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PEFORMANCE OF GROWING RABBITS FED DIETS CONTAINING DIFFERENT LEVELS OF FENNEL AND MARJORAM WASTES UNDER DESERT ENVIRONMENTAL CONDITIONS

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SUMMARY

A total number of 100 unsexed New Zealand White NZW rabbits, aged 6 wk old and average 822 g in weight, were used to evaluate replacing alfalfa hay by different levels of Fennel (Foeniculum vulgare Mill) hay (FH) (18,36 and 54%), Marjoram (*Oreganum marjoranum L*) hay (MH) and their (1:1) mixture of (18,36 and 54%), in growing rabbit diets. Parameters studied included growth performance, digestibility coefficients of nutrients, carcass characteristics, blood parameters, caecum activities and microbiology and economic efficiency. The experiment lasted 8 wk, rabbits were divided into 10 treatments, each containing 10 rabbits in 5 replicates (2 in each).

The results showed that body weight and weight gain of rabbits fed FH+MH at 36% level (T_9) at 4 wk and final weight increased significantly and recorded ($p<0.05$) the best feed conversion ratio and performance index%. Nutrients digestibility decreased significantly ($p<0.05$) with the decrease in feed intake by increasing MH and mixture of FH+MH level. Group fed diet containing 36%FH+MH (T_9) was better in feeding values than each by-product alone and recorded significantly ($p<0.05$) higher plasma values of total protein and globulin, and lower values of cholesterol, triglycerides, AST and ALT than other groups. Increasing dietary FH, MH and their mixture level significantly ($p<0.05$) decreased abdominal fat %, caecum propionic acid values and increased butyric acid values, compared with control group. Using mixtures of medicinal herb by-products increased significantly ($p<0.05$) cellulytic bacteria count and decreased *E. coli* count, more than using each by-product alone .The relative economic efficiency (% Net revenue per unit cost) was the best when rabbits fed diet contained 36% mixture of fennel hay and marjoram hay replaced for alfalfa hay.

In conclusion, the reasonable growth performance, digestibility coefficients and economic results obtained could encourage to incorporate mixture of fennel hay and marjoram hay up to 36% as replacement for alfalfa hay in growing NZW rabbit diets without adverse effects on growth performance.

Keywords: *fennel hay(FH), Marjoram hay (MH), rabbit performance, caecum microflora, conomic efficiency*

INTRODUCTION

In Egypt, shortage in animal feeds has been found to have a negative effect on the development of animal and poultry production .More attention was given to agro-industrial by-products (El-Ashry, *et al.*, 2002). Clover hay considered the main ingredient forage in rabbit diets (Radwan, and Khalil, 2002).

Rabbits have high ability to consume forages and agricultural by–products containing high levels of fiber (Cheeke, 1986). There are about 24 million tons of plant by-products annually produced that can be used in animal, rabbits and poultry diets (El-Manylawi *et al*, 2005).

Medicinal and aromatic plants are cultivated in large areas in Egypt. About 48 thousands feddans were cultivated with medicinal and aromatic plants in Egypt (Agriculture Economic, 2005). Fennel (*Foeniculum volgare Mill*) is cultivated in 2207 feddans and produced 3394 tons seeds and an average of 15-18 tons of green forages / feddan (Abo-Zeid, 1988). Marjoram (*Oreganum majoranum L.*) is cultivated also in 2600 feddans and produced 4350 tons of seeds and leaves and an average of 28 tons of wastes /feddan (Agriculture Economic, 2006).

Fennel and Marjoram hay are wastes produced after yielding the main products (grains from fennel and leaves &seeds from marjoram), these by products include stems, broken leaves, some fruits and seeds.

A little information is available about possibility of using herbal and aromatic by products in rabbits diets. In this respect, Radwan and Khalil (2002) suggest that fennel hay meal (FHM)could be used in rabbit diets up to 50% of experimental diets with a good results on growth, carcass and economic efficiency and may be a promising forage feed in rabbit feeding with out any adverse effects on the performance of growing rabbits. Awad (2003) reported that incorporation of 5% Black cumin meal +5%Lemon grass or 10%Block cumin meal cause a highest values of final body weight, without any negative effect on body weight.

El-Manylawi *et al* (2005) detected that *Geranium* and *Spearmint* by-products are good non-conventional feed stuffs for growing rabbits and can be included in their diets up to 9% in replacement of clover hay without adverse effects on growth performance of rabbits.

Abou Sekken and Abd El-Hakim (2006) concluded that, it is possible to use dietary *Cotula cinerea* meal (CCM) at levels ranged from 8 to 16% as a replacement of alfalfa hay for feeding growing rabbits without adversely affecting performance, and metabolic responses.

Therefore, the present study aimed to investigate the effect of a partial or complete replacement of alfalfa hay in commercial basal diet with wastes of Fennel, Marjoram or their (1:1) mixtures on growth performance, nutrients digestibility, nutritive value, caecum traits and carcass quality of growing New Zealand White (NZW)

rabbits. in addition to the economical efficiency of the experimental diets.

MATERIALS AND METHODS

The present study was carried out at Rabbit Research Unit. Poultry Research Station, belonging to Environmental Studies and Research Institute, Minufiya University. Sadat City, Minufiya Governorate. Egypt, during Winter, 2005.

One hundred growing New Zealand White (NZW) rabbits of both sexes at 6 weeks of age (with average weight 822.41±31 72g) were kept under the same managerial and hygienic conditions. Rabbits were randomly divided into 10 equal groups, 10 for each in five replicates and assigned for control diet and 9 experimental diets contained the Fennel (*Foeniculum vulgare Mill*) hay(FH). Marjoram (*Oreganum-marjoranum L.*) hay (MH) and their (1:1) mixtures ,which were replaced for alfalfa hay at three levels (18,36 and 54%) for each waste.

The Fennel and Marjoram wastes were obtained after preparing the main product of each. from private preparing stations at Fayoum Governorate and from preparing stations of "*Royal Company for herbs*" at Giza Governorate. The wastes were collected in dry ,clean and ground form . The proximate analysis of such wastes and alfalfa hay are presented in Table (1).

The formulations and proximate analysis of the experimental diets have been done according to the Nutrient Requirements Council of growing rabbits NRC (1977) as shown in Table (2).

Digestible energy (DE) were calculated according to Cheek (1987) as following:

DE (MJ/kg)=4.36 – 0.04 x NDF%, where, NDF=28.92 + 0.657 x CF%.

Diets (on pellets form) and fresh water were available all times *ad. Lib.* during the experimental period (8 weeks). Live body weight of rabbits and feed consumption were weekly recorded. Feed conversion ratio (FCR) was calculated as (g feed/ g gain). Growth performance index (PI) was calculated according to the equation described by North (1981) as follows:

$$PI = \frac{\text{Live body weight (kg)}}{\text{Feed conversion}} \times 100$$

At the last week of experimental period, a digestibility trial was carried out over a period of 5 days using 4 rabbits per treatment housed individually in metabolism cages.

