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PERFORMANCE OF GROWING RABBITS FED ON SOME AGRO-INDUSTRIAL BY-PRODUCTS

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A total number of eighty four New Zealand White (NZW) rabbits 5 weeks of age and 608 ± 7.56 g average live body weight were allotted at random to seven similar experimental groups (of 12 rabbits each). Each group of rabbits was fed one of seven experimental pelleted diets (17% crude protein and 12-13% crude fiber on average). The feeding trail extended for 9 weeks. The aim of the study was to investigate the effects of partial substitution (25 or 50%) of soybean meal of control diet with different agro-industrial by-products as the sources for plant protein; rocket (RSM), fenugreek (FSM) and mustard seed meals (MSM) on growth performance, nutrients digestibility, blood constitutions, carcass characteristics and economic efficiency. Results indicated that, digestion coefficients of most nutrients and the nutritive values were significantly ($P < 0.05$) improved in the groups fed 25 or 50% RSM and FSM-diet as compared to the control. The values of TDN increased by (4.85 and 4.52%) for RSM, (4.44 and 4.43%) for FSM and (1.80%) for 50% MSM. The DCP improvement was (9.13 and 2.04%) for RSM, (2.44 and 7.25%) for FSM, respectively. Replacing RSM, FSM or MSM by 25 or 50% in rabbit diets grew (9.85 and 4.58%) for RSM, (3.36 and 7.56%) for FSM and (1.23%) for 25% MSM faster than control. The diets containing 25 and 50% agro-industrial by-products showed better ($P < 0.05$) values of feed conversion than the control diet. Serum total protein, albumin, globulin and urea-N were significantly ($P < 0.05$) affected by different treatments; while, serum alanine aminotransferase (ALT), cholesterol and total lipids were not affected. Hot carcass weight and dressing percentages were significantly ($P < 0.05$) higher in the 25 and 50% RSM, FSM or 25% MSM groups than those of the control and 50% MSM groups. Economical efficiency values of rabbits fed diets contained agro-industrial by-products at marketing age (13 weeks) were higher than those of the control diet.

It could be concluded that substitution of rocket, fenugreek and mustard seed meals up to 50% of soybean meal in the diet of NZW rabbits had good results without adverse effects on growth performance.

Key words: Rocket, Fenugreek, Mustard seed meal, Performance, Digestibility, Blood constituents, Carcass characteristics, Rabbits.



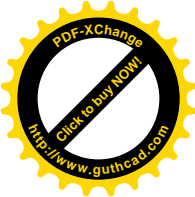
There is a shortage in animal protein in Egypt, rabbits could participate in solving this problem, but feed cost of rabbit production is still expensive. There are a large amount of crops, vegetables and fruit residues, which could be used as new sources of feedstuff with low price and high quality proteins to solve feed shortage and produce least cost diets for rabbits. Production of rocket in Egypt has been steadily increased for the strong demand to volatile oils for pharmaceutical purpose. The rocket seeds contain carotenoids, vitamin C, flavonoids such as sulfuraphene (Talalay and Fahey, 2001), volatile oils like myristicin, apiole β - phellandrene (Bradley, 1992; Leung and Foster, 1996) and several biological activities including anticarcinogenic, antifungal, antibacterial plus their antioxidant action (Kim *et al.*, 2004). They also contain Zn, Cu, Fe and other elements (Abdo, 2003) which increase immune response. After oil removal, rocket seed meal (RSM) could be used as a protein-rich meal for feeding rabbits with about 32% crude protein (El-Nattat and El-Kady, 2007). Fenugreek (*Trigonella foneum graecum L.*), like other legumes is a good source of dietary protein (approximately 20- 30%) for consumption by human and animals. The fatty acids from 5 – 10%; 45 – 65% total carbohydrates with 15% galactomanan (soluble fiber) (Schryver, 2002). It is reported to have anti-diabetics, anti-fertility, anti-cancer, anti-microbial, anti parasitic and hypochlosterolaemic effects (Al-Habori and Roman, 2002). Also, it contains some minerals and vitamins (Michael and Kumawat, 2003). Mustard is rich in proteins and other nutrients and could be used as animal feeds and feed additives. However, because of the presence of glucosinolates, whose hydrolytic products and other anti-nutritional substances are harmful, especially to non – ruminant animals. MSM could not be widely used as animal feed (Francis *et al.*, 2002). These products (RSM, FSM and MSM) are expected to increase in near future due to high demand of the extracted oil; consequently utilizing the by-product may cause some environmental problems if not adequately utilized. When adequately supplemented, RSM may constitute a good vegetable protein source for use in rabbit diets in region where RSM is readily available and relatively inexpensive. RSM, FSM and MSM may be used to replace the imported SBM and in the main time reduces the cost of rabbits feeding.

