Epizootic Situation of Parasitocenoses in Marals and Measures Aimed at Preventing and Treating Them in the Republic of Kazakhstan

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Abstract:
The epizootic situation of parasitocenoses in marals (Siberian red deer) and the species composition of helminths, protozoa and insects parasitizing on marals in the Republic of Kazakhstan were explored; their most frequently found aggregations were determined. A comparative effectiveness of various schemes of therapeutic and preventive measures was studied. The new antiparasitics, not previously used in marals, were tested. Insecticides were used to prevent infection of marals with botfly infestations and antler fly larvae. It is recommended to treat parasitocenosis of marals with broad-spectrum antiparasitics from the group of macrocyclic lactones and synthetic pyrethroids. A granulated feed mixture based on the Alvet antiparasitic was developed for the late chemoprophylaxis of parasitocenosis in marals.

Keywords: Helminthiasis in marals, botfly infestation, antler fly.

INTRODUCTION
Maral breeding is a dynamically developing high-yield and young livestock sector, which is of great importance in the economy of the Republic of Kazakhstan. The manufacture of antler products for the agribusiness is of strategic importance. The social and economic position of the majority of rural population depends on export earnings received from the sale of antler products. The East-Kazakhstan Region is the main producer and exporter of antler deer husbandry products in the Republic of Kazakhstan. Currently, 95 percent of the maral population is concentrated in the East-Kazakhstan Region. The natural and climatic zone of the region is the most favorable for the cultivation of marals. However, unfortunately, the current situation shows that the dynamics of growth in the number of marals and reindeer significantly deteriorates. Moreover, a significant decrease in the population is recorded in the homeland of these animals, in Katon-Karagai. Statistics shows that in the last 10–15 years, there has been a reduction in the number of marals and spotted deer as well as a decrease in their productivity [1].

The constant process of anthropogenic impact on marals for the purpose of domestication led to negative consequences. Marals’ contacts with pets, a lack of natural selection, a high concentration of animals in pastures, and poor feeding contributed to the spread of over 50 different infectious and invasive diseases among marals. Along with helminthiases, marals are objects of parasitism of various parasitic insects, widely distributed in maral breeding farms of the Kazakh Altai [2; 3; 4].

More often, parasitic diseases occur in aggregations, as a result of which mortality (7–14%) and forced slaughter (3–7%) of animals are observed, antler production drops by 9–12% and animal yield decreases by 30–40%. The great economic damage from parasitocenosis is manifested through lagging in growth and development of deer as well as through the shortage in the antler weight increment. It also causes the rejection of affected organs during slaughter [5; 6].

The analysis of literature data has shown that Kazakhstan is on the way of struggling against certain types of parasitic diseases of marals [7; 8]. It has been scientifically proven that parasitic diseases of marals in monoinfestations also have a significant effect on the growth of livestock and the increase in productivity. However, with parasitocenosis, the course of the disease changes and assumes an idiosyncratical character. Associative diseases represent a serious scientific and production problem in animal husbandry [9; 10].

At present, a large arsenal of highly effective means is proposed for combating parasitocenosis, which makes it possible to solve the problem of combating parasitic diseases in a complex manner. Against the backdrop of long-continued use of drugs from the group of macrocyclic lactones, some parasites developed resistance to them, which regulates the search for new drugs and their application in scientifically justified terms. The task of science in this matter is to develop new and improve existing tools and methods for diagnosis and control of invasive diseases of marals [11; 12; 13]. In this regard, based on the knowledge about the biology of helminth development, the selectivity of drug acting and the epizootic situation in specific conditions, a comprehensive system of recreational activities for farms of the Katon-Karagai district is proposed.
**MATERIALS AND METHODS**

The experimental part of the work was carried out at the Parasitology Laboratory of the Shakarim State University and at maral breeding farms of the Republic of Kazakhstan.

