Effect Of Partial Replacement Of Berseem Hay By Ensiled And Dried Sugar Beet Tops On Performance Of Growing Rabbits

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ABSTRACT: Two experiments were done to study the effect of partial replacement of berseem hay by ensiled and dried sugar beet tops on the performance of growing rabbits. In the first one, 8 mature male NZW rabbits with an average body weight of 2.5 kg and 8 months old were used to determine digestibility coefficients and nutritive values of berseem hay (BH), ensiled sugar beet tops (SBTS) and dried sugar beet tops (SBTH). In the second one, 50 NZW growing rabbits of 60 days of age were used in a complete randomized design experiment with five treatments. The first group fed commercial rabbit diet including 40% BH (control diet), while in the other groups 50 or 100% of BH was replaced by SBTS and SBTH throughout the 70 days of experiment. Results of the first experiment showed that the contents of OM and CF were lower and NFE and ash content were higher in SBTS and SBTH compared with of BH. While, CP was higher in SBTS and lower in SBTH than that of BH. The digestibility coefficients of DM, OM, CF, EE and NFE were significantly higher ($P<0.05$) for both SBTS and SBTH compared with BH. However, BH had significantly ($P<0.05$) the highest TDN and DE values followed by SBTS, while SBTH had the lowest values. While, CP digestibility and DCP value of SBTS were significantly higher ($P<0.05$) than that of BH and SBTH. In the second experiment showed that calculated composition was nearly similar for the different diets except OM and CF decreased and ash increased in diets contained SBTS and SBTH compared with commercial diet. Diet contained 100% SBTS showed significantly ($P<0.05$) the highest digestibility coefficients of DM, OM, CP, EE and NFE and DCP value. While, commercial diet revealed the highest CF digestibility and TDN and DE values. Rabbits fed 100% SBTS diet had the highest TVFA's and NH_3-N concentrations and the lowest pH value. Rabbits fed 100% SBTS diet showed significantly ($P<0.05$) the highest final body weight, total and daily weight gain and the lowest average daily and total DM intake and DM/kg gain, however, those fed commercial diet had the opposite trend. Rabbits fed commercial diet showed significantly ($P<0.05$) the highest feed cost and feed cost/kg gain, however, rabbits fed 100% SBTS diet showed significantly ($P<0.05$) the highest total and net revenue and net revenue improvement. Rabbits fed 100% SBTS showed significantly ($P<0.05$) the highest slaughter weight, carcass weight, dressing percentage, meat weight and percentage and the contents of CP, EE and ash and lowest DM content in meat, but, those fed commercial diet had the opposite trend. [Researcher. 2010;2(9):10-15]. (ISSN: 1553-9865).

Key words: NZW rabbits, SBTS, SBTH, digestibility, body weight gain, feed conversion, economic efficiency, carcass traits.

INTRODUCTION

It is well that there is a serious shortage in the available feedstuffs for farm animal feeding. There are animal nutritionists are trying every available source of unconventional and/ or agricultural by-product to cover at least a part of this shortage. Poor economic conditions in many tropical countries and associated increase in the shortage of animal protein has turned attention to rabbit production as a ready solution to the problem. This is in view of the rabbit's fast growth and short generation interval. The problem for most producers however, is the high cost of concentrates feed for the rabbits. This has necessitated the need to seek for alternative feed sources in forages. This is especially so because of the greater availability of forages and ability of rabbits to convert forage into meat for human consumption. The high cost of feed has resulted in the search for cheaper ways of producing rabbits. Use of forage and byproducts of agriculture and food processing to substitute concentrate feed may be an alternative means of reducing the high cost of production associated with all concentrate feeding systems (Iyeghe-Erakpotobor *et al*., 2006).

In Egypt, about 168 thousand feddan (feddan = 0.42 hectare) were cultivated in year 2007 with sugar beet. Accordingly, large quantities of sugar beet tops are produced as an agricultural by-product after harvesting the sugar beet crops, which represented about 12.5 tons per feddan (Central Agency for Public Mobilization and Statistics, 2007).

