THE EFFECT OF NEMATOPHAGOUS FUNGUS Duddingtonia flagrans ON THE GASTROINTESTINAL PARASITES IN SHEEP

ABSTRACT: Sheep production has serious problems due to the spread of intestinal parasites. These parasites cause loss of appetite, maldigestion, slow growth in body weight and wool, all of which results in economic losses as well. The control measures of infestation with strongyloid parasites in ruminants have until now been based mainly on the organization of grazing and the use of antihelmintics. However, due to the occurrence of resistance, alternative methods of control have been introduced. The use of nematophagous fungus Duddingtonia flagrans, which is capable of decreasing the number of infectious larvae and eggs in feces, has been successful. The aim of this study was to determine whether Duddingtonia flagrans decreases the number of eggs of Trichostrongylus spp in sheep feces. Fecal samples of thirty-four sheep were examined and the parasites were found in twelve sheep, six of which were fed with the fungus, and six of which were used as the control. According to $\chi^2$ test, at the level of certainty of $p<0.005$, a statistically important difference in the number of eggs was observed between the sheep which were given the fungus and those which were not.

KEY WORDS: Duddingtonia flagrans, sheep, gastrointestinal parasite, biological control

INTRODUCTION

Sheep production has serious problems due to the spread of intestinal parasites. These parasites cause loss of appetite, maldigestion, slow growth in body weight and wool, all of which results in economic losses as well. The control measures of infestation with strongyloid parasites in ruminants have so far been mainly based on the organisation of grazing and the use of antihelmintics. However, due to the occurrence of resistance, alternative methods of control have been introduced. Grazing systems are often impractical and expensive, whereas frequent use of antihelmintics, which has been the main principle of therapy over the last fifty years, develops resistance of parasites to antiparasitics, especially significant in small ruminants, sheep and goats.
(Condé and Johnson, 1995). Not less important aspect is the increase of consumers’ demand for animal products without residua of drugs (Diez-Tascón et al., 2005; Lalošević et al., 2009). For these reasons, increasing number of alternative control methods is being introduced. The most promising one is the use of nematophage fungus which is capable of reducing pasture contamination and the occurrence of infection (Larsen, 2000). In recent years, “nematode-destroying”, or nematophage fungi, has become focus of attention of many scientists around the world. Among the most important and the most frequently investigated fungi are: *Duddingtonia flagrans*, *Monacrosporium* spp., *Arthrobotrys* spp., *Pochonia chlamydosporia* (Carvalho et al., 2009). A kind of a predatory fungus which attracts the greatest attention is *Duddingtonia flagrans* (Larsen et al., 1997). Modern research shows that *D. flagrans* spores are capable of passing through the gastrointestinal tract of sheep and lessening the number of infectious larvae in feces, which was proved in the research of pasture contamination during spring grazing season (Gomez-Rincon et al., 2006). *Duddingtonia flagrans* reduces the population of larvae on pastures which later results in a smaller number of parasites in animals up to the level where not only clinical signs but also subclinical effects caused by parasites will be prevented. At the same time, reducing the number of infective larvae on pastures should stimulate the development of naturally acquired immunity in young animals. In the fresh feces, *Duddingtonia flagrans* forms a three-dimensional net which leads either to egg destruction or larvae destruction (Araujo et al., 2009). Besides ruminants, the positive effect of *Duddingtonia flagrans* was observed in the control of intestinal parasites of pigs (*Ascaris suum*), and in nematodes of carnivores (*Ancylostoma caninum*) (Larsen et al., 1997, Araujo et al., 2009).

The aim of the study was to determine the effect of nematophage fungus *Duddingtonia flagrans* on the gastrointestinal strongyloids, *Trichostrongylus* spp. in naturally infected sheep.

**MATERIALS AND METHODS**

This research was conducted in the Laboratory for Parasitology, Department of veterinary medicine, Faculty of Agriculture in Novi Sad. Feces samples were collected in the period from July to September 2010 from sheep in Zrenjanin municipality, raised freely on pastures.

Before the beginning of the experiment, stool samples were examined and natural infection by *Trichostrongylus* was found in all animals. Sheep were divided into two groups. The experimental group of six sheep was perorally given 17 ml of water solution of fungus (about 1x10⁶/ml chlamidospora) for five days. The control group of six animals did not receive the fungus suspension. Fecal samples were collected every week in the period of three weeks. The samples were examined by the method of helmint egg concentration with
a saturated solution of saccharose, and the number of eggs per gram of feces
was calculated by the method of Stoll.

*Duddingtonia flagrans* (from the collection of Universite catholique de
Louvian, Belgium) was multiplied on PDA base (potato dextrose agar) in the
Laboratory for Microbiology at the Faculty of Agriculture in Novi Sad.

**RESULTS AND DISCUSSION**

With the aim of determining the presence of parasites from the genus *Trichostrongylus* spp., thirty-four feces samples were examined, and eggs of
parasites were found in twelve sheep (35.9%), six of which were fed with the
fungus (experimental group), and six of which were used as the control group.
One sheep from the control group died during the research. Feces samples
were taken from the sheep which had received the nematophagous fungi for
three weeks in the amount of 20 grams. A statistically important difference in
the number of eggs was observed between the sheep which received the fun-
gus and those which did not.