A study of the parasitocenosis epizootology was carried out by researching the unfavorable maral farms during outbreaks and analyzing the statistical data from veterinary reports on the parasitic disease incidence of animals.

The species composition of parasitoceneses, their quantitative ratio and the dynamics of maral disease incidence were determined by the study of 1,871 samples of faecal masses. A coprological study of the collected samples was carried out by the flotation method according to G. A. Kotel'nikov [14], by the method of Weid and Berman. The intravital diagnosis of microcerciasis was carried out by the method of successive washing. The results obtained were processed statistically with the calculation of the average values of the number of eggs, helminth larvae in one gram of feces. A postmortem helminthological study was performed using K.I. Sibir'in's method [15]. For differential diagnosis, the method of Strongylata larvae cultivation by A.M. Petrov and V.G. Gagarin (1953) was applied [16].

The intensity of infestations was determined from the results of helminthocoprophylactic studies by counting eggs and oocysts in 20 microscope fields of view and helminthological autopsies. The extensiveness was determined by analyzing the data during copro-, ovo- and larvoscopy. The species of helminths and Eimeria were identified according to morphometric parameters using the determinants of Schultz, & Gvozdev [17]; Pryadko [2], Krylov [18]. Strongylata were determined to the species after cultivation of larvae, taking into account their morphology according to Polyakov [9].

In the course of the work, the systematics of helminths quoted in K.I. Skryabin’s and coauthors' monographs [20] was adhered to.

Antlers were examined for being affected by the antler fly larvae after cutting in May–July. During the examination, the localization of the myiasis, the degree of lesion and the number of larvae were taken into account. A total of 257 antlers were examined, including 221 antlers of adult deer and 36 antlers of primiparous hinds. The need for such a subdivision is due to the fact that the antlers of primiparous hinds mature at the end of July with a high likelihood of being affected at this period by the antler fly larvae. The extensive and intensive indices of botfly infestation in marals (hypodermatosis and pharyngeal myiasis) were determined during the winter slaughter of animals (December, January) in the antler deer culled due to the low productivity and fatness that were not subjected to antiparasitic treatments.

The effectiveness of chemotherapeutic drugs was studied in spontaneously infested marals belonging to Aksu, LLP of the Katon-Karagai District. The following antiparasitics were field-tested: Ricazol (Ricobendazole); Sanofly (Cyfluthrin); Eprimec (Eprinomectin). A mixed fodder preparation based on the powdered Alvet (Albendazole) for the autumn chemotherapy of marals against parasitocenosis was prepared and tested. These drugs were experimentally and field tested during a spontaneous associative infestation of marals according to the general scheme.

For the chemoprophylaxis of botfly infestation and antler myiasis, marals were treated by spraying Sanofly thereon. The adult marals were sprayed from an automax since the beginning of the summer against antler flies and botflies. The intervals between treatments were 15 days. The consumption of insecticides per animal was 100 mL. When determining the effectiveness of treatments, the yield and quality of the antler products in the experimental and control groups were compared. The comparison was carried out after spraying the marals from the Verhkhatun experimental department. The antler products of marals from both groups were weighed and the average value was calculated [21].

According to the VNIIVEA method, the relative increase in productivity (E.%) and the saved productivity (SP, kg) were established according to the following formulas:

\[
E = 100 \times (A2 \times B2) / (A1 \times B2) \quad (1)
\]

\[
SP = A2 - A1 \times B2 + B1 \quad (2)
\]

where \(A_1\) and \(A_2\) were the productivity of the experimental group before and during the experiment period;

\(B_1\) and \(B_2\) were the productivity of the control group before and during the experiment period.

The Eprimec and Ricazol preparations were injected subcutaneously into the prescapular area in a dose of 3.0 mL per animal in accordance with the aseptic and antiseptic rules. Control animals (20 units) were not subjected to antiparasitic treatment. Before administering the preparation, the experimental and control animals were subjected to coprological examination. 30 days after dehelminthization, they were re-examined.

