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Wool Of Llama And Alpaca - Unique Textile Material.

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ABSTRACT

This article is devoted to the study of morphometric characteristics of the structure of wool, Alpaca and Llamas for the objective evaluation of its quality. The studies identified and analyzed typical morphological features of wool Alpaca and llama: color, form staples, and tortuosity, ravninnoe; zone of vimutti and contamination, the length that in assessing the quality of raw materials play an important role and determine the productive purpose. Studied the microstructure of the surface of the scaly layer of the studied types of wool that will allow you to develop classification and identification criteria of its evaluation.

Keywords: camelid, Alpaca, llama, wool, morphometric parameters, microstructure fiber

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INTRODUCTION

Domestic light industry and, accordingly, included in its about 30 subsectors, in the globalization era, must develop along the path of production renewal and in the direction of enhancing efficiency of existing plants and the quality of products [12].

Today, the share of light industry, whose main task is to meet the growing needs of all segments of the population, makes around 1.3%, that is low indicator for the branch. The basis of light industry - textile industry has appeared in difficult conditions of competition with foreign enterprises and goods. Insufficient regulation of export regulations, import and re-export of raw materials, semi-finished products and textile products within the Customs Union of the Russian Federation has a negative impact on the economy and the industry is essential. The second main problem is the shortage of domestic raw materials, rising prices and low tariffs on imported and, therefore, cheaper and often low-quality raw materials, low profitability (2-4%) [11,12]. For example, wool production per person is important economic and statistical indicator, that illustrates the level of population maintenance with natural textile fibers [2].

Unfortunately, new high-quality fibers production, insufficient assortment of domestic wool raw materials, lack of modern technological decisions in production isn't mastered that is connected not only with considerable expenses, but also with high competitiveness in the textile materials market [11].

The need to address the problem of increasing efficiency of enterprises, the expansion of product range of raw wool, yarn and manufactured goods determines the particular topic relevance of this paper.

Such species as llama (L.glama), alpaca (L.pacos) and guanacos (L.quanicoe), vicuña (L.vicugna), possessing high consumer properties [10] are well-known and increasingly used in the world wool industry and feathers.

Alpaca and llama wool was highlighted in a search for new natural raw materials for the textile industry; due to this fact fiber has already been processed at a number of British companies in wool industry since 1820 [9].
As white wool is the most popular among manufacturers, when selecting animals, specialists pay attention mainly to the color of the fiber, often ignoring other characteristics.

It should be noted that in the Russian market of sewing and knitted products from llamas, alpacas wool hold a significant share of the segment, due to the increasing needs from consumers to the range and quality of products [12].

MATERIALS AND METHODS

Thus, the comprehensive assessment and systematization of consumer properties of camelids wool family for the development identification criteria is timely and relevant, and the work has scientific novelty and practical importance.

The aim of the work is the study of morphometric characteristics structure of alpaca and llama wool for an objective assessment of its quality.

The objects of the study were:

¬ alpaca uakaya wool samples, different SKUs: baby alpaca and alpaca;
¬ llama wool samples.
Group of llamas (L.glama) and alpaca (L.pacos) belongs to the camelids family (Camelida), detachment camelids (Tylopoda) [8].

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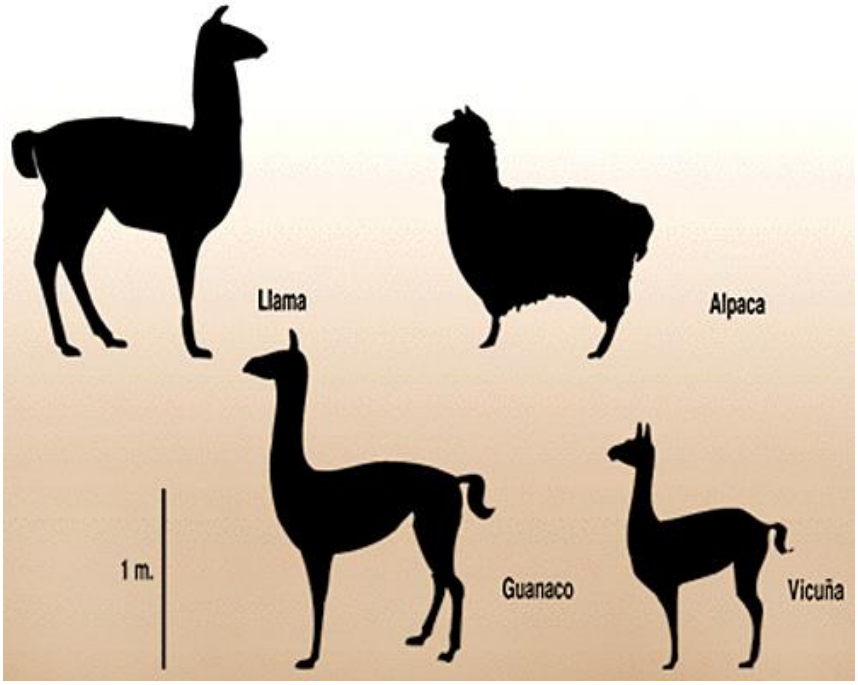

