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NOTES TO CONTRIBUTORS

1. Papers submitted should tackle livestock and poultry production problems in an original way.

2. Review papers of subjects of general interest may be published at intervals and will be prepared on invitation by the Editorial Board.

3. All papers will be subject to critical review by the Editorial Board, or others appointed by the Editor. Papers needing revision will be returned to authors and should be revised and returned promptly. Papers not suitable for publication will be returned to authors with a statement of reasons for not accepting them.

4. Authors are requested to submit their papers, finished in all details in type-script, double line spacing and with ample margins. Two copies beside the original are needed. The length of articles will be limited to 35 printed pages. Typing should be on quarter papers. Tables should be as few and as simple as is feasible for presentation of essential data.

5. Illustrations, should be referred to as figures when ever possible. They should be drawn on smooth white Bristol Board in India Ink with marginal lettering inserted in pencil. Legends for figures and plates should be type-written separately from the illustrations for the reason that the type is set by the printer and the illustrations are made by the engravers. The order and approximate position of the illustration in the text should be marked.

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FACTORS INFLUENCING WOOL FOLLICLE CHARACTERISTICS IN FAT-TAILED SHEEP

BY

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SUMMARY

A histological study was carried out on the skins of 22 Ossimi and Rahmani sheep, eleven of each breed, from birth to six months of age. The number of secondary follicles per unit area was found to increase up to 45 days of age, then decrease afterwards. At the same time, the primaries showed a continuous decrease as the animals' body surface increased, confirming the post-natal initiation of the secondary follicles which did not occur in the primary ones. The S/P ratio increased continuously as the animals grew older. The S/P ratio differed significantly in the two breeds. The Rahmani had higher values than the Ossimi in most of the ages studied. Shedding occurred in the fibers of the primary follicles of both Ossimi and Rahmani sheep, and increased during the spring especially in the Ossimi sheep. The external—and the internal—diameter of wool follicles showed a continuous increase as the animals grew older. The internal diameters of wool follicles were significantly thicker in the Ossimi than in the Rahmani sheep. Sex showed no significant effect on the characters studied, except in the S/P ratio where the females had the higher values than the males in both breeds.

INTRODUCTION

At birth all the primary follicles are present (Schinkel, 1955), meanwhile, the post-natal development in the follicle group occurs only in the secondary follicles (Schinckel, 1953; Fraser, 1954; Short, 1955). The rate of development differs greatly according to the breed or variety (Carter

and Hardy, 1947; Fraser and Hamada, 1952; Fraser, 1954; Margolena, 1954; Ross, 1954; Short, 1955).

Changes in the density of follicles are caused by differences in the ratio of primary to secondary follicles (Fraser, 1953) and to the normal skin expansion accompanying growth after birth (Margolena, 1954; Schinckel, 1955). The increase in the size of the animal leads to a decrease in the number of follicles per unit area (Margolena, 1954).

The final relation between the primaries and secondaries depends mainly on heredity (Carter, 1943). However, some modifications which occur are due to environmental factors that affect the development of follicles (Carter, 1943). Rendel (1954) reported that the major difference between the fleece of various breeds lies in the secondary fibres formed between birth and six weeks of age. The differences in S/P ratio between the different sheep breeds are mostly pronounced between the Merino and non-Merino breeds (Carter and Clarke, 1957 *a* and *b*). In general, the S/P ratio increases with age until maturity of the animals, when the values remain almost constant or show some decline while the age when the animals reach the highest ratio differs according to the breeds (Fraser, 1952, 1954; Carter, 1955; Schinckel, 1955).

A conspicuous post-natal increase occurs in the size of follicles (Burns, 1949, 1953, 1954 *a*). As the animals grow older, the primary follicles become thicker than the secondary ones (Rendel, 1954).

This work was planned to study the nature of wool follicle development in the indigenous breeds of sheep under the natural conditions of rearing and management in Egypt.

MATERIALS AND METHODS

Eleven sheep of each of Ossimi and Rahmani breeds were used in the present work. The lambs were born within the first week of November 1957. They were weaned at four months of age and fed on clover until six months of age. Skin samples were obtained at fifteen-day intervals from birth until the age of two months, and at monthly intervals thereafter until six months of age. The samples were cut from the mid-side region at the thirteenth rib of right and left sides alternatively and

pinned out flat by stainless steel needles on pieces of indian rubber as described by Burns (1949).

