VETERINARSKI ARHIV 86 (3), 323-333, 2016

The prevalence of ovine oestrosis (*Oestrus ovis* Linnaeus, 1761, Diptera: *Oestridae*) and risk factors in Eastern Turkey

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ÖZDAL, N., P. TANRITANIR, F. ILHAN, S. DEĞER: The prevalence of ovine oestrosis (*Oestrus ovis* Linnaeus, 1761, Diptera: *Oestridae*) and risk factors in Eastern Turkey. Vet. arhiv 86, 323-333, 2016.

ABSTRACT

This study was carried out to estimate the prevalence, larval burden and some risk factors of ovine oestrosis in 328 heads of randomly selected sheep slaughtered in one year at Van, eastern Turkey. Of the total heads, 127 (38.71 %) were infested with *Oestrus ovis* (Linnaeus, 1761, Diptera: *Oestridae*) larvae. The prevalence of *O. ovis* was 51.68 % in summer, 40.69 % in spring, 35.80 % in autumn, and 23.61 % in winter. The differences between seasons were statistically significant ($P<0.05$). Out of a total of 511 larvae collected, 17 % were L1, 29 % L2, and 54 % L3 larvae. All three larval instars were observed in all study months, apart from the fact that no first-stage larvae were seen in December and March. The overall larval intensity for the infested sheep was 4.02, with 3.42 in spring, 3.80 in summer, 4.03 in autumn and 5.82 in winter. The infestation rates were 41.26 % in female and 34.42 % in male sheep. The infestation rate in sheep less than 2-years-old was 23.33 %, in those 2 to 4 years-old 36.42 % and inj those older than 4 years old 48.43 %. Sheep with dark head color had a higher risk than sheep with white and spotted heads ($P<0.05$).

Key words: *Oestrus ovis,* prevalence, risk factors, sheep, Turkey

Introduction

Larvae of *Oestrus ovis*, the sheep nasal bot fly, are obligate parasites and cause nasal-sinusal myiasis in sheep and goats, known as oestrosis. This disease has worldwide distribution and is especially widespread in the Mediterranean areas of Europe and Africa (KILANI et al., 1986; PANGUI et al., 1988; DORCHIES et al., 2000; ALCAIDE et al., 2003; GEBREMEDHIN, 2011). It can lead to severe clinical signs, including breathing

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ISSN 0372-5480
Printed in Croatia

difficulties, seromucous or purulent nasal discharge, emaciation, frequent sneezing, incoordination and dyspnea. The pathogenic effects cause significantly reduced animal production and serious economical losses, which have been estimated at 1.1 - 4.6 kg of meat, 200 - 500 g of wool and up to 10 % milk per animal (HORAK and SNIJDERS, 1974; ILCMANN et al., 1986; DORCHIES et al., 1993). Moreover, the infection may be complicated by sinusal tumours, lung abscesses and interstitial pneumonia (RANGATUGA and RAJAMAHENENDRAN, 1972; DORCHIES et al., 1993) and it predisposes the host to secondary bacterial infections (QUIROZ, 1984).

Oestrosis is also considered a zoonotic disease. Ophthalmic and naso-pharyngeal myiasis caused by first-stage larvae of *O. ovis* are reported occasionally in humans in many parts of the world, including Turkey, the Mediterranean region and other Middle Eastern countries (AL-DABAGH et al., 1980; DAR et al., 1980; CAMERON et al., 1991; AMR et al., 1993; MASOODI and HOSSEINI, 2003; AKDEMIR and OZEN, 2013). Despite the fact that *O. ovis* represents a major economic problem for sheep producers, and the presence of the parasite is well-known in Turkey, there are currently very little data on the epidemiological parameters of the infestation (GOKCEN and SEVGILI, 2004; ARSLAN et al., 2008; USLU and DIK, 2006). Furthermore, there are no previous studies on the prevalence and intensity of the disease in this province.

The aim of this study was to determine the monthly prevalence and parasite burdens of *O. ovis* infection in Akkaraman sheep, and to explore some potential risk factors associated with this disease in Van, eastern Turkey.

