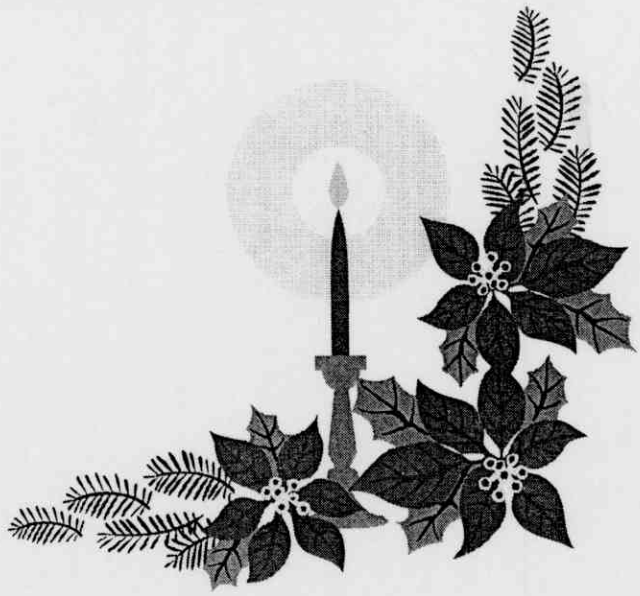
RESULTS & DISCUSSION



4. RESULTS AND DISCUSSION

4.1. Chemical composition of the tested feed stuffs:

Dried sugar beet pulp (SBP) and potato by-product meal (PBM) used in this study were analyzed for their content of dry matter (DM%), organic matter (OM%), crude protein (CP%), ether extract (EE%), crude fiber (CF%), nitrogen free extract (NFE%) and ash %.

The results of chemical composition of ingredients are summarized in Table (4).

Chemical composition for dried sugar beet pulp (SBP) was found to be: 91.24, 95.73, 9.73, 1.25, 21.05, 63.70 and 4.27 for DM, OM, CP, EE, CF, NFE and ash %, respectively. The digestible energy (DE) was 2261 K cal/kg. However, the chemical composition of dried sugar beet pulp is within the published values found by many researcher, Morrison (1959); Boucque *et al.* (1976); Hemingway *et al.* (1986); Gihad *et al.* (1989); Helal *et al.* (1998) and El-Adawy *et al.* (2000). While the chemical composition of potato by-product meal (PBM) was 92.15, 94.88, 11.60, 5.88, 17.00, 60.40 and 5.12% for DM, OM, CP, EE, CF, NFE and ash%, respectively. The digestible energy (DE) was 2392 K cal/kg. These values of chemical composition for potato by-product meal were similar those were obtained by several authors such as El-Sayed (1994) and Soltan (2002).

Chemical analysis of by-products and the shortage of feed stuffs would indicate that those feed stuffs would be used as new feed stuffs in rabbit diets.

Table 4: Chemical composition (%) of the tested feedstuff based on (DM).

Items	Sugar beet pulp (SBP)	Potato by-product (PBM)
DM	91.24	92.15
	On DM basis	
OM	95.73	94.88
CP	09.73	11.60
EE	01.25	05.88
CF	21.05	17.00
NFE	63.70	60.40
Ash	04.27	05.12
Total DM	100.00	100.00
ADF*	28.63	24.94
NDF*	42.75	40.09
DE (kcal/kg)*	2261.00	2392.00

* Calculated according to cheeke (1987).
DE (kcal/g) = 4.36-0.0491 (%NDF)
%ADF = 9.432 + 0.912 (% CF)
%NDF = 28.924 + 0.657 (%CF)

4.2. Body weight:

The effect of sugar beet pulp or potato by-product meal on body weight of the growing NZW rabbits from 6-16 weeks of age is illustrated in Table (5). The analysis of variance for some factors affecting body weight of rabbits are shown in Table (6).

4.2.1. Treatment effect:

The present results showed that the weight of rabbits received the T3 diet (including 25% sugar beet pulp, SBP) recorded higher body weight at most ages than other treatments (Table 5); followed by rabbits fed on the diet containing 25% potato by-product meal (PBM) i.e. of T6. Rabbits received the T4 diet (i.e. including 40% SBP) and T7 diet (including 40% PBM), showed the lowest live body weights.

At the end of the experiment, average body weight of rabbits fed diet of T6 weighed 2579.34 g followed in descending order by those fed diet of T3 (2554.03 g), T1 (2542.19 g), T4 (2527.25 g), T2 (2461.73 g), T5 (2456.43 g) and T7 (2396.48 g).

The differences in body weight between rabbits of different treatment were not significant at most ages studied except at 11 and 14 weeks of age which proved significant ($P<0.05$) Table (6).

These results are in partial agreement with those obtained by Franck and Seroux (1980) who compared beet pulp levels of 0, 10, 20 and 30% in fryer rabbits trial. They reported that production performance was adequate at all levels of beet pulp. Also, Zaza (1997) showed that incorporation of potato by-product meal (PBM) at levels 10, 20 and 30% in growing rabbits

Table 5: Least squares means ±SE of factors affecting body weight of rabbits during different age stages of the experimental period.

Independent variable	Body weight (g)									
	7 weeks	8 weeks	9 weeks	10 weeks	11 weeks	12 weeks	13 weeks	14 weeks	15 weeks	16 weeks
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Treatment										
T_1	948.97±56.04	1162.69±52.80	1332.60±60.08	1537.27±75.83	1737.65±75.07ab	1936.21±76.81	2061.46±73.65	2255.17±75.31ab	2423.97±76.43	2542.19±79.37
T_2	1023.49±52.42	1188.36±49.39	1327.28±54.18	1519.06±65.38	1778.28±64.72ab	1986.98±66.22	2128.13±63.50	2241.18±64.93a	2396.83±65.98	2461.73±68.52
T_3	985.42±53.25	1203.24±50.17	1384.36±54.97	1613.65±66.50	1870.75±65.89a	2060.33±67.36	2185.40±64.58	2330.96±66.04a	2451.04±69.15	2554.03±71.80
T_4	842.88±53.60	1047.91±50.50	1196.37±55.19	1435.09±66.39	1690.42±65.72ab	1916.86±67.24	2054.12±64.48	2183.15±65.93a	2418.38±66.96	2527.25±69.58
T_5	889.99±52.41	1079.07±49.38	1252.65±54.10	1437.94±65.27	1621.59±64.61b	1867.82±66.11	2021.30±63.39	2142.54±64.82ab	2325.10±65.82	2456.43±68.35
T_6	980.94±54.02	1169.57±50.89	1359.02±55.78	1572.02±67.26	1783.10±66.58ab	2005.51±68.12	2151.01±65.32	2267.86±66.79a	2470.82±67.88	2579.34±70.49
T_7	898.10±54.44	1086.63±51.29	1217.10±56.41	1418.96±68.19	1607.35±67.50b	1791.39±69.07	1929.12±66.23	2030.58±67.72b	2235.96±70.41	2396.48±73.11
Sex										
Male	950.12±31.16	1148.97±29.35	1314.11±33.11	1524.63±39.95	1747.31±39.55	1960.67±40.46	2091.58±38.80	2209.63±39.68	2365.50±40.28	2477.94±41.82
Female	926.96±32.35	1118.88±30.48	1277.14±33.42	1485.08±44.78	1706.73±41.35	1915.07±42.31	2060.00±40.57	2205.07±41.49	2412.25±42.20	2527.04±43.82

- **Means with the same letter within each column are not significantly different.**

SE= Standard error

T_1=control diet.

