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1962. Dynamics of an infection by Sarcocystis tenella sarcosporidia in sheep in southeast Kazakhstan. [Dinamika zarazheniya sarkosporidiyami Sarcocystis tenella ovets yugo-vostoka Kazakhstana.] In Boev, S. N. et al., eds. Parasites of farm animals in Kazakhstan. I. [Parazity sel'skhokzyaistvennykh zhyvotnykh Kazakhstana. I.] Izdat. Akad. Nauk Kazakh. SSR, Alma-Ata. pp. 63-68.

Despite their wide distribution and their invasion of many species of domestic and wild animals and even man, the sarcosporidia have been studied far from well. The routes and methods of their transmission are unknown nor do we know how the infectious agent is excreted from the animal's body, or how it behaves outside the host. Moreover, so far it has not been clear what the infectious agent actually is, where it is preserved in nature, from where it gets into the animal's body, what kinds of stages it passes thru in its development and what route it uses to get into the striated muscles--the area where sarcosporidia are usually seen in the host's body. The parasite of sheep is Sarcocystis tenella Railliet, 1886 (Balbiania gigantea Railliet, 1886) first observed by Hensling (1854) (according to Babudieri, 1932) in the cardiac muscle of a sheep.

Observations have shown that the extent and intensity of a sarcosporidial infection depend on the climate, the relief of the locality, the season of the year and the conditions under which the animals are confined, their food and nourishment, sex and age. Bergman (1913) observed increased sarcosporidial infection of farm animals from June thru November and a drop from January thru April; this agrees with Scott's (1943) observations. He felt that sarcosporidia are not resistant to low temperatures.

But Bergman assumed that sarcosporidial infection of sheep takes place in winter, too. According to Scott (1930), infection of sheep does not occur thruout the year, but only from April thru November, so that seasonality is observed. The infection rate increases with age; in adult sheep it reaches 100%.

S. N. Machul'skiy (1947), observing the goitered gazelle (Gazella gutturosa) in Buryat-Mongolia, found a higher infection in males than in females, while A. S. Stepanyan (1950), on the other hand, observed a higher infection rate among females and concluded that infection of sheep increases with age.

According to Lubyanskiy's (1956) data, animals with a low degree of fatness are infected oftener and more intensively by sarcosporidia. Chronic diseases, poor feeding and confinement, pregnancy and post-natal period all abet infection. According to Lubyanskiy, females are more often infected than males, while the incidence of illness fluctuates with the season in all the sheep. A relatively high infection rate is seen twice: in summer (June thru August) and in winter (November to February). The parasite needs 3 months in order to develop from the infective stage to the muscular parasitic form (cyst).

Lubyanskiy felt that animals become heavily infected with sarcosporidia on pasture and that the muscular forms (cysts) of the parasites become visible under the microscope, within 3 months. The infection rate seems higher in winter because the infective forms, which entered the body during the summer and autumn, are then found in the muscles.

The primary infection of the animals in spring and autumn was explained by Lubyanskiy as being due to the change in conditions of confinement and feeding, the transition in spring to pasture, and in autumn, to a stall-type confinement; it is at these times that the animal adapts to new circumstances, which in some measure destroys its resistance.

No study of the dynamics of sarcosporidiosis of sheep has been conducted in Kazakhstan.

In this work an attempt is made to illuminate several questions of the dynamics of sarcosporidiosis of sheep in southeastern Kazakhstan.

OUR OWN RESEARCH

From 1959 thru 1961 the sheep of the Alma-Ata, Dzhambul and South-Kazakhstan Oblasts were examined for sarcosporidial infection. Animals of different sexes, ages and levels of nourishment were checked at various times of the year; 597 were 3-4 days old, 6 were 15 days old, 7 were 1 month old, 7 were 1.5 months old, 15 were 2 months old, 25 were 3 months old, 66 were 4 months olds, 69 were 5 months old, 47 were 6 months old, 25 were 7 months old, 69 were 8 months old, 39 were 9 months old; 43 were 10 months old, 40 were 11 months old, 133 were 12 months old and 583 were more than one year old. By individual months we studied: 183 sheep in January, 108 in February, 379 in March, 397 in April, 35 in May, 57 in June, 113 in July, 75 in August, 124 in September, 72 in October, 78 in November and 150 in December.

Five muscle samples were taken from each animal and studied by Lubyanskiy's sarcosporidioscopic method (1956) with methyl blue stain. The method of research is explained in more detail in our article elsewhere in this handbook.*

* See the article by N. G. Levchenko.

Relationship Between Infection and Nourishment

All sheep were divided into 3 groups according to fatness: above average, average and below average. There were 143 sheep in group 1, 434 in group 2 and 577 in group 3 (Table 1).

As the level of fatness drops the extent of infection rises from 71.3% (in sheep in the above average group) to 90.5% (sheep in the below average group). The sheep in the above average group were less heavily infected; those in the less-fat group were more heavily infected. The number of heavily infected sheep grew with the drop in fatness from 31.4% (in sheep in the 1st group) to 57.6% (sheep in group 3).

Apparently a weakened body is a more favorable medium for a sarcosporidial infection. On the other hand, well-fed sheep are probably less susceptible to infection and become infected less often and less heavily. In sheep with better-than-average fatness the greatest number of cysts in 4 sections from one muscle reaches 300, while in emaciated sheep it reaches 700.

