Fiber quality of carpet-wool sheep breeds

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Abstract

This experiment was aimed to identify characteristics and comparative advantage of Iranian sheep breed wool. Fiber characteristics of 270 male and female sheep of 1, 2, 3 and 4 years of age belonging to Afshari, Zandi, Mehrabani, Lori and Baluchi sheep breeds were studied. Samples of fiber were taken from the left midside of sheep and analyzed using standard objective measurements for staple length (SL), mean fiber diameter (MFD), coefficient of variation of fiber diameter (FDCV), inner coat fiber ICF, outer coat fiber (OCF), kemp fiber (KF) and clean wool production (CWP). A general linear model was used to analyze the data usin SAS package. The mean (s.e) for SL, MFD, FDCV, ICF, OCF, KF and CWP were 110.8±0.1 mm, 36.9±0.5 µm, 50.2±0.8 %, 84.2±0.6 %, 9.8±0.4 %, 5.9±0.4 % and 69.3±0.7 respectively. MFD of 22% of all wool samples les was between 22 – 30 µm. MFD of a further 36 and 42 percent of wool samples was between 31 – 37 µm and coarser than 37 µm . SL of 12 % of wool samples was shorter than 100 mm and 38 % of samples between 100 – 120 mm and 50 % of samples were longer than 120 mm. There is substantial scope to improve the quality of fiber produced by Iranian sheep breeds through genetic selection.

Keywords: fiber diameter, fiber types, sheet, staple length, wool

Introduction

Sheep population of Iran was 53.8 million heads in 2008 which ranks 5th in the world (FAO, 2010) with 27 well defined breeds. This population of sheep produces annually about 400,000 tones of meat, 820,000 tones of milk, 60,000 tones of wool, 22 million skin pelts and 188,000 tones of guts (Ministry of Agriculture, 2009). More than 1.6 million people are directly involved in sheep breeding with significant role in the economy and livelihood of rural and nomadic societies.

The fleece of sheep grows from specialized follicles in the skin. While primary follicles bear medullated outer coat coarse fiber (hair) and provide mechanical

protection, secondary follicles produce non-medullated inner coat fine fiber or true-wool which provide thermal protection (Nixon, et al. 1991). Carpet wool quality and value is primarily determined by fiber diameter and length which reflect the degree of wool growth and fineness respectively. Presently, little technical data is available on Iranian sheep fiber characteristics. Accordingly, the present work was designed to identify fiber characteristics and development options for future utility.

Materials and methods

A total of 212 sheep (75 males and 137 females) of Afshari, Zandi, Mehrabani, Lori and Baluchi breeds respectively from Zanjan, Qom, Hamedan, Lorestan and South Khorasan provinces were used in this study. The sheep grazed all year but their diets were supplemented during winter with limited amount of forage and grain (containing 15 g N kg^{-1} dry matter and 9.1 MJ) and were housed at night during severe weather conditions. Sheep were grouped into 4 age groups: 1, 2, 3 and 4 years old.

About 10 g of fiber containing hair, kemp (medullated) and true wool (non-medullated) from the left mid-side site was cut from a 5 × 5 cm square close to the skin using regular scissors. Each sample was separately packaged and labeled with ear tag number, age, gender and the breed of the sheep.

To determine the percentage of clean wool weight, net bags containing samples without contaminants were weighed immediately, immersed in three scouring bowls solution containing 0.3% of Na_2CO^3 and 0.1% of soap and water and stirred for 15 minutes at a temperature of 52±3 ^oC. This procedure was repeated once more but only with warm water. Washed samples were oven-dried and weighed and the percentage of clean wool weight was estimated. The mean fiber diameter of the washed wool sample was measured using a projection microscope (Chapman, 1960). The average staple length for each wool sample (in triplicates) was measured to the nearest 0.1 cm.. The number of non-meduallated inner coat fiber, meduallated outer coat hair fiber and medullated kemp fiber was measured (IWTO, 1952). Analysis of variance was performed using a general linear model (GLM) of SAS package (SAS, 1996). Differences between means were tested using Duncan's new multiple range test.

