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STUDIES ON BIOLOGICAL TREATMENT OF SALT PLANTS 1- FEED EVALYATION BY SMALL RUMINANTS.

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ABSTRACT

Three salt plants were laboratorial studied concerning the effect of wetting and sterilization on their chemical and structural compositions. The effect of biological treatment (with white fruit fungi) at incubation periods (1 – 3 weeks) on their chemical and structural compositions was studied too. On the light of these *in vitro* results, 6 feed mixtures were formulated from the treated plants (*Acacia saligna* and *Tamarix mannifera*) with either fungi *Pleurotus ostreatus* and *P. florida* or without biological treatment, besides berseem hay as a control. The roughages were offered *ad lib.* besides 125 g barley grains/day/head of Barki rams in palatability trials. Thereafter and from the results of the latest trials (palatability), 3 mixtures were evaluated in metabolism trials followed by rumen liquor and haematological studies. It is to conclude that the physical and biological treatments are useful in improving either chemical and constructural compositions of salt plants The fungal treatment improved animal feed intake from these plants as a consequence of the improvement in their digestibilities and utilization without harm affecting animal's health and performance Hence, it is to recommend offering some of salt plants, which are biologically treated for animals in deserts and shores without danger.

Keywords: Salt plants – Biological treatments – Palatability – Haematology – Rumen liquor – Metabolism trials – Sheep.

INTRODUCTION

Salt plants are widely distributed extensively along the costal region. These plants are poorly consumed by animals due to their high contents of Na, Ca, silica and secondary metabolites, i.e. alkaloids, tannins, oxalates, glucosides and nitrates (Abd El-Rahman, 1996). Therefore, the mature salt plants become unpalatable for animals, and consequently less digestible (Girgis, 1994 and Mahmoud, 2000). Cellulolytic fungi have the ability to produce extracellular enzymes known as cellulases, which are responsible for the hydrolysis of cellulose to glucose. Hence, the fungal treatments improve the feeding values of poor roughages via increasing the availability of nutrients and improving its digestibility besides the enrichment with protein (Khorshed, 2000; Deraz and Ismail, 2001 and El-Ashry *et al.*, 2001). Therefore, the objective of the present work was to study the effects of fungal treatments of some salt plants on their chemical composition and palatability by sheep, as well as water consumption, haematology, ruminal liquor criteria, digestibility, N-balance and feeding value of these biologically treated salt plants.

MATERIALS AND METHODS

This study was carried out at Ras-Siedr Research Station, Desert Research Center on three halophytic plants, namely *Tamarix mannifera* (Tm), *Atriplex nummularia* (An) and *Acacia saligna* (As). These plants were collected by hand, chopped into 2-5 cm length, then air dried to 8-10% moisture content. These salt plants were chemically analysed before and after the physical pre-treatment (wetting and sterilization) and after the fungal treatment with *Pleurotus ostreatus* and *P. florida* according to Foudd *et al.* (1960), Difco Manual (1979) and Gorcho (1981) in a laboratorial trial.

From the results of the laboratorial trial, As and Tm were selected for the palatability trials on Barki rams. Six palatability trials (2 plants x 2 fungal species + 2 controls) were carried out using 18 animals (of 3 – 3.5 years old and 41 – 51 Kg initial body weight), 3 animals/treatment. The animals were group fed (Cafeteria diet) for 45 days and fresh water was available all times. The roughages were offered *ad lib* plus 125 g barley per head / day.

The best mixtures resulted from the palatability trials were used in 3 metabolism trials using 9 Barki rams(46.3 + 0.87 Kg), 3 animals/trial (using metabolism cages for the individual feeding for 45 days) namely mixture 1 [As treated with *P. forida* and Tm treated with *P. ostreatus*, 1:1 (Af + To) + 125 g barley/h/d], mixture 2 [As treated with *P. ostreatus* and Tm treated with *P. florida*, 1:1 (Ao + Tf) + 125 g barley/h/d] and a control (BH + 125 g harley/h/d). The preliminary period lasted for 35 days, whereas the collection period was 7 days. During the following 3 days, rumen liquor and jugular vein blood samples were collected.

Feeds, faeces, urine and ammonia-N (NH_3-N) were chemically analyzed according to A.O.A.C. (1990) and fiber fraction according to Goering and Van Soest (1970), but total volatile fatty acids (VFAs) were determined after Warner (1964). Blood film was made for 3 animals/treatment after 45 days of feeding using blood cell counter (Hycel Diagnostics, France). Statistical analysis of the collected data was carried out using SAS (1998) system for ANOVA procedure (one way analysis of variance, except for ruminal NH_3-N and VFAs were analyzed in factorial design), then Duncan's (1955) multiple range test was calculated when F was significant.

