SOME PHYSIOLOGICAL RESPONSESANDSKIN PROPERTIES OF SHAMI GOATS AS AFFECTED BY SALINITY UNDER DESERT CONDITIONS

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ABSTRACT

This study was performed to through some lights on the effect of salinity stress (i.e. salt tolerant plant feeding and drinking saline water) on skin characteristics (skin layers thickness, follicles area and follicles density) and some physical properties of leather (tensile strength, elongation and tear strength) as well as some physiological responses of male Shami goat. This study was carried out at South Sinai Research Station, Desert Research Center, Ministry of Agriculture, Egypt.

Twenty eight growing male Shami goats were assigned randomly into four equal groups (7 of each).The first group (G1; H&TW) was fed on berseem hay (*Trifoliumalexandrnum*) (BH) and drank tap water (TDS is 274 ppm) and served as control. The second group (G2; H&SW) was fed on H and drank saline water (SW, 5980 ppm). The third group (G3; STP&TW) was fed on salt-tolerant plants (STP, alfalfa) and drank TW while the fourth group (G4; STP&SW) was fed on STP and drank SW. All groups were offered concentrate feed mixture (CFM) and roughages at the rate of 60:40% to cover their maintenance and productive requirements according to Kearl (1982). Physiological responses in terms of some blood electrolytes (calcium (Ca), sodium (Na), potassium (K) and Phosphorus (P) in addition to Triiodothyronine (T_3), Thyroxine (T_4), aldosterone (Ald) and Cortisol (Cort.) hormones were determined.

The results revealed that the histological structure (dermis, papillary and reticular thicknesses) of skin didn't differ significantly among the experimental groups except those animals fed STP with SW were significantly ($P<0.05$) affected. There was a significant ($p<0.05$) effect of salinity on epidermis layer thickness. The thickness of papillary tended to decrease with either SW or STP intake.

Reticular layer thickness were affected ($p<0.05$) by water salinity rather than STP feeding. Results clarified that neither feeding STP nor drinking SW had a significant effect on leather physical properties (tensile strength, elongation and tear strength).Present results indicated that salinity through feed or water had a significant effect ($p<0.05$) on the mean values of plasma minerals (Na, K, Ca and P) concentrations. Triiodothyronine (T_3), Thyroxine (T_4) and aldosterone (Ald) concentrations tended to decrease ($P<0.05$) compared to the control. In contrast, Cortisol (Cort.) concentration tended to increase ($P<0.05$) in SW vs. TW groups and STP vs. H groups to help animals to cope with such stress.

It could be concluded that salt-tolerant plants as animal feeds in salt affected lands could be utilized safely without any adverse effects on animal health and productivity as well as improving the histological parameters of the skin and physical properties of leather of male Shami goats. Therefore, developing small-scale of leather production, as a source of income generating activities, is needed to increase the Bedouins returns from goatskins and improve their livelihood in such areas.

Keywords: Salt-Tolerant Plants, Saline water, Follicle density, Skin Layer Thickness, Leather, Tensile Strength, Tear Strength, Elongation, Shami Goats.

INTRODUCTION

The leather industry in Egypt has been considered one of the most important industrial sectors in the Egyptian economy representing about 5% of the total industrial production of the country (Marina and Noha, 2012). Leather production in Egypt based on raw materials which, collected and preserved with salt after slaughtering then transported to the tanneries. Most tanneries in Egypt are located in Cairo and Alexandria. Collecting and transporting salted skin from desert areas, especially in Sinai, is more difficult leading to waste of a large portion of raw materials.

The population of goat is 144683 head representing 3.5%, respectively of goats in Egypt (Livestock statistics, 2010).

Skins contribute greatly to the economic importance of sheep and goats breeds, especially those which are well known for their superior quality skins. The commercial value of a skin ranges between 5-10 % of the total value of the animal. (Devendra and Mc-Leroy, 1982).The Damascus goats are the dominant types of goats in Sinai, but these animals usually suffer from feed shortage (Al- Sheikh *et al.,* 2006) especially during the critical periods of their reproductive cycle (Badawy and Yousef, 2008).

