PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF NZW RABBITS FED RATIONS CONTAINING PEANUT VINES

1- Growth performance and carcass characteristics

Eweedah[1], N.M.; S. A. Mahmoud[1], N. M. El-Naggr[2], E. M. Abdel-raouf[1] and S. M. Omara[2]
[1] Anim. Prod. Dept., Fac.of Agric. Kafr El-Sheikh University, Egypt.
[2] Anim. Prod. Res. Inst., Agric. Res. Center, Ministry of Agriculture, Egypt.

SUMMARY

This work consists of two experiments; the first one was designed to determine the chemical composition and nutritive values of clover hay (CH) and peanut vines hay (PNVH) or peanut vines silage (PNVS) using twelve mature New Zealand White (NZW) male rabbits with an average body weight of 2.5 kg and 8 months old. The second one was carried out to study the performance of growing NZW rabbits fed diets containing PNVH or PNVS, which replaced different levels (0, 50, 75 and 100%) of CH in the mixed ration. Growth performance, feed conversion, some carcass traits, and economic efficiency of experimental rations were determined. The results indicated that both of PNVH and PNVS had higher EE, NFE and ash content and lower CF content compared with CH. Feed intake was significantly higher ($P<0.05$) for rabbits fed rations containing PNVH than those fed rations containing PNVS. Moreover, PNVH had the highest digestibility coefficients values for OM, CP and NFE compared with the values of CH and PNVS, while CF digestibility was the highest for PNVS. No significant differences were found among both CH and PNVS for OM, CP and NFE or CH and PNVH for CF and NFE. The digestibility values of EE were nearly similar. Rabbits fed rations containing PNVH achieved significantly ($P < 0.05$) the highest body weight and average daily gain compared with the other rations. Moreover, rabbits fed rations containing 75 or 100% PNVH showed the best feed conversion comparing with rabbits fed PNVS. Inclusion of PNV as hay or silage in rabbit rations reduced feed cost. The rabbits fed rations containing 50% of PNV hay or silage recorded the best ($P<0.05$) values for dressing percentage. Based on the nutritional and economical results of the present study, it was clear that PNV as hay or silage were highly palatable roughages. Moreover, PNV have a beneficial effect on improving productive performance of growing rabbits and decreased feed cost due to the lower price of the tested ingredients and this reflected on the economical efficiency values.

Keywords: peanut vines, digestibility, growth performance, carcass characteristics.

INTRODUCTION

The continuous increase in human population together with raising their standard living resulted in continuous increasing demands of animal

products, such as meat, eggs and milk. Rabbit's meat is usually more preferable to consumer. Moreover, rabbit has much higher relative growth rate than either sheep or cattle. In addition, rabbits are able to consume forages and agricultural by-products containing high levels of fiber (Cheeke, 1987; Malhate, 1992 and Gad-Alla, 1997).

In Egypt, although there has been a great attention towards the use of agricultural by-products as hay, few attempts have been successfully performed on ensiled agricultural by-products and forages in rabbit feeding and their effects on growth performance (Abd El-Lateif, 1996; Shetifa, 1999; Omara, 2000 and Abd El-Lateif, 2002).

Many nontraditional agricultural by-products could be used as alternative forages in feeding animals. In this respect, peanut vines as an example of such materials that could be used partially or completely to replace clover hay in rabbit rations. In Egypt, the peanut crop is cultivated in marginal farming areas. Therefore, the lands used for peanut production are rarely suitable for other crops. Recently, about 150767 feddans are dedicated to peanut production in Egypt (Ministry of Agriculture, March, 2002). Therefore, peanut vines are produced in large quantities as green residues at harvesting time; being almost four tons of peanut vines per feddan. The peanut vines could be considered as a nontraditional feed for ruminants. Rabbits can use roughages in their rations due to their ability to induce some fermentation in hindgut, which enable them to use fibrous feeds.

The present study was conducted to determine chemical composition, digestibility and nutritive values of peanut vines hay and silage compared with clover hay. Also, the performance of growing New Zealand White (NZW) rabbits as affected by replacements of clover hay at different levels by peanut vines as hay or silage in the mixed ration was studied. Carcass traits, carcass composition and economical efficiency were also investigated.

MATERIALS AND METHODS

The present study was carried out at Sakha Animal Production Research Station, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture in co-operation with Department of Animal Production, Fac. of Agric., Kafr El-Sheikh University. This work consists of two experiments; the first one was designed to determine the chemical composition and nutritive values of clover hay (CH) and peanut vines hay (PNVH) or peanut vines silage (PNVS). The second one was carried out to study the performance of growing New Zealand White (NZW) rabbits as affected by inclusion of PNVH or PNVS, which replaced different levels of CH in the mixed ration.

