

## Serum zinc concentrations in dogs with *Microsporum canis* dermatophytosis: a pilot study

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**Abstract:** Zinc deficiency may result in alopecia, erythema, crusting, scaling, parakeratosis, inflammation of the skin, and impaired wound healing. Zinc deficiency also may impair the immune response against microorganisms and lead to fungal infections such as trichophytosis. The present study included male and female dogs (n = 7) of various breeds, ages, and diagnosed with *Microsporum canis* dermatophytosis and 4 healthy dogs used as the control group. The influence of dermatophytosis on serum zinc concentrations in dogs was investigated. Wood's lamp examination, fungal cultures, and additionally biopsy specimen were used to confirm the diagnosis and rule out other causes of the skin lesions. Serum zinc concentrations were determined by use of an atomic absorption spectrophotometer. No statistical difference was found in zinc concentrations between the dogs with dermatophytosis and normal dogs. Based upon the findings of this pilot study, no association was documented between the occurrence of dermatophytosis and the serum zinc concentrations.

**Key words:** Serum zinc concentrations, dermatophytosis, dog

### *Microsporum canis* dermatofitozis'li köpeklerde serum çinko konsantrasyonları: pilot çalışma

**Özet:** Bu çalışmada dermatofitozis tanısı konulan çeşitli ırklardan, yaştan ve her iki cinsiyetten 7 köpek ile kontrol grubu olarak sağlıklı 4 köpek kullanıldı. Dermatofitozis serum çinko konsantrasyonu üzerine olan etkileri araştırıldı. Tanı amacıyla Woods lambası ile muayene, mikolojik kültür ve ilave olarak biyopsiye başvuruldu. Serum çinko konsantrasyonu atomik absorpsiyon spektrofotometre kullanılarak ölçüldü. Dermatofitozis'li ve kontrol grubu köpekler arasında serum çinko seviyelerinde istatistiksel olarak öneme haiz bir fark bulunamadı. Sonuç olarak bu bulgular eşliğinde dermatofitozis oluşumu ile serum çinko seviyeleri arasında bir ilişki olmadığı söylenebilir.

**Anahtar sözcükler:** Serum çinko seviyeleri, dermatofitozis, köpek

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**Introduction**

The superficial mycoses are the fungal infections of the cornified dead layers of skin, hair or nails (1). *Microsporium* spp. and *Trichophyton* spp. are the most common causes of dermatophytosis, in particular *Microsporium canis*, *Microsporium gypseum*, and *Trichophyton mentagrophytes* are the most commonly isolated fungi from the clinical cases of dermatophytosis in dogs and cats (1-3). Dermatophytosis is pleomorphic in its presentation and can present as solitary to multifocal areas of inflammation that may be annular to irregular in size. Alopecia, scaling, crusting, follicular papules, and pustules may be seen. Lesions are commonly localized on face, pinnae, paws, and tail (1,2). During the course of infection, the organism’s pathogenicity and the host’s immune system play a significant role in the disease course. In most healthy adult hosts, dermatophyte infections are self-limiting. Clinical infections requiring medical intervention tends to be more commonly observed in young or debilitated, sick and old animals and also in longhaired breeds of domestic cats (3).

Zinc is an essential trace element found in all body tissues and body fluids. Eighty-five percent of body zinc is present in muscles and bones, 11% in skin and liver, and 2% to 3% in other organ tissues. Zinc also has a particular role in keratinisation of the epidermis. The biochemical functions of zinc are related to the functions of the enzymes being a cofactor (4). It also plays a role in activation of several metalloenzymes and is required for normal protein synthesis and metabolism. It is also an insulin component and is therefore essential in carbohydrate metabolism (4).

Zinc-deficient diets or diets containing zinc chelators may cause zinc-responsive dermatosis in dogs (5). Zinc deficiency may result in alopecia, erythema, crusts, scale, parakeratosis, inflammation of the skin, and impaired wound healing (5,6). Zinc deficiency also may impair the immune response against microorganisms and lead to fungal infections, such as trichophytosis (7).

