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Research Article

Correlative Analysis of Cortical Concentrations of Some Metals and Crude Protein in the Brain of Goats

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ABSTRACT

Correlative studies were done on the metal and protein concentrations in the brain cortex of the West African Dwarf and Red Sokoto breeds of goats in Nigeria. Positive correlations (either at 0.01 or 0.05) was found amongst some metals notably Mg and Ca, Mg and Zn, Ca and Mn while negative correlations was observed between AI and Fe, AI and Co amongst others. Female goats in both breeds were found to have more correlative interplay amongst their cortical metal and crude protein levels than their male counterparts. The brain samples apparently displayed a homeostatic balance in the relationship between Pb and Cu and Zn and Cu. The interplay of the metals and protein in the cortex was discussed as vital baseline in comparism with goats under different systems of management.
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Key words : - metals, crude protein, brain, goat

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INTRODUCTION

There have been major advances in research of macro- and microelement status of goats in the recent times with the uniqueness of goats in many aspects of mineral metabolism being documented. The reliability of body tissues as an indicator of deficiencies varies with mineral contents (Haenlein, 2003). One of the organs least studied in the metal profile of the goat is the brain (Olopade et. al., 2005).

The level of crude protein in the brain cortex of two breeds of goats has recently been reported (Olopade et. al., 2005). However there is a dearth in literature on the correlation of cortical protein with metals in the brain. This (correlation study) is important in that there has been an indictment of the interplay of metals in disease neuroepidemiology. Copper imbalances in the brain has been known to occur from zinc deficiency (Gruen et. al., 1986) and from relatively high molybdenum levels in the feed of ruminants (McDowell, 1985); also the feeding of bentonite to goats was found to increase the absorption of iron but decreased that of copper and zinc (Schwarz and Werner, 1987). Such interplay of metals has been the basis for suggesting that location-dependent environmental factors which though may not cause disease conditions like Transmissible Spongiform Encephalomyelitis (TSE) can actually predispose to it (Taylor, 1998).

Sex differences is known to affect mineral profile in humans, as women have been known to have mineral deficiencies linked to fluctuation in hormonal profile (Brain Talk Communities, 2005) The aim of this work is to analyse the correlative pattern of the cortical concentration of some metals and crude protein in the brain of two breeds of goat Nigeria to ascertain if sex differences exist and also document a baseline profile of metal interplay in the brain cortex of these animals.

MATERIALS AND METHODS

Ten Red Sokoto (RS) and ten West African Dwarf (WAD) goats were used in this study (four males and six females in each breed). The animals were between 1-2 years of age and were obtained from Sokoto north western Nigeria and Ibadan, south western Nigerian respectively. The animals were obtained from the slaughter slab and after restraint, were killed through rapid decapitation of the occipito-atlantal joint. The goat heads were immediately kept at -20°C and the brain exposed later according to the method used by Olopade and Onwuka, (2002).

The brain samples were collected using plastic utensils from the lateral frontal cortex of the brain and dried in a laboratory oven (B and T®) at between 40-50°C for four days after which the samples were macerated using plastic pestle and mortar. The level of metals and crude protein was determined using an atomic absorption spectrophotometer according to the procedures described by Benas (1968).

A total of eighteen metals and trace elements, and crude protein values were analysed for this study. The metals were Calcium (Ca), Magnesium (Mg), Manganese (Mn), Iron (Fe), Copper (Cu), Zinc (Zn), Molybdenum (Mo), Lead (Pb), Iodine (I), Silicon (Si), Selenium (Se), Mercury (Hg), Aluminum (AI), Cobalt Co), Nickel (Ni), Argon (Ar), Lithium (Li) and Fluoride (FI). The data of the concentration of metals and crude protein were analysed using SPSS 10 package and each metal value in the brain cortex with other metals and with the crude protein value in both sexes within each breed were correlated using the Pearson correlation at the 0.05 and 0.01 levels.