A single 12.0 g per animal dose of Alvet was given in a mixture. The mixture of fodder concentrate was prepared in a mini fodder plant of the "Agrotechnopark" research center of the Shakarim State University. A total of 20 adult maral stags were treated. The adult marals (17 units) standing next to them in the neighboring winter building served as control. Before applying the antiparasitic drug, after 30 days, biomaterial was taken from a part of the experimental and control animals and coprolarvoscopic studies were performed [22].

In order to achieve high effectiveness of application and exclusion of possible complications in animals (poisonings), it is necessary to pay special attention to the methods for proper preparation and use of solutions and emulsions of the drugs. Therefore, all drugs were used according to the available relevant instructions.

**RESULTS AND DISCUSSION**

The species composition of maral parasitocenosis in maral breeding farms of the Katon-Karagai District of the East Kazakhstan Region were determined through the methods of parasitological studies. Parasitizing of 19 helminth species was determined: 1 species of trematodes,
3 species of cestodes and 15 species of nematodes; 1 species of protozoa and 3 species of insects.

Out of 18 species of helminths found, there are 8 species of biohelminths, and 10 species of geo-helminths. The results of animal autopsies show that a greater percentage of animals infested is determined in dicroceliasis (82.6%), and the lowest percentage is noted in moniasiosis (0.5–0.7%).

More helminths parasitize in the gastrointestinal tract (9 species), in the parenchymal organs (5 species), in the meninges (2 species), and in the subcutaneous tissue (2 species). The localization of individual parasite species revealed the following patterns: localization of Setaria was noted mainly in the abdominal cavity (up to 93.5%) with an intensity of 2–16 specimens, and only 6.5% of cases were localized on the meninges with an intensity of 1–4 specimens.

The accumulation of Ashworthia was noted to a greater extent in the abomasum (77.7% of cases), less often in the omasum and duodenum (22.3%). Trichocephalum was detected in the cecum (57.5%) and in the colon (42.5%). Verdicmansia were more common in the body adipose layer (89.7%) than in the limbs (10.3%), while the

Table 1. The epizootic situation of parasitic diseases in maral breeding farms of the East-Kazakhstan Region

<table>
<thead>
<tr>
<th>Name of farms</th>
<th>Elaphostrongylosis</th>
<th>Dictyocauliasis</th>
<th>Dicroceliasis</th>
<th>Intestinal strongylatosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PI, % II, specimens</td>
<td>PI, % II, specimens</td>
<td>PI, % II, specimens</td>
<td>PI, % II, specimens</td>
</tr>
<tr>
<td>Abzal Farm</td>
<td>40.7 14.3</td>
<td>18.3 15.8</td>
<td>40.25 13.1</td>
<td>22.4 4.3</td>
</tr>
<tr>
<td>Maraldy Farm</td>
<td>55.8 39.8</td>
<td>19.2 16.1</td>
<td>51.0 14.4</td>
<td>25.8 6.3</td>
</tr>
<tr>
<td>Aksu, LLP</td>
<td>46.9 24.3</td>
<td>22.5 16.2</td>
<td>18.4 6.4</td>
<td>31.0 4.7</td>
</tr>
</tbody>
</table>

Table 2. Extensive and intensive indicators of helminthic infestation of marals in the sex and age aspects

