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STUDIES ON THE EFFECT OF SOME SALT ADDITIVES ON THE SKIN AND COAT CHARACTERISTICS OF SHEEP IN HEDERBA VALLEY RANGES

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SUMMARY

Thirty Aboudeleik ewes aged 3-5 years with an average body weight of 37.5±3.75 kg were used in the study at Ras Hederba Valley region (Shalateen Research Station, Desert Research Center). The present work was designed to evaluate the effects of organic and inorganic salt additives on some histological responses of skin and wool follicles and coat changes of Aboudeleik ewes. Sheep skin consists mainly of epidermis and dermis. The epidermis composed of stratified squamous keratinized epithelium. The dermis consists of connective tissue which is divided into an upper papillary layer and a lower reticular layer.The experimental results revealed that the addition of the two forms of salt additives to the sheep nutrition showed variable changes in the thickness of all skin layers of treated animals than the control group. The skin thickness and the papillare layer were thinner in sheep fed on organic salt additives while the reticular layer increased significantly by the two forms of salt additives. Values of all primary and secondary wool follicle dimensions increased by the use of the two forms of salt additives than the control group. The external and internal diameters of the primary follicles increased significantly in the treatment groups. In case of secondary follicles, the external diameter and the wall thickness were affected significantly in the inorganic group than those of the other two groups. The diameter of fibres produced from the primary follicles and the medulla thickness increased significantly by the two forms of salt additives than those of control group with no significant differences between them. Whereas organic salt additives affected significantly the diameter of the fibres produced by the secondary follicle. The coat fibres of Aboudeleik sheep were of bimodal structure usually consists of outer and under coats. Animals have supplemented diets with the two forms of salt additives recorded the highest percentage of fibres from type A and also the under coat percentage whereas inorganic group represented the highest percentage of type B. The greatest percentage of type C was found in the animals supplemented with organic salt additives. The fibres length and number of crimps/centimeter in Aboudeleik sheep was affected by the use of the two forms of salt additives. Sheep had inorganic salt additives recorded a significant increase in the length of type A than those of the other two groups and of type B only with the control group. It could be concluded that the supplementation of sheep diets with salt additives is a useful method in challenging the unbalanced salt conditions found in the rangeland of desert regions which affects the livestock development throughout the production and performance of animals.

Keywords: *Skin, coat, Abou deleik sheep, histology, salt additives.*

INTRODUCTION

Halaieb-Shalateen and Abu Ramad triangle region has a vital and strategic importance to Egypt as a border area between Egypt and Sudan. This region is a mountainous desert with several valleys dissecting mountains. The source of income of most inhabitants depends mainly on range animals where sheep and goats are the most dominant livestock production system in these areas. This region is mostly characterized with low and erratic rainfall which resulted in drought and consequently a poor range condition, especially through summer season. The pasture in Halaieb-Shalateen and Abu Ramad triangle region contained three main plants namely *Panicum turgidum, Lyicum shawii* and *Acacia tortilis* (El Shaer *et al*., 1997). The range vegetation in this region is considered the basic renewable source of ruminants feed, neversless the short duration of rains precipitation, long drought periods, shortage of forage production, seasonal starvation of animals, unavailability of feed concentrates which brought from the Nile valley, unavailability of drinking water for animals during the dry season and improper economic inter-relationship between animal productivity and potential utilization of range plants (El Shaer *et al.,* 1997). It is thought that the interaction between quality of feed resources and physiological status of animal is one of the main constraints to animal production in this region.

Sheep are considered to be the most important for future growth of livestock in Egypt. They provide meat, milk and wool for large section of population especially in desert areas. Sheep reared in desert or in newly reclaimed areas may suffer from several feeding and drinking stressors (Khalil *et al.*, 1990). In comparison with other farm animals, sheep breeding has many advantages as they are not only highly fertile and able to graze in dry scanty areas, but also have a high digestion coefficient for converting the food stuffs to important products. The modern scope of veterinary husbandry is now directed to promote the biological and metabolic efficiency for the productive and reproductive capacities of these animals (Samir, 1990).

Healthy feeding and its supplementation with the sufficient requirements of animal growth were reported by many authors as the main factor for efficient animal production. Maintenance of good health of animals, their adequate growth and performance depend on appropriate concentrations of trace elements and their correct balance in tissues and organs. The required animal supply with micro- and macro-elements is governed by the animal species, physiological status, age and production type (Hylland *et al*., 2009).

