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The Effect of Zinc Injection on the Duration of Protection Against Abscess Diseases in Vaccinated Ewes

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Abstract: The effect of zinc injection on the duration of protection against abscess disease was studied on ewes vaccinated against the disease. Thirty two Najdi ewes, 1 to 2 years of age, were divided into 4 groups of 8 animals each. Group 1 ewes were injected subcutaneously with zinc, as zinc oxide suspended in olive oil, at a dose rate of 5 mg kg⁻¹ body weight. Group 2 ewes were concurrently injected with 5 mg kg⁻¹ zinc and vaccinated against abscess disease. Group 3 ewes were injected with the vaccine only. Group 4 ewes were left as untreated controls. A booster dose of the zinc and/or vaccine was given to ewes of groups 1, 2 and 3 fifteen days after the initial dose. Eight rams infected with abscess disease were used as a source of natural infection and were mixed with the experimental animals in one pen after the injection of the booster dose. Loss of protection of zinc and/or vaccine against the disease is considered when an abscess appeared in one animal of the group. Abscesses appeared in the 16th week post introduction of infected rams in group 1 ewes. Group 2 ewes developed abscesses in the 37th week after introduction of infected rams. The abscesses developed in this group were of smaller size compared to those seen in the other groups. Group 3 ewes developed abscesses in the 19th week after subjection to the natural infection. Group 4 ewes developed abscesses in the 4th week after introduction of infected rams. Concurrent injection of zinc and vaccination gave the longest protection against abscess disease.

Key words: Zinc injection, abscess disease, Najdi sheep, immunity

INTRODUCTION

Abscess disease of sheep, commonly known as Morel's disease (caused by *Staphylococcus aureus* subsp. *anaerobicus*) and caseous lymphadenitis known as pseudotuberculosis (caused by *Corynebacterium pseudotuberculosis*) deserves interest because of its contagious nature and worldwide distribution (Bajmocy *et al.*, 1984; Rodwan, 1996). The disease causes downgrading of sheep carcasses and restriction of importation (Paton *et al.*, 1988, 1994). The need for an effective control against the disease is obvious as its incidence is increasing worldwide (Jones *et al.*, 1997).

Abscess disease is essentially an acute to subacute cellulitis characterized by the development of subcutaneous abscesses at the vicinity of lymph nodes especially those of the head (Jones *et al.*, 1997). The inflammatory process leads to liquefactive necrosis of the affected lymph node due to the secretion of an alpha haemolysin by the organism. Alpha haemolysin is lytic to erythrocytes, dermo-necrotic, lethal and exhibits a wide variety of other biological properties (Cruickshank *et al.*, 1975; Rodwan, 1996). A beta toxin was also found in association with this organism, but, though haemolytic, it had no or negligible lethal action (Jones *et al.*, 1997). Abscesses develop at inoculation sites and regional lymph nodes following skin inoculation. The organism was not pathogenic by the oral route (Hamad *et al.*, 1992).

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Zinc is an essential trace element that has been found in more than 200 enzymes and enzyme-related proteins (Underwood, 1981; Hambridge *et al.*, 1986). Deficiency lead to skin lesions, retarded wound healing and reduced immunity (Mahmoud *et al.*, 1983; Jaja, 1994). Lowered resistance to infection was also manifested by formation of superficial abscesses, diarrhea and progressive pneumonia (Jaja, 1994).

Intensive sheep production in the Kingdom of Saudi Arabia resulted in the emergence of abscess disease with increasing annual frequency (Anonymous, 2005). Sheep farmer are complaining from the effectiveness of available vaccines. In this experiment, the role of zinc on the duration of protection against abscess-disease is investigated in vaccinated Najdi ewes.