<table>
<thead>
<tr>
<th>Type of helminthias</th>
<th>Extensive (%) and intensive (specimen) indicators of infestation by age and sex groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adult stags</td>
</tr>
<tr>
<td></td>
<td>PI, % II</td>
</tr>
<tr>
<td>Infestation by Setaria</td>
<td>40.0 4.6 ± 0.1</td>
</tr>
<tr>
<td>Elaphostrongylosis</td>
<td>62.1 24.6 ± 0.6</td>
</tr>
<tr>
<td>Dictyocauliasis</td>
<td>33.8 32.8 ± 1.3</td>
</tr>
<tr>
<td>Varestrongylosis</td>
<td>27.8 15.1 ± 1.1</td>
</tr>
<tr>
<td>Dicroceliasis</td>
<td>57.4 145.6 ± 10.4</td>
</tr>
<tr>
<td>Verdicmansiosis</td>
<td>53.7 5.7 ± 0.5</td>
</tr>
<tr>
<td>Intestinal nematodosis</td>
<td>32.5 10.6 ± 0.2</td>
</tr>
</tbody>
</table>
Maral breeds were less infested with helminths, as compared to young deer and adult stags, because of their reserved manner of grazing after the birth of calves (early in the morning and late at night), which protected them from attacks of bloodsucking flies. In addition, during the summer-autumn pasture period, they were not disturbed. They were evenly distributed in the park without overcrowding. As a rule, forested remote gardens with good herbage were allocated to them, which prevented infestation with geo-and biohelminths. Baby marals, with the exception of intestinal nematodosis, were less infested with helmintiases, as compared to other sex and age groups, which was associated with the character of nutrition. After the birth and before ablactation, the main food for them was milk. Therefore, since the main transmission factors for helmintiases were pasture grass and water, they might be infested during a later period (in autumn).

Maral stags were more infested with geo-and biohelminths, as compared to hinds, because of specific behavior during the rutting time, on the one hand, and their more intensive crowding on limited pasture areas during the cutting of antlers, on the other hand.

The most common helmintiases in maral breeding farms were dicroceliasis, strongylatosis and trichocephalosis. When examining marals on parasitocenosis, an aggregation was recorded in all animals. The parasitization of Elaphostrongylus and Dicrocoelium was most often noted in 19.1% of cases; Dicrocoelium and the parasitization of Elaphostrongylus and Dicrocoelium; and 6) Dicrocoelium + Ashworthia.

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The infestation of marals by intestinal strongylatosis and dictyocauliasis in farms of the region did not exceed 10–24%, while the intensity of infestation was at the level of 2.8–24.6 specimens/animal unit. The issue of elaphostrongylosis was still acute. Depending on the age and sex group and the study time, the prevalence of infestation was 18–100% with an intensity of 12 to 70 or more larvae/sample.

Features of the epizootology of maral entomosis were studied according to the epizootic survey of such maral farms as Aksu, LLP, Angu-Abzal, LLP, and Maraldy Farm in the Katon-Karagai District of the East Kazakhstan Region.
larval Echinococcus. The main components of the parasitocenosis composition were mainly the Dicrocoelium.

A joint development of microceliasis, elaphostrongylosis, and verdicmansiosis in aggregations of parasitocenosis is not a simple mechanical addition of helminths, but a dynamic disease with a sharp gastrointestinal disturbance, adverse respiratory effect, high body temperature, and intestinal enzymes’ disorder.

A pathogenic influence of helminths in parasitocenosis of marals is aggravated by protozoa. An average incidence of marals is indicated by eimeriosis (8.3%), which progresses in various aggregations with esophagastomosis, dicroceliasis, and trichocephalosis. Such combinations in parasitocenosis of marals cause not only a strong disease with a loss of productive qualities, but also the death of animals.

The extensive and intensive efficiency of antiparasitics were not determined specifically for some form of invasion disease in antler deer (which is very rare in marals). Their effectiveness precisely in the aggregative infestation was determined, which defined the name of the broad-spectrum drugs.

The results of the carried out experiments and field tests of preparations from the group of macrocyclic lactones and synthetic pyrethroids in antler deer have shown that they all possess a pronounced activity against botfly infestations and helminthiases. Such combinations in parasitocenosis of marals cause not only a strong disease with a loss of productive qualities, but also the death of animals.

