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USAGE OF HORSE HAIR AS A TEXTILE FIBER AND EVALUATION OF COLOR PROPERTIES

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Abstract: *The usage of horse hair as a textile material can be traced to the old ages. Although many animal hair fibers have lost their importance due to the introduction of synthetic fibers into our lives, special fibers such as horsehair have been able to survive in some unique applications. Horse hair fiber exhibits durability, stiffness, antibacterial, antifungal antiallergic and thermal comfort properties. Horse hair fibers have been used in a wide range of products from surgical sutures to brushes, musical instruments, upholstery fabrics and accessories. It is a promising animal hair fiber especially for technical textiles and special designed products thanks to its prominent textile propertie. The recent studies which are about to usage of horse hair fibers for car seat covers and reinforcement materials for composites prove this claim. Since the application areas of the fibers are mostly visible surfaces, the color of the hair becomes an important parameter. Therefore, the color properties of two different horse hair types (as tail and mane) from two different Arabian horses were examined in this study. Moreover, the structure, properties and the usage areas of horsehair fibers were reviewed in detail and future uses of the horse hair fibers were also discussed.*

Key words: *horse hair, anti-allergic, thermal comfort, durable, textile, fiber*

1. INTRODUCTION

The usage of animal fibers in the textile industry does not have a large market in general fiber consumption. Wool is the first fiber kind that comes to mind when it is called the most commonly used animal protein fiber. Silk fibers follow the wool fibers. Special fur fibers such as angora, cashmere and camelhair also have a limited area within animal fiber category [1]. Protein fibers, including wool and silk, generally address a specific and niche market.

The usage of horse hair as a textile material can be traced to the old ages. Before the synthetic fibers have entered into our lives, the main sources of textile materials were the only natural fiber sources. Cotton, linen, wool and silk fibers are the oldest fiber sources in the textile history. In the past, horse hair fibers were the type of fiber that was used extensively in different times and in different regions of the world, especially when animal husbandry was important. The fibers obtained from horses' tails and manes were used for production of many different products such as a special usage of single fiber, woven or felt surfaces. Horse hair fibers have been used in a wide range of products from surgical sutures to brushes, musical instruments, upholstery fabrics and accessories owing to its durable, anti-allergic and stiff character [2-5].

In this study, the structure, properties and the usage areas of horse hair fibers were evaluated in special textile fibers category and these characteristics were reviewed in detail from the past to the recent times. In addition, the color properties of two different horse hair types (as tail and mane) from two different Arabian horses supplied from Karacabey-Bursa, which is the one of the most

important horse breeding region in Turkey, were examined. Morever, the future usage areas of horsehair fibers in textile industry were also discussed.

2. HORSE HAIR FIBER

2.1 Basics of horse hair fibers

Horse is an herbivorous mammal, including the *Equidae* family. Horses, whose life spans are around 20-30 years, are among the most talented animals that have served people throughout history [6]. Horses are domesticated animals, although there are also wild species. These animals, which are presumed to have served people for 5500 years, have different races such as Arabian horse, Morgan horse, and pony, etc. Horse hair is obtained from the tail or mane of the horse. The presence of horsehair sutures and fabrics woven from horsehair fibers in archaeological studies shows that the use of horsehair fibers is quite old [2, 7]. Although many animal hair fibers have lost their importance with the introduction of synthetic fibers into our lives, special fibers such as horsehair have been able to survive in some unique applications. In the recent years, with the spread of the concept of sustainability, natural fibers have become more preferable again and new areas of use have been created for many special textile fibers such as horsehair. Nowadays, the main exporters of horsehair fibers, which mostly appeal to a niche textile market, are Argentina, Canada, Mongolia, China and Australia [6, 8].

2.2. Horse hair fiber structure

Even though horse hair fibers can be obtained from the tail or mane of the horse, tail hair is more commonly used for textile applications because the tail hairs are lush and longer. The length of the horse tail fibers can be around 60-80 cm and the fineness are generally between 80-400 micron whereas the length and the fineness of the horse mane fibers 25-45 cm and 50-200 micron, respectively [6]. The average diameter of the horse hair fibers varies between 75 and 280 microns. Horsehair fibers can be in many different colors such as brown, red, white, grey, black. The tail and the mane of the horse may be different from the horse's own color, and the tail or mane may also contain a different color of hair. Horse hair structure is exhibited in Fig. 1.