Materials and methods

Animals and study area. This study was carried out in sheep at the municipality slaughterhouse in Van province. This region is located at 42º40'E and 44º30'E longitude and 37º43'N and 39º26'N latitude, it is at an altitude of approximately 1,725 meters and has close borders to eastern Iran. The climate in Van province is characterised by a continental climate with long, snowy, rainy, frosty and cold winters, short, warm and dry summers, with the annual average temperature about 9 °C and roughly -3.5 °C average in January and +22.3 °C in July. The winter months are not very harsh due to the softening effects of Van Lake. The average annual relative humidity and rainfall on the Van Plain is 59 % and 384 mm, respectively. Of the annual rainfall, 28.5 % falls in winter, 37.5 % in spring, 6.5 % in summer and 27.5 % in the fall. There is frost on 132 days of the year (KALELIOGLU, 1991). Meterological data were supplied from official website of Turkish State Meteorological Service.

Examination procedure. For 1 year, we examined *Oestrus ovis* in sheep on a monthly basis (maximum 31 and minimum 23 per month, total 328) from municipality slaughterhouse in Van (Eastern Turkey). Each week during the one-year study period,

sheep heads were taken from the abattoir. The origin, sex, age, and head colour of animals were recorded. Aging was estimated by dentition and by questioning the owners. Information on prior antiparasitic use was not available. However, according to the information obtained from sheep breeders, the use of effective drugs against this parasite is generally very limited in the study region. After slaughter, the heads were put separately into nylon bags and transported to the laboratory for examination. The sheep heads, with the skin peeled off, were cut through their longitudinal axis with a hand-saw. All existing larvae were collected from the nasal cavities, septum and the middle meatus (site I) and the conchae and sinuses (site II). Collected larvae were counted, washed in physiological saline solution, fixed in 10 % formalin solution and identified to instar under a stereomicroscope for using the keys of ZUMPT (1965).

Statistical analysis. Using the obtained data, the infection was estimated in terms of prevalence (%) and mean intensity (total number of individuals of a particular parasite species in a sample of a host species/number of infected individuals of the host species in the sample). Differences in prevalence of *O. ovis* according to the season, ages, sex, and head color of the sheep were evaluated with the χ-square test, and the Z test was used to compare infection rates between different seasons and larval stages. In all the analyses, the confidence level was set at 95 % and $P<0.05$, $P<0.025$ for significance.

Results

Of the 328 sheep heads examined, 127 (38.71 %) were infected with *O. ovis*. In Table 1, seasonal and monthly patterns in prevalence and intensity of infection, and larval stage structure are given. The highest seasonal prevalence in sheep was in the summer (51.68 %) and spring (40.69 %) and the lowest in the winter (23.61 %). There were significant differences between percentages in winter and spring, winter and summer, summer and autumn ($P>0.05$) (Table 3).

The monthly overall average number of larvae observed per animal ranged from 2.5 to 9 for infected animals only, with the mean intensity of infection at 4.02 larvae. On a monthly basis, the highest infestation rate was in June (64.51 %) and the lowest in December (16 %). The three larval instars were observed throughout the year, except that no first-stage larvae were seen in December and March. The proportion of first stage larvae (L1) decreased markedly in winter. Among the 511 larvae collected in total, 86 were L1 (17 %), 149 L2 (29 %), and 275 L3 (54 %). The maximum number of third instar larvae were observed (34.90 %) during the summer, when the first instar larvae reached its highest figure (55.17 %).

The highest larval burdens in terms of seasonal distribution were obtained in the summer (175 larvae) followed by spring (120 larvae), fall (117 larvae) and winter (99 larvae).

The percentages of larvae infested sheep in two head locations are given in Table 4. The larvae were obtained from both locations throughout the year. Regarding location of larvae, 181 larvae were found in site I (35.4 %) and 330 larvae (64.6 %) in site II. There were significant differences between the percentages of first and third stage larvae at both site I and site II (P>0.05).

Infestation percentages according to the age, sex and color of the heads of sheep are given in Table 2. Although oestrosis was more prevalent in sheep older than four years old (48.43 %) and two-three years old (36.42 %), no positive correlation was found between age groups (P>0.05) in the prevalence of *O. ovis*. Likewise, most of the larval burden was also found in females (41.26 %). However, there was no significant difference in infestation rates regarding sex (P>0.05). With regard to head color, the infestation percentage values were 48.41, 26.59 and 37.96 % for the dark, light and spotted heads, respectively. Head color of the sheep was associated (P<0.05, P<0.025) with the prevalence of nasal bot infestations.