Fig 1: South American camelids family representatives [8]

According to a scientific zoological classification [8] animal llama and alpaca are divided into:

Kingdom: Animals
Type: Chordata
Class: Mammalia
Order: Artiodactyle
Suborder: Tylopoda
Family: Camelids
Genus: South American camelids
View: Alpaca (L.pacos), including 2 breed: Suri (Suri); Huacaya (Uakaya)
View: Lama, breeds: Lama'ara and LamaCh'aku

Fig 2: Alpaca Huacaya (photo by Lubomir Prause)

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Fig 3: Alpaca Suri (photo by Lubomir Prause)

Due to the fact that llamas' domestication process began more around 5,000 years ago, among all species, including the related possible vicuña crossing and it is not uncommon to find animals with mixed signs. In recent years, female alpaca is often crossed with a male vicuna to obtain animal with the finest wool [8].

Fig 4: Llama Q'ara (photo by Lubomir Prause)

Fig 5: Llama Ch'aku (photo by Esepenok K.V.)

RESULTS

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On the first stage of the experiment organoleptic wool samples evaluation was carried out, that includes: staple and crimping shape, equations, washed and pollution zone, color that in the quality assessing of the raw material plays a significant role [3]. The results are presented in table 1.

Table 1: Sensory evaluation wool study n=5

Sample	Fiber categories	Form crimp	Number of crimps	Sensory evaluation
Baby alpaca	*Downy*	Flat	3,30±0,05	Cylindrical staple shape. Staple is closed. Washed area is 1.72 cm, the contamination zone - 1.52 cm Staple is equalized in length and fineness. Wool color is white. Contamination of vegetable origin is presented.
	Intermediate	*Flat*	1,89±0,01	
Alpaca	*Downy*	High	3,31±0,04	Conical staple form. The fiber was less pronounced in length and fineness. Washed area is 1.44 cm, contamination zone - 2.60 cm Coat color is white. Contamination of vegetable origin is presented. The guard unit thin fibers are established.
	Intermediate	High	2,27±0,01	
	Beard	Flat	1,0±0,01	
Llama	*Downy*	Flat	4,2±0,03	Conical staple form. Braids are mainly consisted of down with the presence of guard and transitional fibers. Down has thin, soft, elastic, guard fibers of varying thickness. Contamination of mineral and vegetable origin is presented. Wool color is brown. Fibers are less equalized in length.
	Intermediate	Flat	3,1±0,02	
	Beard	-	-	

During the sensory evaluation it was found that baby alpaca wool has staple structure, well equalized in length and thickness, has white color, consists primarily of fiber powder puff, transition occurs.

With regard to its crimping, it is clearer, flat, the average number of crimps in the fiber fluff on 1cm was 3.30 ± 0.05 units. It should be noted that the down is little convoluted, which is not typical for fluff characterized by high tortuosity (the number of crimps per 1 cm is 8-10) for this category of fiber, according to the literature [3].

A B

Fig 6: Wool type: A - baby alpaca; B – alpaca

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The alpaca wool is identified into three morphological fiber types: feather, transitional and outer coat. The most crimp, as one might expect, had a downy - 3,31 ± 0,04 units per 1 cm, the difference between the average number of crimps and the transition from downy fiber is significant (at p≥0,95).

It is known [3,7] that crimp is wool valuable feature that enhances its resilient properties and has a certain relationship with the thickness of the fibers, respectively, it can be assumed that the elastic-plastic properties are higher in baby alpaca.

According Razumeev K.D. [4], in addition to a rich natural color scheme: alpaca wool is divided into 22 color shades, from pure white, beige, silver and brown to black; it is characterized by high elasticity, softness, beautiful silky shine, that we have also identified during the research.

In turn, the llama wool uniform has plait structure, long, soft, brown color with a single white fiber, presumably - dead hair. The base and mid dreadlocks - brownish-gray, and the tip has auburn tincture, probably due to weathering. Plaints mainly consist of down and transitional fiber, beard hair is thin.

Down has clear, flat crimp, its number per 1 cm is equal to 4,2 ± 0,3pcs., spine is less crimped and transient fiber occupies an intermediate position.

Fig 7: Llama wool sample

It should be noted that llama wool has similar characteristics to the camel by color, braid shape and tactile signs.

In addition, based on the data presented in the literature [4], alpaca wool can also be attributed to the normal camel hair I class.

