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Study on the Thick Tip of Lamb's Wool of Superfine Merino Sheep

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Abstract Superfine wool of Merino sheep has many distinct characteristics, especially its higher fineness. Generally, its mean diameter is about 16.5 μm and it is a good material for fine worsted fabrics. However, the region near the tip of a primary fiber has a coarser fiber diameter, with a value of 35–66 μm. The length of such a segment is usually up to 16–22 mm. The secondary fiber also has a small swelling segment near the tip, but the length of this segment is very short and difficult to determine. The existence of such fibers with thick tips would greatly decrease the final product quality. However, the fiber diameter of the wool becomes even and unchangeable along the fiber when a lamb is 4 months old. Therefore, we suggest that lamb's wool should be sheared for other uses on lambs over 4 months of age.

Key words Merino sheep, lamb's wool, thick tip

In the last hundred years, the development of sheep with fine wool has made great progress. In particular, the production of superfine sheep wool has increased continuously [1]. The products made from superfine wool possess superexcellent handle and they are increasingly preferred by consumers. The handle of superfine wool is determined largely by the average diameter. However, the fiber diameter changes throughout the growth period of the superfine wool [2,3]. Therefore, many researchers have investigated this problem. Brad et al. [4] examined the association between fiber diameter variability and greasy wool staple characteristics within Peppin Merino lambs. They found that both the standard deviation of the diameter and the coefficient of variation of the diameter were significantly and positively associated with the traits such as handle, crimp definition, and so on. Francis et al. [5] investigated the wool quality characteristics of purebred Merino and Merino crossbred lambs from three to 12 months of age, providing information relevant to the choice of shearing date. However, during our research work into the breeding of superfine Merino sheep, we found that there is a thick tip on the lamb's wool, which not only makes the woolen goods rough to handle but also increases the itching sensation of the skin. In addition, the thick tips are difficult to dye, greatly decreasing the product quality. So far, however, little about this problem has been reported, so we have made a preliminary study into the problem.

Experimental Materials and Test Instruments

Experimental materials were provided by Huafeng Fute Special Animals Breed Center, Huanghua City, Hebei province in China. Testing samples were collected from the shearing wool in May 2005 of 963 Merino sheep born in

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Table 1 Test results of the fiber diameters from yearling Merino sheep.

Item	Unit	Secondary fiber		Primary fiber	
		Mean	Standard deviation	Mean	Standard deviation
Length of fiber	mm	97.3	3.19	109.9	1.18
Diameter of whole fiber except tip	μm	14.57	1.17	17.89	1.18
Diameter of tip	μm	5.19	0.35	5.16	0.21
Diameter 0.25 mm from tip	μm	14.16	0.70	8.27	0.11
Diameter 1.00 mm from tip	μm	15.92	0.24	11.57	0.34
Coarsest diameter of fiber	μm	32.19	4.07	51.34	6.39
Distance from tip to coarsest diameter	mm	2.08	0.16	13.18	1.23
Length of coarse region	mm	0.49	0.03	18.97	1.22

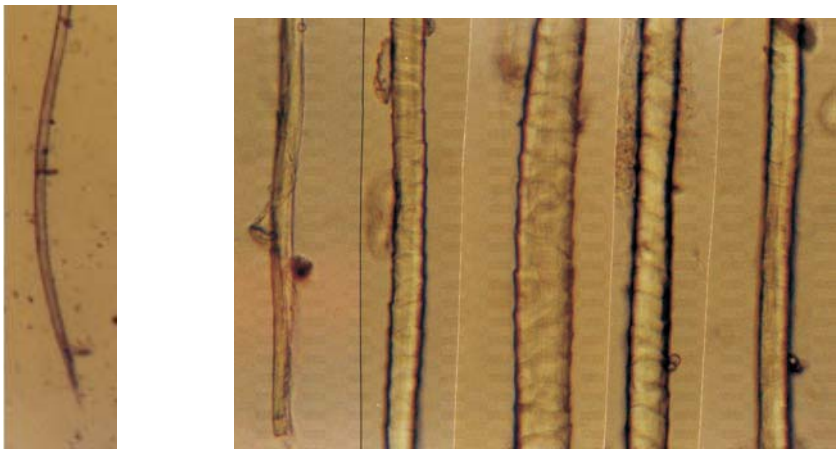
January to February 2004 and the shearing wool in May 2006 of 302 Merino sheep born in January to March 2005. The sampling areas were focused on the back and sides of the body. An optical microscope (with photo-snapping and projection accessories) and an OFDA-100 fiber diameter analyzer were used to observe the shape of a fiber and measure the fiber diameter.

Results and Discussion

Fiber Diameter Distribution of Typical Wools

By analyzing the wool fleece, we found that there are two types of fibers in the wool fleece of yearling sheep born in January to March. One is primary fiber (grown from primary follicles), the other is secondary fiber (grown from secondary follicles). The fiber diameter of the secondary fibers changes little from tip to root and there is a small swelling segment near the tip. However, primary fibers tend to have greater fiber diameter variability than secondary fibers. Furthermore, the fiber diameter near the tip of a primary fiber is significantly thicker than those of other parts of the fiber.