Table 1. The monthly and seasonal prevalence of *Oestrus ovis* and its' larval stages

Months	x/n	(%)	M I	L1	L2	L3	T L C	Season x/n (%)
December	4/25	16	9	-	23	13	36	Winter 17/72 (23.61)
January	5/23	21.73	7.4	3	14	20	37	
February	8/24	33.33	3.25	2	17	7	26	
March	8/28	28.57	4.75	-	19	19	38	Spring 35/86 (40.69)
April	12/28	42.85	3.58	2	9	32	43	
May	15/30	50	2.6	6	5	28	39	
June	20/31	64.51	2.5	12	10	28	50	Summer 46/89 (51.68)
July	14/30	46.66	5.21	17	12	44	73	
August	12/28	42.85	4.3	19	9	24	52	
September	11/30	36.66	4.9	15	9	30	54	Autumn 29/81 (35.80)
October	11/26	42.30	3.45	7	14	17	38	
November	7/25	28	3.57	4	8	13	25	
Total (%)	127/328	38.71	4.02	87 17 %	149 29 %	275 54 %	511	

x/n: number of infested animals/number of examined animals; T L C: Total larvae counts; M I: Mean intensity;

Table 2. Infestation percentage according to the ages, sex and color of head of animals

Animals								
Age			Color of head			Sex		
	x/n	%		x/n	%		x/n	%
<2	14/60	23.33	Dark	61/126	48.41	Male	42/122	34.42
2-4	51/140	36.42	White	25/94	26.59	Female	85/206	41.26
>4	62/128	48.43	Spotted	41/108	37.96			
Total	127/328	38.71		127/328	38.71		127/328	38.71
(P>0.05)			(P<0.05, P<0.025)			(P>0.05)		

Table 3. Comparison of the seasons

Comparisons	Z	P
Winter-Spring	2.34	0.019*
Winter-Summer	3.85	0.001*
Winter-Autumn	1.67	0.095
Spring-Summer	1.47	0.142
Spring-Autumn	0.65	0.515
Summer-Autumn	2.11	0.034*

* (P<0,.5)

Table 4. Location of larvae of *Oestrus ovis* in the head cavities of sheep according to stage

	Site I		Site II		
Larval stage	N	%	N	%	Total
First	40	45.97	47	54.02	87
Second	56	37.58	93	62.41	149
Third	85	30.90	190	69.09	275
Total	181		330		511
Comparisons	Z	P	Z	P	
First-Second	1.81	0.07	1.26	0.207	
First-Third	3.06	0.002*	2.50	0.012*	
Second-Third	1.38	0.169	1.38	0.169	

* (P<0.05)

Discussion

Oestrus ovis has been known to occur in Turkey for years; however, some data on its prevalence have only recently been reported by USLU and DIK (2006) in Konya, ARSLAN et al. (2008) in Kars and GOKCEN and SEVGILI (2004) in Sanliurfa. Hence this study was conducted. The overall prevalence of oestrosis was 38.71 % in the sheep in this study. In some other studies conducted in various regions of the world with different climates from Mediterranean countries (Morocco, Tunisia, Sicily, Spain, Greece etc.), in the West African Sahelian countries (Senegal, Nigeria), in Europe countries such as Germany and in neighboring countries to the east of Turkey (Iraq, Iran), different prevalence rates of the disease were found in sheep. Similar prevalence rates to ours of 36.7, 40.3, 43.4, 46.03, 49.7 % were reported from abattoir surveys conducted in Sanlıurfa and Kars (Turkey), South France, Majorca (Spain) and Iran, respectively (DORCHIES et al., 2000; GOKCEN and SEVGILI, 2004; ARSLAN et al., 2008; PAREDES-ESQUIVEL et al., 2012; SHOORIJEH et al., 2009) and were reported from seroprevalance studies in Greece (48.6 %) and Yucatan in Mexico (30.6 %) (PAPADOPOULOS et al., 2010; MURGUIA et al., 2000). The figures found in the present study was higher than that reported from Iraq (20.96 %) (SHAREEF, 2001), but less than that found in the Konya province of Turkey (59 %) (USLU and DIK, 2006), Germany (50 %) (BAUER et al., 2002), Jordan (58 %) (ABO-SHEHADA et al., 2000). However, it was considerably different from those obtained in Senegal (Africa) (95 %; PANGUI et al., 1988), Sardinia (Italy) (91 %; SCALA et al., 2001), southwest and northeast Spain (71.1 %; ALCAIDE et al., 2003; 84.2 %; GRACIA et al., 2010), Morocco (62.2 %; PANDEY and OUHELLI, 1984), Ambro (Ethiopia) (69.8 %; GEBREMEDHIN, 2011), Central Oromia (Ethiopia) (94.6 %; ALEM et al., 2010) and Tunisia (93.6 %; KILANI et al., 1986). These results indicate the adaptation of *O. ovis* to different climatic conditions, such as Mediterranean, continental and tropical climates.