RESULTS AND DISCUSSION

Laboratory studies:

Table 1 presents the effects of wetting and sterilization as a physical pre-treatment for fungal treatment of the tested salt plants, namely *Acacia saligna* (As), *Tamarix mannifera* (Tm) and *Atriplex nummularia* (An). There were increases in their dry matter (DM) contents as well as acid detergent fiber (ADF) and acid detergent lignin (ADL), but their crude protein (CP) and ether extract (EE) contents decreased comparing with all raw plants (without pre-treatment). Yet, percentages of organic matter (OM), crude fiber (CF), nitrogen free extract (NFE) and ash as well as neutral detergent fiber (NDF), cellulose and hemicallulose tended to differentiate among plants. In this

respect, Gupta and Langer (1988) concluded that wetting made the degradation of lignin better than in the untreated substrates. Moreover, Klyosov (1984) reported that steaming of lignocelluletic material increased the enzymatic digestibility as a result of the cleavage of bonds between cell wall constituents. Yet, Tripathi and Yadav (1989) found that cell wall constituents were lower in case of steaming, whereas water-soluble substances and crude protein contents were higher.

Table 1: Effect of physical pre-treatment on chemical composition and cell wall constituents of salt plants, on DM basis.

Item	*Acacia saligna*		*Tamarix mannifera*		*Atriplex nummularia*	
	Raw	Wetted and Ster*	Raw	Wetted and Ster*	Raw	Wetted and Ster*
Chemical composition:						
DM	39.85	40.30	38.58	40.60	40.83	41.68
OM	91.50	91.52	74.93	72.55	71.62	81.95
CP	8.38	7.63	7.94	7.44	13.09	11.94
EE	2.00	1.84	2.44	1.67	2.31	1.95
CF	32.80	30.74	28.61	27.67	20.64	22.53
NFE	48.32	51.31	35.94	35.77	35.58	45.53
Ash	8.50	8.48	25.07	27.45	28.38	18.05
Cell wall constituents:						
NDF	61.11	76.55	63.84	55.49	53.38	60.57
ADF	47.60	65.09	42.90	45.56	28.16	33.56
ADL	17.56	33.75	13.07	15.93	9.81	12.57
Cellulose	30.04	31.34	29.83	29.63	18.35	20.99
Hemicel-lulose	13.51	11.46	20.94	9.93	25.22	27.01

*Ster = sterilized

Acacia saligna treated by the fungi *P. ostreatus* and *P. florida* reflected lower contents of DM, OM, CF, NDF, ADF, ADL and cellulose, but the contents of CP and ash tended to increase by increasing the incubation period till 3 weeks. However, the fungal treatment was responsible for increasing CP, EE, ash, NDF, ADF and ADL and decreasing DM, OM, CF, NFE, cellulose and hemicallulose contents comparing with the untreated (raw) plant as shown from data in Table 2. Table 3 shows the changes occurred in the chemical composition of Tm by the treatment with the same fungi (*P. ostreatus* and *P. florida*). The contents of DM and CF decreased and CP and EE percentages increased by elongating the incubation period of 3 weeks. Yet, it is worth to note that the biological treatment improved the contents of OM, CP, EE and NFE as well as lowered the contents of DM, CF, ash, NDF, ADF, ADL and cellulose. The treatment of An by either tested fungi (*P. ostreatus* and *P. florida*) led to lowering DM, OM, EE, NFE, NDF and cellulose contents but elevated the contents of CP, ash and ADL by the incubation till 3 weeks. But, comparing with the raw plants, the biological treatment elevated each of OM, CF, EE, NFE, NDF, ADF, ADL and cellulose but lowered DM, CP, ash and hemicellulose contents (Table 4).

In agreement with the aforementioned results, Fouad *et al.* (1998) reported increases in DM, CP, EE, NFE, hemicellulose and decreases in CF contents after fungal treatments of roughage. Also, many researchers came to conclusion that fungal treatments of roughage improve its chemical composition and structure (Khorshed, 2000; Darwish, 2001; El-Ashry *et al.*, 2001; Ibrahim, 2002 and Hamza *et al.*, 2006).

Table 2: Effect of biological treatment by *P. ostreatus* and *P. florida* at different incubation periods (weeks) on chemical composition and cell wall-constituents of *Acacia saligna*, on dry matter basis.

