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Prevalence of *Oestrus ovis* (Diptera: Oestridae) in sheep from Ituiutaba, south-east region of Brazil

Prevalência de *Oestrus ovis* (Diptera: Oestridae) em ovinos de Ituiutaba, região sudeste do Brasil

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Abstract
Among the diseases which can afflict the nasal cavities of small ruminants, oestrosis stands out. In Brazil, more specifically in its South-East region, the reports are limited only to the State of São Paulo and to the municipality of Araxá, Minas Gerais. Therefore, it has been sought to assess the parasitic prevalence of *Oestrus ovis* in sheep farmed in the municipality of Ituiutaba, Minas Gerais-Brazil, while correlating the larval size and stage, and its anatomical localization. Eighty-eight hemiheads of healthy Santa Inês/Dorper crossbreds *Ovis aries* have been used at random. The larvae in view were then collected and fixated to be quantified and analyzed in regard of size and stage of development. It is concluded that the oestrosis is an existing problem in the municipality of Ituiutaba, this being the first complete study on the prevalence of this parasite in the State of Minas Gerais. By anatomical distribution, only the differences of total larval averages between the frontal sinus and the ventral nasal meatus, the common nasal meatus and the nasopharynx have been significant. In size, the significant difference has been there only upon comparison between the size and the larval stage, information that is crucial for a better understanding of the cyclic progression, of the clinical symptomatology, and animal prophylaxis.
Keywords: botfly; larval stages; oestrosis; *Ovis aries*; sheep diseases

Resumo
Dentre as doenças que podem atingir as cavidades nasais dos pequenos ruminantes, destaca-se a oestrose. No Brasil, mais especificamente na região Sudeste, os relatos estão limitados ao estado de São Paulo e ao município de Araxá, Minas Gerais. Assim, procurou-se avaliar a prevalência parasitária do *Oestrus ovis* em ovinos criados no município de Ituiutaba, Minas Gerais-Brasil, correlacionando ao mesmo tempo o tamanho e estágio larval com a sua localização anatômica. Oitenta e oito hemicabeças de *Ovis aries* mestiços Santa Inês com Dorper saudáveis foram utilizadas aleatoriamente.

As larvas visualizadas foram então coletadas e fixadas para serem quantificadas e analisadas em relação ao seu tamanho e estágio de desenvolvimento. Conclui-se que a oestrose é um problema existente no município de Ituiutaba, sendo este o primeiro estudo completo sobre a prevalência deste parasito no estado de Minas Gerais. Por distribuição anatômica, apenas as diferenças das médias larvais totais entre o seio frontal e o meato nasal ventral, meato nasal comum e a nasofaringe foram significativas - o que confirma a preferência das larvas por essa região. Em tamanho, a diferença significativa só ocorreu mediante a comparação entre o tamanho e estágio das larvas, informação crucial para uma melhor compreensão da progressão cíclica, sintomatologia clínica e profilaxia dos animais.
Palavras-chave: doenças ovinas; estágios larvais; mosca; oestrose; *Ovis aries*

Introduction

In sheep farming, parasitism is a dominant limiting factor[1]. Among the diseases that can afflict small ruminants, especially its nasal cavities, oestrosis stands out[2, 3] that is an ailment caused by the larvae of the *Oestrus ovis* fly. This parasite of cosmopolitan occurrence obligatorily infects the nasal cavity and the paranasal sinuses of the animals, mainly sheep, goats at a lesser frequency[4], and accidentally humans[5].

Clinically, the manifestations may include rhinitis, sinusitis, repeated sneezing, purulent nasal discharge, and dyspnea[6-8]. In the long term, the pathogenic effects lead to a decline in immune response and body condition[9] and that, along with the difficult control of that parasite in the environment[10] and its ability of adapting to the predominant climate of the region[11], makes epidemiological studies on such disease to be ever more necessary and important throughout diverse locations in each country.

In Brazil, more specifically in its South-East region, reports on this field are limited but to the State of São Paulo[12, 13] and to the municipality of Araxá, Minas Gerais[14]. Therefore, it has been sought to assess the parasitic prevalence of *Oestrus ovis* in sheep farmed in the municipality of Ituiutaba, Minas Gerais-Brazil, in the period between December of 2013 and December of 2015, while correlating the larval size and stage and its anatomical localization.

