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Prevalence of Oestrusovis L. in caprine livestock from the North of Mexico

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Abstract: *Oestrusovis is a dipterous insect of obligatoryparasitosis, a cosmopolitan larviparus belonging to the Family Oestridae, which gives rise to severe cavitarymyiasis in grazing and stabled caprine and ovine that are bred in different parts of the world. It is considered a very well adapted parasite, difficult to eradicate, and one that affects the well-being and yield of the host, diminishing the profitability of caprine and ovine exploitation. This parasitosisalso affects other wild and domestic animals. The current status of caprine oestrosisin the Comarca Lagunerais unknown. Thus,in order to calculate the prevalence of Oestrusovisin caprine livestock of the North of Mexico,we carried out our investigation at a goat slaughterhouse located in the city of Gómez Palacio, state of Durango, Mexico. The animals came from different municipalities and common lands. Once the animals were sacrificed, the head was removed and, by means of a longitudinal incision, the nasal fossae and frontal sinuses were exposed, to observe the presence of larvae in their interior. The larvae were counted and deposited in a tube of ethyl alcohol 70% for their later observation and classification in the laboratory.The number of caprine heads examined was 66, of which 55 were infested with different larval stages (L1, L2, L3). A high prevalence was obtained of 83%.To our knowledge, this is the first published and registered report on infestationby Oestrusovisin caprine livestock of the Comarca Lagunera.*

Key words: *Oestrusovis,Prevalence, Goats, Myiasis, Horned botfly.*

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I. Introduction

The horned botfly is a larva whose taxonomic classification is as follows: Order: Diptera; Suborder: Ciclorrapha; Tribe: Galyptrata; Family: Oestridae; Genus: *Oestrusovis*; Species: (*Oestrusovis* Linnaeus(Linnaeus, 1761) [1,2].It is a cosmopolitan agent of myiasis in sheep and goats[3].It is even an obligatory parasite of these latter animals, which are common in many areas of Peru[4]; it is the cause of oestrosis or nasalmyiasis, which can lead to severe clinical manifestations in the livestock. Oestrosis tends to affect the well-being as well as the yield of their hosts and invades the nasal cavity and sinuses of caprine and ovine, subsequently giving rise to myiasis: the larvae can migrate to the brain [5,6]. It is known as the ram nasalbotfly [7]. In Mexico, caprine oestrosis has been reported in the states of Zacatecas and San Luis Potosí [8], and in the city of Netzahualcoyotl in the State of Mexico, and in the states of Coahuila and Guanajuato [8],as well as in the state of Baja California Sur [9]. *Oestrusovis*is a dipterous insectof obligatoryparasitosis, a cosmopolitanlarviparusthat causes severe cavitarymyiasisin grazing and stabled caprine that are bred in different parts of the world [10,11,12].It is thought that its pathogenicity is the result of mechanical trauma by two acute, potent, chintinosous, mouth hooks and horns in each segment of the larval body[1].

This is considered a very well adapted parasite that is difficult to eradicate and that affects the host, diminishing the profitability of caprine and ovine exploitations.This parasitosisalso affects other wild and domestic animals, as well as humans [11,13].

The disease entertains a high prevalence, above all in tropical regions. Adult botflies deposit larvae intothe nostrils of the animal, and the first stage (L1) migrates to the nasal passages where they feed on the secretions present at this site, in turn migrating to nasal fossae, where they engage in two molts (L2 and L3),to return afterward to the nasal passages and finally, to be expelled to the exterior when the animals sneezes [14].

The biological cycle of this parasite is very variable and can last from 2 weeks to several months depending on the season of the year and the climatic conditions[15].

The clinical signs depend on the localization and number of larvae present. They are characterized by serous, mucous, or purulent nasal discharges, as well as by frequent sneezes and dyspnea. In sheep, mortality can be high when the larvae migrate to the brain [6].

