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AN EVALUATION OF KARADI SHEEP FLEECES

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ABSTRACT

One hundred and seventy three Karadi sheep (139 ewes & 34 rams) aged 1.5 to ≥ 5.5 years kept on three private flocks were used to study the effect of flock, sex, age and ewe status on body weight and wool physical traits and the relationships among them. Skin samples were also obtained for histological study. The overall mean of follicle density, S:P ratio, body weight, greasy fleece weight, clean wool%, staple length, fiber length, fiber diameter, crimps, medullated fibers, outercoat fibers, undercoat fibers and kemp fibers were respectively, 17.6/mm^2, 3.2, 58.1kg, 1.8kg, 78.4%, 9.1cm, 12.8cm, 30.8μm, 1.14 crimps/cm, 4.2%, 72.2%, 19.7% and 8.2%. Furthermore, it was noticed that the grease content in greasy wool was 4.2 %. Statistical analysis revealed a significant effect of flock on most wool physical traits. Males were significantly heavier than females and had heavier greasy fleece weight, longer lengths and higher outercoat fibers but lower undercoat fibers. Age affects body weight, greasy fleece weight, lengths, fiber diameter and kemp fibers and ewe status affect body weight, clean wool percentage, lengths and crimps significantly. The correlations among Karadi wool traits bring an attention to the possible improvement of this type of fleece by selection.

***Key words**: follicle, karadi sheep, wool traits*

1. INTRODUCTION

Sheep in Iraq represent the most important livestock in the country and are raised for meat, milk and wool and the annual revenue of such products are about 60, 25 and 15%, respectively (Haddadin, 1977) in addition to benefit from its manure. The Karadi (Kurdi) sheep like other Iraqi breeds (Awassi & Arabi) belong to the fat-tailed and carpet-wool type, and contribute 18-20% of the country sheep population. They are native to the undulating dry-farming plains and mountainous region of Iraqi Kurdistan which is characterized by its Mediterranean climatic conditions. Karadi sheep have several indigenous strains. The animals of the mountain flocks are ordinary smaller in size than sheep of the plains (Juma and Alkass, 2000).

The variation in raw wool is caused by complicated interactions of genetical and environmental factors (Ryder & Stephenson, 1968). The importance of raw wool characteristics on price, processing stages and end-products is well known and reviewed (Ince, 1978; Nasrullah, 1983; Kurdo, 1985 and Champion and Robards, 1999).

Due to the availability of limited and conflicting information on the fleece properties of Karadi sheep (Ghoneim *et al*., 1974; Ashmawy and Al-Azzawi, 1982a&b; Aziz, 1991), this study aimed to evaluate Karadi sheep fleeces in Sulaimani Governorate in terms of skin histology, live weight, wool physical properties and grease/wax content and to determine the effects of non-genetical factors (flock, sex, age and ewe status) on these traits, and the relationships among them.

2. MATERIALS AND METHODS

2.1. Histological studies

A 1 cm^2 skin specimens from four body regions namely; anterior, mid and posterior of the side and the mid of the back of each of 15 Karadi ewes, 3-4 year old was taken and fixed in 10% formalin solution neutral buffered for 24-48 hrs. After histological processing (James, 1976), sections of 5-8 mm thickness were prepared and stained with Hematoxylin-Eosin. Primary and secondary wool follicles/mm^2 were counted by a Hamilton Electron Microscope using S-Spline2 computer program and imaged with GKB Digital Camera.

2.2. Raw wool studies

One hundred and seventy three randomly selected Karadi sheep (139 ewes & 34 rams) from three private flocks in Sulaimani Governorate were hand- sheared at the beginning of May,

2005. The sheep aged 1.5 to ≥ 5.5 years and the ewes were either barren, rearing single or twin lambs. Although the managerial practices in terms of feeding and husbandry differed among flocks, the sheep feeding depended on pasture, green grass and cereal stubble. In addition, supplement of barley grain and wheat straw was offered during winter**.**