Materials and methods

Eighty-eight hemiheads of Santa Inês/Dorper crossbreds of *Ovis aries* have been used at random, with estimated ages ranging between 180 and 210 days, and no regard for sex. The animals belong to the Laboratory of Animal Anatomy of the University Center of Patos de Minas (UNIPAM-Brazil) and had been acquired during the spring (October 2014 and 2015) from commercial farms located in the municipality of Ituiutaba, Minas Gerais-Brazil (18°58'08"S 49°27'54"W). The study had been approved by the Ethics Committee on the Use of Animals of UNIPAM, protocol number 22/12.

Euthanasia was performed soon after the animals arrived at the University. The sheep had been subject to the process of fixation and conservation in a 10% formaldehyde solution. Subsequently, with the aid of a vertical band saw, two preparatory cuts would be performed on the cadavers: the first one on the middle third of the neck; and the second one following the level of the median sagittal plane of the heads.

Upon removal of the nasal septum, while resorting to straight anatomical tweezers, a bilateral inspection of the nasal cavities and paranasal sinuses would be performed. The *Oestrus ovis* larvae would then be collected and fixated in 10% formaldehyde solution and forwarded to the Laboratory of Animal Parasitology of the same institution to be quantified and analyzed in regard of size and stage of development. The categorization took place by means of a macroscopic assessment of the larvae under a stereoscopic magnifying glass, with measurement being performed lengthwise, in the ventral face of the larvae, with the aid of a Starrett® digital electronic pachymeter (0-150 mm capacity, 0.05 mm resolution, ± 0.05 mm accuracy).

According to Guimarães and Papavero[15] and Monteiro[16], L1 present between one and three millimeters in length, segmentations, transverse rows of spikes, and two strong short chitinous mouth hooks, which will form the cephaloskeleton. L2 are between 1.5 and 12 millimeters in long, and display few spikes on the second segment. L3 are about 20 millimeters in long, white when young and brownish yellow when mature, with a dorsal display of wide chitinous bands devoid of spikes along all segments, the exception being only the second segment, which presents a reduced number of spikes.

The data gathered have been put in tables and subjected to a descriptive statistical analysis (number of infested hemiheads, and the quantity, the localization, and the size of larvae found), to the Student's *t*-test, with a confidence interval of 95% (significance between infestation by antimeres), and to the ANOVA and Qui-Square tests, followed either by the Tukey test or by the *t*-test (respectively, for significance between the localization / total number of larvae, localization / size of the larvae, and development / size of the larvae; and localization / stage of development of the larvae) by means of the BioEstat® 5.3 software. The anatomical nomenclature used for the referencing of structures is in accordance with the International Committee on Veterinary Gross Anatomical Nomenclature[17].

Results

Considering the 88 hemiheads assessed, 38.6% (34/88) were found to be infested with a total of 56 larvae, which characterizes an average intensity of 1.64 ± 0.9 larvae per hemihead. Regarding antimere, 52.9% of the cases have taken place to the right (18/34) and 47% to the left (16/34), respectively marked by the average presence of 1.4 ± 0.7 (26/18) and 1.87 ± 1.1 (30/16) larvae per hemihead, with no statistically significant difference between them (P=0.719).

Regarding the anatomical distribution of the parasites, there has been 1.8 ± 0.8 larvae in the dorsal nasal meatus (5/34 or 14.70%), 1 ± 0 larvae in the middle nasal meatus (6/34 or 17.64%), 2 ± 1.4 larvae in the ventral nasal meatus (2/34 or 5.88%), 1.75 ± 1.4 larvae in the ethmoid meati (8/34 or 23.52%), 1 ± 0 larvae in the common nasal meatus

(1/34 or 2.94%), 1.4 ± 0.6 larvae in the frontal sinus (15/34 or 44.11%), and 1 ± 0 larvae in the nasopharynx (1/34 or 2.94%), only considering those hemiheads positive for the localization mentioned. The absolute and percentage figures of that distribution, both in terms of region and of antimere, are expressed in the Table I. It is highlighted as well that no statistically significant differences had been observed upon comparison between the anatomical localization of the larvae by antimeres, even though that would occur at times, upon confrontation of the averages of total anatomical distribution.

