AMELIORATING THE ANTI-NUTRITIONAL FACTORS EFFECT IN *ATRIPLEX HALIMUS* ON SHEEP AND GOATS BY ENSILING OR POLYETHELENE GLYCOL SUPPLEMENTATION

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SUMMARY

Succulent twigs of Atriplex halimus naturally grown in Nubaria desert area were cut and sun dried (AH), or ensiled (AS). The AH was offered either alone or with daily supplementation of polyethelene glycol (20 g PEG/kg DMI) as a tannin complex agent to sheep and goats. Berseem (Trifolium alexandrinum) hay (BH) was used as a control. Animals were offered crushed barley grains to cover 50% of maintenance requirements, while tested forages were offered ad lib.

The nutrients proximate analysis of BH was comparable to that of A. halimus. The average daily DM intake by both sheep and goats from BH (32.0 g/kg $w^{0.75}$) was higher (P<0.01) than AH, AS and AH+PEG, which ranged between 20.40 and 22.74 g/kg $w^{0.75}$, due to A. halimus high content of total tannin (95.6 g/kg DM) and its high contents of ash and NaCl. Nutrients digestibility coefficients of BH ration were better (P<0.01) than those of AH and AH+PEG rations, meanwhile they were comparable to those AS one. Ensiled A. halimus showed better digestibilities than AH alone (P<0.01) or with PEG supplementation, but the differences were only significant (P<0.01) with CF and NFE. Crude protein digestibility of AH was raised (P<0.01) from 49.3% without PEG to 54.19% with PEG. Moreover, N balance (P<0.01) and its percent of N intake were also high. Supplementing animals fed A. halimus by PEG improved (P<0.01) N balance and its percent to N intake, being 9.68% vs 8.03%.

It was concluded that ensiling A. halimus showed better nutritional results by sheep and goats than PEG supplementation. Moreover, it is easier to be practiced and coul lower feeding costs.

Keywords: Sheep, goat, atriplex halimus, anti-nutritional factors, ensiling, polyethelene glycol

INTRODUCTION

Browse plants play a significant role in nutrition of ruminant livestock in tropical and sub-tropical regions. Browse species, because of their resistance to heat, drought, salinity, alkalinity, drifting sand, grazing and repeated cutting, are the major feed resources during the dry season (Fagg and Stewart, 1994) . In addition, a major advantage of browses over herbaceous legumes and grasses is their higher crude protein content. However, due to the presence of secondary plant metabolites

(particularly tannins) in browses, digestibility of protein and organic matter in these feeds is low (Terrill *et al*., 1992; Silanikove *et al*., 1997; Waghorn and Shelton, 1997). This limits the availability of nutrients for ruminant livestock. Tannins have both beneficial and adverse effects. Beneficial effects of tannins include suppression of bloat (Jones *et al*., 1973) and protection of dietary proteins in the rumen (Waghorn *et al*., 1994). The adverse effects of tannins are associated with their ability to bind with dietary proteins, carbohydrates and minerals (McSweeney *et al*., 2001).
Crude protein in the browses range from 54.0 to 300.0 g/kg. However, the browses contained considerable amounts of secondary plant metabolites, particularly tannins which ranged from 7.0 to 214 g/kg dry matter as tannic acid equivalent (Getachew *et al*., 2002).

Saltbushes (*Atriplex spp*.) represents an important group of browses. They produce considerable amounts of biomass that can be utilized when herbaceous forage is scare. *Atriplex halimus* is found in semi-arid environments in the Mediterranean basin, where Egypt is located, and is valued as livestock forage when herbage availability is low (Le Houerou, 1993).

Atriplex halimus is characterized by its high ash and crude fiber, moderate crude protein and low crude fat contents (Gihad, 1993). However, it contains up to 10% sodium chloride and secondary plant metabolites, one of them is tannin, which considerably affects its palatability and nutritive value.

The objectives of this work were to study the effect either ensiling *A*. *halimus* or supplementing animals by polyethelene glycol (PEG) as a tannin complexing agent on its palatability and digestion by sheep and goats.

MATERIALS AND METHODS

This study was conducted at Nubaria Experimental Farm, El- Bostan, Behaira Governorate and laboratories of Animal Department, NRC, Giza, Egypt. Succulent twigs of *Atriplex halimus* shrubs naturally grown in Nubaria desert area were cut and either sun dried or ensiled. Dried and ensiled materials were defined as hay (AH) and silage (AS). The AH was fed either alone or with a daily oral supplement of polyethelene glycol (AH+PEG) at the level of 20 g/kg DM intake. Hay was made by chopping and spreading the cut twigs on a thin plastic sheet to avoid mechanical losses and sand contamination.