The mean intensity of infection was 4.02 larvae per host, which is much higher than the results obtained by SHAREEF (2001) in sheep in Iraq, with a mean larval burden of 1.98 per animal, and much lower than results obtained by ALCAIDE et al. (2003) in sheep in southwestern Spain, with a mean larval burden of 18.54 per animal. This may be explained by the climatic variation in the regions, the age of the animals and variations in host resistance.

The highest seasonal prevalence in the sheep was in the summer (51.68 %) and spring (40.69 %) and the lowest in the winter (23.61 %). In the summer, the mean minimum temperature ranges from about 18.2 °C in June to 22.3 °C in July. The maximum temperature varies between 23.6 and 28 °C at that time. Rainfall is also relatively low in summer, with monthly averages of 9.1 kg/sqm (climatic data were obtained from the official website of the Turkish State Meteorological Service).

The monthly prevalence ranged from 16 % in December to 64.51 % in June. The monthly prevalence rate of *O. ovis* in sheep in southern France varied from 14.3 % in February to 65 % in October (DORCHIES et al., 2000), 38.9 % in September to 83.3 % in August in Sicily (CARACAPPA et al., 2000), 62.5 % in January to 100 % in June and October in northeast Spain (GRACIA et al., 2010). This study showed that all larval stages were seen throughout the entire period, except that no first-stage larvae were seen in December and March. SHAREEF (2001) reported that only second and third instar larvae were seen in Iraq. Although the percentage of first stage larvae found throughout in the entire study was quite low compared to that of other larval stages, we described a predominance of L1 larvae from June until the end of September, that may be due to new larvae deposited by gravid female adult flies. According to the regional climate, *Oestrus ovis* larvae cease development during hypobiosis, either in winter under temperate climates or in the hot and dry season of Sahelian countries (YILMA and DORCHIES, 1991; PANGUI et al., 1988). In contrast, BIGGS et al. (1998), suggested that hypobiosis at the pupal rather than the L1 stage is important for the overwintering of *O. ovis* in Namibia. This phenomenon may be considered as an external hypobiotic period (TABOURET et al., 2001).

Conflicting results have been observed in some regions on the existence of a hypobiotic period in *O. ovis*. For example, in southern France, YILMA and DORCHIES (1991) proved that larvae overwintered as L1 stage, however years later DORCHIES et al. (2000) could not arrive at the same conclusion.

In the present study, a significantly ($P<0.05$) higher percentage was found of L3 (54 %) than L2 (29 %) and L1 (17 %). A similarly higher percentage of L3, as compared to L2 and L1, was reported by ARSLAN et al. (2008) in Kars, where the climatic conditions and altitude are more or less similar; but a higher percentage of L1 compared to L2 and L3 was reported by ALCAIDE et al. (2003) in southwest Spain, SCALA et al. (2001 and 2002) in Sardinia (Italy), DORCHIES et al. (2000) in France, YILMA and GENET (2000) in Central Ethiopia, GEBREMEDHIN (2011) in Ambo (Ethiopia) and USLU and DIK (2006) in Konya (Turkey).

Taking into consideration the climatic conditions of the area, we suspect that hypobiosis may be present during the cold and snowy winter months in Van province (the maximum temperatures between December and February vary between 4.4 and 7.7 °C, whilst the minimum vary between -4.5 and -1.8 °C). However we did not find first stage larvae in sufficient quantity in winter to verify this phenomenon. According to BART and MINAR (1992), many L1 are destroyed in the nasal cavities during the hypobiotic period. The decrease of the parasite number is partly related to the development of an immune reaction (TABOURET et al., 2001). The probable reason why there was a low percentage of first stage larvae is that the majority of examined animals were older than two years of age. According to MARCHENKO and MARCHENKO (1989), adult sheep acquire an immune

response to *O. ovis* larvae, through repetitive infestations, whereas lambs remain more susceptible. PAREDES-ESQUIVEL et al. (2012) also found that young animals were more susceptible to infestation by L1 parasitic stages than sheep, and that the mean intensity of infestation was higher in lambs than in sheep.