Trace minerals are needed for vitamin synthesis, hormone production, enzyme activity, collagen formation, tissue synthesis, skin activity and wool growth, oxygen transport, energy production, and other physiological processes related to growth, reproduction and health. Traditionally, supplemental trace minerals have been supplied to livestock in the form of inorganic salts, sulfates, oxides and chlorides. The use of organic trace minerals have increased due to reports of improved feed efficiency, growth, reproduction and immune response (Swenson, 1998). Micro-minerals imbalances have a great impact on animal’s physiology and cause various problems. However, because trace minerals usually antagonize other elements within the diet, they are not generally added to it in high levels (Tayefi-Nasrabadi *et al.,* 2008). Deficiency of trace minerals can affect the production and performance of sheep and goat (Lengarite *et al*., 2012). Deficiencies of trace elements such as cobalt, copper, iron, zinc, and selenium had been reported to occur in all the climatic zones, and the geographic regions of the world (Underwood and Suttle, 2001).

Wool is a natural fibre obtained from sheep. When the quality of pasture is poor, there is a reduction of total fleece yield as well as in the quality of wool per animal and per unit area of grazed land. Proper wool growth requires all the important nutrients like minerals, vitamins and carbohydrates. Minerals can influence wool growth by affecting feed intake by altering rumen function and hence the supply of nutrients flowing from the rumen or by directly disrupting metabolism within the sheep (Hynd and Masters, 2002).

The integument including the coat fibres of an animal is not only the protective cover of its body, but also the medium through which the animal is in continuous contact with its surroundings. The study of the skin would have economic implications and establish the scientific data through which qualitative and quantitative assessment of wool product could be achieved.

The objective of this study is to investigate the effects of organic and inorganic salt additives on sheep skin and coat characteristics in the region of Halaieb, Shalateen and Abu-Ramad triangle. Emphasis was laid on the qualitative comparisons of some skin and coat characteristics that are related to wool production. This would likely help in planning specific strategies for the development of animal production in that region.

MATERIALS AND METHODS

The study was carried out at Ras Hederba Valley region, Shalateen Experimental Research Station, Desert Research Center, Egypt. The station is located in the Shalateen -Abu Ramad - Halaieb Triangle Region, Red Sea Governorate, about 1300 km south eastern ofCairo with latitude 22, 00, 720 N and longitude 36, 48, 955 E.

Thirty pregnant Aboudeleik ewes aged 3-5 years with an average body weight of 37.5±3.75 kg were randomly allocated in three groups (10 ewes each) and reared in semi open pens surrounded with a wire fence and roofed with natural grass. Animals were subjected to the normal management system of the farm; grazing natural pasture about 6 hours daily and have (200 gm. /head/day) concentrate feed mixture which contains 25% cotton seeds cake, 35% yellow corn, 30% wheat bran, 3% rice bran, 3% molasses, 1% urea, 2% limestone and 1% common salt. Animals were allowed to drink water twice daily ad-libitum just before going for grazing and after returning at noon.

The first group (control) grazed the basal ration. The other two groups (treated groups) were diversified with respect to the salt additive mixtures which contain (copper, zinc, manganese and cobalt)in an organic form as a commercial product (Availa 4) distributed by Multi Vita for animal nutrition, St. 14-4c second industrial area, 6 October City, Giza, Egypt. Whereas the other group fed on the same minerals but in an inorganic form as a commercial product produced by Starfarma for feed additives, Industrial region, Arab El-Awamar, Asyut, Egypt. The two mineral forms were given individually to the animals at a dose of 2.7 g/head/day

Skin samples were taken from the mid side region which is considered as a standard follicle population area over the whole skin surface (Schleger and Turner, 1960). Skin specimens were fixed in calcium formol for about 24 hours (Barker, 1958), washed and left for 24 hours in distilled water and preserved in 70% ethanol. The samples were dehydrated, cleared and impregnation was carried out in paraffin wax. From paraffin blocks transverse and vertical sections of 6-8 microns in thickness were prepared.

For general histological observations, sections were stained with Hematoxylin and Eosin stain (Drury and Wallington, 1980). From the histological examination, the thickness of the skin layers and the external and internal follicle diameters were measured. The wall thickness was calculated. Also, the wool fibre diameter and medulla thickness were measured.

Wool fibre samples were collected from sheep at the same time of getting the skin samples. All samples were tested for fibre type ratio according to the method followed by (Guirgis, 1973). The samples (not less than 500 fibres each) were sorted into outer and under coats. Outer coat fibres were classified into 3 types, A, B and C fibre types as mentioned by El-Ganaieny (1996). The average fibre lengths in both outer and under coats were measured from ten observations for each fibre type. Each fibre was measured against a millimeter ruler with enough tension applied to straighten the fibre without stretching it. Both fibre types and fibre lengths were examined on white or black velvet covered board. The number of crimps per centimeter was counted in the fine fibres of the under coat.

All parameters were measured using Image analyzer software (Zen, 2012, Blue edition) and (device Carl-Zeiss micro-imaging G and bh) with lenses 10/0.847 and 40/0.65.

