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Water Absorption and Moisture Properties of Nigerian Sheep and goat Fibres (Pretreated, Separated, and Carded)

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Abstract:

This research paper investigates the water absorption and moisture properties of Nigerian sheep and goat fibres after pretreatment, separation, and carding processes. At the pre-treated stage, the sheep fibres absorb water up to 29.7% and retain moisture of about 19.97% while the goat fibres absorb water up to 28.7% and retain moisture of about 19.43%. At the separated stage, the sheep fibres absorb water up to 26.7% and retain moisture up to 19% while the goat fibres absorb water up to 25.3% and retain moisture up to 18.75%. However, at the carded stage, the sheep fibres absorb water up to 24.2% and retain moisture up to 16.82% while the goat fibres absorb water up to 22% and retain moisture up to 16.08%. It can be observed that the fibres at the pre-treated stage absorb more water and have higher moisture content because of the increased pore size due to their overlapping scales which reduce during the separation and carding process with the sheep having higher water absorption and moisture retention ability than the goat fibres.

Key words: Nigerian sheep fibres, Nigerian goat fibres, water absorption properties, pretreatment, separation, carding.

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1.0 INTRODUCTION

Natural fibres have gained significant attention in recent years due to their eco-friendly nature and potential applications in various industries. Animal fibres are natural fibres that consist largely of proteins. Examples are silk, hair (wool) and feathers. The animal fibres most commonly used both in the manufacturing world as well as by the hand spinners are wool from domestic sheep, goat and silk from silk worm (Mark, 2018).

Fabrics made from animal fibres have greater bulk than other textiles, provide better insulation and are resilient, elastic and durable. Keratin fibres, like wool or human hair, can be considered as natural composite materials, where keratinous protein is the main basic constituents (Molino *et al*., 2015).

In Nigeria, little or nothing is known about some properties of hair fibres. Therefore, in this research work, the water absorption and moisture properties of Nigerian sheep and goat hair fibres were carried out and their result determined.

2.0 MATERIALS AND METHODS

2.1 MATERIALS

Sheep and goat fibres from a local abattoir in Lagos, Nigeria.

Hand gloves

Nose mask

Laboratory glass wares

Mixing bowls and buckets

Detergent

Razor Blade

Weighing balance

Oven

Improvised carder

Moisture analyzer (m/s-70)

2.2 METHODS

2.2.1 Fibre Pre-Treatment

2.2.1.1 Extraction of the fibres (shearing)

The raw materials for this research are the hairs of the sheep (West African dwarf) and goat (sokoto red) obtained from a local abattoir in Lagos, Nigeria. They were expertly scrapped off from their skin using a very sharp razor blade (shearing) (Dalton *et al.*, 2011).

The sheared fibres contains both inherent and acquired impurities such as dried sweat (suint), grease, blood, soil matters, dust, dirt, straw, manure and vegetable matters (Garner, 1997; Glaser, 1996). Therefore, pre-treatment which involves soaking, washing, rinsing and drying

is necessary to remove these impurities and enhance further processing (Banerjee *et al.*, 2009).

2.2.1.2 Soaking

The fibres were soaked in a bowl of water for 24 hours causing the impurities to float out and fibres to swell for easy washing.

2.2.1.3 Washing, rinsing and drying.

The fibres were thoroughly washed with 2% klin detergent in warm water (30-35˚C) for 15 minutes. It was thoroughly rinsed with running water and dried in open air (air dried) for 12 hours and finally in an oven at 60°C for 24 hours.

2.2.3 Fibre Separation

The cleaned fibres were separated using hand separating method to disentangle and singularize the mass of clustered fibres for easy carding.

2.2.4 Fibre Carding

They were then carded using hand improvised carder resulting to an evenly smooth thin web of fibres ready for felting.

2.2.5 Moisture content (ASTM D5229-2004)

2g each of the pre-treated, separated and carded fibre samples of the sheep, goat and sheep/goat blend were weighed respectively into a tray of moisture analyzer (m/s-70). It was closed and monitored to determine the amount of moisture present in the sample. The % moisture content was recorded automatically by the machine. The test was carried out in triplicate and average results were taken**.**

2.2.6 Water absorbency capacity (ASTM D570-98(2018)

2g each of the fibre samples of the pre-treated, separated and carded fibres were submerged in distilled water at room temperature for 24 hours. It was then removed and drained for 2-3 minutes, in accordance with the ASTM D570 standard. The percentage water absorbed is calculated from the formula;

$$\text{Water absorbed \%} = \frac{Y - X}{X} \times 100$$

Where X= initial weight of the fibre and Y= final weight of the fibre plus water absorbed.

