EXPERIMENTAL ASSESSMENT OF PHYSICAL CHARACTERISTICS
OF TEXTILE PROTEINIC FIBRES
FROM ALBANIAN BREEDS

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ABSTRACT
In addition to fineness, length and crimp are the most important physical properties of textile protein fibres. Longer fibres are easier to process and more yarn can be produced, since there are fewer fibre ends in a given yarn length, along with a higher strength yarn for the same level of twisting. In addition, a yarn of the same strength can be produced with a lower level of twisting, resulting in a softer yarn.

The length of natural fibres, as well as their fineness, is not a constant. There is instead a huge amount of variation, even in samples taken from the same breed of animal, or plant. On the other hand, crimp has a technological importance in several contexts: it determines the capacity of fibres to cohere under light pressure, and so, in turn, determines the (i) cohesiveness of card webs, (ii) the amount of fly liberation during processing and (iii) the hairiness of the resultant yarn.

Albania has a substantial production of textile protein fibres. This paper presents the results of an experimental study on measurement of the length and crimp of the textile fibres from Albanian breeds. The aim of this study is an effort to update the data on textile protein fibres from Albanian breeds. The tests were performed in the Textile Laboratory of Tirana Polytechnic University, accredited to ISO/IEC 17025:2005 for textile materials testing.

Keywords: length, crimp, textile fibre, standard, comb sorter

1. INTRODUCTION
The purpose of this paper is to present updated information on two of the most important technological characteristics (length and crimp) of protein fibres from Albanian animal breeds. After fineness, length is the most important characteristic that determines the spinning potential of textile fibres, i.e. production of good fibres for textile production. Length, and its distribution, are critical properties for natural textile fibres, a group that includes animal protein fibres (Morton 2008). Crimp is defined as the number of bends per unit length. Wool fibre has a naturally high crimp level due to its unique chemical and physical structure. It is known that the fibre crimp persists through processing and exerts an effect on the properties of top, roving, yarn and fabric.

For a relatively long time in Albania, there has been a lack of reliable data on physical characteristics of wool fibres (length, fineness, crimp, etc.). Part of the purpose of this paper is the presentation of such data and their analysis, as well as their determination in using international standards methods (ISO, IWTO etc.) from accredited laboratories in testing raw textile material characteristics.

From the classification point of view wool fibre length is less important as a physical characteristic compared to their finesses. However, technologically, fibre length, together with the number of waves (crimp), constitutes very useful information on the performance of industrial processes to convert raw materials to more complicated textile structures. For instance, the greater the length of individual fibres, the smaller the need for yarn twisting. Thus, the effective length in bearing tensile forces is smaller. Traditionally, length has not been determinative in wool fibre classification.
Nevertheless, length indicators, such as percentage of short fibres, their average length and coefficient of variation of $H$ (hauteur) for the length after combing (Morton 2008), currently have an effect on international market prices of raw materials of animal origin. In the case of wool fibres, there is a correlation between fibre finesses and length: finer fibres are shorter [2]. All of the factors detailed above, especially as regards to fine wool fibres, dictate that in order to have objective results, it is necessary to include length and tensile strength testing of fibre bunches (Simpson 2002).

Wool with higher crimp content produces untwisted assemblies with greater cohesion, and results in a thicker fabric with a softer handle, smoother appearance and lower resistance to airflow, slightly less bending stiffness and better drape, as well as slightly better recovery from extension and from wrinkling. Crimp appears to have no influence on the tensile properties of a fabric, or on its resistance to flex abrasion. Crimp is closely associated with fibre fineness; finer fibres generally have more crimps per unit length (Laurence 2003).

2. METHODOLOGY

There are two main methods used for measuring the length of wool fibres: (i) direct measurement of individual fibres, mainly used for very precise measuring, and in general, for fibres that do not have crimp (e.g. cotton fibres), and (ii) methods that include preparation of fibre bunches, or staple, positioned in parallel with each other.