SAS (2008) program, utilizing GLM procedure was used to analyze the obtained data and the differences between means within the different experimental groups were compared using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The skin and its accessory structures make up the integumentary system, which provides the body with overall protection. The skin is made of multiple layers of cells and tissues, which are held to underlying structures by connective tissue. At the surface is a thin keratinized stratified squamous epithelium called epidermis under which there is a connective tissue layer called dermis beneath which is found the hypodermis (Fig. 1).

Wool grows from small structures in the skin known as follicles, and these together with their associated glands (sweat and sebaceous glands) and erector muscles, were enveloped by the dermis that was also rich in blood vessels and nerves (Fig. 2).

The epidermis is a keratinized stratified squamous epithelium which composed of cells of two distinct lineages. Those comprising the bulk of the epithelium undergo keratinization. The dermis is made up of two layers of connective tissue that merge with each other (Fig. 1). The outer layer, which is by far the thinner of the two, is composed of loose connective tissue. It is called the papillary layer and contains fine elastic fibres arranged as a network. The second layer is called the reticular layer that composed of thick or coarser elastic fibres randomly distributed in bundles of collagen fibres that interface with one another in a netlike manner (Fig. 1).

Table (1) summarized the thickness of the epidermal layer, the dermal layer including both papillare and reticular layers and the total skin thickness.

Table (1): Mean thickness values (µm ± SE) of total skin and its different layers in sheep have salt additives.

Skin layers	Treatment		
	Control	Organic salts	Inorganic salts
Epidermal layer	18.65±1.60^{a}	20.65±1.60^{a}	21.47±1.12^{a}
Papillary layer	599.82±50.90^{b}	630.33 ± 47.95^{b}	861.44±35.55^{a}
Reticular layer	600.91±47.95^{b}	733.02 ±50.90^{a}	718.27±33.91^{a}
Totalskin thickness	1219.37±52.11^{b}	1384.01±52.11^{b}	1604.96±36.85^{a}

In each row, means followed by different letters are significantly different (P<0.05)

The experimental results revealed that the addition of different forms of salt additives to the sheep nutrition showed variable changes in the thickness of all skin layers of treated animals in comparison with the control ones. It is clear from Table (1) that the total skin thickness was increased significantly in the sheep fed nutrition supplemented with inorganic salts (1604.96±36.85) than those of organic salts (1384.01±52.11) and also of control group (1219.37±52.11). Meanwhile the papillary layer followed the same trend since it recorded (861.44±35.55) in inorganic salts and (630.33 ± 47.95, 599.82±50.90) in both organic salts and the control groups. The reticular layer aclimed the previous results by showing a clear affection with the supplementation with the two forms of salt additives. It recorded a significant increase in the mean thickness values in the animals of both inorganic (718.27±33.91) and organic salts (733.02 ±50.90) versus (600.91±47.95) among the control group as shown in Table (1). On the other hand, the thickness of the epidermis was not affected by the treatment in the different experimental groups.

Minerals can influence skin activity and wool growth by affecting feed intake (sodium, potassium, sulfur, phosphorus, magnesium, cobalt and zinc) by altering rumen function and hence the supply of nutrients flowing from the rumen (sulfur, sodium, potassium and cobalt) or by directly disrupting metabolism within the sheep (zinc, copper, selenium, iodine and cobalt).However, magnesium has a role in energy providing phosphate transfer reactions and DNA degradation and synthesis-free calcium concentration also provide an important mechanism of signal transduction in keratinocytes (Pruche *et al.*, 1996). Also, manganese is essential for the synthesis of glycoproteins such as chondroitin, Dermatan sulfate and collagen in the dermal extracellular matrix.

The present results were in agreement with the foundation of Eren *et al.* (2012) who observed that the skin thickness and the stratum papillare were thinner in sheep fed on organic copper and zinc during the pre and post partum period may be a result of possible tightening due to a positive effect of Cu and Zn taken organically on connective tissue fibres. They also added that, the mean Cu and Zn values found in the feces of the animals supplemented with organic salts were significantly lower compared to animals supplemented with inorganic salts. In addition, many researches have shown that organic minerals were concentrate more in the organs and tissues and are held more within the body (Ryan *et al*., 2002, and Salama *et al*. 2003).

The availability of both copper (Cu) and zinc (Zn) caused a clear effect on the collagen and elastin in the skin. Copper is an essential micronutrient required for the formation and activity of important enzymes in the skin and its appendages (Danks, 1991). Lysyl oxidase, an enzyme that is dependent on Cu, plays a role in the extra-cellular processing of collagen and elastin (Kosonen *et al.,* 1997). Lysyl oxidase plays a role in elastin and collagen cross-linking which provides the stability of the collagen fibres and the elasticity of the elastin fibres (Maki, 2002). On the other hand, zinc is a component of the free radicals scavengers which are produced during different physiological processes (Zhao *et al.,* 2014). It is required for the normal condition of epidermis, epithelium, skin and hooves (Kruczynska, 2004) and plays a central role in the metabolism and repair of the skin and ligaments (Chien *et al.,* 2006).