3.0 RESULTS AND DISCUSSION

3.1 Fibre Pre-treatment

Plates 1a and b show the pre-treated sheep and goat fibres after the removal of the impurities. The resulting cleaned fibres are entangled and clustered due to the effect of the pretreatment on it.

(a) Pre-treated Sheep fibres (b) Pre-treated Goat fibres

Plate I: Pre-treated Sheep (a) and Goat (b) Fibres

3.2 Fibre Separation

Plates II a and b show the separated fibres of the sheep and goat. It can be observed that the fibres are no more clustered like that of the pre-treated. Fibre separations disentangle and singularize the clustered mass of fibres and also further remove hidden impurities that escaped the pretreated stage. It is at this stage that the fibres can be successfully carded.

(a) Separated sheep fibres (b) Separated goat fibres

Plate II: Separated Sheep (a) and Goat (b) fibres

3.3 Fibre Carding

Plates III a and b also show the results of carding the sheep and goat fibres. it further straightens the fibres resulting to an evenly thin web of fibres.

(a) Carded fibres of the sheep (b) Carded fibres of the goat

Plate III: Carded Fibres of the Sheep (a) and Sheep/Goat (b) Blend

3.4 Water Absorption and Moisture Content of the Sheep and Goat Fibres

The results of the water absorption and moisture content of the pre-treated separated and carded fibres of the sheep and goat fibres are shown in tables 1a and 1b.

Table 1a: Water Absorption and Moisture Content of the Pre-Treated, Separated and Carded Fibres of the Sheep

Sheep Fibres	Water Absorption (%)	Moisture content (%)
Pre-treated	29.7	19.97
Separated	26.7	19
Carded	24.2	16.82

Table 1a shows the results of water absorption and moisture content of the pre-treated, separated and carded fibres of the Nigerian sheep.

The pre-treated fibres absorb water up to 29.7% and retain moisture of about 19.97%. The separated fibres absorb water up to 26.7% and retain moisture of about 19%. The carded fibres also absorb moisture up to 24.2% and retain moisture of about 16.82%.

It can be observed that the pre-treated fibres from the result has higher water absorption and moisture content than the separated and carded fibres. This can be attributable to the fact that at the pre-treated stage, the cuticle of the fibres has more scales and therefore its pores easily absorbs water and retains moisture (Negri *et al*, 1993).

At the separated stage, the fibre scales are further orientated and aligned which reduces the pore size and therefore reduces the water absorption and retain less moisture.

However, the pore size of the fibres is further reduced by carding and therefore absorbs and retain moisture the least.

Table 1b: Water Absorption and Moisture Content of the Pre-Treated, Separated and Carded Fibres of the Goat

Goat Fibres	Water Absorption (%)	Moisture Content (%)
Pre-treated	28.7	19.43
Separated	25.3	18.75
Carded	22	16.08

Table 1b shows the results of water absorption and moisture content of the pre-treated, separated and carded fibres of the Nigerian goat. The pre-treated fibres have water absorption capacity of 28.7% and moisture content of 19.43%. The separated fibres have water absorption capacity of 25.3% and moisture content of 18.75% while the carded fibres have water absorption capacity of 22% and moisture content of 16.08%.

The pre-treated fibres have higher water absorption and moisture content than the separated and carded fibres just like that of the sheep. This may also be attributed to the ease of water absorption by the pores on the scales of the pre-treated fibres which reduces during separation and carding process. Although, the scales in the cuticle layers of the goat are smoother and fewer than the sheep, it still absorbs and retains moisture.

CONCLUSION

The results of the water absorption and moisture content of the sheep and goat fibres depend on the nature of the scale structure. The sheep and goat fibres undergo different stages of pre-treatment, separation and carding depending on their end use. This research work has shown that these stages affect the rate of water absorption and moisture retention properties of the fibres. Separating and carding the sheep and goat fibres not only help in further removing any escaped impurities from the pre-treatment stage but reduce the rate of water absorption and moisture content.

Generally, the sheep fibres have higher water absorption capacity and moisture retention ability than the goat fibres (pre-treated, separated and carded). This is attributed to the difference in scale structure as the sheep fibre has more scales compared to the goat fibres. As a result, its tiny pores absorb water considerably more than the goat.

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