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Frequency of gastrointestinal parasites in cattle at the southern of Sonora, Mexico

Frecuencia de parásitos gastrointestinales en bovinos del sur de Sonora, México

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ABSTRACT

Commonly gastroenteric parasites are a health problem in extensive livestock and could be a risk in the productive efficiency in cattle raised at the south of Sonora, Mexico. In order to determine the frequency of the different gastrointestinal parasitic genera in bovines of the southern region of Sonora, a study was divided in *high-mountain* (n= 218), *low-mountain* (n= 173), *Valley1* (n= 222) and *Valley2* (n= 50) regions. The feces were collected from adult cattle and calves (5 to 6 months of age) from January to March and December 2018; January to February 2019. The samples were analyzed by flotation and MacMaster techniques. The morphology was determined obtaining the L3 stage by coproculture. The *Eimerias* were identified prior to sporulation. The 83.03%, 56.0% and 17.56% were positive for gastrointestinal parasites in *high-mountain*, *low-mountain* and *Valley1* respectively. *Valley2* was negative for nematodes, but 43% were positive for *Eimerias*. The cattle in the study area showed a low 17.56% to high 83.03% frequency of gastroenteric parasites with the presence of one to eight genera of nematode and one to seven of *Eimeria*.

Keywords: Cattle, nematodes, *eimeria* semiarid, mountain.

RESUMEN

Comúnmente los parásitos gastroentéricos son un problema sanitario en la ganadería extensiva y pueden ser un riesgo en la eficiencia productiva del ganado al sur de Sonora, México. Para determinar la frecuencia de los diferentes géneros parasitarios gastrointestinales en bovinos de la región sur de Sonora, se dividió un estudio en región *Sierra alta* (n= 218), *Sierra baja* (n=173), *Valle1* (n= 222) y *Valle2* (n= 50). Las heces fueron colectadas de bovinos adultos y becerros (5 a 6 meses de edad) de enero a marzo y diciembre de 2018; enero a febrero de 2019. Las muestras se analizaron mediante las técnicas flotación y MacMaster. La morfología fue determinada al obtener la etapa L3 mediante coprocultivo. Las *Eimerias* fueron identificadas previa esporulación. Un 83.03%, 56.0% y 17.56% fueron positivos a parásitos gastrointestinales en *Sierra alta*, *Sierra baja* y *Valle1* respectivamente. El *Valle2* fue negativo a nematodos, pero el 43% resultó positivos a *Eimerias*. Los bovinos en la zona de estudio mostraron una frecuencia de baja 17.56% a alta 83.03% a parásitos gastroentéricos con presencia de uno a ocho géneros de nematodos y de uno a siete de *Eimeria*.

Palabras clave: Ganado, nematodos, *eimerias*, semiárido, sierra.

INTRODUCTION

The production of beef cattle in Sonora is developed in more than 15 million hectares of summer pastures, 83% of the state area is used, with 1.5 million head of cattle (Denogean *et al.*, 2013). For the farmer, the weather and ecological conditions are a restrictive

element for adequate production, which depends on the potential of the forage to meet nutritional needs (Denogean *et al.*, 2013; Retes *et al.*, 2013). The delicate balance of nutrients and health of cattle is at constant risk by being exposed to infections by gastroenteric parasites (PGE), which significantly reduce food consumption, feed conversion and weight gain, with morbidity and mortality in animals young people (Stromberg *et al.*, 2012).

In the abomasum, the secretory cells that affect the quantity and quality of the hydrochloric acid are damaged, which modifies the pH value up to 6.5 and the efficiency of the digestion and absorption of nutrients is reduced; affects the mineral and protein metabolism, in subclinical and chronic presentation the animals reduce their food consumption by 15 to 20%, which decreases weight gain or there is weight loss; Therefore, nutritional deficiencies are increased and livestock productivity is reduced (Torres, 2006; Biswajit *et al.*, 2017; Oliveira *et al.*, 2017). In some cases, acute anorexia, anemia, toxemia, tissue damage and death can be observed; usually in young animals in growth and sometimes in adults (Johanssos, 2017).

The potential economic impact of parasites in Mexico was estimated and obtained for gastroenteric nematodes US \$ 445.10 and for coccidia (*Eimeria* spp.) US \$ 23.78 million, based on the national population in 2013 of 32.4 million cattle (Rodríguez *et al.*, 2017). Due to the detrimental effects on production and health, it is important to have information on the presence of PGE in the region.

The objective of this research was to determine the frequency and genera of gastroenteric parasites in cattle from four sectors of southern Sonora, Mexico.

MATERIAL AND METHODS

Geographic location. The study was conducted in a sector of the *High-mountain* and the *Low-mountain*, as well as two sectors of the southern Sonora Valley. In the *High-mountain* sector, work was carried out in the Yécora municipality, which is located 215 kilometers north of Obregón city, at an altitude of 1540 meters; The prevailing climate is mild subhumid with rains for most of the year. In February and March, the temperature reaches 24.0 °C and the annual average is 24.4 °C, with annual average precipitation of 944 mm (SMN, 2018).

In the *Low-mountain* sector, work was carried out in the Rosario municipality, in Tesopaco town, located at an altitude of 450 meters; it has a semi-dry or semi-warm climate, with a maximum average temperature of 29.2 °C and minimum of 14.2 °C. Rains predominate during July and August, with an annual average rainfall of 610.1 mm (SMN, 2018).