Table I. Absolute and percentage figures on the distribution of the *Oestrus ovis* larvae per anatomical localization and antimery in *Ovis aries* from Ituiutaba, South-East region of Brazil. Total n = 56 larvae and 34 hemiheads

Anatomical localization	Right antimere	Left antimere	Total	P
	Absolute / Percentage (%)			
Dorsal nasal meatus	5.00 / 8.92	4.00 / 7.14	9.00 / 16.07	0.820
Middle nasal meatus	3.00 / 5.35	3.00 / 5.35	6.00 / 10.71	1.000
Ventral nasal meatus	1.00 / 1.78	3.00 / 5.35	4.00 / 7.14	0.530
Ethmoid meati	8.00 / 14.28	6.00 / 10.71	14.00 / 25.00	0.747
Common nasal meatus	1.00 / 1.78	0.00 / 0.00	1.00 / 1.78	0.320
Frontal sinus	7.00 / 12.50	14.00 / 25.00	21.00 / 37.50	0.238
Nasopharynx	1.00 / 1.78	0.00 / 0.00	1.00 / 1.78	0.320

*Statistical difference between antimeres with $p < 0.05$.

Specifically concerning the larvae of *Oestrus ovis*, their total size was 14.05 ± 4.8 mm in average, after being analyzed as a group (n = 56), while their mean measurements were also reported in accordance with the anatomical localization of origin: 12.66 ± 4.1 mm for the dorsal nasal meatus (n = 9), 13.66 ± 7.4 mm for the middle nasal meatus (n = 6), 17 ± 2.9 mm for the ventral nasal meatus (n = 4), 12.21 ± 3.5 mm for the ethmoid meati (n = 14), 18 ± 0 mm for the common nasal meatus (n = 1), 15.04 ± 5.1 mm for the frontal sinus (n = 21), and 18 ± 0 mm for the nasopharynx (n = 1). Here, no statistically significante differences have been observed when compared to the averages of the larval size and the specific anatomical localization per antimeres, and neither upon comparison of the averages of larval size between the anatomical localizations (P=0.280) (Table II).

Table II. Mean and standard deviation values of the size in millimeters of *Oestrus ovis* larvae per anatomical localization and antimery in *Ovis aries* from Ituiutaba, South-East region of Brazil. Total n = 56 larvae and 34 hemiheads

Anatomical localization	Right antimere	Left antimere	Total	P
	Mean / Standard deviation (mm)			
Dorsal nasal meatus	11.40±4.33	14.25±3.77	12.66±4.12	0.336
Middle nasal meatus	13.66±2.08	13.66±11.50	13.66±7.39	0.995
Ventral nasal meatus	19.00±0.00	16.33±3.21	17.00±2.94	-
Ethmoid meati	11.62±3.92	13.00±2.96	12.21±3.49	0.506
Common nasal meatus	18.00±0.00	-	18.00±0.00	-
Frontal sinus	12.14±5.64	16.50±4.39	15.04±5.15	0.063
Nasopharynx	18.00±0.00	-	18.00±0.00	-

*Statistical difference between antimeres with $p < 0.05$.

In accordance with the development stage, there has been the visualization of larvae in stages I (1/56; 1.78%), II (22/56; 39.28%), and III (33/56; 58.92%), moreover subdivided in the forms III-young (13/56; 23.21%) and III-mature (20/56; 35.71%). Larvae were distributed in a diversified manner throughout the head, although without the existence of a statistically significant difference for comparison between the presence of the larval stages I, II, and III in specific anatomical localizations (P=0.275), or between the presence of the young and the mature forms of the larval stage III for the same anatomical localizations (P=0.084) (Tables III and IV).

Table III. Absolute figures of the distribution of the *Oestrus ovis* larvae per anatomical localization and development stage in *Ovis aries* from Ituiutaba, South-East region of Brazil. Total n = 56 larvae and 34 hemiheads

Anatomical localization	Stage of development			
	I	*II*	*III*	*Total*
Dorsal nasal meatus	0	4	5	9
Middle nasal meatus	1	2	3	6
Ventral nasal meatus	0	0	4	4
Ethmoid meati	0	8	6	14
Common nasal meatus	0	0	1	1
Frontal sinus	0	8	13	21
Nasopharynx	0	0	1	1
Total	1	22	33	56

Table IV. Absolute figures on the distribution of the *Oestrus ovis* larvae per anatomical localization and stage of specific development in L3 in *Ovis aries* from Ituiutaba, South-East region of Brazil. Total n = 33 larvae and 24 hemiheads

Anatomical localization	Stage of specific development III		
	Young	*Mature*	*Total*
Dorsal nasal meatus	5	0	5
Middle nasal meatus	1	2	3
Ventral nasal meatus	1	3	4
Ethmoid meati	3	3	6
Common nasal meatus	0	1	1
Frontal sinus	3	10	13
Nasopharynx	0	1	1
Total	13	20	33

Finally, respectively for the stages I, II, III-young, and III-mature, there has been the visualization of larvae with an average of 2 ± 0 mm; 10.5 ± 3.2 mm; 14.7 ± 2.1 mm, and 18.15 ± 3.6 mm, thus characterizing a statistically significant difference for this item (the low n of L1 would allow for a statistical comparison).

