr (1964); albumin according to Doumas *et al.* (1971); total cholesterol according to Ratilff and Hall, (1973) and Pisani et al. (1995). Globulin was calculated by subtracting the albumin value from total protein value. Plasma Glutamic Oxaloacetic Transaminase (GOT) and Glutamic Pyruvic Transaminase (GPT) activities were determined as described by Reitman and Frankel (1957), total lipids was determined according to Postma and Stroes (1968).

Chemical analysis of experimental rations, feces and meat were analyzed according to A.O.A.C (2000) methods.

Digestible energy (DE) was calculated according to NRC (1977) as following:

DE (Kcal/ kg DM) = TDN% X 44.3.

Collected data were subjected to statistical analysis as one way analysis of variance using the general linear model procedure of SPSS (1998). Duncan's Multiple Range Test (Duncan1955) was used to separate means when the dietary treatment effect was significant.

RESULTS AND DISCUSSION

Chemical analysis of tested materials and experimental rations

Data of Table (1) showed that linseed meal and sesame meal contained lower protein (33.52% and 35.48%) content compared with 41.21% for soybean meal and nitrogen free extract (41.06% and 41.58%) in comparison with 46.09% for soybean meal. While it contained higher contents of crude fiber (7.56% and 8.63% compared with 5.37%) and ether extract (9.57% and 8.60% compared with 1.33%). These results were agreement with those obtained by Peace Corps (1990), Mamputu and Buhr (1991), Mamputu and Buhr (1995) and (Kaneko *et al.*(2002).

Table (1): Chemical analysis of soybean meal, linseed meal and sesame meal

Item	Tested materials		
	Soybean meal	Linseed meal	Sesame meal
Dry matter	90.18	90.10	90.44
Chemical analysis (%) on DM basis			
Organic matter(OM)	94.00	91.71	94.29
Crude protein (CP)	41.21	33.52	35.48
Crude fiber (CF)	5.37	7.56	8.63
Ether extract (EE)	1.33	9.57	8.60
Nitrogen free extract (NFE)	46.09	41.06	41.58
Ash	6.00	8.29	5.71

Data of Table (2) showed that the experimental diets were iso nitrogenous (17.25, 16.99 and 17.07% crude protein) while, digestible energy values were 2609, 22736 and 2896 Kcal/ kg DM for the three diets, respectively and were almost similar in the other components. The high content of ether extracts in linseed and sesame meals due to use of hydrolytic pressure method for extraction of oil and it increased the EE content of the experimental diets. Diarra and Usman (2008) noted that the soaked sesame seed meal (SSM) had 93.10% DM; 26.21% CP; 7.49% ether extract; 7.10% crude fiber; 6.06% ash; 1.40% lysine; 1.63% methionine and 19.98 µg/g. phytic acid. Full-fat sesame seed contains 22% crude protein and the meal after oil extraction about 44% crude proteins (Peace Corps, 1990; Mamputu and Buhr, 1991). The chemical composition of sesame oil cake varies according to the method of processing the sesame seeds (mechanical or solvent extraction). The reported DM content ranges from 83 to 96%, while the ranges for CP, ash, ether extract, NFE and crude fiber are 23–46%, 7.5–17.5%, 1.4–27%, 25–31% and 5–12% for these nutrients, respectively (FAO, 1990).

Jacob *et al.* (1996) found that SBM contained 90.3% DM, 42.2% CP, 2.5% EE, 8.2% CF and 6.7% ash, while SM contained 90.8% DM, 42.6% CP, 10.4% EE, 8.5% CF and 13.0% ash, respectively. Petit and Gagnon (2009) noted that flaxseed meal contained 92.21% DM 36.69 % CP and 4.7% EE.

