

Epidemiology of *Oestrus ovis* infestations in sheep in Kars province of north-eastern Turkey

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Abstract This study was carried out to determine the prevalence of cavical myiasis caused by *Oestrus ovis* larvae in sheep of Kars province of north-eastern part of Turkey. From 30 to 35 sheep heads (total of 387) were examined every month regularly for *O. ovis* larvae during 12 months. Of 387 heads, 156 (%40.3) were infested with *O. ovis* larvae. The prevalence of nasal myiasis was 54.3% in spring, 41% in summer, 28% in fall, and 38.9% in winter. The differences among seasons were significant statistically ($P < 0.05$). Infestation rate up to 1-years-old was 30.0%, 1 to 3 years-old 40.0% and older than 3 years old was 52.4%. The number of larvae made peak in spring months and went down in the months of fall. The mean number of larvae regarding examined animals was 1.8, and the mean according to infested animals was 4.5. Density of *O. ovis* larvae in infested sheep were changed from 1 to 31. Infestation rate in the morkaraman breed was higher (43.4%) comparing to the rate in the akkaraman breed (31.3%). The differences between sheep breed were also significant ($p < 0.05$). Sheep with dark colored head had higher infestation rate than that of sheep with light colored head ($p < 0.05$).

Keywords *Oestrus ovis* · Sheep · Epidemiology · Kars · Turkey

Introduction

Oestrus ovis is known as the sheep nasal bot fly whose larvae live on mucous surfaces of the nasal passages and sinuses of goats and sheep. The adult looks like a honeybee, it is yellow to gray brown, 10–12 millimeters in length, has black pits between the eyes, and is covered with short hairs. Adults do not feed and the female fly deposits newly hatched first instar larvae in the nostrils of the host. Larvae pass through three stages or instars of increasing size. Fully developed larvae leave the sinuses and nasal passages, drop the ground, and pupate in the soil. The timing of the sheep bot fly life cycle is dependent on season and climatic conditions and it is quite variable from weeks to several months. This nasal bot fly can cause widespread cavicol myiasis with clinical respiratory signs such as seromucous or prulent nasal discharge, frequent sneezing, and dyspnea, which may severely impair the health of small ruminants. Those pathogenic affects causes serious economical losses in hosts, mainly in herds reared for meat and dairy production. Oestrosis is also considered as zoonotic diseases. It sometimes causes ophtalmo-myiasis in humans in different regions of the world including Turkey (Soulsby 1986; Urquhart et al. 1987; Kettle 1995; Dinçer 1997).

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The prevalence *O. ovis* infestations in sheep in the world as follows; 33.2–65% in France (Bergeaud et al. 1994; Dorchies et al. 2000; Jacquet and Dorchies 2002; Yilma and Dorchies 1991), 71.1% in Spain (Alcaide et al. 2003), 55.8–91.0% in Italy (Caracappa et al. 2000; Scala et al. 2001, 2002), 22.6% in Libya (Gabaj et al. 1993), 17.2% in Iraq (Jarjees et al. 2000), 8.7% in Egypt (Amin et al. 1997), 58% in Jordan (Abo-Shehada et al. 2000), 5.5% in Saudi Arabia (Alahmed 2000), 21.0% in Ethiopia (Bekele and Mukasa-Mugerva 1994), 10–100% in Morocco (Pandey and Ouhelli 1984), 67.4% in Algeria (Benakhla et al. 2004), 6–52% in Zimbabwe (Pandey 1989), and 8.1% in India (Pathak 1992). Oestrosis is commonly seen in sheep and goats in Turkey. Unfortunately, only two reports for *O. ovis* were published previously. According to Gokcen and Sevgili (2004) oestrosis were seen in 36.7% of Awassi sheep in Sanliurfa province of Turkey. Uslu and Dik (2006) reported that *O. ovis* larvae were found in 59% of sheep of Konya province at one year study in which animal heads were monthly examined. These references show that the knowledge about the prevalence and epidemiology of oestrosis is quite limited in Turkey. Reports from Mediterranean region show that oestrosis has high prevalence and our study makes to think that oestrosis might be prevalent in Turkey too.

Sheep breeding is common in pastures or high plateaus of the north-eastern Turkey where Kars is located and in which we carried out this study. Sheep owners in this region underestimate the importance of the clinical signs of sneezing and nasal discharge generally and they think that those signs are the results of infection with lung worms. There are no previous works to know the prevalence and intensity of the disease in this province and also in the region. The aim of this article to investigate the monthly prevalence and the numbers of *O. ovis* larval burden among slaughtered Akkaraman and Morkaraman sheep of various characteristics in Kars province, and also we wanted to get sufficient attention of Department of Agriculture for this province.