Copper and zinc also work together to support the metabolism and to activate the enzyme copper-zinc superoxide dismutase. This enzyme serves as an antioxidant, which means that it protects the cells from harmful reactive oxygen species, a group of chemicals that form as a natural byproduct of the cells' metabolism. Since the cells constantly produce new reactive oxygen species, they rely on antioxidants to continually neutralize the compounds and prevent cell damage, so that the cells can continue to function properly. Also, zinc is an integral component of a large number of metallo-enzmes with important metabolic functions ranging from control of gene expression to metabolism of protein fat and carbohydrate (Neldner, 1991). Selenium is incorporated into molecules of glutathione peroxidase that had a vital role in protection of cell membrane against undesirable reactions with soluble peroxidase. This enzyme is a major intracellular antioxidant that catalyzes the reduction of hydrogen peroxide and organic hydroperoxides to nontoxic compounds (Duane, 1987). Good selenium nutrition is of key importance for antioxidant defense as well as efficient enzyme metabolism.

The wool matrix have influenced quantities of calcium, potassium, sodium, zinc, copper, manganese, iron and selenium (Lee and Grace, 1988), but only copper, zinc, iodine and possibly selenium can directly disturb follicle function and wool growth.

In the present study, both primary and secondary wool follicle dimensions were affected by different forms of salt additives.Data in Table (2) demonstrated that there were increased values in all primary and secondary wool follicle dimensions exceeded the control group in the skin of animals represented the different experimental groups.

Table (2): Mean values (µm ± SE) of primary and secondary wool follicle dimensions in the skin of sheep have salt additives.

Follicle dimensions	Treatment	Primary follicle	Secondary follicle
External diameter	Control	110.01±4.60^{b}	35.54±1.60^{b}
	Organic salts	124.54±3.85^{a}	39.35±1.37^{b}
	Inorganic salts	128.98±4.10^{a}	43.79±1.08^{a}
Internal diameter	Control	71.47±3.76^{b}	17.03±1.03^{b}
	Organic salts	86.94±3.15^{a}	20.13±0.88^{a}
	Inorganic salts	92.78±3.36^{a}	17.19±0.70^{b}
Wall thickness	Control	38.54±1. 87^{a}	18.52±1.19^{b}
	Organic salts	37.60±1.57^{a}	19.22±1.02^{b}
	Inorganic salts	36.20±1.67^{a}	26.60±0.80^{a}

In each parameter, means followed by different letters are significantly different ($P<0.05$)

In the primary follicles, the treated groups recorded a significant increase in the mean values of the external and internal diameter of both organic and inorganic salt additives(124.54±3.85,128.98±4.10) and(86.94±3.15, 92.78±3.36 rather than the control group (110.01±4.60, 71.47±3.76) respectively .In case of secondary follicles, the external diameter and the wall thickness were affected significantly in the sheep fed nutrition supplemented with inorganic salts(43.79±1.08,26.60±0.80) than those of organic salts(39.35±1.37, 19.22±1.02)and control group(35.54±1.60,18.52±1.19) which recorded the smallest dimensions in all primary and secondary follicle dimensions. Whereas, sheep had organic salt additives exhibited a significant increase in the internal diameter (20.13±0.88) than the other experimental groups (Table 2).

With the notable exception of the proportion of cells entering the fibre, all of the follicle-cell parameters are influenced by the supplementation of the nutrition with salt additives. It could be observed in the distribution of cells to fibre versus inner root sheath. On the other hand, there is a close relationship between the size of the follicle bulb (and associated dermal papilla) and the dimensions of the fibre produced by that follicle (Hynd, 1994 a,b).However, the hair follicle activity was influenced by the presence of selenium which important in the enzymatic de-iodination of the thyroxin to triiodothyronine (Rhind and Kyle, 2004).And copper is an essential micronutrient required for the maintenance of melanin pigment production in the hair follicles.

The increase in the wool follicle dimensions found in the animals have inorganic salt additives was in agreement with Eren *et al.* (2012) who demonstrated an increase in the primary and secondary follicle diameters of Kivircik sheep supplemented with inorganic salts than that supplemented with organic salts which recorded (135.37±3.35 and 131.36±2.73) and (78.48±1.83 and 75.60±1.23) in the primary and secondary follicles. However, Ozfiliz *et al.* (1997) also showed that these values were 124.44 and 81.67 µm in the primary and secondary follicle diameters in Kivirick and Karacabey sheep respectively.