T_2=diet contained 10% sugar beet pulp (10%SBP).

T_3=diet contained 25% sugar beet pulp (25% SBP).

T_4=diet contained 40% sugar beet pulp (40% SBP).

T_5=diet contained 10% potato by-product meal (10% PBM).

T_6=diet contained 25% potato by-product meal (25% PBM).

T_7=diet contained 40% potato by-product meal (40% PBM).

Table 6: Least squares analysis of variance for factors affecting body weight of rabbits during different age stages of the experimental period.

Source of variance	d.f	MS and value											
		7 weeks		8 weeks			9 weeks		10 weeks		11 weeks		12 weeks	
		Ms	F	Ms	F	d.f	Ms	F	Ms	F	Ms	F	Ms	F
Treatment	6		1.62		1.70	6		1.97		1.51		2.50*		2.10
Sex	1		0.36		0.68	1		0.86		0.66		0.71		0.86
Sire	23		2.60***		3.69***	22		2.99**		2.55***		2.65***		2.77***
Treat x sex	6		0.26		0.88	6		0.79		0.78		0.68		0.38
Regression	1		9.56**		8.59**	1		5.91**		3.54		2.18		2.79
Error	74	32211.43		28593.89		73	34466.58		49642.18		48641.13		50922.01	
Source of variance	d.f	13 weeks		14 weeks			15 weeks		16 weeks					
		Ms	F	Ms	F	d.f	Ms	F	Ms	F				
Treatment	6		2.10		2.55*	6		1.67		1.02				
Sex	1		0.45		0.10	1		0.90		0.92				
Sire	22		2.63***		2.69***	22		2.38**		2.23**				
Treat x sex	6		0.34		0.45	6		0.45		0.82				
Regression	1		3.40		3.83*	1		3.80*		3.13				
Error	72	46819.41		48956.42		70	50240.50		54169.99					

*=(P<0.05) **= (P<0.01) ***= (P<0.001)

diets had no significant effect on live body weight at all ages of his study. Also, the same author recommended that the inclusion of PBM at level up to 30% in growing rabbit diets as a replacement for other expensive traditional cereal grains.

4.2.2. Sex effect:

The present study showed that the average body weight for the males was almost heavier than that of female rabbits, (Table 5).

The differences due to sex effect on body weight were non-significant at all ages studied. This finding is in harmony with that of El-Sayaad (1985) who reported that sex differences in body weight of Bauscat, Giza White, Baladi White and Baladi Red rabbits were non-significant at all ages studied. Also, the same author added that sex differences in body weight of rabbits were generally limited and of negligible importance so that they can be ignored.

4.2.3. Interaction between sex and treatment:

Data of the analysis of variance presented in Table (6) showed that the effect of the interaction between treatment and sex on body weight during the experimental period was not statistically significant.

4.3. Daily gain in weight:

Averages of daily gain in weight of rabbits fed the experimental diets during the periods (6-9, 9-12, 12-16 and 6-16 weeks of age) are illustrated in Table (7).

The analysis of variance of daily gain in rabbits is presented in Table (8).

Table 7: Least squares means ±SE of factors affecting daily gain in weight of rabbits during different age stages of the experimental period.

Independent variable	Daily gain (g)			
	1st period (6-9 weeks)	2nd period (9-12 weeks)	3rd period (12-16) weeks	Whole period (6-16) weeks
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Treatment				
T_1	24.66±2.39	23.62±2.28 c	21.61±2.07	22.21±1.33
T_2	24.99±1.99	29.53±1.89 a	17.43±1.78	22.85±1.11
T_3	28.85±2.02	30.19±1.93 ab	17.98±1.81	24.60±1.13
T_4	23.45±2.00	33.36±1.91 a	21.65±1.79	25.57±1.12
T_5	25.02±1.99	27.51±1.90 ab	20.81±1.78	23.91±1.11
T_6	26.64±2.05	29.12±1.96 ab	20.28±1.83	24.64±1.14
T_7	22.27±2.05	25.41±1.96 b	21.57±1.85	22.38±1.14
Sex				
Male	26.05±1.18	29.11±1.12	18.62±1.09 b	23.63±0.66
Female	24.20±1.24	27.68±1.18	21.76±1.14 a	23.85±0.69

- Means with the same letter within each column are not significantly different.

SE= Standard error
T_1=control diet.
T_2=diet contained 10% sugar beet pulp (10%SBP).
T_3=diet contained 25% sugar beet pulp (25% SBP).
T_4=diet contained 40% sugar beet pulp (40% SBP).
T_5=diet contained 10% potato by-product meal (10% PBM).
T_6=diet contained 25% potato by-product meal (25% PBM).
T_7=diet contained 40% potato by-product meal (40% PBM).

Table 8: Least squares analysis of variance of factors affecting daily gain in weight of rabbits during different age stages of the experimental period.

Source of variance	d.f	MS and F value							
		1st period (6-9 weeks)		2nd period (9-12 weeks)		3rd period (12-16 weeks)		Whole period (6-16 weeks)	
		Ms	F	Ms	F	Ms	F	Ms	F
Treatment	6		1.19		2.56*		1.09		1.25
Sex	1		1.58		1.03		5.66*		0.07
Sire	23		2.53***		2.59***		1.64*		4.05***
Treat x sex	6		0.32		0.57		1.75		0.52
Error	72	46.13		41.96		36.97		14.30	

*= (P<0.05) ***= (P<0.001)

4.3.1. Treatment effect:

The obtained results (Table 7) indicated that the treatment had no significant effect on daily gain in weight of rabbits during the periods of 6-9, 12-16 and 6-16 weeks of age.

Results in Table (8) showed significant ($P<0.05$) effect of treatment on daily gain in weight during the second period (9-12 weeks only). Rsults in Table (8) showed that T4 (feeding a ration including 40% SBP) had the best average daily gain during the intervals of 9-12, 12-16 and 6-16 weeks of age (Table 7).

The increase in daily gain of rabbits fed T4 may be due to that T4 was more efficient than the other treatments. In partial agreement with results obtained, Franck and Seroux (1980) and Jensen (1992) reported that there were no significant differences in daily gain in live body weight between the control ration and other experimental rations containing different levels of dried beet pulp. Also, Zaza (1997) showed that results of weight gain of rabbits for the control ration compared with rations of 10, 20 and 30% of PBM indicated that differences among the groups were insignificant.

4.3.2. Sex effect:

Data illustrated in Table (7) showed the effect of sex on daily gain in weight was significant during the period of 12-16 weeks of age only. Results in the same Table showed that females recorded more daily gain in weight than males during the age intervals of 12-16 and 6-16 weeks of age and the difference due to sex effect was significant ($P<0.05$) while males showed more daily gain than females during the periods of 6-9 and 9-12 weeks but without any significant difference. These

results are quite similar to those obtained by Khayyal (1997) who found that male rabbits had slightly more daily gain than females during all age intervals studied except during 12-16 weeks of age interval.

4.3.3. Interaction between treatment and sex:

The effect of interaction between treatments and sex on daily gain in weight was not significant during all periods of the study (Table 8).

4.4. Feed intake:

Feed intake is defined as the amount of diet consumed per rabbit per day during a certain interval.