Item	Raw	*P. ostreatus*			*P. florida*		
		Incubation period			Incubation period		
		W_1	W_2	W_3	W_1	W_2	W_3
DM	39.85	39.90	35.31	33.96	39.80	37.19	34.95
OM	91.50	91.22	90.53	88.02	91.50	89.83	88.74
CP	8.38	12.31	12.94	14.44	12.75	13.19	16.25
EE	2.00	2.25	2.01	2.20	2.02	2.05	2.30
CF	32.80	31.04	29.90	26.48	31.52	26.76	25.90
NFE	48.32	45.62	45.68	44.90	45.21	47.83	44.29
Ash	8.50	8.78	9.47	11.98	8.50	10.17	11.26
NDF	61.11	70.30	67.15	65.64	65.89	64.80	64.93
ADF	47.60	62.21	54.59	56.75	56.35	54.98	55.02
ADL	17.56	28.51	24.86	26.84	25.81	25.75	25.79
Cellulose	30.04	33.70	29.73	29.91	30.54	29.23	29.23
Hemicel-lulose	13.51	8.09	12.56	8.89	9.54	9.82	9 91

Table 3: Effect of biological treatment by *P. ostreatus* and *P. florida* at different incubation periods (weeks) on chemical composition and cell wall-constituents of *Tamarix mannifera*, on dry matter basis.

Item	Raw	*P. ostreatus*			*P. florida*		
		Incubation period			Incubation period		
		W_1	W_2	W_3	W_1	W_2	W_3
DM	38.58	41.64	38.09	37.09	41.65	36 80	36 53
OM	74.93	73.56	74.63	75.45	73.50	77.72	76.73
CP	7.94	9.75	10.44	12.00	10.06	10.38	12.44
CF	28.61	25.81	24.34	23.42	25.59	24.11	22.85
EE	2.44	1.81	2.43	2.51	2.14	2.55	2.60
NFE	35.94	36.19	37.42	37.52	35.71	40.68	38.84
Ash	25.07	26.44	25.37	24.55	26.50	22.28	23.27
NDF	63.84	56.68	56.98	50.09	53.19	60.09	53.95
ADF	42.90	30.84	33.34	26.78	37.42	33.06	36.98
ADL	13.07	13.16	12.81	9.18	15.42	10.79	12.77
Cellulose	29.83	17 68	20.53	17.60	22.00	22.27	24.21
Hemicel-lulose	20.94	25.84	23.64	23.31	15.77	27.03	16.97

Table 4: Effect of biological treatment by *P. ostreatus* and *P. florida* at different incubation periods (weeks) on chemical composition and cell wall-constituents of *Atriplex nummularia*, on dry matter basis.

Item	Raw	*P. ostreatus*			*P. florida*		
		Incubation period			Incubation period		
		W_1	W_2	W_3	W_1	W_2	W_3
DM	40.83	39.73	37.93	35.75	39.58	35.00	35.29
OM	71.62	80.36	81.80	78.95	80.94	77.52	79.34
CP	13.09	11.88	11.88	11.94	11.25	13.63	12.31
CF	20.64	26.96	26.79	26.08	24.84	23.98	27.14
EE	2.31	2.59	2.55	2.48	2.43	2.59	2.29
NFE	35.58	38.93	40.58	38.45	42.42	37.32	37.60
Ash	28.38	19.64	18.20	21.05	19.06	22.48	20.66
NDF	53.38	56.38	58.21	56.02	61.59	55.39	58.82
ADF	28.16	36.20	31.90	33.36	35.19	31.59	35.31
ADL	9.81	11.83	11.81	12.26	12.52	12.49	13.75
Cellulose	18.35	24.37	20.09	21.10	22.67	19.10	21.56
Hemicel-lulose	25.22	20.18	26.31	22.66	26.40	23.80	23.51

Palatability study:

The animals consumed the highest fresh and dry weights from D_4 (As treated by *P. ostreatus* plus Tm treated by *P. florida*) but still lower than the consumption from D_6 (berseem hay). However, the consumption from D_4 was higher than the daily feed intake from the other tested diets, i.e. D_1 (*Acacia* plus *Tamarix*, each treated with *P. florida*), D_2 (*Acacia* plus *Tamarix*, each treated with *P. ostreatus*), D_3 (*Acacia* with *P. florida* plus *Tamarix* with *P. ostrealus*), and D_5 (*Acacia* plus *Tamarix*, raw without biological treatment) as shown from Table 5. The low feed intake from the salt plants may be due to their high contents of minerals and natural non-nutritious components like ADL, NDF, nitrates, saponins, alkaloids and tannins (Kandil *et al.*, 1991, Girgis, 1994; Abd-El-Rahman, 1996; Fahmy, 1998 and Mahmoud, 2000). Yet, D_4 was relatively better consumed perhaps because of the type of mixture consisting of 2 various plants treated with 2 different fungi. It may also due to the adaptation of the animals for this diet on the long run.