Given the role of zinc in keratinization of epidermis and maintenance of a healthy immune system, the objective of this study was to investigate the possible relationship between dermatophytosis and serum zinc concentrations in dogs naturally infected with *M. canis*.

**Materials and methods**

Animals: Seven dogs (5 males and 2 females) of various breed (cocker spaniel (n = 3), golden retriever (n = 2) great Dane (n = 2)) with naturally occurring *Microsporium canis* dermatophytosis were included in the study. The dogs’ mean age was 3.14 ± 1.68 years; range: 1-5 years. All dogs had confirmed diagnoses (Table 1). Four healthy dogs were served as control animals (Table 2). All the dogs in the control group were selected among the healthy dogs that were brought for annual vaccinations. The diagnostic protocol was reviewed by the owners and the tests were conducted with the owner’s consent. The diagnostic protocol, including all assays, was maintained at the same time for all dogs.

Clinical examinations: A complete history and physical examination was performed and a standard

Table 1. Description of dogs and serum zinc levels in the treatment group.

No	Breed	Age	Sex	Diagnosis	Serum zinc level (µmol/L)
1	Cocker spaniel	4	F	Wood’s lamp Culture Histopathology	13.20
2	Cocker spaniel	3	M	Wood’s lamp Culture Histopathology	11.95
3	Golden retriever	1	M	Wood’s lamp Culture	13.60
4	Cocker spaniel	1	M	Wood’s lamp Culture	12.65
5	Great Dane	3	M	Wood’s lamp Culture	14.75
6	Great Dane	5	M	Wood’s lamp Culture	15.20
7	Golden retriever	5	F	Wood’s lamp Culture	14.42

Table 2. Description of dogs and serum zinc levels in control dogs.

No	Breed	Age	Sex	Serum zinc level ( $\mu\text{mol/L}$ )
1	Cocker Spaniel	2	F	14.80
2	Mix breed	3	M	14.78
3	Great Dane	3	M	13.76
4	Golden retriever	3	F	12.86

set of diagnostics performed. Skin scrapings and skin cultures were taken from lesions to look for demodicosis and bacterial and fungal infections. All swab samples were inoculated onto blood agar plates and incubated overnight at 37 °C. In 2 dogs, the diagnosis was also confirmed by skin biopsy.

**Dermatophyte diagnostic methods:** Wood's lamp examination, fungal cultures and in 2 dogs additionally biopsy specimen were used for diagnosis. All dogs were examined in a dark room under Wood's lamp and yellowish-green fluorescence suggested the presence of dermatophyte infection. After this examination hairs that fluoresced were cleaned with cotton soaked in 70% alcohol and removed with a hemostat. Hair samples were observed under a light microscope at 40 $\times$  magnification after 30 min of incubation in 20% potassium hydroxide. Samples were incubated onto Sabouraud's dextrose agar medium incubated for 3 weeks at 25 °C and 37 °C under aerobic conditions.

Plates were examined, and growing colonies were identified using macroscopic and microscopic characteristics. The species of colonies grown in the medium were identified according to the thallus morphology and by microscopic examination of the hyphae, macroconidia, and microconidia. For microscopic evaluation, the slides were stained with lactophenol cotton blue.

**Measurement of serum zinc concentrations:** Blood samples were collected into vacuum tubes from the 7 dogs with dermatophytosis and 4 control dogs. All vacuum tubes were cooled at 25 °C and allowed to coagulate. After clot formation, samples were centrifuged at 1000 g for 10 min and serum samples were collected and analyses were performed immediately. Serum zinc concentrations were determined by atomic absorption spectrophotometer (Zeeman SIMAA 6000, Perkin Elmer).

**Statistical analyses:** Statistical analyses were performed with SPSS. Student's t test was used to compare mean serum concentration between the affected and unaffected dogs. Calculated P values <0.05 were considered statistically significant.