Immediately after shearing, each animal was weighed and greasy fleece weight was recorded to the nearest 0.5 and 0.1kg, respectively, and approximately 50g of wool sample were taken from its right mid-side. The average staple length from five staples of each greasy wool sample was estimated, by a ruler, from their cut base to the midway in the pyramid formed by the tip (Von Bergen, 1963). About 10g of greasy wool from each sample were conditioned (65 ± 2% R.H. & 20 ± 2c^o for 24 hrs.) prior to scouring in non-ionic detergent, and clean wool was determined as the percentage of scoured oven dry at 16% regain to the weight of conditioned greasy sample. One hundred and fifty fibers were randomly drawn from a degreased staple and used for fiber length measurements, while an average number of crimps/cm was measured from ten selected fibers. The diameter of 200-300 fibers was measured by projection microscope (Lanameter) from each sample in accordance to the ASMTT (1978). The medullation percentage was estimated by counting the number of medullated fibers occurring in the sample used for measuring the diameter as described by the IWTO (1976). Also, the weight of the different fiber types (outercoat, undercoat & kemp fibers) was determined by visual separation of one degreased staple by applying the method of Doney and Smith (1961).

Alcohol extractable matter (grease content) from greasy wool sample was determined for each age group by Soxhlet extraction following the instructions and procedures adopted by the IWTO (1976).

2.3. Statistical analysis

Data were analyzed using the General Linear Model (GLM) procedure (SAS, 1998). Different mathematical models were used, in accordance to the studied traits. The correlations among traits were also computed. The differences between means of subclasses were tested by Duncan's multiple range test using GLM of SAS (1998).

3. RESULTS AND DISCUSSION

3.1. Follicle traits

Karadi primary (P) and secondary (S) wool follicles were arranged in groups as shown in Figure (1). The overall mean of the number of primary, secondary and total follicle density (P+S) /mm^2 and secondary: primary ratio were 4.3, 13.3, 17.6 and 3.2 respectively (Table1). Body site had a significant (P≤0.01) effect on S: P ratio, being the highest at the anterior-side (3.7) and the lowest at the posterior-side (2.7). The above results were similar to those observed in Awassi sheep by Hassan *et al*. (1995). However, Karadi follicle density was found to be lower than Australian Romney (18.9) but higher than other Australian carpet wool breeds (*i.e.*, Drysdale, 14.4;Carpetmaste, 14.6;Elliottdale, 15.3;Tukidale, 16.1) as found by Champion & Robards (2000) and Indian breeds (*i.e.*, Chokla, 9.4 & Malpura, 5.6) as stated by Narayan (1960). The value of S: P ratio was found to be lower than the range of 5.8-8.6 for the above Australian carpet wool breeds but higher than Indian breeds (*i.e*., Chokla, 2.1 & Malpura, 1.3). Due to the values of mid-side that were similar to the overall mean and its highly significant (P≤0.01) correlation, it appears that the samples from the mid-side could be used as a representative of the body.

Table (1): Least square means ± S.E. of body sites affecting follicle traits together with the correlations between mid-side values and overall mean for each trait.

Traits	Overall mean	Body sites				Simple correlation
		Anterior-side	Mid-side	Posterior-side	Mid-back	
Primary follicles/mm^2	4.3±0.15	3.7±0.20^B	4.3±0.27^{AB}	4.5±0.35^{AB}	4.7±0.32^A	**.836
Secondary Follicles/mm^2	13.3±0.34	13.5±0.56^{AB}	13.3±0.70^{AB}	11.9±0.79^B	14.4±0.51^A	**.802
Follicle density/mm^2	17.6±0.45	17.3±0.73^{AB}	17.5±0.93^{AB}	16.3±1.08^B	19.1±0.72^A	** .814
S:P Ratio	3.2±0.08	3.7±0.13^a	3.2±0.12^b	2.7±0.13^c	3.2±0.19^b	** .783

Values within the same row with different small letters are significantly different (P ≤ 0.01).
Values within the same row with different capital letters are significantly different (P ≤ 0.05).

3.2. Body weight

Table (2) indicates that the overall mean of body weight of Karadi sheep was 58.1kg with an average of 53.3kg and 77.6kg for ewes and rams, respectively. In comparison to other Iraqi local

breeds, Karadi sheep is heavier than Awassi and Arabi breeds (Juma & Alkass, 2000) but lighter than its strain (Hamadani) as stated by Aziz & Al-Oramary (2005).

