Egyptian J. Anim. Prod. (2017) 54(3):193-198

SKIN AND FLEECE CHARACTERISTICS OF BARKI SHEEP AS AFFECTED BY DOCKING

S. A. Hekal[1], N. S. Badawy[1], Mona Mohammady I.[2]

1- Wool Production and Technology Department, 2- Animal Breeding Department, Desert Research Center, El-Matariya, Cairo, Egypt

SUMMARY

The present study was carried out in Tegzerty Experimental Farm for Animal Production at Siwa Oasis which belongs to the Desert Research Center, Ministry of Agriculture and Land Reclamation, Egypt. Thirteen single-born male Barki lambs (averaged 3.0±0.20 kg birth weight) were randomly assigned into two groups: (1) docked group (n= 6) and (2) control group (n= 7) to study the effect of docking on histological and histochemical characteristics of the skin together with wool characteristics in terms of clean wool yield, fibre diameter and fiber length. Results revealed that thickness of dermis increased by 17.3% in docked group compared with the control one. This could be related to the increase in reticular layer which increases by 36% in docked animals. The hypodermal thickness in the docked animals showed non-significant increase of 39.81%. Histochemicaly, carbohydrates were higher (P<0.01) in undocked than docked animals. Generally, the external and internal diameter of the follicles, wall thickness of primary, secondary and fibre diameter in the follicle were higher in docked than in undocked sheep. Docking appeared to have insignificant effect on fleece weight, wool yield, staple length, fibre diameter and number of medullated fibre in Barki lambs.

Keywords: Barki lambs, docking, wool characteristics, histology and histochemistry

INTRODUCTION

Barki sheep is the most popular fat-tailed sheep breed dominated in the North western part of Egypt. These sheep are kept mainly for meat production while wool is often considered as a second product. Tail docking is not a common practice in sheep farming in Middle East countries. However, several tail docking experiments have been carried out in an attempt to improve the growth, feed conversion efficiency and carcass characteristics of lambs (Alkass *et al*., 1985 and Shelton *et al*., 1991).

The fat tail plays an important role in adaptation of sheep raised under the harsh feeding conditions of arid and semi-arid regions. It was anticipated that tail docking would result in lower metabolizable energy requirements due to lower fat deposition (Al Jassim *et al*., 2002).

Changes in consumer preferences favoring leaner meat, the growing awareness of the bad effects of high-fat diets as well as the availability of alternative cheaper and healthier fat sources, has resulted in a reduced demand for the fat-tailed sheep in Middle East countries. Moreover, many flock owners consider that lamb docking is necessary for disease prevention and good flock management (Kent *et al*., 1995) and/ or to prevent blowfly strike (Shut *et al*., 1988).

The effect of docking on growth, carcass traits, blood constituents and heat tolerance of sheep had been studied (Marai *et al*., 1989), while literatures dealing with the effect of docking on skin and wool are lacking. The present study was planned to shed some lights on the effect of docking on histological and histochemical structures of the skin as well as some wool characteristics in Barki sheep.

MATERIALS AND METHODS

Study location:

The present study was carried out in Tegzerty Experimental Farm for Animal Production at Siwa Oasis which belongs to Desert Research Center, Ministry of Agriculture and Land Reclamation, Egypt. This station is located 330 Km south of the Mediterranean shoreline and 65 Km east of the Libyan borders.

Experimental design:

A total number of 13 single-born male Barki lambs with an average birth weight of 3.0±0.20 kg, were randomly assigned into two groups: docked group (n = 6) and control group (n = 7). Lambs were docked within two days after birth by applying a tight rubber ring. Rubber ring was fixed after the 3rd and before the 5^{th} tail vertebras. The tails fell off within two weeks after the operation. The experiment lasted for 270 days. At the end of the experiment, wool and skin samples were collected from the mid-side position of each animal using fine curved scissors and kept for further analyses.

Management practices:

Lambs were kept with their dams for 3 months before being weaned. Then docked and undocked animals were fed according to NRC requirements (2007). Animals were housed in shaded pens and fed twice a day (two equal meals at 09:00 and 15:00 h) and they had continuous access to fresh water and vitamin/mineral block over the experimental period.