The study reported herein was undertaken to investigate the effect of partial replacement of soybean meal instated of RSM, FSM and MSM (0, 25 and 50%) on growth performance, digestibility and blood characteristics in growing New Zealand White (NZW) rabbits.

MATERIALS AND METHODS

Animals and experimental design

The present study was conducted on El-Gimaza Experimental station, Animal Production Research Institute, Agriculture Research and Animal Production Department, Faculty of Agriculture, Minufiya University, Egypt.



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The experiment was designed to evaluate the effects of partial substitution (25 or 50%) of soybean meal with different agro-industrial by-products of rocket (*Eruca sativa*), fenugreek (*Tigonella foenum-graecum*) and mustard (*Brassica juncea*) meals (Table 1). Eighty-four males of growing NZW rabbits of 5 weeks old and 608 ± 7.56 g average body weight, were distributed randomly and equally into seven treatments groups, each of 12 animals. Each group was sub- divided into four replicates with three animals each. Rabbits were housed in wire floor batteries of 60 x 55 x40 cm. All batteries were located in a naturally ventilated windowed house. All animals were kept under similar hygienic conditions. Rabbits were offered diets for duration of the feeding trial until reaching 13 weeks of age. Rocket, fenugreek and mustard seed meals were sprinkled and mixed with a solution of 2% Cu SO₄ (500ml/kg) as reported by (Pailan and Singhal, 2003) then spreadsheets on a clean plastic sheet and sun dried for three days then meals were washed by water. Seven pelleted diets were prepared using rocket (RSM), fenugreek (FSM) and mustard seed meals (MSM) as a partial substitution of 25 or 50% soybean meal (SBM) of the control diet. Feed diets were nearly iso-nitrogenous and iso-caloric and, also to the crude fiber percentages of the experimental diets nearly the same. Table 2 show feed ingredients and chemical analysis of the experimental diets.

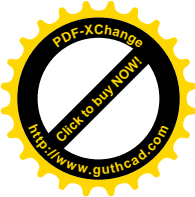
Each group of rabbits was fed one of the seven experimental diets. Fresh water was automatically available at all times through stainless steel nipples for each cage. The experimental diets were offered to rabbits *ad libitum*. The rations were adjusted every week according to the average daily feed intake. Individual live body weight and feed intake were weekly recorded up to 13 weeks of age. Feed conversion ratio was calculated as g feed/g gain and as g TDN/g gain.

Performance index (PI%) was calculated according to North (1981) as below: $PI = \text{Live body weight (kg)} \times 100 / \text{Feed conversion}$. The economical efficiency was calculated by the following equation: $Y = [(A - B) / B]$, where A is selling cost of obtained gain and B is the feeding cost for this gain (Cited from El-Kerdawy, 1997).

Blood samples were individually collected at 13 weeks of age from each rabbit in non heparinized glass tubes to estimate blood parameters. Blood serum was separated by centrifugation at 3000 rpm for 15 minutes. The collected serum was stored at -18°C until analysis. At 14 weeks of age, a digestibility trial was done using three male animals per group.

Chemical analyses:

Chemical analysis of the tested diets and faeces were carried out according to AOAC (2000). Digestible energy (DE) of the experimental diets was calculated according by the equation described by Fekete and Gippert

**Table 1: Chemical analysis of feed stuffs of tested diets.**

Items	DM%	Chemical analysis% (DM basis)						
		OM	CP	CF	EE	NFE	Ash	DE*
Rocket seed meal	90.12	94.16	32.34	9.80	6.20	45.82	5.86	2624
Fenugreek seed meal	91.24	93.48	27.60	8.48	8.80	49.60	6.42	2666
Mustard seed meal	90.25	92.65	38.83	11.67	6.79	35.36	7.35	2564

DE*(kcal/kg DM) = 4253 – 32.6(CF%) – 144.4(Ash%), according to Fekete and Gippert (1986).

Table 2: Feed ingredients and chemical analysis of the experimental diets.