3.3. Wool physical characteristics

The results presented in Table (2) show that the overall mean of greasy fleece weight was 1.8 kg. The average fleece weight was 1.7kg and 2.4kg for ewes and rams, respectively. However, earlier findings for fleece weight on the same breed were 1.5 & 2.2kg (Ashmawy and Al-Azzawi, 1982a; Aziz, 1991). Rams surpass ewes in this trait could be mainly due to their greater size.

The overall mean of clean wool percentage was 78.4%; being 77.6% for ewes and 81.8% for rams. This high value is associated with low wax content due to low S: P follicle ratio of the Karadi sheep. The present result corresponds with the earlier findings of other Iraqi local breeds (Ghoneim *et al*., 1967; Aziz, 1991&1993; Aziz & Al-Oramary, 2005) except than that reported by Ashmawy & Al-Azzawi (1982a), who observed a range of 48.9 and 57.5%, which might be due to the differences in the source of samples.

The overall mean of staple length and fiber length were found to be 9.1 and 12.8cm, respectively. The average staple length and fiber length for ewes were 8.8 and 12.6cm while for rams were 10.1 and 13.7cm, respectively, this might be due to slower growth of the fiber in ewes due to their physiological status (Ryder, 1975). The average staple length and fiber length recorded in the current study were shorter than that reported by other studies (Ghoneim *et al*., 1974; Ashmawy and Al-Azzawi, 1982b; Aziz, 1991) for the same breed. Such differences might be attributed to the environmental and technical factors.

