SOME PHYSICAL AND CHEMICAL PROPERTIES OF FLEECE FROM MENZ SHEEP

Gelaye Gebisa, Sandip Banerjee2*, Mestawet Taye2
1Department of Animal Science, Mettu University; 2School of Animal and Range Sciences, Havassa University

Corresponding author: - sansoma2003@gmail.com

Menz sheep is the only coarse wool producing sheep in Ethiopia. The fleece of this sheep is generally used for producing local handicrafts. The fleece was collected from pedigreed Menz sheep reared at Debre Brhan Research center. Fleece samples were collected thrice during the study period following the standard protocols. The physical parameters of the fleece were staple length (SL), crimp/inch, numbers and diameters (µm) of different types of fibers (wooly, hetero and hairy). While, the chemical parameters were, percentages of ash, wool wax and vegetable matters (burr). The samples pertain to both the sexes and different age groups. The staple length varied with the sexes and age of the sheep. The numbers of crimps per inch varied from 3.78 to 4.14. The percentage of true fiber varied from 37.0 to 40.7, while those of the hetero and hairy fibers varied between 35.0-3 and 25.83 to 28.29, respectively. The diameter of true, hetero and hairy type fibers (µm) varied between 24.98 and 26.58; 29.62 and 40.74; 61.68 and 89.38 respectively. The percentages of wool wax and scouring yield too varied due to sex and age, with values ranging between 7.93- 10.91 and 62.56 - 68.05, respectively. High coefficients of variation between the traits indicate significant within breed variation and therefore a possibility of selection for fleece related traits.

Keywords: Fleece quality, Menz sheep, Ethiopia

Ethiopia has one of the largest livestock populations in Africa and this sector contributes significantly to the economy of the country. Livestock also provide financial and social security to the owners especially in times of crop failure, as they are a “near-cash” capital stock. (CSA 2014). Among the different categories of livestock, small ruminants (sheep and goat) are preferred by the rural communities as these animals are easy to rear and can cope up well with the vagaries of nature. Findings of a study by Solomon et al. (2008) indicated that the sheep population in the country can be categorized in to nine distinct breeds, the breeds identified are Simien, Short-fat-tailed, Weshera, Gumz, Horro, Arsí, Bonga, Afar and Blackhead Somali sheep. These ovine populations are reared across different agro ecologies and can be phenotypically distinguished from one another. The phenotypic differences among the breeds can be attributed to selection mostly based on traditionally important traits (Kassahun and Solomon 2008). Among all the sheep breeds reared in Ethiopia, “Menz” (Figure 1) is the only wool producing breed, while the other breeds produce coarse hairy fibers. Menz sheep are traditionally reared in the highlands of Menz district situated in the Central highlands of Ethiopia (Tekle 2008). The fleece from this breed is used for preparing locally made handicrafts, providing employment to local craftsperson (Galaye 2015).

Figure 1. Menz sheep at Debre Birhan
Menz sheep are adapted to the rugged climate of the region and can thrive on poor quality roughages (Solomon 2007). However, the harsh agro climate impairs their growth which is one of the factors limiting the profitability (Mukasa and Lahlou 1995). Despite having a traditional significance, scientific studies pertaining to wool quality traits of Menz sheep have so far been ignored. Findings of a study by Tekle (2008) indicate that the annual greasy fleece weight from an adult Menz sheep is around 1 kg. The body of the sheep is mostly covered with coarse hair with a wooly undercoat (Kassahun and Solomon 2008). The fleece of Menz sheep is generally black or dark brown; however there are some sheep with white hairs on their head, neck and leg (Kassahun and Solomon, 2008). This study therefore aims to estimate some important physical and chemical parameters of the fleece from pedigreed flock of Menz rams and ewes reared at Central Highlands of Ethiopia.

MATERIALS AND METHODS
This study was conducted at the sheep farm of Debre Birhan Agricultural Research Center (09°35.45" to 09°36.45” N latitude and 39° 29’40” to 39°31’30” E longitude). The farm is spread over 260.81 hectares and situated, 120 km North of Addis Ababa. The average annual temperature and rainfall of Debre Brhan was reported to be 19.9 °C and 897.8 mm. (www.arari.gov.et, 2015).

The fleece samples were collected from 83 pedigreed Menz rams and ewes. The sheep were individually identified by their respective ear tags and were reared according to standard protocols of Debre Brhan Agricultural Research Center. They were also regularly provided with anthelmintics and vaccinated against commonly occurring ovine diseases. The rams and ewes were reared separately in order to avoid panmictic matting’s. The ewes, weaned lambs and rams were grazed separately; on natural pasture, while they were also provided with supplementary feeds in form of hay from Andropogen (Andropogen abissinicus) Clovers (Trifolium sp L) and Vetch (Vicia dasycarpa L), besides they were also provided with measured amount of concentrates prepared from wheat bran, linseed cake and broken maize while salt and limestone too were provided ad lib. Hay was provided twice a day i.e. mid-day and early in the evenings and the concentrate was provided once in a day i.e during the mid-day.