The direct, simpler, method of measuring individual fibres is done manually. Each end of the fibre is tensed with small claws, and then the fibre itself is measured with a ruler. The tension is measured at the moment all the fibre waves disappear, but not beyond the deformation limits of the fibre itself. In order to ensure uniform tension measurement tension could be applied at the end of the fibre, but this would slow down the measuring [2].

The bunches method is mainly used for routine testing of fibre length, as it is a quicker method than the direct method. All the methods have in common preparation in advance of parallel fibre staples. However, there is always the risk that fibres will break during preparation when they pass from a condition of random orientation to drafting.

In the case of natural fibres, the definition of average length is not as direct as would initially appear, because natural fibres vary, both in length and in diameter. However, if natural fibres have a different diameter, coarser fibres ought to have a greater mass. This should be considered when calculating mean length. There are three methods of calculating fibre mean length: 1) a method based on the number of fibres (unbiased mean length) $L$, 2) one based on fibre cross-section (cross-section biased mean length) $H$ (hauteur), and 3) one based on fibre mass (mass biased mean length) $B$ (barbe) [2].

The calculations below refer to each method separately:

$$L = \frac{l_1 + l_2 + l_3}{3};$$ (1)

$$H = \frac{a_1 \cdot l_1 + a_2 \cdot l_2 + a_3 \cdot l_3}{a_1 + a_2 + a_3},$$ (2)

and

$$B = \frac{w_1 l_1 + w_2 l_2 + w_3 l_3}{w_1 + w_2 + w_3},$$ (3)

where $l_1, l_2 \ldots$ is the length of individual fibres, $a_1, a_2 \ldots$ is the cross-section of individual fibres and $w_1, w_2 \ldots$ is the mass of individual fibres. To obtain length measurements, a comb-sorter apparatus [4] was used.

Fibre crimp has indicators that can be divided into four classes: i) number per unit-length, ii) shape, iii) stiffness, and iv) resistance, while crimp density is the number of waves per unit length (cm), under pre-tension load. The number of waves per unit length is expressed by:

$$n_v = \frac{N}{2L_e} = c = \text{crimp density}$$
3. MATERIALS AND METHODS

To standardise the measurements of the length and crimp characteristics of the wool of Albanian sheep breeds, a representative statistical sampling was carried out covering the country and the different breed distributions.

Samples were taken from the following regions: Kukës (Rude breed), Shkodër (Scutari breed), Tirana (Shëngjergj breed) and (Lara e Polisit breed), Korçë, and Vlorë (local breed). Methods of sampling and selecting test specimens followed international standards [4, 5].

In the sampling of protein fibres from Albanian breeds, the weight of each proportional to the total was taken into account. Despite the fact that the northern Albania breeds (Scutari and Rude) have a lower percentage compared to other breeds, they were included in the experimental study because of their valuable spinning characteristics (Fishta, 1990). In addition, in the process of sampling the distribution of wool production in each region of Albania was taken in account. [7]

The methodology used to obtain fibre lengths included the use of an international standard [4] comb sorter (type YG 131). Testing was undertaken on specimens pre-combed at standard atmospheric conditions [8]. Not only average indicators, but also the coefficient of variation for each indicator were determined, by use of formulas 1, 2 and 3 (see above), for each sample, which was also weighed.

In determining the crimp, an FDM-19 apparatus was used. The method consisted of selecting a wool sample and extracting from it the fibre, which was inserted into a torso balance wing. The fibre was fixed at one, the lower, clamp and waves counted with a magnifier.

4. RESULTS AND DISCUSSION

Figures 1 to 5 present the results of the indicators for Albanian wool samples from each region sampled. In order to have a clear picture, not only are the mean lengths \( L \), \( H \) (hauteur) or \( B \) (barbe) presented but also the distribution of fibre lengths, expressed concisely through the coefficient of variance (CV). Vertical bars represent distribution according to length, while the line curve shows accumulated percentage, an alternative way of presenting length distribution and which facilitates calculation of essential parameters for evaluation of technological potential (effective length) of fibres. For this reason, fibre length distributions are presented alongside the accumulated distributions.