Table 6 illustrates that all groups of animals lost weight, except the berseem hay fed group (D_6); yet, D_4 was better than the other test groups, i.e. D_1, D_2, D_3 and D_5, concerning live body gain. Also, the animals fed D_4 consumed dry matter more than the other groups, except D_6 whether g/Kg BW or g/Kg $W^{0.75}$. These results correlated with those in Table 5, since body gain depends mainly on the feed intake, which depends also on feed palatability, and hence on feed utilization (Kandil and El-Shaer, 1990 and Kusina *et al.*, 1991). Loss of body weight was reported too by Abou El-Nasr *et al.* (1996) and Youssef (1999); so, they suggested that saltbush can be added to goats up to 20% only (DM basis). Yet, El-Shaer *et al.* (1991) found that efficiency of feed conversion was similar within animal species (sheep and goats) fed either berseem hay or *Halocnomum* strobilaceum ensiled with broiler litter.

Table 5: Effect of biological treatment of *Acacia* treated with *P. florida* (Af) and *Tamarix* treated with *P. florida* (Tf) (D_1) on palatability of sheep.

Intake (g)	Af	Tf	Total	Total + barley
Fresh	487.84	426.43	914.27	1039.27
DM	449.25	386.26	835.51	953.24
% DM from total	53.77	46.23	-	-
Acacia treated with *P. ostreatus* (Ao) and *Tamarix* treated with *P. ostreatus* (To) (D_2)				
Intake (g)	Ao	To	Total	Total + barley
Fresh	420.98	399.51	820.49	945.49
DM	375.68	361.88	737.56	855.29
% DM from total	50.94	49.06	-	-
Acacia treated with *P. florida* (Af) and *Tamarix* treated with *P. ostreatus* (To) (D_3)				
Intake (g)	Af	To	Total	Total + barley
Fresh	477.01	465.00	942.01	1067.01
DM	439.28	421.20	860.48	978.21
% DM from total	51.05	48.95	-	-
Acacia treated with *P. ostreatus* (Ao) and *Tamarix* treated with *P. florida* (Tf) (D_4)				
Intake (g)	Ao	Tf	Total	Total + barley
Fresh	511.87	514.10	1025.97	1150.97
DM	456.79	462.94	919.73	1037.46
% DM from total	49.67	50.33	-	-
Acacia (A) and *Tamarix* (T) (D_5), air-dried without biological treatment				
Intake (g)	A	T	Total	Total + barley
Fresh	415.66	389.69	805.35	930.35
DM	395.25	366.58	761.83	879.56
% DM from total	51.88	48.12	-	-
Hay, control diet (D_6)				
Intake (g)	Hay		Total + barley	
Fresh	1624.00		1749.00	
DM	1200.00		1317.73	

Metabolism trials:

Chemical composition and cell wall constituents of the tested diets used in the metabolism trials are given in Table 7. Both mixtures 1 and 2 were similar to each other, but contained somewhat lower CP, ash, NDF and hemicellulose and higher EE, NFE, ADF and converted carbohydrate contents than berseem hay (control). The same trends were recorded for the intakes from digestible nutrients given in Table 9. Since both mixtures 1 and 2 were more digestible in CP, EE and converted carbohydrate, but less digestible in DM, CF, NFE, NDF, ADF and hemicellulose (Table 10). The animals consumed dry matter and different nutrients from either mixture 1 (D_3) or mixture 2 (D_4) less than from the control (berseem hay). Mixture 1 resulted in higher feed and nutrients intake, thus reflected higher N-balance than mixture 2. Both mixtures 1 and 2 gave higher N-balance than the control (Table 8) because of the higher N-excretion via faces and urine of the control animals.

The literature confirms the aforementioned data of the metabolism trials, since animal's feed intake from halophytic plants is depending on the form or treatment of the plants (Youssef, 1999); yet, the supplementary feeding improves the intake and performance of the animals (Wilson *et al.*, 1994; Madibela *et al.*, 2002 and Eid, 2003). On the other hand, some biological treatments improve the chemical structure and composition of the treated wastes and by-products (Ali *et al.*, 1987; Kakkar *et al.*, 1991; Abd El-

Aziz *et al.*, 1994 and El-Ashry *et al.*, 2001). Therefore, these treatments improve also the intake, digestibility, feeding value and N-balance (Singh *et al.*, 1990; Khorshed, 2000; El-Ashry *et al.*, 2001; El-Sayed *et al.*, 2002; Ibrahim, 2002; El-Wakeel, 2004 and Hamza *et al.*, 2006).