The sheep included for this study were classified into different age groups viz. 2-3 years and >3 years for the rams while the ewes were categorized in age groups of 2-3 years, >3 to 5 years and >5 years respectively. The age of the rams and ewes were obtained from their respective records. Fleece samples were collected using standard protocols as suggested by Werner Von Bergen (1963).

Fleece samples were collected thrice during the study period and at six month intervals as suggested by Doney and Evans (2000). The samples were labeled and stored in plastic bags, prior to assessment of the physical and chemical parameters. The physical parameters (of the fleece) analyzed were, staple length (cm), crimp (numbers / inch) , fiber diameter (μm) (wool, hetero and hairy), of types of fibers (numbers) (wool, hetero and hairy). While, the respective chemical parameters were scouring yield (%), wool wax (%), burr / vegetable matter (%). The above mentioned parameters were assessed according to the methods suggested by Dagur (1996), Bureau of Indian Standard (2004) and Werner Von Bergen (1963). The data was analyzed statistically using SPSS V 19 for Windows, the means of the observations were compared using Duncan's multiple Range Test and one way analysis of variance.

RESULTS AND DISCUSSION
The findings as presented in Table 1 and 2 pertain to the physical and chemical parameters of the fleece from the rams and ewes respectively.

The findings regarding the staple length (SL) of the rams and ewes (Tables 1 and 2) indicate that there were no differences in SL of rams and ewes for the different age
Table 1: Least squares means (LSM±SE) of fleece quality parameters of Menz Rams at different age groups.

<table>
<thead>
<tr>
<th>Wool quality parameters</th>
<th>Age group( Years)</th>
<th>2 – 3 years</th>
<th>≥3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LSM ± SE</td>
<td>CV</td>
<td>LSM ± SE</td>
</tr>
<tr>
<td>SL (cm)</td>
<td>6.89±0.18</td>
<td>9.53</td>
<td>6.22±0.39</td>
</tr>
<tr>
<td>NC (Per inch)</td>
<td>3.80±0.11</td>
<td>10.68</td>
<td>4.14±0.29</td>
</tr>
<tr>
<td>WFT (%)</td>
<td>38.62±5.73</td>
<td>53.46</td>
<td>37.00±10.22</td>
</tr>
<tr>
<td>HTFT (%)</td>
<td>35.38±4.81</td>
<td>49.05</td>
<td>37.17±10.53</td>
</tr>
<tr>
<td>HRFT (%)</td>
<td>26.00±2.31</td>
<td>32.06</td>
<td>25.83±2.87</td>
</tr>
<tr>
<td>WFD (µm)</td>
<td>26.58±1.08</td>
<td>14.71</td>
<td>25.97±1.22</td>
</tr>
<tr>
<td>HTFD (µm)</td>
<td>29.62±1.22</td>
<td>14.85</td>
<td>31.68±5.00</td>
</tr>
<tr>
<td>HRFD (µm)</td>
<td>73.04±4.41</td>
<td>21.76</td>
<td>61.68±5.10</td>
</tr>
<tr>
<td>WFT (%)</td>
<td>9.57±0.31</td>
<td>11.82</td>
<td>10.91±0.56</td>
</tr>
<tr>
<td>HTFT (%)</td>
<td>68.05±1.41</td>
<td>7.48</td>
<td>62.56±1.81</td>
</tr>
<tr>
<td>HRFT (%)</td>
<td>0.67±0.10</td>
<td>52.46</td>
<td>0.68±0.12</td>
</tr>
</tbody>
</table>

a,b Values across the rows with different superscript are significantly different each other (P<0.05)
N=number of observation, SL= staple length, NC=number of crimp, WFT= wooly fiber type, HTFT= hetero fiber type, HRFT= hairy fiber type, WFD= wooly fiber diameter, HTFD= hetero fiber diameter, HRFD= hairy fiber diameter, WW= wool wax, SY= scouring yield, VM= vegetable matter.