Sugar beet tops can be used in the diet of rabbits up to 10%, replacing part of the clover hay (Tag El-Din *et al*., 2000). Sugar beet tops as hay or silage could be successfully used for growing rabbits

in such areas where sugar beet tops are produced in large quantities. Sugar beet tops can be used instead of berseem hay in rabbit's diets at the level of 40% without any adverse effect (Taie *et al*., 1996).

The present study was carried out to investigate the effect of replacing 50 and 100% of berseem hay in rabbit diet by ensiled and dried sugar beet tops on performance and carcass traits of growing New Zealand White rabbits

MATERIALS AND METHODS

The current work was carried out at Sakha Animal Production Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture to investigate the effect of partial replacement of berseem hay by ensiled and dried sugar beet tops on the performance of growing rabbits.

Dried and ensiled sugar beet tops:

After harvesting sugar beet, about of 1000 kg of tops were taken and divided into two parts with 500 kg. The first one was sun dried until the moisture content was reduced to 10-12% and ground for mixing with commercial rabbit diet. At the same time, the second part was chopped and ensiled in plastic bags (about 50 kg capacity) with added 5% molasses (w/w) for two month. Silage quality parameters determined were pH value using Bechman pH meter, NH_3-N concentration (AOAC, 1990), TVFA's concentration (Warner, 1964) and lactic acid concentration (Analytical Chemistry of Foods, 1995).

The first experiment:

Three digestibility trials were conducted to determine nutritive values of berseem hay (BH), sugar beet tops silage (SBTS) and sugar beet tops hay (SBTH) using 12 mature male NZW rabbits with an average body weight of 2.5 kg and 8 months old. Rabbits were fed twice daily at 8 a.m. and 3 p.m. and refusals were recorded every day and daily feces was weighed. Representative samples of tested feedstuffs and feces were chemical analysis according to AOAC (1990).

The second experiment:

Experimental rabbits and diets:

Fifty NZW growing rabbits of 60 days of age were used in a complete randomized design experiment with five treatments. The first group fed commercial rabbit diet including 40% BH (control diet), while in the other groups 50 or 100% of BH was replaced by SBTS and SBTH throughout the 70 days of experiment. The composition of commercial rabbit diet is shown in Table (1).

Housing and management:

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 weight and feed consumption were recorded at weekly interval throughout the experimental period. Daily weight gain, feed conversion and economic efficiency were calculated.

Digestibility trials:

Digestibility trial was undertaken at the end of the experimental period (16 wk of age) on four animals from each group. Rabbits were housed individually in metabolism cages. The experimental diets were offered daily and fresh water was provided all the time. Feed intake was accurately determined. Feces were collected for 5 days as a collection period, then the feces was dried at 60^{o}C for 12 h. All collected feces for each animal were mixed, then feces were ground for chemical analysis and urine was kept (4-5 ^{o}C) for analysis. Chemical analysis of different foodstuffs and feces was determined according to AOAC (1990).

Carcass traits:

At the end of experiment, 3 rabbits were taken randomly from each group fasted for 18 hours before slaughtering, weighed and slaughtered. Carcass weight (the main body, head, kidneys, liver, heart and other total edible parts) were determined according to Blasco *et al.* (1993). Chemical analysis of meat was done according to AOAC (1990).

Cecum parameters:

Cecum contents of slaughtered rabbits were taken for the determination of pH using Bechman pH meter, NH_3-N concentration according to the method of AOAC (1990) and TVFA's concentration according to Warner (1964).

Statistical analysis:

The data was statistically analyzed using general linear models procedure adapted by **SPSS (2008)** for user's guide with one-way ANOVA. Duncan test within program SPSS was done to determine the degree of significance between the means.

RESULTS AND DISCUSSION

The first experiment:

Chemical composition of tested feedstuffs:

Chemical composition of tested feedstuffs and experimental diets are presented in Table (2).

