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Serum Zinc and Vitamin A Concentrations in Calves with Dermatophytosis

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Summary

The aim of this study was to determine the zinc and vitamin A concentrations in calves with dermatophytosis. Twelve calves infected with dermatophytosis and twelve clinically healthy calves were used in this study. Serum zinc concentrations were determined on a spectrophotometer using commercial kit. Serum vitamin A concentrations were measured spectrophotmeterically. Serum zinc and vitamin A concentrations were found to be significantly lower in calves with dermatophytosis than those of healthy controls. Our results shown that serum zinc and vitamin A concentrations were altered in calves with dermatophytosis.

Keywords: *Calves, Dermatophytosis, Zinc, Vitamin A*

Dermatofitozisli Buzağılarda Serum Çinko ve Vitamin A Konsantrasyonları

Özet

Bu çalışmada, dermatofitozisli buzağılarda serum çinko ve vitamin A konsantrasyonlarının belirlenmesi amaçlandı. Çalışmada, 12 adet sağlıklı ve 12 adet dermatofitozisli buzağı kullanıldı. Serum çinko konsantrasyonları ticari kit kullanılarak spektrofotometrede belirlendi. Serum vitamin A konsantrasyonları spektrofotometrik yöntemle belirlendi. Seum çinko ve vitamin A konsantrasyonları dermatofitozisli buzağılarda sağlıklı kontrol grubundan önemli derecede düşük bulundu ($P<0.001$). Sonuç olarak, dermatofitozisli buzağılarda serum çinko ve vitamin A konsantrasyonlarının değiştiği belirlendi.

Anahtar sözcükler: *Buzağı, Dermatofitozis, Çinko, Vitamin A*

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INTRODUCTION

Dermatophytosis, a transmissible infectious skin disease is caused most often by *Trichophyton verrucosum*, a spore forming fungi [1]. It occurs in all species of mammals including cattle and man [1,2]. It is not fatal but it causes high economic losses in cattle [3,4]. Dermatophytosis is most commonly recognized in calves, in which particularly in the region around the eyes, although generalised skin lesions may develop. In cattle, lesions are characteristically circular, scaly, and hairless and are usually distributed on the head, neck, and trunk [1]. Severity and spread of dermatophytosis depend on the immune system of the host, the causative agent's pathogenicity and environmental factors [5]. The infection causes oxidative stress leading to alterations in homeostasis [6].

Zinc is an essential micronutrient in cattle diets and its deficiency has been associated with several infectious and inflammatory conditions [7,8]. Zinc deficiency therefore enhances oxidative damage to protein, lipids, and DNA in tissues [9]. Zinc is essential components of the body's antioxidant defence that play an important role in the prevention of free-radical-induced damage to tissues for maintenance of health and production [10]. Inflammatory and infectious conditions cause decreased serum and plasma zinc concentrations [7,8,11]. Another important defense booster in living organism is vitamin A. Vitamin A has many functions, including maintenance of epithelial tissue [12]. Vitamin A also increases disease resistance and has stimulatory effects on cell-mediated immunity [12,13]. Deficiency of vitamin A often results in increased prevalence of infectious diseases. The interaction between zinc and vitamin A has already been clarified as absorbtion, metabolism, hepatic release, transport, and tissue utilization of vitamin A may depend on adequate zinc status while severe vitamin A deficiency may reduce absorbtion and lymhatic transport of zinc by altering synthesis of a zinc-dependent binding protein [13]. Zinc appears to regulate the metabolic conversion of retinol to retinal an enzymatic step requiring zinc-dependent alchol dehydrogenase, in the intestine, liver, testes and in the retina, where it participates in an essential step of the visual cycle. Zinc deficiency may also impair synthesis of the protein opsin. Zinc is required for hepatic synthesis cellular retinol-binding protein (cRBP) and retinol-binding protein (RBP), implying a regularatory role for zinc in mobilizing vitamin A within cells and from the liver [14].

It is hypothesized that dermatophytic calves may influence serum concentrations of zinc [15]. It is well-known that zinc deficiency predisposes organism to infections as dermatophytosis [15] but there exist no study evaluating the status of zinc and vitamin A together in dermatophytic calves. The present study was therefore carried out to determine serum zinc and vitamin A concentrations in calves infected with dermatophytosis.

MATERIAL and METHODS

This study was carried out at the animal hospital of the faculty of veterinary medicine, University of Adnan Menderes. Twelve calves infected with dermatophytosis and twelve clinically healthy calves were used in this study. All of the animals were selected from a farm in Izmir in Turkey. All animals were kept in different barns on the same farm. All calves aged between 2 and 4 months old and were not receiving any topical or systemic drugs for the treatment of dermatophytosis or for any other disease. The calves were fed by milk and concentrate feed. The clinical examinations of all calves were performed. After cleaning the area with cotton swab soaked with 70% ethyl alcohol, plucked hairs and scraped scales obtained from 12 calves were examined for fungal agents by direct microscopy in 10% potassium hydroxide and lactophenol [16]. Samples were inoculated on mycobiotic agar. The plates were incubated at 28°C for 2-6 weeks and examined for colony formation. In an attempt to identify the pathogenic fungi, macroscopic and microscopic examinations were carried out and the appearance of fungal growth, colony morphology, colour, shape, size and colony reverse side morphology were examined to remove contaminant fungi and other agents [17]. Blood samples from both groups of calves were taken from jugular vein. The blood samples for zinc concentrations were obtained from the animal twice, at the morning and evening. For the detection of vitamin A concentration, blood samples were obtained only once, at the morning. Samples were immediately centrifuged at 1700 g for 5 min to separate serum. The sera were collected in plastic tubes and frozen at -20°C until analysis. Serum zinc concentrations were determined on a spectrophotometer (Shimadzu 1601) using

