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Original article

Quality of milk of cows in the first lactation vs. presence of anti-*Ostertagia* antibodies in their milk

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Abstract

Invasions of gastrointestinal nematodes in dairy cows may affect animals productivity. The most frequently detected internal parasite of dairy cattle is *Ostertagia ostertagi*. The objective of this study was to determine *O. ostertagi* invasion extensiveness in selected herds of dairy cattle, with special consideration to cows being in the first lactation, and to analyze the milk yield and contents of basic constituents of milk originating from sero-positive cows. Five herds of dairy cattle (403), with different populations of cows, were selected for the study. Invasion extensiveness in particular herds was determined and ranged from 11.9% to 27.27%. Cows being in the first lactation, the udder milk of which was shown to contain anti-*O. ostertagi* antibodies, were producing on average 470 kg of milk annually less than cows being in the same lactation period. The analysis of results did not confirm the statistical significance of this difference, likewise it did not demonstrate any statistically significant differences in contents of fat, protein and dry matter. Despite a lack of the statistical significance a producer suffers great economic losses. The conducted study proves that the occurrence of *O. ostertagi* invasion in herds of dairy cattle is a global problem and that it affects cost-effectiveness of milk production.

Key words: *Ostertagia ostertagi*, ELISA, dairy cattle, milk production, gastrointestinal nematodes

Introduction

Parasitic invasions have been posing and still pose a severe problem in livestock management. Amongst gastrointestinal (GI) parasites, *Ostertagia ostertagi* is the most significant pathogen of dairy cattle. GI invasions are the reasons behind a reduced growth rate

of heifers and may exert negative effects on milk production. The application of antiparasitic drugs in production herds multiplies losses caused by the necessity of introducing waiting periods (Coles 2002) and management of milk that cannot be used for food purposes nor for animal feeds. *O. ostertagi* is a small nematode belonging to the family *Trichostrongyloide*

that inhabits the abomasum of cattle. Damage of mucosa by larvae of the parasite is the cause of deteriorated digestibility and resorption of feed which may in a consequence lead to changes in the productivity and nutritive value of produced milk. As reported by Charlier, estimated annual losses per cow reach 46 € (Charlier et al. 2012). Ca. 86 millions of cattle, including ca. 23 millions in the European Union (Eurostat 2012), are exposed to gastrointestinal parasite invasion in the pasture season. The economic evaluation of losses usually estimates total costs of infection in a selected region (Sanchez and Dohoo 2002, Charlier et al. 2005b, Alameria et al. 2009). Results of earlier studies indicate that the greatest productivity losses occur during the first lactation (Kloosterman et al. 1996, Charlier et al. 2010b).

Gastrointestinal invasions in cattle are detected with a variety of methods. The standard method involves direct counting of nematode eggs in samples of feces, i.e. coproscopic method. Significantly less frequent use is made of biochemical analyses that consist of determining a blood concentration of pepsinogen, the content of which is increasing along with increasing damage of abomasal mucosa (Simpson 2000). In turn, both in monitoring and strategy development for eradication of *O. ostertagi* invasion in herds, increasingly often use is made of the method for antibodies detection in serum or milk with ELISA test (Sanchez and Dohoo 2002, Vanderstichel et al. 2010, Charlier et al. 2012a). The elaborated serological tests enable earlier detection of invasion compared to its detection in feces, as well as allow the invasion to be detected during hypobiosis (autumn and winter), which is not always possible with the coproscopic method. The detection of parasite-specific antibody levels in udder milk would be an effective method of monitoring the parasite-infection status of milking cows.

A lack of data on invasion extensiveness in herds of dairy cattle and the potential effect of *O. ostertagi* invasion on milk yield were the premises for undertaking a study that was aimed at:

1) Determining invasion extensiveness in selected herds of dairy cattle based on the analysis of the level of antibodies in samples of udder milk.

2) Determining invasion extensiveness in cows being in the first lactation based on the analysis of the level of antibodies in samples of udder milk.

3) Evaluating milk yield of cows sero-positive for *O. ostertagi* compared to sero-negative cows being in the first lactation.

4) Analyzing contents of basic constituents of milk originating from cows sero-positive for *O. ostertagi* compared to sero-negative cows being in the first lactation.

