

## REPLACEMENT OF BERSEEM HAY BY DRIED SWEET POTATO TOPS IN SHEEP RATIONS

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### SUMMARY

Eighteen female Rahmany lambs weighting 25 kg were divided into equal three groups in feeding trial to investigate the effect of replacement the berseem hay (BH) by dried sweet potato tops (DSPT) at different levels (0, 50 and 100%) on sheep performance. The animals in all groups were fed on 50% concentrate mixture (CM) from their energy requirements while roughages were fed ad libitum. Digestibility trials were carried out by using nine Rahmany rams to evaluate these roughages. Rumen liquor and blood samples were collected at the end of the experimental period. Results indicated that DM and OM digestibilities were significantly higher ( $P<0.01$ ) for group II (50% DSPT +50% BH) than group I (control, 100% BH). However, CF digestibility decreased ( $P<0.05$ ) for group III (100% DSPT) compared to group I (control). Digestibilities of EE and NFE were decreased ( $P<0.01$ ) for group I compared with both of groups II and III. On the other hand, CP digestibility increased ( $P<0.01$ ) for group II compared to the other groups. Value of TDN improved significantly ( $P<0.01$ ) for groups II and III compared to control group. Conversely, DCP increased ( $P<0.01$ ) for groups I and II compared to the group III. The average daily gain slightly improved by incorporation of DSPT in the rations II and III but the differences were insignificant. Feed conversion improved by 16.15 and 6.70%. Moreover, economical efficiency increased by 42.3 and 59.1% while, feed cost decreased by 29.66 and 37.11% for groups II and III, respectively compared to control group.

*Keywords: Sweet potato tops, berseem hay, sheep, digestibility, rumen, blood and nutritive value*

### INTRODUCTION

Many problems confront development of livestock, one of which is shortage of feedstuffs and the high cost of concentrate feed mixture. In Egypt the gap between the availability and requirements of feed is wide and estimated as 3 million ton of TDN per year, it is covered by 4-6 million ton of concentrate feed mixture (El-Shinnawy, 1990). Moreover, El-Shazly (1988) reported that, the shortage of feeds will be increased to 4.92 million ton of TDN by year 2000.

Animal feed resources in winter are mainly berseem while, in summer there is a serious shortage in feedstuffs. There are large quantities of farm by-products and agricultural residues that can be used as compensatory feeds for feeding ruminants. Inclusion some of the agricultural by-products to replace a part of the concentrate diet or traditional high quality roughages such as berseem hay (high price feeds) for animals become an obligation.

Sweet potato tops (*Ipomoea batatas*) that is one of the vegetable residues as non-traditional roughage in summer season, the sweet potato is cultivated in Egypt especially in the Beheira, Alexandria, Domiat and Kafr El-Sheikh governorate. After harvesting the yield of the sweet potato tubers, large quantities of SPT are produced as an agricultural by-products, its can be used in the ruminants feeding as fresh or dried form. Sweet potato tops may provide a useful source of forage for ruminants, it has low protein and high energy content (Moat and Dryden, 1993). Moreover, the sheep were given SPT maintained body condition and there were no metabolic disturbances (Maika *et al.*, 1989). Rizzi *et al.* (1992) indicated that the digestibilities of DM, OM and NFE were 83.8, 86.9 and 97.8%, respectively when they fed wethers ad libitum on a diet containing 68% integral forage plant of sweet potato. Moreover, when they fed the lambs (9 groups) on pelleted feeds with 40% concentrate mixture and 60% provided by different levels (15, 30 and 60%) of sweet potato forage (SPT), lucerne hay (LH) and wheat straw (WS). The sweet potatoes were well accepted and body fat content increased at high SPT level. Growth rate was best with SPT +LH mixture. Feed conversion was best with 30% SPT. Sweet potato vines containing a useful level of nutrients for ruminants (Nicholson *et al.*, 1978 and Wolfe, 1992). Lopez and Herrera (1998) indicated that the daily milk yield improved when Cuban Holstein cows fed sweet potato integral plant compared with that fed pasture only (7.6 vs. 6.4 liters/cow).

The objective of this work is to study the possibility of partial replacement of berseem hay by dried sweet potato tops (DSPT) in sheep rations to reduce the cost of animal feeding especially in summer season.

## MATERIALS AND METHODS

This study was carried out at the experimental farm of the Department of Animal Production, Faculty of Agriculture, Kafr El-Sheikh, Tanta University, Egypt. Three metabolic trials were carried out using nine Rahmany rams aged about two years and weighed 45 kg to evaluate the following rations: I- 100% berseem hay (control). II- 50% berseem hay + 50% dried sweet potato tops III- 100% dried sweet potato tops

The animals were fed ad libitum on these roughages rations. Water was available continuously. The preliminary period lasted for 14 days followed by 7 days collection period. At the end of collection period, composite feed feces and urine samples were prepared and preserved to analysis according to A. O. A. C. (1990).