Materials and methods

North-eastern Turkey is at an altitude of approximately 1.800 meters and has close borders to Armenia, Georgia, Nakhchivan (Azerbaijan) and Iran. The

climate in Kars province is cold continental with the annual average temperature about 6°C and roughly –10°C average in January and +18°C in July. The area gets regular rainfall from March through November. In the other months of the year it gets heavy snowfall. The province is the major animal (mainly cattle) breeding area of the country and is relatively underdeveloped when compared to the other parts of the country. In Kars province, 46% of farm animals are sheep. The sheep population in Turkey is estimated to be at 23 millions and farmers have 296.000 sheep in the province of Kars according to the official records of 2005.

The heads of slaughtered akkaraman and morkaraman sheep (white karaman and reddish-black karaman) at the Kars Municipality abattoir were examined for *Oestrus ovis*. One visit per week was paid to the abattoir during the 12 month period beginning from June. During this time, 387 heads of from 8-month-old to 11-year-old sheep from two races were opened for cranial examinations. Seven to 9 heads were bought from abattoir every visit. The heads of sheep were randomly chosen. The origin, breed, sex, and age of animal were recorded (Table 1). The age of the animals was estimated by the stage of dentations, season and by questioning the owners; only animals originating from Kars province were examined in the study. Information on a prior antiparasitic treatment was not available. The heads of slaughtered sheep were separated from the rest of the carcass by butchers and the skull was removed by ventral disarticulation of the atlanto-occipital joint and, after removal of the skin, the area just caudal to the frontal bone was cut cross-sectionally using hand-saw, followed by two parallel cuts on the parietal bone. The bone was removed using a chisel and hammer and the meninges incised with a scalpel blade, so exposing the brain. Recovered larvae were collected, counted and washed in saline solution and fixed in 70% alcohol. Larval stages were identified according to the key given by Zumpt (1965). The brains were also carefully examined for gross pathological lesions. The data were analyzed by Chi-square test for statistics (Minitab 1994).

Results

The larval stages of *Oestrus ovis* were found in 156 of 387 sheep heads (40.3%). The monthly and seasonal

Table 1 Time period of the study and different characteristics of examined animals

Months	n	Sex		Breed		Age			Color of head				
		m	f	mk	ak	1≤	2	≥3	b	w	r	bs	rs
June	35	10	25	22	13	6	16	13	9	6	11	7	2
July	35	21	14	28	7	20	12	3	3	4	17	3	8
Agust	35	4	31	29	6	26	4	5	5	4	23	3	–
September	35	15	20	30	5	12	15	8	5	3	17	3	7
October	35	13	22	27	8	3	11	21	2	4	21	4	4
November	30	17	13	20	10	5	9	16	4	4	9	8	5
December	30	15	15	25	5	3	8	19	2	1	20	4	3
January	30	19	11	22	8	1	9	20	3	4	11	5	7
February	30	14	16	21	9	1	12	17	4	3	11	4	8
March	30	10	20	20	8	–	14	16	4	3	10	4	9
April	32	9	23	23	9	–	8	24	7	2	8	6	9
May	30	6	24	19	11	3	6	21	7	3	12	7	1
Total	387	153	234	288	99	80	124	183	55	41	170	58	63

n: number of examined sheep, **m:** male **f:** female, **mk:** morkaraman, **ak:** akkaraman

b: black, **w:** white, **r:** red, **bs:** black spotted, **rs:** red spotted

incidence of infection with *O. ovis* was shown in Table 2. The highest infestation rate was in April as 71.8%. The seasonal prevalence was highest rate in spring (54.3%). There was significant difference between seasonal prevalence during the study ($p < 0.05$). In Table 3, total maggot counts and infestation percentage according to the ages of animals were given. Although oestrosis was more prevalent in sheep which were older than three years old (52.4%), there was no significant difference for infestation rates

Table 2 The monthly prevalence of *Oestrus ovis* and its' distribution according to seasons