4.4.1. Treatment effect:

Results of the average daily feed intake of rabbits at different age intervals as affected by experimental treatments are presented in Table (9). These results showed that differences due to the effect of treatments on feed intakes were of a highly significant ($P<0.01$) effect on feed intake of the experimental rabbits during the whole experimental period. Table (9) showed that rabbits fed on T4 (ration including 40% sugar beet pulp) and on T6 (ration including 25% potato by-product meal) consumed more of experimental diets than those fed on the other diets.

This may be due to that the diet of T4 and T6 were more suitable than treatments of the other experimental diets. The results are in agreement with those obtained by Skrivanova *et al.* (1996) who used diets containing 0 or 20% sugar beet pulp (SBP) for rabbits and showed that daily feed intake was higher ($P<0.05$) in rabbits fed on diets containing 20% SBP. Also, Zaza

(1997) showed that the average feed consumption at the end of the experimental period was 8464, 8065, 9397 and 8479 g per rabbit for the control group and the groups fed on 10, 20 and 30% potato by-product meal (PBM), respectively. Also, the same author indicated that the group fed on a diet containing 20% PBM consumed significantly ($P<0.05$) higher amount of feed than the control group. The diet containing 10 and 30% PBM.

4.4.2. Sex effect:

Results in Table (9) showed that males rabbits consumed more feed than females during the first period (6-9 wks), second period (9-12 wks) and the whole period (6-16 wks) but the reverse was observed during the third period (12-16 wks). The differences due to sex effect on daily feed intake was not significant ($P>0.05$) (Table 10). Similar trend was obtained by El-Gendy (1994a) who found that males consumed more feed intake than females (153.89 vs 134.05 g) during the period of 7-11 weeks of age. Also, similar results were obtained by Khayyal (1997) who found that feed intake values of males were higher than females (94.6 vs 93.9 g).

4.4.3. Interaction between treatment and sex:

Findings of the present study showed that the effect of interaction between treatment and sex on feed intake was not significant during the second, third and the whole periods, while significantly ($P<0.01$) higher during the first period than other periods (Table 10).

Table 9: Least squares means ±SE of factors affecting daily feed intake of rabbits during different age stages of the experimental period.

Independent variable	Average feed intake (g)			
	1st period (6-9 weeks)	2nd period (9-12 weeks)	3rd period (12-16 weeks)	Whole period (6-16 weeks)
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Treatment				
T_1	72.34 ±2.78 c	94.28±3.91 e	104±4.40 d	90.96±3.31d
T_2	68.43±2.31 b	108.88±3.26 c	108.37±3.66 bc	97.78±2.76 c
T_3	71.48±2.36 b	114.86±3.32 bc	108.54±3.73 ab	99.42±2.81 bc
T_4	82.81±2.33 a	120.44±3.29 ab	115.73±3.70ab	107.26±2.78 ab
T_5	79.73±2.32 a	118.57±3.26 ab	111.46±3.67 ab	103.83±2.76 ab
T_6	86.07±2.39 a	124.49±3.36 a	116.66±3.78 a	109.63±2.85 a
T_7	78.69±2.39 a	100.41±3.37 d	95.81±3.78 c	91.51±2.85 c
Sex				
Male	77.30±1.37	112.75±1.93	108.28±2.17	100.61±1.64
Female	76.85±1.44	110.66±2.03	109.11±2.28	99.50±1.72

- Means with the same letter within each column are not significantly different.

SE= Standard error
T_1=control diet.
T_2=diet contained 10% sugar beet pulp (10%SBP).
T_3=diet contained 25% sugar beet pulp (25% SBP).
T_4=diet contained 40% sugar beet pulp (40% SBP).
T_5=diet contained 10% potato by-product meal (10% PBM).
T_6=diet contained 25% potato by-product meal (25% PBM).
T_7=diet contained 40% potato by-product meal (40% PBM).

Table 10: Least squares analysis of variance of factors affecting daily feed intake of rabbits during different age stages of the experimental period.

Source of variance	d.f	MS and F value							
		1st period (6-9 weeks)		2nd period (9-12 weeks)		3rd period (12-16) weeks		Whole period (6-16) weeks	
		Ms	F	Ms	F	Ms	F	Ms	F
Treatment	6		8.55***		9.59***		3.68**		6.28***
Sex	1		0.07		0.74		0.09		0.30
Sire	23		8.84***		7.70***		7.84***		10.51***
Treat x sex	6		3.21**		1.13		0.96		0.33
Error	72	62.57		124.02		156.74		88.90	

= (P<0.01) *= (P<0.001)

4.5. Feed conversion:

Averages of daily feed conversion (g feed intake/g gain) during the whole experimental period (6-16 weeks of age) as affected by level of by-product (treatment) and sex are presented in Table (11).

The analysis of variance of feed conversion as affect by treatment and sex are illustrated in Table (12).

4.5.1. Treatment effect:

It can be observed from the results enlisted in (Table 11) and the analysis of variance (Table 12) that, feed conversion values were nearly similar in all treatments at the second period, third period and whole period without significant differences ($P>0.05$) whereas the differences in feed conversion value due to treatments in the first period were significant ($P<0.05$). These results are in partial agreement with those obtained by Abdel-Azeem (1997) who reported that the feed conversion ratio was 4.52, 3.61, 3.56, 3.61, 3.62 and 3.83, respectively for NZW rabbits fed on the experimental diets containing 0, 5, 10, 15, 20 and 25% dried beet pulp and the treatment differences were not significant. Zaza (1997) showed that feed conversion ratio for the control group and groups fed on diets containing 10, 20 and 30% potato by-product meal (PBM) were found to be 6.77, 5.73, 6.6 and 6.5, respectively. Also the same author noticed that the group fed on diet containing 10% PBM was significantly ($P<0.05$) better in converting feed to meat than the other groups of his study. Ghazalah *et al.* (2002) studied the effect of replacing yellow corn energy at the level of 0, 25, 50 and 75% with either date stone meal (DSM) or potato by-product meal (PBM) in fish

Table 11: Least squares means ±SE of factors affecting feed conversion of rabbits during different age stages of the experimental period.

Independent variable	Feed conversion (g feed/g gain)			
	1st period (6-9 weeks)	2nd period (9-12 weeks)	3rd period (12-16 weeks)	Whole period (6-16 weeks)
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Treatment				
T_1	2.95±0.33 ab	3.98±0.29	5.89±0.55	4.23±0.19
T_2	2.75±0.29 b	3.82±0.25	6.04±0.47	4.45±0.17
T_3	2.50±0.29 b	3.97±0.26	6.81±0.48	4.14±0.17
T_4	3.70±0.29 a	3.77±0.25	5.29±0.47	3.99±0.17
T_5	3.26±0.29 ab	4.63±0.25	5.60±0.47	4.43±0.16
T_6	3.36±0.29 ab	4.40±0.26	6.17±0.49	4.57±0.17
T_7	3.67±0.30 a	4.26±0.26	5.48±0.49	4.17±0.17
Sex				
Male	3.12±0.17	4.05±0.16	6.25±0.30 a	4.37±0.10
Female	3.21±0.18	4.19±0.16	5.54±0.30 b	4.20±0.11

- Means with the same letter within each column are not significantly different.

SE= Standard error

T_1=control diet.

T_2=diet contained 10% sugar beet pulp (10%SBP).

T_3=diet contained 25% sugar beet pulp (25% SBP).