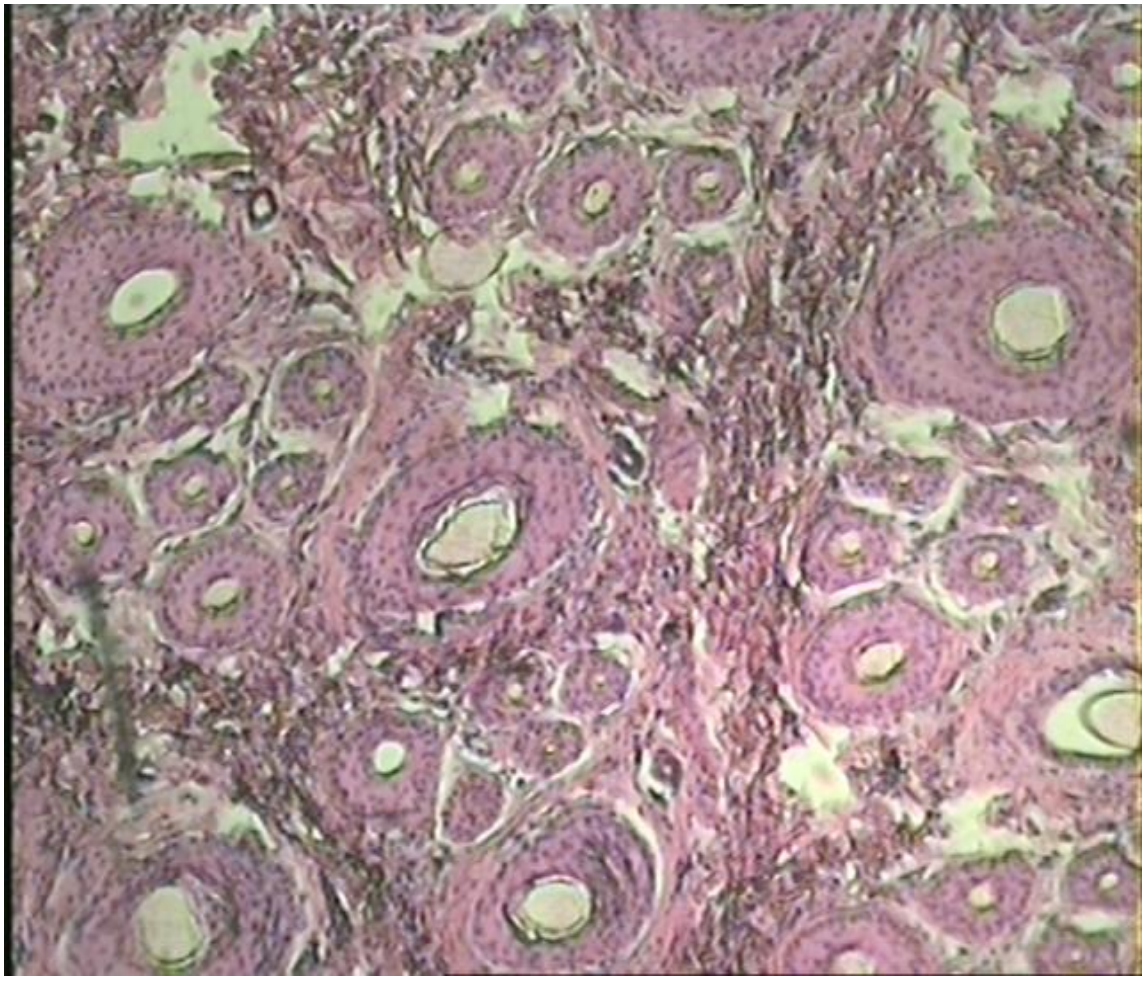

Fig.(1): Primary (large) and secondary (small) karadi wool follicles.

The overall mean of fiber diameter was 30.8µm. The average fiber diameter for ewes and rams were 30.4µm and 32.6µm, respectively. Similar value (30.7µm) was reported by Ashmawy and Al-Azzawi (1982b), whereas higher values (37.2 & 48.1µm) were reported by Aziz (1991) and Ghoneim *et al.* (1974). This difference might be due to the environmental and technical factors, in addition to genetic variation, since this breed has many strains raised under the same name. The wide range of

Table (2): Least square means ± S.E. of factors affecting body weight and wool physical characteristics.

Sheep variables	No.	Body weight (kg)	Greasy fleece weight.(kg)	Clean wool (%)	Staple length (cm)	Fiber length (cm)	Fiber diameter (µm)	Crimps/cm	Medullated fibers (%)
Overall mean	**173**	**58.1±0.95**	**1.8±0.04**	**78.4±1.03**	**9.1±0.15**	**12.8±0.17**	**30.8±0.50**	**1.14±0.02**	**4.2±0.29**
Flock									
1	**58**	**62.2±1.83^{a}**	**2.0±0.06^{a}**	**88.4±0.92^{a}**	**8.3±0.23^{b}**	**13.0±0.25^{A}**	**30.3±0.64^{B}**	**1.17±0.03^{a}**	**3.8±0.35^{A}**
2	**63**	**55.3±1.35^{b}**	**1.6±0.07^{b}**	**80.8±1.27^{b}**	**9.2±0.27^{a}**	**12.4±0.32^{A}**	**29.7±0.57^{B}**	**1.21±0.03^{a}**	**4.7±0.48^{A}**
3	**52**	**56.9±1.63^{b}**	**1.9±0.08^{a}**	**64.5±1.52^{c}**	**9.8±0.21^{a}**	**13.2±0.31^{A}**	**32.8±1.29^{A}**	**1.02±0.02^{b}**	**4.1±0.66^{A}**
Sex									
Ewes	**139**	**53.3±0.59^{b}**	**1.7±0.04^{b}**	**77.6±1.19^{A}**	**8.8±0.15^{b}**	**12.6±0.19^{b}**	**30.4± 0.58^{A}**	**1.17±0.02^{a}**	**4.0±0.32^{A}**
Rams	**34**	**77.6±1.86^{a}**	**2.4±0.09^{a}**	**81.8±1.77^{A}**	**10.1±0.35^{a}**	**13.7±0.35^{a}**	**32.6± 0.86^{A}**	**1.02±0.04^{b}**	**5.0±0.64^{A}**
Age (year)									
1.5	**34**	**50.0±1.27^{b}**	**1.7±0.06^{B}**	**80.3±1.53^{A}**	**9.2±0.37^{ab}**	**13.3±0.33^{A}**	**29.5±0.91^{B}**	**1.21±0.04^{A}**	**4.7±0.72^{A}**
2.5	**38**	**56.9±2.11^{a}**	**2.0±0.10^{A}**	**75.7±2.38^{A}**	**9.7±0.27^{a}**	**13.0±0.38^{AB}**	**29.9±0.69^{B}**	**1.13±0.04^{A}**	**3.9±0.59^{A}**
3.5	**41**	**62.0±2.23^{a}**	**1.9±0.08^{AB}**	**77.2±2.25^{A}**	**9.3±0.26^{ab}**	**12.9±0.37^{AB}**	**30.8±0.71^{AB}**	**1.12±0.04^{A}**	**3.6±0.53^{A}**
4.5	**33**	**61.0±1.97^{a}**	**1.8±0.11^{AB}**	**78.6±2.54^{A}**	**8.6±0.37^{bc}**	**12.7±0.39^{AB}**	**33.4±1.93^{A}**	**1.15±0.05^{A}**	**4.4±0.65^{A}**
5.5	**27**	**60.3±2.11^{a}**	**1.7±0.09^{B}**	**81.5±2.66^{A}**	**8.3±0.34^{c}**	**12.0±0.24^{B}**	**30.8±0.98^{AB}**	**1.07±0.05^{A}**	**4.9±0.81^{A}**
Ewe status ¶									
Barren	**21**	**47.2±1.19^{C}**	**1.6±0.06^{A}**	**83.1±1.84^{A}**	**9.0±0.49^{A}**	**13.3±0.33^{A}**	**28.4±1.12^{A}**	**1.32±0.05^{A}**	**3.6±0.65^{A}**
Rearing single lambs	**106**	**53.9±0.65^{B}**	**1.7±0.04^{A}**	**75.7±1.42^{B}**	**8.9±0.16^{A}**	**12.6±0.23^{AB}**	**30.9±0.70^{A}**	**1.15±0.02^{B}**	**4.2±0.40^{A}**
Rearing twin lambs	**12**	**58.4±1.59^{A}**	**1.7±0.10^{A}**	**85.3±3.66^{A}**	**7.8±0.49^{B}**	**11.8±0.49^{B}**	**29.9±1.24^{A}**	**1.11±0.06^{B}**	**3.5±0.63^{A}**