## Results

**Clinical findings:** Dogs in the present study exhibit annular inflammatory lesions of peripherally invading alopecia, scale, crusts, follicular papules, and/or pustules. In 5 dogs, lesions were localized on head, especially on eye and pinnae, and they were located in trunk and legs in 2 dogs.

**Microbiological findings:** *M. canis* was identified by fungal cultures from lesions of all dogs in the assay group.

**Histopathological findings:** Histopathological examination revealed secondary crusting and ulceration at epithelium, perivascular mixed type inflammatory cell infiltration at dermis, and typical fungal spores in and around the hair follicles.

**Serum zinc concentrations:** In the assay group, mean serum zinc concentration was  $13.68 \pm 1.18$   $\mu\text{mol/L}$  with concentrations ranging between 11.95 and 15.20  $\mu\text{mol/L}$ . These results were not statistically different (Table 3) compared to those obtained in the control group (mean serum zinc concentration:  $14.05 \pm 0.93$   $\mu\text{mol/L}$ ; values 12.86 - 14.80  $\mu\text{mol/L}$ ).

## Discussion

Zinc plays an important role in many enzyme systems; it is necessary for normal growth, keratinization, metabolism, and immune system functions. Zinc deficiency was suggested to play a role in many dermatoses of dogs, although a recent study reported that zinc deficiency is rare in the dog (8).

Table 3. Mean concentration of zinc in affected and unaffected dogs.

	No.	Mean	SD	SE	
Study group	7	13,68	1,17	0,44	NS
Control group	4	14,05	0,93	0,46	

P = 0.58

There was no statistical significance between the study and control groups (P > 0.05).

Relative or absolute deficiency of zinc has been documented in bull terriers with lethal acrodermatitis, zinc responsive dermatitis in Siberian huskies and Alaskan malamutes, and in rapidly growing puppies fed with zinc deficient diets (9-12). Acrodermatitis is similar in many respects to acrodermatitis enteropathica in human infants, which is characterized by the development of alopecia, periorificial dermatitis, and diarrhea (13). Deficiency of zinc in these disorders results in crusts, alopecia, erythema, scaling, pruritus and suppuration around head, face, and perineum (1,5). Zinc supplementation reduces the symptoms except for lethal acrodermatitis. Few field cases of zinc-responsive dermatosis caused by nutritional imbalances have been reported in small ruminants (14-18) and in llamas (19). An inherited skin disorder has been described in several calf breeds (15,20,21), which is characterized by scaly, crusty lesions on the skin, formation of scaly debris over the body, poor appetite, salivation, and alopecia. However, calves with hereditary zinc deficiency generally die of secondary infections, due to impaired immune system (17).

In a previous study, zinc deficiency was found in association with lymphopenia and changes in mononuclear phagocyte counts leading to impaired immunity (22). Zinc deficiency may cause skin lesions and therefore facilitates infections of skin (6,7,23). A lower serum zinc concentration was found in calves

with trichophytosis compared to those of healthy calves (7). In the latter study, the authors suggested that zinc deficiency in calves was linked to diffuse skin lesions and severe clinical symptoms as well as the disease itself. Factors that favor fungal infection include any pre-existing disease that will cause an increase of the epidermal surface humidity, micro-trauma to the skin, and/or concurrently constituting immune suppression (24). Given the involvement of zinc in keratinization of epidermis and in efficiency of the immune system, it would be hypothesized that defects of epidermis and possible immunosuppression due to zinc deficiency might facilitate the development of dermatophytosis. However, in the present study, serum zinc concentrations in dermatophytosis-affected dogs and the healthy dogs were similar. Consequently, the occurrence of zinc deficiency as a predisposing factor for dermatophytosis could not be documented in this work. Another possible explanation for the lack of differences in this study and those in the latter mentioned study is the pathogen: *Trichophyton* and the species of calves. In this study, the pathogen was *M. canis* and the host dogs. This may be an important difference. Also, these 2 species have different digestive systems and diets.

In conclusion no significant association between serum zinc concentrations and dermatophytosis was found in this pilot study.

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