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PRELIMINARY OBSERVATIONS ON TRACE ELEMENT CONTENTS OF THE SKIN AND PELAGE OF WEST AFRICAN DWARF [WAD] GOAT.

S. K. ONWUKA[1*], AVWIORO O. G.[1], OLAIFA A. K.[2]

[1]Department of Veterinary Anatomy and [2]Department of Veterinary Surgery/ Reproduction, University of Ibadan, Ibadan, Nigeria

Studies in the content of magnesium [Mg], copper [Cu] and zinc [Zn] were carried in the skin and hair of 4 West African Dwarf goats. Each of the elements was found to be more abundant in the hair than in the skin. For each of the elements also there were differences in quantity from one region of the body to another. Some of these differences were significant at the 95% confidence level . On the whole magnesium was the most abundant followed by zinc and copper in that order. These findings are discussed in relation to the roles these elements play in ensuring the integrity and normal functioning of the skin and pelage of the animal.

Key words: *Goat, skin, hair, trace elements*

Trace elements, acting, as catalysts in many enzymatic systems, are essential for the normal structure and function of many tissues. [Underwood, 1971] They are further classified as very essential for an organism if they are present in many tissues of the organism and if their withdrawal precipitates observable deficiency symptoms in such organisms. The symptoms should also be reversible on reintroduction of the withdrawn element.

Many trace elements including iron, copper, zinc, manganese and magnesium have been identified, They are not only necessary for normal growth and development of animals but are also important for reproduction. Although these elements are usually found in many tissues of the body some of them occur in greater quantities in some tissues than in others. For instance, copper and iron have been associated mostly with haemopoietic tissues while magnesium is said to influence the interaction between calcium and phosphorus in osseous material.[Suttle,1975; Underwood,1975]

Several health surveys of small ruminants [Mack, 1982; Adeoye, 1985] have revealed differences in their susceptibility to dermatoses not only between species but even between breeds within the same species .It was therefore thought necessary to investigate the reasons for these field observations. Studies were thus embarked upon to evaluate the trace element relationships in the skin and hair coats {pelage} of West African Dwarf [WAD] sheep and goats in this humid zone. This report is on the preliminary observations on the relative distribution of magnesium, zinc and copper in the skin and pelage of the WAD goat.

MATERIALS AND METHODS.

Skin and hair samples were taken from the flayed skins of adult goats slaughtered in abattoirs at Ibadan and Ife. The flayed skins with the hairs still on them were stretched out on wooden boards and held in place with surgical pins. Areas were marked out on the forehead [1], lateral neck [2], shoulder [3], mid-flank region [4], mid-abdominal region [5], the rump [6], lateral thigh [7], and the tail head [8]. Samples were then carefully cut out from these areas with the aid of very sharp scalpel blades. Two samples [left and right] were taken from each site and the average of the two samples represented the value used for analysis. Excess subcutaneous tissue was removed from the samples, as was the hair from the lateral surface. Each skin sample and the hair removed from it were dried overnight in an oven at 60^{oc} and put in thoroughly cleaned and appropriately identified plastic universal bottles with plastic caps. The dry weights of the samples [both skin and hair] were taken before being incinerated or ashed using a crucible in a furnace at 600^{oc} Equal amounts of the ashes were dissolved in 5ml NH_4Cl The amount of the elements magnesium, zinc and copper in each sample was then determined spectrophotometrically using the atomic absorption spectrophotometrical {AAS} facility available at the Institute for International Agriculture [IITA] Ibadan. The resultant data was subjected to statistical analysis using both Student paired samples *t*-test and the analysis of variance [ANOVA] tools.

* *Author for correspondence*

RESULTS

The quantities obtained for the three elements in the skin and hair samples are given on Table 1.for magnesium, zinc and copper respectively. For all three elements greater quantities were found in the hair than in the skin. And for each element there were also regional differences in the amount obtainable. For instance, while the highest amounts of magnesium [277.1134p.p.m.Table 1] were found in the tail-head skin and tail-head hair respectively, the least quantity of Mg [157p.p.m.] was in the forehead skin and hair from the lateral thigh area had the lowest amount of Mg {339p.p.m.}. Analysis of variance revealed no significance-level differences in the values of Mg from different areas of the skin. However. Their hair equivalents were significantly different from one another [p<0.05]

Table 1:
Levels of Magnesium, Zinc and Copper in the skin and hair of WAD goat (ppm)

REGION	Mg		Zn		Cu	
	SKIN	HAIR	SKIN	HAIR	SKIN	HAIR
Forehead	157	522	42.5	211	6.1	0.7
Neck	207	423	30.2	110.1	4.2	9.8
Shoulder	159	629	31.4	177	3.6	57.1
Mid-flank	192	420	31.8	127	3.4	2.65
Abdomnal	168	999	40.1	150	4.6	27.5
Rump	189	460	45.6	67.6	4.0	9.7
Lat. Thigh	199	339	42	83	4.4	12.0
Tailhead	277	1134	53	596	5.9	265

There was more copper in the hair samples than in the skin samples. But while the greatest amount of Cu [265.0 p.p.m.] was found in the hair from the tail region its equivalent value in the skin{6.10p.p.m.} was from the forehead. Again, regional variation in the Cu quantity was significant [p<0.05] in the hair but not in the skin. The least quantity of Cu was found in the hair from the forehead region and that from the flank was next. There was more Zn in the hair than in the skin The tail-head skin and hair had the greatest concentration of Zn [53.0 and 596.0 p.p.m.respectively] of all the body regions Skin from the neck region yielded the lowest amount of Zn [30 20 p.p.m.] while this distinction in the hair fell to that from the lateral thigh area with 67.6 p, p.m.of zinc. As with the copper, regional variations in the distribution of zinc was significant in the hair [p<0 05] but not in the skin .Of the elements investigated Mg was the most abundant followed by Zn and Cu. .

