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IMPROVEMENT THE NUTRITIVE VALUE OF SOME UNPALATABLE DESERT PLANTS BY ENSILING TREATMENT WITH PALATABLE PLANTS AND MOLASSES ADDITIVES.

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ABSTRACT

This work aimed to improving the utilization of some unpalatable desert shrubs by mixing with palatable plants applying ensiling process. Three plants, *Kochia indica* (palatable), *Hammada elegans* and *Thymelaea hirsuta* (unpalatable) were collected during the green season of each plant. Preliminary investigations were conducted for three weeks to determine the palatability and the feed intake by using three mature male local sheep and three mature Baladi goats. Then two silage mixtures were prepared as Kochia with Thymelaea (silage type I) and Kochia with Hammada (silage type II). Four metabolism trials were carried out using six mature male local sheep average 40 Kg and six mature Baladi male goats average 30 Kg live body weight (three animals in each), animals were fed silage *ad lib* and supplement with barley grains to cover 50 % of energy maintenance requirements. Results revealed that Kochia had low ash and silica (13.9 % and 2.8 % , respectively) compared with other two plants, which contain 19.7 % and6.5 % & 21.1 % and 5.7 % for Thymelaea and Hammada, respectively. Average daily DM intake by sheep and goats from Kochia as palatable plant was higher ($p<0.05$) than those other two plants. Ensiling process improved DM intake from the two silage mixtures (28.3 and 35.5 g/kg $w^{0.75}$) for silage type I and II, respectively. The nutrients digestibility of DM, OM, SP and NFE were higher ($p<0.05$) when animal fed silage type II than those fed silage type I. The digestibilities of NDF and ADF were nearly the same for silage type I and II, except the hemicellulose and cellulose digestibilities were attendance increased for silage I than silage II. Nitrogen retention expressed as in terms of (g/kg $w^{0.75}$) for sheep was higher ($p< 0.05$) than goats when animals fed two silage mixtures. The results obtained indicated that the mixing palatable and unpalatable desert plants can be successfully ensiled and that improve the utilization for DM and nutritive values by range sheep and goats.

Keywords: Desert range, Silage making, Intake, Digestibility, Sheep and goats

INTRODUCTION

Egypt is classified as a semi-arid country. The irrigated valley represents 4% of its land while the rained desert is 96%. The existing shortage of animal feeds in Egypt necessitates that research efforts should be directed towards exploring the possibility of using new non-conventional types of plants as animal feeds and improving their nutritive values. Natural desert range plants are mostly halophytic. They are resistant to salinity and drought attribute, which improve their survival in desert. They are extremely valuable as fodder reserve under these harsh conditions palatable plants are few and always over-grazed and disappear fast. Less and unpalatable species are numerous and have a patchy distribution (Gihad and El-Shaer. 1994). Attempts have been made to improve the utilization of halophytic

shrubs by sheep and goats using the ensiling process of low or unpalatable in mixing with some local available additives such as fodder beet or date stone (El-Shaer *et al.*, 1991, Hanafy *et al.*, 1996 and shoukry *et al.*, 1999).Recent study by Abd El-Rahman 2003 classified the natural range plants according average daily dry matter intake by both sheep and goats as a parameter to express palatability to three categories: 1) palatable, 2) less palatable and 3) unpalatable.

The objective of this work aimed to the ameliorating unpalatable plants by mixing with palatable plants by ensiling process and study the effects on feed intake, nutrients digestibility and nitrogen utilization along with some ruminal parameters by sheep and goats.

MATERIALS AND METHODS

This study was conducted at the experimental Nubaria farm and laboratories of NRC, Giza, Egypt. Three range plants naturally grown with relatively high biomass in Nubaria desert and Western Coast of Egypt were collected during the green season of each plant, chemically analyzed. Investigated plants were *Kochia indica* (collected from Nubaria desert), *Hammada elegans* and *Thymelaea hirsute* (collected from North Western Coast). The first plant characterized palatable, while the other two plants were unpalatable. A preliminary investigation was conducted for three weeks to determine the palatability and the intake of the three shrubs before ensiling by sheep and goats. Three mature male of local sheep and three mature Baladi goats were kept in pens individually and offered the three plants *ad lib.* Animals were supplemented by barley grains to cover 50% of energy maintenance requirements. Intake was calculated daily.