Discussion

As has been previously informed, *Oestrus ovis* is distributed worldwide[4]. However, the activity of the fly, the larval development, and the period over which it remains as a pupa on the ground are heavily influenced by the environmental climatic[12], especially regarding a seasonality standard, which seems to be related to the severity of the temperatures in summer and the low pluviometric rates[18]. Indeed, the city of Ituiutaba displays favorable conditions for a rapid parasitic development and, therefore, the larvae presence was already expected to some extent.

In this study, 38.6% of the sheep hemiheads assessed have shown to be positive for oestrosis, a percentage above the 4.1% reported in the Federal District and in the State of Goiás-Brazil[19], the 13.7% of the central region of the State of São Paulo-Brazil[13], the 16.9% of the micro-region of Umuarama in the State of Paraná-Brazil[14], the 19% in Quito-Ecuador[20], and the 27.3% of the South-East region of Spain[21]; albeit below the 40.6% found in the Province of Kars-Turkey[10], the 46% in the Majorca Island-Spain[22], the 50% in Botucatu-Brazil[12], the 53.5% in Abu Arish-Saudi Arabia[23], the 55.8% in Sicily-Italy[24], the 60.9% during summer in the South region of Chile[25], the 69.8% in Ambo-Ethiopia[26], the 84.2% in the North-East region of Spain[27], the 91% in Sardinia-Italy[28], and the 92.1% in La Paz-Bolivia[29].

By period of larval development, authors such as Caracappa et al.[24], Scala et al.[28], Gracia et al.[27], Gebremedhin[26], and Silva et al.[12], have depicted a higher percentage of occurrence of those in the first stage, whereas Hidalgo et al.[25], Choque-Fernandéz et al.[29], and Ortega-Muñoz et al.[20] have observed a predominance of stage number Two

and, just as noticed in the municipality of Ituiutaba, only Hanan[23] and Silva et al.[13] have reported the numeric primacy of tertiary larvae. However, none of them would produce a recalculation considering the young (23.21%) and the mature (35.71%) forms of the stage III, as has been carried out herein. In the present study the euthanasia of the animals occurred a few days after the animals were transferred from the farm, which could explain the higher number of L3 larvae since there was no reinfection during this period.

Apart from all that has been exposed, outbreaks are also reported in the State of Mato Grosso[19], in the North-East region[8], and in the City of Araxá, Minas Gerais[14], all within Brazilian borders, but with no detailed description on account of the percentage of animals infested and the intensity or stage of the larvae collected. Notwithstanding that, in combination with the other reports, it becomes evident that Brazil stands as a country with favorable climatic characteristics for an efficient progression of *Oestrus ovis*, regardless of its cyclic phase, and therefore, maybe the larvae do not need to enter a condition of hypobiosis, which would justify the absence of calcification and the low number of L1 in a scenario of constant and rapid development.

In this very context, and in an equally unique manner, the current study provides an account which correlates the presence and the localization of the *Oestrus ovis* larvae, but in more profound and essentially specific a manner regarding the anatomy of the nasal cavity and the other regions inspected. Ergo, in the sheep of the municipality of Ituiutaba, the most widely affected anatomical localization was the frontal sinus, followed by the ethmoid meati, the dorsal nasal meatus, the middle nasal meatus, the ventral nasal meatus, the common nasal meatus, and the nasopharynx; there being significant difference when comparing the total averages of this first region with the ventral nasal meatus, with the common nasal meatus, and with the nasopharynx.

Nevertheless, considering only the average of larvae distributed in hemiheads positive for a given anatomical region, in a descending order, a higher number of samples would be visualized in the ventral nasal meatus, the dorsal nasal meatus, the ethmoid meati, the frontal sinus, the middle nasal meatus, the common nasal meatus, and the nasopharynx, albeit with no significant statistical difference in this item.