Table 2: Least Square Mean(LSM±SE) of fleece quality parameters of Menz (ewes) at different age groups

<table>
<thead>
<tr>
<th>Fleece quality parameters</th>
<th>Age of the ewes ( years)</th>
<th>2 – 3</th>
<th>≥ 3 – 5</th>
<th>≥ 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LSM ± SE</td>
<td>CV</td>
<td>LSM ± SE</td>
<td>CV</td>
</tr>
<tr>
<td>SL (cm)</td>
<td>5.74±0.20</td>
<td>9.71</td>
<td>5.74±0.31</td>
<td>14.13</td>
</tr>
<tr>
<td>NC (nos/inch)</td>
<td>3.88±0.12</td>
<td>8.93</td>
<td>4.13±0.10</td>
<td>6.20</td>
</tr>
<tr>
<td>WFT (%)</td>
<td>38.50±7.77</td>
<td>57.11</td>
<td>39.71±3.58</td>
<td>23.83</td>
</tr>
<tr>
<td>HTFT (%)</td>
<td>35.00±6.22</td>
<td>50.26</td>
<td>33.14±4.32</td>
<td>34.51</td>
</tr>
<tr>
<td>HRFT (%)</td>
<td>26.50±2.77</td>
<td>29.58</td>
<td>27.14±1.91</td>
<td>18.60</td>
</tr>
<tr>
<td>WFD (µm)</td>
<td>24.98±0.39</td>
<td>4.46</td>
<td>26.48±0.89</td>
<td>8.92</td>
</tr>
<tr>
<td>HTFD (µm)</td>
<td>30.27±1.42</td>
<td>13.23</td>
<td>38.45±3.32</td>
<td>22.82</td>
</tr>
<tr>
<td>HRFD (µm)</td>
<td>76.21±8.14</td>
<td>30.20</td>
<td>85.19±6.88</td>
<td>21.37</td>
</tr>
<tr>
<td>WW (%)</td>
<td>7.93±0.38</td>
<td>13.58</td>
<td>8.86±0.69</td>
<td>20.59</td>
</tr>
<tr>
<td>SY (%)</td>
<td>64.29±2.36</td>
<td>10.40</td>
<td>65.30±1.60</td>
<td>6.50</td>
</tr>
<tr>
<td>VM (%)</td>
<td>0.65±0.10</td>
<td>45.19</td>
<td>0.50±0.08</td>
<td>43.05</td>
</tr>
</tbody>
</table>

a,b Values across the rows with different superscript are significantly different each other (P<0.05)
N=number of observation, SL= staple length, NC=number of crimp, WFT= wooly fiber type, HTFT= hetero fiber type, HRFT= hairy fiber type, WFD= wooly fiber diameter, HTFD= hetero fiber diameter, HRFD= hairy fiber diameter, WW= wool wax, SY= scouring yield, VM= vegetable matter.
specific for a breed, the trait is also influenced by several non genetic factors viz, years and season, the growth of the wool is higher in the season when the sheep are well cared for and receive optimum feed and fodder (Chaudhry and Malik 1972; Charyulu, and Acharya 1985; Cloete et al. 2004 and Qureshi et al. 2013).

Staple length of the rams and ewes are similar to those of many tropical breeds viz. Nilgiri , Hissardale, Marwari and Jaisalmeri sheep ( Arora and Garg 1997), Balochi (Khan et al 1996), Chokla ( Naqvi and Rai 1990) and Mehrabani sheep (Ansari 2012), Barbary, Barbary Blackface, (Harizi et al. 2015). The SL of Salt Range, Lohi, Sipli, Buchi (Khan et al. 1996) sheep were lower than the Menz rams and ewes. On the other hand SL of Hamadani (Kasim and Ali 2006) Afshari, Zandi, Lori and Baluchi breeds (Ansari 2012) Libanian Barbary (Akram et al. 2008) had higher SL when compared to the rams and ewes studied. These differences in SL can be ascribed to both genetic and non genetic factors. Staple length of the rams were higher than the ewes indicating sexual dimorphism for the trait, which is in accordance with those of Mobini (2013); Qureshi et al. (2013) favoring Rensch’s law ( Rensch 1950). Sheep with longer SL are preferred as the trait is correlated with wool strength and spinning capacity (Muhammad et al .2012)

The staple crimp is one of the important criteria for grading the fleece (Taylor et al. 1999). The numbers of crimp in Menz sheep are higher than. Nali (Arora and Acharya 1972) , Garole (Singh and Bohra 1996, Banerjee 2009), Bengal (Banerjee 2015) and Omani (Osman et al. 2010) breeds. The crimp numbers of the studied rams and ewes were similar to Hamadani sheep (Maarof et al. 1982, Maarof 1989 and Kasim and Rabea 2005). The numbers of crimps in Menz (irrespective of both the sexes) sheep are within the range of values reported among Perendale sheep (Dick and Sumner 1996) .The numbers of crimp in a breed of sheep is correlated with its SL as both the traits influence the spinning capacity (Muhammad et al. 2012). The numbers of crimp too are correlated with the levels of copper in the diet of the sheep (Underwood and Suttle 1999, Banerjee and Banerjee 2005).

