American Journal of Materials Engineering and Technology, 2014, Vol. 2, No. 2, 11-13
Available online at http://pubs.sciepub.com/materials/2/2/2

DOI:10.12691/materials-2-2-2

Physical Properties of Angora Rabbit Fibers

Gamze Süpüren Mengüç[1], Nilgün Özdil[2], Gonca Özçelik Kayseri[1,*]

[1]Emel Akın Vocational High School, Ege University, İzmir, Turkey
[2]Department of Textile Engineering, Ege University, İzmir, Turkey
*Corresponding author: gonca.ozcelik@ege.edu.tr

Received May 23, 2014; Revised May 27, 2014; Accepted May 27, 2014

Abstract Angora is a keratinous textile material, produced by the long-haired Angora rabbit. The combination of lightness and high thermal properties of angora fibers makes them exceptional and it is categorized as luxury fiber. In this review article, physical features of this exclusive fiber were given and recent studies on the characteristics of angora fiber were summarized.

Keywords: *Angora, Angora rabbit fiber, physical properties, microscopic view*

Cite This Article: Gamze Süpüren Mengüç, Nilgün Özdil, and Gonca Özçelik Kayseri, "Physical Properties of Angora Rabbit Fibers." *American Journal of Materials Engineering and Technology*, vol. 2, no. 2 (2014): 11-13. doi: 10.12691/materials-2-2-2.

1. Introduction

Luxury fibers incorporate exclusive properties to the fabrics, which make them higher value added products. Even the small quantities of these fibers improve the fabric properties in different ways according to the consumer expectations. On the other hand, these fibers are expensive and often blended with other fibers [1]. Angora rabbit fiber is one of the finest specialty animal fibers with its well-known reputation for fineness, lightness and softness and it can be classified as luxury fiber [2].

Angora rabbit fiber has a good potential for producing textiles with special properties. It is extremely fine, soft, antistatic, lustrous and durable, while giving high insulation and a warmer feeling to the garments due to medulla structure in the core of the fiber [3,4,5].

Today angora fiber is principally produced in China but small quantities are also farmed in South America, Korea and Europe. Fashion trends have big effects on the demand for angora and therefore this cause variation in world prices. Demand has increased over the past decade and angora has always commanded high prices as a specialty animal fiber [6,7].

2. Physical Properties of Angora Rabbit Fiber

Angora fibers have medullated and hollow structure, which gives them loft and a characteristic "floating" feel. They are exceptionally soft and possess the high heat retention and best moisture-wicking properties of any natural fiber [8]. The hairs are all medullated (hollow) which decreases their weight by nearly 20% when compared to wool and also increases their insulating properties [5].

The longitudinal [5] and cross sectional views of angora fibers are given in Figure 1 [9].

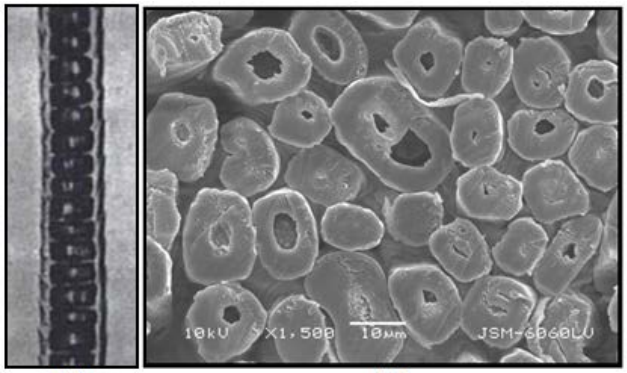

Figure 1. Longitudinal (a) [5] and cross-sectional (b) [9] view of the Angora rabbit fibers

As can be seen in Figure 1 (a), the characteristic of the longitudinal view of Angora rabbit fiber is uni-serial ladder type medullated structure [5]. Their cross-sectional shape changes from oval to rectangular [9].

