The relations between breed and age associated susceptibility/resistance of sheep infection with maedi-visna virus (MVV)

Abstract
Our aim was to estimate the possible impact of genotype and age of sheep on susceptibility/resistance to infection with maedi-visna virus (MVV). Sheep genotype represented two synthetic fecund-meat lines (BCP and SCP), two groups of three-bred hybrids (LB and LS) as well as Suffolk and lowlands sheep breed. In this study 1875 sheep originating from flock in middle eastern part of Poland were serum sampled. The presence of specific antibodies to p25 and gp40 proteins of MVV was determined by ELISA assay. It was shown that 17.3% of the tested animals were serologically positive during three-year-study. The highest susceptibility to MVV infection was noted in Suffolk breed (23.6%) and its three-bred hybrids (31.7%). However, in the other genetic groups this index ranged from 11.3 to 20.6%. Further analysis showed that MVV seroprevalence increased with sheep age, mainly between 2 to 5 years of age. Along with the population aging a downwards tendency of infection increase was observed that may have resulted from the breeding practices followed by the sheep selection. These results provide evidence that susceptibility and resistance of sheep to MVV is associated with age and genotype of animals. The breeds or native lines are characterized by a higher resistance against MVV infection compared to the imported pedigrees.

Key Words: sheep, maedi-visna virus

Introduction
The maedi-visna disease cases are practically recorded all over the world, except for Australia and New Zealand (BRODIE et al., 1998; KEEN et al.,1997; SIHVONENE et al., 1999). This disease causes the deterioration of animal physical condition, a decrease of body weight gains as well as increased mortality of lambs, which is associated with their low body weight at birth (ARSENAULT et al., 2003; CALAVAS et al., 1998). The MVV virus presence in a flock is also connected with the more frequent mastitis prevalence and some changes in joints. In order to prevent these effects, the prophylactic measures are undertaken that aim at the isolation and elimination of the infected sheep (SIHVONEN et al., 1999; STROUB, 2004). Another method to limit the MVV virus spread is search for some breeds, varieties or lines resistant against infections (KĘDZIORA et al., 2005). The studies also attempt to determine the age of sheep at the time of contraction. The obtained results may be helpful in the breeding works as their purpose is to eliminate this disease from flocks and thus to decrease the economic losses in the sheep farms.

The objective of the present investigations was to determine the susceptibility of animals of selected genotypes and the influence of sheep age on the maedi-visna prevalence in a flock maintained in the conditions of natural infections.

Material and Methods
The investigations were conducted in the years 2003-2005 in a sheep flock localized in the central-eastern Poland. They covered the sheep of two synthetic fecund-meat lines
BCP and SCP (938 units), two groups of three-bred hybrids LB and LS (348 units) and two purebreeds: Suffolk (S-220 units) and the Polish lowlands sheep (PON-369 units). During the experimental period, the age of sheep ranged from 4 months up to 7 years. The examined population was kept in the same breeding conditions and under the veterinary-zootechnical inspection. The animals were characterized with a different parturition number. The ewes of BCP and SCP brought forth their first offspring being aged one year, whereas the LB and LS and PON – 2 years.

Throughout the 3-year experimental period, blood for the examination was collected each year at two terms, i.e. April-May and November. The presence of specific antibodies in blood serum was determined using a commercial kit ELISA MVV (Institute Pourquier – France). The determinations were performed in compliance with the producer’s instructions and the read-out made with ELISA reading apparatus using 450 nm wavelength. Total 1875 samples of sheep blood serum were made for the animals that showed negative results of tests in the successive terms.

To determine a relation between the occurrence of a seropositive reaction towards MVV and a genotype and sheep age, a test chi² was applied.