Silage was made by chopping the cut twigs and adding 10% of its weight sugar cane molasses which was deluted by fresh water. The mixture was ensiled for 45 days in hard plastic barrels with tight sealed cover.

Three mature male sheep (31 kg) and goats (21 kg) were used to evaluate nutrients digestibility and N utilization of AH, AS, AH+PEG and berseem (*Trifolium alexandrinum*) hay (BH) rations. The BH was used as a control ration. Crushed barley grains were offered to cover 50% of maintenance requirements for sheep (ARC, 1965) and goats (NRC, 1981), while tested forages were offered *ad lib*. Drinking fresh water was available for the experimental animals.

Proximate analysis and Na were determined according to A.O.A.C., (1990) methods. Goering and Van Soest, (1970) methods were used to determine cell wall constituents (CWC). Tannin was determined according to Pharmacopoeia Europian,

(1974, 1975 and 1978). Data obtained in this study was statistically analyzed according to SAS (1990). Differences among means were examined using Multiple Range Test according to Duncan, (1955).

RESULTS

The data presented in Table (1) showed that nutrients proximate analyses of *A. halimus* were comparable to those of berseem hay. However, it showed better CP content 13.45% vs 11.84%. *Atriplex halimus* showed the highest ash (20.05%) and Na (3.96%) contents. Calculated NaCl (Ishihawa *et al*., 2002) content of *A. halimus* would be 10.50%. It contained 95.6 g/kg total tannin.

Table 1. Chemical analysis of experimental rations ingredients

Item	BH	AH	AS	BG
Moisture, %	12.51	12.30	65.53	10.20
Proximate analysis (DM basis), %				
OM	88.66	79.95	79.65	93.28
CP	11.84	13.45	13.99	8.49
CF	24.97	30.19	26.34	9.59
EE	3.09	4.80	4.17	1.54
NFE	60.10	31.51	35.15	73.66
Ash	11.34	20.05	20.35	6.72
Cell wall constituents (DM basis), %				
NDF	35.43	48.34	48.27	28.67
ADF	19.05	32.57	33.04	15.79
ADL	8.44	11.85	11.42	2.17

BH = Berseem hay; AH = Atriplex hay; AS = Atriplex silage; BG= Barley grains.

The daily DM intake (Table 2) by both sheep and goats from barley to cover 50% of their maintenance requirement was 19.44 g/kg $w^{0.75}$. The dry matter intake (DMI) from the experimental forages as shown in Table (2) was variable. Both animal species consumed higher average amounts from BH (32.56 g/kg $w^{0.75}$) than AH, AS and AH+PEG, being 22.74, 21.22 and 20.40 g/kg $w^{0.75}$, respectively. The variation within DM of the latter three rations was in narrow limits. Differences between sheep and goats were out of the study objectives, therefore the results mean values for the two species were used.

The BH ration showed better nutrients digestibilities than the other three rations *A. halimus* (Table 2). The differences were significant ($P<0.01$) between those of BH and AH and AH+PEG (except for CP), where there were no significant differences compared with those of AH+PEG. Accordingly, these results were reflected on better ($P<0.01$) TDN and DCP values. Ensiling *A. halimus* showed better ($P<0.01$) digestibilities for all nutrients than feeding it as hay alone or with PEG, except CP digestibility of AH+PEG which showed comparable values. Supplementing animals fed AH by PEG improved ($P<0.01$) CP digestibility, being 49.31% for AH vs 54.19% for AH+PEG, however it was almost similar to AS (54.22%).