Results and Discussion

For the measured wool characteristics total mean and standard errors are provided for different breeds, genders and ages (Table 1), and different ranges of fiber are shown (Table 2). 22 and 36% of all wool samples had a fiber diameter between 22-30 and 31-37 μm respectively. A further 42% of the wool samples were coarser than 37 μm. All samples were longer than 80 mm but shorter than 147 mm with 12% less than 100 mm, 38% between 100 and 120 mm and 50% longer than

Table 1. Mean (±s.e.) of yield (Y), mean fiber diameter (MFD), coefficient of variation of fiber diameter (FDCV), staple length (SL), non-medullated inner coat fiber (ICF), medullated outer coat fiber (OCF) and medullated kemp fiber (KF)

		No	SL (mm)	MFD (μm)	FDCV (%)	ICF (%)	OCF (%)	KF (%)	Y (%)
Mean			110.8±0.1	36.9±0.5	50.2±0.8	84.2±0.6	9.8±0.4	5.9±0.4	69.3±0.7
			**	NS	**	NS	NS	NS	**
Sex	Male	75	113.7±0.1^{a}	36.2±0.7	47.4±1.3^{a}	86.0±1.0	9.4±0.8	4.8±0.6	72.0±1.0a
	Female	137	116.9±0.2^{b}	37.1±0.6	51.3±0.9^{b}	83.5±0.8	10.0±0.5	6.4±0.5	68.3±0.9b
			*	*	**	**	NS	**	*
Age	1	53	104.7±0.2^{a}	34.2±0.6^{b}	47.2±1.5^{b}	87.3±1.2^{a}	8.9±0.9	3.8±0.6b	73.4±1.1a
	2	59	112.6±0.2^{b}	38.1±0.8^{a}	53.3±1.1^{a}	82.0±1.0^{b}	10.5±0.6	7.1±0.6a	67.0±1.2b
	3	44	113.3±0.2^{b}	36.2±1.0^{ab}	49.2±2.3^{ab}	85.4±1.7^{ab}	8.8±1.0	6.1±1.0a	68.7±1.8b
	4	56	122.1±0.3^{c}	37.9±1.0^{a}	49.3±1.6^{ab}	83.5±1.4^{ab}	10.4±0.9	6.2±0.9a	69.3±1.4b
			*	*	*	*	*	*	*
Breed	Afshari	68	110.7±0.1^{b}	39.5±0.6^{a}	53.6±1.0^{b}	77.1±0.8^{c}	14.0±0.5^{a}	8.7±0.5^{a}	64.4±1.0^{a}
	Zandi	21	120.0±0.2^{c}	30.6±0.7^{b}	43.4±1.3^{c}	93.7±1.9^{a}	6.1±1.9^{b}	0.8±0.3^{b}	63.2±1.6^{b}
	Mehrabani	41	90.1±0.1^{a}	42.1±1.2^{a}	60.7±2.2^{a}	84.8±1.4^{b}	5.5±0.7^{b}	9.5±0.9^{a}	76.5±1.3^{a}
	Lori	31	120.9±0.2^{c}	32.8±0.8^{b}	39.7±1.7^{c}	91.6±1.5^{a}	7.4±1.1^{b}	1.0±0.5^{b}	74.0±1.8^{a}
	Balouchi	51	130.3±0.1^{d}	31.0±0.4^{b}	42.8±1.2^{c}	92.7±0.6^{a}	6.1±0.5^{b}	1.2±0.2^{b}	75.6±1.3^{a}

* and ** significantly different at P<0.01 and P<0.05 respectively

Table 2. Classification of the incidence (%) of sampled wool based on mean fiber diameter (MFD), staple length (SL) and non-medullated inner coat fiber (ICF).

	MFD	%	SL	%	ICF	%
	22-30	22	<100	12	<65	5
All Breeds	31-37	36	100-120	38	65-80	28
	>37	42	>120	50	>80	67
	22-30	5	<100	0	<65	9
Afshari	31-37	36	100-120	60	65-80	48
	>37	59	>120	40	>80	43
	22-30	60	<100	0	<65	5
Zandi	31-37	35	100-120	62	65-80	5
	>37	5	>120	38	>80	90
	22-30	3	<100	85	<65	5
Mehrabani	31-37	24	100-120	15	65-80	15
	>37	73	>120	0	>80	80
	22-30	35	<100	0	<65	0
Lori	31-37	52	100-120	10	65-80	13
	>37	13	>120	90	>80	87
	22-30	43	<100	0	<65	0
Baluchi	31-37	55	100-120	4	65-80	4
	>37	2	>120	96	>80	96

120 mm. 67% of all samples had a percentage of inner coat fiber greater than 80 while 28 and 5% of wool samples had a non-meduallated inner coat fiber percentage of 65-80 and less than 65 respectively.