The contents of OM and CF were lower and NFE and ash content were higher in SBTS and SBTH compared with of BH. While, CP was higher in SBTS and lower in SBTH than that of BH. These results agreed with those obtained by Taie *et al.* (1996) and Abd El-Hady *et al.* (1998).

Nutrients digestibility and nutritive values of tested feedstuffs:

As shown in Table (2), the digestibility coefficients of DM, OM, CF, EE and NFE were significantly higher (P<0.05) for both SBTS and SBTH compared with BH. However, BH had significantly (P<0.05) the highest TDN and DE values followed by SBTS, while SBTH had the lowest values. While, CP digestibility and DCP value of SBTS were significantly higher (P<0.05) than that of BH and SBTH. These results may be attributed to the differences in chemical composition among the different feedstuffs. These results reflect the differences in chemical composition of tested feedstuffs. The DE value of the different feedstuffs was suitable for growing rabbits as recommended by NRC (1977). These results are in accordance with those obtained by Taie *et al.* (1996) and Abd El-Hady *et al.* (1998).

The second experiment:

Chemical composition of experimental diets:

The calculated composition was nearly similar for the different diets except OM and CF decreased and ash increased in diets contained SBTS and SBTH compared with commercial diet (Table 3). These results are in agreement with those obtained by Taie *et al.* (1996) and Abd El-Hady *et al.* (1998).

Nutrients digestibility and nutritive values

The digestibility coefficients and nutritive values of experimental diets by growing rabbits are shown in Table (3). Diet contained 100% SBTS showed significantly (P<0.05) the highest digestibility coefficients of DM, OM, CP, EE and NFE and DCP value, but commercial diet contained 100% BH had the lowest values. While, commercial diet revealed the highest CF digestibility and TDN and DE values, however, diet contained 100% SBTS had the lowest CF digestibility and diet contained 100% SBTH had the lowest TDN and DE values. These results agreed with those obtained by Abd El-Lateif (1996) and Tag El-Din *et al.* (2000). The values of digestibility coefficients and nutritive values are within the values obtained by Taie *et al.* (1996) with feeding growing rabbits on diets containing sugar beet tops silage and hay.

Cecum parameters

Rabbits fed commercial diet recorded the highest pH value and the lowest TVFA's and NH_3-N concentrations, however, those fed 100% SBTS diet had the highest TVFA's and NH_3-N concentrations and the lowest pH value as shown in Table (4). These results are in accordance with those obtained by Taie *et al.* (1996) who found that incorporation of sugar beet tops silage or hay in rabbit diets led to significant differences in cecum parameters.

Body weight gain

Results in Table (5) showed that rabbits fed 100% SBTS diet showed significantly (P<0.05) the highest final body weight, total and daily weight gain, but those fed 100% SBTH diet had the lowest values. The daily weight gain of rabbits fed 50% SBTS, 100% SBTS, 50% SBTH and 100% SBTH were 100.68, 103.80, 100.46 and 98.67% of those fed commercial diet, respectively. These results are in agreement with those obtained by Taie *et al.* (1996) and Abd El-Lateif (1996) when sugar beet tops silage or hay represents 40% of rabbit's diets.

Feed intake

Rabbits fed commercial died showed significantly (P<0.05) the highest average daily and total DM intake, however, those fed 100% SBTS diet had the lowest intake (Table 5). These results may be attributed to the laxative effect of sugar beet tops. Average DM intake ranged from 91.01 g/day for 100% SBTS diet to 105.35 g/day for commercial diet. These results agreed with those obtained by Abd El-Hady *et al.* (1998) and Tag El-Din *et al.* (2000) indicated that introducing sugar beet tops silage decreased feed intake by rabbits.