Ingredients	Control	RSM		FSM		MSM	
		25 %	50 %	25 %	50 %	25 %	50 %
Barley grain	35	33.25	33.8	33.8	33.8	34.3	32.4
Clover hay	16.0	17.0	17.7	18.3	18.6	19.3	9.0
Wheat bran	16.9	13.15	10.6	10.6	9.6	7.85	15.75
Soybean meal 44%	12.0	9.0	6.0	9.0	6.0	9.0	6.0
Wheat straw	8.2	8.2	8.1	8.15	8.15	8.15	11.45
Yellow corn grain	2.0	5.25	5.9	5.9	5.8	7.5	7.3
Glutens meal	3.25	4.25	4.85	3.0	6.0	4.0	5.2
Rocket meal	---	3.0	6.0	---	---	---	---
Fenugreek meal	---	---	---	3.0	6.0	---	---
Mustard meal	---	---	---	---	---	3.0	6.0
Molasses	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Di-calcium phosphate	2.0	2.3	2.45	2.45	2.45	2.45	2.45
Common salt	0.5	0.5	0.5	0.5	0.5	0.4	0.4
Lime stone	0.7	0.95	0.4	0.4	0.4	0.4	0.4
Premix*	0.3	0.3	0.3	0.3	0.3	0.3	0.3
DL-Methionine	0.15	0.15	0.15	0.15	0.15	0.15	0.15
L-Lysine	---	0.1	0.2	0.1	0.15	0.1	0.1
Total	100	100	100	100	100	100	100
<i>Calculated analysis:</i>							
Crude protein	17.1	17.1	17.1	17.0	17.1	17.0	17.0
Crude fiber	12.0	12.0	12.0	12.0	12.0	12.0	11.5
Ether extract	2.1	2.3	2.3	2.3	2.5	2.07	2.23
Digestible energy kcal/kg (DE)*	2500	2500	2495	2502	2499	2500	2499
Calcium (%)	1.07	1.08	1.06	1.08	1.07	1.08	0.96
Phosphorus	0.77	0.78	0.78	0.79	0.77	0.77	0.78
Cystine (%)	0.76	0.75	0.74	0.77	0.71	0.73	0.62
Methionine (%)	0.41	0.41	0.45	0.46	0.41	0.40	0.40
Methionine + Cystine (%)	0.70	0.67	0.69	0.67	0.66	0.65	0.65

*Each one kilogram of premix contained: Vit.A 2000,000 IU, Vit. D3 150,000 IU, Vit. K 0.33 mg, Vit.B1 0.33 g, Vit. B2 1.0 g, Vit. B6 0.33 g, Vit. B12 1.7 mg, Pantathonic acid 3.33 g, Biotin 33 mg, Folic acid 0.83g, Choline chloride 200 mg, Cu 0.5 g, I 16.6 mg and Antioxidant 10.0 g.



(1986). Total protein, albumin, total lipids, cholesterol, aspartate aminotransferase (ALT) and urea-N concentrations in serum were estimated using commercial kits (Bio Merieux, France) according to the procedure outlined by the manufacturer.

Statistical analysis:

The data were statistically analyzed according to Snedecor and Cochran (1982) in one way analysis of variance design as the model:

$$Y_{ij} = M + A_i + e_{ij},$$

Where: Y_{ij} = An observation, M = Overall mean, A_i = Effect of rations and e_{ij} = Experimental error.

The significant differences between means were tested by using Duncan's multiple range test (Duncan, 1955).

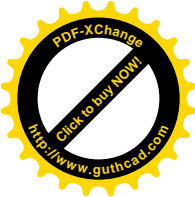
RESULTS AND DISCUSSION

Digestion coefficients:

The effects of different levels are rocket (RSM), (FSM) and (MSM) seed meals on digestion coefficients values presented in Table 3. It could be noticed that feeding growing rabbits diets containing 25 and 50% (RSM) or (FSM) were significantly ($P < 0.05$) increased the digestibility of DM and OM compared with the other experimental groups. The digestion of CP, CF, EE and NFE of diets containing 25% RSM or FSM were significantly ($P < 0.05$) higher than those fed (MSM) or control diet. This improvement in CP digestibility values of diets containing 25% RM or FSM may be due to the higher proportion of soybean meal in these diets, while the improvement in CF digestibility coefficient values of the same diets may be due to increase energy intake. In this respect, rocket cake diet contains flavonoids such as carotenoids, vitamin C and isothiocyanate, which has anti-oxidant and antimicrobial effects. These ingredients as those of natural feed additives is beneficial for stimulation and activation of digestive system by improving digestibility of all nutrients. Ibrahim (2005) found that, crude fiber digestion percentage of rabbits receiving 1% of rocket seed as a supplement was significantly increased. This may be due to flavonoids and essential oils (Namur et al. 1988 and Bradley, 1992). Zeweil *et al.* (2008) showed that rabbits fed 10.5% RSM- improved digestibility of DM by 4.4%, OM by 4.7%, CP by 4.4% and CF by 39.1%.

