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ANNUAL RHYTHM OF WOOL DENSITY AND FIBRE TYPE RATIO IN BARKI SHEEP WITH REFERENCE TO BODY POSITIONS

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SUMMARY

The density of wool fibre types were investigated in relation with season, body position and animal. Wool samples from 29 Barki ewes taken from six body positions at three months intervals to represent wool growth in summer, autumn, winter and spring. An area of 1 cm^2 on each position was tattooed and wool was clipped and splitted into three categories, fine (F) (non-medullated), coarse (C) (medullated) and Kemp fibres (K). Fibres of each category were counted and percentages of each fibre type were calculated.

The averages of wool fibre density/cm^2, was 794.0, 52.90% fine, 31.68% coarse and 14.58% kemp. Animal, season and position indicated highly significant effect on all traits studied. It is likely that the prevailing conditions during July-October period enhance the regeneration of secondary fibres but not primary ones. A distinct dorso-ventral and antero-posterior gradients occurred over the body for all traits. The anterior parts of the body indicated higher density and F% whereas, it had less C%, Rump gave the most representative sample for fibre density while mide-side is the best for F%, C% and K%.

Keywords: Barki sheep, wool density, fibre types, body positions and seasonality

INTRODUCTION

In the mediterranean coastal belt of the western desert of egypt, Barki sheep are raised to produce coarse white fleeces. This type of sheep is proved to be adapted to the hard conditions prevailing in this area with a little rainfall and sparce vegetation. Improvement of wool under such conditions might be more suitable than improvement of mutton production which needs higher levels of feed and management.

Fibre density, as the number of wool fibres grown per unit area of skin, is considered to be the most important contributing factor not only affecting the quantity but also had a great influence on the uniformity and the external appearance of the fleece. Improvement dependes on the fleece density is desirable for two purposes. First, an increase in Fleece density would increase the average fleece weight. Secondly increased density may be needed to produce more weather-resistant fleece.

The proportion of fibre types particularly the medullated fibres might receive greater attention when organising a breeding program. The medullation content in wool effect the monetory value of such wool and determine to large extent the way in which a given wool is going to be processed. Kemp fibres are usually not acceptable by manufacturers because of its low tensile strength and low affinity to dyes. On the other hand, medullated fibres are often preferable to the carpet industry whereas it is not so well accepted by the apparel.

Studies of fibre type ratio have been handicapped mainly because of the tedious and elaborate work involved in obtaining their values. The present study was conducted to investigate the effect of season, animal and body position on wool fibre density and fibre type ratio which affect the productivity and the external appearance of the local Barki fleeces.

MATERIALS AND METHODS

The present study was performed in the Barki sheep flock belong to Mariout research station, 35 km west of Alexandria. During the course of the experiment rainfall averaged 80-110 mm/year. Relative humidity (%), maximum and minimum temperatures (C°) were 77.4, 34.2, and 23.3 in July, 65.1, 24.8 and 17.7 in October, 62.7, 17.6 and 9.2 in January and 74.5, 20.7 and 13.3 in April. Sheep were grazed on irrigated pastures and supplemented by feed co-op mix.

Twenty-nine, 2-year old barki ewes were randomly chosen for this experiment. They were all singles and looked healthy throughout the trial. They received the normal level of managements as the rest of the flock.

Wool samples were obtained from six body positions, three dorsals (Withers, Wth, Back, Bk, rump, Rp) and three laterals(shoulder, Sh, mid-side, Ms, britch, Br). These samples were clipped at intervals of three months in July (summer), October (autumn), January (winter) and April (spring). Thus wool collected in one occassion represented the preceding growth period. for example, summer clip in July representing the wool grown in Spring. At the end of the trial the greasy fleece weight was recorded for each animal.

At each sampling occassion, an area of 1 cm^2 on each position was tattooed and wool was clipped close to the skin using fine scissors. Each greasy clipped sample was very kept carefully a plastic bag for further analysis. These samples were used to obtain fibre density and the fibre type ratio, they were placed on a board covered with black velvet. Fibres of the whole sample were then drawn through, one at a time and allocated by eye to one of the three categories, referred to as fine wool (F), coarse wool (C) and kemp (K). In most cases, There was no difficulty in deciding to which category a given fibre belonged, although some fibres had some features of both coarse and fine wool were difficult to classify. In such cases, benzene test was used, Coarse fibres could be seen when immersed in benzene whereas fine fibres are invisible. The medulla in the core axis of the coarse fibre may be either continuous or interrupted. Kemp fibres are short, very heavily medullated, therefore, it appeared chalky under benzene. Moreover, they are usually of pointed tip and may be shed in the fleece forming a club end. Fibres in each category were counted and then added up to calculate the total fibre density. The percentage of each fibre type from the total number of fibres was also calculated.