Months	x/n (%)	Season	x/n (%)
June	14/35 (40.0)	Summer	43/105 (41.0)
July	11/35 (28.5)		
Agust	18/35 (51.4)		
September	9/35 (25.7)	Fall	28/100 (28.0)
October	11/35 (28.5)		
November	8/30 (26.6)		
December	10/30 (33.3)	Winter	35/90 (38.9)
January	12/30 (40.0)		
February	13/30 (43.3)		
March	14/30 (46.6)	Summer	50/92 (54.3)
April	23/32 (71.8)		
May	13/30 (43.3)		
Total	156/387 (40.3)		156/387 (40.3)

x/n: number of infested animal/number of examined animals

regarding the ages of animals ($p > 0.05$). Most of the larval burden was also obtained from the sheep older than three years old. No positive correlation was found between male and female animals ($p > 0.05$) in the prevalence of *O. ovis* regarding sexuality (Table 4). The anterior nasal region of sheep had more larvae than the posterior region. The larval stages of *O. ovis* between anterior and posterior nasal passages were not remarkably distributed. During this one year study, total of 708 larvae [71 L1 (10%), 188 L2 (26.6%), and 449 L3 (63.4%)] were collected from 156 infested animals. Larval burden stages of L2 and L3 were always present during twelve month study while L1 stages were not seen in the months of January, February, and March. The number of L3 stages was lower in the months of October, November, December, and January. The highest larval burden regarding seasonal distribution were obtained in spring season

Table 3 Larval counts and infestation percentage according to the ages of animals

Age	x/n (%)	Larvae counts (%)
1≤	24/80 (30.0)	147 (20.8)
2	50/124 (40.0)	154 (21.8)
≥3	82/183 (52.4)	407 (57.5)
Total	156/387 (40.3)	708 (100)

x/n: number of infested animal/number of examined animals

Table 4 Larval counts and infestation percentage according to sexuality of animals

Sex	x/n	Larvae counts (%)
Male	67/153 (43.8)	345 (48.7)
Female	89/234 (38.0)	363 (51.3)
Total	156/387 (40.3)	708 (100)

x/n: number of infested animal/number of examined animals

(257 larvae) followed by summer (201 larvae), winter (146 larvae), and fall (104 larvae) seasons. The mean number of larvae regarding examined numbers was 1.8, and the mean according to infested animals was 4.5. The mean intensity of larvae in infested animals was changed from 1 to 31 by infested per head (Table 5).

The larvae were more prevalent in the morkaraman breed (43.4%) than that of the akkaraman breed (31.3%). This data was statistically significant ($p < 0.05$). Beside that the morkaraman breed had more larval stages (81.9%) than that of the akkaraman breed (Table 6). It is obliged to report that *O. ovis* was more common in animals with dark colored heads. Especially the animals with black heads and black noses had more infestation and this was statistically significant ($p < 0.05$) (Table 7).

Table 5 The montly distribution of larval stages of *Oestrus ovis*

Months	Larval types			Total larvae counts	MLC*	MLC**	x/n
	L ₁	L ₂	L ₃				
June	6	8	44	58			
July	11	22	39	72	6.6	2.1	11/35
Agust	16	12	43	71	3.9	2	18/35
September	9	10	28	47	5.2	1.3	9/35
October	7	15	13	35	3.2	1	11/35
November	12	8	2	22	2.8	0.7	8/30
December	5	34	19	58	5.8	1.9	10/30
January	–	19	15	34	2.8	1.1	12/30
February	–	18	36	54	4.2	1.8	13/30
March	–	17	56	73	5.2	2.4	14/30
April	1	16	100	117	5.1	3.7	23/32
May	4	9	54	67	5.2	2.2	13/30
Total	71 (%10.0)	188 (%26.6)	449 (%63.4)	708	4.5	1.8	156/387

MLC*: mean larval counts regarding total infested animals.

MLC **: mean larval counts regarding total examined animals.

x/n: number of infested animal/number of examined animals

Discussion

Because of the lack of information on how wide-spread is *O. ovis* in sheep and its' negative effects in sheep and goats by sheep farmers in Kars provincial area, this one year study conducted. The data showed that oestrosis is a prevalent parasite among the heads examined. This study has proved that *O. ovis* is a prevalent parasite of Kars province of north-eastern region of Turkey, and is epidemic during twelve months of a year in the sheep. The overall prevalency of the parasite was 40.3% (156/387) among the sheep examined. These present results can be compared with those obtained in Konya (Uslu and Dik 2006) and Sanliurfa provinces (Gokcen and Sevgili 2004) of Turkey and also in Jordan (Abo-Shehada et al. 2000), the South-west France (Dorchies et al. 2000), Sardinia (Scala et al. 2001). The overall prevalence 36.7% in Sanliurfa and 59% in Konya and it was 58% in Jordan, 42.8% in South France, 82% in Sardinia. The percentage in our study is lower than that of most of the studies. This can be due to cold continental climate in the province. The mean parasite intensity (4.5 per head) reported in this study was also quite lower than that of the other studies (Pandey and Ouhelli 1984; Yilma and Dorchies 1991; Caracappa et al. 2000; Scala et al. 2002; Alcaide et al. 2003).

