

## THE DISTRIBUTION OF MAGNESIUM, ZINC & COPPER IN THE SKIN AND HAIR OF WEST AFRICAN DWARF SHEEP.

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**Target audience:** Human and Animal nutritionists; Animal Scientists, Animal and human healthcare providers, Livestock farmers, economists and government policy-makers.

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### ABSTRACT

The distribution of magnesium zinc and copper was investigated in the hair and skin of West African dwarf sheep. The 3 elements were found to be present in varying degrees in these organs. All were more abundant in the hair than in the skin. For instance, 2026 p.p.m were the highest amount of magnesium found in the hair while its counterpart in the skin were 1178p.p.m. There were also differences in the quantities of these elements in the samples from the different regions of the body. Statistical analysis revealed that some of these differences were significant { $p < 0.05$ } These findings are discussed in the context of their relevance to the structural and functional integrity of the skin and its adnexa.

**Key Words:** Sheep, Skin, Hair, and Trace Elements.

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### DESCRIPTION OF PROBLEM

According to Wheater {1} the skin is the largest organ in the body, making up about one-sixth the total body weight. In addition to being an inter-face between the organism and the external environment, the skin also functions for protection, sensation, and thermoregulation and in some other metabolic situations. The hair and wool found on the skin of such animals as sheep greatly accentuate these functions.

In the humid tropics, small ruminants—sheep and goats-- are reared traditionally in the extensive management farming system. In this system the animals are allowed to fend for themselves. {2,3} However, while the goat may benefit maximally in this system because of its hardiness and voracious eating habits the sheep is extremely finicky—a necessity imposed on it by the peculiar nature of its oral anatomy. The philtrum {4} on the upper

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lip of sheep restricts its choice of food to very tender parts of the grass. The sheep in this system of management are thus constrained to roam much wider field than goats to garner equivalent levels of nourishment

The sheep in the process become exposed to greater risks of trauma and infection than goats in the same environment. However, several village-based surveys {5,6} have shown the field observations to be contrary to this hypothesis. Sheep were found to be more resistant to dermatoses than goats. It is either that goats are more prone to lacerations that predispose to infections than sheep or that sheep skin possesses some intrinsic properties that effectively deal with such injuries in a way that discourages the establishment of infection.

Trace elements are known to influence the well being of animal tissue in a variety of ways {7,8} Zinc and copper have been frequently mentioned in connection with wound healing and the integrity of connective tissue {9,10,11} This probably explains why many topical preparations for the treatment of skin infections such as dermatophilosis contain these micro-elements {12}. As part of a series of studies designed to elucidate the structure of the skins of small ruminants in Nigeria it was thought necessary {both scientifically and clinically} to include their mineral element composition. This report is on the distribution of magnesium, zinc and copper in the skin and hair of the West African Dwarf {WAD} sheep.