The feed intake and total collection of feces were conducted to determine the digestible coefficients of nutrients and feeding values of the experimental diets.

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

Blood samples were also taken from the slaughtered rabbits and centrifuged at 4000 r.p.m. for 20 min.,for preparation of blood serum,

Table (1): Proximate analysis of Fennel hay, Marjoram hay and Alfalfa hay

Ingredient	Fennel hay (FH)	Marjoram hay (MH)	Alfalfa hay (AH)
DM%	91.72	91.72	93.65
OM%	77.28	74.92	85.15
CP%	10.00	9.92	15.60
CF%	17.91	21.12	26.60
EE%	2.86	1.65	2.20
NFE%	46.51	42.23	40.75
Ash%	14.44	16.73	8.50
Vol. Oil%	0.10	0.15	-
DE* (MJ/kg)	2.362	2.259	2.082

*Calculated according to Cheeke (1987) DE(MJ) = 4.36-0.0491xNDF%. NDF%= 28.92+ 0.657xCF%

Table (2): Formulation and chemical analysis of experimental diets.

Ingredient	C	FH level%			MH level %			FH + MH level%		
		18%	36%	54%	18%	36%	54%	18%	36%	54%
Alfalfa hay	40.0	33.0	18.0	0.2	24.0	7.5	-	28.5	10.5	-
Wheat bran	03.0	0.8	0.1	-	0.8	0.8	-	-	-	-
Barely, ground	10.0	3.0	1.2	-	3.0	-	0.1	-	-	0.1
Soybean meal(44%CP)	12.7	6.9	4.3	4.8	8.9	7.2	5.1	3.6	3.2	5.2
Corn gluten meal 60%	-	5.0	8.3	10.0	5.0	8.0	10.0	8.0	10.0	10.0
Yellow corn	33.0	32.0	30.8	28.5	39.0	38.4	28.2	40.2	38.2	28.2
FH	-	18.0	36.0	54.00	-	-	-	9.0	18.0	27.0
MH	-	-	-	-	18.0	36.0	54.0	9.0	18.0	27.0
Limestone	0.2	0.2	0.2	0.6	0.2	0.7	0.6	0.2	0.7	0.6
Premix[1]	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Na Cl	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
DL- Methionine	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ca_2PO_4	-	-	-	0.8	-	0.3	0.8	0.4	0.3	0.8
Total	100	100	100	100	100	100	100	100	100	100
Proximate analysis(%)										
CP %	16.8	16.9	16.53	16.50	16.6	16.4	16.7	16.5	16.2	16.6
CF %	11.8	12.9	12.35	12.36	12.3	12.0	12.6	12.5	12.4	12.5
DE (Kcal./Kg)[2]	251	2475	2493	2492	2488	2504	2485	2488	2491	2495
EE%	2.3	2.4	2.59	2.38	2.4	2.5	2.9	2.7	2.9	2.4
Ca	0.6	0.5	0.52	0.45	0.5	0.5	0.5	0.5	0.5	0.5
Total P	0.3	0.3	0.25	0.30	0.3	0.3	0.3	0.3	0.3	0.3
Price (PT/Kg)[3]	116	100.7	87.0	73.2	102.8	90.0	72.8	102.5	88.5	74.1

[1]Each 3Kg of vitamin & Mineral mixture contains:- Vit. A, 12.00 MIU; Vit. D_3, 4.00, MIU; Vit.E, 15.00 KIU; Vit. K_3, 2.00g;Vit. B_1; 1.00g; Vit. B_2, 8.00g; Pantothenic acid, 10.87g; Nicotinic acid, 30.00g; Vit. B_6,2.00g; Vit. B_{12}, 10.00mg; Folic acid, 1.00g; Biotin, 150.0mg; Copper, 5.00g; Iron, 15.00g; Manganese, 70.00g; Iodine,0.50g; Selenium, 0.15g; Zinc, 60.00g and Antioxidant, 10.00g.

[2]DE calculated according to Cheek, (1987). DE=4.36-0.0491xNDF%,.%NDF= 29.92+0.657xCF%

[3]According to price of different ingredients available in the market at the experimental time (2004-2005)

C = Control diet, FH =Fennel hay, MH = Marjoram hay

which was assigned to determine total protein according to Domas (1975),albumin according to Doumas *et. al.*, (1971) ; total cholesterol according to Pisani *et al.*, (1995); triglycerides according to Greiling and Gressner (1995), urea by the method described by Patton and Crouch (1977); AST and ALT according to Harold (1975) using commercial kites.

Chemical analysis of diets, feces and caecum contents were carried out according to AOAC (1990). Digestible energy (DE kcal/kg) of alfalfa, Fennel and Marjoram hay meals were calculated according to Cheeke (1987).

Microbiological analysis:

Samples of caecum and ileum contents were taken individually from three rabbits per group after slaughter at the end of the experimental period (14 weeks of age) to estimate pH and micro flora. Total anaerobic bacterial count ,cellulytic bacteria and total count of *Escherichia coli* (as a log of colony forming unit cfu/g) were estimated and recorded according to the microbiological method described by Collin *et al.*,(1995) and Awad,(2003).

Economical efficiency (%) of experimental diets was calculated according to the local market price of ingredients and rabbit live body weight as: Net revenue = Total revenue – Total feed cost.

Economical efficiency (%) = Net revenue / Total feed cost %.

Data were statistically analyzed according to SAS (1999). The significant differences between means were tested by using Duncan's multiple range test (Duncan, 1955), the one way analysis of variance was used as follow : $Yij=U+Ai+Eij$,

Where: Yij = Represented observations, U = Overall mean, Ai = Effect of treatments, Eij = Experimental random error.

RESULTS AND DISCUSSION

Chemical composition :

The chemical composition of Fennel hay (FH) and Marjoram hay (MH) compared with alfalfa hay (AH) (Table 1) revealed higher CP and DE content for FH and MH than AH (10%, 2362kcal/kg, 9.92% and 2259kcal/kg *vs* 8.85% and 2082 Kcal/kg, respectively), while crude fiber of AH was higher than those of FH and MH (26.60 *vs* 17.91% and 21.12%, respectively). Volatile oil contents of FH and MH was very low (0.1% and 0.15%) that make a possibility of using these by-products in rabbit diets without any adverse nutritional effect (Radwan and Khalil, 2002)

Nutrients digestibility of experimental diets :

The results presented in Table (3) showed non-significant ($P<0.05$) increase in digestibility coefficients values of OM, CP, CF and NFE for rabbits fed 18, 36 or 54% FH, MH or mixture. Values of EE digestibility were significantly ($P>0.05$) decreased with groups fed FH compared with control group, while group fed 18% MH achieved significantly ($P<0.05$) the best EE digestibility value compared with control group. Meanwhile, EE digestibility values for groups fed 36

Table (3): Digestibility coefficients as affected by using different levels of Fennel hay, Marjoram hay and their (1:1) mixture in rabbit diets. (Means±SE)