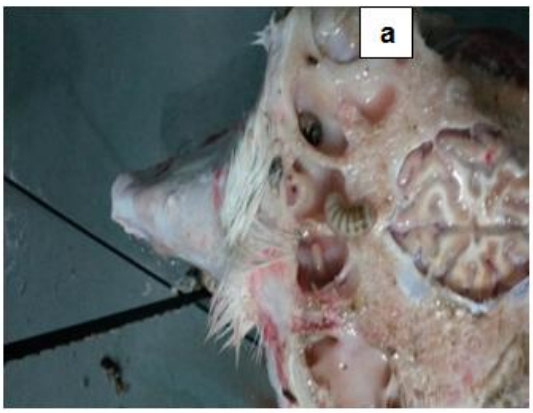
At present, in that the identification of the larvae of *Oestrus*spp is complicated by the morphology of each species, Polymerase Chain Reaction (PCR) is utilized, sequentiation of the mitochondrial Cytochrome Oxidase (*mtCOi*) gene as a diagnostic tool for identifying and demonstrating the phylogenies of *Oestrusovis*larvae in infested sheep; its detection is substantial for approaching their epidemiology and control [3].

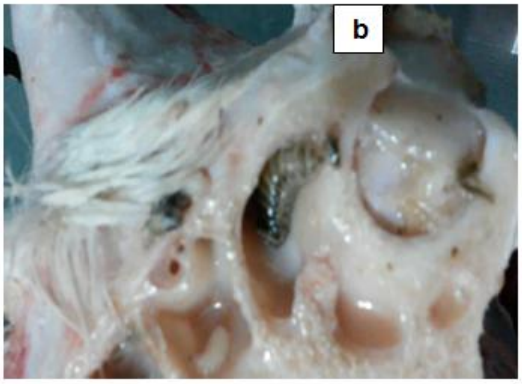
The Secretariat of Agriculture, Livestock, Rural Development, Fisheries andFood (SAGARPA) in Mexico will drive caprinoculture as an economic option for the inhabitants of marginalized zones in the country, by means of the production of meat, milk, candies, cheeses, and for the elaboration of dairy products [16].The breeding of caprine livestock in Mexico finds its profit in the production of meat, which is destined for its sale and consumption and similarly, in the production of goat milk for human consumption, as well as for the elaboration of cheeses and candies. In the Comarca LaguneraRegion and in that of el Bajio, thetechnified caprine industry has been developed that commits its production, mainly, to the confectionary and dairy industries. Sweets elaborated with goat milk have acquired a long tradition in Mexico, and include a great variety, among which "*cajeta*" (goat-milk toffee-like syrup) from Celaya, Guanajuato, and sweet of milk called "*glorias*" in the North of the country. Under the heading of the elaboration of cheese, which is very complete, we find Mexico's main producers in the Central states of the country.The main breeds of goats bred in Mexico for milk production are Alpine, Anglo-Nubia, and Saanen, and for meat, Angora, Noer, Toggenburg,andCriolla. The annualdomestic production of cadaver caprine meat is more than 77 thousand tons, and the yearlyproduction of goat milk is more than 160 thousand liters [17].Among the most important problems that occur in the caprinoculture of the region, we find the lack of technical support, ignorance of the techniques and methods of caprine herd management, overcrowding, and sanitary problems such as "horned botfly" or oestrosis. The current status of caprine oestrosis in the Comarca LaguneraRegion is unknown due to the absence of determinations of prevalence; consequently, the objective of this study was proposed as calculating the prevalenceof *Oestrusovis*in caprine livestock in the North of Mexico.

II. Materials and Methods

The investigation was carried out in a goat slaughterhouse in the city of Gómez Palacio, state of Durango, Mexico. The animals came from different municipalities and *ejidos*(common lands). TheLocalization was 25º 52' 28" North Latitude and 103º 37' 07" West Latitude of the Greenwich Time Line (Prime Meridian): altitude 1,119 msnm,mean annual temperature 20-22ºC, and mean annual precipitation, 300 mm.

Once the animals were sacrificed, the heads were removed and, by means of a longitudinal cut, the nasal fossae and frontal sinuses were exposed(**Figures 1a and 2b**). Likewise, anincision was made at the base of the horn to observe the presence of larvae in its interior. These larvae were collected, counted, and deposited in a tube with ethyl alcohol at 70% for their later observation and classification at the laboratory.The different stages (L1, L2, andL3) were observed and classified employing a stereoscopic microscope and the entomological keys of Zumpt (1965). Prevalence was calculated as a percentage.