Feed conversion

Feed conversion expressed as the amount of DM required per kg body weight gain improved with feeding diets contained both SBTS and SBTH (Table 5). Rabbits fed commercial diet showed significantly (P<0.05) the highest amount of DM/ kg gain (4.01 kg), but those fed 100% SBTS diet had the lowest value (3.35 kg). These results agreed with those obtained by Taie *et al.* (1996) and Abd El-Hady *et al.* (1998) they reported that rabbits fed diets containing sugar beet tops as silage or hay improved feed conversion.

Economic efficiency

Rabbits fed commercial diet showed significantly (P<0.05) the highest feed cost and feed cost/kg gain, however, rabbits fed 100% SBTS diet showed significantly (P<0.05) the highest total and net revenue and net revenue improvement (Table 5). Net revenue of rabbits fed 50% SBTS, 100% SBTS, 50% SBTH and 100% SBTH improved by 14.80, 25.99, 11.77 and 16.27% compared with those fed commercial diet, respectively. These results may be due to the lower prices of sugar beet tops compared

with berseem hay. It is well known that grassland conserved products such as silages are normally cheaper per unit of energy than concentrate. If more increasing amounts of such feeds could replace expensive feedstuffs in the diet of rabbits without adverse effect on their performance, the cost of feeding would be reduced. These results are in accordance with those obtained by Taie *et al*. (1996) and Tag El-Din *et al*. (2000) they stated that feed cost/kg weight gain decreased and economic efficiency increased by feeding rabbits diets containing sugar beet tops silage or hay.

Carcass traits

Rabbits fed 100% SBTS showed significantly (P<0.05) the highest slaughter weight, carcass weight, dressing percentage, meat weight and percentage, however those fed 100% SBTH had the lowest values (Table 6). The differences in carcass traits may be attributed to the differences in slaughter weight. It was obviously that dressing percentage increased with increasing body weight, which was in accordance with those obtained by Szendro *et al*. (1998). These results agreed with those obtained by Taie *et al.* (1996) and Abd El-Hady *et al*. (1998) they found carcass traits improved with using sugar beet tops silage in rabbit feeding.

Meat composition

Rabbits fed commercial diet showed significantly (P<0.05) the highest DM content and the lowest CP, EE and ash contents in meat, however, those fed 100% SBTS revealed the opposite trend (Table 6). The chemical composition of meat reflects the protein and ash content of experimental diets. These results are in agreement with those obtained by Abd El-Lateif (1996) and Taie *et al.* (1996).

Table 1: Composition of commercial rabbit diets.

Ingredient	%	Ingredient	%
Berseem hay	40	molasses	2
Wheat bran	8	limestone	1
Soybean meal	18	Common salt	0.5
Yellow corn	15	Premix*	0.5
Barley grain	15	Total	100

* Each one kg of premix (minerals and vitamins mixture) contains vit. A, 20000 IU; vit. D3, 15000 IU; vit. E, 8.33 g; vit. K, 0.33 g; vit. B1, 0.33; vit. B2, 1.0 g; vit. B6, 0.33 g; vit. B5, 8.33 g; vit. B12, 1.7 mg; pantothenic acid, 3.33 g; biotine, 33 mg; folic acid, 0.83 g; choline chloride, 200 g; Zn, 11.7 g; Fe, 12.5 g; Cu, 0.5 g; I, 33.33 g; Se, 16.6 mg and Mg, 66.7 mg.

Table 2: Chemical composition, digestibility coefficients and nutritive values of berseem hay (BH), sugar beet tops silage (SBTS) and sugar beet tops hay (SBTH).