In order to make a further investigation, typical primary and secondary fibers with approximately the same mean fiber diameter were selected from 29 sheep. After they were carefully washed by ether, 90% alcohol, water, and dried, they were continuously measured from tip to root. Table 1 shows the test results. Note that, with no large difference between the mean fiber diameter of the primary and secondary fibers, the mean fiber diameter for the coarsest of the primary fibers is much larger than that of the secondary fibers. In addition, it can also be seen from Table 1 that the length of the coarse segment of the primary fibers, which on average is 18.97 mm, is significantly longer than that of the secondary fibers, which is on average 0.49 mm. Such a fact can also be verified by the micrographs of the tip and mid-side region of the primary and secondary fibers, as shown in Figures 1 and 2. Figure 3 shows the relationships between the fiber diameter of the



Tip region Coarsest to normal region

Figure 1 The micrographs of the primary fiber (1000×).

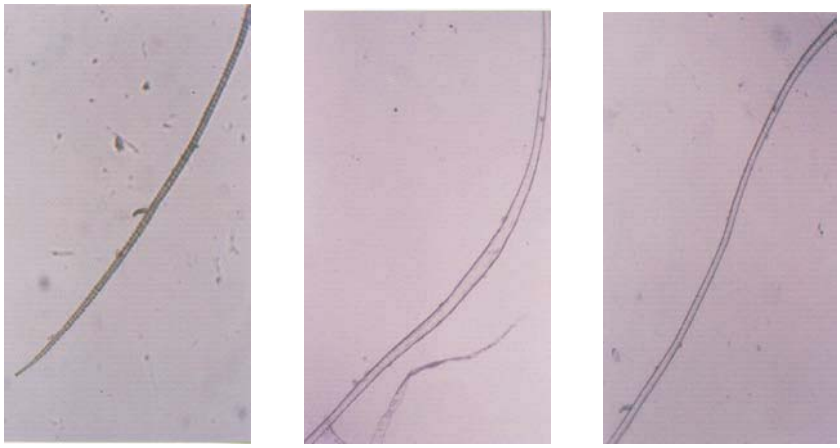


Figure 2 The micrographs of the secondary fiber (1000×).

primary and secondary fibers and the distance from the tip, which also verify the findings mentioned above.

Fiber Diameter Distribution of a Flock

Fleece samples were collected from 963 yearling Merino sheep born in 2004 and 302 yearling Merino Sheep born in 2005. The sample areas were focused on the back and sides of the Merino sheep. The primary fibers were pulled out, washed, and dried according to the methods mentioned above. Then a further investigation into the fiber diameter distribution of the primary fibers was made. Table 2 shows the test results. It can be seen that, for the flock of 963 yearling Merino sheep, the mean fiber diameter at the coarsest region is up to 53.54 m, while that the middle to root is only 16.35 m. The mean fiber diameter at the coarsest region is much thicker than other regions. From Table 2, it is also clear that, for another flock of 302 yearling Merino sheep, the primary fibers exhibit the same characteristics.

However, we also found that, when we sheared the lamb's wool from lambs older than 4 months, the fiber diameter of the newly growing wool basically remains even and unchangeable along the fiber.

Table 2 Fiber diameter distribution of the primary fibers from two flocks.

Year of growth		2004/2005	2005/2006
Number of yearling Merino sheep		963	302
Coarsest region	Mean (μm)	53.54	52.79
	Standard deviation (μm)	6.31	5.98
Middle to root	Mean (μm)	16.35	16.41
	Standard deviationm (μm)	3.21	3.08

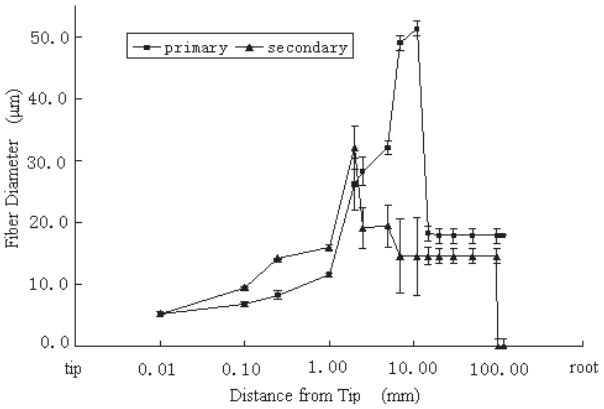


Figure 3 Relationships between fiber diameter of the primary and secondary fibers, and the distance from the tip.

Conclusions

The primary fiber of Merino sheep born in January to March has a very thick tip at the early stages. The diameter near the tip of a primary fiber is 35–66 μm and the length of such a coarse segment is usually up to 16–22 mm. The secondary fiber also has a small swelling segment near the tip, but it is shorter and difficult to determine. However, when we sheared the lamb's wool from lambs older than 4 months, we found that the fiber diameter of the newly growing wool becomes even and unchangeable along the fiber. Therefore, we suggest that the lamb's wool should be sheared for other uses from lambs over about 4 months of age.

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