Two experiments were carried out to evaluate the two silage mixtures which containing Kochia and Thymelaea (Exp. I) or Kochia with Hammada (Exp. II). Four metabolism trials (two with sheep and the other two with goats) were carried out using six mature male local sheep averaged 40 kg live body weight and six mature male Baladi goats averaged 30 kg live body weight (3 animals in each).

Animals were offered the silage *ad lib* and a supplement of barley grains to cover 50% of energy maintenance requirements according to the recommended rations of the NRC (1981)for goats and (NRC) 1985 for sheep. Animals were kept in pens and fed on their rations for three weeks as an adaptation period. During this period, the animals were fed gradually to avoid any adverse effect then they were kept individually in wooden metabolic crates for 15 days as a preliminary period followed by 7 days for total faeces and urine collection. Faeces and urine were collected once daily at 07:00. The animals were usually offered their diet once daily at 08:00. Residual rations if any were daily weighed and representative samples of rations offered and residues were taken for DM determination. Water was always available to the animals. At the end of each digestion trial, rumen liquor samples were taken from each animal before feeding and at 0 and 4 hrs. post feeding; then filtered. Values of pH were immediately measured after

sampling by the digital combination electrode pH meter. The concentration of ammonia-nitrogen and total volatile fatty acids in the rumen liquor was determined according to Conway and O'Malley (1942) and Warner (1964), respectively. Nutrients digestibility of the two silage types were determined by differences using the values of barley obtained by Abd El-Rahman (1996).

Silage making:

Fresh harvested palatable and unpalatable plants were chopped (2.5-5 cm). Two silage mixtures were formulated by mixing the palatable (Kochia) plant with Thymelaea (silage type I) and Hammada (silage type II) in equal portions of each on a DM basis (1:1). The mixtures were ensiled in hard plastic barrels with tight sealed cover after mixing with 10% molasses of the dry matter of chopped plants. Sugar cane molasses dissolved in less amounts of water and sprayed with each mixtures form. Plastic sheet was used and placed under the stock to minimize mechanic losses and soil contamination. Ensiling period usually lasted for 60 days. Individual samples from each silage were thoroughly mixed and composite sample was kept for chemical analyses.

Chemical analyses:

The dietary ingredients, silage mixtures, faeces, feed residues and urinary nitrogen were chemically analyzed according to A.O.A.C. (1990). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to Goering and Van Soest 1970).

Statistical Analysis

Data obtained from this study was statistically analyzed using SPSS (1999). Differences among means were examined using multiple range test according to Duncan (1955).

RESULTS AND DISCUSSION

1- The chemical composition:

Approximate analysis of the plants desert shrubs as silage ingredients (Table 1) showed that Kochia had low ash and silica content (13.9% and 2.8%) compared with other shrubs, which contain 19.7% and 6.5% & 21.1% and 5.7% for Thymelaea and Hammada, respectively. Crude protein content of Kochia was higher than those of Thymelaea and Hammada. The lowest CF values were detected in *Hammada elegans*. The proximate analysis of other nutrients as well as cell wall constituents (CWC) showed buzzing results, which did not follow the establish knowledge with traditional feedstuffs (Table 2).

2- Feed intake:

Average daily DM intake by both sheep and goats from the experimental plants and silage mixtures (Table 3) showed that Kochia as palatable plant had higher ($p<0.05$) DM intake than those other plants as unpalatable shrubs. Similar results were obtained by Gihad *et al.*, (2003). Ensiling the two types plants (palatable and unpalatable) increased ($P<0.05$) DM intake by both sheep and goats.

Table 1. Proximate analysis experimental plants and silage mixtures.