Item	BH	SBTS*	SBTH	±SEM	P-value
Chemical composition					
DM %	89.45	28.13	87.65		
Composition of DM %					
OM	89.70	78.42	77.54		
CP	14.35	15.36	13.78		
CF	27.64	12.35	12.74		
EE	2.45	2.45	2.28		
NFE	45.15	48.26	48.74		
Ash	10.30	21.58	22.46		
Digestibility coefficients %					
DM	66.20^{b}	68.80^{a}	68.35^{a}	0.47	0.037
OM	67.70^{b}	69.95^{a}	69.45^{a}	0.45	0.088
CP	67.60^{b}	70.38^{a}	67.64^{b}	0.42	0.008
CF	63.50^{b}	66.43^{a}	65.67^{a}	0.45	0.009
EE	70.42^{b}	75.63^{a}	74.27^{a}	0.75	0.003
NFE	66.40^{b}	70.57^{a}	69.17^{a}	0.88	0.002
Nutritive values					
TDN %	61.11^{a}	57.24^{b}	55.21^{c}	0.73	0.001
DCP %	9.70^{b}	10.81^{a}	9.32^{b}	0.19	0.002
DE (kcal/kg)	2694^{a}	2524^{b}	2479^{c}	32.25	0.001

*Silage quality was pH 4.15, lactic acid 4.28% of DM, TVFA's 2.52% of DM and NH_3-N 6.45% of total-N.
a, b, c: Values in the same row with different superscripts differ significantly (P<0.05).

Table 3: Chemical composition, digestibility coefficients and nutritive values of experimental diets by growing rabbits.

Item	Experimental diets					±SEM	P-value
	Control	SBTS		SBTH			
		50%	100%	50%	100%		
Chemical composition:							
DM %	91.25	59.94	44.63	90.85	90.47		
Composition of DM %							
OM	90.27	88.01	85.76	87.84	85.41		
CP	16.78	16.98	17.18	16.67	16.55		
CF	17.81	14.75	11.69	14.83	11.88		
EE	2.69	2.69	2.69	2.66	2.62		
NFE	52.99	53.59	54.19	53.69	54.39		
Ash	9.73	11.99	14.24	12.16	14.59		
Digestibility coefficients %:							
DM	69.47^{b}	70.88^{ab}	72.61^{a}	70.17^{b}	70.46^{b}	0.35	0.044
OM	70.84^{b}	72.29^{ab}	73.70^{a}	71.07^{b}	71.52^{b}	0.34	0.032
CP	71.35^{d}	76.71^{ab}	78.27^{a}	73.35^{cd}	74.44^{bc}	0.59	0.002
CF	64.63^{a}	62.17^{b}	61.38^{b}	62.59^{b}	61.44^{b}	0.36	0.015
EE	76.91^{b}	78.48^{ab}	79.62^{a}	77.26^{b}	77.78^{b}	0.31	0.029
NFE	71.18^{b}	72.63^{ab}	73.84^{a}	71.73^{b}	71.95^{b}	0.29	0.029
Nutritive values:							
TDN %	65.86^{a}	65.87^{a}	65.46^{ab}	64.63^{ab}	63.34^{b}	0.34	0.095
DCP %	11.97^{b}	13.03^{ab}	13.45^{a}	12.21^{b}	12.32^{ab}	0.19	0.058
DE (kcal/kg)	2904^{a}	2904^{a}	2886^{ab}	2850^{ab}	2793^{b}	15.38	0.095

a, b, c, d: Values in the same row with different superscripts differ significantly (P<0.05).

Table 4: Cecum microbial activity of growing rabbits fed experimental diets.

Item	Experimental diets					±SEM	P-value
	Control	SBTS		SBTH			
		50%	100%	50%	100%		
pH value	6.12^{abc}	6.07^{cd}	5.99^{d}	6.24^{a}	6.17^{ab}	0.03	0.032
TVFA's (mmol/dl)	8.74^{c}	10.08^{a}	10.58^{a}	9.68^{a}	10.16^{a}	0.18	0.006
NH_3-N (mg/dl)	21.87^{c}	23.90^{ab}	24.83^{a}	22.71^{bc}	23.58^{ab}	0.30	0.007

a, b, c: Values in the same row with different superscripts differ significantly (P<0.05).

Table 5: Body weight gain, feed intake and conversion and economic efficiency of growing rabbits fed experimental diets.