Treatments	Digestibility coefficients %				
	OM	CP	CF	EE	NFE
Control	66.37±1.78^{a}	68.88±2.0^{abc}	31.54±4.06^{a}	59.32±5.50^{a}	72.92±1.72^{ab}
18% FH	59.12±1.78^{acde}	63.62±2.0^{cd}	22.57±4.06^{abc}	57.80±5.50^{a}	66.33±1.72^{cd}
36% FH	55.02±1.78^{e}	65.29±2.0^{bcd}	11.34±4.06^{cde}	51.95±5.50^{ab}	61.58±1.72^{d}
54% FH	61.95±1.78^{abcd}	61.69±2.0^{d}	29.87±4.06^{ab}	54.87±5.50^{ab}	67.82±1.72^{bc}
18% MH	65.40±1.78^{a}	74.99±2.0^{a}	15.38±4.06^{cde}	61.80±5.50^{a}	73.26±1.72^{ab}
36% MH	63.12±1.78^{abc}	70.49±2.0^{ab}	17.66±4.06^{bcd}	18.98±5.50^{d}	72.56±1.72^{ab}
54% MH	57.75±1.78^{cde}	61.73±2.0^{d}	7.03±4.06^{de}	35.08±5.50^{c}	68.75±1.72^{bc}
18% FH + MH	56.96±1.78^{de}	63.01±2.0^{cd}	11.46±4.06^{cde}	10.31±5.50^{d}	66.50±1.75^{cd}
36% FH + MH	64.11±1.78^{ab}	68.12±2.0^{bcd}	2.99±4.06^{e}	38.56±5.50^{bc}	75.63±1.72^{a}
54% FH + MH	62.12±1.78^{abcd}	71.45±2.0^{ab}	15.86±4.06^{cde}	14.10±5.50^{d}	72.70±1.72^{ab}
Significancy	*	*	*	*	*

a, b, c ..... e: means in the same column with different superscripts are significant at P<0.05 level (*).

and 54% MH, 18,36 and 54% (FH+MH) mixture were significantly ($P<0.05$) decreased by 68,40, 82,36 and 76% compared with control group ,respectively . In general, there was a tendency for insignificant ($P<0.05$) differences in OM, CP and NFE digestibility coefficient values for rabbits fed diets which contained FH, MH or their mixtures compared with the control group. El-Manylawi *et al.*, (2005) reported non significance ($P<0.05$) increase in digestibility coefficient values of DM, OM, CP, CF and NFE for rabbit fed diet contained 3 or 6% *spearmint* by-product.

Feeding values:

Data in Table (4) indicated that rabbits fed diet contained 18% of MH had the highest digestible crude protein (DCP), total digestible nutrients (TDN) and digestible energy (DE Kcal/kg) values, while, group fed diet contained 54% MH had recorded significantly ($P<0.05$) the lowest DCP and TDN values. Groups fed diet contained 54% FH, 36% MH and (36 or 54%FH+MH) did not significantly ($P<0.05$) differ from control group in DCP,TDN and DE. In general, Fennel hay (FH) diets appeared significantly ($P<0.05$) lower DCP values compared with MH, FH+MH mixture and control diets. These results indicated that using mixture of FH+MH (T_9) in experimental diets was better in feeding values than each alone, that is may be due to some improvements in digestive tract environment and palatability of feed. This may be refer to Marjoram hay content of volatile oil components such as terpinol ,geroniol ,eugenol and linalol (Hosin,1984). These results are in agreement with those reported by Triantaphyllou *et al.*, (2001) who found that sweet Marjoram and Sage extracts have antioxidant activity due to bound forms of phenolic compounds such as hydroxycinnamic acids and flavonoids.

The same results were observed by El-Manylawi *et al.*(2003) when growing rabbits were fed diets contained 0.1 or 0.2% of dry thyme. Also, El-Manylawi *et al.*(2005) reported that nutritive vales of DCP ,TDN and DE tended to be higher when rabbits fed diets contained Thyme *(Geranium)* or Peppermint (*Spearmint)* by-products .

Nitrogen Balance (NB):

Results given in Table (4) showed that , the nitrogen balance (NB) for rabbit fed diet contained MH at 18 % of diet was significantly ($P<0.05$) higher compared with the control group (1.74, *vs* 1.09 g, respectively).

These results agree with those found by Zeinab *et al.*, (2003) who found that addition of 3% *Marjoram* to broiler chick diets slightly improved NB percentage. Also, El-Manyalawi *et al.*, (2005) noticed that NB for rabbit fed diets contained *Geranium* by-product for rabbit fed diets contained *Geranium* by-product at 6 or 9% increased significantly ($P<0.05$) compared with control group while, other groups had insignificant differences.

Growth performance :

Live body weight and body weight gain:

Results in Table (5) represented the effect of using Fennel hay (FH), Marjoram hay (MH) or their (1:1) mixture at 18,36 and 54%, on growing rabbits performance. The average live body weight (LBW) and live body

Table (4): Feeding values and nitrogen balance as affected by using different levels of fennel hay, marjoram hay and mixture in rabbit diets (Means±SE)

Diet	Feeding Values			N-balance (g/rabbit)
	DCP	TDN	DE(kcal/kg)*	
T_1(Control)	12.83±0.36^{bc}	73.16 ± 1.90^{a}	3240± 84.1^{a}	1.09±0.18^{bcd}
T_2(18%FH)	11.92 ±0.36^{cd}	65.12±1.90^{bcd}	2884.65±84.1^{bcd}	1.15±0.18^{bcd}
T_3(36%FH)	12.50±0.36^{bcd}	62.32± 1.90^{d}	2760.72±84.1^{d}	1.42±0.18^{abc}
T_4(54%FH)	11.84 ±0.36^{cd}	68.51±1.90^{abc}	3035.05±84.1^{abc}	0.63±0.18^{d}
T_5(18%MH)	14.55±0.36^{a}	73.96± 1.90^{a}	3276.51±84.1^{a}	1.74±0.18^{a}
T_6(36%MH)	13.35±0.36^{b}	69.68± 1.90^{ab}	3086.8±84.1^{ab}	1.48±0.18^{abc}
T_7(54%MH)	11.59±0.36^{d}	62.98± 1.90^{d}	2789.88±84.1^{cd}	0.68±0.18^{d}
T_8(18%FH+MH)	11.79±0.36^{cd}	61.86± 1.90^{cd}	2740.48±84.1^{d}	0.70±0.18^{d}
T_9(36%FH+MH)	12.37±0.36^{bcd}	71.34± 1.90^{a}	3160.56±84.1^{a}	1.62±0.18^{ab}
T_{10}(54%FH+MH)	13.48±0.36^{b}	69.15± 1.90^{ab}	3063.26±84.1^{ab}	0.94±0.18^{cd}
Significance	*	*	*	*

*DE(kcal/kg)=TDN*44.3 according to Schneider and Flatt (1975)

a, b, ….. c: means in the same column with different supperscripts are significant at P<0.05 level (*).