Figures 1a and1b. Presence of larvae L1, L2, and L3 in frontal sinuses.

Figure 2. Larvaecollected in paranasal sinuses.

Figure 3. Larval stages L1, L2, and L3.

III. Results and Discussion

The number of caprine heads examined was 66, of which 55 were infested with different larval stages (L1, L2, and L3) (**Figures 2 and 3**), obtaining a prevalence of 83%. In an investigation performed in India by Jumeand collaborators in the year 2012, of a total of 247 caprineexamined, prevalence was found of 78.54%, very close to that encountered in the present investigation. Similarly, Goddard et al.(1999) in the U.K. determined a prevalence of 80%byserodiagnosiswith the direct Enzyme-Linked ImmunoSorbent Assay (ELISA), with a sensitivity and specificity of 97.4% and 97.6%, respectively.Thus, it is evident that the

significant positive correlation between the levels of seroprevalence and caprine population density would be the cause of a greater risk of infestation among herds from the same region.

Likewise, Alcaideet al.(2005a),in a total of 1,590 sera of de 175 herds of adult goats in provinces in the Southeast of Spain, including Caceres, Ciudad Real, and Toledo,obtained important findings of oestrosis, reporting a prevalence of 34.9% in the nasal sinus cavities of 23 goats with ELISA [18]. In similar fashion, Alcaideand collaborators (2005b),in four provinces of Southeastern Spain, including Badajoz,Cáceres, Córdoba, and Seville, determined the seroprevalence of nasal infestation in sheep by *Oestrusovis* L., which was 69.3%.Themost elevated seroprevalencewas observed in Córdoba and Seville, and the authors identified that altitude, latitude, herd size, and ovine population density comprised the possible risk factors that associated oestrosiswith the detection of *Oestrusovis*antibodies by ELISA [19].One possible explanation is that, in the regions of Spain, ovine production prevails due to the high rusticity, rendering the perfect adaptation of these regions in terms of the environment, with the employment of extensive grazing systems and the elevated numbers of hours of light,as well as the characteristics of the ovine race, which make possible the existence of continuing reproductive cycles or the possibility of inducing the state of the animals' being in heat during the least favorable epochs. Thus, it predominates inovercrowding, a situation that favors the imminent contagion among theanimals, not only of oestrosis,but also of any other infection.

Likewise, in Eastern Turkey,the prevalence of *Oestrusovis*in summer was 51.68% in spring,40.69%,in autumn, 35.80%, and of 23.61% in winter.Differences among seasons were statistically significant ($p<0.05$) [2].On the other hand, Dorchieset al. (2000) reported that, in theSouth of France, prevalence was 28.4%; in Mexico, in 100 necropsies conducted in caprine from the states of Zacatecas, San Luis Potosí, Nayarit, Coahuila, and Guanajuato,prevalence was 53% [8].

In the year 2013 in Cuzco, Perú,Gómez-Puertaand collaborators reported a case of myiasis caused by *Oestrusovis*in a llama (*Lama glama*)aged 1 years, 8 months andweighing 70 kg; the diagnosis was pneumonia. It was administered therapy with antibiotics and anti-inflammatory drugs but, 4 months later; it presentedrespiratory difficultyand died due to bilateral hemorrhagic pneumonia. During the necropsy, six intact *Oestrusovis*-dipterous larvae were recovered from the nasal fossae and cranial sinuses; one larva was identified in the second larval stage (L-II),1.6 cm in lengthand 0.6 cm in diameter, and five larvae were found in the third larval stage (L-III), with a length of 2.3-2.8 cm and a diameter of 0.6-0.8 cm.On that the pneumonia persisted, it is probable that the number of the deposited larvae contributed to a state of immunosuppression in the definitive host. In this regard, Dorchieset al. (2000) suggested that the pathogenesis caused by the larva is related with the traumatic event occasioned by the cuticular spines and oral hooks during the migration of the larvae, as well as by the excreted and secreted larval molecules that give rise to an immune reaction of nasal hypersensitivity.