Table (2): Composition and chemical analysis of the experimental diets

Item	Experimental diets		
	SBM	LSM	SM
Diets ingredients			
Alfalfa hay	30.00	30.00	30.00
Wheat bran	34.45	32.45	33.05
Barley	15.00	15.00	15.00
Soybean meal	18.00	9.00	9.00
Linseed meal	-	11.00	-
Sesame meal	-	-	10.4
Molasses	1.00	1.00	1.00
Lime stone	1.00	1.00	1.00
Salt	0.30	0.30	0.30
Vit. & Min. mixture*	0.25	0.25	0.25
Chemical analysis of the experimental diets			
Dry matter	89.88	90.12	89.38
Component, % on DM basis			
Organic matter(OM)	91.44	90.98	91.13
Crude protein (CP)	17.25	16.99	17.07
Crude fiber (CF)	13.76	14.48	14.91
Ether extract (EE)	2.78	3.83	3.56
Nitrogen free extract	57.65	55.68	55.59
(NFE)	8.56	9.02	8.87
Ash			
Digestible energy (Kcal/kg DM)	2609	2736	2896

SBM: Soy bean meal diet, LSM: Linseed meal, SM: Sesame meal.

* Vit. & Min. mixture: Each kilogram contains: 2000.000 IU Vit. A, 150.000 IU Vita. D, 8.33 g Vit. E, 0.33 g Vit. K, 0.33 g Vit. B_1, 1.0 g Vit. B_2, 0.33g Vit. B_6, 8.33 g Vit.B_5, 1.7 mg Vit. B_{12}, 3.33 g Pantothenic acid, 33 mg Biotin, 0.83g Folic acid, 200 g Choline chloride, 11.7 g Zn, 12.5 g Fe, 16.6 mg Se, 16.6 mg Co, 66.7 g Mg and 5 g M.

Nutrient digestibilies and nutritive values of the experimental diets

Data of Table (3) showed that digestibilities of dry matter, ether extract and nitrogen free extract were significantly ($P<0.05$) increased with replacing soybean meal by sesame meal while dry matter and nitrogen free extract were not significantly ($P<0.05$) increased with replacing soybean meal by sesame meal, however EE digestibility significantly increased ($P<0.05$ when soybean meal was replaced by linseed meal. On the other hand, organic matter, crude protein and crude fiber digestibilities not significantly affected ($P>0.05$) when soybean meal was replaced by linseed or sesame meals. These results in agreement with those obtained by Yacout (1993) who found that EE digestibility in the diet containing LSM was higher than that diet contained SBM for male sheep. Omar (2002) found that sesame meal addition enhanced the digestibility of both crude protein

and fiber with growing lambs. Obeidat *et al.* (2009) noted that digestibility of DM, OM, CP, and EE and N retention were similar among all treatment diets composed of 0%, 8% and 16% sesame meal in lamb diets.

Total digestible nutrient value was significantly improved (P<0.05) when soybean meal was replaced by sesame meal. However, digestible crude protein content was not significant among the three treatments. On the other hand total digestible nutrient insignificant (P>0.05) increased when soybean meal replaced by linseed meal. In contrast Gabr *et al.* (1998); Abdel-Salam (2003) and Deraz (2004) noted that SBM containing diet showed significant highest TDN and DCP values.

Table (3) Nutrient digestibilies and nutritive values of the experimental diets

Item	Experimental diets			Significant
	SBM	LSM	SM	
Dry matter	59.67^{b} ± 1.76	61.33^{b} ± 1.20	66.33^{a} ± 0.88	*
Organic matter	61.33 ± 2.03	62.00 ± 2.31	63.44 ± 4.16	NS
Crude protein	74.00 ± 2.31	76.33 ± 2.03	79.33 ± 1.45	NS
Crude fiber	27.33 ± 1.45	29.33 ± 2.03	30.33 ± 1.45	NS
Ether extract	81.33^{b} ± 2.03	88.33^{a} ± 0.45	89.33^{a} ± 1.45	*
Nitrogen free extract	64.67^{b} ± 0.88	66.33^{b} ± 1.45	72.33^{a} ± 2.03	*
Nutritive values, %				
Total digestible nutrient (TDN)	58.90^{b} ± 0.23	61.76^{b} ± 1.32	65.43^{a} ± 1.05	*
Digestible crude protein (DCP)	12.77 ± 0.40	12.97 ± 0.34	13.54 ± 0.25	NS

SBMD: Soy bean meal. LSMD: Linseed meal. SMD: Sesame meal.
a and b: Means in the same row having different superscripts differ significantly (P<0.05).
*: significant at (P<0.05).
NS: not significant.