According to Barroso et al.[21], the major part of the larvae studied by him were found in the horn septa, also located in small quantities throughout the maxillary sinus, olfactory area, and the frontal and the post-orbital septa. Yet, Mustafa et al.[19] report a higher incidence for the nasal concha and septa, the trachea, and the paranasal sinus, followed by the horn septum, the ethmoid conchae, the choana, the oral cavity, and the oropharynx, while Carvalho et al.[30] mention only the nasal cavity and the frontal sinus as regions of collection. Supplementary information to the position of the larvae is provided by different researchers, in accordance with the stage of development observed.

To Moya et al.[31], the L1 are most often found in the most cranial respiratory system, whilst there is a predominance of L2 in the paranasal sinuses. Silva et al.[12] report, a bit more specifically, that the L1 are predominantly found inside the nasal cavity, the L3 specially in the frontal sinus, and the L2 in both locations, with a slight preference for

the latter, which corroborates, in part, with what has been noted in Ituiutaba.

In this case, there has been a subtle predilection of both larvae in stages II and III for the nasal cavity when compared to the frontal sinus, though, at times, the highest intensity would be noticed in the said paranasal sinus, either to the same extent as in the ethmoid meati in L2, or surpassing the ventral nasal meatus and the ethmoid meati in L3-mature. Still, it is worth pointing out that, in spite of the negligible number of L1, which does not permit statements in regard of its distribution per region, there have been no significant differences between the presence of the larval stages I, II, and III in specific localizations, or between the presence of the young and the mature forms of L3 for the same localizations.

Finally, the larval morphometry showed an average total size of 14 mm, in which no statistically significant difference would be characterized as well, when compared between the specific anatomical localization by antimeres, or even when considered between all of the anatomical localizations in scrutiny. Nevertheless, after a breakdown of the data read stage of development, it has been observed that size is a figure relating to that much and, as a topic seldom approached in the literature, it remained yet to be demonstrated, even in a study conducted by Moya et al.[31], in which, by the way, the larvae were found to be proportionally larger than those in Ituiutaba.

Recently, and ever more often, the enhanced systems of production create conditions for the appearance of oestrosis in stocks of small ruminants[25], boosted by a rapid expansion of this farming, and which fosters new hotbeds of infection[15, 32]. As a consoling factor, the mortality caused by this parasite is very low or hardly ever takes place[30], both because the lesions are mild in nearly all cases[3] and, in accordance with the quantity of larvae, they tend not to cause clinical symptomatology in the specimens[19]. Perhaps due to that, and in a disquieting manner, this is a disease that is overlooked in Brazil[12], and which accounts for the decrease in the production of meat and milk on the part of these animals[24, 33]. Thus, a reminder is made herein for its importance and the eminent need of prevention which, as suggested by Portela et al.[2], is more important than suggested by the low number of diagnoses and studies conducted.

Conclusions

It is concluded that the oestrosis is a problem in the spring in Ituiutaba, whilst this is the first complete study on its prevalence in the State of Minas Gerais, South-East region of Brazil. Thus, the favorable climatic condition of the locality gives rise to a warning situation which justifies more research, especially regarding specific prevention strategies. By anatomical distribution, only the differences of total larval averages between the frontal sinus and the ventral nasal meatus, the common nasal meatus and the nasopharynx have been significant. In size, the significant difference has been there only upon comparison between the size and the larval stage, information that is crucial for a better understanding of the cyclic progression, of the clinical symptomatology, and of the animal prophylaxis.

References

1. Waller PJ. International approaches to the concept of integrated control of nematode parasites of livestock. International Journal for Parasitology. 1999;29(1):155-164. http://doi.org/10.1016/S0020-7519(98)00178-7

2. Portela RA, Riet-Correa F, Garino Júnior F, Dantas AFM, Simões SVD, Silva SMS. Doenças da cavidade nasal em ruminantes no Brasil. Pesquisa Veterinária Brasileira. 2010;30(10):844-854. http://doi.org/10.1590/S0100-736X2010001000007

3. Schenkel DM, Cavalcante MKM, Damasceno ES, Campos AK, Furlan FH. Surto de Oestrus ovis em ovinos em Mato Grosso. Pesquisa Veterinária Brasileira. 2012;32(8):754-756. http://doi.org/10.1590/S0100-736X2012000800013

4. Zumpt F. Myiasis in man and animals in the old world: a textbook for physicians, veterinarians, and zoologists. London: Butterworts; 1965. 267p. English.