Values within the same column with different small letters are significantly different (P≤0.01).

Values within the same column with different capital letters are significantly different). (P≤0.05).¶ was in the mathematical model for ewes only.

fiber diameter among the fleeces of karadi sheep is due to the fact that this breed was not selected for its wool production.

The overall mean of the number of crimps was 1.14crimps/cm. This is in agreement with that observed by Ghoneim *et al*. (1974).

The overall mean of medullated fiber percentage was 4.2% with the range of zero to 19.3%. Higher values (6.8-19.5%) were reported earlier by Ghoneim *et al*. (1974), Ashmawy and Al-Azzawi (1982b) and Aziz (1991).

Table (3) indicates that the overall means of outercoat, undercoat and kemp fibers percentage by weight, are 72.2, 19.7 and 8.2%, respectively with the range of (30.1-93.9%), (3.9-50.3%) and (0.0-52.0%) for the above traits, respectively. Lower values (2.3 & 2.9%) for average kemp fibers were reported by Aziz (1991) and Ashmawy and Al-Azzawi (1982a). The high variation of kemp fibers among fleeces, suggest the possibility of eliminating kemp fibers content by a proper breeding program.

3.4. Alcohol extractable matter

Alcohol extractable matter content for greasy wool at different age groups is presented in Figure (2), which tends to decrease after 3.5 years old. The average value was found to be 4.2%. Lower values (1.7%) and (0.4-1.5%) for Hamadani and Pakistani carpet wool sheep were reported, respectively by Aziz & Al-Oramary (2005) and Hasnain (1985). The low wax content is associated with low S: P follicle ratio of the carpet wool sheep (Fraser & Short, 1960).

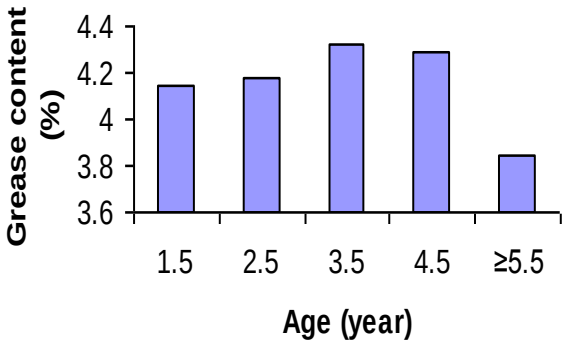

Fig. (2): Grease content in Karadi sheep fleece

3.5. Factors affecting the studied traits

A significant effect of flock (P≤0.05) on fiber diameter and a high significant effect (P≤0.01) on all studied traits except fiber length and medullated fiber percentages was observed (Tables 2&3). This may be attributed to different management practices followed in each flocks, in addition to differences in genotype as the Karadi sheep is not pure breed. Hence, raw wool variability is highly influenced by environmental and genetical factors (Ryder & Stephenson, 1968).