The peanut green foliage was purchased from local farms at Behaira Governorate. After harvesting the peanut, four tons of peanut green residues (vines) were taken, three tons of them were sun dried until the moisture content was reduced to 10-12% and ground for mixing with the other ingredients. One kg of Anti-Toxin/ton of ration was added as anti-toxin during pelleting. Clover hay was prepared by the same method as peanut green vines hay. At the same time the fourth ton of fresh green vines were chopped and ensiled in plastic packets (30-40 kg capacity) with added 5% molasses (W/W). Silage was kept at room temperature. After 2 months, the color and odor of silage were tested and representative samples were taken and divided into two portions. The first portion was dried in a forced air oven at 60°C for 48 hours, ground and kept for chemical analysis (AOAC, 1994). While, the other portion was used to prepare water-soluble extracts by extracting 20 gram (wet material) in a blender with 100 ml of distilled water for 10 minutes (Waldo and Schuitz, 1956). The extracts were filtered through Whatman No. 40 filter papers and the pH value was determined directly in the filtrate solution using Bechman pH meter. The concentration of NH_3-N was determined according to AOAC (1994). Total VFA`s were determined according to Warner (1964), individual volatile fatty acids were determined using Gas Chromatography (Erwin et al., 1961). Lactic acid was estimated by titration with 0.1 N Sodium hydroxide solution using 2-3 drops of Phenolphthalein indicator according to methods of Analytical Chemistry of Foods (1995) using the following equation:-

Lactic acid % of DM = Ml of NaOH × 0.09/ sample weight (in grams).

The first experiment:-

Three digestibility trials were conducted using twelve mature NZW male rabbits with an average body weight of 2.5 kg and 8 months old (4 males each). The rabbits were housed individually in metabolic cages (50 x 40 x 35 cm) to determine the nutritive values of the three feed ingredients used in this study (CH, PNVH and PNVS).

The second experiment:-

Feeding trial was conducted using eighty-four NZW rabbits 6 weeks old (42 males+42 females) with an average body weight of 755 g were randomly distributed into seven equal groups (12 rabbits each) up to 16 weeks old. Each group was subdivided into three replicates (4 rabbits each). Each group was allotted to one of the following experimental rations as shown in Table (1).

Rabbits were housed in galvanized wire cages and fresh water was automatically available at all time. All rabbits were kept under the same managerial, hygienic and environmental conditions. Live body weights and feed consumption were recorded at weekly intervals throughout the

experimental period from 6 to 16 weeks of age. Daily gain, feed conversion and feed efficiency were calculated.

Table 1. Ingredients composition of different experimental rations for growing NZW rabbits.

Ingredient %	R1	R2	R3	R4	R5	R6	R7
	Control	50%	75%	100%	50%	75%	100%
Clover hay	40.00	20.00	10.00	00.00	20.00	10.00	00.00
Peanut vines hay or silage	00.00	20.00	30.00	40.00	20.00	30.00	40.00
Barley grain	18.00	18.00	18.00	18.00	18.00	18.00	18.00
Yellow corn	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Soybean meal (44%)	15.20	15.20	15.20	15.20	15.20	15.20	15.33
Wheat bran	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Molasses	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Sodium chloride	00.25	00.25	00.25	00.25	00.25	00.30	00.30
Minerals and Vit. Mix*	00.30	00.30	00.30	00.30	00.30	00.41	00.41
Dl-Methionine	00.15	00.15	00.15	00.15	00.15	00.15	00.15
Anti-Toxin	00.10	00.10	00.10	00.10	00.10	00.10	00.10
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*Minerals and vitamins mixture manufactured by Egypt Company for Chemical & Pharmaceuticals (ADWIA). Each 2.5 kg contains: Vit. A 12000000 IU; vit. D_3 2000000 IU; vit. E 110000 mg ; vit. B_1 1000 mg ; vit. B_2 4000 mg ; Niacin 20000 mg ; vit. Pantothenic acid 10000 mg; vit. B12 10 mg; vit. K3 2000 mg; Folic acid 1000 mg; vit B6 1500 mg; Biotin 50 mg; Copper 10 gm; Iron 30 gm; Iodine 1000 mg; Manganese 55 gm; Selenium 100 gm; Zinc 55 gm; Choline chloride 500 gm; Ethoxyquine 3000 mg.

R1. Control 40% clover hay R2. 50% of CH was replaced by PNVH.

R3. 75% of CH was replaced by PNVH. R4. 100% of CH was replaced by PNVH.

R5. 50% of CH was replaced by PNVS**

R6. 75% of CH was replaced by PNVS. R7. 100% of CH was replaced by PNVS.

** Silage was offered separately on dry matter basis with dry feed mixture to obtain the dry matter intake, whereas, 20, 30, 40% of peanut vines silage was replaced on dry mater basis for R5, R6 and R7, respectively.

Chemical analysis of feed ingredients was determined according to AOAC (1994). Neutral detergent fiber (NDF) was determined according to Van Soest and Marcus (1964). While, acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to Van Soest (1963). Hemicellulose was determined from the following equation = NDF – ADF. Cellulose was similarly determined from the following equation = ADF - ADL

Carcass traits:-

Three male rabbits were taken at random from each group, fasted for 18 hours before slaughtering. Rabbits were weighed then slaughtered and the slaughter weight was recorded. Dressed weight (the weight after bleeding and removal of skin and ends of legs and tail) and the drawn weight (the

main body, head, kidneys, liver and heart other total edible parts) were determined according to Blasco et al. (1993). The organs were left to drain for 15 minutes before being weighed. Chemical analysis of meat samples of carcass cuts was done according to AOAC (1994). The pH value of meat was determined using the pH meter according to Evans and Niven, 1960). Tenderness and water holding capacity of fresh meat was determined by weighting 0.3 gm of meat and putting it on filter paper (Whatman 54) under pressure of 1 kg for 10 minutes, then the total and internal areas were measured by a planimeter. The area of external and internal zones (in cm^2) expressed the water holding capacity and tenderness, respectively (Udin, 1967 and Forrest, 1981). The color intensity of meat-extracted drip was also determined (Yamazake, 1981).

