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GROWTH PERFORMANCE AND FEED CONVERSION IN V-LINE AND CROSSBRED RABBITS FED DIETS CONTAINING DISCARDED DATES IN SAUDI ARABIA

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SUMMARY- A total of 72 rabbits representing two genetic groups of V-line and crossbred of V-line x Saudi Gabali were used to evaluate dietary treatments containing discarded flesh dates for post-weaning growth performance (in terms of body weights and gains) and feed consumption and conversions. The basal diet (or the control treatment, T1) is the diet in which no date flesh was added. Discarded flesh dates were incorporated into two dietary treatments to replace partially the concentrates (corn and barley) and molasses by 15 % (T2) or 30% (T3) of the diet. The diet containing 30% flesh date lead to slightly increase of 6.6, 2.8, 3.3, 2.9, and 2.8 % in live body weights relative to the control diet at 4, 6, 8, 10 and 12 weeks of age, respectively. Feed conversion ratio at interval of 4-12 weeks was significantly in favour of the control diet. Post-weaning body weights and gains of crossbred rabbits were higher than that of the V-line rabbits, while feed conversion ratios were in favour of V-line rabbits. Crossbred rabbits fed diet containing 30% flesh dates were consume more (89.6 g) and converse lesser (2.57:1) than crossbred rabbits fed the other two dietary treatments (86.4 g of feed consumed with conversion ratio of 2.48:1 in T1 and 84.7 g of feed consumed with conversion ratio of 2.49:1 in T2). V-line rabbits fed the control diet were consume lesser (107.5 g) and converse better (2.95:1) than V-line rabbits fed diet containing 15% or 30% discarded flesh dates (125.4 g of feed consumed with conversion ratio of 3.29:1 in T2; 112.1 g of feed consumed with conversion ratio of 3.04:1 in T3). In practice, diet supplemented by 30% flesh dates gave a positive effect on the relative revenue and was economically efficient higher by 4.2% relative to the control diet.

Key words: Saudi rabbits, dietary treatments, flesh dates, growth, feed conversion.

INTRODUCTION

Conventional feeds for commercial rabbit production are based on concentrates plus other constituents. Concentrates are becoming more expensive and they compete with human needs (Ha *et al.*, 1996). One of the main limiting factors in the rational rabbit production in hot climate countries is the absence of balanced pelleted diets available in an acceptable price. In Saudi Arabia, prices of most concentrates have increased dramatically with the increased demand for animal feeds and therefore, efforts must be made to use local raw materials to produce feeds with a lower price than imported feeds. Palm planting and industry have increased dramatically in the last few years in Arabian Gulf countries so that Saudi Arabia, alone, produces more than half million tons of palm date annually and therefore Saudi Arabia is considered as one of the biggest countries in production of palm dates allover the world (Mikki *et al.*, 1986; Al-Yousef *et al.*, 1993; Ministry of Agriculture and Water Resources, 2004). The considerable amounts of low-quality dates are not suitable for packing (Homeidan *et al.*, 1993). This date is known with high nutritive value and these low-grade fruits could be used in formulation of diets for animals (Mikki *et al.*, 1986; Al-Yousef *et al.*, 1993). As energy source, dates could be used to replace, at least, part of the concentrates in the ration. Eventhough, the effect of addition of discarded dates in formulating the rabbit diets has not been extensively studied. The main targets of the present study were: (i) To determine the consequences of utilizing three dietary treatments containing discarded palm dates in the diets (as a concentrate alternative) for two genetic groups of rabbits (V-line and crossbred of V-line with Saudi Gabali) on post-weaning growth performance and feed consumptions and conversions, (ii) To detect which one of these dietary treatments was interacted considerably with any of the two genetic groups used, and (iii) To evaluate economically the effectiveness and net revenue of replacing a part of the concentrates in rabbits diets by low quality dates