MATERIALS AND METHODS

Thirty two clinically healthy Najdi ewes, 1-2 years of age, were divided into 4 equal groups. Group 1 sheep (8 ewes) were injected with zinc, as zinc oxide suspended in olive oil, at a dose rate of 5 mg zinc kg⁻¹ body weight. Group 2 sheep (8 ewes) were concurrently vaccinated with a killed formalized vaccine (Galnvac 6, CSL Limited, Parkville 3052, Victoria, Australia) at its standard dose (1 mL/animal) and injected with zinc at a dose rate of 5 mg zinc kg⁻¹ body weight. Group 3 sheep (8 ewes) were injected with the vaccine only. Group 4 sheep (8 ewes) were the untreated controls. Eight infected rams heavily infected with abscess disease served as a source of natural infection.

After 15 days, a booster dose of zinc and/or vaccine was injected in ewes of groups 1, 2 and 3 at doses as before. Then the animals in all groups were mixed with the infected rams in one large pen and observed for development of abscesses. Appearance of abscesses in one animal in the group was considered as an indication of loss of immunity against the disease.

RESULTS AND DISCUSSION

Clinical Disease

Table 1 shows the development of abscesses in the animals post mixing with the infected rams. All abscesses developed on the lymph nodes of the head. Abscesses appeared in ewes of group 1 at the 16th weeks of subjection to natural infection. Ewes of group 2 developed abscesses at the 37th week after the introduction of infected rams. The abscesses that developed in animals of this group were of small size compared to those seen in ewes of other groups (Fig. 1 a, b). Ewes in group 3 developed abscesses after the 19th week of exposure to infection. Abscesses appeared in 6 ewes of the control group after the 4th of subjection to the natural infection.

Concurrent injection of zinc and vaccination produced the longest duration of protection against abscess disease of sheep. Group 2 ewes which received both the vaccine and zinc injections remained free of the disease for 36 weeks from subjecting them to a source of natural infection. The abscesses that developed after loss of immunity to infection in this group were of smaller size when compared to those seen in other groups.

Zinc has been shown to have strong wound healing and immune stimulating function (Underwood, 1981; Ibs and Rink, 2003). Zinc depletion has resulted in decreased immune cell functions (Ibs and Rink, 2003). In monocyte, functions have also impaired whereas natural killer cells

Table 1: Appearance of abscesses post introduction of infected rams

Group	No. of ewes in the group	Treatment	First appearance of abscesses
1	8	5 mg zinc kg ⁻¹ b.wt.	16th week
2	8	5 mg zinc kg ⁻¹ b.wt. + vaccine	37th week
3	8	Vaccine	19th week
4	8	-----	4th week



Fig. 1a: Ewe from group 2 developing a small abscess in the neck in the 37 weeks post introduction of infected rams



Fig. 1b: Ewe from group 4 developing a large abscess after 16 weeks of introduction of infected rams

cytotoxicity is decreased. Phagocytic activity of neutrophils and macrophages has been reported to reduced in zinc deficient animals (Ibs and Rink, 2003). Addition of zinc has been reported to result in restored normal functions and resulted in the release of cytokines by immune cells. Microbial growth has been reported to be inhibited in abscesses and it has been suggested that a protein in the abscess fluid through its binding effect with zinc inhibited bacterial growth within an abscess (Ibs and Rink, 2003). These findings might have been involved in longer protection of the disease in this study.

The method of transmission of abscess disease of sheep remained speculative. Dipping, shearing, thorns of Acacia shrubs and feeding of dry barley were just some of the many factors incriminated in the transmission of the disease in different countries (Jones *et al.*, 1997; Jaja, 1994; Anonymous, 2005). We used naturally infected rams to transmit the infection to the study ewes and they transmitted the disease effectively well to the healthy ewes which suggested that direct contact could be an important method of transmission.

Concurrent injection of zinc and vaccination protected against abscess disease for about 7 months. It is logical to assume that concurrent vaccination and zinc injection of sheep every 6 months will confer good protection against abscess disease. For better evaluation, the results of this experiment will be put on field trial involving large number of animals.

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