The Effect of Crossbreeding Sudanese Nubian Goats with Damascus Goats on Physical and Mechanical Properties of Wool

[a]Hashim A.M.Salim, [a]Elfadil Mahmoud Mohamed Ahmed Elkarsany

[a]Textile Engineering Department, College of Engineering, Sudan University of Science and Technology (SUST), Country, Sudan

Abstract

The study focuses on finding the effects of Sudanese Nubian goats crossbreeding with Damascus goats on physical and mechanical properties of wool fibres. Therefore to improve the productivity and quality of wool in the future so that it can be adopted in textile manufacturing. The laboratory tests show positive change signs the breed (groups) in wool characteristics. The moisture regains and moisture content of group (C) is 7.8% and 7.2% respectively which are more than that of group (A) and (B).The fibers appear under the microscope almost straight without crimp and the fiber (groups) nearly circular in cross section. The scales were slightly irregular and tapered at the tip end. The fiber fineness of the breed group (C) is 63.5 – 64.2 microns which is more than that of group (A) and (B). This is reflected negatively on fiber length and strength when compared by group (A) and (B).

KEYWORDS: Buck, bellies, crutch, crossbreeding, medulla.

Introduction:

Wool is different compared to other fibres because of its chemical structure. This chemical structure influences its texture, elasticity, staple and crimp formation. Wool is a protein fibre, composed of more than 20 amino acids. These amino acids form protein polymers. Wool also contains small amounts of fat, calcium and sodium.[1]

Epstien (1971) refers that Nubian Goats come out of the screw horn goats that spread in the ancient world from India in the East to Libya in the West.[2]

Nubian Goats are large, long legged, with pendulous ears and Roman nose especially in the males. Any color solid or patterned, is acceptable.

The Sudanese Nubian Goats are one of the branches of the general Nubian types which includes Zaraibe (Egyptian Nubian Goats), Damascus, Jamnapari, ..etc.

The Animal Production Scientists divided the goats according to the length of ear into two groups: Long and Short eared goats. Mason and Maule (1960), agreed to divide the Sudanese Goats to four types: Nubian, Desert, Nilotic and Mountain goats.[3]

The Sudanese Nubian Goats amount five millions in 1977 i.e. 45.5% of the total amount of the goats in Sudan. It also spreads north of the latitude 12^0 N. It increases around the Nile in the Northern state, as well as in Kassala, Khartoum and Central States, also there are less numbers in the neighboring states.[4]

Materials and Methods:

Sample collection

Goats were obtained from the farm of Animal Production Department of the College of Agricultural Studies, Sudan University of Science and Technology. The goats are in this farm to improve meat and milk.

The wool samples were collected from randomly selected pure Sudanese Nubian Goat (female) which represent group (A) as shown in figure (1). The buck is a Damascus Goat which represent group (B) as shown in figure (2). Their first generation is a buck which represent group (C) as shown in figure (3).
The wool samples have been chosen randomly avoiding the wool of the lower parts of the legs, round about the head and neck, crutch and bellies.

Figure (1)

Group (A) – Sudanese Nubian Goats (female)

Figure (2)

Group (B) – Damascus Nubian Goats (buck)

Figure (3)

Group (C) – first generation of A/B (buck)

Methods:

12 grams sample of wool from each group (A,B& C) is rinsed in about 250 cc. of carbon tetrachloride, by immersing the sample in a beaker and stirring well for about three minutes. Re-immersing the sample in 250 cc of a clean solvent for one minute. Then removing the three samples and exposing them to testing condition.
A Conditioning Test reports the Regain, Moisture Content, and Oven Dry Weight of fibers.
A sample from each group was examined along the length of 35 microns by using Scanning Electron Microscope (SEM) with magnification of 400X to focus the surface appearance of the fibers.
Four hundred fibers from each group were taken and their length was recorded by using the two forceps method.
A sample from each group was examined five times from the root towards the tip by using (SEM) with magnification of 400X to determine the fiber fineness and the obtained results checked by using Gravimetric method from fiber length data.[5]

$$d\ grav. = \frac{97190 + w}{h}$$

d = diameter in microns
w = total weight of fibres in milligrams
h = total length of fibres in centimetre
97190 = constant

Tensile testing of fibers was determined by using Single-Strand Method on Titan - Universal Strength Tester.