Table 6: Effect of the experimental treatments on average body weights and DM- intake of sheep.

Item \ Treat.	D_1	D_2	D_3	D_4	D_5	D_6
Av. body weights:-						
Initial, Kg	51.67	51.00	50.83	46.83	58.33	41.00
Final, Kg	47.50	49.83	49.17	46.00	51.50	46.33
Intake:-						
DMI, g/Kg BW	19.22	16.96	19.56	22.35	16.02	30.17
DMI, g/Kg $W^{0.75}$	51.01	45.20	52.02	58.34	43.60	77.57

D_1 = As and Tm treated with *P. florida* + 125 g barley
D_2 = As and Tm treated with *P. ostreatus* + 125 g barley
D_3 = As and Tm treated with *P. florida* and *P. ostreatus*, respectively + 125 g barley
D_4 = As and Tm treated with *P. ostreatus* and *P. florida*, respectively + 125 g barley
D_5 = As and Tm air dried + 125 g barley
D_6 = Berseem hay + 125 g barley.

Table 7: Chemical composition of feedstuffs (% on DM basis).

Criteria	Barley	BH	Mix-1 (D_3)	Mix-2 (D_4)
DM	94.18	73.96	91.23	92.13
OM	97.56	86.32	88.46	89.12
CP	9.94	12.25	10.06	9.81
CF	3.53	29.22	28.76	28.48
EE	1.57	1.95	2.37	2.02
Ash	2.44	13.68	11.54	10.88
NFE	82.52	42.90	47.27	48.81
NDF	53.61	76.11	65.14	66.93
ADF	5.26	41.71	42.44	45.91
*Converted CHO	46.39	23.89	34.86	33.07
Hemicellulose	48.35	34.40	22.70	21.02

BH = berseem hay
Converted CHO = Converted carbohydrate content calculated as (100 – NDF %).

Fungal treated salt plants in D_3 and D_4 led to lower water consumption comparing with the control (berseem hay), whether measured as ml/head/day or ml/Kg $W^{0.82}$ or ml/Kg DM intake (Table 11). The consequence also that the animals of D_3 and D_4 excreted lower urine volume (ml/head/day) and percentage of the drunk water, relatively to the control animals. However, the specific gravity of D_4 urine was very dense than in the control, but the animals fed D_3 gave urine with lower density than the other animal groups (Table 11).

Table 8: Effect of biological treatment on nutrients consumed (g/head/day) and nitrogen balance by sheep during the metabolism experiment (X ± SE).

Items	Mixture 1	Mixture 2	Control
DMI, g/day	858.2^{b} ± 29.85	862.1^{b} ± 60.05	1227^{a} ± 0.00
DMI, g/Kg BW	19.90^{b} ± 0.26	18.38^{b} ± 1.35	26.00^{a} ± 0.97
DMI, g/Kg W$^{0.75}$	50.98^{b} ± 0.23	47.99^{b} ± 2.72	68.13^{a} ± 1.91
CP	93.69^{b} ± 2.19	92.06^{b} ± 3.29	147.6^{a} ± 0.00
EE	20.73^{b} ± 0.49	17.87^{c} ± 0.75	23.48^{a} ± 0.00
CF	197.5^{b} ± 11.95	191.1^{b} ± 24.44	328.3^{a} ± 0.00
NFE	448.1^{b} ± 13.26	468.4^{b} ± 27.96	573.1^{a} ± 0.00
Ash	98.17^{b} ± 2.04	92.66^{b} ± 3.63	154.6^{a} ± 0.00
NDF	520.0^{b} ± 23.13	535.5^{b} ± 48.71	907.5^{a} ± 0.00
ADF	293.1^{b} ± 16.48	321.8^{b} ± 37.81	468.9^{a} ± 0.00
Converted CHO	338.2^{a} ± 6.74	326.6^{a} ± 11.37	319.7^{a} ± 0.00
Hemicellulose	226.9^{b} ± 6.90	213.7^{b} ± 10.96	438.6^{a} ± 0.00
Feces DM, g/day	423.0^{a} ± 49.14	431.5^{a} ± 53.09	536.7^{a} ± 17.09
N-intake, g/day	14.99^{b} ± 0.35	14.73^{b} ± 0.53	23.62^{a} ± 0.00
Feces-N, g/day	6.67^{b} ± 0.57	7.00^{b} ± 0.67	12.08^{a} ± 0.61
Urinary-N, g/day	2.41^{b} ± 0.20	2.27^{b} ± 0.10	13.83^{a} ± 0.68
Total excreted N	9.07^{b} ± 0.761	9.27^{b} ± 0.765	25.91^{a} ± 1.247
N-balance, g/hed/day	5.91^{a} ± 0.455	5.46^{a} ± 0.239	-2.29^{b} ± 1.25
% of N-intake	39.61^{a} ± 3.788	37.29^{a} ± 3.038	-9.69^{b} ± 5.279
Digested-N, g/day	8.32^{b} ± 0.32	7.73^{b} ± 0.17	11.54^{a} ± 0.61
Average body weight, Kg	43.17^{a} ± 1.99	47.50^{a} ± 5.41	47.33^{a} ± 1.72

