Correlation of Micro Minerals in Primary Hair-Plasma of Dogs

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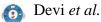
ABSTRACT

Hair can be easily collected, stored and have several characteristics suggesting that it may be useful biopsy materials. The mineral contents of the primary hair give an overview of the mineral levels in the body's tissues and the changes that occur over time. In the present study correlation coefficients of three micro minerals *viz.* (Copper (Cu), Iron (Fe) and Zinc (Zn)) in primary hair-plasma of Pomeranian (n=10) and Labrador (n=10) dogs were evaluated. It has been observed that correlation coefficients of Cu and Zn in primary hair-plasma of Pomeranian and Labrador dogs were significant at 5% and 1% level whereas non-significant (p<0.05) in both the breed of dogs for Fe.

Keywords: Dogs, hair, micro-minerals, plasma

The hair is a slender thread like outgrowth of the epidermis of an animal and thus represents spillover from what is in the body. Each hair follicle is a miniature organ with smooth muscle, apocrine and sebaceous sweat glands, nerves and a rich plexus of blood vessels (Leeson *et al.,* 1985). Many authors demonstrated the presence of correlation between the levels of principal elements in hair and their content in the body, both at the physiological equilibrium and during pathological disturbances (Radomska *et al.,* 2005). Trace elements accumulate in the body over given periods of time thus reflecting the biomedical and environmental history of the body as well as long term metabolic changes (D'Ilio *et al.,* 2000). Chemical composition of hair reflects the maintenance system, nutritional level and also the level of environmental pollutants (Rashed and Soltan, 2005; Patra *et al.,* 2007; Rogowska *et al.,* 2009). During the process of mitosis, differentiation, maturation and melanin synthesis, macro and micro-elements enter the newly formed hair cells. Also the hair shaft is continuously exposed to trace elements of endogenous origin through contact with secretions from sebaceous and apocrine glands that bathe the hair as it emerges through the epidermis. In general, dogs have two main types of hair in their coats. There are short fluffy hairs called secondary hairs or under fur/ undercoat. The second type of hair is the longer and stiffer called primary or guard or outer hairs. Dogs also have a third type of hair i.e. the whisker. Though, hair is most non-invasive biological sample available for evaluation of body health in both animal and human alike, there is lack of relevant literature concerning adequate hair analysis reflecting mineral status in pet dogs. Thus, the aim of the present study was to study correlation between three important micro-minerals *viz.* copper (Cu), iron (Fe) and zinc (Zn) in primary hair-plasma of dogs and to check possibility of primary hair mineral profile for predicting mineral status of dog.

The biological samples were collected from reported disease free twenty adult dogs equally represented by two most common pet breed reporting to Referral polyclinic of IVRI, Izatnagar *i.e.* Pomeranian and Labrador retriever for annual vaccination. Biological samples included plasma, and composite hair samples collected from head, chest upper and lower part of forelimb and hind limb, abdomen, upper and lower sides of the tail and around the base of tail in a self sealing polyethylene bags. Micro-mineral

estimation was done after calibration and standards run using atomic absorption spectrophotometer (ECIL, AAS 4141) with respective element lamps.

Plasma samples were digested as per procedure described by Kolmer *et al.* (1951). Three ml of plasma sample with equal volume of concentrated HNO_3 was mixed in the digestion tube and were kept overnight at room temperature followed by digestion on low heat (70-80ºC) digestion bench, until the volume of samples was reduced to about one ml. To this three ml of double acid mixture (three part concentrated HNO_3 and one part 70% $HClO_4$) was added. Low heat digestion was continued until the digested samples became watery clear and emitting white fumes. As per need, addition of three ml double acid mixture followed by low heat digestion was repeated couple of times. Further heating was continued to reduce the volume to approximately 0.5 ml. Final volume of filtrate was made up to 10 ml with triple distilled deionized water after luke warming the solution. While digesting plasma samples, simultaneous digestion of reagent blank was undertaken and the final volume was similarly made up to 10 ml to have blank.

Data collected were analyzed and interpreted for mean, standard error, analysis of variance (ANOVA) and correlation coefficient (Snedecor and Cochran, 1994).

Hair is a metabolically inactive tissue and its composition reflects levels of trace elements that accumulate in the body (Gonsalez *et al.,* 2008). It has been observed in the present study, that correlation coefficients of Cu and Zn in primary hair-plasma of Pomeranian and Labrador dogs were significant at 5% and 1% level (Table 1).

Table 1: Correlation coefficients of Micro minerals in Hair-Plasma of Dogs of Two Different Breeds

Micro-mineral	Breed	
	Pomeranian (n=10)	Labrador (n=10)
Cu (µg/dl)	0.871**	0.677**
Fe (µg/dl)	0.616	0.532
Zn (µg/dl)	0.446*	0.562*

* $p<0.05$ ** $p<0.01$

Levels of some trace elements in hair may be correlated with dietary intake or mineral status of animals (Combs *et al.,* 1982). If a dog's hair analysis shows a deficiency or an excess of a metal, then this reflects a deficiency or excess within their body. Copper (Cu) is an essential trace element for all organisms, due to its functions as a co-factor in many enzymes (Rasoloson *et al.,* 2004). The cuproenzymes like lysyl oxidase is necessary for molecular cross linking in collagen and elastin. Level of Cu in hair is a sensitive index of Cu status when liver Cu reserves are < 20 µg/g (Kellaway *et al.,* 1978). Clinical signs of Cu deficiency in dogs include hair depigmentation and hyperextension of the distal fore-limbs (Zentek and Meyer, 1991).

It has been demonstrated that the concentration of Zn in hair is correlated with dietary Zn intake (Combs *et al.,* 1983). Zn is known to be an essential component for hair growth and other epidermal tissue (McDowell, 2003). More hair growth with high zinc content in dogs, upon supplementation with zinc is reported (Brinkhaus, 1998; Lowe *et al.,* 1994). In ruminants like cattle and goats the concentration of Zn in hair more consistently reflect dietary Zn intake than Zn in other tissues (Miller, 1970). The clinical signs of Zn deficiency have been described as alopecia, dull, coarse hair coat, and focal erythmia encircling the eyes, ears, nose, mouth and pressure points (Colombini, 1999; Case *et al.,* 2000).

Correlation coefficients of Fe in primary hair-plasma in the present study was found to be non-significant ($p<0.05$) in both the breeds. Furthermore, Fe supplementation has no effect on Fe levels in hair of cattle (Anke, 1966) and swine (Hedges and Kornegay, 1973).

Determination of certain elements in hair may be useful for long term monitoring of mineral status of animals (Puls, 1994). The result presented suggests that the level of Cu and Zn in hair may be used to predict their respective plasma level in Pomeranian and Labrador breed dogs.

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