Item	Moisture	DM Composition %					
		OM	CP	CF	EE	NFE	Ash
Plants							
Kochia indica	68.5	86.1	14.5	31.3	2.7	37.6	13.9
Thymelaea hirsuta	60.7	80.3	8.9	32.5	4.1	34.8	19.7
Hammada elegans	72.8	78.9	8.1	17.8	3.7	49.3	21.1
Silage mixtures							
Kochia + Thymelaea	61.8	87.4	11.3	30.4	3.2	50.5	12.6
Kochia + Hammada	57.5	87.0	10.8	28.3	2.5	55.4	13.0
Barley grains	10.2	96.8	10.2	9.4	3.1	74.1	3.2

Table 2. Cell wall constituents and silica (DM basis %) of the plants and silage mixtures.

	NDF	ADF	ADL	Hemic.	Cellulose	Silica
Plants						
Kochia indica	62.8	39.4	12.0	23.4	27.4	2.8
Thymelaea hirsuta	58.9	35.0	17.3	23.9	17.7	6.5
Hammada elegans	36.6	18.6	7.1	18.0		5.7
Silage mixtures						
Kochia + Thymelaea	62.3	40.6	14.9	21.7	25.7	3.1
Kochia + Hammada	63.3	41.9	13.8	21.4	28.1	2.3
Barley grains	26.6	8.1	2.3	18.5	5.8	-

Table 3: Intake of range plants and silage mixtures by sheep and goats.

Item	Daily feed intake (g DM) $kgw^{0.75}$		
	Sheep	Goats	Means
Plants			
Kochia indica	56.8^{a}	58.6^{a}	57.7
Thymelaea hirsuta	2.6^{c}	2.9^{d}	2.7
Hammada elegans	1.7^{c}	1.9^{d}	1.8
Silage mixtures			
Kochia + Thymelaea	28.3^{b}	28.4^{c}	28.3
Kochia + Hammada	32.0^{b}	39.3^{b}	35.5

A, b, c, d, Means within the same column with different superscript are significantly (P< 0.05)different

This results agree with obtained by EL- Shaer *et al.*, (1990) and Shoukry *et al.*, (1999) increasing DM intake of desert shrubs silage comparing with those before ensiling might be due to the effect of ensiling treatment along with the effect of enriching the mixtures by the high palatable plant (Kochia) and molasses on mixtures palatability.

Abd EL-Rahman (2003) indicated that qualitative screening of the palatable plants showed lowest detected of saponins, sterols and flavonoids and not detected of alkaloids, tannins and coumarine, while the unpalatable plants showed the highest detected contents of alkaloids, flavonoids, sterols and coumarine. Therefore, quantitative analysis could be a reliable indicator to the presence and concentration of secondary metabolites in rangelands. High level of tannins depressed feed intake, digestibility of protein and carbohydrates and animal performance (Reed,1995). High amounts of

alkaloids (1.5% - 4.5 % w/w) causes gastrointestinal disorder in cattle and sheep (Yurshenko and Muratora, 1987) Alkaloids have been reported to limit *in vitro* digestion by rumen organisms (Marten,1973). Saponins have negative effect on growth rates in livestock as well as toxicity effect (Price *et al.*, 1987) and high concentration of saponins decreased Fe absorption (Southorn *et al.*, 1988). Moreover, silage making decreased the detection of the anti-nutritional factors in silage mixtures compared with those before ensiling. This may explain the improved DM intake of the desert shrubs mixtures by ensiling treatment.

3- Nutrients digestibility and nutritive values

Results concerning digestibility of nutrients and cell wall constituents and nutritive values by sheep and goats fed ration containing barley grains plus two type silage mixtures are shown in Table (4). Sheep showed higher (P<0.0 5) values of DM, OM, CP and NFE digestibility when fed two type silage mixtures compared with goats when fed the same diets. Although, there were higher in CF digestibility for sheep than goats, yet this deference were not statistically significant.