According to a research conducted in Malaysia, already after the second day
of the fungus intake, the decrease in larvae development in pastures was over
90%, and when the dose was doubled, the decrease was even 100% (Chandra
et al., 2003). A group of Spanish and Brazilian authors discovered that if sheep are fed with spores of fungus *Duddingtonia flagrans* at the right
moment, from the point of view of epizootiology, this can have an important ef-
fect on infectious larvae on pastures, which was proved by finding 20% fewer
parasites in lambs grazing for three weeks on the same pasture in spring (Gomez
et al., 2006). Apart from the decreased spring contamination of the pasture, the lambs of the treated sheep had smaller total number of para-
sites and better growth than the lambs from the control group (Table 1).

<table>
<thead>
<tr>
<th>Sheep number</th>
<th>0 day number eggs/g</th>
<th>1. week number eggs/g</th>
<th>2. week number eggs/g</th>
<th>3. week number eggs/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. experimental</td>
<td>5700</td>
<td>11200</td>
<td>3000</td>
<td>400</td>
</tr>
<tr>
<td>2. experimental</td>
<td>5200</td>
<td>3100</td>
<td>1700</td>
<td>600</td>
</tr>
<tr>
<td>3. experimental</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td>7. experimental</td>
<td>4000</td>
<td>0</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>8. experimental</td>
<td>4700</td>
<td>1200</td>
<td>900</td>
<td>100</td>
</tr>
<tr>
<td>9. experimental</td>
<td>300</td>
<td>800</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4. control</td>
<td>13700</td>
<td>6300</td>
<td>8600</td>
<td>300</td>
</tr>
<tr>
<td>5. control</td>
<td>9200</td>
<td>100</td>
<td>800</td>
<td>0</td>
</tr>
<tr>
<td>6. control</td>
<td>1900</td>
<td>died</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. control</td>
<td>500</td>
<td>1100</td>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td>11. control</td>
<td>1500</td>
<td>200</td>
<td>1300</td>
<td>800</td>
</tr>
<tr>
<td>12. control</td>
<td>500</td>
<td>0</td>
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</tr>
</tbody>
</table>
A positive effect of *Duddingtonia flagrans* was also noticed in the control of intestinal parasites of pigs, which was confirmed by both *in vitro* experiments and on pastures (Larsen et al., 1997). High potential of the fungus to reduce the number of larvae of pulmonary strongyloid *Dictyocaulus viviparus* was noted during a lab research, and the already mentioned results against gastrointestinal strongyloids show a wide scope of parasitic worms which can be controlled by this method (Larsen et al., 1997, Sarkunas et al., 2000).

It appears that the passing of fungus spores through digestive tract depends on factors related to the nutrition and food flow in the animal, but a good sign is that spores of *Duddingtonia flagrans* can survive in the digestive tract for a significant period of time under difficult conditions (Chandrawathani et al., 2003). It is important to point out that during the implementation of this measure in the strongyloid control, it should be taken into account that some antihelmintics can have potentially negative or inhibiting influence on some nematophagous fungi. The time between the use and/or the possibility of combining the fungus treatment with medicines should be better explored (Larsen et al., 1997).

**CONCLUSION**

Our results show that *Duddingtonia flagrans* significantly reduces the number of eggs of *Trichostrongylus* spp. in the feces of naturally infected sheep. Since gastrointestinal parasites still represent a serious health problem, especially of small ruminants, antihelmintics are still necessary and prescribed in the control of these infections. Due to the resistance to these drugs, especially of *Trichostrongylus* spp. in sheep, the implementation of fungus *Duddingtonia flagrans* in cattle nutrition could be an important way of gastrointestinal and pulmonary strongyloids reduction. By simultaneous decrease
in the number of infected animals, the number of infectious larvae on pasture will decline, and the cycle of parasite development will be disturbed. From the aspect of greater need for safe food for human consumption, the occurrence of residua of drugs will be avoided in the food of animal origin.

REFERENCES


ЕФЕКАТ НЕМАТОФАГНЕ ГЉИВЕ DUDDINGTONIA FLAGRANS НА ГАСТРОИНТЕСТИНАЛНЕ ПАРАЗИТЕ КОД ОВАЦА

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Резиме

Производња оваца су сусреће се са озбиљним проблемима услед раширености желудачно-цревних паразита. Њихов значај огледа се у економској штети због губитка апетита, малдигестије, слабог прираста телесне тежине и вуне. Контрола инфестације преживара стронгилидама до сада се заснивала главном на организацији напасања и употреби антихелминтика, али, због појаве резистенције, уводе се альтернативне методе контроле. Употреба нематофагне гљиве Duddingtonia flagrans, која је способна да смањи број инфективних ларви и јаја у измету, показала се успешном. Циљ овог рада је да се утврди да ли Duddingtonia flagrans смањује присуство јаја Trichostrongylus spp. у измету оваца. Прегледана су 34 узорка фецеса а паразит је доказан код 12 оваца, од којих је 6 након тога добило гљиву, а 6 је коришћено као контрола. На основу \( \chi^2 \) теста, на нивоу сигурности од \( p<0,005 \) доказана је статистички значајна разлика у броју јаја, у измету оваца које су добијале гљиву у односу на оне које нису.