

# Investigation on the Physical Characteristics of Raw Wool Fibers in Ethiopia



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## Abstract

Ethiopia's economy is primarily based on agriculture (46% of Gross Domestic Product). The Ethiopian textile and apparel industry have grown an average of 51% over the last five years. Ethiopia's sheep population, estimated to be 25.5 million heads, is found to be widely distributed across the diverse agro-ecological zones of the country. Wool, common name applied to the soft, curly fibers obtained chiefly from the fleece of domesticated sheep and used extensively in textile manufacturing. The fleece of sheep raised for wool is generally shorn once yearly, in the spring or early summer. In regions where the climate is warm throughout the year, shearing may occur twice annually. The value of wool on the market depends primarily on fineness and length of fiber. Strength, elasticity, amount of crimp, and uniformity are also considered. The present study was carried out to investigate the physical properties of raw wool fibers. A total of 24 sheep were used in this study. Samples of fiber were analyzed using standard measurements for wool fiber crimp, tenacity, moisture and amount of trash in the raw wool and comparing the weight of the raw wool to the cleaned wool fiber. Samples are drowning from four different parts of the country and the breeds are menz, tikur, farta and washera. The fineness of wool was coarser based on the microns grading system.

**Keywords:** Crimp; Tenacity; Lint; Fleece; Raw wool

## Introduction

Ethiopia, with a population of 96.6 million is the second-most populous nation in Sub-Saharan Africa after Nigeria. Ethiopia's economy is primarily based on agriculture (46% of GDP). The government has been determined to diversify the exports with a priority set for strategic sectors like light manufacturing, textile- and garment manufacturing. The Ethiopian government has spearheaded the sector as one of the key priority sectors for the generation of future employment and to realize its aim to enhance foreign currency earnings. This is supported by the creation of various industry policies and incentives to attract foreign direct investors. Keeping in view the current situation of textile industry of Ethiopia, the government is looking forward to taking necessary actions and strategic plans for the future to grant subsidies for the textile sector. Under this strategic plan the textile industry of the country, will have substantial growth in the export of textile yarns and apparel to increase exports projected to \$26 billion, in addition to the creation of further employment opportunities. All manufacturing industries in textile mills are processing cotton fiber and some synthetic and regenerated fiber and producing woven fabric, knitted fabric and other different products whereby using local and imported raw materials. Ethiopia's sheep population, estimated to be 25.5

million heads, is found widely distributed across the diverse agro-ecological zones of the country [1].

It has been reported that about 75% of the total sheep population are kept in small scale mixed farms in the highlands, which cover regions of over 1500 meter above sea level and receive over 700mm of annual rainfall, while the remaining 25% are found in the lowlands [2,3]. Wool is a fiber, or modified hair, that grows from the skin of sheep. Because it is formed as a living substance, its growth is regulated by the inherited characteristics of the sheep and by the general condition of the sheep producing it. Therefore, the amount and quality of wool produced can be changed through management, breeding and feeding practices. The individual wool fiber grows from a small depression, known as a follicle, in the skin. Follicles are well supplied with blood vessels, which carry to the fiber the food materials necessary for its growth. Surrounding each wool follicle are two kinds of glands, known as the sweat and sebaceous (wax) glands, which supply protective materials for the fleece. The sweat glands secrete a material, often called sweat salts, which prevents the fibers from being damaged by sunlight. The sebaceous glands secrete wool grease, which forms a protective covering on the fiber and prevents mechanical damage through rubbing. In the past, there

were many projects has done to improve production of meat, milk and productivity of sheep breed. Early sheep were probably domesticated not for their wool, but rather as a source of food and skins. In Ethiopia the sheep sector is traditionally dominated by small scale sheep breeding and production systems. Farmers lack technical knowledge resulting in low productivity and profitability of the farms. Development strategies for individual agricultural sectors are not implemented (particularly in wool). There are no specialized sheep wool institutions and professional staff supporting sheep sector. Since collection of wool is not organized in many parts of Ethiopian farmers are throwing wool into rivers or set it on fire in open places. The main objective of this thesis is to characterize the physical properties of sheep wool fiber in case of Amhara National Regional State in Ethiopia [4].

### Materials and Methods

The sample were generated from farms sheep and if the sheep is reared in a small-scale enterprise that grouped for breeding and reproductive of animal's center which governed by head of agriculture office. Analyzed virgin wool samples are taken from sheep located in the Amhara regions of different places. Selected sheep are of males and females and four different breeds (menz, washera, farta and tikur). A total of 24 sheep (12 males and 12 females) were used in this study. Selected sheep are of males and females and four different breeds (menz, washera, farta and tikur). Shearing has done from different parts of male and female sheep and mixing properly use core sampling technique by hands. From each breed and sex 50grams of fleece has been drawn for laboratory samples.