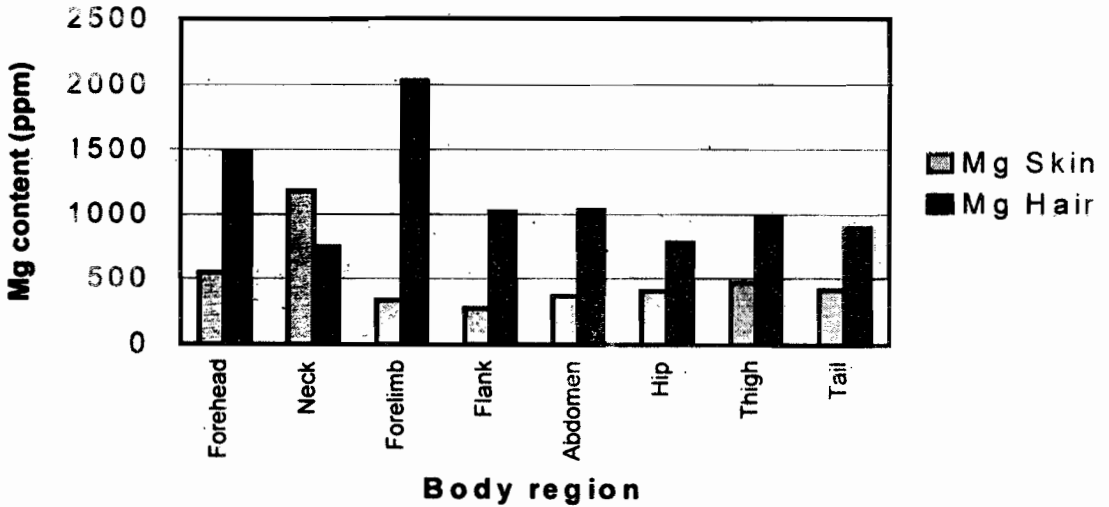
#### MATERIALS AND METHODS

Flayed skins from 4 ewes slaughtered at the Bodija abattoir in Ibadan were used for the study. The skins with the pelage still on them were processed as described previously {13} Briefly, the skins were thoroughly washed and debrided of excess subcutaneous tissue. They were then impaled with the aid of surgical pins on wooden boards. Samples were then taken by means of sharp scalpel blades from 8 designated sites on the forehead, neck, shoulder, flank, back, rump, lateral thigh and the tail head. The samples were taken in pairs—from both sides of the animal. The average of the two samples represented the value used for analysis for that site. The hair on each sample was separated from the skin proper and both were dried, weighed and stored in separate containers until when needed for analysis. The hair and skin samples were later ashed in a furnace at 600<sup>o</sup>c. Each ash was dissolved in 5ml N HCl. The resulting solutions were analyzed for magnesium, zinc and copper content in an atomic absorption spectrophotometer {AAS}. The information obtained from this was subjected to analysis with both ANOVA and Student *t-test*

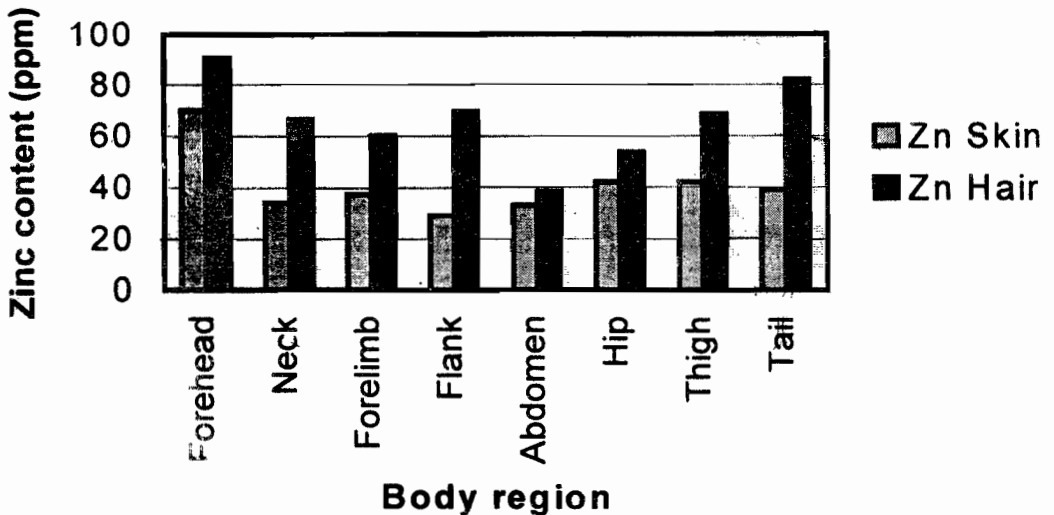
#### RESULTS AND DISCUSSION

The amounts of the various elements assayed are shown on Figures 1-3. Magnesium was the most abundant of the three elements followed by zinc and copper in that order. Each of the elements except copper was more abundant in the hair than in the skin. Copper was more abundant only in the hair of the upper thigh region. In all other areas of the body the skin contained more copper than the corresponding hair. The highest quantity of magnesium {1178 parts per million, p. p. m.} was found in the skin of the neck while the

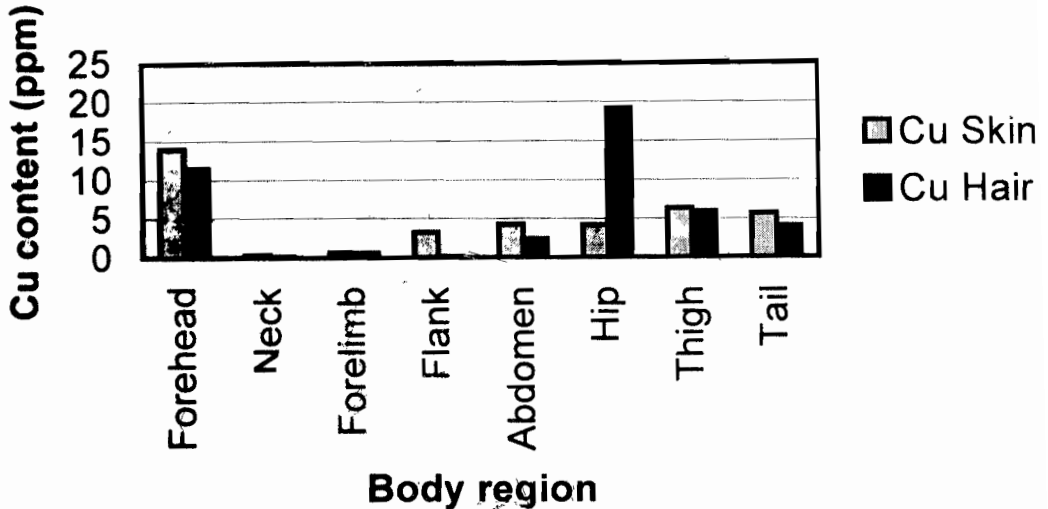
**Fig. 1 Histogram of Magnesium content of Skin and Hair of West African Dwarf Sheep**