T_4=diet contained 40% sugar beet pulp (40% SBP).

T_5=diet contained 10% potato by-product meal (10% PBM).

T_6=diet contained 25% potato by-product meal (25% PBM).

T_7=diet contained 40% potato by-product meal (40% PBM).

Table 12: Least squares analysis of variance of factors affecting feed conversion of rabbits during different age stages of the experimental period.

Source of variance	d.f	MS and F value							
		1st period (6-9 weeks)		2nd period (9-12 weeks)		3rd period (12-16 weeks)		Whole period (6-16 weeks)	
		Ms	F	Ms	F	Ms	F	Ms	F
Treatment	6		2.64*		1.88		1.26		1.68
Sex	1		0.18		0.52		4.14*		1.84
Sire	23		1.31		1.90*		1.08		1.40
Treat x sex	6		0.98		0.57		2.05		1.44
Error	72	0.95		0.75		2.60		0.32	

*= (P<0.05)

diet. They showed that no significant differences were found in feed conversion ratio values among treatments contained PBM up to 50% compared to the control.

4.5.2. Sex effect:

The results of feed conversion of rabbits fed the experimental diets and analysis of variance were illustrated in Tables (11 and 12). These results showed that female rabbits were more efficient for feed conversion than males (Table 11). The difference between the two sexes was significant ($P<0.05$) during the 3rd period (12-16 weeks) only.

4.5.3. Interaction between treatment and sex:

The least-squares of variance in Table (12) indicated that the effect of interaction between treatment and sex on feed conversion ratio was non-significant at all age intervals studied.

4.6. Digestibility coefficient:

Data of nutrients digestibility coefficients of the experimental diets as affected by treatments in addition to coprophagy status are present in Table (13) and results of analysis of variance for all treatments are shown in Table (14).

4.6.1. Treatment effect:

The present results showed that rabbits received diets of treatments T3 and T7 (including 25% SBP and 40% PBM, respectively) recorded higher digestibility for most nutrients (DM, OM, CP, CF and NFE) than rabbits of the other treatments. The lowest value of all nutrients digestibility were recorded for rabbits given T1 (control diet), T2 (diet containing 10% SBP), T4 (diet containing 40% SBP), T5 (diet containing 10% PBM)

and T6 (diet containing 25% PBM) as presented in Table (13). The differences in nutrients digestibility due to treatment effect were not significant (P>0.05). But it could be concluded that inclusion of sugar beet pulp and potato by-product meal at levels of 25 and 40% of diets for growing rabbits had positive influence in improving digestibilities of different nutrients of the experimental diets. These results are in agreement with findings obtained by Zaza (1997) who found the digestibility for rabbits of the control ration and those of the rations containing 10, 20 and 30% potato by-product meal showed that the differences among treatments were insignificant for DM, OM, CP, CF and NFE digestibilities. In this respect, Garcia *et al.* (1993) reported the substitution of sugar beet pulp (SBP) for barley grain (50 : 0, 35 : 15, 15 : 35 and 0 : 50%, respectively) affected significantly energy and CP digestibility which decreased gradually with increasing the level of beet pulp until reached minimal values for the diet 15 : 35%. Digestibility of CF followed a different pattern whereas it increased (P<0.01) with dietary proportion of sugar beet pulp.

4.6.2. Coprophagy status:

Results of the present study showed that values of all nutrient digestibility (DM, OM, CP, EE, CF and NFE) for uncollared rabbits were higher significant (P<0.05, 0.01 or 0.001) than those for collared ones (Table 13).

Results in Table (13) indicated that the prevention of coprophagy in rabbits decreased the digestibility of all nutrients. In agreement with our results, El-Sayaad (1980) found that the apparent digestibility of all nutrients except EE were reduced in

rabbits when coprophagy was prevented. Also, El-Serafy *et al.* (1981) reported that preventing rabbits from re-cycling their feces, had reduced the apparent digestibility of all nutrients, in particular that of CP. El-Sayaad (1985) showed that the digestion coefficients of DM, OM, CP, EE, CF and NFE were greater for non-collared rabbits than those for collared ones. This lead to conclude that the prevention of coprophagy in rabbits decreased the digestibility of all nutrients.

Robinson *et al.* (1985) reported that prevention of cecotrophy decreased significantly ($P<0.01$) the digestibility of most nutrients.

Azzazy (2002) showed that the values of all nutrients digestibility (DM, OM, CP, EE, CF and NFE) in uncollared rabbits were higher than those for collared rabbits and the prevention of coprophagy in rabbits decreased the digestibility of all nutrients.

The analysis of variance in this study for all nutrient digestibilities due to coprophagy status in Table (14) showed that the difference were significant ($P<0.05$, 0.01 or 0.001). It is clear that, results of the present study are in agreement with those reported by several investigators, indicating that the prevention of coprophagy in rabbits reduced the nutrients digestibility of feed. Also, the present finding indicated the importance of coprophagy as a biological process which may improve the performance of rabbits.

Table 13: Least squares means ±SE for nutrients digestibility coefficients in rabbits fed the experimental diets.

Independent variable	Digestibility %					
	DM	OM	CP	EE	CF	NFE
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Treatment						
T_1	66.72±2.54	68.40±2.42	65.46±3.07	81.41±1.46	34.59±5.44	76.81±1.79
T_2	66.27±2.54	67.94±2.42	61.45±3.07	84.13±1.46	32.46±5.44	77.81±1.79
T_3	69.94±2.54	70.80±2.42	64.98±3.07	83.89±1.46	37.23±5.44	79.99±1.79
T_4	63.20±2.54	65.20±2.42	59.18±3.07	79.85±1.46	26.29±5.44	75.95±1.79
T_5	64.78±2.54	65.93±2.42	61.08±3.07	82.39±1.46	29.82±5.44	75.35±1.79
T_6	64.57±2.54	66.13±2.42	57.79±3.07	79.50±1.46	27.88±5.44	77.52±1.79
T_7	70.11±2.54	71.62±2.42	66.56±3.07	78.61±1.46	35.58±5.44	81.06±1.79
Coprophagy status						
Un collared rabbits	69.43±1.36 a	70.71±1.29 a	65.92±1.64 a	83.38±0.78 a	39.17±2.19 a	79.22±0.95 a
Collared rabbits	63.60±1.36 b	65.30±1.29 b	58.80±1.64 b	79.41±0.78 b	24.79±2.91 b	76.35±0.95 b

SE= Standard error
T_1= control diet
T_2= diet contained 10% sugar beet pulp
T_3= diet contained 25% sugar beet pulp
T_4= diet contained 40% sugar beet pulp
T_5= diet contained 10% potato by-product meal
T_6= diet contained 25% potato by-product meal
T_7= diet contained 40% potato by-product meal

Table 14: Least squares analysis of variance for nutrients digestibility coefficients in rabbits fed the experimental diets.

Source of variance	d.f	MS and F value											
		DM		OM		CP		EE		CF		NFE	
		Ms	F	Ms	F	Ms	F	Ms	F	Ms	F	Ms	F
Treatment	6		1.10		1.05		1.20		2.21		0.57		1.36
Coprophagy status	1		9.25**		8.79**		9.44**		12.89***		12.22***		4.53*
treat x coprophagy	6		2.08		2.10		1.69		2.10		2.02		2.01
Error	28	38.69		35.06		56.44		12.84		177.55		19.13	

*= (P<0.05) **= (P<0.01) ***= (P<0.001)

4.6.3. Interaction between treatment and coprophagy status:

The effect of interaction between treatment and coprophagy status on digestibility coefficient of all nutrients was non-significant (P>0.05) (Table 14).