Nutritive values:

The nutritive value of the experimental rations expressed as TDN, DCP are presented in Table 3. No significant differences among all tested diets except diets containing 25 and 50% MSM and control rabbit diets caused a

**Table 3: Digestion coefficients and nutritive values of the experimental rations.**

Items	Experimental Rations (%)						±S E	
	Control	Mustard		Fenugreek		Rocket		
		50	25	50	25	50		25
DM	62.36 ^b	63.70 ^a	63.65 ^a	62.75 ^b	63.66 ^a	63.30 ^a	63.08 ^a	1.35*
OM	63.45 ^b	64.54 ^a	65.20 ^a	64.14 ^a	65.29 ^a	64.75 ^a	64.70 ^a	1.12*
CP	71.50 ^c	75.28 ^a	73.24 ^b	74.10 ^a	74.24 ^a	70.96 ^c	70.60 ^c	1.44*
CF	27.72 ^c	29.81 ^a	28.50 ^b	28.14 ^b	28.59 ^b	28.12 ^b	28.16 ^b	0.66*
EE	68.40 ^c	73.68 ^a	72.45 ^a	71.03 ^b	72.50 ^a	73.68 ^a	68.48 ^c	1.27*
NFE	67.32 ^b	70.15 ^a	69.35 ^a	68.20 ^a	70.08 ^a	70.15 ^a	66.08 ^c	1.45*
Feeding values:								
DE (kcal/kg DM)*	2555 ^b	2687 ^a	2483 ^c	2481 ^c	2581 ^b	2605 ^a	2624 ^a	4.05*
TDN	59.30 ^b	62.18 ^a	61.98 ^a	61.93 ^a	61.92 ^a	60.37 ^b	58.63 ^c	3.25*
DCP%	12.27 ^b	13.39 ^a	12.52 ^b	12.57 ^b	13.16 ^a	12.07 ^b	11.90 ^c	1.63*

+ a, b and c Means with different superscripts on the same row are different at (P<0.05).

significant (P<0.05) decrease in TDN and DCP% compared with other diets. Increasing RSM and FSM levels from 25 to 50%, significantly (P<0.05) increased TDN from 62.18 & 61.98% for RSM and 61.93 & 61.92% and DCP from 13.39 & 12.52% for RSM to 12.57 & 13.16% for FSM, respectively. In this respect, Zeweil *et al.*, (2008) reported that, the nutritive values of this groups were more efficiently as the digested crude protein (DCP) increased by 2.8% and metabolizable energy (ME) by 4.3% in comparison with control). The group fed 21% RSM-diet was not significantly different from the control group in digestion coefficients of CP, CF, EE and NFE. Also, El-Tohamy and El-Kady (2007) mentioned that, digestibility of most nutrients were significantly (P<0.05) increased with rocket diet compared with control diet.

Feed intake and feed conversion ratio:

Results of the feeding trial are shown in (Table 4). Daily TDN intake and energy intake of rabbits fed 25 and 50% RSM or FSM diets showed significantly (P<0.05) higher values than those of the other diets. Also, introducing different levels of RSM or FSM significantly increased live body weight and daily weight gain. Obviously, rabbits fed RSM, FSM and MSM (25 or 50%) grew (9.86 and 4.59% for rocket, 3.36 and 7.56%) for fenugreek and (1.23 and -2.04%) faster than control, respectively.