DISCUSSION

This study has shown that Mg, Zinc and Cu are present in the skin and hair of the West African Dwarf goat, howbeit, in varying quantities .The values obtained for them as shown on the Table may have been exaggerated by contamination from the environment. But, even though it may be impossible to completely eliminate environmental contamination because of the extensive husbandry system in these parts [Cole and Ronning, 1974; Devendra and McLeroy, 1982; Sumberg and Cassaday, 1985], enough washing of the fresh samples was done in order to minimize the effects of such contamination. The figures can therefore be regarded as approximating as closely to the *in vivo* situation as possible. They are therefore useful not only as baseline data but also for comparative purposes.

Magnesium was found to be more abundant than the other elements studied. And as with these other elements there was more magnesium in the hair than in the skin. Magnesium functions in the development of the musculo-skeletal system .It is therefore more distributed to bones and muscular tissue [Miller *et. al.*, 1972]. It also participates in neuro-muscular impulse transmission .It is a component of many enzyme systems particularly those in which thiamine pyrophosphate is a cofactor. It is therefore very important for oxidative phosphorylation. It also activates pyruvic acid carboxylase, pyruvic oxidase and the condensing enzyme for the reactions in the Krebs cycle {Hays and Swenson, 1970}. There is no available information on the daily dietary requirements for Mg in small ruminants in Nigeria but it is estimated to be in the range of 500-750 p.p.m. for cattle, a quantity, which is very readily met in most diets compounded from natural ingredients. If identified before death ensues, Mg deficiency symptomatized by seizures and convulsions as occurs in grass tetany and to promote wound healing (Montagna and Billingham 1964, Zinc concentration in bile increases considerably 40hr-post surgery. This may be in keeping with its wound healing properties as it is said to be involved with DNA synthesis (William and Chester 1970). Zinc is probably abundant in the skin and hair because of the presence of such enzymes as alkaline phosphatase and alcohol dehydrogenase (Onwuka 1981) The regenerative activity in the skin--

producing daughter cells for the replacement of desquamating ones—may also be a reason for the abundance of zinc in this tissue.

Zinc had indeed been associated with epithelial tissue including skin, hair and wool. Traces have also been found in bone, muscle, blood and other organs. It is highly concentrated in pigmented tissue (Maynard et al 1979). Zinc exhibits low toxicity and deficiency symptoms include parakeratosis of skin and esophageal epithelium and stunted growth in chickens. Severe dermatitis may be observed in poultry fed zinc deficient diet (Hays and Swenson 1970). Although the dietary requirement for zinc in small ruminant is not yet established, that of pigs is a mere 3 to 4 p.p.m. and 30 – 40 p.p.m. if in combination with phytic acid. Phytic acid discourages the absorption of zinc from the gut (Green et al 1962). Unless there is high phytic acid content in the forage or supplemental feed of a small ruminant it is not likely to suffer from zinc deficiency which is characterized by unthrifty hair and broken scaly skin especially around the hoof.

Copper was the least abundant element of the 3 investigated in the skin and hair of WAD goats. Underwood (1977) stated that the quantity of Cu in the tissues of an animal depended on the dietary intake. Of the 3 elements studied Cu is the one with the least dietary requirements: 1-2 p.p.m. for sheep and cattle and 4-6 p.p.m. for pigs and chicken (Hays and Swenson,1970). It is found in many tissues and fluids in the body and is a component of the cytochrome enzyme system (Griffits and Wharton 1961; Takemori, 1960). In addition to the cytochromes, Cu occurs in such other enzyme systems as tyrosinase, laccase, ascorbic acid oxidase and many others {Dressler and Dawson, 1960}. Cu is present in blood plasma as a copper-protein complex, ceruloplasmin {Holmberg and Laurell, 1947,1948} Several factors including competition with other trace elements particularly iron, influence the bioavailability of copper .It partakes in haemopoeisis by encouraging optimal utilization of iron in the production of young erythrocytes. Copper deficiency syndromes include osteoporosis and easily fractured bones in sheep, cattle and pigs and neonatal ataxia in lambs. {Bennetts and Chapman, 1937; Follis et. al., 1955} Copper deficiency anaemia would also occur. Ingesting excessive quantities of copper containing feed would expose livestock especially cattle to the risk of toxicity—a condition that can easily become fatal if not immediately attended to {Underwood, 1977}

Information is not available on any previous studies along these lines in domestic animals in Nigeria for comparative purposes. But Broek et al. {1992} studying the distribution of zinc and copper in the hair and plasma of unshampooed domestic cats, found more zinc and copper in the plasma than in the hair Although there was no significant correlation between them, the authors nonetheless asserted that using hair samples was a reliable non-invasive way of estimating the trace element status of an animal. Barring gross contamination, the possibility of which was reduced to the barest minimum in this study, the figures obtained here may not be very much different from the true situation and can therefore be used as baseline data for further studies. We are designing a more comprehensive study with a more extensive sampling area and sample size This planned study will not only yield confirmatory information on individual trace element status but comparative information on age, sex and coat-colour relationships.

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