

Serum, Plasma and Erythrocyte Zinc Levels in Various Animal Species

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SUMMARY

Zinc, the second most found trace element after iron in animal organisms, is essential for a healthy nourishment and continuation of reproduction of the animals. This study was designed to determine and compare the serum, plasma and erythrocyte zinc levels in several animal species. Suitable samples of serum, plasma and erythrocytes were obtained from blood taken from twenty specimens each of rat, dog, sheep, cow and chicken. The zinc levels were measured in these samples by means of known Atomic Absorption Spectrophotometric methods.

Key Words: blood zinc, rat, dog, sheep, cattle, chicken.

Farklı hayvan türlerinde serum, plazma ve eritrosit çinko düzeyleri

ÖZET

Çinko üremenin devamı ve sağlıklı beslenme için hayvan organizmasında demirden sonra ikinci önemli iz elementtir. Bu çalışma farklı hayvan türlerinde serum, plazma ve eritrositlerde çinko miktarını belirlemek amacıyla planlandı. Bu amaçla yirmi rat, köpek, koyun, sığır ve tavuktan usulüne uygun şekilde kan alınarak serum, plazma ve eritrosit elde edildi. Bu örneklerdeki çinko seviyeleri Atomik Absorpsiyon Spektrofotometrik metotla ölçüldü.

Anahtar Kelimeler: kan çinko, rat, köpek, koyun, sığır, tavuk

INTRODUCTION

The determination of trace elements in blood and tissues has been widely used in the last two decades as a tool to understand their metabolic role in humans and animals (14).

Zinc deficiency symptoms were first reported only in winged animals. In subsequent studies it was shown that zinc deficiency is also found in ruminants, and that it is related to pasturing conditions in some regions (12).

In animals, zinc is found in most body tissues. In blood, it is found in plasma, erythrocytes, leucocytes and thrombocytes. About 30-40% plasma zinc is bound to α -2-macroglobulin and 60-70 %, to albumin. Erythrocyte zinc exists mainly as a constituent of carbonic anhydrase and other enzymes (19).

To establish the reference values for zinc in the animal species chosen, the levels of zinc in serum, plasma and in erythrocytes, where 75-88% of blood zinc is found, were used instead of whole blood in this study

MATERIALS AND METHODS

Blood samples were taken from twenty 8-week-old rats, twenty 3-6 year-old dogs, twenty 3-4 week-old sheep, twenty 6-9 year-old cows and twenty broiler chickens. Animal diet's contain 50 mg/kg Zn (DM). The plasma was obtained by centrifuging blood collected into heparin-containing tubes, while the serum was obtained by centrifugation of non-coagulated blood at 700 g for 5 minutes. The plasma and serum were frozen at -20 °C until needed for analysis. The erythrocytes were washed three times with saline solution and then hemolysed by 1:10 dilution with distilled water. A UNICAM 929 Atomic Absorption Spectrophotometer was used for the quantitative determination of zinc in the plasma, serum and erythrocyte samples, following standard analytical procedures (10).

RESULTS

The serum, plasma and erythrocyte zinc levels in rat, dog, sheep, cow and chicken are given in Table 1.

Table 1; Serum, plazma and erythrocyt zinc levels in several animal species

Animal Species	Serum ($\mu\text{g}/\text{dl}$) ($\bar{x}\pm\text{sd}$)	Plasma($\mu\text{g}/\text{dl}$) ($\bar{x}\pm\text{sd}$)	Erythrocytes ($\mu\text{g}/\text{g Hb}$) ($\bar{x}\pm\text{sd}$)
Rat	190 \pm 38	181.3 \pm 32.3	32.5 \pm 2.0
Dog	147.3 \pm 10.4	225 \pm 46	17.9 \pm 1.2
Sheep	203.2 \pm 54.9	178.8 \pm 30.3	47.1 \pm 2.5
Cow	198.7 \pm 45.8	178.8 \pm 33.3	22.82 \pm 1.5
Chicken	170.7 \pm 22.5	186.0 \pm 79.8	55.5 \pm 3.2

DISCUSSIONS

In rats, the measured zinc levels are 190 \pm 38 $\mu\text{g}/\text{dl}$ in serum, 181.3 \pm 32 $\mu\text{g}/\text{dl}$ in plasma and 32.50 \pm 2.0 $\mu\text{g}/\text{g Hb}$ in erythrocytes. For this animal species, Underwood reports zinc levels in erythrocytes of 100 $\mu\text{g}/\text{dl}$, while Tamer et al., reports values of 120 \pm 8 $\mu\text{g}/\text{dl}$ in serum and Antaplı, gives a range of 100-200 $\mu\text{g}/\text{dl}$ (1,17,19).