4.7. Carcass traits %:

Results of carcass traits in rabbits of the study are shown in Tables (15 and 17). The results of the analysis of variance for carcass traits % and organs weight % are showed in the Tables (16 and 18).

4.7.1. Treatment effect:

Data of after slaughter weight (ASW%), after flayinsiding weight (AFW%), dressing percentage (DP%), fore-quarters weight (FQW%), hind-quarters weight (HQW%), chest weight (CHW%) and loin weight (LIW%) were recorded for each experimental rabbits and expressed as a percentage of fasted live body weight.

As shown in Table (15) values of dressing percentage for rabbits were 51.47, 51.76, 51.91, 52.90, 52.12, 49.26 and 50.09% for T1 (control), T2 (10% SBP), T3 (25% SBP), T4 (40% SBP), T5 (10% PBM), T6 (25% PBM) and T7 (40% PBM), respectively. These results indicated that rabbits received the diet containing 40% sugar beet pulp, SBP, (T4) showed the highest dressing percentage value while, the lowest value of DP% was recorded by rabbits of T6 which contained 25% potato by-product meal (PBM). However, no significant differences were detected in dressing percentage of rabbits fed the experimental

Table 15: Least squars means ± SE of factors affecting carcass traits % of rabbits fed the experimental diets.

Independent variable	After slaughter weight (ASW%)	After flayinsiding weight (AFW%)	Dressing percentage (DP%)	Fore quarters weight (FQW%)	Hind quarters weight (HQW%)	Chest weight (CHW%)	Loin weight (LIW%)
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Treatment							
T_1	96.62±0.59	77.88±0.93	51.47±1.70	8.46±0.56	20.34±1.45	10.33±1.19	12.34±1.60
T_2	96.98±0.54	78.55±0.86	51.76±1.55	8.11±0.51	18.24±1.33	12.20±1.09	13.21±1.46
T_3	95.76±0.55	77.15±0.87	51.91±1.57	9.20±0.52	19.88±1.35	11.13±1.10	11.70±1.48
T_4	96.53±0.51	76.11±0.80	52.90±1.46	8.21±0.48	18.59±1.25	13.17±1.02	12.39±1.37
T_5	97.63±0.57	77.51±0.90	52.12±1.64	9.67±0.54	19.87±1.40	10.65±1.15	11.93±1.54
T_6	96.94±0.66	78.47±1.04	49.26±1.89	8.62±0.62	19.09±1.62	8.73±1.32	12.82±1.78
T_7	95.27±0.69	75.25±1.10	50.09±1.99	8.74±0.66	19.90±1.71	11.51±1.40	9.95±1.88

SE= Standard error

* Dressing percentage (DP%) = $\frac{\text{Hot carcass weight [Dressed wt. (g)]}}{\text{Fasted body weight (g)}} \times 100$

* Hot carcass weight (g) = Fore-quarters (g) + Hind-quarters (g) + Chest weight (g) + Loin weight (g)

Table 17: Least squares means ± SE of factors affecting carcass (organs) % of rabbits fed the experimental diets.

Independent variable	Flay head weight (FHW%)	Full intestine weight (FIW%)	Empty intestine weight (EIW%)	Liver weight (LW%)	Heart weight (HW%)	Kidneys weight (KW%)	Blood weight (BW%)	Coat weight (CW%)	Spleen weight (SW%)	Fat carcass weight (FCW%)
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Treatment										
T_1	5.64±0.44	16.09±1.17	7.63±1.23	2.50±0.41	0.28±0.06	0.69±0.07ab	3.38±0.59	15.37±1.10	0.03±0.009	1.57±0.25b
T_2	5.91±0.40	14.08±1.07	6.79±1.13	2.45±0.37	0.24±0.05	0.47±0.07b	3.02±0.54	16.34±1.00	0.03±0.008	1.74±0.23b
T_3	6.50±0.40	14.19±1.08	8.19±1.15	2.08±0.38	0.27±0.05	0.52±0.07b	4.24±0.55	16.33±1.02	0.04±0.008	2.50±0.23a
T_4	5.80±0.38	13.50±1.01	6.05±1.06	1.82±0.35	0.19±0.05	0.42±0.06b	3.47±0.51	17.19±0.95	0.03±0.007	1.38±0.22b
T_5	6.19±0.42	15.40±1.13	6.59±1.19	2.91±0.39	0.33±0.06	0.69±0.07ab	2.37±0.57	16.25±1.06	0.05±0.008	1.66±0.24b
T_6	5.70±0.49	16.78±1.30	6.59±1.38	2.49±0.45	0.34±0.07	0.75±0.08a	3.06±0.66	15.71±1.23	0.05±0.010	1.45±0.28b
T_7	5.76±0.51	18.46±1.38	6.36±1.46	2.46±0.48	0.31±0.07	0.78±0.09ab	4.73±0.70	16.25±1.30	0.06±0.010	0.78±0.30b

- Means with the same letter within each column are not significantly different.

SE= Standard error

T_1=control diet.

T_2=diet contained 10% sugar beet pulp (10%SBP).

T_3=diet contained 25% sugar beet pulp (25% SBP).

T_4=diet contained 40% sugar beet pulp (40% SBP).

T_5=diet contained 10% potato by-product meal (10% PBM).

T_6=diet contained 25% potato by-product meal (25% PBM).

T_7=diet contained 40% potato by-product meal (40% PBM).

Table 16: Least squares analysis of variance of factors affecting carcass traits % of rabbits fed the experimental diets.

Source of variance	d.f	MS and F value of													
		After slaughter weight (ASW%)		After flayinsiding weight (AFW%)		Dressing percentage (DP%)		Fore quarters weight (FQW%)		Hind quarters weight (HQW%)		Chest weight (CHW%)		Loin weight (LIW%)	
		Ms	F	Ms	F	Ms	F	Ms	F	Ms	F	Ms	F	Ms	F
Treatment	6		1.84		1.18		0.57		1.10		0.30		1.60		0.29
Sire	13		1.62		3.27		1.80		1.01		0.63		0.95		0.47
Regression	1		0.63		0.33		0.84		0.33		0.47		2.16		0.49
Error	7	0.65		1.61		5.32		0.57		3.91		2.60		4.71	

Table 18: Least squares analysis of variance of factors affecting carcass (organs) % of rabbits fed the experimental diets.

Source of variance	d.f	MS and F value of																	
		Flay head weight (FHW%)		Full intestine weight (FIW%)		Empty intestine weight (EIW%)		Liver weight (LW%)		Heart weight (HW%)		Kidneys weight (KW%)		Blood weight (BW%)		Coat weight (CW%)		Spleen weight (SW%)		Fat carcass weight (FCW%)	
		Ms	F	Ms	F	Ms	F	Ms	F	Ms	F	Ms	F	Ms	F	Ms	F	Ms	F	Ms	F
Treatment	6		0.56		2.16		0.52		0.18		1.01		4.41*		1.84		0.26		2.20		4.48*
Sire	13		0.36		1.06		0.38		0.81		0.85		1.57		1.62		1.95		0.73		1.78
Regression	1		1.04		2.15		2.30		0.00		2.00		0.33		0.63		0.15		0.46		2.34
Error	7	0.35		2.52		2.82		0.30		0.006		0.010		0.65		2.24		0.0002		0.118	

*= (P<0.05)

diets. In general, there were no significant differences due to treatment effect on all carcass traits % (Table 16).