Histological preparation and measurements:

Skin biopsy were carefully taken from all experimental animals (left midside position) and flattened on foam and fixed in calcium formol about 24 hours according to Barker (1958) then washed and left for 24 hours in distilled water and transferred to 70% ethanol. Specimens were then dehydrated in an ascending series of ethanol (30 minutes in each of 70%, 80% and 90% ethanol and finally two changes each for 15 minutes in absolute ethanol). The specimens were cleared in benzene for about 30 minutes, infiltrated in paraffin wax with a melting point of 60°C (4 changes, 20 minutes each) and then embedded in the same paraffin to prepare the blocks. Vertical and transverse sections (6-8 microns in thickness) were prepared for histological studies.

For general histological observations, the sections were stained by Haematoxylin and Eosin stain (Drury and Wallington, 1980). The stained sections were used to measure different skin layer thickness. Wool follicle groups were counted and the secondary to primary follicles ratio (S/P ratio) was estimated in ten follicle groups for each skin sample of the experimental animals. Histochemical demonstration of general carbohydrates was performed by Periodic acid Schiff's (PAS) reaction (Mc-Manus and Cason, 1950).

Wool measurements:

From each collected greasy wool sample, a sub-sample of at least 300 fibres was taken for measuring fibre diameter. The sub-sample was taken and mounted in paraffin oil on glass slides and covered with glass cover using the method adopted by ASTM (1993). While measuring fibre diameter, the number of medulated fibres were recorded and the percentage of these fibres were calculated for each sample. For fibre length, ten fibres were taken at random from each wool sample to measure their length, as the distance between the base and the tip of the fibre using a millimeter ruler fixed on a black velvet board. Just enough tension was applied to straighten the fiber without stretching. The average of ten fibre lengths was calculated and considered as the fibre length for each wool sample. Determination of clean wool yield for each sample was carried out as a percentage of clean, dried and scoured wool to the greasy wool by using the method suggested by Chapman (1960). At the end of the experiment, animals were shorn and the fleece weight was recorded for each animal.

Both histological, histochemical and fibre diameter measurements were estimated using a microscope and image captured by image analysis software (Zen 2012, Blue edition) and device (Carl Zeiss Micro-Imaging GmbH) .

Statistical analysis:

Data were statistically analyzed by one way analysis of variance using the General Linear Model (GLM) procedures described by SAS (2004), and applying the following model:

$Y_{ij} = \mu + t_i + e_{ij}$

Where:

Y_{ij} = the observations,

μ = the overall mean,

t_i = the effect due to i^{th} experimental treatment; docked i =1 and undocked i=2,

e_{ij} = random error associated with the ij^{th} observation..

RESULTS AND DISCUSSION

The structural features of the skin components obtained in the present study for both docked and undocked Barki sheep were found to be similar to that observed in other breeds of sheep (Ryder and Stephenson, 1968). The skin is composed of two main layers. The outer thin layer called epidermis and the thicker inner one called dermis which extends down to the muscular layer. The dermis is a connective tissue in which hair follicle is embedded with various associated glands. It supports the epidermis and binds it to the subjacent layer, the subcutaneous tissue hypodermis (Fig 1). The dermis is subdivided into two strata, the papillary layer superficially and the reticular layer beneath according to Lesson and Lesson (1981).

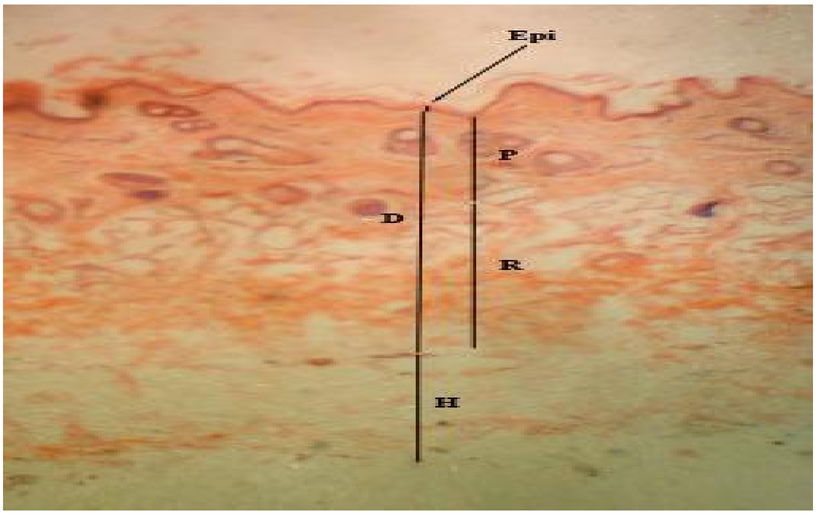

Fig. 1. Vertical section of Barki sheep skin showing its different layers; dermis (D), epidermis (Epi), hypodermis (H), papillary (P) and reticular (R) (H. E., X40)