Statistical procedures:

The arcsine transformation was used for all percentages included in the study. The model used to partition the variability included the following components, season, position, animal and the interaction of season X position. These sources of variations are considered to be fixed except the random animal effect.

Correlation coefficients were calculated for each trait between each of the six body positions and the average of these positions, the fleece average. Correlations were also obtained between traits for each season. Where no significant differences between correlations were found. they were pooled over seasons using Fisher's Z transformation (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

The present study estimated the overall mean density, D, of 794.00 fibres/cm^2, 52.90% of which were fine fibres, F, 31.68% coarse fibres, C, and 14.58% kemp fibres, K. In Barki sheep of the same flock, Guirgis (1973) obtained wool samples from 5 body positions and calculated the averages of F(62.9%), C(26.2%) and K fibres (8.6%). His results were not so far from what was observed in this study although the present materials were collected from different seasons and six body positions mentioned earlier.

The average wool fibre density, D, found in the present study are considered much lower than that of European breeds (Ryder and Stephenson, 1968). Low fibre density could be responsible for the poor greasy fleece weight attained from this flock (2.42 kg). The changes in the rate of wool production were attributed (Dony, 1964) to the changes in both fibre number and fibre weight. The latter is fluctuating randomly thus the density of fibre population had a major contribution towards increasing wool productivity. Improvement of feeding regimes together with selecting animals for heavier fleece weight could enhance wool production of Barki sheep in this flock.

It has been indicated that wool follicle group consisted of primary and secondary follicles and that kemp and coarse fibre are produced mainly from the primary follicles whereas fine fibres are usually grown from secondaries(Ryder and Stephenson, 1968). Each follicle group consists of the original three primary follicles and various number of secondaries. Therefore larger follicle group means dense and uniform fleeces while small groups would increase the variation in fibre sizes. In some breeds, such as local breeds, there is marked differences between primary and secondary follicles which resulted in a considerable variation among various fibre types. Whereas in Merino sheep, such differences appeared to be relatively small accordingly the fleece seems to consist of only one fibre type. In fine wool breeds, density plays the major role in wool production while in strong wool breed the length and diameter are suggested to be of more importance (Young and Chapman, 1958).

The proportion of various fibre types appeared to vary considerably according to season as the latter showed highly significant effect in all traits studied (Tables 1 and 2). The F% was highest in October clip while C%, K% and D were indicated to be highest in July clip. On the other hand, Very few kemp fibres were found in April sample. During July to October period, There was a relatively greater increase in F% attained together with the corresponding reduction in both coarse and kemp fibres. Ragab and GHoneim (1963) showed significant season effect on wool density of some imported breeds in Egypt. They found the highest density in both winter and spring while the least value were recorded in summer and autumn. In the present study, the prevailing condition from July to October might be convenient for regeneration of secondary follicles but not primary ones. Ryder (1978) claimed that seasonal variation in wool fibre density could be associated with variations in the proportion of inactive follicle in different seasons.

Sheep could adapt themselves to the changing season by controlling the character of the wool coat and develop a suitable coat for different climates. Shedding and regrowth of fibres are involved in this process while it is a relatively slow operation and the animal requires advanced warning of a change of a season. Monthly changes in temperatures could give signals of approaching hot or cold season but these are erratic in comparison with day length. Therefore, photoperiod has been considered to be of important role in controlling the character of the wool coat (Morris, 1961).

Table 1. Means of percentages of fine, F, coarse, C and Kemp fibres, K as well as fibre density, D ± their standard errors from different positions and seasons.