Statistical analysis:-

The data were statistically analyzed using general linear models procedure adapted by SPSS (1997) for user's Guide, with one-way ANOVA model was used in the data of experiment and appropriate means were separated using Duncan's multiple range tests. (Duncan, 1955).

RESULTS AND DISCUSSION

The first experiment:-

Chemical compositions of CH, PNVH and PNVS are shown in Table (2). The present results showed that both of PNVH and PNVS had higher EE, NFE and ash content and lower CF content compared with CH. Values of the chemical composition of CH, PNVH and PNVS were within the range obtained by Oyawoye et al. (1990); Awadalla et al. (1997); Mostafa et al. (1999); Talha (2001); El-Adawy and Borhami (2001) and Mohamed (2002).

Table 2. Chemical composition of clover hay, peanut vines hay and peanut vines silage.

Rations	DM%	DM composition, %					
		OM	CP	EE	CF	NFE	Ash
Clover hay	88.0	89.86	14.26	2.36	30.56	42.68	10.14
Peanut vines hay	89.0	89.00	13.54	3.48	23.72	48.26	11.00
Peanut vines silage*	39.20	87.61	14.49	3.30	23.05	46.77	12.39
		Cell wall constituents (% on DM basis)					
		NDF	ADF	ADL	Hemicellulose		Cellulose
Clover hay		79.88	17.21	5.90	62.67		11.31
Peanut vines hay		76.23	17.00	4.90	59.23		12.10
Peanut vines silage		84.85	19.57	4.90	65.28		14.67

*Parameters of PNVS quality were, pH 4.4, total VFA`s 3.44% of DM, lactic acids 4.14% of DM, NH_3-N of total nitrogen 6.47%, acetic acid 33.66%, propionic acid 3.24%, butyric acid 2.78%, isobutyric acid 0.14%, valeric acid 1.53% and isovaleric acid 1.02%.

Concerning fiber fractions (Table 2), the results of cell wall constituents of feedstuffs and experimental rations showed that CH contained higher value of acid detergent lignin (ADL) than PNVH or PNVS, which contained the highest value of ADF, while, CH and PNVH had nearly the same values. Cellulose values were about the same for CH and PNVH (11.31 and 12.10%, respectively). Values of ADL in the different rations ranged from 4.90 to 5.90%, while cellulose values ranged from 11.31 to 14.67%. Awadalla and Mohamed (1997) tested berseem hay, PNVH and pea vine hay for fiber fractions and found that NDF ranged from 36.8-46.5%, ADL ranged from 6.9-9.7%, hemicellulose values were from 13.9-16.5% and cellulose values were 27.1-37.4%. The same trend was also reported by Mohamed (2002) who found that the values of NDF, ADF, hemicellulose, cellulose and ADL for alfalfa hay, groundnut vines hay and pea vines hay ranged between 47.2-51.9, 30.5-32.3, 14.9-20.2, 24.7-26.5 and 4.4-6.7%, respectively.

Feed intake, digestibility and nutritive value:-

The average feed intake, digestion coefficients and nutritive values for the different experimental feedstuffs are shown in Table 3. Results showed that PNVH had the higher digestibility coefficients values for OM, CP and NFE compared with the values of CH and PNVS, while CF digestibility was the highest for PNVS. No significant differences were found among CH and PNVS for OM, CP and NFE or CH and PNVH for CF and NFE. The digestibility of EE was nearly similar.

Table 3. Feed intake, nutrient digestibilities (%) and nutritive values of different experimental feedstuffs.

Item	Experimental feedstuffs			
	CH	PNVH	PNVS	SEM
Feed intake (g/DM)	80.60	77.20	54.40	4.03
Digestibility %				
OM	66.30^{b}	71.40^{a}	67.72^{ab}	0.70
CP	70.96^{b}	78.10^{a}	69.12^{b}	0.67
CF	59.32^{b}	62.97^{ab}	65.68^{a}	0.79
EE	77.39	75.18	74.77	1.58
NFE	69.43^{ab}	73.39^{a}	67.62^{b}	0.71
Nutritive value %				
TDN	62.0^{b}	66.82^{a}	62.33^{b}	0.67
DCP	10.12^{b}	10.57^{a}	10.02^{b}	0.09
DE (kcal/kg)*	2734	2946	2748	
DE/DCP ratio	270	279	274	

^{a,b} Means in the same row with different superscripts differ significantly at (P<0.05).
*DE (Kcal/kg) = TDN x 4.409x10 (NRC, 1977).