The tested results were analyzed by comparison the significance value of the tested fiber from breed to breed and sex based on International Wool Secretariat [IWS], International Wool Testing Organization[IWTO], Australian wool standards and other wool processing and manufacturing standards. Australia Wool Testing Authority [AWTA] raw wool provides independent and objective wool certification services. AWTA raw wool's major services are sampling, testing and certifying the yield, fiber diameter, vegetable matter content, crimp, moisture and staple strength of tenacity greasy wool before it is sold.

### Results and Discussion

#### Determination of crimp of wool fiber

Crimp refers to waves, bends, twists or curls along the fiber length. It is expressed as Crimps per unit length. Some natural fibers are linear; others form two Dimensional or three-dimensional crimps. Crimped fibers tend to have higher elongation than linear fibers. Crimp is an important fiber property affecting fiber cohesion, drafting, bulkiness, processing performance, spinning, yarn quality, fabric handle, comfort and bulk etc. Higher crimp tends to be associated with less entanglement during scouring, lower yarn hairiness and neps and fabric felting shrinkage, but higher noil, yarn irregularity and thin and thick places and spinning end breaks and lower the yarn strength. Higher crimp wools tend to be stiffer than lower crimp wools, which impacts their handling properties (Table 1). High crimp frequency arises from highly curved follicles, and these crimped fibers contain a high proportion of para cortical cells [5,6].

**Table 1:** Crimp of Wool Fiber in Percentage.

	Breed							
	Menz		Tikur		Farta		Washera	
	Male	Female	Male	Female	Male	Female	Male	Female
Crimp%	13	13	18	6	7	12	6	8
	6	15	8	10	7	6	5	8
	14	11	10	10	11	8.5	8	6.2
	11	9	13	13	9.5	9	11	7.8
	11.5	10	10.5	9.8	8	7.5	9.4	7
Average	11.1	11.6	11.9	9.76	8.5	8.6	7.88	7.4

#### Determination of tenacity of wool fiber

**Table 2:** Tenacity of Raw Wool.

Parameters	Breed							
	Menz		Tikur		Farta		Washera	
Sex	Male	Female	Male	Female	Male	Female	Male	Female
Tenacity (cN/tex)	27	30	15	17	14	15	8	9.2
Count(Ne)	31 <sup>s</sup>	33 <sup>s</sup>	21 <sup>s</sup>	20 <sup>s</sup>	20 <sup>s</sup>	19 <sup>s</sup>	18 <sup>s</sup>	19 <sup>s</sup>

Tenacity of wool fiber has done by using the breaking strength of wool fiber and its linear density which measured the

weight of different single wool fiber by using torsion balance and take the length of each fiber summation [7-9] which is illustrated

in Table 2. We can calculate the spinning count (English count) for comparison based on its linear density [10].

### Determination of moisture content of raw wool fiber

Moisture Content Measurement: The entire samples were preconditioned in a stability chamber for 24hr at  $65 \pm 2\%$  RH and  $27 \pm 20^\circ\text{C}$ . The moisture content was determined after obtaining

the weight of wool dried at  $105^\circ\text{C}$  for 20mins on the ETADRY machine and the results showed in (Table 3). Wool fibers have a hygroscopic behavior; it can be the ability of absorbed and give up moisture [11,12]. The normal standards of raw wool fiber moisture content and regain in percentage are around 13.8 and 16.0 respectively. Our results are almost similar within the standard values, but it depends on the structure of the fiber [13].

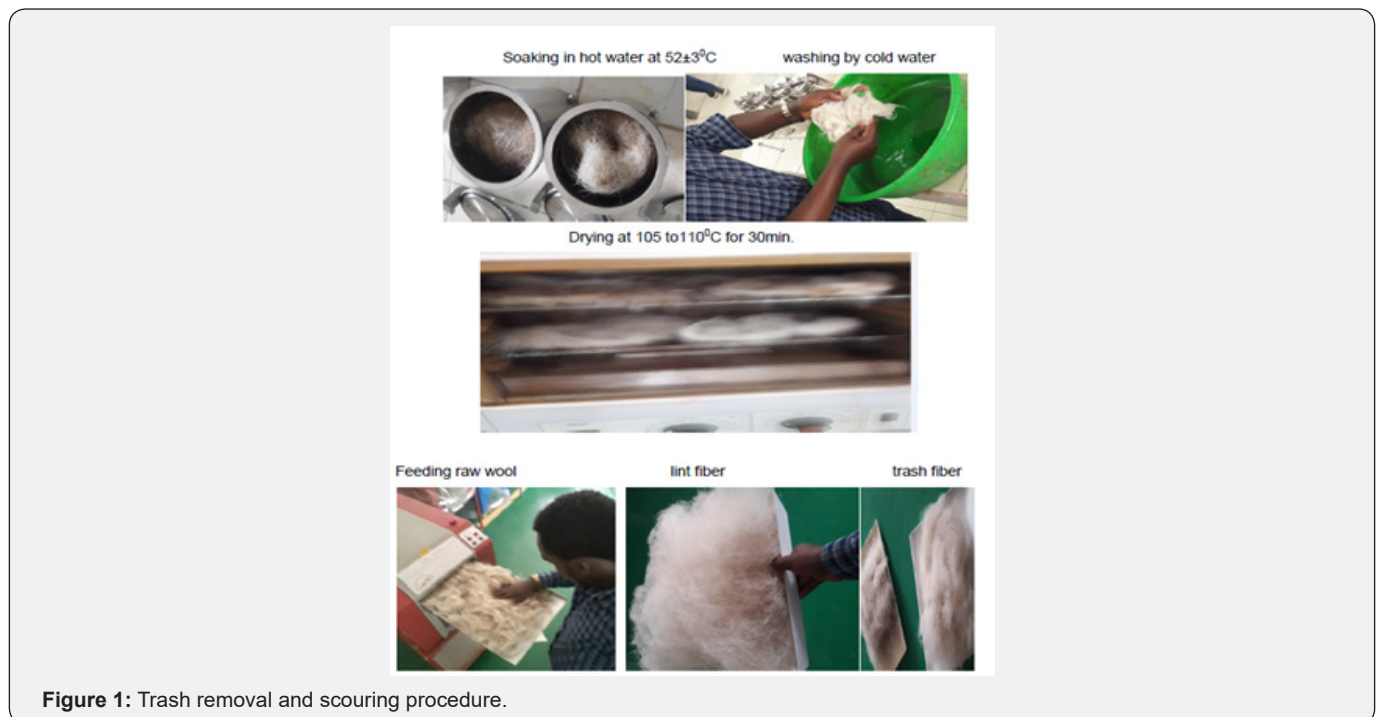
**Table 3:** Moisture Measurement.