Table (5): Growth performance of NZW rabbits as affected by dietary Fennel hay (FH), Marjoram hay(MH) and their (1:1)mixture (Means±SE).

Item	Control	Fennel hay (FH) level, %			Marjoram hay (MH) level, %			Mixture of (FH+MH) level,%			Sig.
		18	36	54	18	36	54	18	36	54	
Initial weight (kg)	0.82±0.04	0.84±0.04	0.84±0.04	0.82±0.04	0.82±0.04	0.82±0.04	0.83±0.04	0.81±0.04	0.82±0.04	0.83±0.04	NS
					Live Body Weight (kg) at:						
10 wks	1.60±0.08^{abc}	1.39±0.08^{c}	1.51±0.08^{abc}	1.74±0.08^{a}	1.67±0.08^{ab}	1.37±0.08^{c}	1.41±0.08^{bc}	1.48±0.08^{abc}	1.61±0.08^{abc}	1.42±0.08^{bc}	*
14 wks	1.99±0.13^{ab}	1.84±0.13^{bc}	1.88±0.13^{bc}	2.07±0.13^{ab}	2.01±0.13^{ab}	1.52±0.13^{c}	1.73±0.13^{bc}	1.95±0.13^{ab}	2.31±0.13^{a}	1.83±0.13^{bc}	*
					Live Body Weight Gain (kg) at:						
0-4wks	0.78±0.07^{ab}	0.55±0.08^{b}	0.67±0.08^{ab}	0.92±0.07^{a}	0.84±0.07^{a}	0.55±0.07^{b}	0.58±0.08^{b}	0.68±0.08^{ab}	0.79±0.08^{ab}	0.59±0.05^{b}	*
0-8 wks	1.18±0.13^{ab}	1.00±0.93^{bc}	1.03±0.13^{bc}	1.25±0.13^{ab}	1.19±0.13^{ab}	0.70±0.13^{c}	0.90±0.13^{bc}	1.14±0.13^{ab}	1.50±0.13^{a}	1.00±0.13^{bc}	*
					Feed Intake (FI) (kg) at:						
10 wks	3.45±0.11^{a}	2.61±0.11^{b}	3.18±0.11^{a}	3.21±0.11^{a}	3.31±0.11^{a}	3.29±0.11^{a}	2.52±0.11^{bc}	2.42±0.11^{bc}	2.24±0.11^{cd}	0.08±0.11^{d}	*
14 wks	7.01±0.15^{ab}	5.96±0.15^{d}	6.73±0.15^{ab}	6.62±0.15^{bc}	6.27±0.15^{cd}	7.08±0.15^{a}	5.22±0.15^{e}	5.15±0.15^{e}	4.90±0.18^{e}	4.90±0.15^{e}	*
					Feed Conversion Ratio (kg) feed/kg gain at:						
10 wks	4.76±1.39^{ab}	6.47±1.39^{ab}	5.09±1.39^{ab}	3.56±1.39^{b}	4.52±1.39^{ab}	6.51±1.39^{ab}	4.89±1.39^{ab}	3.86±1.39^{b}	2.88±1.39^{b}	8.61±1.39^{a}	*
14 wks	6.43±2.12^{ab}	10.52±2.12^{a}	7.05±2.12^{ab}	5.53±2.12^{ab}	6.13±2.12^{ab}	11.49±2.1^{a}	6.60±2.12^{ab}	4.99±2.12^{ab}	3.29±2.12^{b}	10.56±2.1^{a}	*
					Performance Index % at:						
10 wks	36.71±6.11^{bc}	31.07±6.11^{bc}	32.5±6.1^{bc}	50.5±6.1^{ab}	44.63±6.1^{ab}	23.35±6.1^{c}	33.43±6.1^{bc}	42.5±6.1^{abc}	57.7±6.11^{a}	45.11±6.1^{ab}	*
14 wks	35.54±6.23^{b}	33.97±6.23^{bc}	29.60±6.2^{bc}	40.12±6.2^{b}	40.64±6.2^{b}	15.94±6.2^{c}	30.74±6.2^{bc}	44.54±6.2^{b}	70.84±6.2^{a}	42.60±6.2^{b}	*

a, b, c.....e= means in the same row with different superscripts are significantly different (P<0.05).

weight gain (LBWG) at 10 weeks of age indicated that groups fed diets contained 54% FH (T_4) and 18% MH (T_5) were (P>0.05) better than control and other groups. While, at 14 weeks of age, the average final LBW and LBWG of rabbits were (P>0.05) higher at level 36% (FH+MH) (T_9) than in control group (2.31 and 1.50 kg *vs* 1.99 and 1.18 kg, respectively). The worst (p<0.05) body weight and gain values were obtained with group fed diet contained 36% MH(T_6) (1.52 and 0.70 kg), compared to the control. In this connection, El-Manylawi *et al.*, (2005) showed that final body weigh and weight gain of growing rabbits fed diets contained 3, 6 or 9% of *Geranium* by-product were significantly (P<0.05) higher than the control group. On the other hand, Fatma Ahmed *et al.*, (2005) reported that neither live body weight nor daily weight gain of growing rabbit was affected by inclusion of *Eucalyptus* leaves in the diets. The improvements in LBW and LBWG with group fed diet contained FH and MH mixture, may be due to the biological functions of the main residual essential oil in Fennel and Marjoram hay as reported by Trianlaphyllou *et al.*, (2001) and El-Manylawi *et al.*, (2005). Also, Soliman *et al.*, (1995) and Soliman *et al.*, (1999) indicated that herbs, edible plants and some plant seeds have been found to have positive effects on the performance parameters, immunity and the viability of both rabbits and birds.

Results in Table (5) showed that increasing MH in the diet at 54% and the use of MH+FH mixture at levels 18, 36 and 54% of the diet, significantly (P<0.05) decreased feed consumption at 4 and 8 weeks of study, copared to the control and other experimental groups. Groups fed diet contained 36 or 54% mixture of FH+MH (T_9, T_{10}) recorded significantly (P<0.05) lower feed intake than other experimental groups including control group. While, group fed 36% dietary MH recorded significantly (P<0.05) the highest total feed intake compared with control group (7.08 kg *vs* 7.01 kg). In this respect, Rawiha (1994) stated that using mixtures of medicinal plants was preferable than using each alone. It may be attributed to the synergism between the main components of plants included in these mixtures.

Concerning to feed conversion ratio (FCR) and performance index (PI) values, it could be observed that rabbit fed 36% dietary mixture of FH+MH(1:1) were significantly (P<0.05) the best compared to other experimental groups and control group, while group fed 36% MH was the worst one. These results were in agreement with those obtained by Ibrahim *et al.*, (2000) who showed a significant (P<0.01) improve in feed conversion when weaned NZW rabbits were fed diet supplemented with peppermint leaves at 0.5% . Moreover, El-Manylawi *et al.*, (2005) found that feed conversion values were significantly better than control when rabbit fed diets contained 3.6 or 9% of *Geranium* by-products. Also, Abd El-Azeem (1999) reported that use of 5% *Cymbopogon citrates p* plus 3% *Eucalyptus globules* in sheep diets improved the feed conversion efficiency.