Weight of different organs (Flay head %, full intestine %, empty intestine %, liver %, heart %, kidneys %, spleen %, fat carcass %, blood % and coat %) varied with treatments but without any consistent trend.

The differences were very small and non-significant except those of the kidneys and fat carcass percent which differed significantly ($P<0.05$) according the experimental diets fed (Table 18). These results are quite similar to those obtained by Battaglini and Costantini (1978) who found that there was no sizable difference in carcass dressing percentage between growing rabbits of the control diet and those fed on a diet contained 8% sugar beet pulp (61.50 VS 61.40%). Also, Abdel-Azeem (1997) showed that the differences in percentage of kidneys, heart, lungs, legs, empty intestine and blood weights in addition to cecum length among all experimental treatments were not statistically different ($P>0.05$).

4.8. Chemical composition of the meat:

Results of chemical composition of rabbits meat fed the experimental diets are illustrated in Tables (19 and 20).

4.8.1. Treatment effect:

Results presented in Table (19) showed that CP, EE and ash contents of rabbit meat fluctuated with treatment without any definable trend.

The analysis of variance of chemical composition of meat of the experimental rabbits showed that the differences among

Table 19: Least squares means ±SE of treatments on chemical composition of the rabbit meat fed the experimental diets (based on DM).

Independent variable	CP%	EE%	ASh%
	Mean ± SE	Mean ± SE	Mean ± SE
Treatment			
T_1	78.71±3.12	15.88±3.23	4.37±0.24
T_2	80.75±3.12	13.19±3.23	4.52±0.24
T_3	77.56±3.12	17.56±3.23	4.01±0.24
T_4	83.26±3.12	10.51±3.23	4.94±0.24
T_5	78.77±3.12	16.08±3.23	4.19±0.24
T_6	76.12±3.12	18.13±3.23	3.91±0.24
T_7	82.77±3.12	11.12±3.23	4.41±0.24

SE= Standard error
T_1=control diet.
T_2=diet contained 10% sugar beet pulp (10%SBP).
T_3=diet contained 25% sugar beet pulp (25% SBP).
T_4=diet contained 40% sugar beet pulp (40% SBP).
T_5=diet contained 10% potato by-product meal (10% PBM).
T_6=diet contained 25% potato by-product meal (25% PBM).
T_7=diet contained 40% potato by-product meal (40% PBM).

Table 20: Least squares analysis of variance of treatments on chemical composition of the rabbit meat fed the experimental diets (based on DM)

Source of variance	d.f	MS and F value of					
		CP		EE		ASH	
		Ms	F	Ms	F	Ms	F
Treatment	6		1.46		1.79		2.13
Error	21	38.87		41.80		0.223	

means of CP, EE and ash contents of meat differed slightly with treatments but the differences were not significant (P>0.05).

These results are in agreement with those obtained by Abd El-Rahim *et al.* (1992), El-Gendy (1994a, b) and El-Sayaad *et al.* (1995). They showed that there were no significant differences in chemical composition (CP, EE and ash) of NZW rabbits meat among all groups fed their experimental diets.

4.9. Some blood components:

Averages and analysis of variance of total protein, albumin, globulin, creatinine, urea, GOT and GPT of blood plasma in rabbits as affected by treatments are presented in Tables (21 and 22).

4.9.1. Treatment effect:

Results in Tables (21 and 22) of blood plasma components showed that the differences due to treatments on albumin, globulin creatinine, urea, GOT and GPT were statistically non-significant, but proved significance (P<0.01) on plasma total protein.

In general, values of blood plasma components of rabbits fed the experimental diets of T2, T3, T4, T5, T6 and T7 surpassed almost those of rabbits fed the control diet (T1).

Results of the study in this concern are in partial agreement with those of El-Sayaad *et al.* (1990) who showed that total protein, albumin and globulin content of blood serum in rabbits ranged from 6.50 to 7.74, from 2.43 to 2.82 and from 3.70 to 4.26 g/100 ml, respectively. Also, these results are very close to those obtained by Abd El-Rahim *et al.* (1992) who found

Table 21: Least squares means ±SE of factors affecting some blood components of rabbits fed the experimental diets.

Independent variable	Blood components						
	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Creatinine (mg/dl)	Urea (mg/dl)	GOT (U/L)	GPT (U/L)
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Treatment							
T_1	5.77±0.33 c	2.50±0.32	3.30±0.40	1.44±0.25	56.84±4.27	52.02±4.62	61.47±5.16
T_2	5.86±0.33 c	2.76±0.32	3.16±0.40	1.62±0.25	51.37±4.27	61.11±4.62	64.46±5.16
T_3	5.90±0.33 c	2.94±0.32	2.96±0.40	1.77±0.25	53.46±4.27	68.03±4.62	76.81±5.16
T_4	6.73±0.33 bc	3.49±0.32	3.24±0.40	1.90±0.25	61.00±4.27	68.74±4.62	75.85±5.16
T_5	6.23±0.33 bc	3.01±0.32	3.22±0.40	1.47±0.25	51.34±4.27	59.49±4.62	66.79±5.16
T_6	7.17±0.33 ab	3.46±0.32	3.70±0.40	1.54±0.25	63.06±4.27	63.64±4.62	64.33±5.16
T_7	7.93±0.33 a	3.71±0.32	4.22±0.40	2.07±0.25	67.36±4.27	71.13±4.62	83.82±5.16

- Means with the same letter within each column are not significantly different.

SE= Standard error

T_1=control diet.

T_2=diet contained 10% sugar beet pulp (10%SBP).

T_3=diet contained 25% sugar beet pulp (25% SBP).

T_4=diet contained 40% sugar beet pulp (40% SBP).

T_5=diet contained 10% potato by-product meal (10% PBM).

T_6=diet contained 25% potato by-product meal (25% PBM).

T_7=diet contained 40% potato by-product meal (40% PBM).

Table 22: Least squares analysis of variance of factors affecting some blood components of rabbits fed the experimental diets.

Source of variance	d.f	Total protein		Albumin		Globulin		Creatinine		Urea		GOT		GPT	
		Ms	F	Ms	F	Ms	F	Ms	F	Ms	F	Ms	F	Ms	F
Treatment	6	0.33	5.99**	0.31	1.86	0.49	1.10	0.18	0.89	54.58	2.13	63.97	2.03	79.81	2.60
Error	14														

**= (P<0.01)

that the total protein levels in blood serum of growing NZW rabbits are significantly ($P<0.05$) lower than levels of other blood components. They added that blood serum contents of urea-N, creatinine, GOT and GPT were not significantly affected with by-product diets.

Zaza (2005) investigated the effect of diet containing 0, 50 and 75% biologically treated sugar beet pulp (BTSBP) of the rations on blood components. He found that there were no significant difference in each of total protein, albumin, globulin, GPT and GOT among rabbits fed the experimental diets. But rabbits fed 50% BTSBP were significantly ($P<0.05$) higher in blood urea compared with those fed 75% BTSBP or the control diet.