Moisture Measurement					
Breed	Sex	Original Mass(gm)	Oven-Dry Mass (gm)	Moisture Regain (MR%)	Moisture Content (MC%)
Menz	Male	25	21	19	16
	Female	25	21.09	18	15
Tikur	Male	25	22.1	13	11
	Female	25	22.23	12	11
Farta	Male	25	22.45	11	10
	Female	25	22.2	12	11
Washera	Male	25	22.6	10	9
	Female	25	22.52	11	10

### Scouring the raw wool fleece

Scouring is a washing process which removes the dirt and the natural grease called lanolin. Unscoured wool is called “wool in the grease” [14]. We can wash the raw wool fiber by using hot water, soap, and alkaline chemicals. I was done by used only hot water and I soaked the wool overnight in cold water, this ensures that it's thoroughly wet through, it already starts removing the dirt, and it can help remove staining too. Take the wool from the cold water and place it into warm water, add hot water to

bring this up to temperature, somewhere just above  $52 \pm 30^\circ\text{C}$  at 5 minutes [ASTM D 584 and ASTM D 1060]. After soaking I had pull out from the bath and make to drying  $105$  to  $110^\circ\text{C}$  until the wet removed. Take the weight difference between the raw fleece and the cleaned fiber [6,15]. Table 4 showed that the percentages of waste after scouring the raw wool fleece. The above Figure 1 shows that the practical process of trash removal of raw wool fleeces on by scouring processes and the results (Table 4) and the Shirley trash analyzer (for wool) to determine the trash and the lint of the raw wool fiber and results (Table 5).



**Figure 1:** Trash removal and scouring procedure.

**Table 4:** Scouring.

Breed	Scouring of Raw Wool Fiber			
	Sex	Raw Wool Fleece Weight	Cleaned Fiber Weight	Waste in Percentage
Menz	Male	12	8.4	30%(40-70)%
	Female	12	8.28	31%
Tikur	Male	12	7.36	38%
	Female	12	7.9	34%
Farta	Male	12	9.54	20%
	Female	12	8	33%
Washera	Male	12	8.64	28%
	Female	12	8.16	32%

**Table 5:** Trash and Lint of Raw Wool.

Breed	Raw Wool Weight(gm)	Total Lint Content(gm)	Total Trash (gm)	Trash Content in %
Menz	50	26	13.07	26%(40-70)%
Tikur	50	26.65	15.16	30%
Farta	50	29.96	14.76	29%
Washera	50	34.04	10.4	20%

### Determination of trash of raw wool fiber

MK2 Trash Analyzer/F102/A for cotton /wool model [ASTM D 584, 1060, 1113]. To determine lint, trash and dust content within a sample of wool fiber up to 100 grams. The analyzer uses the carding principle with air separation of lint and non-lint content. The Analyzer Mk2 (Wool Model). To determine vegetable and other foreign matter content in raw wool. Wool tops and waste and preparation of samples for fineness testing. But it does not determine the amount of grease, suits and wax, see in (Table 5), [16,17].

### Conclusion

The results of experiment for determined the physical properties of raw wool fiber involving of Amhara National Regional State in Ethiopia and to compare the properties of different breeds [18-21]. The crimp of menz and tikur breeds is better than the others and the fineness and the tenacity has better. The moisture content and regains has no significance (they are similar moisture properties between them). Raw wool trash is very high when compared to the clean wool fibers. We can use such fibers for the application of rugs, coverings, carpets and other products because of its coarseness [22-25].

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