The percentages of different types of fleece (wooly, hetero and hairy) are genetically influenced traits with differences between breeds and also among animals within a particular breed (Lupiton et al. 2004)). The degrees of medullation influence the percentages of hairy, hetero types of fibers within a breed of sheep (Krishnarao et al. 1960; Ince & Ryder 1984). The wooly fibers are devoid of any medullation (central core of cells which are highly vacuolated), Auber (1950). Fibers with larger diameter are usually meddulated and such fibers develop from larger follicles (Lang 1947, Skarman and Nommera 1954, Handerson 1965). .

The numbers of different fiber types (Tables 1 and 2) indicate that wooly fibers were higher when compared to the hairy fibers, the findings are in consonance with those of Dashab et al (2006), Ansari (2012) in Naeni,Zandi breeds respectively . The numbers of hairy fibers (Table 1 and 2) were higher than Hamdani sheep (Maarof et al.1982). While, the numbers were lower than Arabi (Al-Azzawi1977 ; Aziz 1991 ; Maarof et al. 1982 ; Kasim and Rabea 2005 and Ashmawi and El-Azzawly, 1980), Awassi (Tabbaa et al. 2001) Moghani (Farahvash et al. 2010) , Ossimi and Rahmani (Maria et al. 1992) and Ghezel , (Farahvash et al. 2010) breeds of sheep . The fleece of Garole and Bengal sheep (Banerjee 2009, 2015) were hairy when compared to those of Menz sheep.

Medullation percentages in this study are independent of the age in both the sexes, which is contrary to the reports of Ansari (2012). The numbers of true, hetero and hairy fibers are also independent of the ages of the sheep ( irrespective of both the sexes) the observations are in agreement with Kasim and Rabea (2005), Tabbaa et al. (2001), Ashmawi and El-Azzawly (1980). High coefficient of variation (across the different fiber types) indicates that there are scope for improving the fleece quality of Menz sheep.

The average fiber diameter (true, hetero and hairy) are higher than those of Naeni sheep (Dash et al. 2006). The fiber diameters are
higher than those of Awassi (Tabbaa et al. 2001), Ossimi (Maria et al. 1992), Barbary (Akram et al. 2008) and Karakaya (Cimen, 2006) sheep. However, the fiber diameter are similar to Omani (Osman et al. 2010), Afshari, Zandi, Meherbani, Lori and Bolouchi (Ansari 2012), and Garole and Bengal sheep (Banerjee 2009, 2015). Barbary, Barbary Blackface, (Harizi et al. 2015).

Fiber diameter did not vary across the sexes and ages which concurred with the findings of Quereshi et al. (2013) in Poonchi sheep. The average wool wax (WW) percentage varied across the sexes and also across the different age groups. The percentages of WW were higher than Karadi (Al-Murrani 1975), Hamadan, Arabi, Awassi (Kasim and Rabea 2005), Garole and Bengal (Banerjee, 2009, 2015) sheep. The high WW percentages in this study might be attributed to high ratio of secondary/primary follicle of the fleece (Fraser and Short, 1960). The WW percentages was higher in the rams, which is in consonance with Arabi rams, (Nasratollah et al. 2012). The WW percentages increased with the age of the sheep which is in agreement with the findings of Roberts (1963); Venter (1966 1983). Scouring yield (SY) indicate the clean yield of the wool and hence of commercial importance. Scouring yield too is influenced by both genetic and non- genetic factors and is influenced by the season of wool growth. The SY among the rams and ewes in this study is lower than Arabi (Nasratollah et al. 2012), Mehrabani, Lori, Balouchi (Ansari 2012), Omani (Osman 2010), Barbary (Harizi et al. 2015), Kari (Sohail et al. 2010) sheep. The values are similar to those of Afshari and Zandi (Ansari 2012), Barbary Blackface (Harizi et al. 2015), Rambouillet (Qureshi 2013), Merino (Olivier and Roux 2007), Salt range, Lohi, Sipli (Khan et al. 1996) breeds of sheep. Scouring yield is negatively correlated with WW percentages as high WW facilitates the adherence of dirt/squint thus lowering the SY values (Banerjee 2009).

Vegetable matter/squint are the foreign matters which adhere with the fleece while the sheep are grazing. High vegetable matter decreases the yield of clean fleece and also the quality of the commercial fiber. The vegetable matter values in this study concurs with the findings of Taherpour et al. (2012).

**CONCLUSION**

Menz sheep is the only coarse wool producing breed in Ethiopia. The sheep are reared in the Menz district of the Central Highlands. This fleece of this breed is used to prepare handicrafts thereby providing employment to many people in the district. The staple length of the fleece was longer among the rams when compared to the ewes. However, differences in the number of crimps/inch, numbers of wooly, hetero and hairy fibers too did not vary across the sexes. The diameter of the wooly fibers was the narrowest while it was the widest in the hairy fibers with no differences among the sexes. The average scouring yield, wool wax and the vegetable matter were comparable to many tropical sheep breeds. High coefficient of variation indicates that there is scope of selecting Menz rams and ewes for wool quality traits.

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