Materials and Methods

Selection of dairy cattle herds

Five herds of dairy cattle with different populations of cows were selected for the study from the Warmia and Mazury region, including: herd B with 201 cows, W – 84, G – 44, S – 43, and herd K with 31 cows (Table 1).

Table 1. Invasions extensiveness in herds of dairy cattle based on the presence of antibodies.

Herd	Total [%]	Cows in the first lactation
B	20.39%	40.62%
G	18.18%	41.66%
S	32.55%	71.42%
K	27.27%	40.00%
W	11.90%	18.75%
Mean	22.05%	38.80%

The following number of cows from particular herds were in the first lactation: B – 32, W – 16, G – 12, S – 7, and K – 5 cows. Apart from herd K, all animals were kept in the pasture feeding system.

Collection of milk samples

In the beginning of 2011, samples of udder milk were collected from cows being in the first lactation. The number of samples collected from particular herds were as follows: B – 159, W – 76, G – 41, S – 34, and K – 31 samples. The samples were collected following guidelines of the Polish Standard PN-A-86002:1999

Serological assays

The titre of antibodies was assayed with the *O. ostertagi* antibody ELISA test by Ab Svanova. Analyses of milk samples were carried out following producer's instruction, adopting the result of OD > 0.99 (optical density) as positive, whereas OD < 0.4 as negative.

Evaluation of milk performance

In the selected herds, the evaluation was conducted with the AT4 method pursuant to the decision of the EU Commission (Commission Decision No 2006/427/EC of 20 June 2006). Milk performance was analyzed for a 305-day lactation period by determin-

Table 2. Mean values of the productivity and the content of selected nutritional components in cow's milk in first lactation, depending on the results of the serological assay.

Ostertagia	N	Yield [kg]		Fat [%]		Protein [%]		Dry matter [%]	
		mean	STDM	mean	STDM	mean	STDM	mean	STDM
Total	72	5805	337	4.43	0.07	3.30	0.03	13.28	0.08
Negative	44	5988	463	4.39	0.10	3.33	0.05	13.26	0.12
Positive	28	5518	475	4.51	0.10	3.25	0.05	13.30	0.11

N – number of samples, Mean – mean value, STDM – standard deviation of the mean value.

ing yield of milk from cows and contents of protein, fat and dry matter in milk.

Statistical analysis

The significance of the effect of antibodies presence in milk samples on the analyzed parameters was evaluated based on results of the U Mann-Whitney test. The adopted level of significance was $p < 0.05$. Analyses were carried out using STATISTICA 9.0 package (StatSoft Inc., USA).

Results

The mean invasion extensiveness, determined based on the presence of antibodies in milk samples, reached 20.2% and differed between particular herds (Table 1). Despite keeping cows from herd K indoors, the extensiveness of invasion in that herd was higher than the mean value for all herds examined. Likewise, almost twofold higher invasion extensiveness was noted for the cows being in the first lactation.

The mean milk yield per cow in all herds examined reached 5798.36 kg/year and was the highest in herd W – 7339.2 and the lowest in herd G – 4230.08. The cows being in the first lactation were characterized by a milk yield higher by 114.8 kg/year on average, and differences between herds turned out to be significant (herd W – 7078.68 kg/year vs. herd G -4675.46 kg/year). Cows being in the first lactation were characterized by higher mean contents of protein and dry matter and by a lower content of fat, i.e. respectively: protein +8.89 kg/year, dry matter by +68.73 kg, fat – 8.2 kg/year (Table 2). The cows manifesting sero-positive reactions in the ELISA test were producing on average 394.6 kg/year less milk compared to the cows being in the same lactation period but with OD < 0.4 in the ELISA test. Even greater differences, reaching 470 kg/year, were noted for the cows being in the first lactation (Fig. 1). Despite so great differences, the statistical analysis did not con-

firm their significance. No statistically significant differences were noted either regarding the effect of the presence of *O.ostertagi* antibodies on the percentage content of fat. Fluctuations between the highest and the lowest % content of fat in particular herds were as follows: herd B – 2.37%, herd G – 1.36%, herd W – 2.68%, herd K – 1.12%, herd S – 2.09%. The highest percentage content of fat was observed in the cows from herd W – 6.14%, and the lowest one in one cow from herd B – 3.29%. Statistically significant differences in fat content were noted only between groups of cows with negative results in the ELISA test from herd K and both groups of herd S, for all possible combinations of factors between herds S and G, for cows with the negative result of ELISA test in herd G and for cows with the negative result of ELISA test in herd W as well as for cows with the negative result of ELISA test in herd G and for cows with the negative result of ELISA test in herd B. Statistically significant differences in protein content were determined only between two groups. The first group included cows with the negative result in ELISA test from herd G and cows with the negative result in ELISA test from W and cows with the negative result in ELISA test from herd B. Statistically significant