		July	October	January	April	Pooled
Sh	F%	59.23± 1.2	68.87± 1.2	68.20± 1.2	62.33± 0.2	64.71± 0.5
	C%	29.75± 1.3	25.01± 1.3	25.26± 1.3	33.37± 1.3	28.30± 0.6
	K%	9.28± 1.1	5.18± 1.1	4.69± 1.1	2.99± 1.1	5.17± 0.5
	D%	1017.79±41.4	620.97±41.4	822.69±41.4	1001.52±41.4	865.71±18.8
Ms	F%	53.13± 1.2	66.63± 1.2	63.83± 1.2	58.86± 1.2	60.79± 0.5
	C%	33.45± 1.3	25.51± 1.3	28.44± 1.3	34.89± 1.3	30.51± 0.6
	K%	10.77± 1.1	6.26± 1.1	5.38± 1.1	4.71± 1.1	6.60± 0.5
	D%	967.24±41.4	636.52±41.4	802.24±41.4	949.79±41.4	838.95±18.8
Br	F%	45.23± 1.2	61.05± 1.2	56.83± 1.2	54.05± 1.2	54.31± 0.5
	C%	45.39± 1.3	30.89± 1.3	37.21± 1.3	40.56± 1.3	38.45± 0.6
	K%	7.29± 1.1	6.74± 1.1	4.36± 1.1	3.99± 1.1	5.52± 0.5
	D%	959.31±41.4	580.35±41.4	722.69±41.4	897.14±41.4	789.90±18.8
Wth	F%	64.69± 1.2	75.37± 1.2	73.69± 1.2	68.29± 1.2	70.59± 0.5
	C%	28.31± 1.3	18.09± 1.3	21.65± 1.3	26.54± 1.3	23.51± 0.6
	K%	4.83± 1.1	4.24± 1.1	2.72± 1.1	3.07± 1.1	3.67± 0.5
	D%	899.00±41.4	621.86±41.4	722.76±41.4	869.07±41.4	778.03±18.8
Bk	F%	57.99± 1.2	73.29± 1.2	71.10± 1.2	70.63± 1.2	68.37± 0.5
	C%	27.16± 1.3	14.50± 1.3	17.20± 1.3	18.76± 1.3	19.19± 0.6
	K%	13.01± 1.1	10.20± 1.1	9.02± 1.1	8.05± 1.1	9.98± 0.5
	D%	890.31±41.4	713.86±41.4	665.72±41.4	762.52±41.4	758.10±18.8
Rp	F%	55.18± 1.2	69.55± 1.2	65.10± 1.2	59.91± 1.2	62.51± 0.5
	C%	33.89± 1.3	19.04± 1.3	26.60± 1.3	27.93± 1.3	26.70± 0.6
	K%	9.38± 1.1	9.09± 1.1	6.00± 1.1	7.77± 1.1	8.01± 0.5
	D%	818.10±41.4	644.17±41.4	706.79±41.4	763.97±41.4	733.26±18.8
Pooled	F%	55.95± 0.4	69.23± 0.4	66.56± 0.4	62.43± 0.4	
	C%	32.89± 0.5	21.94± 0.5	25.83± 0.5	30.10± 0.5	
	K%	8.75± 0.4	6.80± 0.4	5.21± 0.4	4.91± 0.4	
	D%	925.29±15.4	636.20±15.4	740.50±15.4	874.00±15.4	

Animal appeared to be of highly significant effect on various fibre types as well as wool fibre density (Table 2). This generally implies the role of genetic factors for possible improvement of these traits. There is marked variation in the follicle population between animals within a breed. The follicle density is largely determined by genes that control the extent to which secondary follicles develop. Many generations of selection for a high fleece weight-fine wool combination have resulted in the Merino population having a high frequency of the genes stimulating secondary follicle development (Carter, 1955). Perhaps genetic factors had the major role, though feed and other environmental factors might play a part. For example, feeding lambs poorly can slightly limit the follicle development.

Table 2. Analysis of variance estimates and F values for the studied traits.

Source of variation	df	F % MSQ	F % F	C % MSQ	C % F	K % MSQ	K % F	D MSQ	D F
Total	695								
Season(S)	3	2049.47**	62.4	1671.60**	39.5	713.78**	24.3	2981340.30**	72.5
Animal	28	330.79**	10.1	525.65**	12.4	963.74**	32.8	392828.73**	9.6
Position(P)	5	1386.85**	42.2	2030.95**	84.0	792.78**	27.0	288074.09**	7.0
S x P	15	28.36	0.9	59.20	1.4	30.75	1.0	96477.99*	2.4
Residual	644	32.85		42.31		29.39		41120.72	

* P < 0.05 ** P < 0.01

Table 2 indicated highly significant position effect on F%, C%, K% and D. There is a distinct dorso-ventral and antero-posterior gradients over the body. Variations in wool fibre density followed the general biological principle in which the densest regions of the fleece tend to be those where fibre develop first. Thus, the anterior parts of the body (Sh and Wth) showed the highest density which tended to decrease towards the posterior parts. F% followed the same trend whereas C% were in the opposite direction. On the other hand, K% were generally highest in the mid-line (Ms and Bk) and appeared to decrease towards the rear and front parts. Similar findings were reported in Barki (Ghanem, 1965, Guirgis, 1973) and Awassi sheep (Ghoneim and Ashmawy, 1968). A constant relationship between rate of skin expansion and rate of fibre increase in all body regions was suggested by Henderson (1953). He argued that both variables are largely governed by heredity and there might be a common control of both by some strongly inherited physiological characteristics.