5. Brini C, Nguon B, Miglietta E, Sala L, Acutis PL, Riina MV, Rossi L, Serusi E, Gervasio CF, Tamponi C, Scala A, Varcasia A. Rhinomyiasis by *Oestrus ovis* in a tourist returning from Corsica. Parasitology Research. 2019;118:3217-3221. http://doi.org/10.1007/s00436-019-06508-2

6. Taylor MA, Coop RL, Wall RL. Parasitologia Veterinária. Rio de Janeiro: Guanabara Koogan; 2010. 768p. Portuguese.

7. Angulo-Valadez CE, Ascencio F, Jacquiet P, Dorchies P, Cepeda-Palacios R. Sheep and goat immune responses to nose bot infestation: a review. Medical and Veterinary Entomology. 2011;25(2):117-125. http://doi.org/10.1111/j.1365-2915.2010.00911.x

8. Vasconcelos TC, Macêdo JTSA, Silva A, Silva MMN, Bittencourt TCC, Santos MVB, Costa JN, Pedroso PMO. Oestrose: uma parasitose emergente em pequenos ruminantes no Nordeste do Brasil. Pesquisa Veterinária Brasileira. 2016;36(10):925-929. http://doi.org/10.1590/s0100-736x2016001000001

9. Silva BF, Bassetto CC, Amarante AFT. Immune responses in sheep naturally infected with *Oestrus ovis* (Diptera: Oestridae) and gastrointestinal nematodes. Veterinary Parasitology. 2012;190(1-2):120-126. http://doi.org/10.1016/j.vetpar.2012.06.004

10. Arslan M, Kara M, Gicik Y. Epidemiology of *Oestrus ovis* infestations in sheep in Kars province of north-eastern Turkey. Tropical Animal Health and Production. 2009;41:299-305. http://doi.org/10.1007/s11250-008-9190-x

11. Horak IG. Parasites of domestic and wild animals in South Africa. I. *Oestrus ovis* in sheep. Onderstepoort Journal of Veterinary Research. 1977;44(2):55-64.

12. Silva BF, Bassetto CC, Amarante AFT. Epidemiology of *Oestrus ovis* (Diptera: Oestridae) in sheep in Botucatu, State of São Paulo. Revista Brasileira de Parasitologia Veterinária. 2012;21(4):386-390. http://doi.org/10.1590/S1984-29612012000400008

13. Silva BF, Machado GP, Izidoro TB, Amarante AFT. Prevalence of *Oestrus ovis* (Diptera:

Oestridae) in sheep from the São Paulo Central region, Brazil. Revista Brasileira de Parasitologia Veterinária. 2013;22(1):18-21. http://doi.org/10.1590/S1984-29612013005000011

14. Carvalho TF, Pietricoski KA, Pereira LS, Pereira WAB, Coelho HE, Machado FME, Nogueira GM. Infestação de rebanho ovino por *Oestrus ovis* na região de Araxá-MG, Relato de caso. PUBVET. 2011;5:art.1201.

15. Guimarães JH, Papavero N. Myiasis in Man and Animals in the Neotropical Region. São Paulo: Pleiâde/FAPESP; 1999. 308p. English.

16. Monteiro SG. Parasitologia na Medicina Veterinária. São Paulo: Roca; 2014. 368p. Portuguese.

17. International Committee on Veterinary Gross Anatomical Nomenclature. Nomina Anatomica Veterinaria. Hannover, Ghent, Columbia and Rio de Janeiro: Editorial Committee; 2017. 178p. English.

18. Fonseca O, Moya VM, Montano DN, Centelles Y, Percedo MI, Alfonso P. Spatial modeling of oestrosis in sheep in Guantánamo province, Cuba. Small Ruminant Research. 2018;164:32-38. http://doi.org/10.1016/j.smallrumres.2018.05.001

19. Mustafa VS, Guedes KMR, Lima EMM, Borges JRJ, Castro MB. Doenças da cavidade nasal em pequenos ruminantes no Distrito Federal e no Estado de Goiás. Pesquisa Veterinária Brasileira. 2015;35(7):627-636. http://doi.org/10.1590/S0100-736X2015000700005

20. Ortega-Muñoz G, Luzuriaga-Neira N, Salazar-Silva R, Rodriguez-Hidalgo, R. *Oestrus ovis* in Ecuador: Importance in the Andean sheep farming. Veterinary World. 2019;12(4):522-526. http://doi.org/10.14202/vetworld.2019.522-526