The present study showed that the thickness of different skin layers was affected by docking (Tables 1 and 2). There is general trend for dermal, hypodermal and reticular layers to be thicker in docked animals compared with those of undocked one. The average thickness of dermis was found to be 1609.09±75.0 µ vs. 1372.25±72.0 µ { FOR SD/ SE USE ONLY ONE DECIMAL} for docked and undocked animals, respectively. Docking resulted in 17.3% increases in the thickness of dermis (Table 1). In this context, Kassem (2009) found that the dermal thickness was 1496.25 µ which was higher than 697.27 µ obtained by Shedeed (2005) and less than 2035 µ as recorded by Kotb (1987) in Barki sheep.

Table 1. Least squares means ± SE (µ) of different skin layers in docked and undocked sheep

Group	Epidermis	Dermis	Hypodermis	Papillary	Reticular
Undocked	28.13^{a}±1.3	1372.25^{a}±72.1	366.81^{a}±87.6	614.86^{a}±27.5	757.39^{a}±54.6
Docked	21.49^{b}±1.3	1609.09^{b}±75.1	513.21^{a}±87.6	578.75 ^{a} ±27.5	1030.33^{b}±54.6

Means within the same column with different superscripts were different significantly at (P<0.05).

Table 2. Least squares means ± SE for different measurements of primary follicles of docked and undocked Barki sheep. FOR SE USE ONLY ONE DECIMAL

Trait	Undocked	Docked
External diameter, µ	142.91^{b}±3.36	153.78^{a}±2.07
Internal diameter, µ	67.33^{b}±1.96	72.88^{a}±1.13
Wall thickness, µ	72.59^{b}±3.21	80.90^{a}±1.57
Fibre diameter, µ	50.18^{a}±2.09	53.70^{a}±1.01

Means within the same row with different superscripts differed significantly at P<0.05

Concerning the dermal layers, the significant differences between dermis thickness of both groups might be related to the thickness of reticular layer which increased by 36% in docked animals compared with those of undocked ones. While not significant, the hypodermal thickness increased in the docked animals by 39.81% (513.21 *vs*. 366.8) compared with those of undocked ones (Table 1). In contrast, the thickness of epidermal and papillary layers tended to be thicker in undocked animals compared with docked ones. That trend was significant for the former while not significant for the latter layer (Table 1).

In contrast, the papillary layer showed a small and non-significant decrease in its average thickness as the same trend of the epidermal layer (Table 1). The thickness of the epidermal layer of the docked animals was significantly lower than undocked animals. (Table 1). The docked animals had 24% less epidermal layer than those of undocked ones.

Subcutaneous fat layer was thicker in docked than undocked lambs, this was in agreement with the findings of Snyman *et al*. (2002) also whereas Isani *et al*. (2012) showed the opposite trend. Al Jassim *et al*. (2002) demonstrated that docking affected feed conversion efficiency and in docked lambs the fat normally deposited in the tail was partially (less than 50%) re- allocated as subcutaneous plus intramuscular and internal fat.

There are two types of follicles in the skin; primary and secondary follicles. Primary follicles are associated with an erector pili muscles, a sweat gland and sebaceous glandes (Fig 2).