In another investigation, conducted inSanta Inés,Brazil, and in IIe-de-France, the infestation of *O. ovis*was evaluated in 24 lambs sacrificed at 2 months of age; larvae were recovered, counted, and identified according to larval stage. The average number of larvae recovered in the nasal cavity per animal was 14-39 larvae in the 12 lambs in Brazil, and of 11-39 larvae in France; a significant difference was not found between both groups ($p>0.05$) in terms of larval count[20].

Likewise, Cepedaet al. (1993)reported a prevalence of 52% in the State of Mexico while, in 1993, a prevalence was reported of 88% in caprine.In the Mexican state of Baja California Sur in an investigation carried out by Quintero andcollaborators (1987).

In **Table 1**, we are able to observe that, in the present investigation during the months of January, February, March, and October, the greatest number of larvae was registered(124 larvae). The highest percentage of L1 was observed in the months of January, February, and July (40, 41, and 40 larvae, respectively), while the months of March, July, and September were those with the greatest number of L2 larvae; L3 predominated in the months from October to December (22 larvae). In this respect, in the study of Alcaideet al. (2005a), larval stage L1 was recovered in the month of April,with a progressive increase until reaching the first peak in the month of July; after this, the percentage of L1 diminished during July, but again reached the highest level in the month of August through October. The percentage of L1 correlated positively with the monthly precipitation ($r = 0.714$; $p = 0.03$), while we observed a significant negative correlation with the temperature ($r = 0.058$; $p = 0.8$). The percentage of larval stage L2 demonstrated a significant increase from February to April; thereafter, the percentage of L2 began to diminish, observing some fluctuations, until it reached its lowest level in August.

The percentage of L2 coincided with the highest percentage of L1 and viceversa,due to the lack of influence caused by the very high percentage of L3;in relation to the total number of botflies recovered, solely one peak was observed during July-August.The correlation between the percentage of L2 and climatic conditions was negative and was significant for temperature ($r = 0.76$; $p = 0.01$).In this investigation, we observed that the favorable period for the development of larval stages L1 and L2 in livestock begins inFebruaryand ends in September and, in the present study, we observed that larval stage L1 predominates from March to October.

On the other hand, of a total of 85 larvae, 21.2% were L1, 37.6% were L2, and 41.2% were L3; all three larval stages of *Oestrusovis*were recovered from the sacrificed animals, which demonstrates the existence of favorable climatic conditions for the larval development of the botfly in ovine livestock bred in the central region of the State of São Paulo, Brazil [15]. In the present work, larval stage L1 was obtained in live animalsand larval stages L2 and L3,in sacrificed animals.

Özdaland collaborators (2016) reported that, of a total of 511 larvae collected, 17% were L1, 29% were L2, and 54% were L3 larvae. All three of the larval stages were observed during the 3 months of the study, aside from the fact thatfirst-stage larvae were not observed inDecember and March. Global larval intensity for infested sheep was 4.02, with 3.42 in spring 3.80 in summer, 4.03 in autumn, and 5.82 in winter. Infestation rates were 41.26% in female and 34.42% in male ovine.

Table1. Number of larvae found during the study.

Month/larvae	L1	L2	L3	Total number of larvae (%)
March	26	14	3	43 (10.2)
April	23	11	1	35 (8.3)
May	21	11	3	35 (8.3)
June	23	10	4	37 (8.8)
July	28	12	0	40 (9.5)
August	24	8	1	33 (7.8)
September	17	12	6	35 (8.3)
October	25	11	7	43 (10.2)
November	4	9	8	21 (5.0)
December	6	3	7	16 (3.8
January	27	8	5	40 (9.5)
February	20	8	5	41 (9.7)
Total	252	117	50	419

IV. Conclusion

The prevalence of myiasis due to*Oestrusovis*in caprine was 83%, which is considered high. Thus, it is necessary to establish systematic deparasitationcalendars with the purpose ofcontrolling this parasite. The duration of the parasite's life cycle varies considerably, ranging from a few weeks to several months, depending on ndepending on the season and the climatic conditions. This is, to our knowledge, the first registered and published report on *Oestrusovis*-associated infestation in caprine livestock in Northern Mexico.

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