MATERIALS AND METHODS

Animals and diets

Seventy two V-line and V-line x Gabali crossbred weaned male rabbits (thirty six each) were randomly distributed into three comparable dietary groups (24 animals each with 12 animals from each genetic group). Animals of the first group (control treatment T1) was fed a basal diet (where no flesh date was added), while animals of the other two groups were fed diets supplemented with 15 and 30 % of flesh dates in treatments T2 and T3, respectively to substitute the same levels from the concentrate part *(corn and barley) and molasses*. Experimental diets were supplied to the animals from 4 (weaning age) up to 12 weeks of age. Animals were fed *ad libitum* individually and they offered the three experimental diets as presented in Table 1. The approximate chemical compositions of the three experimental diets and the ingredients used in formulating these diets were carried out according to A.O.A.C. (1990) as shown in Tables 1 and 2. DM, CP, EE, NFE and ash contents in diets containing dates were nearly similar relative to the control diet.

All animals used in this study were locally born in the rabbitry of a project funded by a great grant (ARP: 18-62) from King Abdulaziz City for Science and Technology. This project was carried out in College of Agriculture and Veterinary Medicine, King Saudi University, Al-Qassim, Saudi Arabia. V-line rabbits are original Spanish line and were born in this project, while crossbred rabbits were produced from crossing Gabali Saudi rabbits with V-line in the same project. Rabbits used in this experiment were weaned four weeks post parturition, ear tagged, transferred to standard progeny individual wire cages arranged in two-tier batteries and housed in a semi-closed air-conditioned rabbitry. All cages were equipped with feeding hoppers and drinking nipples. Animals in this experiment were drink *ad libitum*.

Data collected

After weaning, animals were weighed at 4 weeks and biweekly thereafter up to 12 weeks. Weight at 12 weeks of age could be used as marketing weight for the Saudi consumers. Animals were fasted 12 hr before recording their weights to avoid the gut content weight effect. Feed intake and residual feed were recorded at 14-d intervals to be used in feed conversion calculations. Daily gains in weight and feed consumption and conversion per animal were calculated or measured at intervals of 4-8 weeks, 8-12 weeks, and total 4-12 weeks. Feed conversion ratios (FCR) were calculated as the amount of feed consumed divided by the amount of gain in weight.

Statistical analysis

Data of post-weaning body weights and gains and feed consumptions and conversions were analyzed using GLM procedure of the SAS program (1996). The following linear model was used:

$Y_{ijk} = \mu + A_i + B_j + AB_{ij} + eijk$

Where: Y_{ijk} = Observation on ijk^{th} trait; μ = Overall mean; A_i = Effect of i^{th} dietary treatment (i= 1, 2, 3; 1= control diet, 2= diet supplemented with 15% date flesh, 3= diet supplemented with 30% date flesh); B_j = Effect of j^{th} genetic group (j= 1, 2; 1= V-line rabbits, 2= Crossbred rabbits); AB_{ij} = Effect of two-order interaction of A_i and B_j; and Eijk = Random error. Duncan's test (1955) was used to compare the treatment means.

Table 1. The ingredients used in formulating the experimental diets associated with approximate chemical composition for these diets

Ingredients	Chemical composition (%)*					
	DM	CP	TDN	CF	Ca	P
Alfalfa	0.909	17	56.6	30.1	1.19	0.24
Barley	0 886	13.0	85.9	5.7	0.05	0.38
Wheat bran	0.890	17.4	70.5	11.3	0.14	1.27
Molasses	0.9	8.5	77	0.5	0.17	0.03
Flesh dates	0.880	3.8	84	2.8	0.17	0.03
Corn	0.88	8.5	87	2.5	0.02	0.35
Soybean	0.89	44	88	6.5	0.33	0.71

*DM= dry matter; CP= crude protein; TDN= total digestible nutrients; CF= crude fiber; Ca= calcium; P= phosphorous.

