# Effect of non-genetic factors on wool quality traits in Patanwadi breed of sheep

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## ABSTRACT

In all 2897 performance records were collected, compiled and analyzed to study the contribution of non-genetic factors affecting wool quality traits in Patanwadi sheep during a period of 13 years (1999-2011). Least squares analysis method (Harvey, 1990) was used to study the effects of location of herd, season and year of shearing and sex of the animal on wool quality traits. Wool quality traits studied included staple length, fibre diameter and medullation percentage. The overall means of staple length, fibre diameter and medullation percentage were 5.919 ± 0.122 cm, 41.055 ± 0.456 µ and 70.662 ± 1.197 %, respectively. Year and season of shearing as well as location of the herd had significant effects on all wool quality traits. The sex of the animal did not have a significant effect on wool quality traits. Performance of Patanwadi sheep can thus be improved by optimizing the environmental and managemental conditions.

**Key words:** Least Squares Analysis, Patanwadi, Non-genetic factors, Wool Quality traits

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## INTRODUCTION

Breeding and development of superior breeds of sheep for wool play an important role in improvising the economical status of rural areas in developing countries like India. Wool production till date is still considered to be inadequate in India. India is importing 18 to 20 million kg of wool every year to meet the increasing demand of apparel type wool. Wool is a versatile product in demand mainly because of its physical characteristics that directly influence wearer's comfort (Hatcher et al., 2010), processing performance, durability (Swan et al., 2008) and textile attributes (Wood, 2003). However, wool is not a uniform biological product because its physical characteristics vary depending on sheep genetics, environment and management strategies (Poppi and McLennan, 2010). Staple length, fibre diameter and medullation percentage are traits of importance in determining the wool quality in sheep. Key wool characteristics include: fibre diameter, fibre diameter coefficient of variation, fibre curvature, staple length, and clean fleece yield (Anderson et al., 2009). While the influence of these characteristics on wool quality and value differs, they all contribute to an entire fleece's attributes.

These traits are possibly influenced by various non-genetic factors. Patanwadi, Marwari and Dumba are three important sheep breeds of Gujarat. Patanwadi sheep are medium- to large-sized animals, with white coat and brown face and legs, mainly distributed in Patan, Mehsana, Surendranagar, Rajkot and Jamnagar districts of Gujarat. The majority of them are stationary. They are a superior carpet-wool-producing breed with the capacity to survive well under harsh environmental and management conditions

Therefore, the present investigation was undertaken to evaluate the effects of environmental or non-genetic factors on the wool quality traits for developing effective breeding strategies for the improvement of fleece traits in Patanwadi sheep.

## MATERIALS AND METHODS

The performance records of 2897 Patanwadi sheep were collected over a period of 13 years (1999-2011)

from wool analysis laboratory, sheep breeding farm, Morbi, Rajkot. The data on wool quality traits viz. staple length, fibre diameter and medullation percentage were collected and compiled.

The available data pertained to 18 districts of Gujarat state (to study the effect of location of the herd). The seasons were divided in three groups viz. Winter (November to February), Summer (March to June) and Monsoon (July to October). Least squares analysis method (Harvey, 1990) was used to study the effects of location of herd, season and year of shearing and sex of the animal on wool quality traits. All animals were drenched with anthelmentics to control internal parasites; anti-tick bathing was carried out on wool shearing time.

The sheep were let loose for grazing for six hours a day, the pregnant and the growing stock was fed with supplementary ration. The statistical model used included the location of herd, season and year of shearing and sex of the animal as fixed effects.

Model assumed:

$$Y_{ijklm} = \mu + P_i + S_j + C_k + T_l + e$$

where,

$Y_{ijklm}$ = the fleece trait to be analysed of the animal with kth sex, at the lth location, shorn in the jth season of the ith year

$\mu$ = overall mean;

$P_i$ = fixed effect of ith year of shearing

$S_j$ = fixed effect of jth season of shearing

$C_k$ = fixed effect of kth sex of lamb

$T_l$ = fixed effect of lth location of the herd and

e = residual error assumed to be normally and independently distributed with mean zero and variance $\sigma_e^2$

The least squares means of only the factors which contributed significantly were further compared by Duncan's New Multiple Range Test (DNMRT).

## RESULTS AND DISCUSSION

The least squares mean along with respective standard errors for the fleece quality traits as influenced by location, year, season and sex are presented in Tables 1. The overall means of staple length, fibre diameter and medullation percentage were 5.919 ± 0.122 cm, 41.055 ±0.456 μ and 70.662±1.197%, respectively. However, Bhat and Arora (1990) reported estimates of 8.51 ± 0.09 cm, 31.95 ± 0.26 μ and 29.88 ± 0.95% for staple length, fibre diameter and medullation percentage, respectively.