Table 6 Larval counts and infestation percentage according to the breed of animals

Breed	x/n (%)	Larvae counts (%)
Morkaraman	125/288 (43.4)	580 (81.9)
Akkaraman	31/99 (31.3)	128 (18.1)
Total	156/387 (40.3)	708 (100)

x/n: number of infested animal/number of examined animals

The larvae were less observed in the animals when the monthly average temperature was lower than +10°C. Heavier infestations occurred in spring and summer. In the present work, the degree of infestation occurred mainly for L3 which were always present every month in a year. The percentage of first stage larvae found throughout in the entire study was quite low comparing to that of other studies (Dorchies et al. 2000; Scala et al. 2002; Gokcen and Sevgili 2005). It is known that *O. ovis* maggots have the capacity to adjust their biological cycles during the developmental phase according to particular climatic conditions of the area. When the climate is adverse, L1 cease its' development goes to hypobiotic period (Cobbet and Mitchell 1941). We are suspicious that diapause was also present during the winter months. But we don't have enough data to support this phenomenon. It is thought that reinfestations do not occur in Kars region and this data for larval evolution profile suggest that *O. ovis* has the existence of one long cycle (October to May) and possibly one short cycle (June to September).

According to our visual observations, body condition of sheep was not associated with nasal bot infestations. In this study, sex is not considered as one of the important risk factors of the disease as it was seen in other studies (Howard 1977; Gupta et al. 1985; Belem and Rouille 1988; Murguia et al. 2000). Head color of sheep had effect ($p < 0.05$) on the prevalence the nasal bot infestations similar to the results reported by Martinez (1989). Murguia et al. (2000) found that sheep with dark noses had a higher probability (OR=1.46) of acquiring the disease. In a different study also in Kars province, Kara et al. (2005) reported that piebald animals were less attractive; in a mixed cattle herd, *Hypoderma bovis* flies (Diptera: Oestridae) had tendency to select dark and colored animals to lay their eggs. It gives the idea that the flies of this family have attraction to dark colored animals.

Considering quite cold climate of the area, the persistence of *O. ovis* infestations in Kars sheep flocks can be also explained by other factors. Most of the farmers are not conscious in treating as long as clinical signs severe, and some do not treat the sheep at all. It is not common but it is heard that some farmers buy lambs (3–6 month-old) from other provinces to put out to green fertile pastures of Kars highland and graze them until October. This situation might have also effect on the prevalence of the parasite. Eradication of *Oestrus ovis* is difficult because of the location of the parasite in the host. The goal in the treatment must be eliminating the parasite or reducing clinical signs of oestrosis. Currently, the most effective method is the use of an approved parasitic drug on the larvae. This goal may be achieved by choosing a persistent drug such as closantel to treat in the presence of L3. By this way, reinfections can be avoided. Ivermectin, doramectin or moxidectin must be used as non-persistent drugs to eradicate the burden when there is no L3 and many hypobiotic L1 (Dorchies et al. 2000; Jacquiet and Dorchies 2002; Scala et al. 2002; Tabouret et al. 2001). Depending on our findings and observations, we advice two strategic treatments per year for *O. ovis* in the area; the first one is in March, at the beginning of the growing period of the larvae, and the second administration in October, at the end of growing period. It is concluded that *Oestrus ovis* is present and widespread in the sheep of Kars province of Turkey. We claim that head colors of sheep must be considered as one of the important factors in the prevalence of the disease.

Table 7 Infestation rate of *O. ovis* larvae regarding head colors of sheep

The color of head	x/n (%)	Proportion to total infested animals (%)
Black	32/55 (58.1)	32/156 (20.6)
White	15/41 (36.5)	15/156 (9.7)
Red	64/170 (37.7)	64/156 (41.0)
Black spotted	16/58 (27.6)	16/156 (10.3)
Red spotted	29/63 (46.0)	29/156 (18.6)
Total	156/387 (40.3)	156/156 (100)

x/n: number of infested animal/number of examined animals

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