Table 4: Mean values for nutrients digestibility and nutritive values by sheep and goats fed rations containing barely grains plus silage mixtures,

Item	Rations				Means			
	Ration I		Ration II		Silage treatment		Animal species	
	Sheep	Goats	Sheep	Goats	Treat I	Treat II	Sheep	Goats
Nutrients digest., %								
DM	65.5	60.6	68.4	66.0	63.1	67.2*	66.9*	63.3
OM	67.0	63.1	69.5	67.2	65.1	68.4*	68.3*	65.2
CP	62.5	58.1	65.1	61.2	60.3	63.2*	63.8*	59.7
CF	57.1	53.4	59.5	55.1	55.3	57.3	58.3	54.3
EE	70.4	67.7	67.9	63.6	69.1*	65.8	69.2*	65.7
NFE	73.7	69.0	74.5	72.8	71.4	73.7*	74.1*	70.9
CWC, digest., %								
NDF	52.2	48.9	51.9	49.6	50.6	50.8	52.1*	49.3
ADF	44.7	44.9	43.6	43.2	44.8	43.4	44.2	44.1
Hemicellulose	62.8	54.9	64.9	59.2	58.9	62.1	63.9*	57.1
Cellulose	55.1	56.7	56.7	58.4	55.9	57.6	55.9	57.6
Nutritive values, %								
TDN	65.3	60.4	66.3	63.2	62.9	64.8	65.8*	61.8
SV	49.9	44.0	52.3	48.8	46.9	50.6*	51.1*	46.4
DCP	7.0	6.6	6.9	6.6	6.8	6.8	7.0*	6.6

* Significant at 5 % level of probability.

Results obtained indicated, also that sheep showed higher (P<0.05) in values of TDN, SV and DCP when fed rations containing two type silage mixtures compared with goats.

Concerning the digestibility of cell wall constituents results showed that sheep digested more (P<0.05) NDF, ADF and hemicelluloses than goats, while goats showed higher (P<0.05) cellulose digestibility than sheep when animals fed two types silage mixtures of halophytic plants.

On the other hand, the nutrients digestibility of DM, OM, CP and NFE were higher (P <0.05) when animals fed silage mixture type II than those fed silage mixture type I. Although, there were increased in CF digestibility for silage mixture type II than silage mixture type I, yet this difference was not statistically significant. Results indicated that TDN values was a tendency increased for silage type I than silage type II, except SV values was higher (P<0.05) four silage type I than silage type II when animals fed two rations.

The digestibilities of cell wall constituents showed nearly the same NDF and ADF for silage I and II, when animals fed two rations. While, silage II was a tendency for increased hemicelluloses and cellulose digestibilities than silage I, yet these differences were not significant.

Results concerning digestibility of nutrients and cell wall constituents and nutritive values of two silage mixtures (Table (5) calculated by differences using sheep and goats.Silage mixture containing Kochia and Hammada showed higher (P<0.05) digestibilities of DM, OM, CF and EE than silage mixture containing Kochia and Thymelaea when both animals fed two type silage mixtures. The nutritive values expressed as TDN, SV and DCP (Table 5) should higher (P<0.05) in SV values for the silage type II than type I. The TDN values was slightly higher for silage II than those of silage I (52.6% VS 50.9%, respectively) when sheep and goats fed two type silage mixtures.

Table 5: Mean values for nutrients digestibility and nutritive values of silage mixtures by sheep and goats calculated by difference.

Item	Silage mixtures				Means			
	Type I		Type II		Silage treatment		Animal species	
	Sheep	Goats	Sheep	Goats	Treat I	Treat II	Sheep	Goats
Nutrients digest., %								
DM	53.7	53.4	56.7	58.6	53.6	57.7*	55.2	56.0
OM	53.4	55.1	55.6	58.1	54.3	56.9*	54.5	56.6*
CP	51.4	51.3	52.8	52.4	51.4	52.6	52.1	51.9
CF	52.7	53.3	59.0	58.0	53.0	58.5*	55.9	55.7
EE	62.1	65.7	51.6	56.0	53.9	53.8	56.9	60.9
NFE	54.1	55.6	58.5	56.4	54.9	57.5*	56.3	56.0
CWC, digest., %								
NDF	48.7	48.6	47.8	49.4	48.9	48.6	48.3	49.0
ADF	44.9	45.8	43.6	44.4	45.4	44.0	44.3	45.1
Hemicellulose	55.8	53.7	57.9	59.3	54.9	58.6	58.9	56.5
Cellulose	56.4	56.9	57.6	60.7	56.7	59.2*	57.0	58.8*
Nutritive values, %								
TDN	50.3	51.4	52.1	53.0	50.9	52.6	51.2	52.2
SV	30.5	31.5	33.8	34.7	31.0	34.3*	32.2	33.1
DCP	6.1	6.0	5.8	5.7	6.1*	5.8	6.0	5.9