Table 2. Formulation and chemical composition of the experimental diets on dry matter basis (g/kg dry matter)

Items	Experimental diets		
	T1	T2	T3
Ingredients:			
Alfalfa hay	35	35	35
Barley	9	4.5	0
Wheat bran	8	6.75	5.5
Molasses	3	1.5	0
Date flesh	0	15	30
Limestone	1.2	1.1	1
Corn, grain	20.5	10.25	0
Soybean, 44%	22.78	25.38	27.98
Salt	0.25	0.25	0.25
Vitamin Premix	0.27	0.27	0.27
Total amount as fed, kg	100	100	100
Chemical composition (%):			
DM (g/ kg)	89.61	89.55	89.50
TDN	65.49	65.52	65.55
Crude protein	18.37	18.29	18.22
Calcium	0.87	0.86	0.85
Phosphorous	0.41	0.36	0.32
Crude fiber	12.62	12.55	12.49
DE kcal/kg	2882	2883	2884

*T1= Control diet; T2= Diet supplemented with 15% discarded dates; T3= Diet supplemented with 30% discarded dates.

RESULTS AND DISCUSSION

Dietary treatments

Descriptive performances of post-weaning body weights and gains, feed consumption and conversions of rabbits fed diets containing 0% or 15% or 30% of flesh dates are illustrated in Table 3. Allover the experiment period, partial replacement of concentrates (corn and barley) and molasses with date flesh did not attain significant differences in all weights and gains in the dietary treatments used (Table 3). Relative to the control diet, the diet containing 30% flesh dates lead to slightly increase of 40, 35, 58, 61, and 75 grams in live body weights at 4, 6, 8, 10 and 12 weeks of age, respectively. Marai *et al.* (1999) reported that a diet containing 10% palm oil *vs* a control diet gave an improvement of 5.6%, 8.9% ($P<0.05$) and 38.3% ($P<0.01$) in 12-week weight, 5-12 weeks gain in weight and 5-12 weeks feed conversion, respectively associated with a favourable decrease in feed intake by 32.8%. Urease activity and ammonia concentration in gastrointestinal tract of the rabbits fed diet containing dates can be suppressing factors to inhibit growth performance (Amber *et al*, 2004). Also, ammonia produced by ureolysis in the intestinal mucosa can exert a significant damage to the surface cells and urease has been known to play an essential role in pathogenesis of gastritis induced by Helicobacter pylori (Hussain *et al*, 1996; Amber *et al*, 2001; Amber *et al*, 2004).

Opposite to body weights and gains, differences in feed consumptions and conversions among dietary treatments were significant (Table 3). Daily feed consumptions at intervals of 4-8 and 4-12 weeks and feed conversion ratio at interval of 4-12 weeks were significantly in favour of the control diet. In most cases, daily feed intakes and feed conversion ratios were reduced in the control diet compared with diets containing 15 or 30% discarded dates. Feed conversion ratios for different dietary treatments were favourable and ranged from 2.04:1 to 3.27:1 (Table 4). In Egypt, Amber *et al* (2004) reported that feed conversion ratio was significantly ($P<0.01$) improved to be 3.615:1 for diet supplemented with yucca extract relative to 3.865:1 for the control diet.

From the results here, the concentrates in rabbit diets could be replaced partially by flesh dates without affecting growth performance and feed efficiency. Absence of any desirable significant increase

in the estimated values does not minimize the importance of replacement. The economic benefit comes from the big cost that will be saved by comparing the price of discarded dates to that of concentrates. Results of the present study agree with results of some studies that approaching the same concept but with different replacement additives. In this respect, Cavani *et al.* (1996) found that addition of either 3% or 6% of whole soybeans in the rabbit diets did not affect body weight gains. Similar findings were obtained by Radwan (2002) who added discarded sunflower seeds to growing rabbit diets with replacement rate of 17.5 and 35%. Addition of potato processing by-products or sweet potato tubers up to 30% in rabbit's diet was also recommended by Helaly *et al.* (2002). Nevertheless, results in some replacement trials were not encouraging factors since the alternative additive(s) was resulted in a decrease of growth rates in rabbits (Amber et al, 2001; FalcÃo et al, 1996).