In general, Hekal and Fahmi (2009) concluded that minerals level had a role in the activity of the wool follicles according to their foundation that the secondary follicle dimensions were significantly increased in the level of 0.7 ppm than in the level of 1.4 ppm

In this study, the increased values of secondary follicle dimensions in animals have the organic additives were probably due to the presence of the organic form which correlated with the presence of methionine that illustrated by the study of Souri *et al*. (1996) who demonstrated that methionine is essential to support the growth and the viability of secondary follicles of the cashmere goats. Ward *et al.* (1996) and Bailey *et al.* (2001) explained that, Chelated organic trace minerals are bound to organic ligands through coordinate covalent bonds. The bonds between the ligand and the mineral can prevent the minerals from interacting with antagonists and improve the bioavailability of the mineral. In addition, chelated mineral of Cu- and Zn-methionine provide Zn and Cu as well as methionine to animal system. Since the essential amino acids as lysine, methionine and cysteine stimulate wool growth (Puchala *et al*., 1999). Spears (1996) stated that, Cu and Zn-methionine complexes escape the ruminal lumen and passage to small intestine without microbial alteration and then from the intestinal lumen into mucosal cells resulted in increasing supply to tissue and hence improved animal productivity.

The wool growth response to dietary intake reflects a response to changes in the supply of amino acids (particularly the S-containing amino acids), energy substrates, minerals and vitamins to the wool follicles. However, the activity of the wool follicle culminates in the production of the fibre. The wool fibres were found to be composed of a thin outer layer (the cuticle) that surrounded the cortex, which in turn surrounded a central medulla (Fig. 3). The cortex formed the bulk of the fibre substance, and the cuticle provided a covering surface. In the coarse fibres there was a large central core (the medulla) that contained apparently empty spaces filled with gases probably air. The cuticle was found to be cellular in nature originating in the follicle bulb, so it was more correctly included as a part of the microstructure of the wool fibres. On the other hand, cortex cells which are considered the most important segment of the wool structure appeared columnar in shape, variable in size, keratinized and cemented together to form the body of the fibre (Fig. 3). The medulla was found consisting of soft keratin. The cells of the medulla were found elongated horizontally across the fibre especially in wide medulla.

Wool fibres could be divided into many categories according to their diameter and existence of a hollow center known as the medulla.

Table (3): Mean diameter values and medulla thickness (µm ± SE) of the fibres produced from both primary and secondary wool follicles in the skin of sheep have salt additives.

	Control	Organic salts	Inorganic salts
Primary fibres	61.40±3.51^{b}	76.37±2.94^{a}	81.98±3.16^{a}
Secondary fibres	12.78±0.95^{b}	16.22±0.81^{a}	13.18±0.64^{b}
Medullathickness	47.31±2.86^{b}	62.65±2.40^{a}	68.49± 2.56^{a}

In each row, means followed by different letters are significantly different (P<0.05)

Fibre diameter is the most important character affecting the economic value of wool. Measurements of the diameter of fibres produced from the primary follicles in the present study indicated that they are influenced by the supplementation of the nutrition with the two forms of salt additives than those of control group with no differences between them. They recorded (76.37±2.94, 81.98±3.16) in theanimals fed organic and inorganic salt additives versus (61.40±3.51) among the control group. Relating the primary fibre diameter to its follicle dimensions, it is interesting to point out that groups with larger follicle diameters had the thicker fibres and vice versa. It is obvious that the larger follicles have greater precursor materials, greater number of cells and larger bulbs as illustrated by Schinckel (1961).On the other hand, fibre diameters from secondary follicles recorded a significant increase inthe animals supplemented with organic salt additives(16.22±0.81µm) than those of the other treatment group (13.18±0.64µm) and the control group (12.78±0.95 µm) (Table 3).This result was in agreement with the Souri *et al*. (1996) who demonstrated that methionine is essential to support the growth and the viability of secondary follicles of the cashmere goats. Also, (Hekal and Fahmi, 2009) recorded that selenium showed a slight increase in the fibre diameter of secondary follicles at the level of 0.7 ppm. However, Fry *et al.* (1996) found that selenium supplemented sheep had greater fibre diameter over summer-autumn seasons. They also added that supplementation of selenium to deficient sheep increase wool length and the diameter of the fibres. The results in the present study confirmed the previous foundation that there was a relationship between the secondary fibre diameters and its internal follicle diameters as shown in Table (2 and 3).

The medulla is an important characteristic structure in sheep fleeces because of its association with hairiness. Generally, the two treatment groups exhibited the greatest primary fibre medullation (Table, 3). They increased significantly by the mean values of(68.49±2.56, 62.65±2.40µm) in the inorganic, organic salt additives rather thanthe control group(47.31±2.86 µm). This result is in harmony with those obtained on fibre diameter of the different groups studied as shown in the same Table.