*** Significant at 5 % level of probability.**

Concerning the digestibilities of cell wall constituents, the results showed nearly the same for NDF and ADF digestibility's (48.9 and 48 6% and 45.4% and 44.0% , respectively) when both animals fed two silage mites while, the silage mixture type II recorded higher (P<0.05) values of hemicelluloses and cellulose digestibilities than those of silage mixture type I.

On the other hand, results indicate that sheep and goats were nearly the same values for almost nutrients digestibility and nutritive values when animals fed two silage mixtures

4. Nitrogen utilization:

The results concerning the nitrogen intake excreated nitrogen and nitrogen retention expressed as g/kg $w^{0.75}$ are shown in Table (6). Goats fed silage mixtures showed higher ($P<0.05$) of nitrogen intake as g/kg $w^{0.75}$ than sheep fed the same silage mixtures. While, sheep excreated less fecal and urinary nitrogen (g/kg $w^{0.75}$) than goats when fed rations containing silage mixtures. These results reflected on nitrogen retention for sheep was higher ($P <0.05$) than goats.

Table 6: Nitrogen balance of sheep and goats fed the experimental rations.

Item	Rations							
	Silage I + BG				Silage II + BG		Animal species	
	Sheep	Goats	Sheep	Goats	Treat1	Treat2	Sheep	Goats
Nutrients balance, 9/kgw$^{0.75}$								
N intake	0.85	1.05	0.75	0.79	0.95*	0.73	0.8	0.92*
N loss								
Fecal N g/kgw$^{0.75}$	0.32	0.44	0.26	0.31	0.38	0.29	0.29	0.38
Urinary g/kgw$^{0.75}$	0.36	0.48	0.40	0.39	0.42	0.40	0.38	0.44
Total N loss, g/kgw$^{0.75}$	0.68	0.92	0.66	0.70	0.80	0.68	0.67	0.81
Nitrogen retention								
N retention g/kgw$^{0.75}$	0.18	0.14	0.08	0.06	0.16*	0.07	0.13	0.10
% from intake	20.52	12.80	11.33	7.58	16.7*	9.45	15.93*	10.19

* Significant at 5 % level of probability.

All sheep and goats were positive nitrogen balance. Sheep showed higher ($P<0.05$) nitrogen balance in terms of % from nitrogen intake than goats when fed two silage mixtures.

On the other hand, the silage mixture type I was better ($P<0.05$) than silage type II in nitrogen intake and nitrogen balance when both animals species fed on two silage mixtures. Generally, ensiling process improved the utilization form nitrogen intake and nitrogen balance for sheep and goats when fed rations containing the two types silage mixtures. This result is in agreements with those obtained by Khamis (1988); El-Shaer *et al.*, (1990) and Shoukry *et al.*, (1999), who reported that ensiling process could be improved the utilization of some unpalatable halophytic plants.

5. Rumen liquor Parameters:

Results of rumen liquor parameters (pH, ammonia-nitrogen and TVFs concentration) were comparable to those obtained by several investigations (Fenner *et al.*, 1967 and Wheaton *et al.*, 1970). Who reported that pH values decreased and reached the lowest level through 2-6 hr. after feeding. The same trend was recorded in this study for sheep and goats (Table 7).

Finally the present study indicated that the possibility of improving the utilization of unpalatable desert plants by silage making.

Table 7: Rumen parameters of sheep and goats fed the experimental rations.