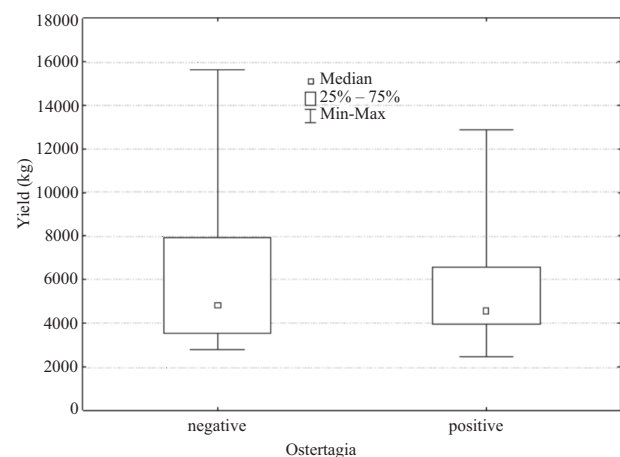


Fig. 1. Interrelations between the yield and the result of serological assay of cow milk samples towards *Ostertagia ostertagi*

differences in dry matter content were observed only between the following groups of cows: these with the positive result in ELISA test from herd S and these with the positive result in ELISA test in herd G.

Discussion

The elaboration of ELISA technique for the detection of anti-*O. ostertagi* antibodies afforded new possibilities for investigations conducted with samples of udder milk and bulk milk from production farms. The serological analyses conducted in herds of dairy cattle in the north-eastern Poland and the demonstrated extensiveness of invasion demonstrate that the prevalence of gastrointestinal parasites is still a significant problem in Poland as well as in many other countries, including e.g. Germany, the Netherlands, Belgium, Ireland, Spain or Canada (Sanchez and Dohoo 2002, Charlier et al. 2005a,b, Alameria et al. 2009), where invasion extensiveness ranges from 56% in Canada to over 90% in the Netherlands and Belgium (Sanchez and Dohoo 2002). So significant differences in invasion extensiveness may, apart from environmental factors, be due to seasonality of parasitoses. The highest number of sero-positive animals was diagnosed in the late summer and in the autumn, whereas considerably lower number in the spring and in the early summer (Charlier et al. 2005a). Our study was conducted in February of 2011, which may be the reason of achieving lower OD values in the ELISA test.

Parasitic invasions are a significant cause of production losses in herds of dairy cattle (Corwin 1997), hence correlations were sought between the OD value in ELISA test and productivity, milk quality and elements of herd management. As reported in literature, increasing both heifers and cows exposure to pasture was causing a successive increase in the OD value, whilst the anthelmintic treatment of heifers in the autumn contributed to a significant decrease in the OD value (Guitian et al. 1999). Animals from the herds investigated in our study were not subjected to the anthelmintic treatment in the autumn, therefore it could not affect study results. A high OD value is significantly negatively correlated with a daily milk production in the grazing period, which was demonstrated by Sanchez and Dohoo (2002) who computed a productivity decline by 1.2 kg daily per cow. Likewise, a decrease in milk production by 0.9 to 1.2 kg was observed in investigations conducted in Belgium, France, Spain and Nova Scotia (Guitian 1999, Sanchez and Dohoo 2002, Charlier et al. 2005a, 2009a). Our study shows that a decrease in productivity was even greater, especial-

ly in the cows being in the first lactation (1.54 kg/day), which leads to greater economic losses. Results of analyses of correlations between a high OD value and contents of basic milk constituents are in-explicit. In the reported study, we did not demonstrate a correlation between these values. A similar lack of correlations was observed in Dutch studies (Charlier et al. 2010a), however it did not include lactations in the autumn months when an increase in the OD value (threefold) was causing a decrease in protein and fat contents of milk.

In summary, the OD value – as a result of the ELISA test confirming the presence of anti-*O. ostertagi* antibodies in milk – may be applied in practice to evaluate productivity losses in herds of dairy cattle.

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