Abstract

The relationship between the results of serological examination for Mycobacterium avium subspec. paratuberculosis infection and milk production and milk quality in cows showing no clinical symptoms of Johne’s disease was studied. Total cell count, somatic cell count and milk yield were assayed over 12 months in 4 dairy cattle herds. It was demonstrated that seropositive and serodoubtful animals showed lower milk yield than seronegative animals. The quality of raw milk yielded by seropositive and serodoubtful cows was worse than the quality of milk produced by seronegative cows.

Key words: cows, Mycobacterium, paratuberculosis, milk quality, milk yield.

Changes in raw milk quality can be caused by a variety of factors, including mastitis and systemic cattle diseases as most frequent causes. In Poland, according to the Ministry of Agriculture and Rural Development Regulations, milk originating from cows showing obvious clinical symptoms and confirmed diseases is banned from the collection for consumption purposes.

Paratuberculosis is a disease with a long incubation period. Clinical symptoms are most frequently observed in 3-5-year-old animals and are not specific. They include: persistent watery diarrhoea, body weight loss, apathy, milk production drop and irregular fluctuations of body temperature. Lack of pathognomonic symptoms often leads to incorrect or late diagnosis. Currently, paratuberculosis occurs considerably more frequently in a subclinical form with two possible stages. The first is when infected cattle do not excrete Mycobacterium avium subspec. paratuberculosis (MAP) cells, and the other is when these cells are disseminated to the environment, mainly with faeces (10). One of the methods used in the diagnosis of subclinical infection in animals over 2 years of age is ELISA. It is currently acknowledged as the most sensitive and effective laboratory diagnostic method for the detection of infection in a herd. The absorption phase allows to remove the majority of non-specific immunoglobulins and to prevent false positive results (3, 4).

Due to the lack of characteristic clinical symptoms, the prevalence of subclinical form of paratuberculosis is likely to be more extensive than expected (5). In recent years in Poland, clinical cases of this disease have not been reported. However, studies carried out on dairy cattle herds in north-eastern Poland have demonstrated the presence of subclinical form of paratuberculosis. Cases of this disease have also been diagnosed in other European countries (6, 9, 13).

The aim of this paper was to study the relationship between paratuberculosis seropositive and serodoubtful results and milk yield and milk hygienic quality in dairy cows.

Material and Methods

The experimental material were samples of raw milk taken from 4 dairy cattle herds throughout a year. The samples were previously selected the basis of serological analysis using ELISA. Two small herds (A and B) with 10 cows in each and two large herds (C and D) with 100 cows in each were selected for the study. Using the ELISA, both positive and doubtful reactions were recorded in the large herds, while positive reactions were found in the small herds only. The herds were evaluated for milk yield based on production recording made systematically by milk farm owners.

The milk yield was analysed for animals with:
- positive reaction of blood serum in the ELISA (D1 group),
- doubtful reaction of blood serum in the ELISA (D2 group),
- negative reaction of blood serum in the ELISA (K-control).
Hygienic quality evaluation of the raw milk samples collected from all the groups once a month was also performed. The sampling was performed according to the Polish norm PN-A 86040 and the samples were delivered on the same day (at 4º C) to an independent analytical laboratory where the total cell count (TCC) and somatic cell count (SCC) were assayed using the Bactoscan and Fossomatic, respectively.

Results

Mean milk yield in the particular animal groups in 4 herds is given in Table 1. In the small herds in paratuberculosis affected animals, the milk yield in herd A was by 9.7% lower and in herd B it was by 10.3% lower than the mean milk yield in the control animals (K). In the large herds in the seropositive animals (D1), the milk yield in herd C was by 21% lower and in herd D it was by 24.7% lower than the mean milk yield in the control animals. Even greater differences in the milk yield were observed in the serodoubtful animal group (D2); they were by 23.5% and 33.5% lower than the mean values in herd C and D, respectively.