4.10. Cecum activity:

Results of cecum activity in rabbits fed experimental diets are illustrated in Tables (23 and 24).

4.10.1. Treatment effect:

The differences between means of total bacterial count of cecum contents in rabbits fed the experimental diets were highly significant ($P<0.001$), but, *E. coli* seems to be undetected (Table 23). The analysis of variance of pH of cecum content refer to non-significant effect of treatment on pH (Table 24). In this concern, El-Sayaad *et al.* (1995) showed that total count of bacteria in cecum content of rabbits increased with increasing dietary level of artichoke bracts in their experimental diets. Also, mean values of pH are quite similar to those obtained by Khayyal (1997) and Azzazy (2002) who found that the pH values of cecal content of rabbits were not affected by type of diet.

Table 23: Least squares means ±SE of factors affecting cecum activity of rabbits fed the experimental diets.

Independent variable	Cecum activity		
	Total bacterial count mean	*E.Coli* total count	pH
	Mean ± SE	Mean ± SE	Mean ± SE
Treatment			
T_1	65.00±10.22 c	Nd	7.49±0.097
T_2	92.50±10.22 bc	Nd	7.41±0.097
T_3	84.75±10.22 bc	Nd	7.24±0.097
T_4	95.00±10.22 bc	Nd	7.41±0.097
T_5	62.50±10.22 c	Nd	7.40±0.097
T_6	110.00±10.22 ab	Nd	7.53±0.097
T_7	137.50±10.22 a	Nd	7.38±0.097

* APHA (1960) and Difco Manual (1977)

Number of bacterial cells per gram of cecum content (total count. $X10^5$).

Means with the same letter within each column are not significantly different.

SE= Standard error

T_1=control diet.

T_2=diet contained 10% sugar beet pulp (10%SBP).

T_3=diet contained 25% sugar beet pulp (25% SBP).

T_4=diet contained 40% sugar beet pulp (40% SBP).

T_5=diet contained 10% potato by-product meal (10% PBM).

T_6=diet contained 25% potato by-product meal (25% PBM).

T_7=diet contained 40% potato by-product meal (40% PBM).

Table 24: Least squares analysis of variance of factors affecting cecum activity of rabbits fed the experimental diets.

Source of variance	d.f	MS and F value					
		Total count mean		E. Coli total count mean		pH	
		Ms	F	Ms	F	Ms	F
Treatment	6	417.89	6.47***	Nd	Nd	0.038	0.90
Error	21						

***= (P<0.001)

4.11. Some doe traits:

Doe weight at kindling, litter size and weight at birth, feed intake of doe, doe weight at weaning of its litter, litter size and weight at weaning of rabbits fed rations containing different agriculture by-products (sugar beet pulp and potato by-product meal) are presented in Table (25). The differences due to the experimental diets effect are shown in Table (26).

4.11.1. Treatment effect:

Results showed that there were no difference due to the differences in nutritional treatments of the study on doe weight at kindling and at weaning of its litter, feed intake of doe, size and weight of the litter at birth and at weaning (Table 26). Results revealed that group of rabbits fed the experimental diet of T6 was better than those of other groups of the study in reproductive performance represented by its litter size and weight and weaning. This lead to state that it is better to use the treatment with least costs and/or the treatment which showed the best performance. Similar findings were obtained by Mangood (1994) who reported that increasing dried sugar beet pulp in rabbit diets up to 22.5% negatively affected female reproductive performance.

Table 25: Least squares means ± SE of factors affecting some doe traits of rabbits fed the experimental diets.

Independent variable	Doe weight at kindling (DWB) (g)	At birth		Feed intake of doe (FID) (g)	Doe weight at weaning of the litter (DWW) (g)	At weaning	
		Litter size (LS)	Litter weight (LW) (g)			Litter size (LS)	Litter weight (LW) (g)
	means ± SE	means ± SE	means ± SE	means ± SE	means ± SE	means ± SE	means ± SE
Treatment							
T_1	3015.44±96.42	5.71±0.94	322.58±46.09	199.69±4.24	3027.15±62.22	3.90±1.74	1783.10±429.47
T_2	3055.46±120.54	6.40±1.18	270.15±57.62	207.23±7.81	2972.43±79.60	4.99±2.22	2126.95±549.44
T_3	3165.43±96.78	4.79±0.94	209.72±46.26	206.91±6.27	3231.10±36.61	3.31±1.78	2198.05±439.02
T_4	2942.46±103.82	5.78±1.01	258.97±49.63	184.74±6.72	2875.51±74.89	3.25±2.09	1333.95±516.98
T_5	2931.16±110.82	4.63±1.08	242.24±52.97	198.29±7.18	2961.01±71.60	3.50±1.99	1590.90±494.23
T_6	2919.00±123.98	6.41±1.21	381.62±59.26	200.33±8.03	2962.80±80.17	5.59±2.24	2327.87±553.36
T_7	3071.88±107.05	7.07±1.04	346.80±51.17	198.52±6.93	3045.06±70.92	4.17±1.98	1473.33±489.54

SE= Standard error
T_1= control diet
T_2= diet contained 10% sugar beet pulp
T_3= diet contained 25% sugar beet pulp
T_4= diet contained 40% sugar beet pulp
T_5= diet contained 10% potato by-product meal
T_6= diet contained 25% potato by-product meal
T_7= diet contained 40% potato by-product meal

Table 26: Least squares analysis of variance of factors affecting some doe traits of rabbits fed the experimental diets.

Source of variance	d.f	MS and F values													
		Doe weight at at kindling (DWB)		At birth				Feed intake doe (FID)		d.f	Doe weight at weaning of the litter (DWW)		At weaning		
				Litter size (LS)		Litter weight (LW)							Litter size (LS)		Litter weight (LW)	
		MS	F	MS	F	MS	F	MS	F		MS	F	MS	F	MS	F
Treatment	6		0.53		0.86		1.73		1.22	6		2.67		0.24		0.77
Sire	15		0.72		0.95		1.33		0.52	15		1.24		0.32		0.75
Regression	1		8.61		0.02		0.13		0.60	1		13.24		0.09		0.35
Error	3	33663.90		3.21		7691.68		141.18		2	14195.73		11.06		676318.84	

4.12. Economical efficiency:

The average feed cost and economical efficiency of using the by-products [sugar beet pulp (SBP) and potato by-product meal (PBM)] in the experimental rabbit diets are shown in Table (27).

The economic efficiency values were calculated according to official prices of different feed ingredients used for formulating the experimental diets prevaibling in the market through the experimental period in 2002. The economic efficiency values of the control diet (T1) was taken as a standard for comparing between the different experimental treatments.

Results in Table 27 showed that feed costs for males and females during the interval of 6-9 weeks of age were the highest in T1 (without any by-product) being 6.5 and 7.2 PT, respectively, followed in a descending order by T5 (ration contained 10% PBM) since the feed costs were 6.6 and 6.2 PT, for males and females, respectively. The lowest values of feed costs for males and females of T7 (feed on the ration contained 40% PBM were 4.9 and 4.5 PT, respectively. Moreover, almost the same trend of feed cost was observed during all age intervals of the study (9-12, 12-16 and 6-16 weeks of age).

The best average economic efficiency [net revenue (PT)/feed cost (PT)] values was almost shown by rabbits of T7 (40% PBM) at all age intervals of the study followed by that of rabbits of T3 (25% SBP).