**Results**

Table 1 gives the size of the examined population and percentage of sheep with the recognized positive result of ELISA test. It was proved that in the years 2003-2005, 17.3% sheep became infected with maedi-visna disease and the statistically significant differences were noted between the genetic groups. The Suffolk breed sheep and hybrids LS (50% Suffolk pedigree) exhibited the highest incidence and the seropositive reaction rate reached 23.6% and 31.7%, respectively. Among the PON animals, this value was 20.6%, while in the other genetic groups the percentage of sheep with a high concentration of MVV antibodies appeared substantially lower and oscillated between 11.3% up to 17.9%. The detected differences between the genetic groups were confirmed statistically (p≤0.01).

<table>
<thead>
<tr>
<th>Genetic group</th>
<th>Birth year</th>
<th>Number of examinations</th>
<th>Seropositive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>total</td>
<td>mean for ewe</td>
<td>n</td>
</tr>
<tr>
<td>BCP 2001-2005</td>
<td>505</td>
<td>2.46</td>
<td>57</td>
</tr>
<tr>
<td>SCP 2001-2005</td>
<td>433</td>
<td>2.34</td>
<td>54</td>
</tr>
<tr>
<td>LB 1997-2003</td>
<td>184</td>
<td>2.33</td>
<td>33</td>
</tr>
<tr>
<td>LS 1994-2003</td>
<td>164</td>
<td>1.93</td>
<td>52</td>
</tr>
<tr>
<td>PON 1994-2005</td>
<td>369</td>
<td>1.14</td>
<td>76</td>
</tr>
<tr>
<td>Suffolk 1996-2005</td>
<td>220</td>
<td>2.12</td>
<td>52</td>
</tr>
<tr>
<td>Total</td>
<td>1875</td>
<td>1.91</td>
<td>324</td>
</tr>
</tbody>
</table>

<sup>ABC</sup>— means denoted with the same letters within column are statistically significant (P≤0.01)

Analysing the age distribution of the infected population, it was found that to the end of the second year of life, a seropositive reaction was shown by 16% sheep. The highest percentage of seroreagents was recorded at the 2-5 years age interval. At that time, 57% sheep got infected (Fig.).

The occurrence of MVV antibodies within each genotype according to the age was differentiated (Table 2). It was demonstrated that in the BCP and SCP sheep, the infection intensification was reported at a younger age as compared to the other breed the groups. In the animals of the mentioned genotypes, 9% of the population showed a
seropositive response in the first year of life. This process enhanced in the second year, while the incidence peak was observed between the second and third year, when nearly 50% of individuals showed a seropositive reaction (Table 2).

Table 2  
Rate of sheep with seropositive result for MVV subject to age and genetic group

<table>
<thead>
<tr>
<th>Genetic group</th>
<th>Age in years</th>
<th>Significance of differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n &lt;1 (1)</td>
<td>1-2 (2)</td>
</tr>
<tr>
<td>BCP</td>
<td>57</td>
<td>8.8</td>
</tr>
<tr>
<td>SCP</td>
<td>54</td>
<td>9.2</td>
</tr>
<tr>
<td>LB</td>
<td>33</td>
<td>3.0</td>
</tr>
<tr>
<td>LS</td>
<td>52</td>
<td>1.9</td>
</tr>
<tr>
<td>PON</td>
<td>76</td>
<td>9.2</td>
</tr>
<tr>
<td>Suffolk</td>
<td>52</td>
<td>1.9</td>
</tr>
</tbody>
</table>

<sup>ABCD</sup> means denoted with the same letters within columns are different significantly (P ≤ 0.01)  
<sup>**</sup> Differences significant statistically (P ≤ 0.01) between age groups

Some different reactions were noted for LB and LS hybrids in which 6% and 13.4% infected sheep aged up to three years were recognized. A rise of infection intensity in these groups was noted between the third and fifth year of life. While growth in a seroreagents percentage up to the third year of life was recorded for the Suffolk sheep breed (11.5%) as well as for the Polish lowlands sheep (18.4%). Along with the population ageing, similar tendencies were observed in the range of the described index.