The Bedouins in Sinai are using drip irrigation systems for vegetable production to optimize and increase efficiency of water use, since water resources are scarce. Forage crop production was begun using the available resources, starting with the cultivation of alfalfa under drip irrigation using salt-affected water on a commercial level (El-Nahrawy, 2011). This new system of planting alfalfa using drip irrigation has been well-accepted by farmers due to the considerable need for feed in animal wealth development.

The combination of salt in feed and water is of critical importance. When, the high salt intake becomes from feed alone, and there is an unlimited supply of fresh water, the animal can cope by increasing water intake. This cannot be done if the salt is present in both feed and water. Such an interaction is likely to be more important during the hotter, dry periods of the year than during colder, wetter times of the year (Wilson, 1975).

To improve the livelihood of the Bedouins in such areas, there is a need to establish an initiative program to increase the Bedouins returns from goatskins. The main objective from establishing this development program is through developing small-scale leather production as a source of income generating activities. Developing such program requires detection of physical and histological properties of raw skins which is the first step towards the determination of skin quality (Abdel Salam and Haider, 1993).

Therefore, this study was planned to through some lights on the effects of feeding salt tolerant plants, drinking saline water and their interactions on skin characteristics and its leather physical properties in addition to some physiological responses of male Shami goats under the semi-arid conditions of South Sinai.

MATERIALS AND METHOD

The present study was carried out at South Sinai Research Station (Ras Sudr), (latitude: 29,6236 N; longitude: 32,7148 E; elevation: 16 m), belonging to the Desert Research Center (DRC), Ministry of Agriculture and Land Reclamation, Egypt.

Experimental animals and management:-

Twenty eight growing Shami males (2.0 – 2.5 months old and 13.02 ± 0.34 kg average body weight) were assigned randomly into four equal groups (7 of each). The first group (G1; H and TW) was fed on berseem (*Trifoliumalexandrnum*) hay (BH) and drank tap water (TW) 274 mg/L of total dissolved salts (TDS) and served as control group. The second group (G2; BH and SW) was fed on BH and drank saline water (5980mg/Lof TDS). The third group G3; STP and TW) was fed on salt-tolerant plants (alfalfa) and drank TW while the fourth group G4; STP and SW) was fed on STP and drank SW (Table 1). All groups were offered concentrate feed mixture (CFM) and roughages (60:40%) to cover their maintenance and productive requirements according to Kearl (1982). Samples from roughage and CFM were taken monthly to determine their chemical composition according to the standard methods of A.O.A.C. (1995).

Table (1): Chemical analysis of drinking tap and saline water

Parameters	Tap water	Saline water
Total dissolved solids (mg/L)	274	5980
Electric conductivity (µs/cm)	0.53	9.96
Sodium (mg/L)	2.40	86.00
Chloride (mg/L)	2.47	61.34
Calcium (mg/L)	1.75	15.00
Magnesium (mg/L)	2.25	19.00
Potassium (mg/L)	0.15	0.36
Hardness* (mg/L)	4.00	34.00
Carbonate (mg/L)	0.40	0.20
Bicarbonate (mg/L)	2.60	3.00
pH	7.63	7.23

Hardness is a measure of the amount of calcium and magnesium salts in water.

Blood sampling and analyses:-

Blood samples were taken monthly in the morning from all experimental animals, before feeding and drinking, through vein puncture (using clinical needle) and withdrawn into sterile tubes containing EDTA as anticoagulant.

Blood plasma minerals concentrations of sodium (Na), potassium (K), calcium (Ca), chloride (Cl), phosphorus (P), zinc (Zn) and magnesium (Mg) were determined by commercial kits supplied by Biostc Company for Laboratory Services, Egypt. The hormones of thyroid gland (triiodothyronine, T_3 and thyroxine, T_4), aldosterone (Ald) and cortisol (Cort) were quantified by ELISA method using IMMUNOSPEC kits supplied by Immunospec

Corporation, 7018 Owensmounth Ave. Suite 103 Canoga Park, CA 91303, USA.

Skin samples:-

The skin samples were taken from the mid side position which is considered as a standard follicle population area over the whole skin surface (Schleger and Turner, 1960) and prepared according to Barker (1958). For general histological observations, sections were stained with Haematoxylin and Eosin stain (Drury and Wallington, 1980). An image analyzer software (Zen 2012, Blue edition) and device (Carl Zeiss Micro-Imaging GmbH) with lenses 10/0.847 and 40/0.65 was used for undertaking the quantitative histological studies in all sections.