However, there were significant (P<0.05) differences among treatments in feed conversion ratio Table 4. Rabbits fed diets containing 25 and 50% RSM or FSM were significantly (P<0.05) higher than those fed the other experimental diets. These results were similar to those obtained by EL-Nattat

**Table 4: Performance of growing NZW rabbits fed diets containing rocket, fenugreek and mustard meal.**

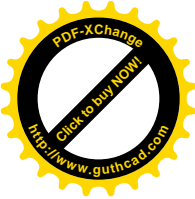
Items	Experimental Rations (%)							±S E
	Control	Mustard		Fenugreek		Rocket		
		50	25	50	25	50	25	
No. of Animals	12	12	12	12	12	12	12	-----
Duration of trail, days	63	63	63	63	63	63	63	---
Av. Initial weight, g	604	624	625	574	624	602	603	7.56 NS
Av. Final weight, g	2087 ^e	2253 ^a	2176 ^d	2107 ^c	2219 ^b	2078 ^a	2056 ^f	6.16*
Total gain, g	1483 ^e	1629 ^a	1551 ^c	1533 ^d	1595 ^b	1476 ^e	1453 ^f	3.27*
Av. Daily gain, g	23.54	25.86	24.62	24.33	25.32	23.83	23.06	1.23*
Av. DM intake, g (DM basis):	4971 ^c	4979 ^a	4971 ^c	5191 ^a	4962 ^d	5025 ^b	4948 ^e	3.624*
Av. TDN intake, g	2948 ^d	3096 ^b	3081 ^b	3215 ^a	3072 ^b	3033 ^c	2901 ^e	3.012*
Av. DCP intake, g	610 ^c	667 ^a	622 ^b	652 ^a	653 ^a	607 ^c	589 ^d	1.82*
Feed conversion:								
Kg DM/kg gain	3.35 ^a	3.06 ^d	3.21 ^b	3.39 ^a	3.11 ^c	3.40 ^a	3.41 ^a	0.12*
Kg TDN/kg gain	1.99 ^{ab}	1.90 ^{ab}	1.93 ^{ab}	2.07 ^a	1.87	2.02 ^a	2.00 ^a	0.315*
Kg DCP/kg gain	0.41	0.40	0.40	0.43	0.41	0.41	0.40	0.02NS
Performance index (PI %)	62.30 ^c	73.63 ^a	67.79 ^b	62.15 ^c	71.35 ^a	61.12	75.07 ^a	1.65*

+ a, b, c, d,e and f Means with different superscripts on the same row are different at (P<0.05).

and ELKady (2007) indicated that 9% RSM in the diet gave the best final body weight and feed conversion ratio compared to control.

These improvements may be attributed to the properties of this material that act not only as antibacterial, antiprotozoal and antifungal but also as antioxidant (Bradley, 1992; Leung and Foster, 1996). This incorporation of such non-conventional meals protein had no adverse effect on palatability and voluntary feed intake in rabbits. However, Rajendra *et al.* (2000) reported that mustard cake which belong to the same family of *Eruca sativa* could be used up to 30% of the rabbit diet without an adverse effect on broiler rabbit performance.

On the other hand, Abdo (2003) indicated that, the best values were for 0 and 25% substitution of soybean protein, while 50% substitution decreased both BW and BWG significantly (P≤0.05) when compared to the 0% substitution (without *Eruca sativa* seed meal).

**Performance index (PI%):**

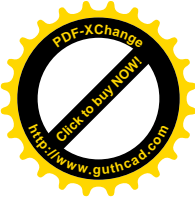
The performance index results of rabbits fed rations with 25 and 50% of RSM, FSM and MSM showed significantly ($P<0.05$) higher values than those fed the diets containing 25% FSM, MSM and control (Table 4). On the other hand, diets which contained 25 or 50% of RSM or 50% FSM and 50% MSM significantly ($P<0.05$) performance index values were increased by (18.2 and 8.8%) for RSM, (14.5%), (20.5%) for 50% replacement of FSM and MSM, respectively than those of the control diet. These results were in agreement with the finding of Cheeke and Patton (1979) and Zaki El-Din (1996).

Blood parameters:

Data presented in (Table 5) illustrated that some metabolic enzymes such as aspartate aminotransferase (ALT) exhibited insignificant activities in rabbits fed diets containing two levels (25 or 50%) of RSM, FSM or MSM which reflect a better function of liver. These results were agreement with finding of Zeweil *et al.* (2008) who, reported that GPT were not affected and can be concluded that rocket seed meal at 10.5% level of the diet in NZW rabbits had the best results without adverse effects on growth performance, kidney or liver function. Abdel - Azeem (2006) show that plasma GPT were decreased for groups fed fenugreek diets compared to those fed the control diet. Serum total protein, albumin and globulin were significantly ($P<0.05$) affected by the presence of rocket, fenugreek and mustard seed meal in rabbit diets. Zeweil *et al.* (2008) reported that, Serum total protein and albumin were significantly affected by the present of rocket seed meal in rabbit diets. In this respect, Habeeb *et al.*, (1989) pointed that total serum protein concentration may be due to decrease of thyroxine production which stimulates the protein synthesis. Abdel-Azeem (2006) reported that supplementation of fenugreek into broiler diets increased plasma total protein, albumin and globulin. The broiler chicks fed fenugreek were superior ($P<0.01$) to these of broiler chicks fed the control diet. The majority of the increase on plasma total protein, albumin and globulin occurred at highest levels fenugreek.