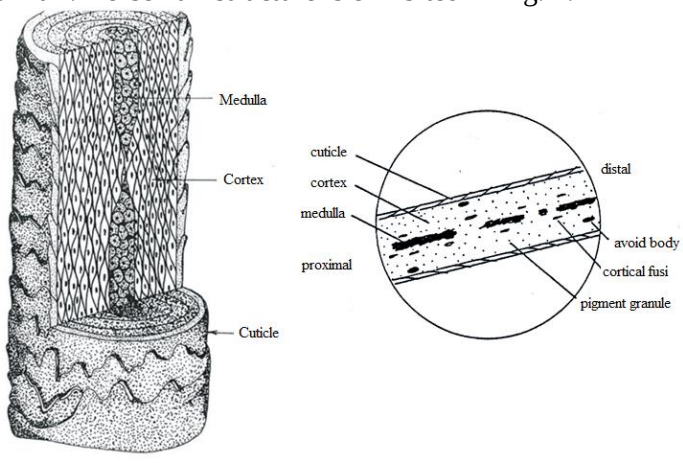

Fig. 1: *Horse hair fiber structure [9, 10]*

2.3 Horse hair fiber properties

Horse hair fibers are mostly stiff, flexible and smooth fibers. They are also well ventilated and washable fibers and resistant to wear [6, 8]. Horse hair fibers and cotton fibers can be blended for some specific lining and tailoring textile applications [11]. The good ventilation of horsehair

fibers promotes the use of these fibers as a filling fiber. In addition, the stiffness of the fibers allows the use of lining and interlining for tailored garments and millinery. The texture of the horse hair can be differed by the breed, diet and climate [3, 6]. Horse hair fibers provides good air circulation thanks to its special fiber structure when it is especially used as a filling material [6]. Therefore, they have become a popular filling material for mattress filling. Horse hair fibers provide transferring of heat and moisture dissipated from the human body during sleep due to its long and very open core (medulla) fiber structure [8]. Horse hair fibers can be dyed/colored easily by using conventional dyes suitable for protein fibers in spite of absorbing water slowly. Although it is not easy, horse hair fibers also can be felted [8].

2.4 End-uses of horse hair fibers

Horse hair fibers can be used in many different areas thanks to their advantageous fiber properties. Main usage types of horse hair fiber are summurized in Table 1. In addition to these general uses, they were used for wall coverings and winter clothes thanks to its good insulation property. It is possible to find horse hair fibers inside lime plasters in the historical buildings [12]. Horse hair fiber is a kind of fiber which has the potential to be used in many different industries and, especially in technical textiles field thanks to its strength, durability and thermal comfort properties. Nowadays, the recent studies which are about to usage of horse hair fibers for car seat covers and reinforcement materials for composites prove this claim [6, 8, 13-15].

Table 1: *The End-use applications of horse hair fibers[3-8]*

Fiber Properties	→	**Usage**	**Fiber Properties**	→	**Usage**
Antibacterial Anti-fungal	→	Sutures	Stiffness Durability	→	Industrial and domestic brushes
Durability Lustre	→	Woven fabric	Stiffness Durability	→	Crinoline
Good air circulation Moisture transfer effect Thermal comfort Antibacterial Anti-fungal Anti-mite	→	Filling material for mattress, sofas, etc.	Durability Lustre	→	Handbags, cases and bags
Stiffness Durability	→	Interlining for clothes	Durability Lustre Washability	→	Upholstery and interiors
Stiffness Durability	→	Musical instruments (violin and other stringed instrument bows)	Durability Lustre	→	Accessorizes (bracelets, necklaces, earrings and barrettes)

3. MATERIAL AND METHOD

3.1. Material

The utilized horse hair fibers were supplied from Karacabey-Bursa which is the one of the

most important horse breeding region in Turkey. The utilized hair was from the two pured-bred Arabian horses are shown in Fig.2. Fiber sapmles were taken from manes and tails.

3.2. Method

The horse hair fibers were rinsed with 50 ºC water before evaluation. The color properties of the horse hair fibers were measured by using DataColor SpectraFlash 600 (DataColor SpectraFlash 600, Datacolor International, USA) spectrophotometer (D65 day light, 10° standard observer). The CIE *L**, *a**, *b** and *C** color coordinates [16] were measured and the K/S (color strength) values were calculated for each horse hair sample. Moreover, the reflectance curves were also obtained.