a-b: Means in the same row with the same letter are not significantly ($P \geq 0.05$) different.

Table 9: Effect of biological treatment on digestible nutrients consumed (g/head/day) by sheep during the metabolism experiment (X ± SE).

Items	Mixture 1	Mixture 2	Control
CP	52.01^{b} ± 1.98	48.32^{b} ± 1.07	72.06^{a} ± 3.79
EE	11.64^{a} ± 0.27	10.55^{a,b} ± 0.17	8.13^{b} ± 1.24
CF	43.94^{b} ± 10.11	41.42^{b} ± 6.16	134.4^{a} ± 6.26
NFE	262.3^{b} ± 8.21	271.2^{b} ± 3.06	383.9^{a} ± 4.96
NDF	204.7^{b} ± 20.34	218.7^{b} ± 11.66	497.0^{a} ± 24.17
ADF	62.37^{b} ± 13.91	92.49^{b} ± 11.75	171.9^{a} ± 10.41
Converted CHO	230.5^{a} ± 0.63	211.9^{a} ± 3.86	193.4^{a} ± 25.80
Hemicellulose	142.4^{b} ± 6.41	126.2^{b} ± 2.88	325.2^{a} ± 25.44

a-b: Means in the same row with the same letter are not significantly ($P \geq 0.05$) different.

Rumen liquor:

Data of ammonia-N and volatile fatty acids in rumen liquor are given in Table 12. Ammonia levels increased 2-hours post-feeding all diets, except mixture 1, thereafter decreased till 6-h post-feeding. Total VFAs concentration increased in mixtures 1 and 2 till 4-h post-feeding and then decreased again, but in the control there were increases up to 2-h post-feeding, decreases at 4-h post-feeding and thereafter increases again. However, the fungal treatment, particularly in mixture 1, prolonged the duration of high ruminal ammonia and VFAs levels. However, there were no significant differences among sampling times in NH_3-N concentrations; yet,

VFAs levels were higher at 2 h post-feeding and go on. Also, mixture 1 and the control reflected higher ($P \leq 0.05$) NH_3-N and VFAs concentrations, respectively.

Table 10: Effect of biological treatment on digestibility coefficient and nutritive values by sheep during the metabolism trials (X ± SE).

Items	Mixture 1	Mixture 2	Control
Digestibility coefficient %:			
DM	50.98^{a} ±4.09	50.35^{a} ±2.91	56.27^{a} ±1.39
CP	55.62^{a} ±2.93	52.71^{a} ±3.07	48.82^{a} ±2.65
EE	56.21^{a} ±2.14	59.30^{a} ±3.35	34.64^{b} ±5.20
CF	22.99^{b} ±6.48	21.64^{b} ±1.14	40.92^{a} ±1.91
NFE	58.74^{a} ±3.42	58.26^{a} ±3.02	66.95^{a} ±0.87
NDF	39.83^{b} ±5.52	41.21^{b} ±2.31	54.77^{a} ±2.66
ADF	21.90^{b} ±5.89	28.72^{ab}±0.92	36.65^{a} ±2.22
Converted CHO	68.21^{a} ±1.57	65.13^{a} ±3.39	60.51^{a} ±8.07
Hemicellulose	63.05^{b} ±4.55	59.42^{b} ±3.90	74.15^{a} ±5.80
Average body weight, Kg	43.17^{a} ±1.99	47.50^{a} ±5.41	47.33^{a} ±1.72
Nutritive values (Feed unite intake)			
TDN, g/head/day	384.5^{b} ±19.8	384.7^{b} ±8.10	608.4^{a} ±15 3
TDN, g/Kg BW	8.98^{b} ± 0.84	8.26^{b} ± 0.70	12.91^{a} ±0.81
TDN, g/Kg $W^{0.75}$	22.96^{b} ±1.89	21.53^{b} ±1.29	33.82^{a} ±1.81
% of DMI	45.05^{a} ±3.76	44.96^{a} ±2.47	49 58^{a} ±1.25
DCP, g/head/day	52.01^{b} ±1.98	48.32^{b} ±1.07	72.06^{a} ±3.79
DCP, g/Kg BW	1.21^{ab} ± 0.09	1.04^{b} ± 0.12	1.53^{a} ± 0.14
DCP, g/Kg $W^{0.75}$	3.10^{b} ± 0.19	2.72^{b} ± 0.25	4.01^{a} ± 0.32
% of DMI	6.08^{a} ± 0.38	5.68^{a} ± 0.55	5.88^{a} ± 0.31