The Angora rabbit produces three kinds of hair such as guide hair, guard hair and down hair. Guide hairs are in 100 to 110 mm long and they guide and cover the growth of the other hairs. Guard hairs are in 80 mm long and have rough points that lock together, lie over the down and seal it off. Down hairs are in 60 mm long and very smooth, with few cuticle scales. The diameter of 14 μm makes down hairs as one of the finest animal fibers used in textiles [5].

The guard hairs are composed of 3 regions: the relatively fine shaft or proximal portion closest to the skin; the distal portion that is much wider, flatter and shield-like in appearance; which then tapers down to a very fine point. The guard hairs vary considerably in thickness and length but are generally longer than the fur fibers and thus project above the undercoat. The lower portion of guard hairs, fur

fibers, and part of the guard hair tip contain a single medulla composed of a longitudinal series of cavities. Where the guard hairs coarsen and become shield-like, multiple series of cavities (2 to 6) make up the medulla. Only some of the very fine fur fibers (<8 μm) and the tips of the guard hair are solid protein. This medulla arrangement is very characteristic of rabbit fibers [10].

The tenacity of fiber is around 14 cN/tex and the breaking extension is 40% [11]. Pure angora fibers are rarely woven into fabric because the fibers are so fine and fragile [8]. For this reason angora fibers are usually blended with another fiber such as wool to improve its performance both in processing and fabric wearability. French Angora products usually contain 20% wool, however; to gain the properties of Angora in the finished product no more than 30% Angora fiber is required in the fabric. Angora can be successfully blended with a range of natural and synthetic fiber to maintain the desired fabric characteristics of pure Angora fabrics [12].

Angora fiber has a low density of about 1.15 g/cm^3 to 1.18 g/cm^3 compared to 1.33 g/cm^3 for wool and 1.50 g/cm^3 for cotton. This gives the Angora garments a feeling of being very light but warm [12].

The moisture regain of angora rabbit hair fibers ranges from 12.6 to 13.3% at the standard atmospheric condition of 21ºC and 65% relative humidity [11].

The Angora rabbit produces hairs of several colors however the strain bred for textile fibers is an albino strain that produces white fibers only. Coloured Angora rabbits are bred in India and their hair is used to produce artisanal fabrics [5].

Important physical properties of Angora rabbit fibers are surface morphology, diameter, length, strength, color and etc. These properties play an important role in fiber identification and quality control. In literature, studies related to the physical properties of angora fibers are very limited. Some of them are being summarized below.

Broeck et al., investigated the micro architecture of the cover hairs, wool hairs and tactile (sinus) hairs of feral, New Zealand White and Angora rabbits by means of scanning electron microscopy. The morphology and variability of the cuticular scale patterns, hair cortex, medullary arrangement and profile of the hairs were described, illustrated and compared with findings resulting from conventional light microscopy, cuticular casting and medullary impregnation [13].

Supuren et al., investigated the surface properties of wool and various luxurious fibers by using Scanning Electron Microscopy. The diameters, scale patterns and scale heights of the fibers were measured and the results were compared. The diameter distribution was found between 9,13 μm and 24,20 μm that shows the fineness of the fibers. Medullated structure of the fibers improves the insulation characteristic and decreases the weight of the Angora rabbit fiber. Angora fibers have the thinnest cuticle scales, with the height of 0,42 μm and the scale frequency is the lowest among the other animal fibers, that naturally creates a smooth surface and low surface friction for these fibers [9].

Onal et al. evaluated the angora fiber shape and morphology in comparison with cashmere and wool fiber as well as the relation between characteristics of angora fiber. Unlike other keratinous textile fibers, single angora fiber composes of two sections named as body and head, each of which has individual surface characteristics. Differences between the scale shapes, scale length and scale frequency of angora hair types were explained in details. Medullation in angora fiber was explained for different types of angora hairs defined as down, awn and bristle. This classification was done according to the fiber fineness starting from the finer one. Relation between fiber shape and comfort factor was also analyzed. The relation between mean fiber diameter (MFD), fiber curvature (FC) and percentage of medullation by volume (MEDV) for Angora rabbit fiber was not as strong as wool and cashmere fiber. Accordingly, when angora hair types were analyzed individually, it was observed that relation between FC and MEDV for angora fiber was stronger than wool and cashmere fiber. Multiple regression analysis was also performed. Diameter distribution along the snippet length (about 200 μm) of angora fiber is uneven compared to cashmere fiber and wool [2].