Skin samples were fixed in formol-saline for three days. After fixation, the wool fibres were thoroughly cut. Dehydration was accomplished by transferring the samples into 50 % alcohol for 24 hours, 70 % for 24 hours and 90 % alcohol for two hours followed by three changes of absolute alcohol for six hours. Clearing was carried out using cedarwood oil for 24 hours followed by xylol for half an hour. Embedding in paraffin wax was carried out under vacuum (press. 9 cms./hg.) at 58°C. When blocking, the specimens were pressed flat by a warmed brass square with a handle, which was removed before the block was allowed to harden. Horizontal sections were obtained by the use of a rotary microtome at a thickness of 12 microns. The sections were stained by haematin and counterstained by erythrosin.

Follicle population counts were estimated per field of microscope as described by Burns (1949, 1953). The counts were carried out in ten fields per each section. The S/P ratio (relative number of secondaries per each primary) was determined from relative mean number of primary and secondary follicles in the complete bundles per field. The number of follicles per square millimeter of skin was calculated from the square surface and the mean number of follicles per field. The diameter of follicles was measured using a micrometer stage. Statistical analyses were carried out after Snedecor (1952).

RESULTS

Density :

At all ages, the number of secondary follicles per square millimeter was almost the same in both Ossimi and Rahmani sheep (Table 1). The number of secondaries did not change remarkably in Rahmani sheep, while it increased significantly in the Ossimi between one and 45 days of age. The number of secondaries, however, decreased in both breeds between the ages of 45 and 180 days. The decrease was highly significant between the different ages (Table 5). Sex showed no significant effect on density of the secondary follicles in both the Ossimi and Rahmani sheep (Tables 1 and 5).

The number of primary follicles per square millimeter was nearly the same in both the Ossimi and Rahmani sheep, except at one day old; the Ossimi had the higher values (Table 1). In both breeds, however, primary follicles density decreased significantly with age (Table 5). Within breeds, the number of primaries per square millimeter of skin was the same in both sexes in most of the ages (Table 1) and the differences between males and females were not significant (Table 5).

As for the total number of wool follicles, the Ossimi had higher but not significant values than the Rahmani from one to 90 days old (Tables 1 and 5). These values showed highly significant decrease from one age to another, while there was no significant difference between males and females in both breeds (Tables 1 and 5).

S/P ratio :

Breed had a highly significant effect on S/P ratio (Table 5). The Rahmani sheep had higher value of S/P ratio than the Ossimi sheep in most of the ages except at 30 days of age when the Ossimi surpassed the Rahmani (Table 2). In both breeds, the S/P ratio increased significantly with the advance of age until 180 days. In the Ossimi, the females showed superiority over the males in S/P ratio in most of the ages, (Table 2), but in the Rahmani there was no obvious difference between males and females. The effect of sex was statistically highly significant for S/P ratio in both breeds (Table 5).

External diameter of wool follicles :

The external-diameter of primary, secondary and average diameter of wool follicles were somewhat more in the Ossimi than in the Rahmani sheep (Table 3), but these differences were not significant (Table 5). Age showed highly significantly effects on the diameter of primary, secondary and average diameter of wool follicles throughout the experimental period (Table 5). Follicles in the Rahmani males had thicker diameter than those in the females, while the Ossimi sexes showed conflicting results at all ages (Table 3), but in general, sex showed no significant effect on diameter values (Table 5).

TABLE 1
The number of wool follicles per square millimeter of skin
in the Ossimi and Rahmani sheep

Breed	Sex	Wool follicles	Age in Days			
			1	45	90	180
Ossimi.....	Male	Primary	30±3	13±1	9±0.2	8±1
		Secondary	29±3	31±2	21±2	21±1
		Total	59±2	44±2	30±2	29±1
	Female	Primary	29±2	13±1	10±1	8±0.3
		Secondary	29±2	35±5	27±3	23±2
		Total	58±4	48±6	37±2	31±1
	Average	Primary	29±2	13±1	9±0.4	8±0.3
		Secondary	29±2	33±2	24±2	23±1
		Total	58±3	46±3	33±2	31±1
Rahmani...	Male	Primary	25±2	14±2	9±1	8±0.4
		Secondary	29±2	32±5	24±2	24±2
		Total	54±4	46±7	33±2	32±1
	Female	Primary	26±2	11±3	8±1	8±0.3
		Secondary	30±4	25±2	24±1	22±1
		Total	56±6	36±2	32±1	30±1
	Average	Primary	26±2	12±1	9±0.4	8±0.2
		Secondary	29±2	28±3	24±1	23±1
		Total	55±1	40±3	33±2	31±1
Total average	Male	Primary	27±2	13±1	9±0.3	8±0.1
		Secondary	29±2	32±2	2±31	23±1
		Total	56±3	45±3	32±1	31±1
	Female	Primary	27±1	12±0.4	9±0.2	8±1
		Secondary	30±2	30±3	25±2	23±0.3
		Total	57±3	42±3	34±1	31±2
	Average	Primary	27±2	13±1	9±0.3	8±0.2
		Secondary	29±1	31±2	24±1	23±1
		Total	56±2	44±2	33±1	31±1