Assuming that values of relative economic efficiency % of T1 (control) equal 100. Rabbits of T7 recorded the highest

values of relative economic efficiency during the intervals of 6-9, 9-12, 12-16 and 6-16 weeks of age (being 148.1, 177.8, 200.0 and 187.5%, respectively).

From the nutritional point of view it could be concluded that it is possible to include by-products in rabbit diets as new sources of non-conventional feedstuff for solving the problem of shortage of animal feeds in Egypt and Yemen without any adverse effects on the performance of their growth and reproduction.

Table 27: Economical efficiency of experimental diets used for feeding rabbits at different age intervals.

Variable		T_1	T_2	T_3	T_4	T_5	T_6	T_7
Price/kg diet (PT)		84.1	81.7	76.5	71.2	76.4	67.3	56.4
		During the interval of 6-9 weeks of age						
Average daily feed intake as fed (g):	Male	77.62	69.92	75.96	85.42	86.31	79.94	86.01
	Female	85.48	71.01	75.68	82.26	81.07	94.69	80.36
Feed cost (PT):	Male	6.50	5.70	5.80	6.10	6.60	5.40	4.90
	Female	7.20	5.80	5.80	5.90	6.20	6.40	4.50
Ave. daily gain (g):	Male	24.33	26.70	31.43	26.44	25.03	29.20	25.77
	Female	32.14	27.32	31.01	23.30	28.72	28.39	25.89
Total revenue (PT):	Male	21.90	24.00	28.30	23.80	22.50	26.30	23.20
	Female	28.90	24.60	27.90	21.00	25.80	25.60	23.30
Net revenue (PT):	Male	15.40	18.30	22.50	17.70	15.90	20.90	18.30
	Female	21.70	18.80	22.10	15.10	19.60	19.20	18.80
Economical efficiency:	Male	2.40	3.20	3.90	2.90	2.40	3.90	3.70
	Female	3.00	3.20	3.80	2.60	3.20	3.00	4.20
	Average	2.70	3.20	3.90	2.80	2.80	3.50	4.00
Relative economical efficiency %		100.00	118.50	144.40	103.70	103.70	129.60	148.10
		During the interval of 9-12 weeks of age						
Average daily feed intake as fed (g):	Male	101.07	108.01	122.85	126.27	124.94	129.85	104.23
	Female	112.37	121.70	118.06	120.56	125.48	128.57	107.74
Feed cost (PT):	Male	8.50	8.80	9.40	9.00	9.50	8.70	5.90
	Female	9.50	9.90	9.00	8.60	9.60	8.70	6.10
Ave. daily gain (g):	Male	26.98	31.10	29.58	33.90	29.32	31.43	28.00
	Female	28.67	34.55	31.93	34.46	28.90	31.22	27.11
Total revenue (PT):	Male	24.30	28.00	26.70	30.50	26.40	28.30	25.20
	Female	25.80	31.10	28.70	31.00	26.00	28.10	24.40
Net revenue (PT):	Male	15.80	19.20	17.30	21.50	16.90	19.60	19.30
	Female	16.30	21.20	19.70	22.40	16.40	19.40	18.30
Economical efficiency:	Male	1.90	2.20	1.80	2.40	1.80	2.30	3.30
	Female	1.70	2.10	2.20	2.60	1.70	2.20	3.00
	Average	1.80	2.20	2.00	2.50	1.80	2.30	3.20
Relative economical efficiency %		100.00	122.20	111.10	138.90	100.00	127.80	177.80
		During the interval of 12-16 weeks of age						
Average daily feed intake as fed (g):	Male	120.71	107.64	113.35	116.76	116.97	126.52	103.62
	Female	116.68	119.64	116.74	122.23	122.14	120.80	105.89
Feed cost (PT):	Male	10.20	8.80	8.70	8.30	8.90	8.50	5.80
	Female	9.80	9.80	8.90	8.70	9.30	8.10	6.00
Ave. daily gain (g):	Male	25.42	20.36	25.42	21.03	22.90	24.20	20.49
	Female	24.09	23.66	22.59	22.28	21.76	19.87	24.24
Total revenue (PT):	Male	22.90	18.30	22.90	18.90	20.70	21.80	18.40
	Female	21.70	21.30	20.30	20.10	19.60	17.90	21.80
Net revenue (PT):	Male	12.70	9.50	14.20	10.60	11.80	13.30	12.60
	Female	11.90	11.50	11.40	11.40	10.30	9.80	15.80
Economical efficiency:	Male	1.20	1.10	1.60	1.30	1.30	1.60	2.20
	Female	1.20	1.20	1.30	1.30	1.10	1.20	2.60
	Average	1.20	1.20	1.50	1.30	1.20	1.40	2.40
Relative economical efficiency %		100.00	100.00	125.00	108.30	100.00	116.70	200.00

Table 27: Continued.

Variable		T_1	T_2	T_3	T_4	T_5	T_6	T_7
Price/kg diet (PT)		84.1	81.7	76.5	71.2	76.4	67.3	56.4
		During the interval of 6-16 weeks of age						
Average daily feed intake as fed (g):	Male	101.89	99.25	105.60	110.26	110.16	113.55	98.52
	Female	107.90	105.64	105.18	109.74	110.88	115.30	98.43
Feed cost (PT):	Male	8.60	8.10	8.10	7.90	8.40	7.60	5.60
	Female	9.10	8.60	8.00	7.80	8.50	7.80	5.60
Ave. daily gain (g):	Male	24.23	22.98	25.84	26.51	25.50	27.90	24.30
	Female	26.73	27.03	26.83	26.24	26.00	25.80	25.20
Total revenue (PT):	Male	21.80	20.70	23.30	23.90	23.00	25.10	21.90
	Female	24.10	24.30	24.10	23.60	23.40	23.20	22.70
Net revenue (PT):	Male	13.20	12.60	15.20	16.00	14.60	17.50	16.30
	Female	15.00	15.70	16.10	15.80	14.90	15.40	17.10
Economical efficiency:	Male	1.50	1.60	1.90	2.00	1.70	2.30	2.90
	Female	1.60	1.80	2.00	2.00	1.80	2.00	3.10
	Average	1.60	1.70	2.00	2.00	1.80	2.20	3.00
Relative economical efficiency %		100.00	106.30	125.00	125.00	112.50	137.50	187.50

T_1= control diet
T_2= diet contained 10% sugar beet pulp
T_3= diet contained 25% sugar beet pulp
T_4= diet contained 40% sugar beet pulp
T_5= diet contained 10% potato by-product meal
T_6= diet contained 25% potato by-product meal
T_7= diet contained 40% potato by-product meal

Prices of ingredients:

* Prices of the Egyptian market during the experimental period (2002) prices (L.E./ton) was 650 for berseem hay meal (14% CP), 1300 for soybean (44% CP), 770 for yellow corn, 670 for wheat bran, 1000 for barley, 100 for salt, 40 for limestone, 9000 for premix, 18000 for methionine, 250 for molasses, 420 for sugar beet, 110 for potato by-product meal.
* Price of one kg body rabbit weight on selling was 9.00 L.E. feed cost of kg weight gain was calculated on the basis of previous prices.

Total revenue (PT) = Daily gain (g) X Price live weight, g, (P.T.)
Net revenue = total revenue – Feed cost (PT)

$$\text{Economic efficiency} = \frac{\text{Net revenue (PT)}}{\text{Feed cost.}}$$