Region **Horse A** **Horse B**

Fig. 2*: Photos of utilized Arabian horses and supplied region map of the horses in Turkey*

4. RESULTS AND DISCUSSIONS

Colorimetric measurements of horse hair fibers were given in Fig. 3 and Table 2. It can be clearly seen from the measurements that tail and mane hairs of both Arabian horses differ from each other (Fig. 3). The colorimetric properties exhibited well fit with the appearance of the mane ant tail fibers of the utilized horses (Figs. 2 and 3). In general, tail fibers are slightly darker than mane fibers for both horses A and B. It is clearly visible from reflectance curves and colorimetric values that Horse B fibers exhibited darker appearance with higher color strength (K/S), higher chroma (*C**) and lower lightness (*L**) levels than Horse A fibers (Fig. 3). Horse A tail fiber is clearly brighter than Horse B tail with higher lightness and higher chroma values. Both horse A fibers exhibited significantly redder appearance with higher *a** values than both horse B fibers (Fig. 3 and Table 2).

Table 2: *CIE-Lab measurements of horse hair fibers*

	*L**	*a**	*b**	*C**	h^o
Horse A-mane	68,3	-0,23	6,16	6,16	92,1
Horse A-tail	67,0	0,93	13,7	13,7	86,1
Horse B-mane	38,2	9,37	16,4	18,9	60,3
Horse B-tail	31,0	6,07	8,70	10,6	55,1

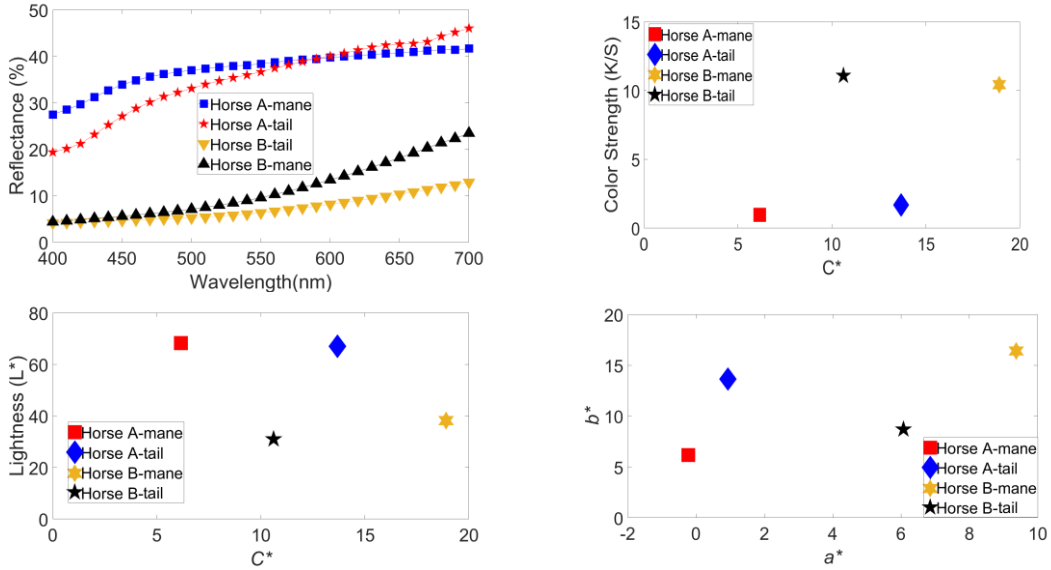

Fig.3: *Colorimetric properties of Arabian horse hair fibers (manes and tails)*

5. CONCLUSIONS

Horse hair fiber is a promising animal hair fiber with its special fiber properties such as durability, stiffness, antibacterial, antifungal anti allergic and thermal comfort. Since the application areas of the fibers are mostly visible surfaces, the color becomes an important parameter. However, the colors of horsehair fibers may vary between the fibers obtained from the tail and mane. The use of fiber reinforced composite materials is increasing day by day. Considering the increasing demand for natural fiber reinforced composite structures, it is thought that horse hair fibers may be among the textile fibers of the future. In this study, color properties of tail and mane samples taken from two different Arabian horses were investigated. As a result, it was observed that the color properties of horse hairs slightly vary between the tail and the mane. Consequently, possible color differences should be considered in cases where the tail and mane fibers were used together.

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