The effect of sex appeared to be significant (P≤0.01) on most studied traits. The superiority of rams over ewes in body weight is due to difference in sex hormones (Owen, 1976), and in wool production which might be attributed to the larger size of the rams compared to ewes and to

Table (3): Least squares means ± S.E.of factors affecting fiber type ratio by weight

Sheep variables	No.	Outercoat fibers (%)	Undercoat fibers (%)	Kemp fibers (%)
Overall mean	**173**	**72.2±0.92**	**19.7±0.66**	**8.2±0.57**
Flock				
1	**58**	**71.0±1.36^{b}**	**19.4±1.04^{ab}**	**9.6±0.85^{a}**
2	**63**	**68.9±1.71^{b}**	**22.1±1.14^{a}**	**9.0±1.17^{a}**
3	**52**	**77.4±1.43^{a}**	**17.1±1.17^{b}**	**5.5±0.76^{b}**
Sex				
Ewes	**139**	**70.8±1.05^{b}**	**20.6±0.75^{a}**	**8.7±0.68^{A}**
Rams	**34**	**77.8±1.53^{a}**	**16.1±1.25^{b}**	**6.1±0.73^{A}**
Age(year)				
1.5	**34**	**72.5±1.82^{A}**	**20.5±1.24^{A}**	**7.0±1.00^{B}**
2.5	**38**	**72.8±1.78^{A}**	**20.5±1.46^{A}**	**6.8±0.85^{B}**
3.5	**41**	**73.6±1.71^{A}**	**19.4±1.37^{A}**	**7.1±0.98^{B}**
4.5	**33**	**71.1±2.29^{A}**	**19.3±1.62^{A}**	**9.6±1.50^{AB}**
5.5	**27**	**70.1±2.99^{A}**	**18.6±1.81^{A}**	**11.4±2.12^{A}**
Ewe status ¶				
Barren	**21**	**71.3±2.44^{A}**	**20.6±1.60^{A}**	**8.1±1.39^{A}**
Rearing single lambs	**106**	**70.8±1.23^{A}**	**20.8±0.89^{A}**	**8.5±0.80^{A}**
Rearing twin lambs	**12**	**69.8±3.45^{A}**	**18.9±2.19^{A}**	**11.3±2.44^{A}**

Values within the same column with different small letters are significantly different (P≤0.01).
Values within the same column with different capital letters are significantly different (P≤0.05).
¶ was in the mathematical model for ewes only.

the physiological status of the ewes (Ryder, 1975;Yeates *et al*., 1975).

Age of animal showed a significant effect (P≤0.05) on fleece weight, fiber length, fiber diameter and kemp fibers and highly significant effect (P≤0.01) on body weight and staple length. In general, a slight increase in most traits with advancing age up to the third or fourth year old and thereafter decline was observed in the current work. Similar trends were reported (Aziz, 1993; Juma & Alkass, 2000; Alkass *et al.*, 2003; Aziz and Al-Oramary, 2005). The low productivity of older group (5.5 years) may be attributed to low feed intake, consequently low follicle efficiency, in addition to the effects of reproduction (Yeates *et al*., 1975).

Ewe status had a significant effect (P≤0.05) on body weight, clean wool percentage, staple length and fiber length. The possible explanation is that most of the barren ewes were aged 1.5 year.

3.6. Correlation analysis

The correlations among the studied characteristics are given in Table (4). The value of correlation between body weight and greasy fleece weight (0.49, P≤0.01) was similar to that observed by Maarof (1989) and Aziz& Al-Oramary (2005) for Hamadani sheep but was higher than those of other Iraqi breeds (Awassi & Arabi) which were 0.19 and 0.33 (Juma & Alkass, 1996 and Al-Saigh *et al*., 1992, respectively). The highly significant (P≤0.01) positive correlations between the greasy fleece weight and each of the staple length (0.35), fiber length (0.41) and outercoat fibers (0.37) from one side and the highly significant (P≤0.01) negative correlation between the greasy fleece weight and the undesirable kemp fibers (-0.33) from the other side may possibly increase the efficiency of selecting individuals for heavy fleece weight but lower kemp fiber content.