Effect of year: Year of shearing had a highly significant effect (P<0.01) on all wool quality traits. It can be seen from Table 1 that the longest staple length (7.243±0.595 cm) was recorded in 2004, while samples taken in the year 2011 had the shortest staple length (4.991±0.305 cm). Lowest fiber diameter was observed to be 34.569±2.560 μm in the year 2005, while the highest value (49.255±2.222 μm) was recorded in the year 2004. The highest percentage of medullated fibres (83.550±5.827%) was found in the year 2004 while the lowest percentage (51.339±7.552%) of medullated fibres was found in the year 1999. The results suggest that different macro-environmental conditions over the years can lead to differential performance for wool quality traits in Patanwadi sheep and attempts are advisable to be made at optimizing the environmental conditions for improved performances with respect to all the three wool quality traits.

*Effect of Season*: Season of shearing also had a highly significant effect (P<0.01) on all wool quality traits. The longest staple length (6.102±0.141cm) was observed in winter season, while the shortest staple length (5.676±0.131cm) was observed in summer season. The smallest fibre diameter (39.264±0.527μm) was observed in winter season. Highest medullation percentage (74.381±1.287%) was recorded in summer season, while the lowest (72.113±1.335%) medullated fibre percentage was recorded in the monsoon season. This observation was supported by earlier reports of Chaudhary and Malik (1972) in Chokla sheep. This may be due to favourable winter climatic conditions.

*Effect of Sex:* Sex of the animal did not have a significant effect on any of the wool quality traits. Comparison of means was thus not done. The results are in agreement with Krishnamurthy et al., (1975) in Nilgiri and its crosses and Krishnappa (1979) in Corriedale X Deccani and Deccani who also reported that sex had no effect on staple length. Contrary to this, Thiagarajan and Jayashankar (2012) observed longer staple length (4.20 ± 0.05 c.m) in rams than in ewes (3.93 ± 0.05 c.m). The difference was significant ($P \leqslant 0.01$) which may be