a-b: Means in the same row with the same letter are not significantly ($P \geq 0.05$) different.

Table 11: Water intake, urine excretion and urine specific gravity of sheep as affected by the dietary treatments (X ± SE).

Items	Mixture 1	Mixture 2	Control
Water intake, ml/head/day	1070^{b} + 166	927.6^{b} + 94.8	5144^{a} + 263
ml/Kg $W^{0.82}$	48.4^{b} + 5.93	39.5^{b} + 4.31	219^{a} + 16.9
ml/Kg DM	1237^{b} + 153	1072^{b} + 52.6	4192^{a} + 215
Urine excretion, ml/head/day	183^{b} + 79.5	83.2^{b} + 11.1	2259^{a} + 93.1
% of water intake	15.9^{a} + 4.64	9.45^{a} + 2.37	44.0^{a} + 0.66
Specific gravity of urine	1.032^{a} +0.009	1.163^{a} + 0 049	1.039^{a} + 0 004

a – b: Means in the same row with different letters are significantly ($P \leq 0.05$) different.

Also, Henics (1987) reported higher rumen ammonia but lower VFA's levels in animals fed fungal treated wheat straw; yet, Wiedmerier *et al.* (1987) found that ruminal parameters were nearly unaffected by biological treatments of cattle feed. However, Khattab *et al.* (1996) and Ibrahim (2002) reported that the maximum concentrations of NH_3-N and VFA's were observed at 3 hours post-feeding. Moreover, Deraz and Ismail (2001), El-Sayed *et al.* (2002) and Ibrahim (2002) indicated that fungal treatment of agricultural by-products increased NH_3-N and total VFA's concentrations. In addition, El-Wakeel (2004) reported that there were large increases in VFA concentrations in response to enzyme treatment. She added that VFA concentrations were often inversely related to DM disappearance, a response that she cannot explain.

Table 12: Rumen liquor concentrations of ammonia-nitrogen and total volatile fatty acids at different intervals in sheep fed the experimental diets ($\bar{X} \pm SE$).

Criteria	Sampling time, h	Mixture 1	Mixture 2	Control	Mean
Ammonia-N, mg/100 ml	0	9.73 ± 0.43	8.24 ± 0.43	8.48 ± 1.25	8.81[a]
	2	8.49 ± 0.25	8.99 ± 0.43	9.97 ± 0.90	9.15[a]
	4	10.2 ± 0.25	8.73 ± 2.13	6.24 ± 0.66	8.39[a]
	6	9.48 ± 1.09	5.24 ± 1.15	4.99 ± 0.25	6.57[b]
	Mean	9.48[a]	7.80[b]	7.42[b]	
VFAs, m.eq/100 ml	0	4.20 ± 0.54	3.62 ± 0.22	5.09 ± 0.46	4.30[b]
	2	4.27 ± 0.50	3.77 ± 0.07	6.79 ± 0.63	4.94[b]
	4	6.96 ± 0.07	6.16 ± 1.29	4.62 ± 0.45	5.91[a]
	6	3.97 ± 0.30	3.98 ± 0.27	9.36 ± 0.81	5.77[a]
	Mean	4.84[b]	4.39[b]	6.46[a]	

a – b: Means in the same row with different letters are significantly ($P \leq 0.05$) different.

Table 13: Hematology of sheep fed the experimental diets ($\bar{X} \pm SE$).