Blood components:

The results of the blood constituents as affected by using different levels of Fennel hay (FH), Marjoram hay (MH) and their (1:1)

mixture in growing rabbit diets (Table 6) indicated a significantly ($P<0.05$) decrease in values of plasma albumin , cholesterol, triglycerides, aspartate amino transferase (AST) and alanine amino transferase (ALT) compared with control group.

Group fed diet contained 36% FH+MH(T_9) recorded significantly ($P<0.05$) highest values of plasma total protein and globulin compared with other experimental groups and control group.

These results were in agreement to those of El Manylawi *et al.*, (2005) who reported that supplemented *Geranium* by-product at 6 or 9% to the rabbit diets decreased significantly ($P<0.05$) the activities of ALT and AST enzymes compared with control group. Also, Sherlock (1975) reported that AST and ALT levels reflect the impairment of liver function when their levels increase. Nazar (1994) found significant effect as a result of using fenugreek as a feed additive in feeding buffalo and goats.

Carcass characteristics:

The average values of carcass characteristics as a percentage of live body weight of NZW rabbits are presented in Table (7) .

Data showed that group fed diet contained 54% FH achieved significantly ($P<0.05$) better carcass, dressing%, edible giblets % and small intestine length, than control group and other traits. Abdominal fat% slightly decreased significantly ($P<0.05$) by increasing the dietary level of FH, MH or mixture. Groups fed diet contained either 18% FH or 18 ,36 and 54% FH+MH (1:1) mixture had significantly better deboning % than other groups . In this concern, El-manylawi *et al.*, (2005) reported that rabbits fed 6 or 9% of *Geranium* by-products had the best values ($P<0.05$) of empty carcass and dressing % compared with that of the control group. On the other hand, they observed there were insignificant differences in giblets % of rabbit group fed diets contained 3,6 and 9% of *geranium* by-products compared with that of the control group.

Generally, it was clearly that feeding growing rabbit diets containing different levels of FH+MH mixture, significantly improved rabbit carcass characteristics. Abd El-Latif *et al.*, (2002) stated that, the highest values of dressing and edible giblets were noticed when Japanese quail fed either dietary Thyme or Fennel compared with the control group.

Caecum and Ileum characteristics:

Data presented in Table (8) showed that caecum weight and empty caecum weight (as % of live body weight) for group fed diet contained 54% FH were significantly ($P<0.05$) higher than control group, while, caecum length was significantly ($P<0.05$) higher with lower level (18%) of FH compared to the control and other experimental treatments .

The differences in pH of ileum among the experimental treatments were insignificant. While, group fed 54% dietary MH recorded significantly ($P<0.05$) the highest pH value (6.94) of caecum compared with control and other tested groups, while, group fed 36% FH+MH (T_9) mixture recorded the lowest caecum pH (6.16). These results agreed with Fatma Ahmed *et al.*, (2005)

Table (6): Blood parameters as affected by using different levels of fennel hay (FH) or marjoram hay (MH) and their mixture in growing rabbit diets (Means±SE)

Item	Urea	Albumin	Total protein	Globulin	A/G ratio	Cholesterol	Triglycerides	AST (µ/L)	ALT (µ/L)
Control	34.61±2.21^{c}	3.73±0.34^{a}	7.27±0.30^{ab}	3.51±0.42^{ab}	1.08±0.99^{ab}	143.35±4.88^{b}	156.90±4.17^{abc}	68.00±3.02^{a}	4.0±0.67^{bc}
8% FH	34.94±2.21^{c}	3.71±0.34^{a}	4.86±0.30^{cd}	1.16±0.42^{c}	4.05±0.99^{a}	87.11±4.88^{d}	156.78±4.17^{abc}	56.33±3.02^{bc}	6.0±0.64^{ab}
36% FH	45.121±2.21^{b}	0.30±0.34^{ab}	5.54±0.30^{c}	2.23±0.42^{bc}	3.47±0.99^{ab}	86.98±4.88^{d}	140.46±4.17^{de}	50.0±3.02^{c}	4.0±0.64^{bc}
54% FH	45.72±2.21^{ab}	3.25±0.34^{ab}	4.40±0.30^{d}	1.156±0.42^{c}	3.31±0.99^{ab}	52.53±4.88^{ef}	134.41±4.17^{e}	50.0±3.02^{c}	5.33±0.64^{abc}
18% MH	59.03±2.21^{a}	2.54±0.34^{b}	4.74±0.30^{cd}	2.20±0.42^{bc}	1.20±0.99^{ab}	43.07±4.88^{f}	157.84±4.17^{abc}	70.0±3.02^{a}	4.67±0.64^{abc}
36% MH	55.66±2.21^{a}	2.67±0.34^{ab}	6.74±0.30^{b}	4.04±0.42^{a}	0.67±0.99^{b}	168.33±4.88^{a}	167.41±4.17^{a}	64.0±3.02^{ab}	3.33±0.64^{a}
54%MH	44.34±2.21^{b}	3.47±0.34^{ab}	7.44±0.30^{ab}	3.97±0.42^{a}	0.89±0.99^{ab}	59.26±4.88^{e}	128.02±4.17^{e}	48.33±3.02^{c}	4.33±0.64^{abc}
18%FH+MH	32.81±2.21^{c}	3.27±0.34^{ab}	5.25±0.30^{cd}	1.98±0.42^{c}	1.69±0.99^{ab}	121.19±4.88^{c}	161.99±4.17^{ab}	49.67±3.02^{c}	3.67±0.64^{c}
36%FH+MH	367.03±2.21^{c}	3.43±0.34^{ab}	7.80±0.30^{a}	4.37±0.42^{a}	0.79±0.99^{ab}	76.42±4.88^{d}	147.99±4.17^{cd}	54.67±3.02^{c}	4.33±0.64^{abc}
54%FH+MH	33.01±2.21^{c}	3.43±00.34^{ab}	7.80±0.30^{ab}	4.37±0.42^{ab}	0.79±0.99^{ab}	76.42±4.88^{ef}	147.99±4.17^{bcd}	54.67±3.02^{c}	4.33±0.64^{abc}
Significant	*	*	*	*	*	*	*	*	*

a, b, c.....e= means in the same column with different super scripts are significantly different (P<0.05).

Table (7): Carcass characteristics of rabbits fed diets containing different levels of Fennel hay(FH) ,Marjoram hay (MH) and their (1:1)mixture (Means±SE).

