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Antibodies to major pasture borne helminth infections in bulk-tank milk samples from organic and nearby conventional dairy herds in south-central Sweden

Johan Höglund[a,*], Frida Dahlström[b], Annie Engström[a], Anna Hessle[b], Eva-Britt Jakubek[a], Thomas Schnieder[c], Christina Strube[c], Sofia Sollenberg[a]

[a] Department of Biomedicine and Veterinary Public Health, Section for Parasitology (SWEPAR), Swedish University of Agricultural Sciences (SLU), Ulls väg 2B 7036, SE 750 07 Uppsala, Sweden
[b] Department of Animal Environment and Health, Swedish University of Agricultural Sciences (SLU), Sweden
[c] Institute for Parasitology, University of Veterinary Medicine Hannover, Germany

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ABSTRACT

The objective of this randomised pairwise survey was to compare the regional distribution of antibody levels against the three most important helminth infections in organic and conventional dairy herds in Sweden. Bulk-tank milk from 105 organic farms and 105 neighbouring conventional dairy farms with access to pasture in south-central Sweden were collected in September 2008. Samples were also collected from 8 organic and 8 conventional herds located in a much more restricted area, on the same as well as 3 additional occasions during the grazing season, to reveal evidence for seasonal patterns against cattle stomach worm (*Ostertagia ostertagi*). Antibody levels to the stomach worm (*O. ostertagi*), liver fluke (*Fasciola hepatica*) and lungworm (*Dictyocaulus viviparus*) were then determined by detection of specific antibodies using three different enzyme-linked immunosorbent assays (ELISAs). According to the Svanovir® *Ostertagia* ELISA, the mean optical density ratio (ODR) was significantly higher in the milk from organic compared to conventional herds, i.e. 0.82 (95% CL = 0.78–0.86) versus 0.66 (0.61–0.71). However, no significant differences were observed in the samples collected at different time points from the same 16 herds ($F_{3,39}$ = 1.18, P = 0.32). Antibodies to *D. viviparus* infection were diagnosed with an ELISA based on recombinant major sperm protein (MSP), and seropositivity was found in 21 (18%) of the 113 organic herds and 11 (9%) of the 113 conventional herds. The seroprevalence of *D. viviparus* was somewhat higher in the organic herds (Chi-square = 3.65, P = 0.056), but with the positive conventional herds were located in the vicinity of infected organic herds. Of the 16 herds that were sampled on repeated occasions, as many as 10 (63%), were seropositive on at least one sampling occasion. Many of these turned positive towards the end of the grazing season. Only one herd was positive in all 4 samples and 3 were positive only at turn-out. Considering *F. hepatica* there was no difference in seroprevalence between organic and conventional herds according to the Institute Pourquier® ELISA. In general, liver fluke infection was low and it was only diagnosed in 8 (7%) organic and 7 (6%) conventional herds.

1. Introduction

Cattle are economically the most important livestock in Sweden where milk and beef originate from approx-

* Corresponding author. Tel.: +46 18 67 14 56; fax: +46 18 67 43 04.
E-mail address: Johan.Hoglund@bvf.slu.se (J. Höglund).

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imately 1.6 million cattle, including 355,000 dairy cows, which accounts for 64% of the economic value in the domestic animal production (Anon., 2009). Most dairy cattle (93%) in Sweden are raised in conventional herds (Anon., 2009). At the same time there is a political goal to increase the Swedish organic production of agricultural commodities to 20%. As a result the proportion of Swedish livestock production run organically is steadily increasing.

A major difference between organic and conventional cattle production is that the prophylactic use of anthelmintics is prohibited in organic herds (Anon., 2008), although anthelmintics are not always used even in conventionally reared cattle. There are also regulations about prolonged minimum lengths of the grazing periods in organic production (Anon., 2008). However, irrespective of whether Swedish dairy producers are organic or conventional, according to the national animal welfare legislation act cattle older than 6 months, bulls excluded, must have outdoor access during grazing season for at least 2–4 months depending on region (DFS, 2007:5). Thus all dairy cattle in Sweden are exposed for at least several months to a wide range of helminth parasites with larval stages that are picked up with the grass grazed on pasture.