Genetic-group

Post-weaning body weights and gains and feed consumptions of crossbred rabbits were higher than that of the V-line rabbits during the whole period of the experiment (Table 3). This could be attributed to that crossbred rabbits are theoretically containing 50% of their constituents from the Gabali genes which are more adapted to the Saudi climatic conditions. Opposite to body weights and gains, the feed conversion ratios were in favour of V-line rabbits; ranging from 2.41:1 to 2.59:1 (Table 3). Ramon *et al.* (1996) in Spain and Medellin and Lukefahr (2001) in USA stated that post-weaning growth and feed efficiency in crossbred rabbits were better than in straightbreds. In Brazil, Bianospino et al (2004) with Botucatu rabbits and crossbreds of Botucatu x White German Giant found that post-weaning body weights and feed consumptions in crossbreds were larger than those in straightbreds, while feed conversion ratios were similar in both genetic groups. In Hungary, Metzger *et al.* (2004) with Hyplus hybrid, purebred Pannon White rabbits and their crossbreds found that crossbreds were higher in weight gains (38.9 g/day) than the purebreds (36.6 g/day). In Spain, Orengo et al (2004) with five straightbred groups of rabbits (A, V, P, C, R lines) and their twenty crossbred groups reported that genetic groups of C and R x C were the heaviest in daily gain from 5 to 9 weeks of age (44.9-46.8 g/d); associated with the favourable feed intakes and feed conversions (2.48:1 to 2.54:1).

Table 3. Least-square means for post-weaning body weights and gains in weight and feed consumptions and conversions (±SE) for different dietary treatments and genetic groups

Traits	Dietary treatment (T)			Genetic group (G)		T x G	RSD*
	T1	T2	T3	V-line	Crossbred		
Body weight (*g*):							
4 weeks	610±25	605±26	650±25	584±19^{a}	660±22^{b}	NS	126
6 weeks	1254±31	1261±31	1289±33	1242±24	1295±28	NS	159
8 weeks	1778±40	1805±43	1836±41	1765±36	1848±31	NS	204
10 weeks	2072±41	2125±42	2133±44	1921±37^{a}	2299±32^{b}	NS	208
12 weeks	2708±40	2722±43	2783±41	2685±36^{a}	2789±31^{b}	NS	204
Daily gain in weight (*g*):							
4-8 week	41.7±1.3	42.8±1.4	42.4±1.3	42.1±1.2	42.4±1.0	NS	6.6
8-12 week	33.2±0.8	32.7±0.8	33.8±0.8	32.9±0.7^{a}	33.6±0.6^{b}	NS	4.2
4-12 week	37.3±0.6	37.8±0.6	38.1±0.6	36.2±0.5^{a}	39.3±0.5^{b}	NS	3.1
Daily feed consumption (*g*):							
4-8 week	89±3.7^{a}	103±4.0^{b}	95±3.8^{ab}	89±3.3^{a}	103±2.9^{b}	*	18.9
8-12 week	104±3.6	107±3.8	106±3.6	85±3.2^{a}	127±2.8^{b}	**	18.2
4-12 week	97±2.8^{a}	105±2.9^{b}	101±2.8^{a}	87±2.5^{a}	115±2.1^{b}	*	14.0
Feed conversion ratio (g feed /g gain):							
4-8 week	2.40±0.08	2.63±0.09	2.55±0.09	2.54±0.08^{a}	2.51±0.07^{a}	*	0.43
8-12 week	3.16±0.13	3.27±0.14	3.22±0.13	2.59±0.11^{a}	3.84±0.10^{b}	*	0.65
4-12 week	2.58±0.07^{a}	2.76±0.07^{b}	2.66±0.07^{ab}	2.41±0.06^{a}	2.92±0.05^{b}	*	0.35

$^{a, b}$ Values having different superscripts within each row are significantly different (P<0.05).
*RSD= Residual standard deviation.