Also, rabbits fed diets containing 25 and 50% RSM, FSM or MSM showed slightly lower serum total lipids and cholesterol than those fed the other diets. These results were agreement with finding of Abdel-Azeem (2006) who showed that plasma total lipid and total cholesterol were decreased for broiler groups fed fenugreek diets compared to those fed the control diet. On the other side, Zeweil *et al.* (2008) reported that, Serum cholesterol were significantly affected by the presence of rocket seed meal in rabbit diets.

The significantly ($P<0.05$) increase of serum urea-N levels in rabbits fed diets containing 25 and 50% RSM, FSM or MSM was within the normal range. The obtained results of urea-N levels indicated normal function of kidneys as reported by Habeeb *et al.*, (1997) who reported that, serum urea

**Table 5: Effect of feeding diets containing levels of the experimental diets on some blood parameters of growing NZW rabbits.**

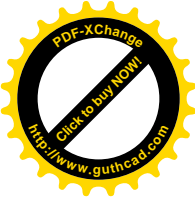
Items	Experimental Rations(%)							±S E
	Control	RSM		FSM		MSM		
		25	50	25	50	25	50	
ALT, (IU/l)	25.54	26.72	25.84	25.61	25.52	26.03	26.4 2	0.86 NS
T. protein (g/d)	7.15 ^c	6.38 ^a	7.34 ^b	6.10 ^a	6.26 ^a	7.86 ^c	7.06 ^c	0.58*
Albumin (mg/dl)	4.75 ^a	2.73 ^c	4.88 ^a	3.09 ^b	3.06 ^b	4.74 ^a	5.22 ^a	0.72*
Globulin (mg/dl)	2.40 ^c	3.65 ^a	2.46 ^a	3.01 ^b	3.20 ^a	3.08 ^a	2.84 ^c	0.59*
Cholesterol (mg/dl)	96.33	96.25	95.45	96.20	94.08	95.13	95.08 ^c	1.65 NS
T. lipids (mg/dl)	257.23	256.70	254.63	252.45	256.40	255.17	254.20	2.64 NS
Urea -N (mg/dl)	15.56 ^c	16.73 ^b	16.83 ^b	15.81 ^c	15.81 ^c	17.05 ^a	17.94 ^a	0.08*

+ a, b, c, d,e and f Means with different superscripts on the same row are different at (P<0.05).

levels were 1.4 and 2.1 mg/100 ml, respectively, for NZW rabbits. Also, Zeweil *et al.* (2008) reported that, serum urea-N values were not affected. Otherwise, Abdel-Azeem (2006) show that plasma total lipid and uric acid were decreased for groups fed fenugreek diets compared to those fed the control diet.

Carcass characteristic:

Table (6) showed the carcass characteristics of slaughtered rabbits at 13 weeks of age. The differences in relative carcass traits as a results to the effect of feeding treatments were significantly (P<0.05). Under the condition of this experiment, it appears that, the highest values for dressing % was recorded with rabbits fed diet containing 25 and 50% RSM or FSM compare to those fed on the other diets. These treatments had the best digestion coefficients, which reflect on improving feed conversion and weight gain as previously mentioned in Table 2 and 3. The data was in agreement with those reported by Perez *et al.*, (1991). Also, Gowda *et al.* (1996) mentioned that none of the carcass traits including percentage yield of edibles and in edibles were affected by dietary treatments except for a higher (P<0.05) dressing percentage (65.1+or-1.61 vs. 59.9+or-1.09%) in Angora rabbits fed on urea-ammoniated deoiled mustard meal diet. On the contrary, Abdel - Azeem (2006) mentioned that, supplementation of fenugreek into broiler diets did not affect relative internal organs weight (liver, heart, spleen, bursa and pancreas).