Feeding trials were conducted using eighteen female Rahmany lambs weighing about 25 kg for 88 days. Animals were divided into three similar groups according to their weight. In all groups the animals were fed on 50 % concentrate mixture from their energy requirements according to NRC (1985). While the roughages were fed ad libitum at the same levels used in the digestibility trials. Animals were weighed (before feeding) on 2 consecutive days at the beginning and at the end of the treatment period and once bi-weekly during the experimental period. At the end of feeding trial the rumen liquor samples were taken 3 hours after the morning feeding by using stomach tube. pH was determined directly by using Beckman pH meter, while 1 ml. concentrated HCl was added to the rest samples to stop microbial activity and after that filtered through a double layer of cheese cloth and stored in polyethylene bottles in freezer until analysis. Total volatile fatty acids (VFA's) concentrations were estimated by using steam distillation methods (Warner, 1964). The concentration of  $\text{NH}_3\text{-N}$  was determined by using magnesium oxide (MgO) as described by the AOAC (1990). Blood samples were drawn at the same time of rumen liquor collection from the jugular vein into clean tubes. Ethylene diaminetetra acetate (EDTA) was added as anticoagulant. Blood samples were centrifuged at 3500 r.p.m. for 15 minutes to obtain plasma and then was stored at  $-20^\circ\text{C}$  until analysis. Blood haemoglobin (Hb) concentration was determined according to Drabkin (1932). Total plasma protein was determined according to Cornall *et al.* (1949), albumin was determined according to Weickse, (1946), globulin was estimated by the difference between total protein and albumin. Urea concentration was determined according to Patton and Crouch (1977).

The experimental data were statistically analysed by using Statgraphic Statistical Graphics System Software (Statgraphics, Version 5.0, Rockville, 1991). The model was used to estimate the significant differences, one-way analysis of variance.

## RESULTS AND DISCUSSION

Chemical composition of feed ingredients used in experimental rations is presented in Table 1. Dried sweet tops were higher in EE, ash and NFE content, while it is lower in CP, CF, ADF and NDF content comparing with berseem hay. Sauter *et al.* (1979) indicated that the chemical composition of potato vine for CP ranged from 9.9 to 11.9 %, CF 8.5 to 18.9 %, EE 1.0 to 4.6 %, starch 25.7 to 67.5 % and 17.4 to 33.4 % for ash.

Table 1. Chemical composition of the feed ingredients used in the experimental rations

Ingredients	DM%	Dry matter composition, %							
		OM	CP	CF	EE	NFE	Ash	ADF	NDF
Concentrate mixture*	90.01	91.87	15.57	9.64	3.85	62.81	8.13	---	---
Berseem hay	87.01	86.27	15.74	33.23	1.92	35.38	13.73	40.56	52.94
Dried sweet potato tops	88.92	84.50	10.24	24.69	2.15	47.42	15.50	34.99	44.18

\* Concentrate mixture composed of 35% undecorticated cotton seed cake, 23% yellow corn, 32% wheat bran, 4% rice bran, 3% molasses, 2% limestone and 1% common salt.

Feed intake, nutrients digestibility and nutritive value of experimental roughages used in sheep feeding are showed in Table 2. Dry matter intake ranged from 1.33 to 1.55 kg/day being significantly higher ( $P<0.05$ ) for group II (50 % BH+50% DSPT) comparing with the other groups. These results were in accordance with those found by Maika *et al.* (1989) when they fed ewes on sweet potato tops with or without elephant grass hay. Crude protein digestibility increased ( $P<0.01$ ) for group II compared to the other groups, this may be due to the differences in N intake and fecal-N for feed ingredients. Substitution of 50% BH with DSPT (group II) increased ( $P<0.01$ ) DM, OM, EE and NFE digestibilities compared to the control group. Whereas, CF digestibility was higher for ration I than ration III, this may be due to higher CF, ADF and NDF contents for BH comparing with DSPT. These results were in agreement with those reported by Ffoulkes *et al.* (1978), Ruiz *et al.* (1980), Rizzi *et al.* (1992) and Moat

and Dryden (1993), they reported that DM, OM and NFE digestibilities increased when sweet potato tops used in feeding ruminants. Nicholson *et al.* (1977) indicated that the DM of potato hay-silage and corn silage was equally digestible, while CP digestibility was higher for the potato hay-silage than the corn silage.