Among many different species of pasture borne nematode parasites that can infect cattle, there are only a few that cause major problems, notably the stomach worm *Ostertagia ostertagi* and lungworm *Dictyocaulus viviparus*. Both of these parasites are widely distributed in Sweden, particularly in first season grazing (FSG) animals, where they may act as the major causes of impaired or reduced productivity of both beef and milk even where infection levels are sub-clinical. For example, the weight-gain penalties in unprotected set stocked FSG animals were on an average in the range of 20–65 kg from turn-out to housing, compared to simultaneously grazed calves that were fully protected from parasites by the use of effective anthelmintics (Dimander et al., 2000, 2003; Larsson et al., 2007).

Although, it is particularly the FSG that are at risk of developing disease and sub-clinical production losses, pasture borne nematodes are also important infections potentially limiting production in adult dairy cattle (for reviews see Ploeger, 2002; Charlier et al., 2009b). The liver fluke *Fasciola hepatica* is another important helminth parasite, but baseline data on its distribution and importance in dairy in Sweden is currently missing. In contrast to the nematodes, this trematode parasite is indirectly transmitted, mainly through the snail *Galba* (*Lymnaea*) *truncatula* with a preference for wet areas (Torgerson and Claxton, 1999).

It is often anticipated that organic livestock production leads to an increased risk of being exposed to pasture borne parasite infection, but comparative information on the level of parasitism in organic versus conventional dairy herds is limited (Kijlstra and Eijck, 2006). According to an earlier Swedish study, the levels of gastrointestinal nematode infections in FSG animals were not dramatically increased in 15 organic herds monitored over a 2-year period (Höglund et al., 2001). This was so despite a restricted use of anthelmintic drugs in combination with increased access to outdoor areas, including a prolonged period of grazing. The loss of an effect could partly be explained by the fact that alternative preventive antiparasitic measures were adopted more frequently by organic than conventional dairy farmers (Svensson et al., 2000). However, it is nearly a decade since these studies were conducted, and some of the farms that participated had been managed in an organic fashion only for a few years when the studies were started.

There is still limited scientific evidence as to whether the movement towards increased organic production in Sweden has had any significant effects on the severity of parasite infection in grazing livestock. Especially for adult dairy cattle, information on the level of parasitism and its constraints on organic farming is restricted. The purpose of the present study was to compare the antibody levels towards major pasture borne helminth parasites in organic and nearby conventional dairy herds, and thereby to examine if the level of parasitism has been changed in response to this managerial shift. To this end we have for the first time in Sweden tested a novel surveillance technique based on the examination of antibody levels to all major cattle helminths in bulk-tank milk samples (Bennema et al., 2009).

2. Material and methods

2.1. Milk samples

A research system was established consisting of farm-pairs, where each pair included one organic farm matched with one conventional. Overall a total of 210 bulk-tank milk samples were collected in September 2008 by a technician at the Eurofins laboratory in Jönköping, Sweden, who randomly selected milk from each of 105 organic farms, representing 22% of all organic herds in Sweden ($n = 470$), and from 105 matching nearby conventional herds. All samples, except for 16 herds monitored more closely, were taken from herds situated in a restricted district that delivered their milk to Arla-Foods (Fig. 1). This is a dairy intensive area situated in south-central Sweden covering about 65% of the total milk production in Sweden. Furthermore, 8 organic and 8 matching nearby conventional herds were selected, located in an even more restricted area between the large lakes shown in Fig. 1. On these farms, additional milk samples were also taken throughout the grazing season to study the time course of antibody responses to *O. ostertagi*. These samples were first taken at the time for turn-out and then again 6, 15 and 20 weeks post-turn-out. All milk samples were collected in special tubes pre-treated with bronopol as a preservative. Upon arrival at our laboratory, fat was removed from the milk by centrifugation (16,000 × g for 5 min) and samples were stored at −20 °C before being analysed.

2.2. Antibodies in milk

Three different enzyme-linked immunosorbent assays (ELISAs) were used to determine the antibody levels in the collected bulk-tank milk samples. Two tests are commercially available and were used and interpreted according to the manufacturers' instructions. First, specific antibod-