Growth performance of the experimental groups

Data of Table (4) showed that average daily gain was significantly (P<0.05) increased when soybean meal replaced by linseed or sesame meal. On the other hand SM diet recorded the highest average daily gain (30.50 g) compared with SBM and LSM diets (26.40 and 29.00g), respectively. Also, replacing SBM by LSM or SM improved average daily gain by 9.8% and 15.5% for LSM and SM, respectively. The lack of improved growth performance, even in the high protein diets, might be related to the composition of

the SM. Sesamin, a lignan in sesame seed oil, does not affect BW gain or feed intake at the 0.5% dietary diet level (Hirose *et al.*, 1991) in rats.

Table (4): Growth performance of the experimental groups

Item	Experimental diets			Significant
	SBM	LSM	SM	
Initial body weight, g	665	664	667	NS
	± 11.1	± 8.5	± 8.6	
Final body weight, g	2141^{b}	2286^{a}	2372^{a}	*
	± 42.3	± 21.5	± 10.8	
Total body weight gain, g	1476^{b}	1622^{a}	1705^{a}	*
	± 45.7	± 20.7	± 10.2	
Average daily gain, g	26.40^{b}	29.00^{a}	30.50^{a}	*
	± 0.82	± 0.37	± 0.18	
Daily feed intake, g	115^{ab}	118^{a}	111^{b}	*
	± 1.8	± 1.31	± 2.5	
Feed conversion ratio (g.intake/ g. gain)	4.39^{c}	4.08^{b}	3.64^{a}	*
	± 0.14	± 0.09	± 0.08	

SBD: Soy bean meal. LSD: Linseed meal. SD: Sesame meal.
a, b and c: Means in the same row having different superscripts differ significantly ($P<0.05$).
*: significant at ($P<0.05$). NS: not significant.

The lack of improved growth performance, even after feedings of the high protein diets, could be caused by low protein digestibility due to the phytic acid in the SM. However, growth performance did not decrease significantly up to the 20% dietary SM levels (Yamauchi *et al.*, 2006).

Growth performance of broiler chicks fed the diet containing SM at 15% of dietary CP was not different from that of the control chicks fed the soybean meal diet but was depressed by a diet containing SM at 30% of dietary CP (Mamputu and Buhr 1995). Khan *et al.* (1998) found that sesame meal improved growth performance when incorporated into diets for steers and growing calves. Omar (2002) reported that sesame meal addition at 10 and 20% improved average daily gain (ADG), feed conversion ratio, and cost of feed/kg gain in growing lambs when compared with diets did not contain sesame meal. Demirel *et al.* (2004) and Bas *et al.* (2007) recorded a lack of effect of linseed supplementation on growth rate during the short fattening period of lambs and ovines and bovines.

Peiretti *et al.* (2007) noticed no significant differences among the group rabbits in live weight, live weight gain, feed consumption, feed efficiency of rabbits fed 0%, 10%, or 15% false flax (*Camelina sativa L.)* seed. Galbreath *et al.* (2008) found no difference in initial or final body weight or body condition score of Ovariectomized ewes fed linseed meal (LSM) containing diet. Obeidat *et al.* (2009) recorded that final weight and average daily gain were greater ($P<0.05$) for lambs fed 8% sesame meal than for both 0% or 16% sesame meal containing diets. However, all groups had similar feed conversion ratio.

Daily feed intake ranged from 111-118g/h/d, this result was in the same trend with those obtained by Dupasquier *et al.* (2006) they found that all four treatment group rabbits consumed approximately 125g daily. Obeidat *et al.* (2009) found that dry matter, organic matter crude protein and ether extract intakes were increased ($P < 0.05$) for the lambs fed 8% sesame meal than the control diet.

Feed conversion ratio in our study was significantly ($P<0.05$) improved when SBM replaced by LSM or SM. Also, the differences between linseed and sesame meal groups was significant ($P<0.0.5$). The group rabbits fed SM containing diet recorded the best fed conversion ratio followed by rabbits fed LSM diet and rabbits fed SBM recorded the lowest fed conversion ratio. Yamauchi *et al.* (2006) noted that body weight gain and feed conversion ratio tended to be improved at 10% dietary Sesame meal. Consideration of these observations and the findings of similar studies in the literature lead to the general conclusion that the SM would have no detrimental effect on the growth performance and could be incorporated at up to 20% in commercial chicken diets fed to males of a laying strain.