The coat of sheep raised in Halaieb, Shalateen and Abu Ramad triangle were of bimodal structure, usually consists of two main types. The first is the outer coat which grows from the primary follicles and was highly medullated and act as camouflage to hide animals from predatory animals on range and forests.The second is the under coat which grows from the secondary follicles that contained fine and crimpy fibres. In this study, Table (4) demonstrated that the outer coat is consisting of three fibre types (A, B and C) while the under coat represented by fine fibres.

Table (4): Mean percentage ± SE of the outer coat fibre types and under coat in the fleece of sheep have salt additives.

Fibre types	Treatment		
	Control	Organic salts	Inorganic salts
A	7.66±2.98^{a}	9. 21±2.98^{a}	9.49 ±2.98^{a}
B	15.72±3.26^{a}	13.36±3.26^{a}	16.95±3.26^{a}
C	6.95±3.06^{a}	7.17±2.65^{a}	3.68±3.74^{a}
Under coat	69.99±5.43^{a}	70. 76±5.43^{a}	70.61 ±5.43^{a}

In each row, means followed by different letters are significantly different (P<0.05)

There are small and non-significant variable differences among the different groups of the fibre type percentages in the fleece of Aboudeleik breed. Animals supplemented with the two forms of salt additives recorded the highest percentage of type A and also the under coat percentage whereas inorganic group represented the highest percentage of type B. The greatest percentage of type C was found in the animals supplemented with organic salt additives as shown in Table (4).

The present findings in Table (5) indicated that the nutritional supplementation with the two forms of salt additives had an effect on the Abou deleik fibres length and its number of crimps/cm especially in the sheep had inorganic salt additives. It had a significant increase in the length of type A (2.56±0.11) than those of organic salts (1.99±0.11) and control group (1.87±0.11).The same trend was observed only with the control group of type B (1.95±0.18) versus (2.65±0.18) in the inorganic salt additives group.

Crimp is the term used to designate the natural waviness of wool fibres. The number of crimps will vary from 1 to 30/2.5 cm, depending on the degree of coarseness (Wool production in canada, 2009). More crimps are present in the finer wools. The average fibre length in the under coat ranged between 1.61±0.15 cm with 4.76±0.54 crimps/cm in organic salt group,1.79±0.15 cm with 5.30±0.54 crimps/cm in the inorganic salt group and 1.46±0.15 cm with4.02±0.54 crimps/cm in the control group with slightly increment in the two forms of salt additives than the control group as shown in Table (5).

Table (5): Mean length ± SE of the outer coat fibre types, under coat and its number of crimps/cm in the fleece of sheep have salt additives.

	Control	Organic salts	Inorganicsalts
A	1.87±0.11^{b}	1.99±0.11^{b}	2.56±0.11^{a}
B	1.95±0.18^{b}	2.10±0.18^{ab}	2.65±0.18^{a}
C	1.40±0.26^{a}	1.62±0.21^{a}	1.56±0.18^{a}
Under coat	1.46±0.15^{a}	1.61±0.15^{a}	1.79±0.15^{a}
Crimps/cm	4.02±0.54^{a}	4.76±0.54^{a}	5.30±0.54^{a}

In each row, means followed by different letters are significantly different (P<0.05)

These observations were explained by the foundation of Feng *et al*. (2013) who illustrated that dietary supplementation with ZnSO4 or HMBi (2-hydroxy-4-(methylthio) butyric acid isopropyl ester) improved cashmere growth with no effects on its fineness, especially the ZnSO4 supplement which provide sulfur to meet the requirements for protein metabolism and methionine production and HMBi can be degraded and then produce methionine via transamination. They added that this was probably due to ZnSO4 and HMBi supplements increasing the cysteine content and the raw materials of keratoprotein synthesis, thereby providing optimum conditions for cashmere growth. On the other hand, the results of Xie *et al*. (2003) showed that coated methionine remarkably enhances the growth rate and the length of cashmere fibres in the catagen phase but that it has no significant effects on cashmere fineness. Underwood (1981) stated that physical properties of wool are dependent on the presence of disulfide groups to provide the cross-linkages of keratin, which is adversely affected in the absence of Cu because copper is the essential micronutrient required forthe post translational formation of disulphide bonds between cysteine molecules in hair protein and has a role in the formation of crimp and maintenance of structural strength in wool of sheep (Danks, 1991).