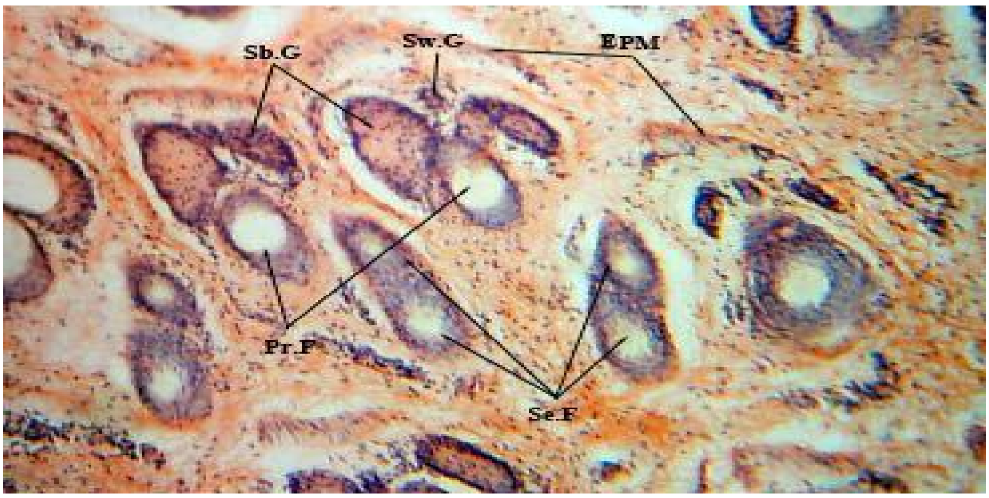

Fig. 2. Cross section of Barki sheep skin showing erector pili muscle (EPM), primary follicles (Pr.F), sebaceous gland (Sb.G), secondary follicles (Se.F) and sweat gland (Sw.G). (H. E., X100)

Results showed that docking tend to significantly affect the internal diameter of both primary and secondary follicles and the wall thickness of primary follicle (Tables 2 and 3). The effect of docking was also significant on the mean diameter of fibre produced from secondary follicles. Generally, both primary and secondary follicles dimensions and fibre diameter were higher in docked than in undocked sheep (Tables 2 and 3). In Rahmany sheep, Marai *et al*. (1992) found significant effect of docking on internal diameter of primary follicle and on the external and internal diameters of secondary follicle. Marai *et al*. (1992) also, indicated that the effect of docked lambs on most histological structure characteristic may stem from the higher feed consumption and efficiency in regulating body temperature under the subtropical environment in Egypt. This was in agreement with Hafez *et al*. (1958), Juma *et al*. (1971) and Marai *et al*. (1987 and 1989) who suggested that docking changes metabolic rate and anatomy of the animals. Histologically, the S/P ratio was found to be 1.89 and 1.69 in undocked and docked animal, respectively.

Histochemicaly, the distribution of general carbohydrates in both primary and secondary follicles was shown in figure (3). The carbohydrates are considered the sign of follicle activity according to the assumption of Montagna (1956) that the carbohydrates in the outer root sheath is the source of energy for protein synthesis during fibre growth.

Table 3. Least squares means ± SE for different measurements of secondary follicles of docked and undocked Barki sheep. FOR SE USE ONLY ONE DECIMAL

Item	Undocked	Docked
External diameter, µ	80.78^{a}±1.80	83.93^{a}±1.92
Internal diameter, µ	28.39^{b}±0.86	33.30^{a}±0.92
Wall thickness, µ	50.40^{a}±1.40	50.63^{a}±1.50
Fibre diameter, µ	20.35^{b}±0.77	25.65^{a}±0.82
S/P ratio	1.89^{a}±0.10	1.69^{a}±0.11

Means within the same row with different superscripts differed significantly at P<0.05