Internal-diameter of wool follicles :

Breed showed highly significant effect on the primary, secondary and average wool follicles internal diameter (Table 5). The internal-diameter of primary, secondary and average wool follicles were thicker in the Ossimi than in the Rahmani in most of the ages (Table 4). Age showed highly significant effect on the internal diameter of different wool follicle types (Table 5). The wool follicles internal-diameter showed highly significant increase with the advancement of age, except between 90 and 180 days of age in the secondary follicles where no increase occurred. The increase between 90 and 180 days of age in the average internal-diameter was only one which could be clearly observed. The internal-diameter of wool follicles showed nearly the same values in both sexes of both breeds, except at 45 days of age when females had the higher value of internal-diameter of primary follicles in the Ossimi breed. Also, the Rahmani males, at the same age, had the higher value than females in both primary and average wool follicles internal-diameter (Table 4). Generally, the differences between sexes were not significant (Table 5).

TABLE 2
The S/P ratio in the Ossimi and Rahmani sheep

Breed	Sex	Age in Days								
		1	15	30	45	60	90	120	150	180
Ossimi.....	Male	1.0	1.8	2.1	2.3	2.4	2.5	2.7	2.8	3.0
	Female	1.1	1.9	2.1	2.5	2.5	2.7	3.0	3.1	3.2
	Average	1.0	1.9	2.1	2.4	2.4	2.6	2.8	3.0	3.1
Rahmani.....	Male	1.1	1.9	2.0	2.3	2.5	2.7	2.9	3.1	3.1
	Female	1.2	1.9	2.1	2.3	2.7	2.9	3.0	3.1	3.1
	Average	1.2	1.9	2.0	2.3	2.6	2.8	2.9	3.1	3.1
Total average.....	Male	1.1	1.8	2.1	2.3	2.4	2.6	2.8	2.9	3.1
	Female	1.1	1.9	2.1	2.4	2.6	2.8	3.0	3.1	3.2
	Average	1.1	1.9	2.1	2.3	2.5	2.7	2.9	3.0	3.1

TABLE 3

External diameter of wool follicles in the Ossimi and Rahmani sheep (Micron)

Breed	Sex	Wool follicles	Age in Days			
			1	45	90	180
Ossimi	Male	Primary	63±3	78±3	88±3	91±0.3
		Secondary	40±3	48±2	54±2	55±2
		Average	52±3	63±2	71±6	72±1
	Female	Primary	67±5	74±6	86±5	92±7
		Secondary	40±2	50±2	54±3	55±2
		Average	54±3	62±3	70±4	74±2
	Average	Primary	65±3	76±3	87±5	91±4
		Secondary	40±2	49±1	54±1	55±1
		Average	53±3	63±2	70±3	73±2
Rahmani ...	Male	Primary	64±3	81±6	87±2	95±4
		Secondary	41±3	52±3	54±2	58±1
		Average	53±3	66±3	71±2	76±2
	Female	Primary	63±4	72±5	80±5	87±2
		Secondary	36±2	50±2	51±2	52±2
		Average	50±3	61±3	65±3	69±1
	Average	Primary	63±2	76±4	84±3	91±3
		Secondary	39±2	51±2	53±1	55±2
		Average	51±3	63±2	68±2	73±2
Total average	Male	Primary	64±2	80±3	88±4	92±2
		Secondary	41±2	49±2	54±1	56±1
		Average	52±2	64±2	71±3	74±1
	Female	Primary	65±3	72±3	83±4	91±5
		Secondary	38±1	50±1	53±2	54±2
		Average	52±2	61±2	68±2	72±3
	Average	Primary	64±2	76±2	85±3	91±3
		Secondary	39±1	50±1	53±1	55±1
		Average	52±2	63±1	69±3	73±2