However, Pal *et al.* (2010) demonstrated that periodical analysis of wool samples indicated no significant difference in Cu and Zn content between Cu-and Zn-methionine and Cu- and Zn-sulfate groups. Also, Jia *et al.* (2009) concluded that no differences were observed among treatment groups by Zn SO_4 and Zn Methionine for the length of Cashmere goat fibres. However, another result was observed by Puchala *et al.* (1999) who found that supplementation with 40 mg Zn/d (the basal diet containing 22mg Zn/kg DM) improved mohair yield but did not affect mohair length and diameter in Angora goats. In addition, wool growth was increased in Merino sheep fed a diet containing 17 mg Zn/kg compared with 10 mg Zn/kg (White *et al.*, 1994). Also, (Purser, 2000) concluded that copper supplementation may specifically stimulate wool growth but the evidence is meager. It is also known that selenium is a good antioxidant and it is important in sulfur amino acid synthesis.

Finally, it could be said that inorganic salts are generally added to the diet to prevent deficiency and diseases but not in a high level because their antagonism to other elements within the diet. On the other hand, the organic elements are absorbed without alterations and stored in their same organic forms and it has been stated that their absorption and bioavailability are high because of no antagonism is formed. According to the examined parameters, the salt additives treatments were significantly increased wool production without incurring penalty from increased fibre diameter.

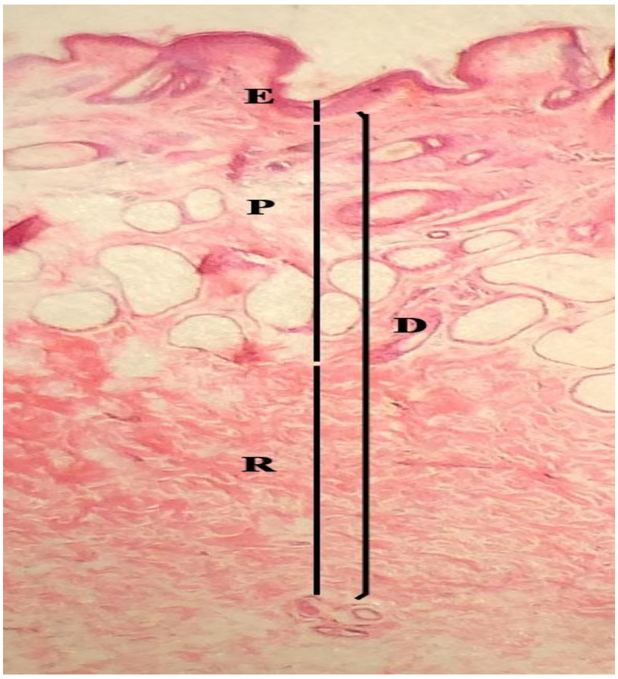

Fig (1): vertical section of sheep skin showing its layers. D, dermal layer; E, epidermal layer; P, papillary layer; R, reticular layer (Hx& E. x100).

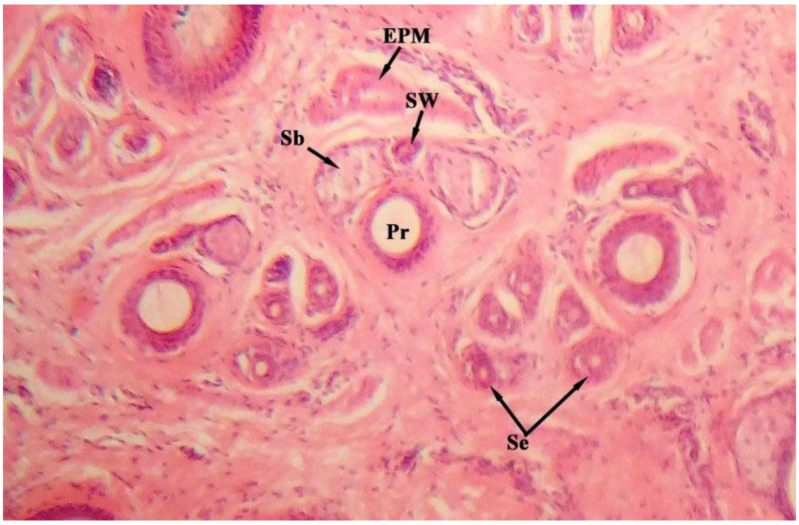

Fig (2): Transverse section insheep skin showing wool follicles and their associated glands. EPM, erector pili muscle; Pr, primary follicle; Sb, sebaceous gland; Se, secondary follicles; Sw, sweat gland. (Hx& E. x100).