Item	Control	Fennel hay (FH) level, %			Marjoram hay (MH) level, %			Mixture of (FH+MH) level,%		
		18	36	54	18	36	54	18	36	54
LBW (Kg)	2.12±46.8	22.22±46.8	2.18±46.8	2.17±46.8	2.17±46.8	2.08±46.87	2.17±46.8	2.15±46.8	2.15±46.8	2.18±46.8
Carcass (Kg)	1.20±0.12^{ab}	1.40±0.12^{ab}	1.40±0.12^{ab}	1.50±0.12^{a}	1.24±0.12^{ab}	1.07±0.12^{b}	1.13±0.12^{ab}	1.09±0.12^{ab}	1.11±0.12^{ab}	1.09±0.12^{ab}
Dressing %	56.25±5.22^{ab}	54.0±5.22^{ab}	64.12±5.22^{a}	68.54±5.22^{a}	57.49±0.5.2^{a}	51.53±5.22^{ab}	52.21±5.22^{ab}	50.55±5.22^{b}	51.51±5.22^{ab}	49.77±5.22^{b}
Deboning %	86.95±0.83^{b}	92.33±0.83^{a}	89.93±0.83^{ab}	87.18±0.83^{ab}	90.0±0.83^{b}	87.34±0.83^{b}	86.83±0.83^{b}	90.97±0.83^{a}	90.26±0.83^{a}	90.93±0.83^{a}
Total giblets %	15.63±0.76^{ab}	17.97±0.76^{a}	16.0±0.76^{abc}	16.24±0.76^{ab}	14.94±0.76^{bc}	15.99±0.76^{ab}	13.76±0.76^{bc}	12.15±0.76^{c}	13.93±0.76^{bc}	15.01±0.76^{b}
EG %	21.53±0.9^{abc}	20.33±0.91^{bc}	21.2±0.91^{abc}	23.79±0.91^{a}	20.49±0.91^{b}	23.19±0.91^{ab}	20.36±0.91^{bc}	21.65±0.9^{abc}	18.98±0.91^{c}	22.70±0.91^{ab}
AF %	1.09±0.25^{b}	3.10±0.25^{a}	1.14±0.25^{b}	0.70±0.25^{b}	0.56±0.25^{cd}	0.53±0.25^{b}	0.97±0.25^{b}	0.31±0.25^{b}	0.95±0.25^{b}	0.75±0.25^{b}
Liver %	2.94±0.11^{a}	2.92±0.11^{a}	2.66±0.11^{ab}	2.73±0.11^{bcd}	2.32±0.11^{ab}	2.30±0.11^{cd}	2.572±0.11^{bc}	2.10±0.11^{d}	2.61±0.11^{abc}	2.19±0.11^{d}
Heart %	0.38±0.02^{ab}	0.42±0.02^{a}	0.36±0.02^{ab}	0.36±0.02^{ab}	0.39±0.02^{cd}	0.36±0.02^{ab}	0.37±0.02^{ab}	0.37±0.02^{ab}	0.33±0.02^{b}	0.33±0.02^{b}
Spleen %	0.60±0.02^{cd}	0.68±0.02^{ab}	0.73±0.02^{a}	0.63±0.02^{bc}	0.60±0.02^{cd}	0.62±0.02^{bc}	0.64±0.02^{bc}	0.59±0.02^{cd}	0.59±0.02^{cd}	0.54±0.02^{d}
BL (cm)	40.1±1.19^{abc}	40.00±1.19^{abc}	39.3±1.19^{bcd}	41.33±1.19^{ab}	37.0±1.19^{cd}	37.7±1.19^{bcd}	37.7±1.19^{bcd}	36.0±1.19^{d}	37.7±1.19^{bcd}	42.33±1.19^{a}
SIL cm	331.7±18^{abc}	333.0±18.0^{abc}	345±18.0^{abc}	390.3±18.0^{a}	330.3±18^{abc}	373.3±18.0^{ab}	321.7±18.0^{bc}	357.3±18.0^{ab}	296.0±108.0^{c}	376.3±18.0^{ab}
Large ints. (cm)	72.33±3.69^{a}	61.00±3.69^{abc}	63.3±3.69^{abc}	71.33±3.69^{ab}	60.0±3.69^{abc}	58.0±3.69^{c}	65.0±3.69^{abc}	59.0±3.69^{bc}	61.33±3.7^{abc}	64.33±3.7^{abc}

SIL = Small intestine length, EG = Edible giblets, AF = Abdominal fat, BL = Body length
a, b, c.....e= means in the same row with different super scripts are significantly different (P<0.05).

Table (8): Caecum and ileum characteristics of growing rabbit fed diets containing different levels of FH,MH and their (1:1) mixture (Means±SE).

Item	Control	Fennel hay (FH) level, %			Marjoram hay (MH) level, %			Mixture of (FH+MH) level,%		
	Diet	18	36	54	18	36	54	18	36	54
Caecum wt. %	0.37±0.05^{b}	0.38±0.05^{bc}	0.35±$^{0.05}$bc	0.59±0.05^{a}	0.40±0.05^{b}	0.45±0.05^{ab}	0.41±0.05^{b}	0.21±0.05^{c}	0.40±0.05^{b}	0.49±0.05^{ab}
Empty caecum wt.%	0.3±0.0.03^{bc}	0.29±0.03^{bc}	0.26±0.0.3^{bc}	0.45±0.0.3^{a}	0.26±0.03^{c}	0.31±0.03^{bc}	0.25±0.03^{c}	0.12±0.03^{d}	0.30±0.03^{bc}	0.4±0.03^{b}
Cecum length	12.5±0.75^{bcd}	20.33±0.75^{a}	11.58±0.75^{cde}	10.57±0.75^{de}	9.47±0.75^{e}	13.37±0.75^{bc}	11.33±0.8^{cde}	11.3±0.75^{cde}	11.19±0.8^{cde}	14.0±0.8^{b}
Ileum pH	6.69±0.26	6.58±0.26	6.48±0.26	7.15±0.26	6.25±0.26	6.40±0.26	6.51±0.26	6.58±0.26	6.37±0.26	6.47±0.26
Caecum pH	6.44±0.18^{abc}	6.52±0.18^{abc}	6.46±0.186^{abc}	6.33±0.18^{abc}	6.28±0.18^{bc}	6.88±0.18^{ab}	6.94±0.18^{a}	6.43±0.18^{abc}	6.16±0.18^{c}	6.49±0.18^{abc}

a, b, c.....e^{m} means in the same row with different superscripts are significantly different (P<0.05).

who recorded that high level of (Eucalyptus) *Eucalyptus Globulus* causes significantly decrease in caecum pH compared with control group (5.73 *vs* 6.03) that may be due to chang in microbiological population in caecum as a result to some essential oil in dietary FH or MH. These results were supported by Cowan (1999) who reported that Marjoram plants are rich in a wide variety of secondary metabolites, such as terpenoids, which was found to have antimicrobial properties.