The penetration depth of the mineral and basic impurities (contamination zone) depends on climate conditions and animal welfare principles, the number of suint in wool, crimp, staple form, etc. The most desirable is dense staple closed cylindrical shape, preventing pollution of the lower zones rune [3].

Due to the fact that non-uniform colored wool area is washed and contamination zone is not defined. Samples data of baby alpaca and alpaca staple are presented in table 2.

Table 2: Staples status, see n=5

Sample	Washed zon			Pollution zone			% of natural length
	$X \pm m_x$, см	±σ	C_v,%	$X \pm m_x$, см	±σ	C_v,%	
Baby alpaca	1,72±0,09	0,19	11,05	1,52±0,09	0,17	11,18	19,90
Alpaca	1,44±0,04	0,08	4,65	2,60±0,07	0,14	5,38	43,48

The studied wool is characterized by low washed area, in average it did not exceed in baby alpaca 1.8 cm and 1.5 cm alpaca, respectively. Low variation coefficient shows low variability of feature and indirectly shows closeness of fibers staple and equations in it [13,14].

The smallest pollution area was detected in baby alpaca wool 19.90% of the total natural length, which is a positive factor as to commodity research and technological point of view. The alpaca pollution zone has a significant percentage - 43.48%, due to the conical shape of the staple, which promotes deep pollution penetration. It should be noted that the results correspond to sensory evaluation data samples.

It is important to note that the considered wool views have different morphological structure, staple form, crimp, and its number.

Commodity and technological properties and assign are predetermined by raw fibers length, so the length wool depends on the breed, sex and animal age, as well as topographic plot [5].

In the spinning process solid fine yarn with less torsion, this increases equipment productivity and reduces it to a minimum fiber amount, is obtained of longer and uniform along the length fibers [7]. These natural fiber lengths data are shown in table 3.

Table 3: The natural wool length of camelids family n=5

Wool type	Fiber length, см	
	$X \pm m_x$	C_v,%
Baby alpaca	7,6±0,5	13,1
Alpaca	5,9±0,4	13,5
Llama	13,4±1,3	19,4

Maximum length is defined from llama wool - 13,4 ± 1,3 cm, that is characteristic of an inhomogeneous wool braids which are formed by long guard fibers, this fact confirms the high coefficient of variation (20%).

Alpaca fiber wool possessed the smallest length -5.9 ± 0, 4 cm, in comparison with baby alpaca, which is probably related to age and seasonal variability of camelids animal family. The difference between the average values is valid when $p \geq 0.95$. Fibers along the length are well aligned, that points the low coefficients of variation [13,14].

The surface scaly layers microstructure of the explored type of raw material was studied by electron microscopy method. Fibers structure is different by multiform and some features have diagnostic value, allowing you to determine whether the sample is studied to different taxonomic unit [1.6].

There are the pictures of the baby alpaca, alpaca and llamas microstructure fiber duvet cuticle in figures 8-10.

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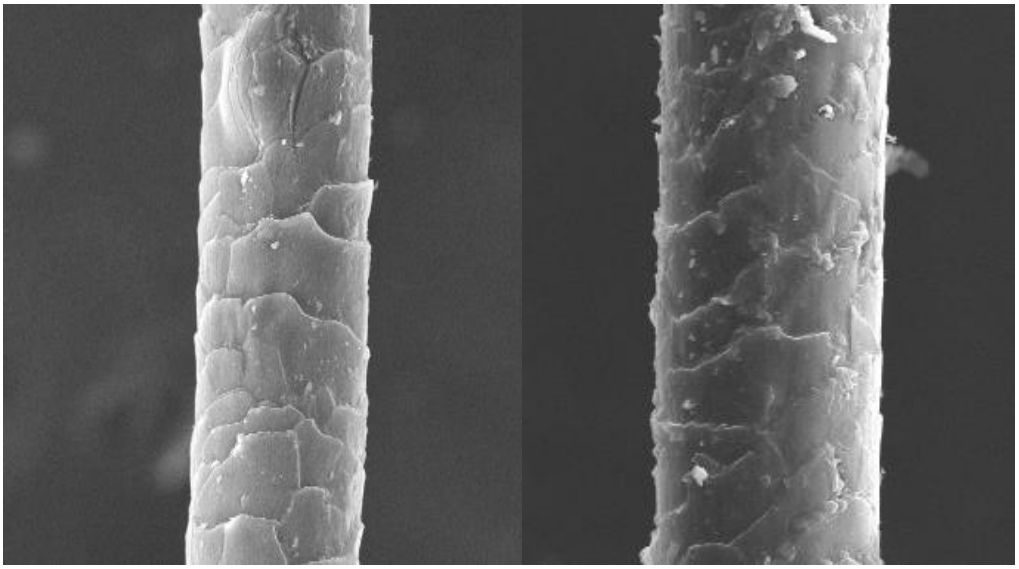
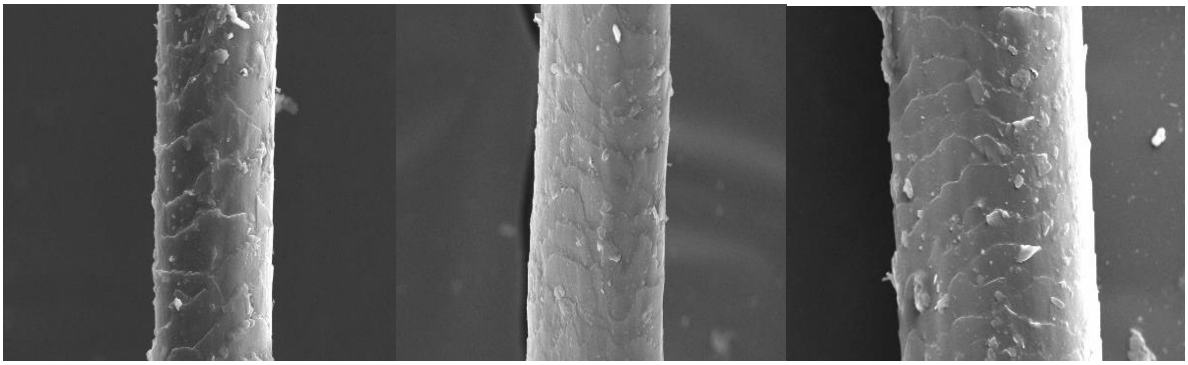