The present results revealed that OM and CF digestibility of CH and PNVH were higher than those obtained by Afifi (1999) using NZW rabbits. The data presented in Table (3), indicated that the nutritive value as TDN and DCP were the highest for PNVH compared with CH and PNVS while, no significant differences were found between CH and PNVS. These values were nearly similar to those reported by Afifi (1999). The DE (kcal/kg) values were 2946, 2748 and 2734 for PNVH, PNVS and CH, respectively. It was slightly higher for PNVH and the DE/ DCP ratios for CH, PNVH and PNVS were suitable for feeding growing rabbits and were within the range recommended by NRC (1977).

The second experiment:-

Chemical composition of the experimental rations is presented in Table 4. Generally, all tested rations contained nearly similar values for all nutrients except CF contents, which ranged between 12.46% in 100% PNVS ration and 15.46% in the control ration.

Table 4: Chemical analysis of experimental rations for growing rabbits.

Items	DM	DM composition, %				
	%	OM	CP	EE	CF	NFE
R1 (Control)	88.62	93.43	16.70	3.50	15.46	57.77
R2	89.14	93.26	16.56	3.73	14.10	58.87
R3	89.01	93.18	16.49	3.84	13.42	59.43
R4	89.45	93.09	16.42	3.95	12.73	59.99
R5	79.39	92.98	16.75	3.69	13.96	58.58
R6	73.83	92.76	16.68	3.79	13.21	59.08
R7	69.06	92.53	16.80	3.88	12.46	59.39
		Cell wall constituents (% on DM basis)				
	NDF	ADF	ADL	Hemicellulos	Cellulose	
R1 (Control)	78.15	16.01	4.33	62.14	11.68	
R2	80.73	15.16	4.70	65.75	10.46	
R3	79.36	17.51	5.91	61.85	11.60	
R4	79.34	14.81	5.34	64.53	9.47	
R5	77.81	15.73	4.75	62.08	10.98	
R6	78.84	16.36	5.91	62.48	10.45	
R7	75.31	16.65	4.06	58.66	12.59	

R1. Control 40% clover hay
R2. 50% of CH was replaced by PNVH. R3. 75% of CH was replaced by PNVH.
R4. 100% of CH was replaced by PNVH R5. 50% of CH was replaced by PNVS
R6. 75% of CH was replaced by PNVS. R7. 100% of CH was replaced by PNVS.

Performance of rabbits fed the different experimental rations:

It has been established that animal's performance generally reflects the nutritional value of the diet and feed consumption (Malhate, 1992). Data

concerning growth performance for rabbits fed different rations are presented in Table (5). Feed intake was nearly similar in all groups and ranged from 90.69 (R6) to 100.50 (R5). Similar trend was observed by Joyce et al. (1971) and Aghina and Ladetto (1973) who reported that after weaning, feed intake quickly increased until DM intake was about 5.5% of live body weight and this level was maintained until maturity. Afifi (1999) found that the differences in feed intake were not significant ($P < 0.05$) for rabbits fed rations in which CH was replaced by PNVH at levels 33, 66 and 100%.

Rabbits fed rations containing PNVH achieved significantly ($P < 0.05$) the highest ($P<0.05$) average daily gain (ADG) compared with those fed rations containing PNVS and the control ration. Moreover, no significant differences in ADG between the rations containing PNVS and the control ration were found.

Average feed conversion values of rabbits fed rations containing PNVH (R3 and R4) showed the best feed conversion being 3.21 and 3.17 kg DM/kg gain, respectively, comparing with rabbits fed PNVS (R5, R6 and R7) where feed conversions were less efficient being 3.60, 3.34 and 3.57 kg DM/kg gain, respectively. Generally, average body weight values were higher and feed conversion was more efficient for rabbits fed all experimental rations compared to the values reported by Abd El-Lateif (2002); El-Mahdy (2000) and Volek et al. (2002). Furthermore, feeding growing NZW rabbits on rations containing different levels of PNVH and PNVS had a beneficial effect on feed conversion.

Results showed that inclusion of PNV as hay or silage in rabbit rations reduced feed cost, therefore, feed cost/kg gain decreased compared to control (Table, 5). Data also, showed that the relative economical efficiency was the best for rabbits fed rations containing either PNVS or PNVH compared with the control ration (containing CH).

The econoinic age of marketing, from the marketing point of view, is when marketing live weight is about 2 kg. This weight was obtained with feeding rations R2, R3, R4, R5 and R6 (2058, 2098, 2102, 2050 and 2028 g), respectively at 12 weeks of age. However, rabbits of R1 and R7 recorded suitable marketing live weight at 14 weeks of age (2347 and 2328 g, respectively).

Table 5. Means of growth performance for rabbits fed the different experimental rations.