**Table 1:** Least squares means (LSM) for various factors affecting wool quality traits

| Effects | Staple length (cm) | | Fibre diameter (µ) | Medullation (%) |
|---|---|---|---|---|
| Overall mean | 2897 | 5.919 ± 0.122 | 41.055 ± 0.456 | 70.662 ± 1.197 |
| Location | | ** | ** | ** |
| Ahmedabad | 19 | $5.196^{cde}$ ± 0.416 | $55.533^{a}$ ± 1.554 | $93.514^{a}$ ± 4.074 |
| Amreli | 270 | $5.825^{bcd}$ ± 0.151 | $40.663^{defgh}$ ± 0.562 | $74.404^{cde}$ ± 1.474 |
| Anand | 15 | $7.098^{a}$ ± 0.463 | $39.550^{efgh}$ ± 1.729 | $64.529^{fg}$ ± 4.533 |
| Bhavnagar | 628 | $5.985^{bc}$ ± 0.128 | $40.586^{defgh}$ ± 0.479 | $72.959^{cde}$ ± 1.255 |
| Banaskantha | 38 | $5.639^{cde}$ ± 0.314 | $39.123^{fgh}$ ± 1.172 | $72.563^{def}$ ± 3.074 |
| Gandhinagar | 15 | $5.607^{cde}$ ± 0.463 | $45.671^{b}$ ± 1.727 | $78.708^{bcd}$ ± 4.530 |
| Jamnagar | 432 | $7.198^{a}$ ± 0.135 | $41.455^{cdef}$ ± 0.506 | $73.994^{cde}$ ± 1.326 |
| Junagadh | 76 | $6.064^{bc}$ ± 0.226 | $41.134^{defg}$ ± 0.844 | $73.927^{cde}$ ± 2.213 |
| Kheda | 15 | $5.488^{cde}$ ± 0.493 | $45.259^{b}$ ± 1.840 | $85.348^{b}$ ± 4.824 |
| Kutch | 69 | $5.315^{cde}$ ± 0.230 | $37.364^{h}$ ± 0.860 | $53.626^{h}$ ± 2.255 |
| Mehsana | 68 | $5.133^{cde}$ ± 0.237 | $44.898^{b}$ ± 0.886 | $79.148^{bcd}$ ± 2.324 |
| Patan | 415 | $5.933^{bcd}$ ± 0.158 | $29.009^{j}$ ± 0.588 | $43.070^{i}$ ± 1.542 |
| Porbandar | 128 | $6.590^{ab}$ ± 0.189 | $44.435^{bc}$ ± 0.704 | $77.987^{bcd}$ ± 1.847 |
| Rajkot | 542 | $6.900^{a}$ ± 0.127 | $38.191^{fgh}$ ± 0.474 | $66.534^{efg}$ ± 1.243 |
| Sabarkantha | 26 | $5.630^{cde}$ ± 0.355 | $42.973^{bcd}$ ± 1.326 | $81.873^{bc}$ ± 3.477 |
| Surendranagar | 101 | $7.043^{a}$ ± 0.196 | $42.616^{bcde}$ ± 0.733 | $73.360^{cde}$ ± 1.921 |
| Vadadora | 16 | $4.869^{e}$ ± 0.480 | $32.739^{i}$ ± 1.793 | $42.512^{j}$ ± 4.701 |
| Panchmahal | 24 | $5.025^{de}$ ± 0.371 | $37.790^{gh}$ ± 1.384 | $63.865^{g}$ ± 3.629 |
| Sex | NS | NS | NS | |
| Male | 749 | 6.001±0.132 | 41.243±0.492 | 70.732±1.289 |
| Female | 2148 | 5.836±0.124 | 40.867±0.462 | 70.592±1.211 |
| Season | ** | ** | ** | |
| Winter | 679 | $6.102^{a}$ ±0.141 | $39.264^{c}$ ± 0.527 | $65.492^{c}$ ± 1.381 |
| Summer | 1129 | $5.676^{b}$ ± 0.131 | $42.418^{a}$ ± 0.491 | $74.381^{a}$ ± 1.287 |
| Monsoon | 1089 | $5.979^{a}$ ± 0.136 | $41.482^{b}$ ± 0.509 | $72.113^{b}$ ± 1.335 |
| Year | ** | ** | ** | |
| 1999 | 5 | $5.243^{c}$ ± 0.771 | $36.193^{fgh}$ ± 2.880 | $51.339^{g}$ ± 7.552 |
| 2000 | 740 | $5.608^{bc}$ ± 0.099 | $40.468^{def}$ ± 0.368 | $75.201^{abc}$ ± 0.965 |
| 2001 | 114 | $6.707^{ab}$ ± 0.192 | $39.829^{efg}$ ± 0.718 | $77.070^{abc}$ ± 1.884 |
| 2002 | 18 | $5.787^{bc}$ ± 0.416 | $37.176^{fgh}$ ± 1.554 | $68.484^{cde}$ ± 4.075 |
| 2003 | 19 | $5.367^{c}$ ± 0.404 | $35.877^{gh}$ ± 1.508 | $56.677^{fg}$ ± 3.955 |
| 2004 | 9 | $7.243^{a}$ ± 0.595 | $49.255^{a}$ ± 2.222 | $83.550^{a}$ ± 5.827 |
| 2005 | 7 | $6.167^{abc}$ ± 0.686 | $34.569^{h}$ ± 2.560 | $63.204^{def}$ ± 6.712 |
| 2006 | 254 | $5.646^{bc}$ ± 0.139 | $43.396^{bcde}$ ± 0.518 | $72.471^{abcd}$ ± 1.357 |
| 2007 | 546 | $5.318^{c}$ ± 0.110 | $45.623^{dabc}$ ± 0.410 | $73.239^{abcd}$ ± 1.074 |
| 2008 | 282 | $6.116^{abc}$ ± 0.141 | $44.552^{bcd}$ ± 0.527 | $81.846^{ab}$ ± 1.381 |
| 2009 | 465 | $6.176^{abc}$ ± 0.113 | $41.850^{cde}$ ± 0.421 | $70.838^{bcde}$ ± 1.105 |
| 2010 | 402 | $6.576^{ab}$ ± 0.113 | $47.386^{ab}$ ± 0.420 | $83.815^{a}$ ± 1.103 |
| 2011 | 36 | $4.991^{c}$ ± 0.305 | $37.542^{fgh}$ ± 1.138 | $60.875^{efg}$ ± 2.985 |

Means bearing different superscripts differ significantly from each other (P<0.05);
N = Number of observations; NS = Non-significant effect (P>0.01); | ** indicates highly significant effect (P<0.01)

due to hormonal differences .This findings closely allied with the results of Chopra and Chopra (1972)

*Effect of Location:* Location of the herd had a highly significant effect (P<0.01) on all wool quality traits. Samples from Jamnagar district recorded the longest staple length (7.198±0.135 cm) while the samples from Vadodara district had the shortest staple length (4.869±0.480 cm). The samples from Patan district had the least fibre diameter (29.009±0.588 µm) while the samples from Ahmadabad district had the highest fibre diameter (55.533±1.554 µm). Ahmadabad and Vadodara districts had the samples with maximum (93.514±4.074 %) and minimum (42.512±4.701 %) medullation percentages, respectively. Different locations with obvious modified grazing and managemental practices thus contribute to the performance of wool quality traits in Patanwadi sheep.

The investigation in Patanwadi sheep reveals influences of some of the most important environmental factors on fleece traits *viz.* staple length, fibre diameter and medullation percentage. Location of the herd as well as season and year of shearing contribute to non-genetic variability in expression of important fleece traits. Sex of the animal however does not contribute to non-genetic variation. These factors accordingly need to be accounted for in the genetic evaluation of Patanwadi sheep for wool quality traits.

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