Caeucum activities :

Total volatile fatty acids (TVFA) in caecal contents are illustrated in Table (9). Data indicated that TVFA for growing rabbits were not affected by supplementation of FH or MH and their mixture in the diets and these results were in agreement with those found by El-Manyalowi *et al.*, (2005) with *Geranium* or *Spearmint* by-products supplementation. Also, Djouvinov *et al.*, (1997) noticed no differences in TVFA concentration when sheep fed dietary *Peppermint* by-products compared with control group. Groups fed control diet, 18% MH and 36% FH+MH mixture were significantly ($P<0.05$) the highest in acetic acid percentage of caecum.

It was observed that increasing level form FH or MH and their mixture significantly ($P<0.05$) causes increasing in butyric acid percentage and decreased ($P<0.05$) propionic acid values in their caecal contents compared with control group. Carabafio and Fraga (1989) reported that increasing CF content in rabbit diets, increased acetic acid and decreased butyric acid percentage. Also, the same trend was observed by El-Manyalawi *et al.*,(2005) .

Caecum microflora:

Results of caecum microflora (Total anaerobic bacterial count,(TBC); anaerobic cellulytic bacterial count (CBC) and *E.coli* count (ECC) as log cfu/g, Table (10) showed that number of TBC were significantly ($p<0.05$) lower for rabbits fed 36%FH+MH(T_9) compared to other dietary groups. The highest number for anaerobic cellulylic bacterial count were significantly ($p<0.05$) observed for group fed 36%FH+MH(T_9) while the lowest number was recorded with group fed 54%MH (T_7).

Data in Table (10) indicated that caecum content of *E. coli* significantly ($p<0.05$) decreased with group fed 36% FH+MH9 (T9)(4.09), followed by group fed 18% FH.

Generally, using of mixtures of the tested wastes increased significantly cellulytic bacterial count and decreased *E.coli* content, more than using each by-product alone. The results of TBC were in agreement with those obtained by Radwan and khalil(2002) and Abou Sekken and Abd El-hakim(2006).

Awad (2003) observed an insignificant differences with rabbits fed different levels of Lemon grass meal ; Black cumin meal and their mixture. While, Wyatt *et al.*, (1988) studied the effect of microflora on the digestion of non-digestible dietary polysaccharides and noticed that all dietary polysaccharides led to enlargement of the caecum and colon and the density of bacteria in the caecum and colon varied significantly with diet and the proportion of aerobic bacteria in the flora was increased by cellulose diet and

Table (9): Volatile fatty acids content of caecum for growing rabbits fed diets contained different levels of Fennel hay(FH), Marjoram hay (MH) and their(1:1) mixture (Means±SE).

Item	Control	Fennel hay (FH) level,%			Marjoram hay (MH) level, %			FH+MH mixture level,%		
		18	36	54	18	36	54	18	36	54
TVFA*	2.26±0.16	2.18±0.16	2.48±0.16	2.42±0.16	2.37±0.16	2.42±0.16	2.24±0.16	2.41±0.16	2.51±0.16	2.12±0.16
Acetic acid%	49.56±0.63^{a}	48.96±0.63^{ab}	48.15±0.63^{abc}	46.40±0.63^{c}	49.0±0.63^{ab}	48.64±0.63^{ab}	44.38±0.63^{d}	47.07±0.6^{bc}	49.52±0.63^{a}	43.26±0.63^{d}
Butyric acid%	24.24±0.35^{bc}	28.72±0.35^{a}	24.46±0.35^{bc}	25.90±0.35^{b}	23.83±0.35^{c}	25.81±0.35^{a}	23.49±0.35^{c}	24.17±0.4^{bc}	25.64±0.35^{a}	25.±0.35^{ab}
Propionic acid%	22.42±0.53^{a}	20.16±0.53^{bc}	19.32±0.53^{cd}	17.71±0.5^{de}	20.0±0.53^{bc}	16.74±0.53^{e}	21.20±0.53^{ab}	20.11±0.5^{bc}	18.03±0.53^{de}	19.34±0.53^{cd}

*TVFA meq/ 100 ml caecal juice , a, b, c.....e= means in the same raw with different super scripts are significantly different (P<0.05).

Table (10): Microflora of caecum as affected by feeding different levels of Fennel hay(FH), Marjoram hay (MH)and their(1:1) mixture (Means±SE).

Item	Control	Fennel hay (FH) level,%			Marjoram hay (MH) level, %			FH+MH mixture level,%		
		18	36	54	18	36	54	18	36	54
TABC (log cfu/g)	5.84±0.26^{ab}	6.28±0.26^{a}	6.23±0.26^{a}	6.61±0.26^{a}	6.33±0.26^{a}	6.37±0.26^{a}	6.08±0.26^{ab}	6.27±0.26^{a}	5.32±0.26^{b}	5.98±0.26^{ab}
ACBC (log cfu/g)	6.27±0.18^{bcd}	5.85±0.18^{de}	6.40±0.18^{abc}	6.65±0.18^{ab}	5.36±0.18^{ef}	6.39±0.18^{abc}	5.27±0.18^{f}	6.57±0.18^{ab}	6.97±0.18^{a}	5.80±0.18^{def}
E. coli count (log cfu/g)	5.68±0.24^{ab}	4.35±0.24^{d}	5.13±0.24^{bc}	5.46±0.24^{ab}	4.65±0.24^{cd}	5.41±0.24^{ab}	5.34±0.24^{abc}	6.07±0.24^{a}	4.09±0.24^{d}	5.66±0.24^{ab}

TABC = Total anaerobic bacterial count , ACBC = Anaearobic cellulytic bacterial count, a, b, c.....e= means in the same raw with different super scripts are significantly different (P<0.05).

Table (11): Economical efficiency of growing rabbits as affected by feeding different levels of Fennel hay (FH), Marjoram hay(MH) and their (1:1) mixture (Means±SE).

Item	Control	Fennel hay levels, %			Marjoram hay levels, %			(F+M) hay levels, %		
		18	36	54	18	36	54	18	36	54
Av feed intake (kg/rabbit)a	7.01	5.96	6.73	6.62	6.27	7.08	5.22	5.15	4.90	4.90
Price /kg feed (PT)* b	116.01	100.68	87.02	73.17	102.78	90.04	72.76	102.52	88.52	74.11
Total feed cost (LE) axb=c	8.13	6.00	5.86	4.84	6.44	6.38	3.80	5.28	4.34	3.63
Av body wt. gain (kg/rabbit)d	1.18	1.00	1.03	1.25	1.19	0.70	0.90	1.14	1.50	1.00
Price/kg live wt. (LE)**e	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Total revenue (LE) (dxe=f)	11.8	10.0	10.3	12.5	11.90	7.00	9.0	11.40	15.0	10.0
Net revenuer (LE) (f-c=g)	3.67	2.0	4.44	7.66	5.46	0.62	5.20	6.12	10.66	6.37
Economic efficiency*** (g/c)	0.45	0.33	0.76	4.58	0.85	0.10	1.37	1.16	2.46	1.76
Relative economic efficiency ****	100.0	73.33	168.89	351.11	188.89	22.22	304.44	257.78	546.67	391.11

* According to the price of different ingredients available in the market at the experimental time.