Items	Experimental rations							SEM
	R1	R2	R3	R4	R5	R6	R7	
Feed intake, as DM (g/head/day)	96.07	97.89	95.99	96.05	100.50	90.69	95.55	0.46
Av. Initial wt. g	750	755	749	759	752	765	761	1.93
Av. Final wt., g	2698	2810	2847	2883	2708	2665	2633	11.65
Av. Total gain, kg	1.948	2.055	2.098	2.124	1.956	1.900	1.872	0.01
Av. Daily gain, g/day	27.83^{b}	29.36^{a}	29.97^{a}	30.34^{a}	27.94^{b}	27.14^{b}	26.74^{b}	0.16
Feed conversion (kg DM/kg gain)	3.45^{b}	3.33^{c}	3.21^{d}	3.17^{d}	3.60^{a}	3.34^{c}	3.57^{a}	0.09
Total revenue (LE)	19.48	20.55	20.98	21.24	19.56	19.00	18.72	0.10
Feed consumption (kg DM)	6.73^{b}	6.85^{ab}	6.70^{b}	6.76^{b}	7.04^{a}	6.35^{c}	6.72^{b}	0.03
Feed cost (LE/head)	6.84^{a}	6.45^{b}	6.02^{c}	5.82^{c}	5.43^{d}	4.17^{e}	3.79^{f}	0.03
Net revenue (LE/head)	12.65^{c}	14.10^{b}	14.96^{a}	15.42^{a}	14.00^{b}	14.84^{a}	14.94^{a}	0.08
Feed cost /kg gain (LE)	3.51^{a}	3.14^{b}	2.87^{c}	2.74^{d}	2.20^{cd}	2.19^{e}	2.02^{f}	0.01
Economical efficiency (%)	184.90^{f}	218.47^{e}	248.43^{d}	264.96^{c}	257.14^{cd}	356.62^{b}	395.05^{a}	1.54
Relative economical efficiency to control	100.0^{f}	118.16^{e}	134.36^{d}	143.30^{c}	139.07^{cd}	192.07^{b}	213.66^{a}	0.82
Relative feed cost/kg gain to control	100.0	89.46	81.77	78.06	79.77	62.39	57.55	

$^{a, b, f}$ Means in the same row with different superscripts are differ significantly at ($P<0.05$).

$$\text{Economical efficiency} = \frac{\text{Price of kg gain - feed cost / kg gain}}{\text{Feed cost / kg gain}} \times 100$$ **(Shetifa, 1999)**

Price of kg gain = 10 (LE)

R1 = 40% clover hay (Control)

R2= 50% of CH was replaced by PNVH.

R3 = 75% of CH was replaced by PNVH

R4 = 100% of CH was replaced by PNVH.

R5 = 50% of CH was replaced by PNVS.

R6= 75% of CH was replaced by PNVS.

R7 = 100% of CHwas replaced by PNVS.

Carcass characteristics:

Data of carcass traits of rabbits as affected by the different experimental rations are summarized in Table (6). The best (P<0.05) values for drawn weight (dressing percentage) were 64.24 and 64.12% for rabbits fed R2 and R5 (containing 50% of PNV hay or silage), respectively. Higher percentage of boneless meat was recorded for rabbits fed rations containing PNVH than these fed PNVS. These results are in agreement with those obtained by Omara (2000). While it was higher than those obtained by Abd El-Lateif (1996); Gad-Alla (1997) and Shetifa (1999) who reported lower dressing percentage values with rabbis slaughtered at 12 or 13 weeks of age. This may be attributed to the higher body weight and age of slaughter of rabbits. Moreover, Szendro et al. (1998) found that increasing live body weight resulted in an increase in the dressing percentage.

Table (6). Some carcass traits for growing NZW fed different experimental rations.

Item	Experimental rations							
	R1	R2	R3	R4	R5	R6	R7	SEM
Pre-slaughter weight, g[(1)]	2583^{ab}	2567^{ab}	2650^{a}	2658^{a}	2525^{ab}	2483^{b}	2450^{b}	18.71
Carcass weight, g[(2)]	1602^{ab}	1649^{a}	1680^{a}	1687^{a}	1619^{ab}	1562^{ab}	1496^{b}	14.17
Dressing percentage	62.41^{bc}	64.24^{a}	63.36^{ab}	63.48^{ab}	64.12^{ab}	62.89^{abc}	61.07^{c}	0.25
Boneless meat weight, g[(3)]	1149^{bc}	1221^{ab}	1258^{a}	1257^{a}	1120^{bc}	1087^{c}	1060^{c}	12.09
Boneless meat percentage	44.31^{b}	47.56^{a}	47.43^{a}	47.30^{a}	44.39^{b}	43.78^{b}	43.24^{b}	0.24

a, b and c Means in the same row with different superscripts are differ significantly at (P<0.05).
(1) The live weight
(2) The weight includes carcass, head, liver, heart and kidney
(3) The weight includes boneless meat, liver, heart and kidney.

Some physical characteristics of rabbit's meat are shown in Table (7). Results indicated that the pH values of meat for rabbits in the different dietary treatments ranged from 5.00 to 5.59. It is clear that meat of NZW rabbits fed rations containing silage had significantly (P<0.05) higher pH values than those fed rations containing CH or PNVH and were within the values reported by many workers. Mohy El-Deen (1989) found that pH of buffaloes meat ranged between 5.52 and 5.78; also, Kyouhei (1994) found that pH of Japanese black steer meat ranged between 5.4 and 5.5.

The average color intensity of fresh meat ranged between 0.213 and 0.413 (Table 7). The results indicated that the fresh meat of the seventh treatment was slightly darker than other treatments with significant

differences (P < 0.05). In this respect, Yamazake (1981) attributed darkness of meat to more myoglobin content and the decrease of color intensity of fresh meat is due to low myoglobin and high fat content in muscle.