TABLE 4

Internal diameter of wool follicles in the Ossimi and Rahmani sheep (Micron)

Breed	Sex	Wool follicles	Age in Days			
			1	45	90	180
Ossimi.....	Male	Primary	33±1	42±2	46±3	46±2
		Secondary	21±1	25±1	26±1	25±1
		Average	28±3	33±1	36±2	35±2
	Female	Primary	33±2	44±3	47±2	48±3
		Secondary	20±1	25±1	26±2	26±1
		Average	26±1	34±2	37±1	37±2
	Average	Primary	33±1	42±2	47±2	47±2
		Secondary	21±1	25±1	26±1	26±1
		Average	27±1	34±1	36±1	36±1
Rahmani ...	Male	Primary	30±1	40±2	21±2	41±3
		Secondary	21±1	25±1	26±1	25±0.3
		Average	26±1	33±1	33±1	33±2
	Female	Primary	29±2	36±2	39±2	44±3
		Secondary	20±1	24±1	24±1	25±0.3
		Average	26±1	30±1	32±1	34±1
	Average	Primary	29±1	38±1	40±1	42±2
		Secondary	20±1	24±1	25±1	25±1
		Average	26±1	31±2	33±1	34±1
Total average	Male	Primary	31±1	41±1	44±2	44±2
		Secondary	21±1	25±1	26±1	25±1
		Average	27±2	33±1	35±1	35±1
	Female	Primary	31±1	39±2	44±2	47±3
		Secondary	20±1	24±1	25±1	26±1
		Average	26±1	32±2	35±1	36±1
	Average	Primary	31±1	40±1	44±1	45±2
		Secondary	21±1	25±1	26±1	26±0.4
		Average	26±1	32±1	35±1	35±1

TABLE 5

The calculated «F» value in the test of significance
for the different items

Items	Breed	Age	Sex
Density of primaries.....	0.01	139.90 ^{xx}	1.23
Density of secondaries.....	0.16	6.46 ^x	0.004
Total density of wool follicles ..	0.93	34.32 ^{xx}	0.14
S/P ratio.....	30.11 ^{xx}	640.16 ^{xx}	84.25 ^{xx}
External diameter of primaries.....	2.46	24.87 ^{xx}	0.65
External diameter of secondaries.....	2.13	50.28 ^{xx}	0.15
Average external diameter of wool follicles.	1.77	30.74 ^{xx}	0.53
Internal diameter of secondaries.....	46.07 ^{xx}	46.61 ^{xx}	0.57
Internal diameter of primaries.....	39.35 ^{xx}	27.38 ^{xx}	0.46
Average internal diameter of wool follicles..	20.34 ^{xx}	23.03 ^{xx}	0.02

DISCUSSION

The number of secondary follicles per unit area increased up to the age of 45 days, then showed a gradual decrease in the later ages. This may be due to the formation of new secondaries at a faster rate than the rate of expansion of the growing skin at the early ages. But, in the later ages, the rate of skin expansion increased more than the formation rate of the new secondaries. The number of primaries per unit area decreased with age. This may be also due to the expansion of the skin surface and to the non-existence of post-natal development of the primaries as reported by Fraser (1953), Margolena (1954) and Schinckel (1955).

Since the secondaries and primaries are affected by age, the S/P ratio varied greatly according to the advancement of age. Its value at birth is about one-third of its value at six months of age. Since the S/P ratio can be taken as a criterion for estimating the abundance of secondaries, it may be suggested that the development of the secondaries in both Ossimi and Rahmani sheep takes place all over the period of study, as the

ratio was found to increase continuously during this period. It could be considered that the adult fleece structure is well established after six months of age and not before. This agrees with the findings of Carter and Hardy (1947) working on Merino, while it differs from that found by Burns (1949, 1953, 1954 *a* and *b*) working on English breeds in which the hair follicle group is completed at one to three months of age.

Comparing the two Egyptian breeds of sheep with other foreign breeds, it was found that both Ossimi and Rahmani possess higher density of primary follicles per unit area than in the Merino, Merino crosses and English breeds examined by Carter and Clarke (1957 *a* and *b*).