Conclusions

It is clear from the study that Karadi sheep belongs to the carpet-wool type and produce low quantity of wool with high contamination of undesirable kemp fibers. However, the large variations in wool physical traits suggest that Karadi sheep are not selected for fleece characteristics. The highly significant and negative correlations existed between kemp fibers and most studied traits will assist breeders in the improvement of wool production quantitatively and qualitatively by initiating a selection program.

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Table (4): Correlation coefficients for body weight and studied wool physical characteristics of karadi sheep.

Character	Greasy fleece weight	Staple length	Fiber length	Fiber diameter	Crimps	Medullated fibers	Outercoat fibers	Undercoat fibers	Kemp fibers
Body weight	.49**	.11	.06	.13	-.23**	.11	.07	-.15*	.06
Greasy fleece weight		.35**	.41**	.10	-.32**	-.06	.37**	-.23**	-.33**
Staple length			.42**	.25**	-.40**	.09	.49**	-.43**	-.30**
Fiber length				.17*	-.31**	-.11	.52**	-.29**	-.50**
Fiber diameter					-.37**	.20**	.23**	-.28**	-.04
Crimps						-.09	-.46**	.42**	.25
Medullated fibers							-.15*	-.04	.28**
Outercoat fibers								-.78**	-.69**
Undercoat fibers									.10

**P< 0.01 *P< 0.05

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تقويم جزة الأغنام الكرادية

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ملخص

اجريت هذه الدراسة فى بداية شهر أيار (مايو) عام 2005 فى محافظة السليمانية، حيث استخدم 173 رأسا من الأغنام الكرادية (139انثى و 34 ذكرا) باعمار تراوحت بين1.5 – 5.5 سنة واكثر ومن ثلاثة قطعان اهلية وكانت غالبية النعاج والدة ونوع الولادة فردية او تؤمية. استخدم البرنامج الاحصائى الجاهز (SAS) لمعرفة تاثير العوامل اللاوراثية (القطيع، الجنس، العمر و حالة النعجة) على الصفات المدروسة. كذلك اجريت الدراسة النسيجية لايجاد كثافة الحويصلات و نسبة الحويصلات الثانوية الى الأولية. بلغ المتوسط العام لكثافة الحويصلات، نسبة الحويصلات الثانوية الى الأولية، وزن الجسم، وزن الجزة الخام، نسبة الصوف النظيف، طول الخصلة، طول الليفة، قطر الليفة، التجعدات، الألياف النخاعية، ألياف الغطاء الخارجى، ألياف الغطاء الداخلى و الألياف الشعرورة 17.6/ملم^2، 3.2، 58.1كجم، 1.8كجم، 78.4%، 9.1سم، 12.8سم، 30.8مايكرون، 1.14تجعد/سم، 4.2%، 72.2%، 19.7% و 8.2% على التوالي. كما ان نسبة الدهن فى الصوف الخام بلغت 4.2%. كان للقطيع التأثير المعنوى على معظم صفات الصوف المدروسة. أنتجت الذكوراثقل وزنا للجسم وللجزة واطول الألياف واعلى نسبة لألياف الغطاء الخارجى ولكن اقل نسبة لألياف الغطاء الداخلى عما عليه فى الأناث. تاثيرات العمر على وزن الجسم، وزن الجزة الخام، طول الخصلة، طول الليفة، قطر الليفة والألياف الشعرورة وكذلك تاثيرات حالة النعجة على وزن الجسم، نسبة الصوف النظيف، طول الليفة والتجعدات كانت معنوية. التباين الواسع لصفات الصوف الفيزيائية وكذلك الأرتباط المعنوى والسالب بين الياف الشعرورة ومعظم الصفات المدروسة سيجعل امكانية تحسين ألأغنام الكرادية كماً ونوعاً أمرا ممكنا عن طريق وضع برنامج انتخابى بذلك.

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