The average values of tenderness of fresh meat (as indicated by plasticity) ranged from 2.05 to 2.77 cm^2 with significant differences (P < 0.05) between the dietary treatments. The differences in tenderness of fresh meat might be due to the variation of difference of fiber diameter, amount of connective tissue and solubility (Udin, 1967). Omara (2000) found that the tenderness values of fresh meat of rabbits ranged between 2.49 and 2.82 cm^2 without significant differences. In general, it was observed that meat of NZW rabbits fed rations containing PNVS had higher pH, color intensity and tenderness values than those fed CH or PNVH rations. The water holding capacity (WHC) was better in the fresh meat of rabbits fed R3, the difference in WHC might be attributed to kind of feeding and change in myofibril proteins in different carcass muscles (Goll et al., 1974 and Forrest, 1981). The results obtained of WHC ranged between 4.70 and 6.60 cm^2 with significant differences (P < 0.05). Omara (2000) found that WHC of fresh meat of rabbits ranged between 5.6 to 8.1 cm^2.

Table (7). Physical characteristics and chemical composition of rabbits meat fed different experimental rations.

Item	Experimental rations							
	R1	R2	R3	R4	R5	R6	R7	SEM
Physical characteristics:-								
pH	5.12^{b}	5.02^{b}	5.00^{b}	5.03^{b}	5.59^{a}	5.52^{a}	5.54^{a}	0.02
Color intensity	0.323^{ab}	0.310^{ab}	0.213^{b}	0.353^{ab}	0.350^{ab}	0.313^{ab}	0.413^{a}	0.02
Tenderness (cm^2)	2.47^{ab}	2.43^{ab}	2.49^{ab}	2.05^{b}	2.64^{ab}	2.77^{a}	2.59^{ab}	0.08
Water holding capacity cm^2)	5.70^{ab}	6.60^{a}	4.70^{b}	6.36^{a}	5.40^{ab}	6.06^{ab}	5.49^{ab}	0.19
Chemical composition %, on DM basis								
DM	27.02^{b}	28.48^{a}	28.12^{a}	27.96^{a}	28.10^{a}	28.08^{a}	27.24^{b}	0.21
CP	81.58	81.90	80.79	81.11	81.55	81.65	81.04	0.38
EE	11.39^{b}	11.40^{b}	11.98^{a}	11.25^{ab}	11.00^{ab}	10.77^{ab}	10.69^{ab}	0.16
Ash	6.47^{b}	6.19^{b}	6.81^{ab}	6.84^{b}	6.99^{ab}	7.10^{ab}	7.69^{a}	0.13

[a,b] Means in the same row with different superscripts differ significantly at (P<0.05).

The chemical composition of NZW rabbit's meat for the different dietary treatments on DM basis showed that, dry matter content of meat ranged from 27.02 to 28.48%, with significant differences (P < 0.05). The average protein content of meat ranged from 80.79 to 81.90%. Ether extract content of rabbit's meat ranged from 10.69 to 11.98%, with significant differences (P < 0.05).

Results obtained revealed also that the average ash content of rabbit's meat ranged between 6.19 and 7.69%, with significant differences ($P < 0.05$). The chemical composition presented herein is within the normal range of the values reported on meat of NZW rabbits (Shetifa, 1999, Omara, 2000 and Abd El-Lateif, 2002). Using different levels of PNV as hay or silage in NZW rabbit rations had a desirable effect on chemical composition of meat as presented in a higher protein content and lower fat.

From the present study, it could be concluded that PNV as hay or silage were highly palatable roughages and can be successfully used for feeding rabbits without any healthy troubles and adverse effects. Improved meat quality and improved productive performance as well as improved economical efficiency were reported. A decrease in the cost of feeding rations containing PNV compared with feeding clover hay was also noticed. Moreover, using PNV as hay is more suitable to incorporate into commercial pelleted rabbit diets.

REFERENCES

Abd El-Lateif, A.I. (1996). Effect of treated low quality roughages on rabbits. M.Sc. Thesis, Fac. Agric. Menoufiya Univ., Shebin El-Kom. Egypt.

Abd El-Lateif, A.I. (2002). The use of silage in rabbit nutrition. Ph.D. Thesis, Fac. Agric. Menoufiya Univ., Shebin El-Kom. Egypt.

Afifi, S. (1999). Digestibility and acceptability of some agricultural by-products by growing rabbits. M.Sc. Fac. Agric. Cairo Univ., Egypt.

Aghina, G. and G. Ladetto (1973). Development aspects of rations for meat rabbits. Proceedings of International Conference on Rabbit Production ERBA (Italy). 152-187.

Analytical Chemistry of Foods (1995). Published by Blockie Academic and Professional, an imprint of Chapman & Hall, Western Cleddens Road, Bishoporiggs, Glasgow G64 2NZ. U. k.

AOAC (1994). Association of Official Analytical Chemists. Official Methods of Analysis. 11th Edition. Washington D.C., U. S. A.

Awadalla, I.M. and M.I. Mohamed (1997). Nutritional evaluation of some leguminous by-products. J. Agric. Sci. Mansoura Univ., 22: 4325-4330.

Awadalla, I.M.; M.I. Mohamed; M.A.M. Ibrahim and A.K. El-Asheeri (1997). Efficiency of using groundnut hay in rations of Rahmani Lambs. Egypt. J. Anim. Prod., 34: 126-134.