Item	Experimental diets					±SEM	P-value
	Control	SBTS		SBTH			
		50%	100%	50%	100%		
Initial weight (g)	772	774	774	773	775	2.39	0.997
Final weight (g)	2613^{ab}	2628^{ab}	2685^{a}	2622^{ab}	2592^{b}	12.94	0.221
Total weight gain (g)	1841^{ab}	1854^{ab}	1911^{a}	1849^{ab}	1817^{b}	11.11	0.084
Average daily gain (g/day)	26.30^{ab}	26.48^{ab}	27.30^{a}	26.42^{ab}	25.95^{b}	0.16	0.084
Feed intake (g DM/head/day)	105.35^{a}	93.81^{c}	91.01^{c}	98.56^{b}	94.55^{bc}	1.18	0.002
Feed consumption (kg DM)	7.37^{a}	6.57^{c}	6.37^{c}	6.90^{b}	6.62^{bc}	0.08	0.002
Feed conversion (kg DM/kg gain)	4.01^{a}	3.54^{b}	3.35^{c}	3.73^{b}	3.64^{b}	0.05	0.002
Total revenue (LE)	29.46^{ab}	29.66^{ab}	30.58^{a}	29.58^{ab}	29.07^{b}	0.18	0.097
Feed cost (LE/head)	14.60^{a}	12.61^{b}	11.86^{c}	12.98^{b}	11.80^{c}	0.23	0.002
Feed cost (LE)/kg gain	7.93^{a}	6.80^{bc}	6.21^{d}	7.02^{b}	6.49^{cd}	0.13	0.002
Net revenue (LE/head)	14.86^{c}	17.05^{b}	18.72^{a}	16.60^{b}	17.27^{b}	0.28	0.002
Net revenue improvement %	100.00^{c}	114.80^{b}	125.99^{a}	111.77^{b}	116.27^{b}	1.83	0.002

a, b, c, d: Values in the same row with different superscripts differ significantly (P<0.05).

The price of commercial rabbit diet 1800 LE/ ton, berseem hay 800 LE/ ton, sugar beet tops silage 150 LE/ ton, sugar beet tops hay 350 LE/ to, body weight gain 16 LE/ kg (2009).

Table 6: Carcass traits and chemical composition of meat of growing rabbits fed experimental diets.

Item	Experimental diets					±SEM	P-value
	Control	SBTS		SBTH			
		50%	100%	50%	100%		
Carcass traits							
Slaughter weight (g)	2508^{bc}	2525^{abc}	2583^{a}	2573^{ab}	2475^{c}	12.35	0.015
Carcass weight (g)	1512^{ab}	1529^{ab}	1590^{a}	1568^{a}	1468^{b}	13.46	0.022
Dressing %	60.29^{ab}	60.55^{ab}	61.56^{a}	60.94^{a}	59.31^{b}	0.25	0.054
Meat weight (g)	1058^{ab}	1070^{ab}	1113^{a}	1097^{a}	1028^{b}	10.47	0.071
Meat %	42.19^{ab}	42.38^{ab}	43.09^{a}	42.64^{ab}	41.54^{b}	0.18	0.084
Chemical composition of meat %							
DM	29.06^{a}	27.69^{bc}	26.96^{c}	27.97^{b}	27.24^{bc}	0.19	0.001
CP	77.17^{c}	80.01^{b}	81.63^{a}	80.00^{b}	79.50^{b}	0.36	0.001
EE	10.33^{b}	11.34^{a}	11.41^{a}	11.23^{a}	11.30^{a}	0.15	0.103
Ash	8.95^{b}	10.32^{a}	10.62^{a}	10.17^{a}	10.46^{a}	0.14	0.001

a, b, c: Values in the same row with different superscripts differ significantly (P<0.05).

CONCLUSION

From the present study, it could be concluded that replacing 100% of berseem hay by ensiled sugar beet tops showed the beast results concerning growth performance and carcass traits of growing rabbits.

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