RESULTS

West African Dwarf Goats (WAD)

Females

There was a strong positive correlation (at 0.01 level) in WAD females between Mg and Ca, Mn, Mn and Ca, Mg and Mn and Si, Fe and Pb, Pb and Si, while a positive correlation (at 0.05 level) occurred between Ca and Zn, Ca and Pb. e.t.c.(see Table 1)

There was however a strong negative correlation (at 0.01 level) between Mg and I, Mn and Se, Pb and crude protein, while a negative correlation (at 0.05 level) was found between Ca and crude protein, I and Si, Se and Co (See Table 1).

Males

In the WAD males, a strong positive correlation (at 0.01 level) was found between Ca and Fe while a positive correlation (at 0.05 level) existed between Mg and Zn, Mg and Co, and between Pb and Hg, e.t.c (see Table 2).

While a strong negative correlation (at 0.01 level) was not found between the metals and crude protein in this study, a negative correlation (at 0.05 level) occurred between Fe and Al and between Mn and Li amongst others.

Red Sokoto Goats (RS)

Females

There was a strong positive correlation (at 0.01 level) between the values of Ca and Mg, while a positive correlation (at 0.05 level) existed between Ca and Mn, Ca and Cu, and between Cu and Mo e.t.c (see Table 3).

A strong negative correlation (at 0.01 level) in this study was observed between AI and Co, while a negative correlation (at 0.05 level) was observed between Mg and I and between Cu and I e.t.c (see Table 3)

Males

A strong positive correlation (at 0.05 level) was observed in Red Sokoto males between AI and Mg while the correlations between Ca and Mg, Zn and FI were positive at 0.05 level.

The correlations between Mg and Fe, Zn and Fe, AI and Fe, Ni and Ar, were negative at 0.05 level while no correlations in this study was strongly negative (at 0.01 level) in the Red Sokoto males (see Table 4).

Table 1: Correlative Interplay of the cortical concentrations between some metals and crude protein in the brain of female WAD goats

	Mg	Ca	Mn	Si	Fe	Pb	Zn	Co	Cu	Se	I	Al	CP
Mg		**	**				*				-**		-*
Ca	**		**	*		*	*						-*
Mn	**	**		**		*		*		-**			-**
Si		*	**		*	**		*			-*		-**
Fe				*		**			*				-*
Pb		*	*	**	**			*	*				-**
Zn	*	*											
Co			*	*		*			*	-*		-*	-*
Cu					*	*		*					
Se			-**					-*					*
I	-**			-*									
Al								-*					
CP			-**	-**		-**		-*		*			

Table 2: Correlative Interplay of the cortical concentrations between some metals in the brain of male WAD goats

	Ca	Fe	Mg	Pb	Zn	Co	Hg	Mn	Ar	Cu	Si	Al	Li	Se
Ca		**												
Fe	**											-*		
Mg					*	*								
Zn			*	*		*								
Hg				*							*			-*
Co			*		*									
Mn									*				-*	
Ar								*		*			-*	
Cu									*		*			
Si							*			*				-*
Al		-*												
Li								-*	-*					
Se							-*				-*			

Table 3: Correlative interplay of the cortical concentrations between some metals and crude protein in the brain of female goats

	Ca	Mg	Fe	Mo	Cu	Ar	Pb	Co	Mn	Si	Al	Li	I	Se	CP
Ca		**	**	**	*	*		*	*		*				
Mg	**		**	*	**	*			*				-*		
Fe	**	**		*	**	*	*	*			-*				
Mo		*	*		*	**			*						
Cu	*	**	**	*		*	*						-*		
Ar	*	*	*	**	*		*						-*		
Pb			*		*	*									
Co	*		*							*	-**				
Mn	*	*	*	*							-*	-*			
Si								*							
Al	-*		-*					-**	-*			*			
Li									-*		*				
I		-*			-*	-*									
Se															-*
CP														-*	