Parameters	Mixture 1	Mixture 2	Control
WBCs	95.4[a] ± 49.3	161.2[a] ± 27.9	135.0[a] ± 27.7
Lym.	2.83[a] ± 1.56	5.03[a] ± 1.07	3.53[a] ± 0.62
Mid. , K/µl	5.37[a] ± 3.10	9.47[a] ± 0.49	9.17[a] ± 0.78
Grn.	87.2[a] ± 44.7	146.7[a] ± 27.2	122.3[a] ± 24.3
RBCs, M/µl	9.35[a] ± 0.68	11.3[a] ± 1.09	10.4[a] ± 0.63
HCP, 221	28.0[b] ± 2.12	30.9[a] ± 2.84	32.1[a] ± 0.67
HCT, %	31.9[b] ± 2.13	36.4[a] ± 2.85	37.2[a] ± 2.84
MCV, FL	34.1[ab] ± 0.32	32.3[b] ± 0.54	35.7[a] ± 0.68
MCH, Pg	30.0[ab] ± 0.94	27.3[b] ± 0.35	31.1[a] ± 1.38
MCHC, g/dl	87.9[a] ± 3.31	84.7[a] ± 1.25	87.2[a] ± 5.31
RDW, %	13.9[a] ± 0.29	14.0[a] ± 0.15	14.3[a] ± 0.44
PLT, K/µl	627[a] ± 23.4	939[a] ± 48.7	783[a] ± 184
PCT, %	0.48[a] ± 0.02	0.72[a] ± 0.05	0.60[a] ± 0.15
MPV, FL	7.40[a] ± 0.21	7.67[a] ± 0.13	7.67[a] ± 0.19
PDW, %	48.9[a] ± 0.55	53.4[a] ± 4.20	50.7[a] ± 0.49

a – b: Means in the same row with different letters are significantly ($P \leq 0.05$) different.

Haematology:

Haematological parameters of the sheep groups fed the 3 tested diets mixture 1, mixture 2, and the control illustrated in Table 13 reveals that most of the tested criteria reflected nearly similar values in mixture 2 group (*P._ostreatus* treated *Acacia* and *Tamarix*) and the control (berseem hay). The *P. florida* treated salt plants (mixture 1) gave varied values than those realized in mixture 2 and the control with lowest values for most parameters tested in mixture 1. However, most of the haematological parameters were not affected significantly by the dietary treatments. In this respect, many authors reported positive effect of biological treated roughages on the blood picture of small ruminants, particularly on blood proteins (El-Ashry *et al.*, 1997; Fouad *et al.* 1998 and Khorshed, 2000). Yet, Ibrahim

(2002) found no significant differences regarding the effect of biological treatment of roughages on the blood criteria measured in sheep. However, it well known that some of macro (gill, fruit or flesh)-fungi produce secondary metabolites which destroy the red blood cells or negatively affect liver, kidney and heart's functions (Abdelhamid, 1998, 1999 and 2000).

CONCLUSION

Biological treatment of some salt plants (e.g. *Acacia saligna* and *Tamarix mannifera*) with white fungi (*Pleruotus ostreatus* and *P. florida*) can improve their chemical and structural compositions leading to better consumption, digestibility and feeding value. Therefore, these treated plants could be offered (with concentrates) for ruminants in deserts near shores without negatively affecting animals' health and performance.

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دراسات على المعاملة البيولوجية للنباتات الملحية:

١- التقييم الغذائي في المجترات الصغيرة.

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تم دراسة ٣ نباتات ملحية معمليا من حيث تأثير النقع والتعقيم على التركيب الكيماوي والبائي، كما درس تأثير المعالجة البيولوجية (بالفطريات الثمرية البيضاء) على التركيب الكيماوي والبنائي كذلك لهذه النباتات بعد فترات تحضين (١ - ٣ أسابيع). وعلى ضوء النتائج المعملية تم عمل ٦ خلطات علفية من النباتات المعالجة (أكاسيا وطرفة) بفطرى بلوروتس أوستريادس وبلوروتس فلوريدا وغير المعالجة بيولوجيا، إضافة لدريس البرسيم كعليقة مقارنة تقدم جميعها لحد الشبع، والمركز فى الستة خلطات كان شعير ١٢٥ جم/حيوان/يوم، وذلك لتقييم الاستساغة. ثم أجريت تجارب ميتابوليزم على ثلاثة خلطات (التى أعطت أفضل نتائج من تجربة الاستساغة) للتقييم الغذائى، أعقبها دراسة لسائل الكرش وأخرى هيماتولوجية، وذلك كله على كباش البرقى. وقد أفادت المعالجة الطبيعية والبيولوجية فى تحسين كل من التركيب الكيماوي والبنائى للنباتات الملحية، كما أفادت المعالجة الفطرية فى تحسين استهلاك الحيوانات من هذه النباتات نتيجة تحسين هضمها والاستفادة منها دون الإضرار بصحة وأداء الحيوانات. وعليه ينصح بتقديم بعض النباتات الملحية المعالجة بيولوجيا (مع المركزات) لحيوانات الصحراء والسواحل دون خطورة.