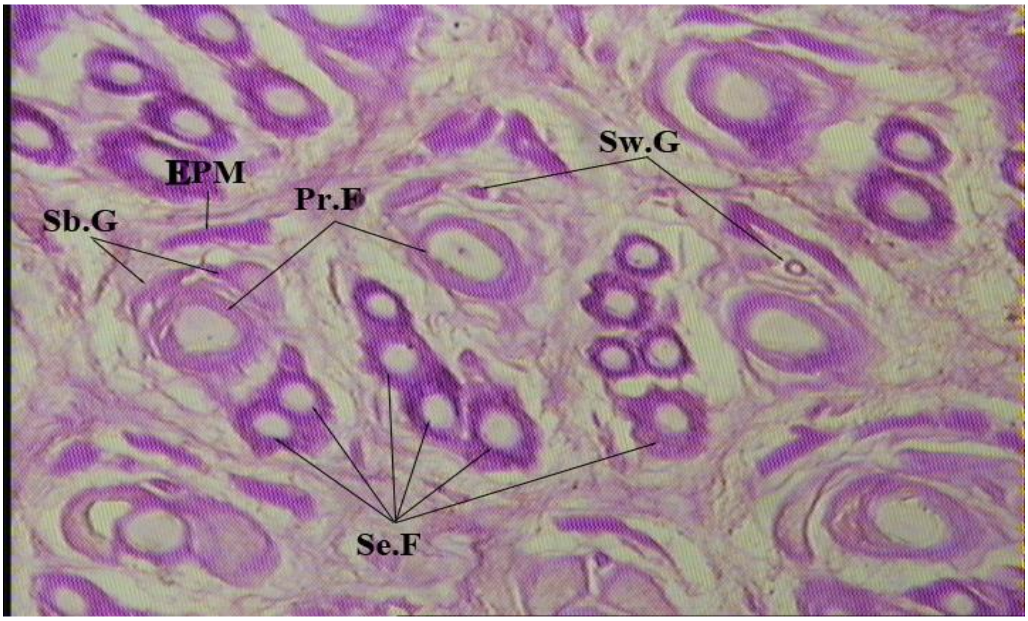

Fig. 3. Cross section of Barki sheep skin stained by PAS method showing general carbohydrates distribution in different follicles types. (X100) erector pili muscle (EPM), primary follicles (Pr.F), sebaceous gland (Sb.G), secondary follicles (Se.F) and sweat gland (Sw.G).

Table (4) demonstrates the concentration of general carbohydrates optical density (O.D.) content in primary and secondary follicles in docked and undocked sheep. Carbohydrates were higher (P<0.01) in undocked than docked animals. In undocked animals' primary follicles had average carbohydrates content of 0.59± 0.007 in the outer root sheath while was 0.57± 0.005 in inner root sheath. The corresponding values in docked animals were 0.51± 0.007 and 0.47± 0.005, respectively. In case of the secondary follicles, the averages of carbohydrates content in the outer and inner root sheath were 0.66± 0.009 and 0.64± 0.009, respectively in undocked, while they were 0.49±0.009 and 0.48± 0.009, respectively in docked animals.

Results of increasing carbohydrates in outer than inner root sheathes in both types of follicles are in full agreement with those found by Badawy (2006). Same results were found in Kashmir sheep (Tej Sharma, 1982), Barki sheep (Hekal, 1996) and Baladi goats (Abdou *et al*., 2002). It is demonstrated that this trend of carbohydrates localization might be due to the assumption that the carbohydrates in the outer root sheath was the main source of energy for protein synthesis during the fibre growth. The decrease in the carbohydrate content in docked animal might be related to the consumption of carbohydrates by wool follicles for wool production that resulted in heavier fleece weight.

Table 4. Least squares means±SE of general carbohydrates optical density (O.D.) in primary and secondary follicles in docked and undocked Barki sheep

Item		Docked	Undocked
Primary follicles	Outer	0.51^{b}±0.007	0.59^{a}±0.007
	Inner	0.47^{b}±0.005	0.57^{a}±0.005
Secondary follicles	Outer	0.49^{b}±0.009	0.66^{a}±0.009
	Inner	0.48^{b}±0.009	0.64^{a}±0.009

Means within the same row with different superscripts differ significantly at (P<0.01)

Table (5) shows that docking had no significant effect on fleece weight, yield%, fibre diameter, fibre length and medullated fibre percentage of Barki sheep. These results agreed with those of Marai and Bahgat (2003) in Egyptian fat tailed Ossimi sheep. On the other hand, Marai et. al (1992) found that docking had significant effects on staple length and wool diameter in Rahmani sheep. Docked animals had heavier fleece weight although not significantly as compared with undocked ones (2.33 *vs*. 1.25 kg) (Table 5). That is probably matched with the findings of Marai *et al.* (1992) who stated that docking appeared to affect the fleece growth in fat tailed sheep.

Table 5. Least square means ± SE of fleece weight, FW, yield%, fibre diameter, FD, fibre length, FL and medullated fibres, MF% in docked and undocked Barki sheep

Groups	FW (kg)	Yield%	FD (µ)	FL (cm)	MF %
Undocked	1.25^{a}±0.405	55.16^{a}±5.57	40.30^{a}±3.41	10.20^{a}±0.71	24.67^{a}±4.46
Docked	2.33^{a}±0.188	48.22^{a}±5.57	38.70^{a}±3.41	10.05^{a}±0.71	20.53^{a}±4.46

No significant differences were observed (P<0.05)

CONCLUSION

We can concluded from current results that, docking have insignificant effect on fleece weight, wool yield, staple length, fibre diameter and number of medullated fibre and decreased the carbohydrates in the skin of Barki lambs.

REFERENCES

Abdou, A.S.A., M.M. El-Ganiaeny, F.I. Khatab, and S.A. Hekal, 2002. Seasonal changes of histology and histochemestry of the hair follicles of Baladi goats in Egyptian desert areas. J. Agric. Sci. Mansoura Univ., 27: 3721-3736.