Results and Discussion:

Moisture regain and moisture content:

Wool is very hygroscopic and can take up greater amount of moisture than any other fiber without feeling damp. This property plays an important role in making wool a

desirable material to wear next to the skin because it has a considerable capacity to absorb perspiration.[6]

The physical properties of fibers can be affected by their moisture content. In general the fibers that absorb greatest amount of moisture are the ones whose properties change the most. Three main properties are affected namely dimensional, mechanical and electrical.[7]

The amount of moisture in a fiber sample can be expressed as either regain or moisture content. Regain is the weight of water in a material expressed as a percentage of the oven dry weight:

$$\text{Regain (R)} = \frac{100 \times W}{D}\%$$

Where D is the dry weight and W is the weight of absorbed water.

Moisture content is the weight of water expressed as a percentage of the total weight

$$\text{Moisture content (M)} = \frac{100 \times W}{D+W}\%$$

Table (1) and figure (4&5) shows moisture regain and moisture content of the three groups.

Table (1) Moisture Regain and Moisture Content of the three groups

Sample	(D) g	(W) g	(R) %	(M)%
A	5.993	0.449	7.5	7.0
B	5.710	0.355	6.2	5.9
C	7.307	0.569	7.8	7.2

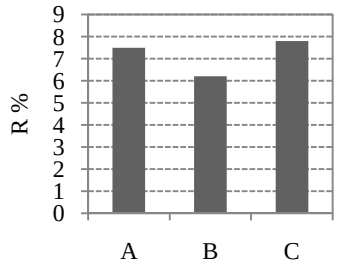

Figure (4)

Moisture Regain of the three groups

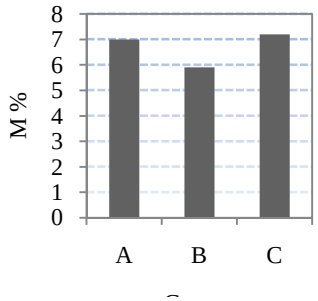

Figure (5)

Moisture Content of the three groups

When referred to table (1) and figure (4&5) we find that the moisture regains and moisture content of group (C) is more than that of group (A) and (B) that might be an affect of the fiber fineness.

Surface appearance:

Wool's unique cellular structure gives it a number of desirable properties. Most properties are typical of all wool, but there are some differences in wool from various

animal breeds. The differences affect the appearance and the feel of the wool and what it's used for.[8]

The three samples of fibers appear under the microscope straight without crimp, very nearly circular in cross section and finely tapered at the tip end as shown in Figures (6, 7, 8 and 9). Also we can observe that, medulla appeared like a dark spot in white color fiber of group (C) and reddish brown color fiber of group (B) but comparatively light in black fiber of group (A). The three samples scales were slightly irregular, waved type with smoother edges; this may have been affected due to weathering or type of diet or both.

Figure (6)
Group (A) fiber.
X400. SEM

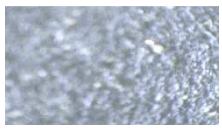

Figure (7)
Cross-section of
Group (A) fiber.
X400. SEM

Figure (8)
Group (B) fiber.
X400. SEM

Figure (9)
Group (C) fiber.
X400. SEM

Fiber length:

One of the most important characteristics of fiber is fiber length, because it is the most important characteristic for spinners. For yarns, longer fibers lead to greater strength than shorter fibers, and finer yarns can be spun from longer fibers. For some important yarn characteristics such as the frequency of neps and slubs which is due to the adjustment of machine settings and some processing effects, as well the dominant factor is the fiber length distribution.[9]

Tables (2, 3 and 4) and figure (10) show individual length of 400 fibers taken from each group (A, B and C) respectively. The relative mean length was 165, 179 and 156 mm respectively, this due to the fact that coarser hair is longer than fine.