Tanning process:-

After slaughtering, skins were weighed (fresh skin weight, FSW) just after taking them off, then flatted and salted. After 4 days, the skins were weighed to get the dry skin weight (DSW). Then tanning process steps were applied according to the following main steps: Pre-soaking, Soaking, Unhairing / Liming, White Liming, Washing, Deliming, Bating, Degreasing, Pickling, Tanning, Fixation, Washing, Naturalization, Dyeing and Retanning, Fatliquoring, Fixation, Washing.

RESULTS AND DISCUSSION

Effect of salinity on some blood electrolytes: Minerals play an important role in the regulation of body fluids, acid-base balance and metabolic processes (Milne, 1996).Sodium (Na) and potassium (K) are of particular importance in maintaining the electrolyte balance and osmolality of blood and other body fluids. Present data in table (2) indicated that salinity through feed or water increased significant ($P<0.05$) values of plasma minerals.

The highest value of Na concentration was found in group 4 that suffered from the two stresses (SW and STP) while Potassium (K) concentration was not affected by type of feeding but affected by water type (Table 2and Fig. 1). These results are in a harmony with those reported by Shaker *et al.* (2008) on sheep and Badawy*et al.* (2002)on sheep and goat while, El-Hawy (2013)on goat found a significant ($P<0.05$) increment in Potassium (K) concentration with groups fed STP.

Generally, Na and K concentrations were within the normal concentrations which are in agreement with the findings of El-Shaer *et al.* (2001) and Potter and McIntosh (1974) on sheep.

Likewise, mean values of plasma calcium (Ca) and phosphorus (P) concentrations tended to increase significantly ($P<0.05$) among the salt affected groups compared to control ones.

It is worthy to note that alfalfa as STP in animal feeding decreases the effect of high content of oxalate tannins and in salty plants. Tannins were found to disturb the absorption of minerals through the gastrointestinal tract and/or increase the endogenous losses of minerals such as Ca, Mg and P (Mansoori and Acamovic, 1997).

Table (2): LSM ± SE of some blood electrolytes average concentration (mEq/L) of Shami goats as affected by salinity conditions

	Experimental diets	Drinking water		Overall means
		TW	SW	
Na	H	108.18±2.668	147.27±2.668	127.73 [b]±1.887
	STP	148.74±2.668	155.30±2.668	152.02 [a]±1.887
	Overall means	128.46 [b]±1.887	151.29 [a]±1.887	
K	H	6.58±0.216	7.53±0.216	7.05 [a]±0.153
	STP	6.62±0.216	7.87±0.216	7.24 [a]±0.153
	Overall means	6.60 [b]±0.153	7.70 [a]±0.153	
Ca	H	5.65±0.481	9.82±0.481	7.73 [b]±0.340
	STP	9.51±0.481	10.03±0.481	9.77 [a]±0.340
	Overall means	7.58 [b]±0.340	9.92 [a]±0.340	
P	H	6.44±0.629	8.77±0.629	7.60 [b]±0.445
	STP	9.91±0.629	10.28±0.629	10.10 [a]±0.445
	Overall means	8.17 [b]±0.445	9.52 [a]±0.445	

Means with different letters differed significantly at $p<0.05$

Effect of salinity on some blood hormones: Triiodothyronine (T_3) concentration was slightly decreased among the different groups with differences being insignificant (Table 3). Thyroxine (T_4) concentrations was also decreased although differences were significant ($P<0.05$).

The present results are in agreement with those reported by El-Hawy (2013) who concluded that feeding salt tolerant plants and drank saline water decrease blood T_3 and T_4 concentration. Also, Metwally (2001) in camel, concluded that saline water treatment in camels decreased both T_3 and T_4 and attributed that to the decrease of feed intake, so that the metabolism process decreased.