Dietary treatments by genetic groups' interaction

All post-weaning body weights and gains were not significantly affected by interaction of dietary treatments (T) x genetic groups (G) as shown in Figures 1&2. Curves in Figures 1 and 2 were mostly parallel and indicate that dietary treatments and genetic groups act independently (separately or additively) during the whole period of growth from 4 weeks up to 12 weeks of age, i.e. there was no carry-over effect for this interaction during the whole experimental period of growth.

Figure 1: Body weights in different levels of interaction between dietary treatments and genetic groups

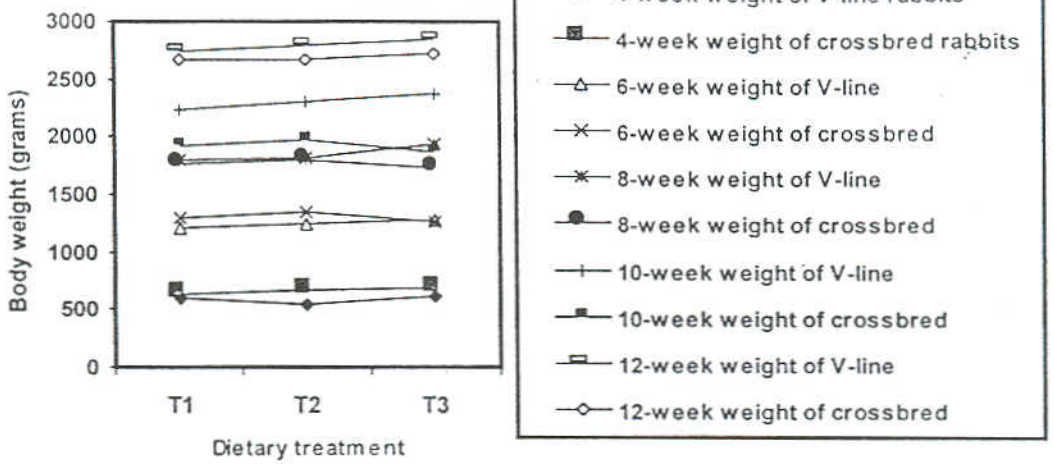
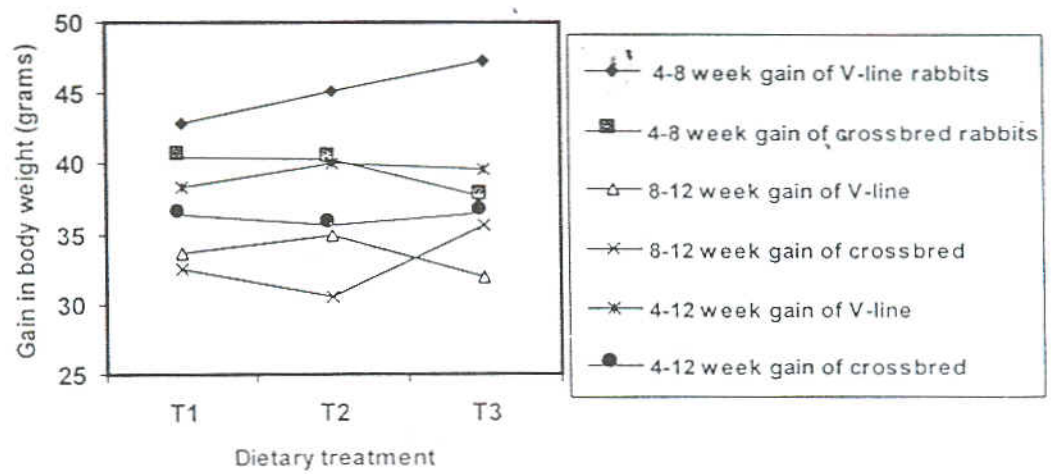


Figure 2: Daily gains in body weights in different levels of interaction between dietary treatments and genetic groups