Item	Rations							
	Ration I		Ration II		Silage II + BG		Animal species	
	Sheep	Goats	Sheep	Goats	Treat1	Treat2	Sheep	Goats
	PH							
Sampling time								
0	6.8	6.7	6.9	6.7	6.75	6.80	6.85	6.7
4 hr	6.1	6.0	5.9	6.2	6.05	6.05	6.0	6.1
	Ammonia-nitrogen (mg/100 ml)							
0	5.7	5.6	5.3	5.1	5.65	502	5.5	5.35
4 hr	9.8	9.7	10.0	9.3	9.75	9.65	9.9	9.5
	TVFA's (m.eg./100 ml)							
0	7.8	8.5	8.9	8.8	7.65	8.85	8.35	8.65
4 hr	9.6	10.5	10.4	10.1	10.05	10.25	10.	10.3

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تحسين القيمة الغذائية لبعض النباتات الصحراوية غير المستساغة بتصنيعها سيلاج بعد خلطها بالنباتات المستساغة والمولاس.

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تهدف هذه الدراسة الى تحسين الاستفادة من بعض النباتات الصحراوية غير المستساغة بعد خلطها بالنباتات المستساغة والمولاس وتصنيعها سيلاج.استخدم في هذه الدراسة ثلاث نباتات هي نبات الكوخيا كنبات مستساغ ونبات الرمث والمتنان كانباتات غير مستساغة. حيث جمعت هذة النباتات فى مواسم نموها الخضرى .اجريت دراسة اولية لمدة ثلاثة اسابيع لتحديد الاستساغة لهذة النباتات وكذلك حساب المادة الجافة المأكولة واستخدم فيها ثلاث ذكور من الاغنام والماعز البالغة .تم تصنيع السيلاج باستخدام نبات الكوخيا مع نبات المتنان (سيلاج رقم ١) ونبات الكوخيا مع الرمث (سيلاج رقم ٢) مع اضافة الملاس لكلا النوعين بنسبة ١٠% من المادة الجافة.اجريت اربعة تجارب هضم باستخدام ستة ذكور اغنام محلية بمتوسط وزن ٤٠ كجم وستة ذكور ماعزبالغة بمتوسط وزن٣٠كجم (ثلاث حيوانات فى كل تجربة). تم تغذية هذة الحيوانات على السيلاج الى حد الشبع مع تغطية نصف الاحتياجات الحافظة لها من الطاقة من حبوب الشعير اشارت النتائج الى ان نبات الكوخيا ليتميز بانخفاض محتواة من الرماد السيلكا (١٣,٩% , ٢,٨% على الترتيب) بالمقارنة بالنباتات الاخرى التى تحتوى على ١٩,٧%,٦,٥%& ٢١,١%,٥,٧%, لكلا من نبات المتنان و الرمث على الترتيب . متوسط الغذاء المأكول اليومى للاغنام والماعز من نبات الكوخيا كنبات مستساغ كانت مرتفعة معنويا (عند مستوى ٠,٠٥%) عن النباتات الاخرى .عملية السيلجة حسنت من كمية الغذاء المأكول من مخلوط السيلاج الأول والثانى (٢٨,٣, ٣٥,٥) على التوالى .كذلك اظهرت النتائج ارتفاع معنوى لمعامل هضم كلا من الما دة الجافة والبروتين ومستخلص خالى الأزوت عندما تم تغذية الحيونات على السيلاج الثانى عن التى تم تغذيتها على السيلاج الأول بينما كانت معاملات هضم مكونات الألياف الخام (ADF,NDF) كانت متقاربة الى حد ما فى السيلاج الأول والثانى باستثناء معامل هضم الهيميسيليلوز والسيليلوز حيث كان يميل للزيادة مع السيلاج الثانى عنالسيلاج الأول.اظهرت الاغنام ارتفاعا معنويا بالنسبة للنيتروجين الحتجز عن الماعز بعد تغذية هذة الحيوانات على مخاليط السيلاج المختلفة .يستخلص من هذة الدراسة أن عملية السيلجة للنباتات الصحراوية غير المستساغة بعد خلطها بأحد النباتات المستساغة مع اضافةالمولاس لها نجحت في تحسين كمية الغذاء المأكول والقيمة الغذائية لها باستخدام الأغنام والماعز.