commercial kit (Randox, United Kingdom). Serum vitamin A concentrations were measured spectrophotmeterically according to the method detailed by Suzuki [18]. The data were analysed statistically using student's t- test (P<0.05) to determine the significance of differences between the mean values of two study groups.

RESULTS

Clinical examination revealed dermatophytosis. The clinical signs observed in all calves with dermatophytosis were alopecia, scaly patches in head, neck, and limbs. Culture examination revealed *T. verrucosum* as the usual cause of dermatophytosis. Serum Zinc and vitamin A concentrations are shown in dermatophytotic and healthy calves in *Table 1*. Serum zinc concentrations in calves with dermatophytosis were found to be lower than in the healthy controls (P<0.001). When compared to healthy controls, serum vitamin A concentration in the dermatophytotic calves was significantly lower (P<0.001).

Table 1. *Serum zinc and vitamin A concentrations in calves with dermatophytosis and healthy controls*
Tablo 1. *Dermatofitozisli ve sağlıklı kontrol gruplu buzağılarda serum çinko ve vitamin konsantrasyonları*

Parameter	Reference values	Dermatophytosis (n=12) (x±SE)	Controls (n=12) (x±SE)	P
Zinc (µg/L)	6.0-12	7.92±0.77	11.87±0.47	<0.001
Vitamin A (µg/dl)	15.4-32.3	9.47±1.68	14.91±0.49	<0.001

Reference values according to the reports of Can et al [24], Surynek et al [25]

DISCUSSION

Dermatophytosis is superficial skin infection caused by a filamentous fungus. Dermatophytosis has a worldwide distribution in cattle and is responsible for high economic losses in cattle farming [2]. Deficiencies of specific nutrients can reduce immune responses and increase disease susceptibility [19]. The trace element zinc is essential components of the body's antioxidant defense that play an important role in the prevention of free-radical-induced damage [10]. The role of certain inflammatory products in the regulation of zinc balance has been reported [20]. Interleukins are released from activated phagocytes, causing a lowering of zinc concentrations, resulting from increased synthesis of metallothionein in liver and other tissues [21]. Metallothionein is an efficient mechanism for removing zinc from circulations [21]. We were unable to determine metallothionin but the decrease in serum zinc concentrations may be attributed to increased synthesis of metallothionein. Zinc deficiency have also been reported in several infectious diseases and inflammatory conditions [7,8]. It has been reported that serum zinc concentrations decreases in dogs with dermatosis [22]. This study showed that serum zinc concentration decreases in infectious diseases. We found decreased serum zinc concentrations in the diseased calves with respect to the control group. This finding is agreement with previous observations [15]. The decrease in serum zinc concentrations might affect immune system and support the idea that zinc deficiency causes skin lesions and facilitates dermatophyton infections [15]. It has been reported that the decrease in serum zinc concentrations may be related to diet [15]. Unfortunately, we did not measure the levels of zinc and vitamin A in feed consumed by calves used in the study.

Vitamin A has numerous functions such as maintenance of epithelial cells, vision, immune cell function and gene regulation [12]. Vitamin A concentrations in serum samples change during infection [12,13]. These changes are part of the defense strategies of the organism, induced by IL-1 and IL-2 [12,13]. It was reported that vitamin A deficient - animals were more susceptible to various types of infections [23]. In this study, we showed that serum vitamin A concentrations were significantly lower in calves with dermatophytosis. The decreased vitamin A may be the result of infection [12]. In response to infection, IL-1 from macrophages, IL-2 from lymphocytes is excreted, resulting in a decrease of vitamin A [12].

Two mechanisms are most often postulated to explain a potential dependence of vitamin A on zinc. One relates to a regulatory role of zinc on vitamin A transport mediated through protein synthesis. Zinc deficiency can depress the synthesis of RBP in the liver and lead to lower concentrations of RBP in the plasma. The other postulated mechanism is an interaction between vitamin A and zinc through the ubiquitous, oxidative conversion of retinol to retinaldehyde (retinal), a critical step in the metabolic pathway of vitamin A that is well-described in the visual cycle in the

retina of the eye and requires the action of a zinc-dependent retinol dehydrogenase enzyme [14]. In this study, we found that calves infected with dermatophytosis showed a significantly low serum zinc and vitamin A concentrations. In conclusion, zinc and vitamin A supplementation may be benefits for recovery dermatophytosis as well as antifungal therapy.

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