Table (2) Fiber Length of group (A)

Class frequency (F)	Fibre length (L) in (cm)	(F) * (L)	Class frequency (F)	Fibre length (L) in (cm)	(F) * (L)
13	14.5	188.5	10	16.9	169.0
09	14.6	131.4	19	17.0	323.0
08	14.7	117.6	09	17.1	153.9
07	14.8	103.6	16	17.2	275.2
04	14.9	059.6	05	17.3	086.5
18	15.0	270.0	08	17.4	139.2
07	15.1	105.7	16	17.5	280.0

13	15.2	197.6	04	17.6	070.4
10	15.3	153.0	03	17.7	053.1
05	15.4	077.0	04	17.8	071.2
07	15.5	108.5	05	17.9	089.5
09	15.6	140.4	10	18.0	180.0
14	15.7	219.8	01	18.1	018.1
06	15.8	094.8	03	18.2	054.6
03	15.9	047.7	07	18.3	128.1
24	16.0	384.0	05	18.4	092.0
11	16.1	177.1	05	18.5	092.5
10	16.2	162.0	03	18.6	055.8
14	16.3	228.2	04	18.7	074.8
13	16.4	180.4	06	18.8	112.8
11	16.5	297.0	03	18.9	056.7
18	16.6	099.6	03	19.0	057.0
06	16.7	133.6	02	19.1	038.2
08	16.8	218.4	01	19.2	019.2
248		3895.5	152		2690.8
Mean fibre length = 16.5 cm					

Table (3) Fiber Length of group (B)

Class frequency (F)	Fiber length (L) in (cm)	(F) * (L)	Class frequency (F)	Fiber length (L) in (cm)	(F) * (L)
07	15.0	105.0	03	18.1	054.3
07	15.1	105.7	05	18.2	091.0
06	15.2	091.2	07	18.3	128.1
02	15.3	030.6	06	18.4	110.4
04	15.4	061.6	08	18.5	148.0
08	15.5	124.0	07	18.6	130.2
05	15.6	078.0	16	18.7	299.2
05	15.7	078.5	09	18.8	169.2
01	15.8	015.8	04	18.9	075.6
02	15.9	031.8	09	19.0	171.0
09	16.0	144.0	12	19.1	229.2
07	16.1	112.7	04	19.2	076.8
05	16.2	081.0	09	19.3	173.7
05	16.3	081.5	06	19.4	116.4
03	16.4	049.2	13	19.5	253.5
16	16.5	264.0	03	19.6	058.8
03	16.6	049.8	12	19.7	236.4
15	16.7	250.5	03	19.8	059.4
04	16.8	067.2	02	19.9	039.8
03	16.9	050.7	11	20.0	220.0
20	17.0	340.0	07	20.1	140.7
08	17.1	136.8	02	20.2	040.4
07	17.2	120.4	04	20.4	081.6

07	17.3	121.1	04	20.5	082.0
06	17.4	104.4	01	20.6	020.6
17	17.5	297.5	03	20.7	062.1
04	17.6	070.4	03	20.8	062.4
10	17.7	177.0	01	20.9	020.9
09	17.8	160.2	02	21.0	042.0
05	17.9	089.5	02	21.1	042.2
12	18.0	216.0			
222		3706.1	178		3435.9
Mean fibre length = 17.9 cm					

Table (4) Fiber Length of group (C)