**Table 2. Feed intake, nutrient digestibilities and nutritive value of the experimental roughages using in sheep feeding**

Items	Groups			SEM	Significant level
	I	II	III		
Feed intake (kg, DM)	1.33 <sup>b</sup>	1.55 <sup>a</sup>	1.35 <sup>b</sup>	0.06	0.05
Digestibility, %					
DM	61.51 <sup>b</sup>	71.31 <sup>a</sup>	66.75 <sup>ab</sup>	1.06	0.01
OM	60.36 <sup>b</sup>	70.58 <sup>a</sup>	69.15 <sup>a</sup>	0.98	0.01
CP	60.35 <sup>b</sup>	71.37 <sup>a</sup>	58.35 <sup>b</sup>	1.19	0.01
CF	55.64 <sup>a</sup>	53.00 <sup>ab</sup>	48.66 <sup>b</sup>	1.37	0.05
EE	50.77 <sup>b</sup>	63.69 <sup>a</sup>	59.77 <sup>a</sup>	1.40	0.01
NFE	65.57 <sup>b</sup>	82.46 <sup>a</sup>	82.58 <sup>a</sup>	0.95	0.01
	Nutritive value, %				
TDN	53.23 <sup>b</sup>	61.81 <sup>a</sup>	60.04 <sup>a</sup>	0.86	0.01
DCP	9.50 <sup>a</sup>	8.99 <sup>a</sup>	5.97 <sup>b</sup>	0.16	0.01

I. 100 % Berseem hay      II. 50% Berseem hay +50% Dried sweet potato tops

III. 100 % Dried sweet potato tops

<sup>a, b</sup> Means within a raw with different superscripts are significantly differently

The presented data showed that TDN value ranged from 53.23 to 61.81 %, it increased ( $P < 0.01$ ) for DSPT than BH. Increasing TDN value may be due to improving the most nutrients digestibility when sheep fed DSPT. Moreover, DCP value ranged from 5.97 to 9.50%, it was higher ( $P < 0.01$ ) for ration I and II compared with ration III, this may be attributed to lower CP content in DSPT than BH. Sauter *et al.* (1979), Moat and Dryden (1993) reported that SPT is low in CP content, it ranged from 9.9 to 11.9% (on DM basis).

Data presented in Table 3. showed that the average values of nitrogen balance (g/day) were lower ( $P < 0.01$ ) for rams fed DSPT (group III) than the other groups, whereas group II showed higher value than group I, but the differences were insignificant. These results may be attributed to a low N intake and digestibility in group III compared to the other groups and a variable values of N in feces and urine for all groups. Nitrogen retention (as % of total N-intake) was higher ( $P < 0.01$ ) for group II than the other groups.

**Table 3. Average of nitrogen balance and nitrogen retention for Rahmany rams fed the different experimental rations**

Items	Groups			SEM	Significant level
	I	II	III		
Daily N. intake (g)	33.38	31.25	22.09	-----	-----
Daily N. in feces (g)	13.25	8.90	9.19	-----	-----
Daily N. in urine (g)	12.42	12.62	8.13	-----	-----
N. balance (g/day)	+7.71 <sup>a</sup>	+9.73 <sup>a</sup>	+4.77 <sup>b</sup>	0.46	0.01
N. retention (as % of total N. intake)	23.10 <sup>b</sup>	31.14 <sup>a</sup>	21.59 <sup>b</sup>	0.95	0.01

I. 100% Berseem hay      II. 50% Berseem hay +50% Dried sweet potato tops

III. 100% Dried sweet potato tops

<sup>a, b</sup> Means within a raw with different superscripts are significantly different

Data concerning of ruminal pH, VFA's and  $\text{NH}_3\text{-N}$  are presented in Table 4. There is no significant differences were observed in the ruminal pH values between the experimental groups. The concentration of VFA's and  $\text{NH}_3\text{-N}$  were significantly higher ( $P < 0.05$ ) for lambs fed 100% DSPT (group III) compared with those fed 100% BH (group I), while there is no significant differences between the two groups feed DSPT in their rations. Higher NFE content for DSPT in rations II and III may be lead to increase the efficiency of energy utilization by lambs caused increase of ruminal VFA's concentration. However, decrease ruminal  $\text{NH}_3\text{-N}$  in group I fed berseem hay may be due to higher CF, ADF and NDF content in BH comparing with DSPT. These results were in accordance with those reported by Varel *et al.* (1984), they found that inclusion of fiber in the diet decreases large intestine

ammonia levels. This circumstance would lead to reduction urinary N output as a result of decrease in non alpha-amino N absorption through the caecum and colon as it has been observed by Malmlof and Hakansson (1984). Moreover, Dominguez and Ly (1997) indicated that the inclusion of sweet potato vine in a diet of pigs by level of 100 and 200 g/day caused increase of ileal pH and daily flow of NH<sub>3</sub>-N concentration in feces, but it was unchanged in the ileum.