Percentage of wool fiber types

The 9.8 % medullated OCF in the present study is similar to that reported for Arabi (10.9 %) (Ashmawi and El-Azzawy, 1980) lower than those in the Awassi sheep in Jordan and Iraq (12%) (Tabbaa *et al*. ,2001, Al-Azzawi, 1977) and higher than those in the Ossimi (5.3%) and Rahmani (2.3%) sheep (Maria *et al*., 1992). There was no significant difference in inner coat fiber percentage between males and females of Iranian breeds of the present study, in agreement with the findings of Jordanian Awassi sheep breed. Tabbaa et al. 2001 reported 11 and 10% medullated inner coat fiber for male and female Awassi lambs respectively. One year old sheep had highest percentage of inner ICF percentage and decreased with age. Tabbaa *et al*. (2001) and Seoudy *et al*. (1973) also reported that the percentage of inner coat decreased with advancing age in Awassi and Barki sheep breeds. One year old sheep

had the lower percentage of kemp fiber than older sheep, a finding in agreement with Awassi sheep (Tabbaa *et al*., 2001).

Large variation in the percentage of ICF (58.9-98.6) and undesirable KF (0-33.6) demonstate the possibility for improving Iranian sheep fleece quality by selection. Farmers need to be trained on selection criteria for breeding rams based on subjective wool assessment to avoid keeping breeding males with high kemp percentage.

Mean fiber diameter and staple length

Zandi and Balouchi breed had the finest and longest wool while Mehrabani sheep had the coarsest and shortest with 73% of wool samples coarser than 37 µm. While Baluchi and Zandi wool is used in making fine carpets, Mehrabani wool is used in very rough and bulky appearance carpets indicating the need for breeding programs to decrease the fiber diameter and increase the staple length.

Results indicated that overall fiber diameter was 36.9 µm which is comparable to Middle Eastern carpet wool sheep breeds, 36.0 µm for Awassi (Tabbaa *et al.,* 2001), 31.0 µm for Barki (Seoudy *et al*., 1973), 35.4 µm for Ossimi and 31.5 µm for Rahmani (Maria *et al*., 1992). A significant effect of age on fiber diameter is in agreement with younger animals (Sidwell *et al*., 1971) and the Barki and Merino breed crosses in Egypt (Seoudy *et al*., 1973). The impact of age could be associated with larger body size and reduced skin follicle density and competition for nutrients and therefore fiber diameter of older sheep increases. In contrast with the present study, increasing age had no significant effect on fiber diameter in Awassi and Arabi sheep (Tabbaa *et al*., 2001, Al-Azzawi, 1977, Ashmawi and El-Azzawy, 1980) possibly because the animals were younger.

The staple length of 110.8±0.1 mm of Iranian sheep breeds of the present study is lower than that of Awassi sheep in Jordan 140.0 mm (Tabbaa *et al*., 2001) but higher than Arabi (Ashmawi and El-Azzawy, 1980) Ossimi and Rahmani sheep (Maria *et al*. 1992). A significant effect of age and sex on staple length is in agreement with Tabbaa *et al*. (2001), Sidwell *et al*. (1971) and Azzawi (1977).

Fiber shedding

It was observed that Afshari sheep was the only breed that had fiber shedding. Shedding is also common in double-coated British sheep breeds such as primitive Wiltshire and Soay sheep (Slee, 1963) and feral sheep such as Merino breed in Arapawa Island (Orwin and Whitaker, 1984) however the level of shedding which causes complete wool casting in latter breeds is much higher.

Conclusion

It is apparent that there are differences between Iranian sheep breeds in the way

the fibers they produce which contributes to different fleece characteristics such as fiber diameter, staple length and the level of medullation. Hand made carpet weavers and manufacturers prefer finer wool with lower fiber diameter and medullation for making highly notted/mm^2 and softer carpets. Significant difference is found between sheep in wool characteristics indicating the potential to improve wool quality and the need for adopting proper management and selection methods.

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