Figure: Percentage of sheep with seropositive reaction towards MVV subject to their age
Discussion

The first cases of maedi-visna disease in Poland were discussed by ZADURA et al., in 1975. KOPACZEWSKI et al. (1987) proved the presence of specific antibodies MVV in 80% the Pomeranian sheep and 23% the Polish merino. KOŁODZIEJ et al. (1995) investigating the sheep from the Lower Silesia reported that the percentage of the infected animals oscillated from 30%-70% subject to a flock. The serological survey performed by KOZACZYŃSKA et al. (2002) showed a differentiated infection level (0.5%-96.1%). The preliminary assessment of the serological situation made by KĘDZIORA et al. (2005) implies that this disease entity is also localized in the flocks from the central-eastern Poland.

In the present studies, the analysis of sheep from different genetic groups exhibited that a seropositive MVV result averaged 17.3% in the examined population and the highest infection rate was recorded for the Suffolk breed sheep (23.6%) and their three-bred hybrids LS (31.7%). High sensitivity towards MVV in the early stage of sheep life was also noted for the animals of the synthetic lines SCP (25% Suffolk pedigree).

The domestic breeding of the Suffolk sheep was based on the material imported from England and France in the 80’s of the last century. However, a severe problem of the Polish flocks of this breed appears to be a high death rate of lambs (LIPECKA et al., 1991). It is noteworthy that the reason for such a situation has not been recognized so far.

It is interesting, though, that the research work carried out by KEEN et al. (1997) gave different results. The authors claim that a percentage of seropositive Suffolk sheep was markedly lower (22.4%) compared to the Finnish sheep (77.4%) or teksel breed animals (65.4%). In the present studies, the analysis on susceptibility to infections induced by MV virus made on the native Polish lowlands sheep showed a seropositive reaction in 20.6% of animals, that is lower compared to the Suffolk or LS hybrids sheep. However, it should be emphasized that the mentioned above Polish lowland sheep were bred in the central-eastern region of Poland and based on the breeds like, the Polish merino, Leine and Kent.

According to WENDE and STRAUBE (quoted after ZADURA et al., 1975), merino exhibits low sensitivity towards infections as against teksel breed and eastern-Frisian sheep, whereas Leine pedigree has been recognized to possess remarkably high immunity to any disease (DOMAŃSKI et al., 1976). However, KOPACZEWSKI et al. (1987) proved that the merino sheep were characterized with sixfold lower death rate percentage as compared to the Pomeranian sheep.

The analysis of our own results and data available in the literature indicates that the native populations are more resistant to MVV than the imported breeds. It may be assumed that this fact is a result of the animal acclimatization in a new breeding environment.

On the basis of the conducted research, it was found that the animal ageing induces an increase of susceptibility towards MVV infection. In most of the examined genetic groups of sheep, the highest prevalence was recorded at the age of 3-5 years. Later, a smaller percentage of animals with seropositive reaction was observed and this fact, in the present authors’ opinion, may arise from rejection of week animals from the basic flock.

Similar dependences were mentioned by KEEN et al. (1997), who reported the intensification of positive results of ELISA assay in the sheep aged 3-4 years (63.2-
62.6%), while the highest percentage in a group of 6-year and older animals (73.6%). The same relations were also depicted by BERRIATUA et al. (2003). Besides, a decreased level of specific antibodies against MVV is likely to arise from both short exposure time to infection by a vertical way and the fact of the retarded seroconversion occurrence (HOUWERS et al., 1989).

In the sheep from BCP and SCP lines, (compared to other groups), the elevated immunity towards MVV was recorded at the earlier stage of life. It seems that this effect may have resulted from their inclusion into reproduction as early as in the first year of life and not at the age of two years as in the other genetic groups.

Basing on the carried out research, the authors are of the opinion that sheep susceptibility towards maedi-visna infection grows with their age (to 4-6 years old). Moreover, interbreed variation is observed in respect of the discussed trait. Besides, it was found that the native breeds show far higher immunity towards MVV compared to the imported populations.

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