Carcasses characteristics of the experimental groups

Data of Table (5) showed that dressing percentage was significantly ($P<0.05$) improved with substituted SBM by LSM and SM. However, the differences between LSM and SM diets were not significant. External offal's, Digestive tract (full and empty) and giblets weights were not significantly differing among the experimental groups.

Replacement of SBM by LSM or SM had no significant ($P>0.05$) effect on dry matter, crude protein, ether extract and ash content of eye muscle lean.

Peiretti *et al.* (2007) recorded that the percentage values of head, skin and limbs, fore legs, hind legs, breast and ribs, loin and abdominal wall in fattening rabbits were not affected by the inclusion level of false flax (*Camelina sativa L.*) seed. Also, there were no significant differences among the groups in carcass yield and the percentages of edible organs. Obeidat *et al.* (2009) noticed that dressing percentage was decreased ($P < 0.05$) for lambs fed 8% or 16% sesame meal compared to control diet (0% sesame meal). Also, No differences were observed in carcass and longissimus muscle linear dimensions, fat measurements, and meat quality characteristics among the treatment diets. O'Neil *et al.* (2009) recorded that liver mass of ewes fed linseed meal (LSM) for 14 d (613.7 g) was decreased compared with liver mass of ewes fed LSM for 1 d ($P = 0.04$; 668.8 18.2 g) or 7 d ($P = 0.004$; 695.4 g) and was similar to liver mass of ewes fed LSM for 0 d ($P = 0.22$; 647.5 g).

Table (5): Carcasses characteristics of the experimental groups

Item	Experimental diets			Sig.
	SBM	LSM	SM	
Slaughter weight, g (SW)	1930[b] ± 46.19	2085[a] ± 31.75	2125[a] ± 31.75	*
Carcass weight, g (CW)	1000[b] ± 24.66	1125[a] ± 24.66	1151[a] ± 17.40	*
Dressing percentage, %	51.81[b] ± 0.14	53.95[a] ± 0.38	54.20[a] ± 0.079	*
Total meat weight, g	765[b] ± 14.43	845[a] ± 20.21	860[a] ± 23.09	*
External offal's, g	459 ±4.05	476 ± 3.51	480 ± 8.38	NS
Digestive tract weight, g				
Full, g	300 ± 11.55	318 ± 9.28	320 ± 5.77	NS
Empty, g	73.00 ± 2.03	77.00 ± 4.04	78.00 ± 1.15	NS
Giblets (Edible offal's) weight , g				
Liver weight, g	55.00 ± 2.89	56.00 ± 2.33	61.00 ± 3.46	NS
Kidneys and spleen weight, g	16.00 ± 0.88	18.00 ± 0.58	17.00 ± 0.33	NS
Heart weight, g	11.00 ± 0.41	11.00 ± 0.41	10.00 ± 0.41	NS
Chemical analysis (%) of the eye muscle lean				
Dry matter	25.86 ± 0.05	26.02 ± 0.71	25.87 ± 0.71	NS
Crude protein	81.86 ± 0.35	82.16 ± 0.24	81.16 ± 0.58	NS
Ether extract	13.17 ± 0.15	13.37 ± 0.09	13.47 ± 0.29	NS
Ash	4.97 ± 0.47	4.47 ± 0.32	5.37 ± 0.42	NS

a and b: Means in the same row having different superscripts differ significantly (P<0.05).
SBMD: Soy bean meal. LSMD: Linseed meal. SMD: Sesame meal.
External offal's included Fur, head, ears and feet.
Dressing percentage, % = Carcass weight, g X 100 / Slaughter weight, g.
*: significant (Sig.) at (P<0.05). NS: not significant.

Blood parameters of the experimental groups

Data of Table (6) showed that replacement 50% of soybean meal crude protein (CP) by LSM or SM significantly (P<0.05) increased both plasma total protein and albumin contents. However, dietary treatments had no significant effect (P>0.05%) on globulin, total lipids, cholesterol, GOT and GPT contents among the experimental groups. The high content of total protein and albumin in LSM and SM may results to adequate amount of protein, high quality and high utilization of protein. These results were in agreement with those found by Abdel-Salam (2003) and Deraz (2004) with lambs fed rations containing linseed or soybean meals.