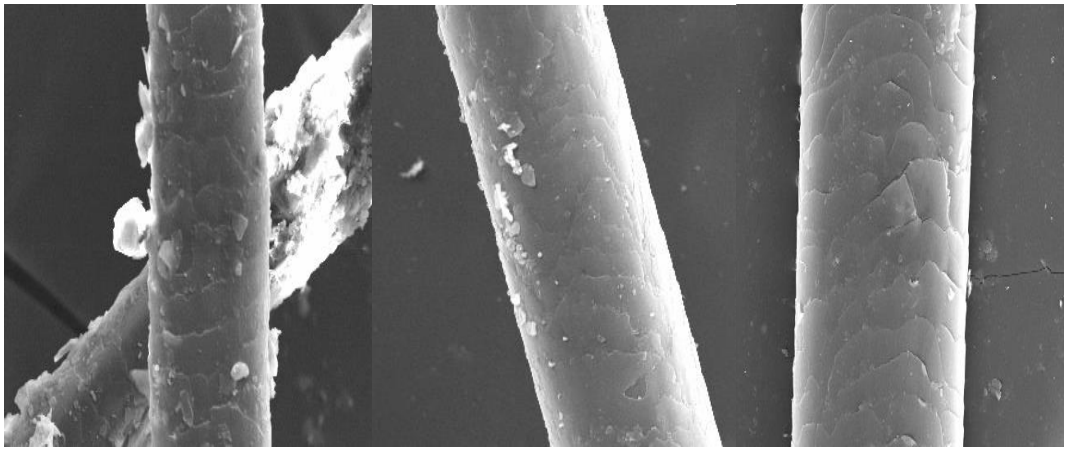
A B

Fig 8: Photo of baby alpaca downy (A) and transition (B) fiber. Increased X1000



A B C

Fig 9: Photo of alpaca downy (A), the transition (B) and guard (C) fiber. Increased X1000



A B C

Fig 10: Photo of llama down (A), the transition (B) and beard (C) fiber. Increased X1000

Downy fiber cuticle has a ring-shaped scales, and the tops of the lower scales cover the top of the base, so that one ring as it is inserted into another, this form is characteristic of sheep and camels downy

fibers. Baby alpaca hair feather, alpaca and llama by type of cuticle structure has a "normal" non-inverted form (i.e. free flakes edge are directed downwards along the rod). The samples scales are adjacent and have tiled form.

The microstructure of the baby alpaca, llama and alpaca transition-fiber is characterized by non ring shaped location scales, which cover the hair shaft in several scales range (from 2 to 5 or more).

The surface scale structure is grainy, implicate, ribbed.

Cuticle figure of llamas and alpaca beard fiber has non ring shaped (reticular) shape - scales are formed on the surface of the irregularly shaped fibers grid like layout scales characteristic of the beard fibers.

In conclusion, it should be noted that the shape, configuration and cuticle pattern of morphological fibers types of viewed camelids family wool are similar. Cuticle structure details are closely related to the main characteristics of wool and correlate that data confirmed in the preliminary microstructure studies.

However, it is necessary to continue a number of studies and architectonic characteristics for objective analysis and comprehensive classification and identification criteria that will predict the technological properties of yarns and fabrics.

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