![Fig. 1. Length distribution and accumulated graphic for Kukës region](image-url)
Fig. 2. Length distribution and accumulated graphic for Shkodër region

Fig. 3. Length distribution and accumulated graphic for Tiranë region

Fig. 4. Length distribution and accumulated graphic for Korçë region

Fig. 5. Length distribution and accumulated graphic for Vlorë region

Table 1 reports a summary of the results of average indicators of length and variance coefficients.
The change in these indicators across Albania is shown in Figures 6 and 7. Figure 6 shows indicator \( H \) and the variance coefficient, while Figure 7 shows indicator \( B \) and the variance.

Data on well-known breeds elsewhere in the world show that the length can vary from 375 mm (15 inch) for the quality 36s of the Lincoln breed, up to 137–150 mm (5½–6 inch) for the quality 64s of Merinos, while the fine qualities 80s–90s have a length of 87–112 mm (3½–4½ in.).

Among local breeds, the longest fibre appears to be Scutari (\( H = 75.5 \) mm, \( B = 132.2 \) mm), and the shortest, the Rude breed from Kukës (\( H = 31.1–32.1 \) mm, \( B = 55.2–56.3 \) mm). The Scutari breed not only is the longest but also has the greater variation in length (CV=45.8%). From the local crossbreeds of Korçë and Vlora, and from Tirana as well, the better length indicators are found in the Korçë area (\( B = 112.8 \) mm \( H = 85.7 \) mm), while Tirana has lower indicators (\( B = 56.33 \) mm; \( H = 31.1 \) mm).

### Table 1. Length indicators and variance indicators according to samples

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Sample 1 (Kukës)</th>
<th>Sample 2 (Shkodër)</th>
<th>Sample 3 (Shëngjergj)</th>
<th>Sample 4 (Korçë)</th>
<th>Sample 5 (Vlorë)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( H ) (mm)</td>
<td>32.12</td>
<td>75.5</td>
<td>31.1</td>
<td>85.7</td>
<td>55.8</td>
</tr>
<tr>
<td>( B ) (mm)</td>
<td>55.19</td>
<td>132.2</td>
<td>56.33</td>
<td>112.8</td>
<td>97</td>
</tr>
<tr>
<td>CV ( H ) (%)</td>
<td>127</td>
<td>128.5</td>
<td>130.8</td>
<td>110</td>
<td>128</td>
</tr>
<tr>
<td>CV ( B ) (%)</td>
<td>49</td>
<td>45.8</td>
<td>57</td>
<td>34.6</td>
<td>48.6</td>
</tr>
</tbody>
</table>

![Fig. 6. Length diagram \( H (hauteur) \) (mm) for five regions of Albania](image)

![Fig. 7. Diagram of length \( B (barbe) \) (mm) for five different regions of Albania](image)

The distribution of wave density testing results is reported in Figures 8 to 10.
5. CONCLUSIONS AND RECOMMENDATIONS

This paper provides the first recent information on two of the most important physical characteristics of protein textile fibres from Albanian breeds. The experimental study was based on international standards of selection and testing, and the tests were carried out at the Textile Physical-Mechanical and Chemical Laboratory of Polytechnic University of Tirana, accredited to ISO/IEC 17025, standards for textile materials testing.

In the experiment analysis, we included samples from typical local breeds, and covered a wide geographical distribution in Albania.

The results indicate that local protein fibres in Albania have much spinning potential and could therefore could be industrially processed for textile production. However, before taking a final
decision, their finesses must also be considered as this is a decisive characteristic in any capacity for industrial use.

The length and number of waves of protein fibres are not characteristics that can directly assess the quality of the fibres. The wool samples analyzed here are very similar to the *Merinos* breed in terms of length and wave indicators, but this cannot be said for their finesses.

Analysis of physical characteristics of local protein fibres could be extended to all areas of the country and for all existing breeds. We recommend that these type of tests are performed annually in order to get accurate data on these fibre indicators and their industrial potential.

REFERENCES

[5] ISO 1130; Textile fibres, Methods of fibre sampling for testing.
[8] ISO 139; Textiles, Standard atmospheres for conditioning and testing.