Table (6) Blood parameters of the experimental groups

Item	Experimental diets			Significant
	SBM	LSM	SM	
Total protein, g/dl	6.83^{b} ± 0.09	7.10^{ab} ± 0.12	7.30^{a} ± 0.09	*
Albumin, g/dl	3.93^{b} ± 0.04	4.77^{a} ± 0.06	4.43^{a} ± 0.09	*
Globulin, g/dl	2.90 ± 0.13	2.63 ± 0.18	2.87 ± 0.03	NS
Total lipids, mg/dl	4.75 ± 2.03	4.72 ± 0.04	4.83 ± 0.03	NS
Cholesterol, mg/dl	108 ± 2.03	107 ± 2.31	110 ± 2.31	NS
GOT, (U/L)	65.0 ± 3.46	63.0 ± 1.73	66.0 ± 2.31	NS
GPT, (U/L)	19.00 ± 1.15	18.00 ± 1.15	19.00 ± 0.58	NS

a and b: Means in the same row having different super scripts differ significantly (P<0.05).
SBMD: Soy bean meal. LSMD: Linseed meal. SMD: Sesame meal.

Jenkins *et al.* (1999) noted that partially defatted flaxseed reduced total cholesterol (4.6 ± 1.2%; $P = 0.001$), LDL cholesterol (7.6 ± *1.8%;* $P < 0.001$), apolipoprotein B (5.4 ± 1.4%; $P = 0.001$), and apolipoprotein A-I (5.8 ± *1.9%;* $P = 0.005$), but had no effect on serum lipoprotein ratios at week 3 compared with the control. There were no significant effects on serum HDL cholesterol, serum protein carbonyl content, or ex vivo androgen or progestin activity after either treatment. Unexpectedly, serum protein thiol groups were significantly lower (10.8 ± 3.6%; $P = 0.007$) at week 3 after the flaxseed treatment than after the control, suggesting increased oxidation. Kang *et al.* (1999) noted that serum total cholesterol, HDL concentrations, phospholipid and triglyceride levels were unaffected for rabbits fed diets containing 1% cholesterol with or without 10% defatted sesame flour (containing 1% sesaminol glucosides) for 90 d. by the addition of DSF. Nestel *et al.* (1999) recorded that total cholesterol levels were not significantly different. However, insulin

sensitivity and HDL cholesterol diminished and LDL oxidizability increased with α-linolenic acid/low fat (ALF). Bhathena *et al.* (2002) found that flaxseed protein significantly decreased plasma cholesterol and triglyceride concentration in rats. Dietary flaxseed caused a significant increase in plasma ALA in the rabbits from 2 to 15 g/100 g of total fatty acids (Bradley *et al.*, 2004).

Chen *et al.* (2005) showed that the diet with sesame significantly decreased the levels of serum total cholesterol and low-density lipoprotein (LDL) cholesterol.

Dietary flaxseed increased plasma ALA levels significantly, as would be expected due to the high ALA content of flaxseed. ALA was metabolized in the mice to the longer chain omega-3 fatty acid EPA (eicosapentaenoic acid) but not to DHA (docosahexaenoic acid). This differs from the inability of rabbits to metabolize ALA derived from dietary flaxseed to the longer chain omega-3 fatty acids (Ander *et al.* 2004 and Dupasquier *et al.*, 2006). Hemoglobin concentration, serum total protein, albumin and globulin were reduced ($P<0.05$) above 25.00% level of replacement of soybean meal by soaked sesame meal. The reduction in the values of most blood parameters above 25.00% replacement was not understood (Diarra and Usman 2008). Also, the same authors concluded that up to 12.50% of dietary soybean meal can be replaced by soaked sesame seed meal in the diet of laying hens without adverse effects on blood variables.

CONCLUSION

From these results, it can be concluded that replacement 50% of soybean meal crude protein (CP) by linseed or sesame meal in rabbit's diet as a good alternative source of protein realized improvement in all digestion coefficients and nutritive values also, caused significantly ($P<0.05$) increasing in total body weight gain and average daily gain of growing rabbits.