Table 1

<table>
<thead>
<tr>
<th>Animal group</th>
<th>Small herds</th>
<th>Large herds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seropositive (D1)</td>
<td>5340</td>
<td>4824</td>
</tr>
<tr>
<td>Serodoubtful (D2)</td>
<td>5401.5</td>
<td>4667</td>
</tr>
<tr>
<td>Seronegative (K)</td>
<td>5917.5</td>
<td>6104</td>
</tr>
</tbody>
</table>

--- missing animal group.

Figure 1 presents the TCC and SCC values in thousand/ml in milk samples obtained from herd C animals. Respecting the microbiological milk quality, 100% of the samples from the seropositive (D1) and seronegative (K) animals as well as 90% of the samples from serodoubtful cows (D2) were classified in the extra class. In relation to the cytological quality, 50% of the samples from the seropositive (D1) and 100% of the samples from the serodoubtful (D2) were classified in the extra class. Ten per cent of the samples obtained from herd B (D2) were classified in the class I. Fifty per cent of the samples from the seropositive animals (D1) and 100% of the samples from the serodoubtful animals (D2) were under classification.

Figure 4 presents the TCC and SCC values in milk samples obtained from herd D animals. Twenty-five samples obtained from group D1 animals (seropositive) were classified as the extra class, 8% as the class I and 67% were under classification. As far as the cytological quality is concerned, 90.9% of samples obtained from seronegative animals (K) were classified as the extra class and 9.1% of samples obtained from the serodoubtful animals (D2) and as many samples obtained from the seropositive animals (D1) were classified as the class I. Hundred per cent of the samples obtained from the serodoubtful animals (D2) were under classification.

The microbiological quality of the batch milk was also evaluated. Concerning this feature, in herd A 90% of the batch milk was classified as the extra class, while 10% as the class I. In herd B, 100% of the batch milk samples were classified as the extra class. In herd C, 80% of milk samples were classified as the extra class, while 20% as the class I. In herd D, 27.2% of the samples were classified as the extra class, while 36.4% as the class I and as many samples were under classification.

Discussion

The obtained results indicated that the milk yield of the seropositive and serodoubtful cows was lower than in those with no MAP antibodies. These results have been confirmed by numerous scientific papers which reported that the MAP infection decreased milk yield by 7.8-25% in cows with clinical form (1, 14) and by 6-16% in animals with subclinical form of the disease (1, 2, 4). Research completed in Denmark showed that the greatest productivity losses were recorded in young infected cows during their first and second lactation. During further lactation periods, this process was slower but persistent and led to even lower productivity (6).
**Fig. 1.** TCC and SCC in herd A milk obtained throughout a year.
D1- animals with seropositive reaction for paratuberculosis, K- animals with seronegative reaction for paratuberculosis

**Fig. 2.** TCC and SCC in herd B milk obtained throughout a year.
D1- animals with seropositive reaction towards paratuberculosis, K- animals with seronegative reaction towards paratuberculosis

**Fig. 3.** TCC and SCC in herd C milk obtained throughout a year.
D1- animals with seropositive reaction towards paratuberculosis, D2 - animals with serodoubtful reaction towards paratuberculosis, K- animals with seronegative reaction towards paratuberculosis

**Fig. 4.** TCC and SCC in herd D milk obtained throughout a year.
D1- animals with seropositive reaction towards paratuberculosis, D2 - animals with serodoubtful reaction towards paratuberculosis, K- animals with seronegative reaction towards paratuberculosis
It was demonstrated that the hygienic quality of raw milk was also decreased in infected animals. The samples from MAP infected animals showed considerably lower cytological quality, and in one of the big herds the microbiological quality was also lower. The observations of other authors (3, 7, 8, 12) have confirmed an increase in TCC and prevalence of mastitis in infected cows. On the other hand, some papers are at variance with these findings and did not indicate any increase in the disease prevalence nor increase in the TCC (11, 15).

These ambiguous findings concerning changes in milk during course of different stages of Johne’s disease require further and more thorough studies.

The described decline in milk yield and decrease in the hygienic quality of the raw milk (in the present study it was often unclassified milk) caused by subclinical MAP infection have decidedly negative effect on economic situation of the investigated dairy cattle farms.

References