Table (3): LSM ± SE of triiodothyronine (T_3) (ng/ml), thyroxine (T_4) (µg/ml), aldosterone (pg/ml) and cortisol (µg/dl) concentrations in blood of Shami goats as affected by salinity conditions

	Experimental diets	Drinking water		Overall means
		TW	SW	
T_3	H	4.36±0.196	3.92±0.196	4.14 ^{a}±0.138
	STP	4.16±0.196	3.82±0.196	3.99 ^{a}±0.138
	Overall means	4.26 ^{a}±0.138	3.87 ^{a}±0.138	
T_4	H	8.37±0.367	7.48±0.367	7.93 ^{a}±0.260
	STP	7.62±0.367	6.62±0.367	7.12 ^{b}±0.260
	Overall means	7.99 ^{a}±0.260	7.05 ^{b}±0.260	
Ald.	H	39.10±1.997	30.45±1.997	34.77 ^{a}±1.412
	STP	26.44±1.997	24.38±1.997	25.41 ^{b}±1.412
	Overall means	32.77 ^{a}±1.412	27.41 ^{b}±1.412	
Cort.	H	13.87±2.008	21.19±2.008	17.53 ^{a}±1.420
	STP	18.17±2.008	24.46±2.008	21.31 ^{a}±1.420
	Overall means	16.02 ^{b}±1.420	22.82 ^{a}±1.420	

Means with different letters differed significantly at $p<0.05$

In consistency, result of aldosterone (Ald) concentrations followed the same trend of reduction with differences being significant ($P<0.05$).

The present results are in a harmony with those found by Digby *et al.* (2008) in Merino ewes and Shaker *et al.* (2008) in Barki lambs. In contrary, El-Hawy (2013) found that Ald concentration of does fed salt-tolerant alfalfa were insignificantly lower than those fed berseem hay. However the decreases in aldosterone concentration might be related to high salt content of such salt-plants (Shaker *et al.* 2008). In addition, Aboulnaga (1987) demonstrated that the Ald secretion and concentration of Na and K in urine and blood plasma would be changed when the ratio of sodium and potassium intake changed. Moreover, Hamdi *et al.* (1982) clarified the association of aldosterone and Na^{+}/K^{++} index in the blood suggesting that it might be attributed to an increase in the aldosterone release in response to drinking the diluted seawater.

On the other hand, Cortisol (Cort.) concentration tended to increase with increasing salinity where SW and STP groups had higher ($P<0.05$) values than that of TW and H groups (Table 3).

These results are in-agreement with those found by Abdel-Hameed *et al.* (2006) in camels, using four groups the first served as a control that fed on berseem hay while the other three treated- groups were fed on fresh *Atriplexnummularia* (T2), fresh *Acacia saligna* (T3) and mixture from Atriplex with Acacia (T4). They found that cortisol levels among treated groups (T2, T3 and T4) were high in comparing with the control group in both seasons (summer or winter).

Histological structure of goat skin: The histological study revealed that the skin of goats consists of two main layers: a thin outer epidermis and a thicker dermis. Hairs grow from small structures in the skin known as follicles. These follicles associated with glands (sweat and sebaceous glands) and erector pili muscles are enveloped by the dermis which is reach in blood vessels and nerves (fig. 1).

The epidermis is composed of stratified squamous keratinized epithelium. The hair follicle and their associated glands are epidermal structures derived as down growths from the cellular epidermis. The epidermis epithelium is continuous with the hair follicles in areas where the later opens to the surface. The epidermis of Shami goatskin covers approximately 1.5 to 2.2% of the total thickness of the skin.

The dermis is composed of a connective tissue that supports the epidermis and binds it to the subjacent layer, the subcutaneous tissue (hypodermis). The surface of the dermis is very irregular and has many projections (dermal papillae) that interdigitate with projections (epidermal pegs or ridges) of the epidermis. The dermis is subdivided into two strata, the papillary layer superficially and the reticular layer beneath. Or/ it's subdivided into grain and corium.