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الإحلال الجزئى لكسب فول الصويا بكسب الكتان أو كسب السمسم فى علائق الأرانب النامية

سها سيد عبدالمجيد ، حامد عبدالعزيز على عمر ، عبدالمجيد أحمد عبيدو ، ممدوح إبراهيم محمد ، إبراهيم محمد عوض الله

قسم الإنتاج الحيوانى- المركز القومى للبحوث- الدقى- الجيزة- مصر.

تم إجراء هذه الدراسة بمزرعة الخير والبركة لإنتاج الأرانب بسقارة- جيزة - مصر وتم إجراء التحليلات المعملية بقسم الإنتاج الحيوانى- المركز القومى للبحوث- دقى جيزة- مصر.

أستخدم فى هذه الدراسة سبعة وعشرون أرنب نيوزيلاندى ابيض عمر ٥- ٦ أسابيع ومتوسط وزن ٦٦٥ ± ٠,٨٧ جم وقسمت إلى ثلاثة مجاميع تجريبية متساوية تحتوى كل مجموعة تسعة حيوانات بهدف دراسة تأثير استبدال ٥٠% من بروتين كسب فول الصويا (مجموعة الكنترول) بكسب الكتان (المجموعة الثانية) أو كسب السمسم (المجموعة الثالثة) واستمرت تجربة التغذية لمدة ٥٦ يوم وغذيت الحيوانات تغذية حرة (حتى الشبع) وكانت العلائق متشابهة تقريباً فى محتواها من البروتين.

وأظهرت النتائج ما يلى:

* معدل المأكول اليومى بين المجاميع التجريبية كان تقريباً فى نفس مستوى الاستهلاك والذى تراوح بين ١١١ إلى ١١٨ جم/رأس/يوم.

* معاملات هضم كل من المادة الجافة ، والمستخلص الخالى من الأزوت والكربوهيدرات الذائبة قد تحسنت معنوياً عند مستوى (٠,٠٥). ومع هذا فإن معاملات الهضم لكل من المادة العضوية ، والبروتين الخام والألياف الخام لم تختلف معنوياً بين المجاميع التجريبية عند مستوى (٠,٠٥).

* المركبات المهضومة الكلية TDN قد تحسنت معنوياً عند مستوى (٠,٠٥) فى حين أن البروتين المهضوم DCP قد تحسن تحسناً غير معنوياً عند مستوى (٠,٠٥).

* الوزن النهائى والزيادة الوزنية الكلية ومعدل النمو اليومى قد تحسن معنوياً عند مستوى (٠,٠٥) كما أن الكفاءة التحويلية قد تحسنت تحسناً معنوياً عند مستوى (٠,٠٥) وسجلت الأرانب المغذاه على العليقة المحتوية على كسب السمسم أفضل كفاءة تحويلية تليها الأرانب المغذاه على العليقة المحتوية على كسب الكتان مقارنة بمجموعة الكنترول المغذاه على العلائق المحتوية على كسب الكتان فقط.

* تحسنت نسبة التصافى ووزن الذبائح تحسناً معنوياً عند مستوى (٠,٠٥) فى حين لم تتأثر باقى القياسات الخاصة بالذبيحة تأثراً معنوياً عند مستوى (٠,٠٥).

* مكونات بلازما الدم من البروتين الكلى والألبيومين قد ذادت زيادة معنوية عند مستوى (٠,٠٥) فى حين لم تتأثر باقى مكونات بلازما الدم تأثراً معنوياً عند مستوى (٠,٠٥) عند استبدال ٥٠% من بروتين كسب فول الصويا بكسب الكتان أو كسب السمسم.

* من هذه النتائج المتحصل عليها يمكن الإشارة إلى أن استبدال ٥٠% من بروتين كسب فول الصويا بالعليقة الضابطة بكسب الكتان أو كسب السمسم كمصدر بديل للبروتين أدى إلى تحسن فى معاملات الهضم والقيم الغذائية المحسوبة من المركبات المهضومة الكلية والبروتين المهضوم كما أدى إلى زيادة معنوية عند مستوى (٠,٠٥) لكلاً من الزيادة الوزنية الكلية ومعدل النمو اليومى للأرانب النامية وبالتالى فإنه يمكن استبدال ٥٠% من بروتين كسب فول الصويا بكسب الكتان أو كسب السمسم فى علائق الأرانب النامية.