The number of secondary follicles in both native breeds is less than that of the other breeds; meanwhile, the total wool follicles per unit area is higher in the native breeds than in the Lincoln, Corriedale and all English breeds examined by Burns (1949, 1953, 1954 *a* and *b*), and Carter and Clarke (1957*b*). This may be due to the excess in the number of primaries. It also coordinates with the values of S/P ratio which are less in both native breeds than the other breeds.

Rendel (1954) stated that when the S/P ratio is low, the primaries give rise to coarse shedding in the adult fleece. Both Ossimi and Rahmani sheep showed evidence that the shedding of the fibres increases with age. Similar results were obtained in the Merino (Carter, 1940) and in the Suffolk breed (Burns, 1954 *b*). Shedding in the Ossimi could be markedly illustrated when comparing the density of wool follicles in the present work with the density of fibres per unit area estimated by Labban (1954). The wool follicles density is approximately twice as much as the fibres density.

The primary follicles in both Ossimi and Rahmani are conspicuously thicker than the secondary follicles of any other breed such as Blackface (Burns, 1953); Herdwick (Burns, 1954 *b*) or Corriedale (Sugai, 1954). The difference in the diameter of the primary and secondary follicles has been attributed to the time of initiation of these fibres, and this is correlated to the depth at which each type of follicle extends into the skin (Fraser, 1952; Fraser and Short, 1952). In both the Ossimi and Rahmani, the primary follicles are deeper than the secondaries, whereas in sheep with more uniform fleece the primaries and secondaries

are at about the same depth. Generally, the wool follicles average diameter in both native breeds is higher than in the Merino, Polworth, Corriedale, Lincoln and English breeds (Carter and Clarke, 1957 *a* and *b*). However, the Ossimi had thicker internal-diameter and lesser S/P ratio than the Rahmani. Also, Ragab *et al* (1956) found that the Ossimi had the highest fibre diameter. This may be an evidence of the inherent characters of fineness of wool in the Rahmani. However, the fleece of the Rahmani is reddish brown in colour. It is more desired in the manufacture of carpets as its colour is more fixed than the artificial dyes.

Individual variation is markedly observed in the estimated density and diameter of wool follicles in both breeds examined. As these characters are the important factors of quantity and quality of wool production, selection of individuals with fleece characterized with high density of fine wool of the native sheep may lead to the improvement of wool production. It is suggested to carry out histological examinations soon after birth. Sheep skin which comprises more secondary follicles with less primaries and thinner cross-sections of follicles, is those needed to select for better wool production. Even if crossing is desired to improve wool quality of the native sheep, it would be much more advisable to cross the European breeds which have more secondaries and less primaries with the indigenous breeds.

The breeding program thus suggested would be coupled with better management. In Egypt, the local breeds suffer from poor management and mal-nutrition during the pre-natal life and soon after weaning. Mal-nutrition during the pre-natal life reduces the number of follicles at the critical period of follicles initiation (Glavin, 1948; Schinckel, 1955).

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الملخص

عملت قطاعات ميكروسكوبية في جلود أحد عشر رأساً من الأغنام الأوسيمي ومثلها من الأغنام الرحمانى من عمر الولادة إلى عمر ٦ شهور . وقد وجد أن عدد بصيلات الصوف الثانوية في وحدة المساحة زاد من الولادة إلى عمر ٥ ٤ يوماً ثم نقص بعد ذلك . وفي نفس الوقت قل عدد البصيلات الأولية كلما زاد مسطح جسم الحيوانات مما يثبت أنه لا تتم أى زيادة في عدد البصيلات الأولية بعد الولادة وإن كل الزيادة تتم في عدد البصيلات الثانوية . وقد زادت نسبة البصيلات الثانوية الأولية كلما زاد الحيوان في العمر . وقد اختلفت هذه النسبة فيما بين نوعى الأغنام المستعملة ، حيث كانت النسبة أعلى في الأغنام الرحمانى عنها في الأوسيمي . وقد ظهر القلش في البصيلات الأولية في كلا النوعين وقد كان القلش أوضح ما يمكن في موسم الربيع . وقد زاد كلا من القطر الخارجى والداخلى لنوعى البصيلات مع زيادة عمر الحيوانات . ووجد أن القطر الداخلى في الأغنام الأوسيمي أسمك عن الأغنام الرحمانى .

ولم يظهر أى تأثير للجنس في أى من الصفات المدروسة فيما عدا نسبة البصيلات إلى بعضها حيث كانت النسبة أعلى في الإناث عنها في الذكور في كلا النوعين المستعملين من الأغنام .