Herrmann et al., conducted a study to quantify various parameters of angora fiber quality including fiber and medulla diameter and the proportion of medullated fibers in samples of angora wool obtained from Germany, France and China. The mean fiber diameter of the French Angora fleeces (19.8 microns) is significantly higher than the German fleeces (12.8 microns) which are related to the higher proportion of coarser hairs in the pelage of French Angora rabbits [14].

Rafat et al., conducted a study to describe the characteristics of angora rabbit fiber using optical fiber diameter analyzer (OFDA). A total of 349 fleece samples were collected from 60 French Angora rabbits. Recorded measurements of OFDA were as follows: mean fiber diameter, CV of fiber diameter, comfort factor, spinning fineness, mean fiber curvature, standard deviation of fiber curvature, mean opacity of fibers, percentage of medullated fibers, mean fiber diameter along the length, and standard deviation of fiber diameter along the length. Comfort factor is the percentage of fibers less than or equal to 30 microns. Correlations among total fleece weight, compression, and OFDA measurements were calculated. Mean fiber diameter was lower than the fiber diameter along the length. Mean percentage of medullated fibers was very low and ranged from 0.1% to 7.3%. The mean comfort factor was 97.5% and ranged from 93.3 to 99.8%. The mean fiber curvature was 40.1 degrees/mm. The major changes in angora fleece characteristics from 8 to 105 week of age were an increase in fiber diameter, CV of fiber diameter, mean fiber diameter along the length and curvature, and a decrease in compression and comfort factor. The effect of harvest season was significant on some fiber characteristics. Mean fiber diameter and the mean fiber diameter along the length had a positive correlation with total fleece weight [15].

Ölmez and Dellal, searched some physical characteristics such as fiber length, fiber diameter, ratio of kempy fiber breaking strength and elongation of German originated 40 angora rabbit fibers. It was revealed that the mean single nutare fiber length (length with crimps) is 6.49 cm, the mean single true fiber length is 8.99 cm, fiber diameter is 16.64 microns, ratio of kempy fiber is 2.23 %, fiber breaking strength 12.27 g and breaking elongation is 56.88 % [16].

Rogers et al., compared the fiber characteristics and fiber production between genetically furred and furless

rabbits and among classes of furless rabbits. Furless rabbits were 9% heavier and produced approximately 90% less fiber per unit area of skin than furred rabbits (1.74 vs. 15.83 mg/cm^2, $p<0.01$). The fibers from furless rabbits were shorter (1.54 vs. 2.56 cm, $p<0.01$) and coarser (15.8 vs. 14.5 µm diameter, $p<0.01$) than those from furred rabbits and exhibited greater prickle factor (11.3 vs. 3.5%, $p<0.01$) and curvature values (47.5 vs. 38.5 deg/mm, $p<0.01$) [10].

Supuren, investigated the properties of the fabrics produced from 100% animal fibers including wool, cashmere, alpaca, silk, angora rabbit fiber and angora goat fiber. According to the subjective handle evaluation results, it was observed that fabrics including 100% cashmere and 100% Angora rabbit fiber are the softest among the others. Besides, 100% angora, 100% silk and 100% cashmere fabrics have the smoothest and the least prickly surfaces [17].

3. Conclusions

Angora rabbits produce high quality fibers throughout their lives. They are bred for their long, soft fibers which incorporate unique properties to the garments. The clothes including angora fibers are warmer and lighter than most of other animal products, which is due to the hollow structure of the fiber.

