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Review paper

Control of bovine ringworm by vaccination in Norway

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ABSTRACT

Bovine ringworm caused by *Trichophyton verrucosum* is a notifiable disease in Norway. New infected herds are reported to the Norwegian Food Safety Authority. To limit spread of the disease, restrictions are imposed on holdings including access to common pastures and sale of live animals. Bovine ringworm has been endemic in the Norwegian dairy population for decades. Since 1980 a vaccine (Bovilis Ringvac LTF-130, Merck Animal Health) has been available. The vaccine contains an attenuated strain of *T. verrucosum* and stimulates humoral and cellular immune responses conferring protection. Efficacy and safety of the vaccine have been evaluated in experimental and field studies. Vaccination campaigns in densely populated counties have contributed to a substantial decrease in number of ringworm outbreaks. The annual incidence of new infected herds decreased from 1.7% in 1980 to 0.043% in 2004. Few herds remained with restrictions and a "mopping up" project was established to offer assistance specifically to these holdings. A milestone was achieved in 2009; no new herds with cases of clinical ringworm caused by *T. verrucosum* were reported to the authorities. By end of 2012, there are only two herds with restrictions. Vaccination during the last 30 years has been a key control measure in the effort to prevent disease outbreaks and eradicate bovine ringworm in Norway.

Contents

1. Introduction

Fungal infection of the hair and keratinized layers of the epidermis is termed ringworm or dermatophytosis. In cattle, the dermatophyte *Trichophyton verrucosum* is most commonly isolated from the skin lesions (Radostits et al., 2007) and therefore the disease is also named trichophytosis. Bovine ringworm is endemic in many countries worldwide. It is particularly common in calves and outbreaks usually occur during the autumn and winter months when animals are confined in-house. High density of animals and close contact promote direct transmission

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between animals and spreading of the fungus in the herd or between herds on pasture. Shedding of dermatophyte spores contaminates the farm environment lasting for several years and is a source of maintaining the infection in the herd.

Ringworm is considered to be a self-limiting disease and the course of duration usually varies between 4 and 12 weeks leaving the animal with a life-long immunity (Radostits et al., 2007). Appropriate treatment may shorten the period with clinical signs. Hygienic measures are important in order to eliminate the dermatophyte from the environment. Movement restrictions of live animals have been recommended to limit spreading of the disease between herds.

In most countries, bovine ringworm is considered a relatively harmless disease with little impact on production parameters, farm economy and animal welfare. Control measures are rarely implemented by the veterinary authorities or the livestock industry (Radostits et al., 2007). In Norway, a different view prevails and cattle ringworm caused by *T. verrucosum* has been notifiable for decades (Gudding and Naess, 1986). New infected herds are reported monthly to the Norwegian Food Safety Authority. Until 1980, bovine ringworm continued to spread in the dairy cattle population and the disease became rampant in almost every county (Gudding and Lund, 1995). Introduction of prophylactic vaccination at a national scale had a significant impact on number of new ringworm outbreaks. This paper reviews the use of vaccination as a key measure to control bovine ringworm in Norway.

2. Development and use of the vaccine against *Trichophyton verrucosum* infection in cattle in the former Soviet Union

During the 1960s, bovine ringworm was common in the former Soviet Union (Sarkisov and Koromyslov, 1983). The situation called for action and a project was initiated to develop a vaccine at the All-Union Institute of Experimental Veterinary Science (VIEV) in Moscow. More than 1600 isolates of *T. verrucosum* were collected from specimens submitted by laboratories in different European countries, USA, Canada and Mongolia (Sarkisov, 1976). Several isolates were considered as vaccine candidate, and isolate number 130 was selected originating from a calf presenting typical ringworm lesions in 1964.

Kielstein and Richter (1970) used inactivated preparations of *T. verrucosum* for vaccination of cattle, but with limited success. Sarkisov and coworkers (1971, 1976) therefore decided to develop a vaccine containing viable elements of the dermatophyte. By serial sub-cultures *in vitro* of the selected isolate, a stable attenuated strain was obtained characterized by abundant production of microconidia (Fig. 1). Experimental and field trials of the vaccine demonstrated efficacy in prevention of dermatophytosis in individual animals and at herd level (Sarkisov, 1987). Experimental vaccines containing either live mycelium or microconidia of the vaccine candidate strain 130 were given intramuscularly into two groups of calves (48 altogether) with no previous history of trichophytosis. After two months the immunized calves and a group of non-vaccinated calves were challenged with a virulent field strain of *T. verrucosum*. The calves vaccinated with the vaccine containing microconidia did not develop signs of trichphytosis, whereas calves in the other two groups did. A follow-up study included 323 calves immunized with the microconidia containing vaccine and observed for eight years also after cohabitation with ringworm infected cattle. Vaccinated animals were protected against trichophytosis and the author suggested life-long duration of immunity (Sarkisov, 1987).

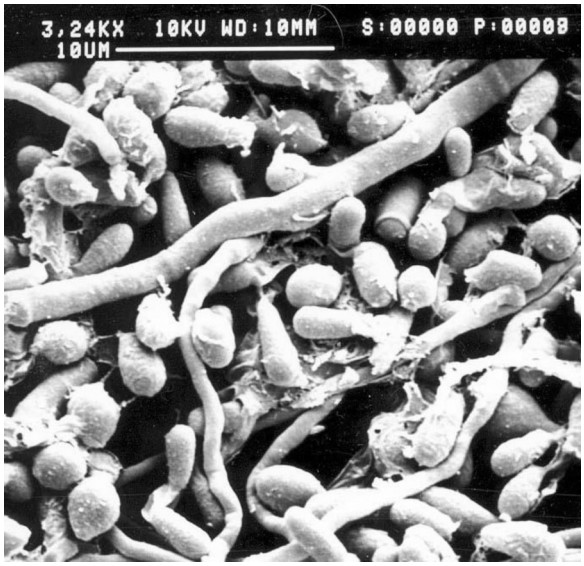

Fig. 1. Scanning electron micrograph of the vaccine strain of *Trichophyton verrucosum* LTF-130 (Bovilis Ringvac LTF-130, Merck Animal Health, Boxmeer, the Netherlands) producing abundant numbers of microconidia (from Lund and DeBoer, 2008).

A nationwide campaign was launched in the Soviet Union in 1969, and approximately 250 million cattle were vaccinated in the period 1970–1980 (Tretiakov et al., 1980). The results were promising and the percentage of infected herds dropped from almost 100% to less than 10% in 1975 (Fig. 2) (Sarkisov and Koromyslov, 1983). The prevalence decreased further to less than 1% by 1984 (Sarkisov, 1987). As bovine ringworm became a rare disease, a substantial decrease in human cases was observed (Sarkisov and Koromyslov, 1983; Heifits, 1985).

When vaccination was introduced in the herds, both adult and young stocks were vaccinated to establish herd immunity. Thereafter, only calves were vaccinated starting at 2–4 weeks of age. In infected herds, vaccination was recommended to continue for 7–10 years. Thus, the former Soviet Union was the first country to demonstrate that bovine ringworm was a vaccine preventable disease. During the 1970s, the vaccine was introduced in Hungary (Horvath and Gaal, 1977), former German Democratic Republic (Rotermund et al., 1977), former Yugoslavia (Krdzalic et al., 1978), Bulgaria (Stankushev et al., 1979) and in Norway as the first country in Western Europe (Aamodt et al., 1982).