# The mechanical properties of fibres and yarns in different group of animals

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**ABSTRACT**. Natural protein animals fibres are essential source in textile materials make use of wide range production yarns, warp and woven fabric.
In this study single fibres and yarns were taken from 3 grade of animals: alpaca, merino and goat. All of this samples were tested destructively in axial direction using a uniaxial material testing machine. The mechanical properties between different animals fibres and yarns were determined by the force-displacement and stress-strain curves. The results of the experimental tests define strength, stiffness and high quality of textiles.

**KEYWORDS**. Fibre; Yarn; Mechanical properties; textile materials.

## INTRODUCTION

Animal wool fibres have a future of the textile industry as a high quality natural protein structures [3]. Knowledge of mechanical and structural properties characteristics fibres play essential role in understanding yarns properties [5]. Strength and elasticity are the most important parameters decisive about suitability and valence fibres in textile industry. Spatial organization of fibers in yarns influence for the future profitability and development manufacture [2,4].

## MATERIAL AND METHODS

In this work were used single fibres and yarns taken from 3 grade of animals: alpaca, merino and goat. Density of samples were measured using light microscope Zeiss Axio Imager M1m. The average diameters values of fibres were 30±7μm and yarns 796±121μm (Fig. 1).

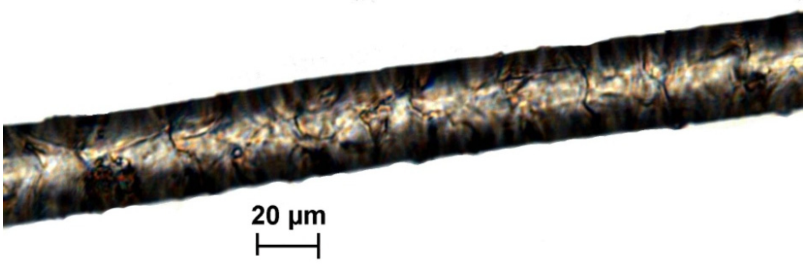



Figure 1: Fibre image from optical microscope.

Uniaxial tensile tests of yarns and fibres were made on a MTS Synergie 100 testing machine (Fig. 2). Initial length of each specimen between clamps was approximately 20 mm. Samples were conducted at constant speed of 20mm/min until rupture [1].

From non-linear characteristics stress-strain curves were determined: breaking stress ($\sigma_{MAX}$), breaking strain ($\varepsilon_N$) and Young's modulus (E). The mechanical properties were expressed as average with standard deviation (X±SD). All date were tested by student's t-test (Statistica 8.0 StatSoft) for independent samples with significance level $p<0.05$.

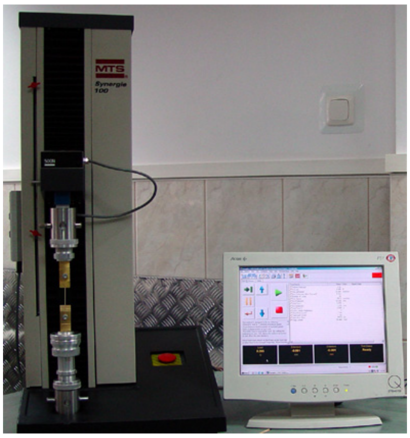


Figure 2: Experimental testing machine MTS Synergie 100.

## Results

The experimental tests have shown that at the similarly value of breaking strain (0,40) (Fig.3a) we obtained difference mechanical properties for 3 grade of animals.

Breaking stress ($\sigma_{MAX}$) in the goat fibres were significantly higher than that of the merino fibres. The goat fibres Young's modulus (E) were significantly higher than that of the merino and alpaca fibres (Fig.3c).

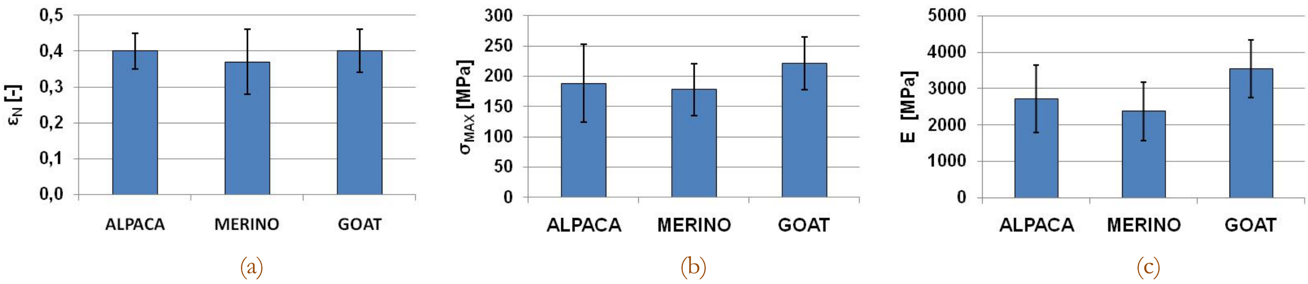
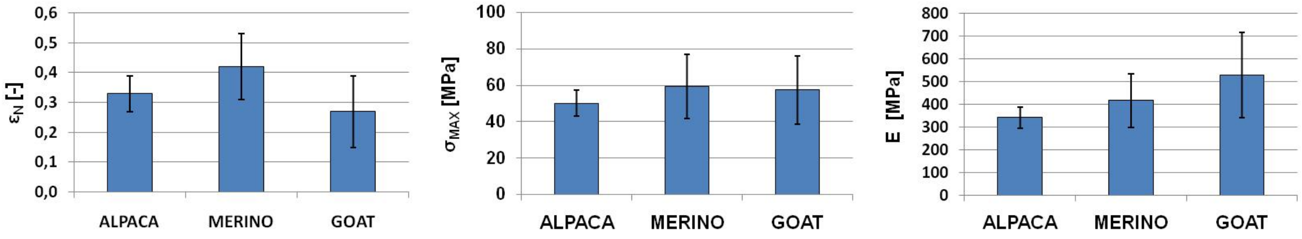



Figure 3: The mechanical properties: (a) breaking strain ($\varepsilon_N$), (b) breaking stress ($\sigma_{MAX}$), (c) Young's modulus (E) of single fibres for different animal's group.

Breaking strain ($\varepsilon_N$) in the goat and alpaca yarns were smaller than value of merino yarn (Fig.4a). Breaking stress ($\sigma_{MAX}$) of yarns were no significant between different animal group but the yarns parameters were 3 times smaller than fibres parameters. However the value of alpaca group was smaller from the rest group (Fig.4b). Young's modulus (E) in yarns were 6 times smaller than fibres. For the goat yarns were significantly higher than that of the alpaca yarns.

## Discussion

In the present study, the mechanical characteristics test indicated that natural animal proteins fibers and yarns are the best suitable to practical application in textile industry. The smaller mechanical properties for the yarns arise from array fibres.




(a) (b) (c)

Figure 4: The mechanical properties: (a) breaking strain ($\varepsilon_N$), (b) breaking stress ($\sigma_{MAX}$), (c) Young's modulus (E) of yarns for different animal's group.

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