Blasco, A.; J. Ouhayoun and G. Masoero (1993). Harmonization of criteria and terminology in rabbit meat research World Rabbit, Sci., 1: 3-10.

Cheeke, P.R. (1987). Rabbit Feeding and Nutrition. Academic Press. Inc. Corvallis. Oregon. U.S.A.

Duncan, D. B. (1955). Multiple Range and Multiple F test. Biometrics, 11: 1.

El-Adawy, M.M. and B.E. Borhami (2001). Utilization of peanut hay and dried sugar beet tops in feeding growing rabbits. Egypt. J. nutrition and Feeds, 4 (Special issue): 869-877.

El-Mahdy, M.R.M. (2000). Evaluation of feeding diets containing different forage mixtures of hay on performance of growing rabbits. Egypt. J. Rabbit Sci., 10: 369-387.

Erwin, E. S., G. J. Marco and E. M. Emery (1961). Volatile fatty acid analysis of blood and rumen fluid by gas chromatography. J. Dairy Sci., 44: 1768.

Evans, J. B. and T. V. Niven (1960). Microbiology of meat bacteriology. The Science of meat and meat products. American Meat Institute Foundation-W-H-Freeman and Company, San Francisco California. U. S. A.

Forrest, R. J. (1981). Differences in meat tenderness between sires and breeds. Res. Rev. Res. Station, May, 9-10.

Gad-Alla, S. A. (1997). Utilization of some agriculture by-products in feeding rabbits. Ph.D. Thesis, Fac. of Agric., Tanta Univ., Egypt.

Goll, D.E.; M.H. Stromer; D.G. Olson; W.R. Dayston; A. Suzuki and R.M. Rabison (1974). The role of myofibrillar protein in meat tenderness. Proc. of Meat Industry Res. Conf. 75-98.

Joyce, J.P.; P.V. Rattray and J. Parker (1971). The utilization of pasture and barley by rabbits: 1- Feed intakes and live weight gains. Agric. Res., 14: 173-179.

Kyouhei, O. (1994). Meat quality and non-destructive evaluation of beef cattle. Publications on High Technology. The Bi-monthly Publication on Agric. Forestry and Fisheries, 28-2, (Special Issue).

Malhate, M.H. (1992). The effect of feeding some by-products on the productivity in rabbits. M.Sc. Thesis, Fac. Vet.. Med. Zagazig Univ. Benha Branch, Moshtohor, Egypt.

Ministry of Agriculture (March, 2002). Agricultural Statistics, Economical Business. Ministry of Agriculture and Land Reclamation, A. R. E.

Mohamed, S.F.K. (2002). Utilization of crop residues for feeding ruminants under desert farming systems. Ph.D. Thesis, Fac. of Agric. Tanta Univ., Kafr El-Sheikh, Egypt.

Mohy El-Deen, M.M. (1989). Effect of milk replacers on the performance of buffalo calves. Ph.D. Thesis, Fac. of Agric. Tanta Univ., Kafr El-Sheikh, Egypt.

Mostafa, M.R.M.; M.F. El-Sayes; M.K. Hathout and K.E.I. Etman (1999). Nutritional studies on conserved peanut tops as silage and hay using sheep. Egypt. J. Nutrition and Feeds, 2 (Special Issue): 253-263.

NRC (1977). Nutrition Requirements of Rabbits. National Research Council. 2nd Ed. Nat. Acad. Sci., Washington. D.C., USA.

Omara, S.M.A. (2000). Silage in Rabbit feeding. M.Sc. Thesis, Fac. Agric., Tanta Univ., Kafr El-Sheikh, Egypt.

Oyawoye, E.O.; M.E. Oyikin and Y. Shehu (1990). Studies in the nutrition of rabbits. 1-Chemical evaluation of some tropical legumes as replacements for alfalfa in rabbit diets. J. Appl. Rabbit Res., 13: 32-34.

Shetifa, M.A.M. (1999). Nutrition and physiological studies on the use of non conventional feed resources in rabbit production. M.Sc. Thesis, Fac. Agric. Mansoura Univ., Mansoura. Egypt.

SPSS (1997). SPSS Base 7.5 for windows, User's Guidei; SPSS Inc.

Szendro, Z.S.; I. Radnail; E. Biro-Nemeth, R. Romvarir; G. Milisits; A. Kenessey (1998). The effect of live weight on the carcass traits and the chemical composition of meat of Pannon weight rabbits between 2.2 and 3.5 kg. World Rabbit Sci., 6: 243-249.

Talha, M.H.; R.I. Moawad; M. Marghany and K.E.I. Etman (2001). Some nutritional studies on groundnut vines hay in sheep rations. Egypt. J. Nutr. and Feeds, 4 (Special Issue): 677-684.

Udin. V. M. (1967). Histological studies on the longissimus dorsi and semimembranosus muscles. Proc. of Raizanski Res. Vet. Inst., 17, 37-40, Moscow. USSR.

Van Soest, P. J. (1963). Use of detergents in the analysis of fibrous feeds. II-A rapid method for the determination of fiber and lignin. 46: 830.