Class frequency (F)	Fiber length (L) in (cm)	(F) * (L)	Class frequency (F)	Fiber length (L) in (cm)	(F) * (L)
18	14.5	261.0	11	15.8	173.8
08	14.6	116.8	04	15.9	063.6
28	14.7	411.6	22	16.0	352.0
10	14.8	148.0	13	16.1	209.3
09	14.9	134.1	20	16.2	324.0
29	15.0	435.0	13	16.3	211.9
20	15.1	302.0	13	16.4	213.2
21	15.2	319.2	16	16.5	264.0
24	15.3	367.2	11	16.6	182.6
17	15.4	261.8	14	16.7	233.8
29	15.5	449.5	05	16.8	084.0
15	15.6	234.0	04	16.9	067.6
17	15.7	266.9	09	17.0	153.0
245		3707.1	155		2532.8
Mean fibre length = 15.6 cm					

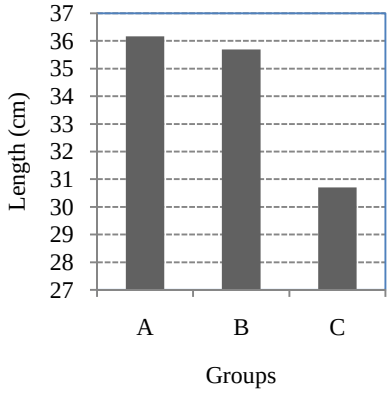

Figure (10)
Fiber Length of the
three groups

Fiber fineness:

Table (5) shows fiber fineness of the three groups determined by examining each fiber five times from the root towards the tip by using (SEM) with magnification of 400X. Table (6) shows fiber fineness of the three groups calculated from fiber length data by using gravimetric method.
When referred to tables (5 and 6) and figure (11) we can observe that the two methods of determination have given same results. It is observed that crossbreeding of group (A) by group (B) increases the fineness of the fibers of group (C).

Table (5) Fiber Fineness of the three groups (SEM)

Specimen	Fiber Width of Group (A) in microns	Fiber Width of Group (B) in microns	Fiber Width of Group (C) in microns
1	86.7	94.6	64.6
2	83.6	94.3	63.8
3	85.3	93.7	63.8
4	85.6	93.3	64.0
5	88.5	93.0	65.0
Mean	85.9	93.8	64.2

Table (6) Fiber Fineness of the three groups (d. gravimetric.)

Group	w (milligrams)	h (centimetres)	d gravimetric. (microns)	d (SEM) (microns)
A	499	6586.3	85.8	85.9
B	714	7142.0	98.6	93.8
C	259	6239.9	63.5	64.2

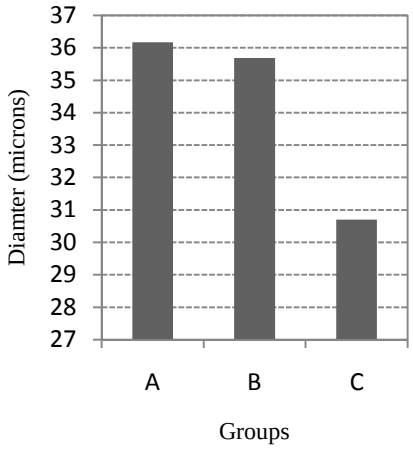

Figure (11)
Fiber Diameter of
the three groups

Tensile testing:

Table (7) and figure (12&13) shows statistical analysis summary of tensile testing of specimen fibers of the three groups obtained by using Single-Strand Method on Titan - Universal Strength Tester. Figures (14, 15&16) show the tensile strength curves of Groups (A, B&C) respectively. It can be seen that fiber tenacity of group (C) is slightly less than that of groups (A&B). The fiber tenacity of group (B) is slightly more than that of groups (A&C) that might be due to fibers diameter. Also we can observe that the elasticity might be affected by sex as seen in group (A) which is greater than that of groups (B&C).