Opposite to body weights and gains, feed consumptions and conversions during the whole period of the experiment were clearly affected by T x G interaction as shown in Figures 3 and 4. The intersected curves in these figures indicated that crossbred rabbits fed diet containing 30% flesh dates were consume more (89.6 g on average basis) and converse lesser (2.57:1) than crossbred rabbits fed the other two dietary treatments (86.4 g of feed consumed with conversion ratio of 2.48:1 in T1 and 84.7 g of feed consumed with conversion ratio of 2.49:1 in T2). On the other side, V-line rabbits fed the control diet were consume lesser (107.5 g on average basis) and converse better (2.95:1) than V-line rabbits fed diet containing 15% or 30% discarded flesh dates (125.4 g of feed consumed with conversion ratio of 3.29:1 in T2; 112.1 g of feed consumed with conversion ratio of 3.04:1 in T3). No comparisons could be made with results of the present study since, unfortunately, there is no published

literature available dealing with the effect of T x G interaction on post-weaning growth performance and feed consumptions and conversions.

Figure 3: Daily feed consumption (DFC) in different levels of interaction between dietary treatments and genetic groups

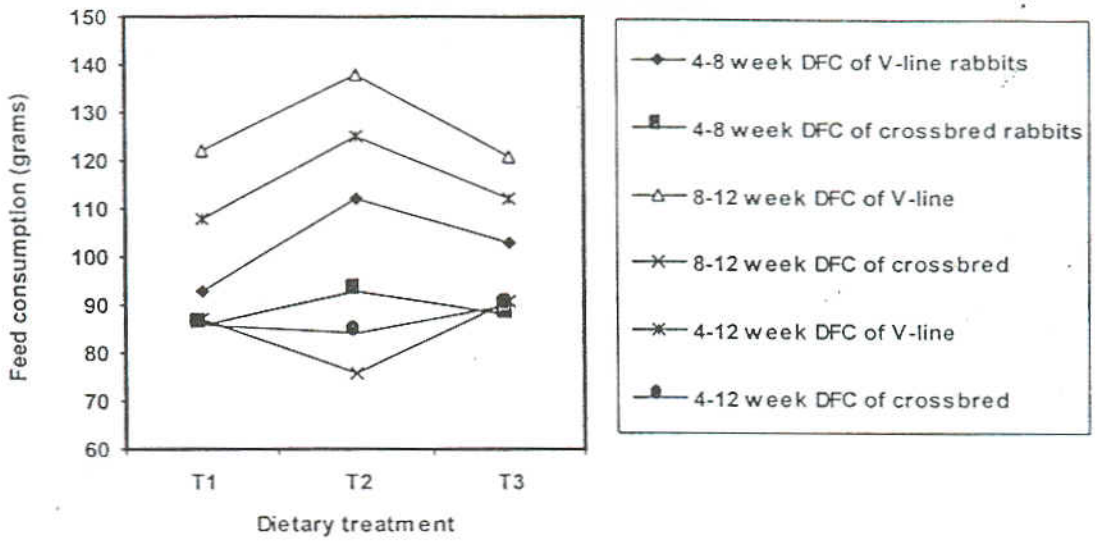
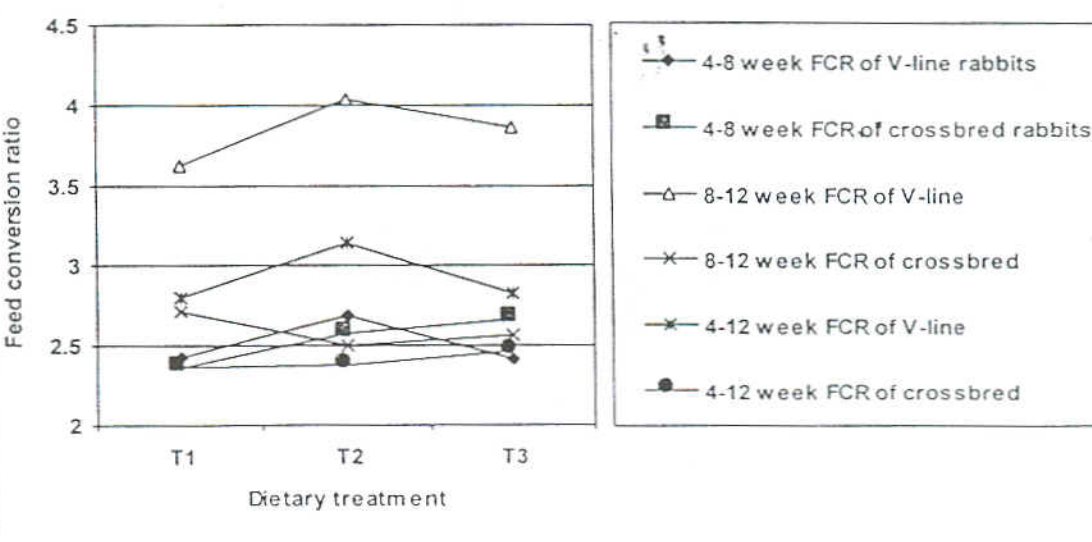


