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Effect of dietary supplementation of zinc oxide and sodium Sulphate on wool quality in Sandyno sheep

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Abstract
Wool production in sheep is determined by genetic factors, environmental conditions, nutrition, and the frequency of shearing. Heritable traits such as fleece weight, fibre diameter, and staple length significantly influence wool quality. Zinc deficiency adversely affects wool growth, resulting in weaker fibres and loss of crimp, while sculpture supplementation enhances wool yield, improves fibre characteristics. Therefore, this study aims to evaluate wool fibre characteristics of the Sandyno breed. Eighteen adult female Sandyno sheep of similar age and body weight were selected from the ILFC, Pookode, and divided into three groups of six in a Completely Randomized Design. The control group (T_1) was fed a basal diet, while groups T_2 and T_3 received the basal diet with 20 mg zinc oxide + 3 g sodium sulphate/kg DM and 40 mg zinc oxide + 6 g sodium sulphate/kg DM, respectively. The 90-day trial involved shearing at the start, followed by assessments of wool properties (fibre diameter, fibre length, medullation percentage) on 0^{th} day and 90^{th} day. Wool fibre diameter was significantly different ($p<0.01$) between treatments on day 90. No significant difference ($p>0.05$) was observed in fibre length and medullation percentage on day 90.These findings conclude that supplementation of inorganic zinc and sulphur positively influences wool quality in Sandyno sheep.

Keywords: Sheep, zinc oxide, sodium sulphate, wool fibre

1. Introduction
Wool is a natural raw material obtained mainly from sheep, but also from alpacas, llamas, some breeds of goats and *Rabi* bits. The amount of wool that a sheep produces depends upon its genetic make-up, climate, nutrition, and shearing interval. Proper nutrition of the animals stands out as one of the principal factors affecting both the quantity and quality of wool produced. Minerals are crucial for the health, reproduction, and productivity of sheep (Sharma, 2006) [9]. Since many feeds do not contain all essential minerals in quantities that optimize animal performance, it is frequently necessary to supplement minerals in the required amounts and suitable forms (Pamp, 1977) [6]. Furthermore, certain minerals like zinc and sulphur can influence wool production. A lack of zinc in the feed results in inhibited wool growth, wool loss, and increased fragility of wool fibers. A deficiency in zinc results in the loss of crimp, thinning of fibers, and in some cases, shedding of the entire fleece. The most important nutrients that affect its production include sulfur amino acids (cystine, cysteine and methionine) and lysine. Sheep can synthesize cysteine for wool growth from sulfate supplements. Supplementation with sulfur improves performance by boosting bacterial protein synthesis in the rumen and optimizing the amino acid balance. Inorganic sulfur enhances wool growth and enhances wool quality in sheep.

2. Materials and Methods
Eighteen adult female Sandyno sheep of similar age and body weight were selected from the Instructional Livestock Farm Complex, Pookode, and divided into three groups of six using a Completely Randomized Design. A 90-day feeding trial was conducted following ICAR (2013) guidelines.

On day 0, all sheep were shorn to standardize wool regrowth, and wool characteristics such as fiber diameter, fiber length, and medullation percentage were assessed. The dietary treatments included a control group (T_1) with no supplementation, T_2 with 20 mg Zinc oxide and 3 g sodium sulphate/kg DM of feed, and T3 with 40 mg Zinc oxide and 6 g sodium sulphate/kg DM of feed. After the 90-day experimental period, all animals were shorn, and wool physiochemical characteristics were assessed.
Before measurements, the fibers were washed with a mild detergent to remove suint. All measurements were taken from the middle part of the fibers. Wool fiber diameter and medullation percentage were measured using an inverted dark field microscope. Fiber length was determined without stretching, using a ruler and a 10x magnifying glass. For this, fibers were mounted on slides and immersed in paraffin oil. Measurements for fiber diameter and length were taken from 300 fibers per animal.
The measurements were made at the sheep breeding research station, sandynallah, Nilagiri district of Tamil Nadu.
All statistical analysis of data performed using SPSS version 24.0 software. The differences between the mean values were determined using one way ANOVA.