There is some evidence of increasing numbers of larvae as the animals become older. However we did not find enough data to confirm this in our study. In this study, despite the increasing prevalence with age in sheep, age and sex were not considered important risk factors of oestrosis, as in other studies conducted in sheep and goats (CHHABRA and RUPRAH, 1976; HOWARD, 1977; BELEM and ROUILLE, 1988; ARSLAN et al., 2008). Although age groups and sex did not show significant differences in prevalence of *O. ovis*, some studies have indicated a higher frequency in adults than in young animals (CHHABRA and RUPRAH, 1976; MURGUIA et al., 2000; ABO-SHEHADA et al., 2000; USLU and DIK, 2006; SHOORIJEH et al., 2009; PAPADOPOULOS et al., 2010) and in females than in males (SHOORIJEH et al., 2009; USLU and DIK, 2006).

In previous studies, some investigators reported a significant association between the face (ARSLAN et al., 2008) or nose color (MURGUIA et al., 2000) of animals and the presence of oestrosis. However, in other studies, it was reported that face color (MURGUIA et al., 2000) and nose color (PAPADOPOULOS et al., 2010) were not associated with the disease. In this study, head color did affect the prevalence of infection in sheep ($P<0.05$, $P<0.025$). Namely, sheep with dark head color were more susceptible to *O. ovis* infestation than sheep with white head color and spotted heads.

Conclusion

Infection by *O. ovis* is considered to be an important problem in sheep in Van and is likely to be of importance for animal production and welfare. Additionally, the sheep's head color should be considered as a potential risk factor for oestrosis. In order to estimate the economic importance of oestrosis and the efficiency of control measures, and determine the precise seasonal prevalence of *O. ovis* infestation in this area, further investigations are required including more animals, determining more risk factors and rnonitoring *O. ovis* fly activites over the year, as well as work on the role of immunity in the disease.

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Received: 24 February 2015
Accepted: 10 December 2015

ÖZDAL, N., P. TANRITANIR, F. ILHAN, S. DEĞER: Prevalencija ovčje estroze (*Oestrus ovis* Linnaeus, 1761, Diptera: *Oestridae*) i rizični čimbenici njezina širenja u istočnoj Turskoj. Vet. arhiv 86, 323-333, 2016.

SAŽETAK

Ovo istraživanje provedeno je radi procjene prevalencije, opterećenja ličinkama i čimbenika rizika estroze u 328 nasumično odabranih ovaca na klaonici u Van-u u istočnoj Turskoj. Od toga broja je 127 ovaca (38,71%) bilo invadirano ličinkama ovčjeg štrka *Oestrus ovis* (Linnaeus, 1761, Diptera: *Oestridae*). Prevalencija *O. ovis* iznosila je 51,68 % ljeti, 40,69 % u proljeće, 35,80 % u jesen i 23,61 % zimi. Sezonske razlike bile su statistički signifikantne (P<0,05). Od ukupno 511 prikupljenih ličinaka 17 % bile su ličinke L1, 29% L2 te 54 % L3. Razvoj svih triju stupnjeva ličinaka bio je promatran svaki mjesec tijekom istraživanja, osim što ličinke prvog stupnja nisu bile ustanovljene u prosincu i ožujku. Prosječna jačina invazije po ovci iznosila je 4,02: na proljeće 3,42, ljeti 3,80, u jesen 4,03 te zimi 5,82. Stupanj invazije iznosio je 41,26% u ovaca i 34,42% u ovnova. Stupanj invazije u životinja mlađih od 2 godine iznosio je 23,33%, u onih u dobi od 2 do 4 godine bio je 36,42 %, a u onih starijih od 4 godine bio je 48,43 %. Ovce s tamnom bojom dlake na glavi imale su veći rizik od oboljevanja u usporedbi s ovcama koje su imale bijelu ili šarenu glavu (P<0,05).

Ključne riječi: *Oestrus ovis,* prevalencija, rizični čimbenici, ovce, Turska