** According to the local market price at the experimental period.

*** Net revenue per unit cost.

**** Group fed control diet (1)=100%.

there was no correlation with bacterial density as well as the number of bacteria per organ.

Economical efficiency (%):

The economical efficiency of dietary treatments are presented in Table (11). The profitability of using FH, MH or their mixture depends upon the price of hay and the growth performance of rabbits fed these dietary wastes. The total feed cost was reduced by 26, 28 and 41%, respectively, from control diet by adding 18, 36 and 54% dietary FH, respectively while, using the same levels from dietary MH reduced total feed cost by 21, 21.53 and 53%, respectively, of control diet. Meanwhile, by supplementing the same levels of dietary FH+MH mixture, total feed cost reduced by 35, 47 and 55%, respectively from feed cost of control diet.

As a result of improvement in feed conversion efficiency of dietary, 36% FH+MH mixture group, recorded the greatest percent of economical efficiency (% of net revenue/feed cost) compared with other dietary treatments and with the control diet (100%). These results agree with Radwan and Khalil (2002) who reported that economical efficiency values were increased with increasing Fennel hay meal (FHM) levels and the relative economical efficiency values of FHM diets were 120.2, 142.8 and 167.0% for 17, 34 and 50% FHM diets, respectively. In this connection, Awad (2003) reported that incorporation of 5% Black cumin meal and 5 or 10%Lemon grass meal in the diet had a positive effect in decreasing the cost of the diets and recording the highest economical growth efficiency comparing with control diet.

Abd El-Latif *et al.,* (2004) concluded that using dietary Spearmint, Marjoram, sweet basil and Santonica at levels 0.3 or 5% for growing Japaneses quails improved the growth performance and economical efficiency. El-Manyalawi *et al.,* (2005) reported that the best relative economical efficiency was detected with rabbits fed diets contained 9% *Geranium* by-product followed by those fed 6% *Geranium* by-product. The relative low price of Fennel hay (FH) and Marjoram hay (MH) as compared with that alfalfa hay (AH) made using these by-products in rabbit diets a feasible and a promising feed.

CONCLUSION

It could be concluded that incorporated mixture of fennel hay and marjoram hay by 36% of growing rabbit diets, achieved a better results of growth, carcass, digestibility and economic efficiency than using each waste alone, without any adverse effect on performance of growing rabbit diets. In addition, further studies are necessary for improving digestibility and nutritive values of fennel and marjoram by-products as alternative feedstuffs that can be used in rabbit feeds formulation.

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أداء الأرانب النامية المغذاة على علائق تحتوى على مخلفات كل من الشمر والبردقوش تحت ظروف البيئة الصحراوية

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أستخدم في هذه الدراسة 100أرنب نيوزلاندى أبيض نامي غير مجنس عمر 6أسابيع بمتوسط وزن 822جم وذلك لدراسة تأثير استبدال دريس البرسيم الحجازي بمستويات مختلفة من دريس الشمر أو من دريس البردقوش،وكذلك خليط منهما ،في العلائق على الأداء الانتاجى للأرانب تحت ظروف البيئة الصحراوية.

قسمت الأرانب إلى 10 مجاميع بكل مجموعة 5 مكررات بكل مكرر عدد 2 أرنب نامي ثم إحلال كل من دريس الشمر و دريس البردقوش ومخلوطهما محل دريس البرسيم الحجازي في العلائق بثلاث مستويات هي 18، 36، 54 % وذلك في 9 علائق بالإضافة إلى عليقة الكنترول للحصول على 10 علائق متساوية تقريبا في محتواها من البروتين الخام والطاقة المهضومة والألياف الخام (16% بروتين خام 2550 كيلو كالورى / كجم 12% ألياف خام) وذلك لتغذية الأرانب النامية لمدة 8 أسابيع تبعتها تجربة هضم تم خلالها دراسة تأثير هذة المخلفات مفردة ومجتمعة على معاملات الهضم وميزان الازوت وبعض خصائص الأعور ومحتواة من الميكروبات وبعض مكونات الدم وصفات الذبيحة بالإضافة إلى الكفاءة الاقتصادية لإضافة تلك المخلفات ومقارنة المتحصل عليها بمجموعة الكنترول. ويمكن تلخيلخنتائج التجربة كالاتى

1- سجلت مجموعة الأرانب المغذاة على عليقة تحتوى على 36% مخلوط دريس الشمر مع دريس البردقوش أحسن معدل زيادة في الوزن الحي والزيادة في الوزن وكذلك معامل التحويل الغذائي ودليل الأداء وذلك بنهاية الا ربع أسابيع الأولى من الدراسة وكذلك عند نهاية الدراسة(14 أسبوع من العمر).

2-انخفضت معاملات الهضم للمركبات الغذائية بدرجة معنوية وانخفاض المأكول مع زيادة مستوى دريس الشمر وكذلك مخلوط دريس الشمر و البردقوش في العلائق.

3-أظهرت المجموعة المغذاة على عليقة تحتوى على 36% من مخلوط دريس الشمر والبردقوش (T_9) مستوى أحسن معنويا في القيم الغذائية من استخدام كل منهما منفردا في العلائق ، وكذلك سجلت هذه المجموعة -معنويا- أعلى القيم للبروتين الكلى والجلوبيولين ،وأقل القيم من الكوليستيرول والجلسريدات الثلاثية ،والإنزيمات الدالة على نشاط الكبد (AST,ALT) وذلك مقارنة بباقي مجموعات الدراسة.

4-لوحظ أن زيادة مستويات كل من دريس الشمر ،دريس البردقوش ،ومخلوطهما أدى إلى انخفاض معنوي في دهن البطن وقيم حمض البروبيونيك في مكونات الأعور، بينما أدى إلى زيادة معنوية في قيم حمض البيوتيريك مقارنة بعليقة الكنترول.

5-لوحظ أن استخدام مخلوط دريس الشمر والبردقوش أدى إلى الزيادة بدرجة معنوية في أعداد البكتريا المحللة للسيللوز،وانخفاض معنوي في أعداد بكتريا *E.Coli* ،وذلك بدرجة أكبر من استخدام كل منهما على حده.

6-تحسنت الكفاءة الاقتصادية باستخدام دريس كل من الشمر والبردقوش في العلائق كنتيجة لانخفاض أسعار تلك المخلفات وتحسن معامل التحويل الغذائي ، ولكن أظهرت المعاملة التي تحتوى على 36% مخلوط دريس الشمر والبردقوش أعلى كفاءة اقتصادية مقارنة بالمجموعات التجريبية الأخرى بما في ذلك مجموعة الكنترول. *وبناء على ذلك* :

و توصى الدراسة بإمكانية إحلال مخلوط دريس الشمر والبردقوش محل دريس البرسيم في علائق الأرانب النامية بمستوى حتى 36% من العليقة دون حدوث اى تأثيرات على أداء النمو للأرانب مع تحسن ملحوظ في الكفاءة الاقتصادية تحت ظروف البيئة الصحراوية.