3. Results
The data pertaining to fibre diameter, fibre length, medullation percentage in different groups as well as at different intervals are presented in Table 4.6.
The mean fibre diameter (µm) at the end of trial in T_1, T_2 and T3 groups were 40.83±3.93, 29.83±3.50 and 24.33±1.20 respectively. Statistical analysis of data showed significant (p<0.01) difference between T_1 and T_2, T_1 and T_3 group on 90th day of experiment.
The mean fibre length (mm) at the end of trial in T_1, T_2 and T_3 groups were 34.00±2.73, 40.67±2.33 and 40.17±6.52 respectively. Statistical analysis of data showed no significant (p<0.05) difference among T_1, T_2, T_3 groups on 90th day of experiment.
The mean medullation percentage (percent) at the end of trial in T_1, T_2 and T_3 groups were 37.65±3.16, 36.09±4.13and 30.73±5.33 respectively. Statistical analysis of data showed no significant (p<0.05) difference among T_1, T_2, T_3 groups on 90th day of experiment.

Table 1: Wool physiochemical parameters of sheep in different groups

Group	Days (Period)	
	0th	90th
Fibre diameter (µm)		
T_1	42.67 ± 4.61	40.83 ± 3.93^a
T_2	43.33 ± 4.83	29.83 ± 3.50^b
T_3	37.83 ± 4.83	24.33 ± 1.20^b
P-Value	0.65 ^{ns}	0.00**
Fibre length (mm)		
T_1	99.17 ± 8.40	34.00 ± 2.73
T_2	95.17 ± 9.45	40.67 ± 2.33
T_3	101.67 ± 6.00	40.17 ± 6.52
P-Value	0.85 ^{ns}	0.16 ^{ns}
Medullation percentage (percent)		
T_1	33.53 ± 2.49	37.65 ± 3.16
T_2	40.40 ± 4.93	36.09 ± 4.13
T_3	37.78 ± 3.11	30.73 ± 5.33
P-Value	0.43 ^{ns}	0.50 ^{ns}

** Significant at 0.01 level (p<0.01); * Significant at 0.05 level (p<0.05);
NS non-significant (p>0.05)

4. Discussion
The physicomechanical characteristics of wool fibers are essential in the textile industry, as they determine the fibers' suitability and specific applications.
In current study the mean fibre diameter (µm) at the end of trial in T_1, T_2 and T_3 groups were 40.83±3.93, 29.83±3.50 and 24.33±1.20 respectively. Statistical analysis of data showed significant (p>0.01) difference between T_1 and T_2, T_1 and T_3 group on 90th day of experiment. Similar findings observed by White *et al.* (1994) [14] and Minervino *et al*. (2018) [3] reported that increased zinc intake is associated with finer wool fibers, as observed in sheep with optimal zinc levels compared to those with deficiencies. Masters *et al.* (1998) [2] reported that diet composition, including zinc levels, influences wool characteristics such as fiber diameter
In current study the mean fibre length (mm) at the end of trial in T_1, T_2 and T_3 groups were 34.00±2.73, 40.67±2.33 and 40.17±6.52 respectively. Statistical analysis of data showed no significant (p>0.05) difference among T_1, T_2, T_3 groups on 90th day of experiment. Similar findings observed by Page *et al*. (2020) [5] reported that the source of zinc had no impact on the increase in wool fiber length in growing rams.
The observed mean medullation percentage (percent) at the end of trial in T_1, T_2 and T_3 groups were 37.65±3.16, 36.09±4.13and 30.73±5.33 respectively. Statistical analysis of data showed no significant (p>0.05) difference among T_1, T_2, T_3 groups on 90th day of experiment. Similarly, Nezamidoust *et al*. (2014) [4] reported that sulfur supplementation had no impact on the proportions of medullated and non-medullated fibers in both ewes and lambs (p>0.05).
Contractory findings reported by Saini *et al.* (2011) [8] indicated that sulfur supplementation significantly increased staple length, and medullation percentage compared to the control group and Williams (1995) [16] reported that sulfur supplementation had no effect on the wool fiber diameter. Similarly, White *et al*. (1977) found no significant effect of varying sulphur levels on wool fiber diameter in Merino withers over 35 days.

5. Conclusion
Sheep that received inorganic zinc and sulfur supplementation produced wool with finer fibers, which is advantageous for the textile industry. However, no significant differences were observed in fiber length or medullation percentage across the experimental groups. Therefore, it can be concluded that inorganic zinc and sulfur supplementation improves wool quality by reducing fiber diameter, but it does not affect fiber length or medullation percentage.

Conflict of Interest: Not available

Financial Support: Not available

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