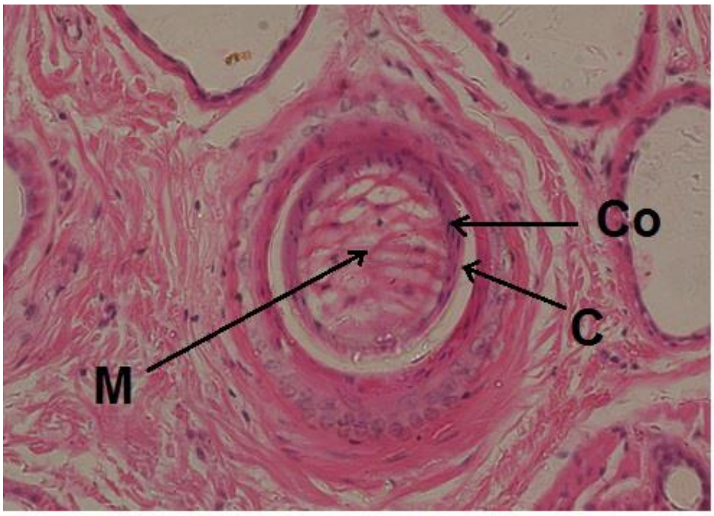

Fig (3): Transverse section in a wool follicle showing the wool fibre structures. C, cuticle; Co, cortex; M, medulla. (Hx & E. x 400).

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دراسات على تأثير بعض الإضافات الملحية على خصائص الجلد والألياف للأغنام بوادي حدربة

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أجريت هذه الدراسة بمزرعة الإنتاج الحيواني بوادي حدربة-محطة بحوث الشلاتين بمحافظة البحرالأحمر، مركزبحوث الصحراء- مصرعلى عدد 30 من نعاج أبو دليك والتي تتراوح أعمارها ما بين3- 5سنوات بمتوسط وزن الجسم 37.5±3.75 كجم ومقسمة إلى ثلاث مجموعات الأولي ضابطة والمجموعات الأخرى حصلت على غذاء مضاف اليه أملاح عضوية ومعدنية.تم تصميم هذا العمل لإلقاء الضوء على الإستجابات الهستولوجية لجلد نعاج أبو دليك وبصيلات الصوف وكذلك التغيرات في الغطاء فيما يتعلق بآثار الإضافات الملحية العضوية وغير العضوية.

يتكون جلد الأغنام بصفة أساسية من طبقتي البشرة والأدمة. وتتكون البشرة من الخلايا الطلائية الكيراتينية. اما الأدمة فتتكون من النسيج الضام وتنقسم إلى طبقة حلمية عليا وطبقة شبكية سفلي.أوضحت النتائج أن تغذية الأغنام على نوعين من الإضافات الملحية أدي إلى زيادات مختلفة في سمك جميع طبقات الجلد لمجموعتي الحيوانات المعاملة عن المجموعة الضابطة وكان سمك الجلد والطبقة الحلمية أرق في الأغنام المغذاة على إضافات الأملاح العضوية. أما الطبقة الشبكية فتأثرت تأثرا معنويا بإضافات نوعي الأملاح عن المجموعة الضابطة.

زادت قيم جميع أبعاد بصيلات الصوف الأولية والثانوية بإضافة النوعين من الأملاح عن المجموعة الضابطة كما زاد القطر الخارجي والداخلي للبصيلات الأولية بشكل معنوي في المجموعتين المعاملتين. أما في حالة البصيلات الثانوية فقد تأثر القطر الخارجي وسمك الجدار للبصيلات تأثرا معنويا في المجموعة الحاصلة على الأملاح غير العضوية مقارنة مع المجموعتين الأخرتين. كما زاد قطر الألياف المنتجة من البصيلات الأولية وكذلك سمك النخاع زيادة معنوية متأثرا بنوعي الإضافات الملحية عن المجموعة الضابطة مع عدم وجود فروق معنوية بينهما. في حين أن إضافات الأملاح العضوية أثرت بشكل معنوي على أقطار الألياف المنتجة من البصيلات الثانوية.

ينقسم الغطاء في أغنام أبودليك إلى نوعين رئيسيين غطاء خارجي وداخلي. وقد سجلت حيوانات مجموعتي الإضافات الملحية أعلى نسبة من نوع الألياف (A) وكذلك الغطاء الداخلي بينما كانت المجموعة الحاصلة على الأملاح غير العضوية تمثل أعلى نسبة من النوع (B). وكانت النسبة الأكبر من النوع (C) موجودة في الحيوانات المدعمة بالأملاح العضوية. كما تأثر طول ألياف أغنام أبو دليك وكذلك عدد التموجات في السنتيميتر باستخدام نوعي الإضافات الملحية حيث سجلت الأغنام المغذاة على إضافات الأملاح غير العضوية زيادة معنوية في طول الألياف من النوع (A) عن المجموعتين الأخرتين وكذلك النوع (B) فقط مع المجموعة الضابطة.والخلاصة أن تدعيم غذاء الأغنام بالإضافات الملحية من الطرق المفيدة في تحدي عدم التوازن الملحي الموجود بمراعي المناطق الصحراوية والذي يؤثر بدوره على تنمية الثروة الحيوانية من خلال أداء وإنتاجية الحيوانات.