Figure 4: Feed conversion ratio (FCR) in different levels of interaction between dietary treatments and genetic groups



Economic evaluation

Parameters used in economic evaluation of the three diets are summarized in Table 4. The feed cost per kg decreased by 7.2 and 14.5 % in diet supplemented with 15 and 30 % discarded dates, respectively. The feeding costs during the whole experimental period decreased by 0.8% and 11.5% in the diet supplemented with 15% and 30 % discarded dates, respectively as compared to the control diet. The selling prices of the total gain in weight increased slightly by 1.03 and 1.8% for the diets

supplemented with 15 and 30 % discarded dates, respectively. The diet supplemented with 30 % dates was higher in economic efficiency by about 12.1 % relative to the control diet, while the diet supplemented with 15 % dates was lower in economic efficiency by about 2.2 %. These findings are similar to those reported by Amber *et al.* (2004) who found that the feeding costs for the diet supplemented with yucca extract were increased by 11.6% and the selling prices of meat yield were also increased by 11.9% as compared to the control diet. From the economic point of view particularly in the Arabian Gulf area, substitution of 30 % dates in the diet mixed with barley and bran will lead to (i) a reduction in feed costs, (ii) a decrease in cultivating areas of feedstuffs, and (iii) a decrease in importing energy resources. In Egypt, Amber *et al.* (2001) found that Nigella Sativa cake could be used economically up to 12.5% in the rabbit diets to replace the soybean meal. Amber *et al.* (2004) in another study concluded that feed additives (e.g. dietary yucca extract) can be used profitability in diets of growing rabbits without affecting the growth performance and net revenue.

Table 4. Effect of experimental diets on relative revenue of growing rabbits from weaning up to 12 weeks of age

Items	Experimental rations		
	T1	T2	T3
Feed cost per kg, SR	0.722	0.67	0.617
Daily feed intake (kg/head)	0.112	0.120	0.116
Total feed intake (kg/head)	6.272	6.720	6.496
Daily feed cost, SR	0.081	0.080	0.072
Total feed cost per head, SR	6.793	6.749	6.013
Selling price (for total live gain), SR	15.58	15.74	15.86
Net revenue, SR	8.791	8.987	9.851
Relative revenue, SR	100	102.2	112.1

Selling price of 1 kg live body weight = 8 SR where SR= Saudi Riyal.

CONCLUSIONS

(1) Using discarded flesh dates in the diets of rabbits could be economically sounded in hot climate countries for growth performance and feed conversion ratios.
(2) Good performances of V-line rabbits and their crossbreds in this study could be an encouraging factor to increase the rabbit production in Saudi Arabia and other similar hot climatic regions through using V-line rabbits and crossbreds involving V-line.
(3) Genetic groups by dietary treatments interaction concluded that rabbits of any genetic group (V-line or crossbred) could be grown efficiently in hot climate areas using any of the dietary treatment studied (included or not included discarded dates).

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