**Fig. 2 Histogram of Zinc Content of Skin and Hair of West African Dwarf Sheep**



**Fig. 3 Histogram of Copper content of Skin and Hair of West African Dwarf Sheep**



least {273 p. p m} was in the skin of the flank Similarly, hair from the shoulder area had the highest amount of magnesium {2026 p. p. m.} while that from the neck area had the least magnesium content {744 p. p. m.} The skin in the forehead area had the greatest amount of zinc {70 p. p. m.} while the least amount {29 p. p. m.} was found in the skin of the flank region. Also the forehead hair had the highest amount of zinc {90.6 p. p. m.} but the smallest quantity of zinc {38.3 p. p. m.} was found in the hair of the abdominal region. The highest amount of copper {14 p. p. m.} in the skin was in that from the forehead region while the least amount {0.4 p. p. m.} was found in the skin of the neck region. Hair from the upper hip area had the highest amount of copper {9.20 p. p. m.} while that from the neck region had the least amount of copper {0.156 p. p. m.} Statistical analyses showed that these variations and differences in the quantities of the various minerals in the various body regions and between the skin and hair were significant at the 95% level { $p < 0.05$ }

Trace elements perform their functions in various ways and are therefore widely distributed in various tissues of the body. The biggest concentration of each being at the site of its greatest activity. Many trace elements are sourced from the diets to which the animals are exposed. So the needs of the animal are often very readily met. However, in some situations such as rapidly growing young animals and pasture or where there is abnormal level of ionic interaction, there could be inadequate supply of a particular trace element and characteristic deficiency disease syndromes ensue. Cutaneous manifestations of such syndromes have been shown to include rough and scaly hair and skin and parakeratosis {14.15.16.17.18.19} There is also poor wound healing and lack of integrity and stability of connective tissue {11.20.21}

Magnesium was found to be the most abundant of the three elements assayed. Magnesium is often associated with skeletal tissue. It is said to be residually deposited in bones and is important in the metabolism of calcium and phosphorus {19,21,22} A mean of 496.13 and 1120.4 p. p. m. of magnesium were found in sheep skin and hair respectively. This is very close to the 500-700 p. p. m. estimated for cattle by the National Research Council Committees in the United States {23} While sheep in these climes may not easily lack the supply of dietary magnesium, the skin and its adnexa may represent a source of mobilisable magnesium in the event of such occurrence since according to Blaxter *et. al.* {24} skeletal magnesium cannot be easily mobilized.

Zinc was the next most abundant element followed by copper. These two microelements have been associated with skin integrity and hair growth {15}. Their deficiency has been said to lead to alopecia, parakeratosis, poor and delayed wound healing {19, 21} Both trace elements occurred in the sheep skin and hair in excess of the dietary requirements i.e.4 and 1-2 p. p. m. Zn and Cu respectively estimated for sheep {23}. Their roles in the skin and hair may not be unconnected with the processes of pigmentation and keratinization especially in the oxidation of the sulphhydryl groups -SH-SH- to -S-S- {disulphide} bonds in wool and hair. They can also be involved in the maintenance of connective tissue integrity {15,24,25}

There are no available previous data with which the values obtained here could be compared. A similar study on the West African dwarf goat {13} revealed similar but slightly lower endowment of these microelements in the skin and hair. The level of precaution taken to prevent contamination makes it possible to suggest that the figures obtained in this study are reliable and can be used as baseline information in this regard.

### CONCLUSIONS AND APPLICATION

1. That trace elements magnesium, zinc and copper occur in the skin and hair of West African dwarf sheep.
2. That more of these elements are found in the hair than in the skin.

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