Table 4:
Correlative Interplay of the cortical concentrations between some metals and crude protein in the brain of males RS goats

	Ai	Mg	Ca	Zn	Fl	Fe	Ni	Ar
Al		**				-*		
Mg	**		*			-*		
Ca		*		*	*			
Zn			*					
Fl			*					
Fe	-*	-*		-*				
Ni								-*
Ar							-*	

Keys:

**	*Positive significantly correlated at p < 0.01*
-**	*Significant negatively correlated at p < 0.01*
*	*Positively significantly correlated at p< 0.05*
-*	*Negatively significantly correlated at p < 0.05*
CP	*Crude Protein*

DISCUSSION

A total of 58 positive correlations (at 0.05 and 0.01 levels) occurred amongst the eighteen metals and crude protein in this study. Fourty five (77.6%) positive correlations were found in the female goats (WAD and RS), while of the 31 negative correlations (at 0.05 and 0.01 levels) that existed in this study, 21 (67.7%) occurred in females. This interplay of metals in the females may indicate a variation of the demands and activities of these metals and crude protein based on changes in the hormonal profile. Mineral studies had suggested that supplementation in females needs to be given a more critical role than males as some mineral deficiencies has been linked to increased heart attacks in menopausal women that are undergoing hormone replacement therapy (Brain Talk Communities, 2005).

The most reoccurring positive correlation at both levels examined in both sexes of the two breeds of goat was between Mg and Ca, but less so for the ones between Mg and Zn, Fe and Pb, Cu and Pb, Si and Co and between Ca and Mn. The positive correlation between Mg and Ca is contrary to the studies that was found in water samples and heart tissue of patient of cardiovascular mortality (Rylander et. al., 1991) although the same authors agree that a critical balance of both metals needs to be achieved to assure proper use of both of them and thus recommend that supplementation of calcium should also take into cognizance magnesium supplementation.

The brain level and relationship of Mg and Zn have been well studied (Yang et. al, 2004). The positive correlation of Mg and Zn noticed in this study is important in assessing their profile in the brain of goats as derangement of extracellular Mg and Zn levels could indicate progression of cell injury and may be associated with cerebral ischaemic insult (Yang et. al., 2004).

The most common occurrence of negative correlation at all levels in this study was seen between AI and Fe in both sexes and in both breeds. In the western countries, studies have linked iron and aluminium and their interplay to neurological diseases like Alzheimer's (Joshic et. al, 1994, Beard and Connor, 2003). The homeostasis of iron and aluminium as seen in this brain study is worthy of note. The small ruminant breeds in Nigeria apparently are free of neuropathies like Transmissible Spongiform Encephalopathies (TSE), since iron and aluminium have been implicated in neuropathies, any aberration from the relationship observed in this study should be further investigated particularly if the animals are bred under an intensive management system. The animals in the study were usually animals that graze freely in a semi-intensive system of management and such have been known to pick up a balance of minerals from the environment (Kirkwood et. al., 1993; Yoshikawa et. al. 1996).

The absence of a negative correlation between Pb and Cu, and Zn and Cu indicate that to a larger extent that there is a balance of these elements in both breeds in this study since deficiency of zinc increase copper content in the brain (Gruen et. al., 1986) whlie Lead toxicity has been known to exacerbate copper deficiency (Suttle et. al., 1975. This homoestatic relationship in the brain cortex between these metals may apparently be a reflection of a balance between these metals in the environments of the goats.

The animals in this study were mainly bred in a semi intensive system. These results are important particularly at a time when interest groups are clamouring for the setting up of grazing reserves and intensive animal farming (Fetuga, 2003), where a balanced uptake of minerals from the environment (Kirkwood, 1993; Yoshikawa, 1996) can no longer be guarantied. The result in this study has given a baseline report on the interplay of metals and crude protein in the brain cortex of goats in Nigeria and will be vital in comparism with data from goats bred or living in metal polluted environments.

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