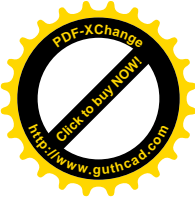
**Table 6: Dressing percentage and carcass offal's of slaughtered growing WNZ rabbits fed rations containing rocket, fenugreek and mustard seed meals.**

Items	Experimental Rations(%)								±S E
	Control	RSM		FSM		MSM			
		25	50	25	50	25	50		
Pre-slaughter wt.,g	2170 ^d	2420 ^a	2280 ^c	2340 ^b	2435 ^a	2200 ^c	2075 ^c	4.15 *	
Dressed wt., g	1155 ^c	1366 ^a	1263 ^b	1302 ^a	1350	1170 ^c	1059 ^d	3.25 *	
%	53.24 ^b	56.45 ^a	55.40 ^a	55.60 ^a	55.44 ^a	53.18 ^b	52.96 ^c	1.63 *	
Carcass wt., g	1061 ^b	1218 ^a	1128 ^a	1173 ^a	1198 ^a	1083 ^b	985 ^c	2.18 *	
%	48.9 ^a b	50.32 ^a	49.20 ^a	50.13 ^a	49.20 ^a	49.23 ^a	47.30	1.62 *	
Liver wt., g	105 ^a	107 ^a	96 ^c	105 ^a	90 ^d	100 ^b	80 ^e	1.85 *	
%	4.84 ^a	4.42 ^a	4.21 ^a	4.49 ^a	3.70 ^b	4.55 ^a	3.86 ^b	0.07*	
Kidney wt., g	15.96 ^a	15.23 ^a	15.07 ^a	14.37 ^b	14.80 ^b	14.70	15.81 ^a	0.12*	
%	0.07	0.06	0.07	0.06	0.06	0.07	0.07	0.03 NS	
Heart wt., g	7.60 ^b	7.10 ^b	7.19 ^b	6.20 ^c	7.72 ^b	6.17 ^c	8.52 ^a	0.86*	
%	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.02 NS	
Giblets wt.,g	128.55 ^a	129.33 ^a	118.26 ^b	125.57 ^a	125.57 ^b	112.52 ^c	104.33 ^d	2.78*	
%	5.92	5.34	5.19	5.37	4.62	5.49	5.03	0.78NS	

+a, b, c, d and e Means with different superscripts on the same row are different at (P<0.05).

Economical efficiency:

Accordingly, feed cost per kg gain and economical efficiency was better with diets containing rocket, fenugreek and mustard meals than those fed control diet Table 7. These results were due to mainly high price of weight gain which ranged between 36.33 and 40.73L.E. for diets containing oilseed meals with the price of daily weight gain of control 37.08 L.E. each. It was noticed that the cheaper in feed cost /kg gain 13.90 and 13.86 L.E. for diets containing 50% rocket and mustard, while diet containing control was the highest of the other groups (15.20 L.E.). These results agree with finding with Rajendra *et al.* (2000) who mentioned that cost of feed input/kg live weight gain was 12.64 L.E.for diet containing mustard cake vs. 14.05 L.E. for diet containing soybean meal and corresponding net return per animal was 29.1 vs. 26.5, respectively. Abdo (2003) mentioned that the economic efficiency of the

**Table 7: Feed cost and economical efficiency of growing WNZ rabbits fed diets containing rocket, fenugreek and mustard meals.**

Items	Experimental Rations(%)							±SE
	Control	RSM		FSM		MSM		
		25	50	25	50	25	50	
Live body wt. (g)	2087	2253	2176	2107	2219	2078	2056	---
Total feed intake (g)	5629	5608	5605	5755	5621	5710	55.90	---
Total weight gain (g)	1483	1629	1551	1533	1595	1476	14.53	---
Feed cost (L.E.)	15.20	14.13	13.90	14.50	13.94	14.39	13.86	---
Price of wt. gain (L.E.)	37.08	40.73	38.78	38.33	39.88	36.90	36.33	---
Return	21.60	26.60	24.88	23.83	25.94	22.51	22.47	---
EE %***	1.44	1.88	1.79	1.64	1.86	1.56	1.62	---
Relative E.E.%***	100.0	130.6	124.3	113.9	129.2	108.3	112.5	---

* Based on free market prices of feed ingredients 2012, the cost of the experimental rations was estimated as the total prices of the ingredients used in the concentrate feed mixture, soybean meal, rocket, fenugreek and mustard meals, bearing, 2700, 3900, 180 L.E/ton., respectively,

** Prices of one kg body weight on selling 25.00 L.E.

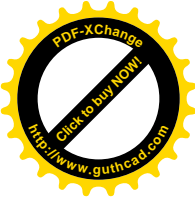
*** Economical efficiency.

different formulated diets was affected by different treatments. The obtained results indicated that increasing *Eruca sativa* seed meal level decreased the price/kg feed, but increased total feed cost/kg weight gain by 101 and 111% of the control (0% *Eruca sativa* seed meal) for 25 and 50% substitution level, respectively.