21. Barroso P, Ruiz-De-Ybáñez R, Martínez-Carrasco C, Gens MJ, Escribano F, Sánchez A, Pérez JM. First report of oestrosis in aoudad from southeastern Spain. Parasitology Research. 2017;116:2053-2055. http://doi.org/10.1007/s00436-017-5504-0

22. Paredes-Esquivel C, del Rio R, Monerris M, Borràs D, Laglera LM, Miranda MÁ. The influence of sheep age group on the seasonal prevalence of oestrosis in the island of Majorca. Veterinary Parasitology. 2012;186(3-4):538-541. http://doi.org/10.1016/j.vetpar.2011.11.065

23. Hanan BA. Seasonal prevalence of *Oestrus ovis* L. (Diptera: Oestridae) larvae in infested sheep in Jazan Region, Saudi Arabia. Journal of Parasitology and Vector Biology. 2013;5(5):66-71. http://doi.org/10.5897/JPVB2013.0112

24. Caracappa S, Rilli S, Zanghi P, Di Marco V, Dorchies P. Epidemiology of ovine oestosis (*Oestrus ovis* Linné 1761, Diptera: Oestridae) in Sicily. Veterinary Parasitology. 2000;92(3):233-237. http://doi.org/10.1016/s0304-4017(00)00317-4

25. Hidalgo A, Palma H, Oberg C, Fonseca-Salamanda F. *Oestrus ovis* infection of grazing sheep during summer in southern Chile. Pesquisa Veterinária Brasileira. 2015;35(6):497-500. http://doi.org/10.1590/S0100-736X2015000600002

26. Gebremedhin EZ. Prevalence of ovine and caprine oestrosis in Ambo, Ethiopia. Tropical

Animal Health and Production. 2011;43:265-270. http://doi.org/10.1007/s11250-010-9687-y

27. Gracia MJ, Lucientes J, Peribáñez MA, Castillo JA, Calvete C, Ferrer LM. Epidemiology of *Oestrus ovis* infection of sheep in northeast Spain (mid-Ebro Valley). Tropical Animal Health and Production. 2010;42:811-813. http://doi.org/10.1007/s11250-009-9503-8

28. Scala A, Solinas G, Citterio CV, Kramer LH, Genchi C. Sheep oestrosis (*Oestrus ovis* Linné 1761, Diptera: Oestridae) in Sardinia, Italy. Veterinary Parasitology. 2001;102(1-2):133-141. http://doi.org/10.1016/S0304-4017(01)00515-5

29. Choque-Fernandéz GC, Loza-Murguia MG, Vino-Nina NL, Coria-Conde LA. *Oestrus ovis* (Diptera: Oestridae) un importante ectoparásito en ovinos de cuatro cantones del municipio de Sorata provincia Larecaja, departamento de La Paz. Journal of the Selva Andina Animal Science. 2017;4(1):3-12.

30. Carvalho RS, Ruivo MA, Colli MHA, Pereira V, Martinez AC, Mazzucatto BC, Cruz BC, Maciel WG, Felippelli G, Teixeira WFP, Soares VE, Costa AJ, Lopes WDZ. Occurrences of *Oestrus ovis* parasitism in necropsied sheep in the Umuarama microregion, Paraná, Brazil. Revista Brasileira de Parasitologia Veterinária. 2015;24(3):370-374. http://doi.org/10.1590/S1984-29612015044

31. Moya VM, Diego JGR, Alfonso P, Pérez JM, Olivares J. Morfometría de larvas de *Oestrus ovis* (Diptera: Oestridae) de ovinos, en Cuba. Revista de Salud Animal. 2012;34(3):184-187.

32. Cansi ER, Castro MB, Mustafa VS, Porto MR, Borges JR. *Ovis aries* (Artiodactyla: Bovidae) e *Capra hircus* (Artiodactyla: Bovidae) parasitados por *Oestrus ovis* (Diptera: Oestridae) no Distrito Federal, Brasil. Entomo Brasilis. 2011;4(3):147-149.

33. Shoorijeh SJ, Negahban S, Tamadon A, Behzadi MA. Prevalence and intensity of *Oestrus ovis* in sheep of Shiraz, southern Iran. Tropical Animal Health and Production. 2009;41:1259-1262. http://doi.org/10.1007/s11250-009-9309-8