Zinc levels for chickens are 170.7 \pm 22.5 $\mu\text{g}/\text{dl}$ for serum, 186 \pm 79.8 $\mu\text{g}/\text{dl}$ in plasma and 55.48 \pm 3.2 $\mu\text{g}/\text{g Hb}$ in erythrocyte. Mert gives serum zinc levels of 115 $\mu\text{g}/\text{dl}$ (13) and for plasma, Dede and Deger (5) report 226 \pm 59 $\mu\text{g}/\text{dl}$.

In dogs, we found zinc levels of 147.3 \pm 10.4 $\mu\text{g}/\text{dl}$ in serum, 225 \pm 46 $\mu\text{g}/\text{dl}$ in plasma and 17.93 \pm 1.2 $\mu\text{g}/\text{gHb}$ in erythrocytes. For dogs, Underwood (19) gives values of erythrocyte zinc as 9 $\mu\text{g}/\text{g Hb}$. Kızıler and Barutcu (11) found serum zinc levels to be in the 83.93-46.13 $\mu\text{g}/\text{dl}$ range, in some agreement with the value 88.5-95.7 $\mu\text{g}/\text{dl}$ established by Fisher (7), but below that of Tiftik (18), who reported a serum zinc level of 140 $\mu\text{g}/\text{dl}$ in dogs.

Sheep yielded zinc levels of $203.2 \pm 54.9 \mu\text{g/dl}$ in serum, $178.5 \pm 30.3 \mu\text{g/dl}$ in plasma and $47.07 \pm 2.5 \mu\text{g/gHb}$ in erythrocytes. Gücüs et al (8), measured plasma zinc levels between 30.2 and 90.0 $\mu\text{g/dl}$. Antaplı (1) reported values of 108.56 ± 2.05 and $58.3 \pm 9.6 \mu\text{g/dl}$ and, also in plasma as 70-100 $\mu\text{g/dl}$. Other reports serum zinc at 80-117 $\mu\text{g/dl}$ (13), 46 $\mu\text{g/dl}$ (16), 140 $\mu\text{g/dl}$ (18) and in the 50 - 90 $\mu\text{g/dl}$ range (3).

In cattle, we found zinc levels as $198.7 \pm 45.8 \mu\text{g/dl}$ in serum, $178.5 \pm 33.3 \mu\text{g/dl}$ in plasma and $22.82 \pm 1.5 \mu\text{g/gHb}$ in erythrocytes. Previously reported serum zinc values, some by authors already mentioned are 150 $\mu\text{g/dl}$ (6), $319 \pm 34 \mu\text{g/dl}$ (13), 214-292 $\mu\text{g/dl}$ (9), 15 $\mu\text{g/dl}$ (15) and 140-150 $\mu\text{g/dl}$ (18). For plasma the previously reported values are 37.2-90.7 $\mu\text{g/dl}$ (8), 44.5-98.9 $\mu\text{g/dl}$ (4) and 53-13.8 $\mu\text{g/dl}$ (1). The same authors report whole blood zinc in the 122-284 $\mu\text{g/dl}$ range.

In all studies published to date zinc is recognized as an essential element for which deficiency can be the origin of many symptoms. Most relevant in mammals are disruption of normal growth and maturation, loss of appetite, mental disorders, delayed recovery from injuries, higher susceptibility to infection, inability to adapt to darkness, appearance of wounds and hair shedding (8,12,19).

The diagnosis of zinc deficiency requires the availability of reliable analytical methods and reference data. Although plasma levels can show the amount of zinc that was taken with the diet, it does not give a complete picture of zinc status in tissues. The concentration of zinc in hair and body bristles can be accurately measured, but there are too many factors that can affect interpretation of the results, so hair zinc measurements must be accompanied by those in other matrices to have a better understanding of this important parameter. Measuring zinc levels in erythrocytes, leucocytes and fluid secretions, or measuring the activity of zinc-containing enzymes may thus be put into practice as auxiliary tests for the determination of zinc status in animals (2).

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