Van Soest, P. J. and W. C. Marcus (1964). A method for the determination of cell wall constituents in forages using detergents and the relationship between this fraction and voluntary intake and digestibility. J. Dairy Sci., 47: 704.

Volek, Z.; V. Shrivanova; M. Marounek; M. Skrivan and P. Klein (2002). Performance, digestive anatomy and caecal parameters in rabbits fed diets differing in digestible fiber content. 53rd Annual Meeting of European Association for Animal Production Cairo 1-4 Sept.

Waldo, D. R. and L. H. Schultz (1956). Lactic acid production in the rumen. J. Dairy Sci., 39:1455.

Warner, A.C.I.(1964). Production of volatile fatty acids in the rumen, methods of measurement, Nutr. Abstr. and Rev., 34:339.

Yamazake, T. (1981). The effect of age and fatteness on meat quality and quantity of beef cattle. IV. The changes of colour and tenderness of meat with advance of age. Bulletin of National Grassland Res. Inst., 20: 119-131.

الملخص العربى

الأداء الإنتاجى والتناسلى للأرانب النيوزيلندى المغذاة على علائق تحتوى على عروش الفول السودانى

١- الأداء الإنتاجي وصفات الذبيحة

نبيل محمد عويضة[١]، سعيد احمد محمود[١]، نجيب محمود النجار[٢]، السيد عبد الرؤف[١]، صلاح محمد عمارة[٢]

[١] قسم الإنتاج الحيواني كلية الزراعة- جامعة كفر الشيخ - مصر

[٢] معهد بحوث الإنتاج للحيواني- مركز البحوث الزراعية- وزارة الزراعة- القاهرة- مصر

اشتملت هذه الدراسة على تجربتين، **التجربة الأولى** صممت لدراسة التركيب الكيميائى والقيمة الغذائية لكل من دريس البرسيم المصرى وعروش الفول السودانى فى صورة دريس أو سيلاج باستخدام الأرانب النيوزيلندى التامة النمو عمرها ٨ شهور ومتوسط وزنها ٢,٥ كجم. **التجربة الثانية** لدراسة الأداء الأنتاجى للأرانب النيوزيلندى النامية عند إدخال عروش الفول السودانى فى علائقها فى صورة دريس أو سيلاج محل دريس البرسيم المصرى بنسب مختلفة (صفر، ٥٠، ٧٥، ١٠٠%). حيث تم تقدير مقاييس النمو ومعدل التحويل الغذائي وبعض صفات الذبيحة والكفاءة الأقتصادية. **وكانت أهم النتائج كالأتى:-**

١- ارتفع محتوى عروش الفول السوداني في صورة دريس أو سيلاج من الدهن الخام والكربوهيدرات الذائبة والرماد بينما انخفض محتواها من الألياف الخام بالمقارنة بدريس البرسيم المصرى.

٢- ازدادت معنويا كمية الغذاء المأكول بالنسبة للأرانب المغذاة على دريس عرش الفول السودانى بتلك المغذاة على سيلاج عروش الفول السوداني.

٣- ازدادت معنويا (٥%) معاملات هضم كلا من المادة العضوية والبروتين الخام والكربوهيدرات الذائبة بالنسبة لدريس عروش الفول السودانى بالمقارنة دريس البرسيم المصري وسيلاج عروش الفول السودانى بينما ازداد معامل هضم الألياف معنويا (٥%) بالنسبة لسيلاج عروش الفول السوداني بالمقارنة بمواد العلف الأخرى.

٤- لم يكن هناك اختلافات معنوية بين كلا من دريس البرسيم وسيلاج عروش البنجر بالنسبة لمعاملات هضم المادة العضوية والبروتين الخام والكربوهيدرات الذائبة. ومن ناحية اخري لم يكن هناك اختلافات معنوية بين كلا من دريس البرسيم ودريس عروش الفول السوداني بالنسبة لمعاملات هضم الألياف الخام والكربوهيدرات الذائبة.

٥- سجلت الأرانب المغذاة على العلائق المحتوية على دريس الفول السوداني أعلى زيادة فى الوزن الكلي وكذلك معدل النمو اليومي بالمقارنة بالعلائق الأخرى.هذا بالأضافة ان الأرانب المغذاة على العلائق المحتوية على ٧٥ أو ١٠٠% دريس عروش الفول السودانى سجلت أفضل كفاءة تحويلية للغذاء مقارنة بتلك المغذاة على سيلاج عروش الفول السودانى. كما سجلت العلائق المحتوية على ٥٠% عروش الفول السودانى (دريس أو سيلاج) أعلى نسبة تصافي.

بناء على النتائج السابقة يتضح أن عروش الفول السودانى فى صورة دريس أو سيلاج من مواد العلف المائلة العالية الأستساغة والتى يمكن استخدامها فى بنجاح فى تغذية الأرانب دون حدوث مشاكل صحية أو أثار سلبية على جودة اللحم. أيضا استخدام عروش الفول السودانى (دريس أو سيلاج) أدى الى تحسين الإداء الأنتاجى للأرانب النيوزيلندى النامية وكذلك انخفاض تكاليف الغذاء نتيجة لأنخفاض أسعارها كما ان استخدام دريس عروش الفول السودانى مناسب لعمل العلائق التجارية والتى غالبا ما تكون في صورة مكعبات.