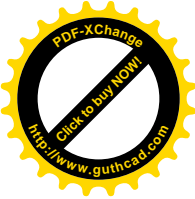
In conclusion, from the previous results, rocket, fenugreek and mustard seed meals can be used up to 50 % instead of soybean meal in the growing New Zealand rabbit diets improved the digestibility, daily weight gain, feed and economical efficiency, hot carcass weight and dressing percentage without any adverse effects on growth performance or kidney or liver function.

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أداء الأرانب النامية المغذاة على بعض نواتج التصنيع الزراعي

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تم تقسيم ٨٤ من ذكور الأرانب النيوزيلندي الأبيض عمره أسابيع ومتوسط وزن حي 7.56 ± 6.08 جم عشوائيا على سبعة مجموعات تجريبية (١٢ أرنب في كل مجموعة)، وزعت الأرانب على سبعة علائق مختلفة على هيئة مكعبات تحتوى على مستويين ٢٥ و ٥٠% من أكساب الجرجير والحلبة والخردل كمصدر رئيسي للبروتين (تحتوى ١٧% بروتين خام و ١٢-١٣% ألياف خام)، امتدت تجربة التغذية حتى ٩ أسابيع، وتهدف الدراسة لبيان تأثير الإحلال الجزئي لهذه الأكساب في علائق الأرانب على معاملات الهضم و معدل النمو و قياسات الدم و خواص الذبيحة والكفاءة الاقتصادية.

وقد أشارت النتائج المتحصل عليها إلى أن قيم معاملات الهضم للبروتين الخام و الألياف الخام و المستخلص الاثيرى و المستخلص الخالي من الأزوت للعلائق المحتوية على ٢٥ و ٥٠% من أكساب الجرجير والحلبة كانت أعلى معنويا (٥%) عن مثيلاتها لعليقة الكنترول كما زادت قيم المركبات المهضومة الكلية بدرجة معنوية (٥%) من $63.094.85$ و 4.52 % لكسب الجرجير و 4.44 و 4.43 % لكسب الحلبة و 1.8 % لمجموعة ٥٠% كسب الخردل على التوالي، إحلال أكساب الجرجير والحلبة بنسبة ٢٥ و ٥٠% في علائق الأرانب النامية زاد من نمو الأرانب بنسبة (٩.٨٥ و ٤.٥٨%) و (٣.٣٦ و ٧.٥٦%) على التوالي، بينما بلغت الزيادة ١.٢٣% في مجموعة ٥٠% كسبنا الخردل مقارنة بمجموعة المقارنة. كما أدى إحلال أكساب الجرجير والحلبة بنسبة ٢٥ و ٥٠% في علائق الأرانب تحسنا معنويا (٥%) في قيم معامل التحويل الغذائي عن المقارنة، أظهرت تركيزات البروتين الكلى والألبومين والجلوبيولين واليوربيا فى سيرم الدم تأثيرا معنويا فى الأرانب التي غذيت على علائق تحتوى ٢٥ و ٥٠% أكساب مخلفات التصنيع الزراعي عن الأرانب التي غذيت على علائق أخرى، في حين أنه لم تتأثر تركيزات انزيم الألنين ترانس أمينيز والكوليسترول والليبيدات الكلية. كان وزن الذبيحة الساخن ونسبة التصافي أعلى معنويا (٥%) في المجموعات التي تحتوى علائقها على ٢٥ و ٥٠% كسب جرجير أو كسب الحلبة أو ٢٥% كسب الخردل مقارنة بالمجموعة التي غذيت على عليقة تحتوى ٥٠% كسب خردل أو عليقة الكنترول.

التوصية: نستنتج أنه يمكن إحلال أكساب الجرجير و الحلبة و الخردل محل كسب فول الصويا في علائق الأرانب النيوزيلندي الأبيض النامية حتى ٥٠% دون أية آثار عكسية على أدائها الإنتاجي .