**Table 4. Average values of pH, NH<sub>3</sub>-N and total VFA's in rumen liquor for lambs fed the different experimental rations**

Item	Groups			SEM	Significant Level
	I	II	III		
PH	6.02	5.96	6.18	0.16	n.s
NH <sub>3</sub> -N (mg/100 ml.)	22.96 <sup>b</sup>	26.37 <sup>ab</sup>	28.13 <sup>a</sup>	1.28	0.05
VFA,s (meq/100 ml)	8.78 <sup>b</sup>	10.59 <sup>ab</sup>	11.56 <sup>a</sup>	0.59	0.05

I. 100% Berseem hay

II. 50% Berseem hay +50% Dried sweet potato tops

III. 100% Dried sweet potato tops

<sup>a, b</sup>. Means within a row with different superscripts are significantly different

Data concerning growth performance for lambs fed different rations are presented in Table 5. Total feed intake was nearly similar in all groups. However, average daily gain was 91, 112 and 104 g/day for groups I, II and III, respectively. Inclusion of DSPT in lambs ration increased growth rate by 23.1 and 14.3 % for groups II and III compared to the control group, but these increases were insignificant. These results may be due to DSPT is higher in energy content and more palatable than BH.

Feed conversion as kg DM/kg gain increased by 16.2 and 6.7 % for lambs fed rations II and III (containing DSPT), respectively compared to the control group (fed BH). Moreover, economical efficiency improved by 42.3 and 59.1 %, while feed cost as L.E/kg gain decreased by 29.7 and 37.1 % for lambs fed rations II and III, respectively compared to the control group. These results were in accordance with those reported by Maika et al. (1989), Rondon et al. (1989) and Rizzi et al. (1992) when they fed sheep on different levels of sweet potato with other roughages. Rizzi et al. (1992) indicated that sweet potato was well accepted and increased body fat content at high level. Moreover, growth rate was the best when sheep fed sweet potato and lucerne hay mixture, also feed conversion was the best when sweet potato fed at level 30% from the ration.

**Table 5. Means of growth performance for lambs fed different experimental rations**

Item	Groups		
	I	II	III
DM intake, g/day			
Concentrate mixture	521	521	521
Berseem hay	639	330	-----
Dried sweet potato tops	-----	338	648
Total feed intake	1160	1189	1169
Roughage, %	55.09	56.18	55.43
Initial wt., kg	25.04	24.99	25.29
Final wt., kg	33.08	34.83	34.42
Total gain, kg	8.04	9.84	9.13
Av. Daily gain, g/day	91 ± 5.75	112 ± 4.86	104 ± 5.74
Feed conversion (kg DM/kg gain)	12.69	10.64	11.84
Feed cost* (L.E/kg gain)	6.71	4.72	4.22
Economical efficiency**	1.49	2.12	2.37

\* Based on the assumption that prices of each one ton from concentrate mixture, berseem hay and dried sweet potato tops were 550, 400 and 150 L. E, respectively and one kg body weight on selling was 10 L.E. in year 2000.

\*\*Economical efficiency = Money output (price of weight gain)/Money input (price of feed consumed).

The average of some blood constituents for lambs consumed different rations is presented in Table 6. No significant differences were observed between groups for haemoglobin and urea concentration. However, plasma protein, albumin and globulin concentrations were higher significantly ( $P < 0.05$ ) for groups II and III than the control group. This may be due to inclusion of DSPT to the rations of ruminants increased the quantities of VFA,s formed to provide metabolizable energy and to stimulate protein synthesis in the rumen. Generally, the blood constituents values obtained were within the normal average as described by Reece (1991), El-Zayat and Kassem (1976) and Stanek et al. (1992)

indicated that blood plasma of sheep contains about 7.0 gm/100 ml protein, the latter composed of 4.0 % albumin, 2.7 % globulin and 0.3 % fibrinogen.

**Table 6. Average values of some blood constituents in lambs fed the different experimental rations**

Items	Rations			SEM	Significant level
	I	II	III		
Plasma protein, g%	5.83 <sup>b</sup>	6.72 <sup>a</sup>	6.96 <sup>a</sup>	0.18	0.01
Albumin, g%	3.16 <sup>b</sup>	3.66 <sup>a</sup>	3.60 <sup>a</sup>	0.01	0.05
Globulin, g%	2.67 <sup>b</sup>	3.06 <sup>ab</sup>	3.36 <sup>a</sup>	0.12	0.05
Haemoglobin, g%	12.22	9.65	10.75	0.76	n.s
Urea, mg %	37.43	37.45	36.75	1.84	n.s

<sup>a, b</sup>. Means within a row with different superscripts are significantly different

According to the results obtained in this study, it could be concluded that inclusion of dried sweet potato tops in sheep rations at levels 50 or 100 % is beneficial, it improved the digestibility of most nutrients, nutritive value, growth rate, feed conversion and economical efficiency. Moreover, it decreased feed cost, also it was more palatable than berseem hay.

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