Table 2. Daily intake, digestibility, nutritive value and nitrogen utilization of feeds and experimental rations by sheep and goats

Item	BH		AH		AS		AH+PEG		Mean of treatments			
	Sheep	Goat	Sheep	Goat	Sheep	Goat	Sheep	Goat	BH	AH	AS	AH+ PEG
No. of Animals	3	3	3	3	3	3	3	3	6	6	6	6
Av. Body wt.:												
,kg	34.92	22.53	24.53	19.54	31.26	21.66	33.69	20.98	28.72	22.06	26.46	27.33
,kg $w^{0.75}$	14.36	10.34	11.04	9.29	13.22	10.04	13.98	9.80	12.35	10.16	11.63	11.89
DM intake g/kg $w^{0.75}$:												
Forage	29.86	35.26	24.99	20.50	20.98	21.46	20.81	19.99	32.56^{a}	22.74^{b}	21.22^{b}	20.40^{b}
Forage+barley	49.30	54.70	44.43	39.94	40.42	40.90	40.25	39.43	52.00	42.18	40.66	39.84
Nutrient digestibility, (%):												
DM	58.73	67.12	49.21	52.13	54.81	63.34	49.96	56.33	62.92^{a}	50.67^{c}	59.07^{ab}	56.65^{b}
OM	57.68	65.40	50.37	53.08	58.93	58.49	53.85	58.19	61.54^{a}	51.72^{c}	58.71^{ab}	56.02^{b}
CP	51.45	57.25	48.52	50.11	53.39	55.06	50.07	58.31	54.35^{a}	49.31^{c}	54.22^{a}	54.19^{a}
EE	46.18	56.27	49.89	52.19	50.28	52.31	50.10	50.29	51.22	51.04	51.29	50.19
CF	61.26	61.59	53.93	55.23	60.37	60.37	55.73	59.73	61.42^{a}	54.58^{c}	60.37^{a}	57.73^{b}
NFE	62.56	72.00	50.64	56.73	62.34	67.37	52.09	59.45	67.28^{a}	53.68^{b}	64.85^{a}	55.77^{b}
Nutritive value, (%):												
TDN	60.52	68.23	45.31	49.45	52.60	56.94	46.86	52.33	64.34^{a}	47.38^{c}	54.77^{b}	49.59^{c}
DCP	5.41	6.18	4.27	4.39	4.84	4.96	4.39	4.83	5.79^{a}	4.33^{c}	$4.9a^{b}$	4.61^{b}
N utilizatin, mg/kg $w^{0.75}$:												
N intake (NI)	829	931	624	560	644	590	564	552	880^{a}	592^{c}	617^{b}	558^{c}
Fecal N	371	390	301	243	319	273	247	250	380.5^{a}	272^{bc}	296^{b}	248.5^{c}
Urinary N	329	382	281	264	252	241	268	243	355.5^{a}	272.5^{b}	246.5^{c}	255.5^{c}
N alance	129	159	42	53	73	76	49	59	144^{a}	47.5^{d}	74.5^{b}	54.0^{c}
N balance/NI, %	15.56	17.08	6.73	9.46	11.33	12.88	8.69	10.69	16.36^{a}	8.03^{d}	12.07^{b}	9.68^{c}

$^{a, b, c, d}$ means in the same row with different superscripts differ ($P<0.01$).

The data (Table 2) of daily N balance of BH ration showed the highest (P<0.01) N balance which was reflected on high N balance / N intake percent than rations contained *A. halimus*.

Ensiling *A. halimus* showed better (P< 0.01) N balance and accordingly N balance / N intake percent than being fed as AH or AH+PEG.

Supplementing animals by PEG showed better (P<0.01) nitrogen retention than animals fed AH rations. Meanwhile, PEG supplementation improved (P<0.01) N retained / N intake percent, being 8.03% for AH and 9.68% for AH+PEG rations.

DISCUSSION AND CONCLUSION

Both berseem hay and *Atriplex halimus* showed comparable chemical nutrients contents. Nevertheless, dry matter intake by both sheep and goats from BH was higher (P<0.01) than AH. In the other words, AH was less palatable than BH. This result might be due to high ash, Na and NaCl contents. Moreover, AH contained considerable amounts of total tannin, being 95.6 g/kg DM, which seems to be an anti-nutritional factor which decreased its palatability. Getachew et al., (2002) found that total tannin content in browsed plant species were from 7 to 214 g/kg DM.

Supplementing both sheep and goats by PEG as a tannin complexing agent did not obviously affect AH palatability measured as DM intake. This result agreed with Decandia *et al*. (2000) who reported that PEG supplementation did not affect DM intake. Nevertheless, it caused higher (P< 0.01) increase in organic matter digestibility and crude protein digestion and utilization.They found that the *in vivo* CP digestibility of the diet increased from 37% without PEG to 71% with 50g PEG supplementation. Moreover, Silanikove *et al*., (1996) reported a significant increase in organic matter digestibility of Mediterranean browses from maintenance level to levels considerably exceeding the maintenance requirements of goats as a result of daily supplementation of PEG. The present results were in line with the above authers findings showing that 20g PEG daily supplementatin enhanced (P<0.01) organic matter and crude protein digestibilities of AH by sheep and goats. Moreover, PEG improved (P<0.01) CP utilization estimated as N balance and N balance / N intake percent. Similar trends were obtained by Decandia *et al*. (2000) who found that PEG increased the intake of digestible N and tended to increase N balance.