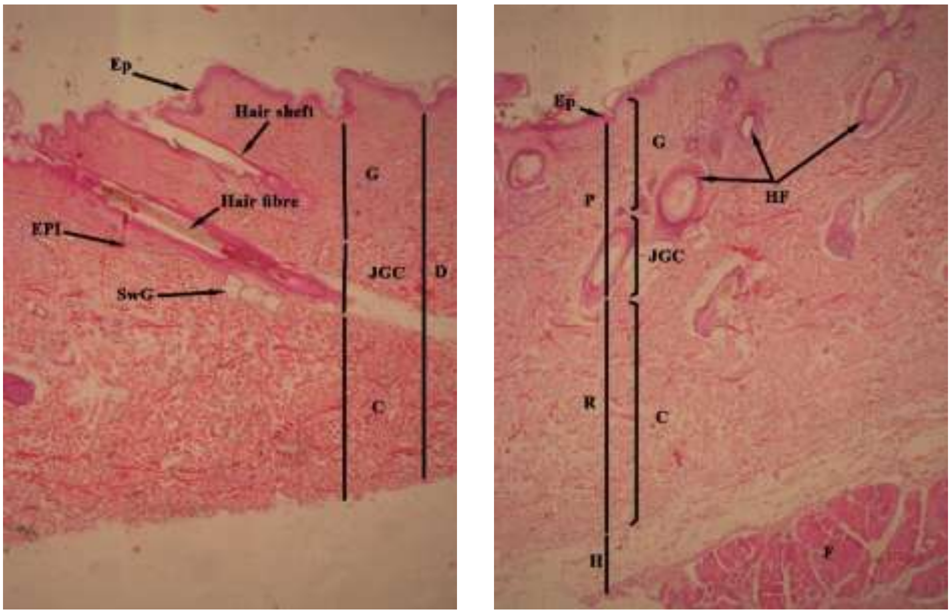

Fig. (1): vertical section of Shami goatskin showing different layers of the skin (Corium layer, C; Dermis, D; Epidermis, Ep; Erector pili muscle, EPI; Flesh, F; Grain layer, G; Hair follicles, HF; Hypodermis, H; Junction of grain and corium, JGC; Papillary layer, P; Reticular layer, R; Sweat gland, SwG) (Hx.E., X100).

The papillary layer of Shami goatskin occupies approximately 29.8 to 36% of the total thickness of the skin while, the reticular layer occupies approximately 61.6 to 68.4% of the total thickness of the skin (Fig. 1). In general, the collagen fibers of papillary layer are compactly woven while, in the reticular layer the collagen fibers are fuller and firmer.

Present results (Table 4) showed that the thickness of epidermis layer was affected ($P<0.05$) by both type of drinking water and type of feeding whereas papillary layer thickness and follicle depth was not affected.

Table (4) shows that the skin thickness was affected significantly ($p<0.05$) by water salinity while, the follicle depth was affected significantly ($p<0.05$) by STP feeding. The higher skin thickness value was obtained in (STP&TW) 2087.10 µm and lowest one was obtained in (STP&SW) 1561.49 µm (Table, 4). The follicle depth was decreased with increasing salinity. The higher values were obtained in (H&TW) followed by (H&SW), (STP&TW) and (STP&SW) with values 1049.97, 927.43, 788.04 and 666.68 µm, respectively.

Table (4): LSM ± SE of skin layer thickness of Shami goats as affected by salinity conditions

	Experimental diets	Drinking water		Overall means
		TW	SW	
Ep.	H	36.11±2.194	42.21±1.900	39.16 [a]±1.451
	STP	33.37±1.551	35.73±2.687	34.55 [b]±1.551
	Overall means	34.74 [b]±1.343	38.97 [a]±1.645	
P.	H	674.18±31.396	641.99±27.189	658.09 [a]±20.766
	STP	624.37±22.200	562.25±38.452	593.31 [a]±22.200
	Overall means	649.28 [a]±19.226	602.12 [a]±23.547	
R.	H	1174.14±56.273	1293.27±48.734	1233.71 [a]±37.221
	STP	1429.36±39.791	963.50±68.920	1196.43 [a]±39.791
	Overall means	1301.75[a]±34.460	1128.39[b]±42.204	
S.Th.	H	1884.44±71.469	1977.48±61.894	1930.96 [a]±47.272
	STP	2087.10±50.536	1561.49±87.531	1824.30 [a]±50.536
	Overall means	1985.77[a]±43.765	1769.48[b]±53.602	
Fd	H	1049.97±64.765	927.43±56.088	988.70 [a]±42.838
	STP	788.04±45.795	666.68±79.320	727.36 [b]±45.795
	Overall means	919.01 [a]±39.660	797.06 [a]±48.573	

Means with different letters differed significantly at p<0.05

Epidermis, Ep; Follicles depth, Fd; Papillary layer, P; Reticular layer, R. and Skin thickness, S.Th.