In general, spraying the pelage and skin coat of animals with a dose of 100 mL per animal in the form of 0.02% water emulsion of Sanofly is an effective way to protect marals from attacks of nasopharyngeal and subcutaneous botflies, zoophilic flies and nematodes (gadflies, midges, mosquitoes, and black gnats). In the conditions of summer pastures, the residual effect of the drug is preserved up to 28 days, which makes it possible to protect marals from attack of nasopharyngeal and subcutaneous botflies, zoophilic flies and gnatosis as well as to prevent pharyngeal myiasis and hypodermatosis among marals.

In view of the poor taming of marals, special conditions of their breeding, their biological rhythms and the nature of production, preventive and therapeutic measures in maral farms are possible only at certain times of the year.

Marals are bred in the conditions close to the natural habitat (fenced wooded, mountain pastures with 1.5–2.0 hectares per animal). Over the 150-year history of domestication, they have not become obedient agricultural animals. They are characterized by a wild temper, herd instinct, and seasonal biological rhythms. Consequently, when developing schemes of therapeutic and preventive measures against parasitocenosis of marals, it is necessary to mind not only the biological cycles of parasites, determining optimal treatment times, but also the above-mentioned features.

Given the above facts, the treatment of marals is possible only after fixing them on an antler cutting machine. Sanofly, due to a long residual effect, can be introduced into production as part of a complex of summer prophylactic treatments of marals to regulate the number of zoophilic flies and blood-sucking dipterous insects. These measures can be carried out during the mass summer of parasitic insects in June–August with an interval of 21–28 days. At the same time, it must be remembered that chemoprophylaxis should be used no more than 3–4 times per season, since repeated use of several drugs adversely affects the health of animals.

### Table 4. Efficiency of Eprimec under the experimental conditions

<table>
<thead>
<tr>
<th>Group of marals</th>
<th>Number of animals in the group</th>
<th>Examined before Treatment</th>
<th>Examined after treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>20</td>
<td>15</td>
<td>108 ± 7.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Control</td>
<td>20</td>
<td>15</td>
<td>116 ± 3.8</td>
</tr>
</tbody>
</table>

### Table 5. The effectiveness of Sanofly for the protection of marals from botflies, zoophilic flies and gnatosis

<table>
<thead>
<tr>
<th>Group of marals</th>
<th>Years</th>
<th>Changes in the weight of antlers, kg</th>
<th>Comparative increase in antler products, %</th>
<th>Preserved productivity, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2016</td>
<td>5.49 ± 0.44</td>
<td>11.5</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>2017</td>
<td>6.08 ± 0.27</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Experimental</td>
<td>2016</td>
<td>5.54 ± 0.08</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2017</td>
<td>5.47 ± 0.31</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
As can be seen in Table 5, the proposed dose of the insecticide proved to be very effective against ectoparastites and made it possible to increase the antler productivity by 11.5%.

The prevention and treatment of maral parasitocenosis is a complex of measures that requires from veterinary specialists the correct and precise organization of all antiparasitic activities. To ensure the well-being of marals by parasitocenosis, it is necessary to conduct a complex of organizational, economic, therapeutic, preventive and veterinary-sanitary antiparasitic measures.

In the fight against parasitocenosis of marals, a set of measures should be applied, consisting of measures that prevent the disease and, in case of occurrence, provide timely treatment of sick animals.

**CONCLUSION**

The high rates of the maral industry development, and a large number of newly organized farms created certain difficulties in the organization of veterinary services, which adversely affects the well-being in respect of infestation diseases in antler deer. The introduction of the developed complex system of control and prevention measures, consisting of rational schemes for diagnosis, prevention and treatment, into the veterinary practice of maral farms will accelerate the diagnosis of aggregative parasitic diseases, increase the effectiveness of therapeutic and preventive measures, and reduce the morbidity and mortality of marals. Therefore, the development and implementation of complex measures for the prevention and therapy of parasitocenosis will certainly lead to the stabilization of maral population, the increase in the productivity and quality of raw materials, the provision of the epizootic well-being of maral farms, and, respectively, to the socio-economic revival of the region.

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