Al Jassim, R. A. M., G. Brown, Salman, E. D. and A. Abodabos, 2002. Effect of tail docking in Awassi lambs on metabolizable energy requirements and chemical composition of carcasses. J. Anim. Sci., 75:359-366.

Alkass, J. E., N. H. Rashid, M. A. Ishak, and H. Talib, 1985. The combined effects of docking and castration on growth rate and carcass characteristics of Awassi lambs.World Review of Animal Production 11:49-52.

ASTM, 1993. D2130. Standard test method for diameter of wool and other animal fibers by microprojection. Annual Book of ASTM Standards. Sect. 7, Vol. 07.01:568. American Society for Testing and Materials, Philadelphia, PA.

Badawy, N.S., 2006. Histological and histochemical studies on the skin of local sheep breeds in Halaieb, Shalateen and Abou Ramad triangle. M.Sc. Thesis, Fac. Sci. Ain Shams Univ., Cairo, Egypt.

Barker, J.R., 1958. Principles of Biological Technique. London, Methuen, New York, John Wiley, Bancroft. J. D.

Chapman, R. E., 1960. In The Biology of the Fleece, edited by A. S. Fraser, and B. F. Short, Animal Research Laboratories Technical Paper NO.3. CSIRO, Australia.

Drury, R. A. P., and E. A. Wallington, 1980. Carlton's Histological Technique. Fourth Ed., Oxford, New York, Toronto, Oxford University Press.

Duncan, D. B., 1955. Multiple range and multiple F tests, Biomet. 11: 1-42

Hafez, E.S.E., A.L. Badreldin, and M.A. Sharafeldin, 1958. Heat tolerance studies on fat tailed sheep in the subtropics. Journal of Agricultural Science, Cambridge 47.280-286.

Hekal, S.A., 1996. Histological and histochemical changes of the wool follicles in the local Barki desert sheep during its postnatal developmental stages. M.Sc. Thesis, Fac. Sci., Ain Shams Univ., Cairo, Egypt.

Isani GB, M. Yaqoob Khan BB, M .Younas, and Hanjra SH, 2012. A comparative study of effect of docking fat tailed sheep and crossbreeding fat tailed and then tailed sheep on growth and carcass characteristics. Pak. J. Agric. Sci., 49: 87-93.

Juma, K.H., F.J. Gharib, and J. Eliya, 1971. A note on studies on heat tolerance in awassi sheep.Animal production 13. 369-370.

Kasem, S.T., 2009. Production of skins with physical properties suitable for tanning from Barki sheep underdesert conditions. M.Sc. Thesis, Fac. Agric., Ain Shams Univ., Cairo, Egypt.

Kent, J.E., V. Molony, and I.S. Robertson, 1995. Comparison of the Burdizzo and rubber ring methods for castrating and tail docking lambs. Vet. Record. 136:192.

Kotb, A.A., 1987. Studies on physical and histological properties of hids and skins of farm animals. M.S.Thesis, Fac. Agric., Alex. Univ., Alexandria, Egypt.

Lesson, T.S. and C.R. Lesson, 1981. Histology .4th .E.d W.D.B . Saunders Company, Philadelphia , London ,Toronto.

Marai, I.F.M. and L.B. Bahgat, 2003. Fat-tailed sheep Traits as affected by docking .Journal Tropical animal Health and production,35:351-363.

Marai, I.F.M., M.S. Nowar, L.B. Bahgat, and J.B. Owen, 1987. Effect of docking and shearing on growth and carcass traits of fat-tailed Ossimi sheep. Journal of Agricultural Science, Cambridge 73:211-213.

Marai, I.F.M., M.N. El-Gaafaary, and B.A.K. Ahmed, 1992. A note on effect of docking on skin structure and characteristics of the fleece in Rahmani fat –tailed sheep.Animal Prodution 55:292-294.

Marai, I.F.M., M.S. Nowar, A.S. El-Shobokshy, and L.B. Bahgat, 1989. Effect of docking on blood constituents and docking and shearing on heat tolerance of fat- tailed sheep, under a sub-tropical environment. Research and development in agriculture 6: 83-86

Mc-Manus, J.P.A. and J.E. Cason, 1950. Carpohydrate histochemistry studied by acetylation techniques periodic acid method. J. Exp. Med. 91: 651.

Montagna, W., 1956. The structure and function of the skin. Academic press, New York. Pp. 174.