Salinity had a significant (P<0.05) effect on reticular layer thickness while, the effect of STP was non-significant. Results (Table 5) clear out that there was a decrease in thickness of reticular layer in case of drank SW. However, the highest value was 1429.36 µm and lowest one was 963.50 µm for (STP&TW) and (STP&SW) groups, respectively.

Effect of salinity on leather physical properties: The physical properties of leather (tensile strength, elongation, and tear strength) were not affected significantly by treatments (Table 5). The physical properties of leather determine to a large extent the quality of the leather and the mechanical tests were designed to assess how the leather will perform during the manufacture and use of the finished leather goods.

Tensile strength is the widely used measure defined as "the greatest longitudinal stress a substance can bear without tearing apart".

The higher value of Ts (131.43 kg/cm^2) was obtained in (H & SW) group while the lower one (93.65 kg/cm^2) was obtained in (STP & SW) group.

Table (5): LSM ± SE of leather physical properties (tensile strength, elongation and tear strength) of Shami goat skin as affected by salinity conditions

	Experimental diets	Drinking water		Overall means
		TW	SW	
Ts	H	104.60±12.165	131.43±12.165	118.02 ^{a}±8.602
	STP	120.55±12.165	93.65±14.900	107.10 ^{a}±9.617
	Overall means	112.58 ^{a}±8.602	112.54 ^{a}±9.617	
El	H	52.21±2.928	66.39±2.928	59.30 ^{a}±2.070
	STP	56.80±2.928	49.58±3.586	53.19 ^{a}±2.315
	Overall means	54.51 ^{a}±2.070	57.98 ^{a}±2.315	
Trs	H	19.07±1.186	20.00±1.186	19.53 ^{a}±0.839
	STP	18.13±1.186	16.96±1.453	17.54 ^{a}±0.938
	Overall means	18.60 ^{a}±0.839	18.48 ^{a}±0.938	

Means with different letters differed significantly at $p<0.05$

Elongation, El; Tear strength, Trs andTensile strength, Ts

In general, a good tensile strength value is desired in all leather types and this characteristic is an important indicator of leather quality (Venkatachalam, 1962). In the present study, the tensile strength ranged approximately from 93.65 to 131.43 kg/cm^2, which was greater than those reported by Kassem (2009) for Barki sheep and Azzam (2003) for Abu-Dleek sheep and lower than those reported by Seid*et al.* (2012) for Arsi-bale goats and Onu *et al.* (2011) for indigenous goat skin under different feeding management.

Results of the present study are in accordance with those obtained by Ebrahiem *et al.* (2015).They found that feeding on enrich and poor pasture level had insignificant effects on leather tensile strength (kg/cm^2). Also, Negussie *et al.* (2015**)** indicated that regardless of the feeding regime, all lambs produced leathers that fulfilled most of the chemical and physic-mechanical quality parameters required by leather industry.

On the other hand, the elongation ability at break of leather provides information about the fullness property (Negussie *et al.*, 2015). Lower elongation at break value refers to a less elastic leather character. Less elastic leather cannot withstand the applied force and is not liked by leather processing industry. Data represented in table (5) showing a non-significant effect of STP /or SW on elongation. Whereas, the higher value of elongation was obtained in group (H & SW) and lowest one was obtained in group (STP & SW). In general, the values of elongation arranged from 66.39 to 49.58 %. This result was in-agreement with Kassem (2009) as 50.39 % in Barki sheep, Nasr (2005) as 56.36% and 60.49% in Barki and Abu-Dleek, respectively and by Kotp (1987) as 59.6% and 42.4% in Rahmany and Barki sheep, respectively.

The result of the present study indicated that, using of SW /or STP as a supplementary feeding could improve the thickness of leather and higher value of leather thickness was attributed to higher strength and percentage of elongation. However, G4 (STP & SW) was the lowest one in tensile strength and elongation of leather. Another group of strength parameters manifested in finished leathers during usage are tear load resistance (Altan *et al.,* 2010). Distension at burst of leather tells the performance of leather to burst when multidirectional force is applied (Negussie *et al.*, 2015).