Although the popularity and added value of the angora products increase, there is still limited number of studies about these fibers in the literature. Most of the existing studies are based on fiber properties including diameter and length distribution. For further researches, comprehensive studies related to the properties of the yarns and fabrics produced from this fiber and its blends should be investigated.

References

[1] Langley K., Kennedy T., "The Identification of Specialty Fibers", Textile Research Journal, 51(11), 703-709, 1981.

[2] Onal L., Korkmaz M., Tutak M., "Relations between the characteristics of Angora rabbit fibre", Fibers and Polymers, 8(2), 198-204, 2007.

[3] Schlink, A. C., Liu, S. M., "Angora Rabbits–A Potential New Industry for Australia", RIRDC Publication No. 03/014, RIRDC Project No. CSA-19A, 2003.

[4] Oglakcioglu, N., Celik, P., Bedez Ute, T, Marmarali, A., Kadoglu, H., "Thermal Comfort Properties of Angora Rabbit/Cotton Fiber Blended Knitted Fabrics", Textile Research Journal, 79(10), 888–894, 2009.

[5] Franck, R.R., "Silk, Mohair, Cashmere and Other Luxury Fibres", Published by Woodhead Publishing Limited in association with The Textile Institute, 136-137, 2001.

[6] Ossard H., Thébault R.G., Vrillon JL, Allain D., Rochambeau H., "Economic Overview of the French and World Markets for Angora Rabbit Wool", European Fine Fibre Network, Occasional Publication, No. 5, 35-47, 1995.

[7] McGregor, B.A., Slatter, K., Terry, C., Gilbert, K.D., Horton, B.J., Houston, K., Couchman, R.C., "Specialist Fibre Production and Marketing", *Proc. Aust. Soc. Anim. Prod*. 19, 261, 1992.

[8] http://www.arcticqiviut.com/index.php?option=com_content&view=article&id=63.

[9] Supuren G., Özdil N., Lskovsek M., Demsar A., "Surface Properties of Wool and Various Luxury Fibers", *Fiber Society Spring Conference*, Bursa Merinos Atatürk Congress and Culture Center, Turkey, 12-14 May, 2010.

[10] Rogers A. D., Lupton C. J., Lukefahr S. D., "Fiber Production and Properties in Genetically Furred and Furless Rabbits", *Journal of Animal Science*, 84, 2566-2574, 2006.

[11] http://www.fibre2fashion.com/industry-article/47/4694/angora-rabbit-hair-fibres2.asp.

[12] Schlink, A.C., Liu, S.M., Angora Rabbits A Potential New Industry for Australia, A Report for the Rural Industries Research and Development Corporation, CSIRO Livestock Industries, RIRDC Publication No 03/014, RIRDC Project No CSA-19A, 34, 2003.

[13] Broeck W.V., Mortier P., Simoens P, "Scanning electron microscopic study of different hair types in various breeds of rabbits", *Folia Morphol*, 60(1), 33-40, 2001.

[14] Herrmann, S., Wortmann, G., Wortmann, F.J., "Characteristics of Angora Rabbit Fibre 1-The influence of Fiber Origin on Fibre and Medulla Diameter in Angora Wool", World Rabbit Science ,4 (3), 149-153, 1996.

[15] Rafat S. A., Rochambeau H., Brims M., Thébault R. G., Deretz., S., Bonnet M., Allain D., "Characteristics of Angora Rabbit Fiber Using Optical Fiber Diameter Analyzer", *Journal of Animal Science*, 85, pp. 3116-3122, 2007.

[16] Ölmez, F.N., Dellal, G., "Almanya Orijinli Ankara Tavşanlarının Bazı Yün Özelliklerinde Bir Araştırma", *Tavukçuluk Araştırma Dergisi*, 2 (2), 45-47.

[17] Süpüren Mengüç, G., "Bazı Özel Hayvansal Liflerden Elde Edilen İpliklerden Üretilen Kumaşların Özellikleri Üzerine Bir Araştırma", *Ege Üniversitesi Fen Bilimleri Enstitüsü, Doktora Tezi*, Bornova- İzmir, 2012.