NRC., 2007. Nutrient Requirements of Small Ruminants. Sheep, Goats, Cervids, and New World Camelids. Pages 39-80. National Academy Press, Washington, DC.

Ryder, M.L. and S.K. Stephenson, 1968. Wool Gowth. Academic Pess, New Yok, USA

SAS., 2004. Statistical Analysis System Institute, SAS User's Guide Statistics, SAS Institute Inc., Cary, NC.

Shedeed, H.A., 2005. Some physioloical parametres in sheep and goats and their relation to skin charactristics and tanning. M.Sc. Thesis, Fac. Agric., Ain-Shams Univ., Cairo. Egypt.

Shelton, M., T.Willingham, P. Thompson, and Roberts, E. M., 1991. Influence of docking and castration on growth and carcass traits of fat-tail Karakul, Rambouillet and crossbred lambs. Small Ruminant Research 4: 235-243.

Shutt, D.A., L.R. Fell, R. Connell, and A.K. Bellt, 1988. Stress responses in lambs docked and castrated surgically or by the application of rubber rings. Aust. Vet. J. 65:5-7.

Snyman, M., A. M. van Heerden, B. R. King and J. A. N. Cloete., 2002. The effect of docking on growth, carcass quality, fat distribution and reproductive performance of Namaqua Afrikaner sheep. Grootfontein ADI, Private Bag X529, Middelburg EC, 5900

Tej sharma, F.A.Z., 1982. Histology and histochemistry of the skin of the cashmere Merino sheep. The Academay of Zoology. Vol. XLX. 97-127.

Zen, 2012. (Blue edition) Carl Zeiss MicroImaging GmbH. 07740 Jena, Deutschland, BioSciences Location Göttingen, P.O.B. 4041, 37030 Göttingen, Germany.

تاثير قطع الذيل على صفات جلد و صوف الأغنام البرقى

سامية هيكل[١]، نجلاء بدوى[١]، منى محمدى ابراهيم[٢]

شعبة الإنتاج الحيوانى والدواجن ، مركز بحوث الصحراء، ١ شارع متحف المطرية ، ص ب ١١٧٥٣ ، المطرية، القاهرة
١ - قسم أنتاج وتكنولوجيا الصوف، ٢ - قسم تربية الحيوان

اجريت هذه الدراسة بمزرعة تجزيرتى التجريبية بواحه سيوه والتابعه لمركز بحوث الصحراء- وزاره الزراعة واستصلاح الاراضى . استخدم فى الدراسة ١٣ حولى برقى حديث الولادة عمر اسبوع (متوسط وزن الميلاد ٣.٠ ± ٠.٢٠ كجم) قسموا عشوائيا الى مجموعتين : الاولى (عدد ٦ حملان) وهى مجموعة الحملان مقطوعة الذيل فى حين ظلت المجموعة الثانية (عدد ٧ حملان) كمجموعة قياسية سليمة دون قطع للذيل بهدف دراسة تاثير قطع الذيل على الصفات الهستولوجية والهستوكميائية للجلد بالاضافة الى صفات الصوف (النسبة المئوية لتصافى الصوف- قطر الليفة وطول الالياف).

أظهرت النتائج ان سمك طبقة الأدمة زاد معنويا بنسبة ١٧.٣ % فى الحملان مقطوعة الذيل بالمقارنة بالمجموعة غير المقطوعة الذيل وربما يكون ذلك راجع الى الزيادة فى طبقة الشبكية والتى بلغت ٣٦% فى الحملان مقطوعة الذيل. أوضحت النتائج ايضا وجود زيادة غير معنوية بنسبة ٣٩.٨١ % في سمك طبقة تحت الأدمة في الحملان مقطوعة الذيل. هستوكيميائياً أظهر تركيز الكربوهيدرات نقص معنوي ($P<0.01$) في المجموعة مقطوعة الذيل مقارنة بالحملان التي لم يتم قطع ذيلها.

بصفة عامة فان أبعاد حويصلات الصوف المختلفة (القطر الداخلي والخارجي للحويصلات وسمك الجدار) علاوة على قطر الياف الصوف للحويصلات الاولية والثانوية قد اظهر زيادة في الحملان مقطوعة الذيل. كما اتضح من الدراسة ان قطع الذيل ليس له تأثير معنوي علي كلا من وزن الجزة ، طول الخصلة ، سمك الليفة ، ونسبة الاليا ف ذات النخاع في الاغنام البرقي تحت الدراسة.