Table (7) Summary of Tensile Strength results of the three Groups

Statistical analysis	Max. Force (gf)			Extension (%)		
	Group (A)	Group (B)	Group (C)	Group (A)	Group (B)	Group (C)
Mean	99	146	46.0	36.17	35.69	30.70
Maximum	129	165	65.4	40.76	54.54	37.11
Minimum	75	125	32.5	26.03	21.67	21.52
Range	54	40	32.9	14.73	32.87	15.59
Median	105	148	44.6	37.31	35.88	35.03
Std. Dev.	20	12	12.1	4.98	9.15	7.66
Conf. Limits+	114	155	60.9	40.00	42.23	40.19
Conf. Limits-	84	138	31.1	32.34	29.14	21.20
Coefficient of Variation	19.84	8.30%	26.21%	13.77%	25.65%	24.96

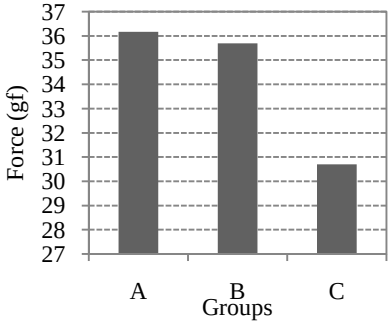

Figure (12)
Fiber Strength of
the three groups

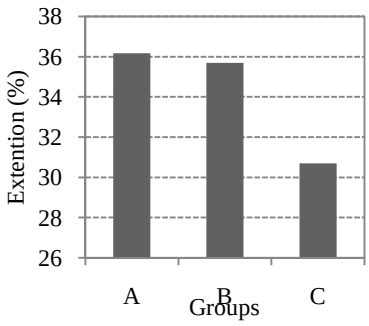

Figure (13)
Fiber Extension of
the three groups

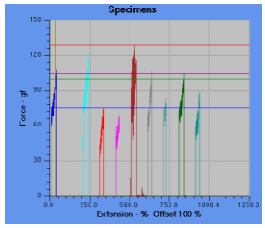

Figure (14)
Tensile Strength
curves of group (A)

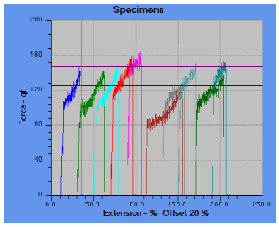

Figure (15)
Tensile Strength
curves of group (B)

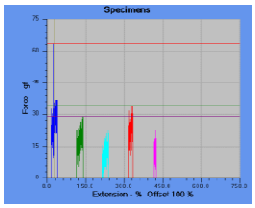

Figure (16)
Tensile Strength
curves of group (C)

Conclusions and Recommendations:

From the results obtained in this work, it can be concluded that Sudanese Nubian goats crossbreeding with Damascus goats have:

- Positive effect on wool fibres characteristics such as fineness, amount of water absorbed from atmosphere.
- Negative effect on wool fibres characteristics such as tensile strength and staple length.

This study recommends that veterinarian has to manage goat cares so as to improve productivity and quality of wool and also recommends that much reaches is needed for this interested field.

References:

1. www.binhaitimes.com/**wool**.html *(retrieved 9 July 2014).*
2. Epstein H.(1971), The Origin of the Domestic Animals of Africa. 2nd edition. Africana Publishing Corporation; New York.
3. Cf.I. L. Mason and J. P. Maule, (1960), *'The Indigenous Livestock of Eastern African and Southern African"*, London.
4. M. Abuelazam Madani,(1996), *'livestock and animal production in Sudan"*, U of K Publishers, Khartoum, Sudan.
5. John E. Booth (1968): *Principles of Textile Testing*, 3rd edition, Butterworths, London.
6. E. R. Trot man, (1984), *'Dyeing and Technology of Textile Fibers", 6th edition*, England.
7. B. P. Saville, (2002),*'Physical Testing of Textiles", 3rd edition*, Textile Institute, Manchester.
8. www.biotechlearn.org.nz/focus_stories/**wool**.../**wool**_fibre_properties. *(retrieved 5 July 2014).*
9. http://www.wraindia.com/Projects%20Sponsored%20by%20Department%20of%20Science%20and%20Technology.htm *(retrieved 9 July 2014).*