Correlation coefficients calculated in the present study revealed the most representative sample to the fleece average of each trait. The latter was expressed by the highest correlation coefficient between each of the six positions and the average of these positions, the fleece average. Rp seemed to be the most representative sample for D (r= 0.84) whereas Ms position was the best for F% (r= 0.76), C% (r= 0.85) and

K% (r= 0.88). These correlations were also done on the basis of the absolute number of fibre types , i.e. number of fine fibres (NF), number of coarse fibres (NC) and number of kemp fibres (NK). Similar results were obtained in which Ms was found to be the best sampling position for NC (r= 0.77) and NK (r= 0.91) whereas Sh sample was good for NF (r= 0.85).

Correlation coefficients among the studied traits were estimated while the most significant of which are discussed hereunder. NF was found to be correlated ($P<0.01$) with D (r= 0.90) Which implies that fine fibres are the major contributor to the total fibre density in Barki fleeces. On the other hand, as expected, NK was found to be negatively correlated ($P<0.01$) with greasy fleece weight (r= -0.51). During 16 months in Barki sheep it was observed (Guirgis et al. 1979) that kemp fibres occurred in three generations separated by two resting phases. In the shedding process, kemp producing follicles undergo resting stage in which the follicle remain dormant and no Keratin production occurred which resulted in less wool production harvested. Therefore, kemp fibres are not only affecting the quality of the fleece but also affecting the wool production.

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التغيرات الموسمية لكثافة الياف الصوف ونسب الانواع المختلفة لالياف الصوف فى الاغنام البرقى بالاشارة لمواقع الجسم المختلفة

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دراست كثافة الانواع المختلفة لالياف الصوف بالاضافة لمدى تأثرها بالاختلافات بين المواسم وبين مواقع الجسم المختلفة وبين الحيوانات – ولذلك فقد اخذت عينات الصوف من ٢٩ نعجة برقى من ستة مواقع على جسم الحيوان كل ثلاثة شهور لتمثل نمو الصوف فى المواسم المختلفة فى الصيف – الخريف – الشتاء – الربيع – وفى كل من هذه الاوقات اخذات عينة الصوف من مساحة قدرها ١ سم^{٢} من كل موقع . وفى كل من العينات تم فصلها بالكامل لالياف الصوف الناعمة – والخشنة والياف الكمب كل على حده وتم عد الياف الصوف بكل قسم وحساب النسبة المئوية لكل منهم بالاضافة لحساب الكثافة الكلية لالياف الصوف .

وقدرت كثافة الياف الصوف الكلية بمتوسط قدره ٧٩٤ ليفة / سم^{٢} منها ٥٢,٩ ٪ الياف ناعمة و ٣١,٦٨ ٪ الياف خشنة و ١٤,٥٨ ٪ الياف كمب . وقد اتضح من الدراسة ان كل من الاختلافات بين المواسم وبين مواقع الجسم المختلفة وبين الحيوانات له تاثير عالى المعنوية على كل الصفات المدروسة – كذلك اوضحت الدراسة ان الظروف السائدة من يوليو الى اكتوبر ربما يكون لها تاثير على زيادة الياف الصوف الناعمة ومن ناحية اخرى فقد اتضح وجود تدريج واضح فى صفات الصوف المختلفة على جسم الحيوان حيث تميزت المواقع الامامية من الجسم بزيادة كثافة الياف الصوف وارتفاع نسبة كل من الالياف الناعمة والخشنة – وقد اوضحت الدراسة كذلك ان منطقة الكفل تعتبر ممثل جيد لقيمة الجزة الكاملة عند تقدير كثافة الياف الصوف بينما تعتبر منطقة منتصف الجانب ممثل جيد للجزة الكاملة عند تقدير نسبة كل من الياف الصوف الناعمة والخشنة والياف الكمب . كذلك كان هناك ارتباط سالب ومعنوى بين عدد الياف الكمب وبين وزن الجزة الخام .