Ensiling *A. halimus* as a process to ameliorate the anti- nutritional factors effect on both sheep and goats showed better (P<0.01) nutrients digestibiliy and nutritive value as energy (TDN) or digesible crude protien (DCP) than untreated one, however, it did not affect its palatability measured as dry matter intake. Atriplex silage showed better (P< 0.01) N balance and N balance / N intake percent than rations contained *A. halimus* with or without PEG.

Ensiling *A. halimus* as a browse forage showed comparable results to PEG supplementation. In the mean time this process might be easier and might lower feeding cost than daily PEG supplementation. Therefore, it might be preferable than the later one in developing countries to ameliorate the anti-nutritinal factors effect of browsed plant species on ruminant livestock.

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الحد من أثر المواد الضارة فى نبات القطف الملحى على الأغنام والماعز بواسطة السيلجة أو إضافة مادة البولى ايثيلين جليكول

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تم الحش والحصول على كميات من الأغصان والفروع الغضة من نبات القطف الملحى والموجودة بصورة طبيعية فى صحراء النوبارية وتجفيفها شمسيا (دريس القطف) وكذلك تم عمل جزء منها سيلاج. تم تغذية الأغنام والماعز على دريس القطف بصورة منفردة أو بإضافة مادة البولى ايثيلين جليكول (٢٠ جم / كجم مادة جافة مأكولة) وأستخدم دريس البرسيم كعليقه مقارنة. وغذيت المجموعة الأخيرة من الحيوانات على سيلاج نبات القطف. غذيت الحيوانات على حبوب الشعير المجروشة لتغطى ٥٠% من الاحتياجات الحافظة لها.

تشير النتائج الى أن كمية المادة الجافة المأكولة من دريس البرسيم بواسطة الأغنام والماعز (٣٢.٥ جم /كجم حيز جسم تمثيلى) كانت أعلىمعنويا من الحيوانات التى غذيت على دريس القطف بدون أو بإضافة مادة البولى ايثيلين جليكول أو التى غذيت على سيلاج نبات القطف حيث تراوحت كمية المادة الجافة المأكولة ما بين ٢٠.٤ الى ٢٢.٧٤جم /كجم حيز جسم تمثيلى) و يعزى ذلك الى ارتفاع محتوى نبات القطف من الرماد وكلوريد الصوديوم والتانينات.

كذلك أشارت النتائج الى أن معاملات الهضم للمجموعة المغذاة على دريس البرسيم كانت أفضل معنويا من كل العلائق الأخرى. عملية السيلجة لنبات القطف أظهرت أن معاملات الهضم كانت أحسن معنويا من التى غذيت على دريس القطف بدون أو بإضافة مادة البولى ايثيلين جليكول ولكن هذه الاختلافات كانت معنوية فقط مع معامل هضم كل من الألياف ومستخلص خالى الأزوت. وانعكس ذلك النتروجين المحتجز فى الجسم وكذلك نسبة النتروجين المحتجز الى النتروجين المأكول. كما أوضحت النتائج أن إضافة مادة البولى ايثيلين جليكول رفعت معامل هضم البروتين من ٤٩.٣١% لدريس القطف بدون إضافة مادة البولى ايثيلين جليكول الى ٥٤.١٩% بإضافة مادة البولى ايثيلين جليكول الى دريس القطف. أيضا حسنت هذه الإضافة من النتروجين المحتجز تحسنا معنويا وكذا نسبة النتروجين المحتجز الى النتروجين المأكول عن دريس القطف بدون إضافة حيث كانت ٩.٦٨% مع الإضافة مقابل ٨.٠٣% بدون إضافة.

يستخلص من هذه النتائج أن علية إعداد نبات القطف سيلاج حسنت من أداء الأغنام والماعز عن إضافة مادة البولى ايثيلين جليكول الى دريس القطف كما أنها أسهل من الناحية العملية وذات تكلفة أقل.