The present results showed a non-significant effect for STP /or SW on leather tear strength (Table 5). The highest value of tear strength was obtained with (H&SW) while, the lowest one was in (STP&SW) group. Results reflected the effect of nutrients supplementary feeding on leather tear strength. This is in line with Negussie *et al.* (2015) who reported that tear strength was improved due to the increased level of supplement in the diets of animals. The leather produced from better fed was more extensible grain layer than the leather produced from the poorer fed (Passman and Summer, 1983).

CONCLUSION

This study recommend that in salt affected lands where animals were suffered from feed shortage and scares of fresh water, salt-tolerant plants as animal feeds could be utilized safety without negative impact on their performance. Manufacture of animals skins at a small scale represent one of income generating activities in this area led to improve the livelihood and income of such families and reduce the severe poverty.

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بعض الإستجابات الفسيولوجية وخصائص الجلد للمعز الشامي المتأثرة بالملوحة تحت الظروف الصحراوية

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المستخلص

صممت هذه الدراسة لبيان تأثير ملوحة مياة الشرب والتغذية بنباتات مقاومة للملوحة علي خصائص الجلد في ذكور المعز الشامى ودراسة سمك الطبقات المختلفة للجلد ومساحة وكثافة حويصلات الشعر وأيضا دراسة بعض الصفات الطبيعية للجلد المدبوغ مثل قوة الشد والأستطالة ومقاومة الجلد للتمزق وتم تسجيل بعض الاستجابات الفسيولوجية للحيوانات محل الدراسة.

أجريت التجربة بمحطة بحوث جنوب سيناء (رأس سدر) التابعة لمركز بحوث الصحراء. استخدم في الدراسة ثماني وعشرون ذكر معز شامي قسمت إلي اربعة مجاميع متساوية. المجموعة الأولي (المجموعة الضابطة): غذيت علي دريس برسيم وماء عذب. المجموعة الثانية: غذيت علي دريس برسيم وماء مالح. المجموعة الثالثة: غذيت علي نباتات مقاومة للملوحة وماء عذب. المجموعة الرابعة: غذيت علي نباتات مقاومة للملوحة وماء مالح.

أظهرت الدراسة أن الملوحة سواء في التغذية أو ماء الشرب قد أثرت معنويا علي تركيز العناصر المعدنية (صوديوم، بوتاسيوم، كالسيوم، فوسفور) في بلازما الدم. وقد اتجه كلا من هرمون الثيروكسين والتراي ايودوثيرونين والألدوستيرون إلي الأنخفاض مقارنة بالمجموعة الضابطة والذي يرجع إلي تأثير الملوحة علي كمية الغذاء المأكول بينما اتجه هرمون الكورتيزول إلي الأرتفاع لمساعدة الحيوان علي مقاومة الضغوط البيئية المتمثلة في الملوحة.

أوضحت النتائج أيضا عدم وجود تأثير معنوي بين المجموعات الختلفة علي التركيب الهستولوجي للجلد (سمك طبقات الجلد المختلفة) فيما عدا المجموعة الرابعة التي تغذت بنباتات مقاومة للملوحة وماء مالح فقد أظهرت تأثيرا معنويا ($p<0.05$) علي سمك طبقة الآدمة كما أتجه سمك الطبقة الحبيبية إلي الأنخفاض. وقد أظهرت الصفات الطبيعية للجلد المدبوغ تأثرا واضحا بنفس المجموعة.

يستخلص من الدراسة أنه يمكن الأستفادة من النباتات المقاومة للملوحة في تغذية الحيوانات في الأراضي المتاثرة بالملوحة بطريقة أمنه بدون تأثيرات ضارة علي صحة الحيوان وإنتاجيتة ولاسيما الصفات المختلفة للجلد الخام والمدبوغ وامداد هذه المناطق الصحراوية بمصادر تغذية غير تقليدية وبالتالي إمكانية تنمية الصناعات الصغيرة من الجلود والتي تعتبر مصدر دخل للبدو في هذه المناطق.