Relationship Between Infection and Sex

689 ewes and 465 rams (Table 2) were studied. The females were infected somewhat more often than the males. To an equal degree the infection was higher in females than in males. In males light and moderate infections predominated, while heavy infections predominated in females (54.8%). By our own studies we confirmed the data produced by Lubyanskiy stating that females, due to their physiologic characteristics, are infected more often and more heavily than males.

Relationship between Infection and Age

Sheep ranging in age from 3-4 days to 8 years were examined. The youngest animals in which sarcosporidia were observed were 2-month-old lambs. Figure 1 shows that, starting from the age of 2 months, the prevalence of infection increased from 13.3%. This can be explained by the presence in the external environment of easily obtained infective stages of sarcosporidia and even more by the fact that the young body is more susceptible to infection. An especially sharp rise in infection rate was observed in 4-5 month old lambs (57.5 and 85.5%, respectively) during and after weaning.

During these periods the lambs adapt to new circumstances of life and nourishment. The infection rate grows quickly in young sheep by the 10th or 11th month, according to our data, it reaches 100%.

In sheep 1-4 years old there is a low infection rate. These are already adult sheep, but still young and, apparently, less susceptible to infection. In sheep 5 years of age or older there was also a 100% infection rate.

In this respect our data on southeast Kazakhstan correspond with those of Scott (1918) (cited by Scott, 1943) and Stepanyan (1948). Along with the increase in infection rate with age there is also an increase in heaviness of infection. Two-month-old lambs had solitary cysts (2 cysts in 4 sections from one sample), 3-month-olds had a maximum of 20 cysts in 4 sections, 4-month-olds had 60 cysts, etc., up to 700 cysts in lambs 9 months old and older.

At the age of 4-5 months, when the lambs are weaned, and one month later, heaviness of infection, like infection rate, is markedly increased (from 60 to 350 cysts). This testifies to the poor resistance to infection of the young body, weakened by the transition to a new feeding regime and unable to adapt to new circumstances of existence.

Relationship Between Infection and Time of Year

We studied seasonal dynamics by examining sheep aged 8 months to 8 years. The results obtained (Fig. 2) revealed no dependence of the extent of infection on the season, since infection was equally high thru the entire year.

Sharp rises in the degree of infection in the summer and autumn-winter were not observed, altho Berman (1913), Scott (1918) and Lubyanskiy (1956) reported them. According to our data, the highest sheep infection rate (100%) occurred in the spring-summer and early autumn (in May-October), while the minimum occurred in the late autumn and winter (November-January). The lowest infection level was observed in December (77.7%). We know that in countries with a hot climate the sarcosporidia infection rate is significantly higher than in countries with a temperate or cold climate. It should be pointed out that Bergman's (Switzerland), Scott's (U.S.A.) and Lubyanskiy's (Ul'yankovsk Oblast, USSR) studies were conducted in areas where the winters are comparatively severe and the sheep are kept in stalls in winter. Consequently, the circumstances of confinement of sheep in summer and winter differed sharply from one another; in summer the animals were pastured, while in winter they were kept in stalls. Our investigation, however, were carried out in southeast Kazakhstan, where the climate is comparatively warm and the great majority of sheep are found on the pastures thruout the year, consequently, infection is possible thruout the year. For this same reason, obviously, no sharp fluctuations in infection rate were observed at specific times during the year. The slight drop in severity of infection during the autumn-winter months may be explained by the low temperatures, to which sarcosporidia are not resistant; nevertheless, infection of sheep by sarcosporidia, tho somewhat less in the autumn-winter period, still takes place thruout the year in southeast Kazakhstan, as is proven by the comparatively even and high extent of infection in sheep over the course of the whole year.

CONCLUSIONS

Sarcocystis tenella infects sheep in southeast Kazakhstan starting in their 2nd month of life. As the sheep age the extent and intensity of

infection grows, by the 10th or 11th month, 100% of the sheep are infected. Adult sheep more than 5 years old are all infected with sarcosporidia.

As the level of fatness decreases the extent and severity of sarcosporidial infection rises.

Females become infected oftener and more heavily than males.

Infection of sheep by sarcosporidia occurs thruout the year in southeast Kazakhstan, with a rise in the spring-summer and early autumn periods; its prevalence is somewhat less in the late autumn and winter.

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Seven other references are given in Latin script.

Table 1

Relationship of extent and intensity of sarcosporidial infection
of sheep to fatness of the animal

Degree of fatness	No. of head	No. Infected	Intensity of Infection		
			Slight	Moderate	Heavy
Above average	143	102 (71.3)	22 (21.5)	48 (47.1)	32 (31.4)
Moderate	434	366 (84.3)	65 (17.7)	125 (34.3)	176 (48.0)
Below Average	577	524 (90.5)	56 (10.7)	166 (31.7)	302 (57.6)

Table 2

Relationship between extent and intensity of infection of sheep and
sex of the animal

Sex	No. of head	No. Infected	Intensity of Infection		
			Slight	Moderate	Heavy
Male	465	391 (84)	70 (17.9)	139 (35.6)	182 (46.5)
Female	689	586 (85)	68 (11.6)	197 (33.6)	321 (54.8)

Note: Numbers in parentheses are percentages.

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