Sampling. In stockpiles of the *High-mountain* sector, 218 calves (140 males and 78 females) were sampled and from *Low-mountain* to 173 calves (130 males and 43 females); they were all cattle breeding grounds, mostly creole weaned or at the beginning

of weaning, between 5 and 10 months of age, raised extensively and free grazing. The samples from the Valley 1 region were 222 samples from 8 herds of adult dairy cattle; from the Valley 2 region, there were 50 adult cattle in summer pastures. Sampling was carried out from January to March and December 2018, and from January to February 2019, to conduct an observational and cross-sectional study (Thursfield, 2018). Sampling was carried out for convenience in the collection pens and in the herds, where sampling was allowed (Scheaffer *et al.*, 2012).

To the stool samples, the qualitative flotation and quantitative technique of MacMaster was performed to obtain eggs per gram of feces (HGH), oocysts per gram of feces (OGH); co-culture and Baerman (Yacob *et al.*, 2009); In the latter, the larvae (L3) present were identified based on their morphological characteristics (Pinilla *et al.*, 2018). Sporulation technique was performed to identify *Eimerias* (Mitchell *et al.*, 2012). Through the Microsoft Excel 2016 program, the results shown in descriptive statistics were obtained (Wayne, 2014).

RESULTS AND DISCUSSION

In the High-mountain were: 83.03% (181/218) positive calves and 16.97% (37/218) negative to gastroenteric parasites. The gender type for nematodes was 88.95% (161/181) positive, cestodes 19.33% (35/181) and protozoa 80.11% (145/181). The MacMaster range for each genus was: 50-900 HGH nematodes, 50-6850 HGH cestodes, 50-5050 OGH protozoa.

The most frequent genera were: *Haemonchus* spp. 79.5%, *Oesophagostomum* spp. 40.37% and *Trichostrongylus* spp. 34.78% (table 1).

Gastroenteric nematode infections occurred in one to eight genera, the most frequent being: single 43.47% (70/161), double 25.46% (41/161) and triple 20.49% (33/161) (table 2).

In the Low-mountain it was found: 56% (97/173) positive calves and 43.93% (76/173) negative to the parasites under study. The distribution by gender was found for nematodes 86.6% (84/97), positive and protozoan 23.71% (23/97). The MacMaster range was: 50-300 HGH nematodes and 50-200 OGH protozoan.

The most frequent nematodes were: *Cooperia* spp. 58.33%, *Haemonchus* spp. 17.85% and *Ostertagia* spp. 17.85% (table 1).

With respect to gastroenteric nematode infections, there were one to six genera, the two most frequent were: single 80.9% and double 19.04% (table 2).

In the study the areas of High-mountain and Low-mountain were positive for nematodes in calves, which is consistent with reports where the prevalence of PGE in calves is present and increases in the months close to the year of age; the highest prevalence occurs in calves from 4 to 12 months of age, and the highest frequency between 6 and 9 months (Colina *et al.*, 2013). Another important factor to consider is the coexistence of the calves with the adult bovines, when they are carriers of PGE they contaminate the forage and the infection of the calves is favored (Encalada *et al.*, 2009).

The management of livestock in Sonora state mountains is known as "runs", these are done once or twice a year, is the best season between the months of October to April of the following year. Adults receive reproductive and sanitary management such as deworming and vaccination; Calves are separated and most go to pre-export stockpiles. The adult cattle that remain on the farm when dewormed once, it is not enough to control the populations of PGE; these contaminate grazing areas and calves when infected are evidenced by the results of an infection intensity for PGE from low (0-500 HGH) to medium (550-1000 HGH); It causes a delay in growth, reduced productivity and reinfection of calves due to forage contamination (Encalada *et al.*, 2009).

Regarding the genera of PGE found, it varied in each region of the mountain, which is consistent with a study conducted, which indicates that the nematodes *Haemonchus* spp., *Mecistocirrus* spp., *Trichostrongylus* spp., *Cooperia* spp., and *Oesophagostomum* spp, are considered important from a pathological and epidemiological point of view in various geo-ecological, temperate and warm areas (Vázquez *et al.*, 2004). In other regions of Mexico the distribution, diversity of the frequency and genus of PGE in cattle in different states is shown, and they give the guideline of the adaptation that they have to the different ecosystems such as the subtropical and tropical (Quiroz, 2011; Fernández *et al.*, 2015; Figueroa *et al.*, 2018; Pinilla *et al.*, 2018). The results of the two regions of the mountains show an important advance in the knowledge of the frequency and identification of PGE, in calves in southern Sonora.

In the Valley 1 region, 17.56% (39/222) positive and 82.43% (183/222) negative for gastroenteric parasites were found. Regarding the type of gender for nematodes 17.94% (7/39) and protozoa 82.05% (32/39) positive, respectively. The MacMaster range for each parasitic genus was: 50-1100 HGH nematodes and 50-3250 OGH protozoa.

Table 1. Number and percentage of gastroenteric nematodes in cattle in four regions of southern Sonora

Nematodes	High-mountain Frequency	Percentage (%)	Low-mountain Frequency	Percentage (%)	Valley 1 Frequency	Percentage (%)	Valley 2 Frequency	Percentage (%)
<i>Haemonchus</i> spp.	128	79.5	15	17.85	6	50	0	0
<i>Oesophagostomum</i> spp.	65	40.37	7	8.33	1	8.33	0	0
<i>Trichostrongylus</i> spp.	56	34.78	7	8.33	3	25	0	0
<i>Skrjabinema</i> spp.	40	24.84	0	0	1	8.33	0	0
<i>Cooperia</i> spp.	23	14.28	49	58.33	1	8.33	0	0
<i>Strongyloides</i> spp.	18	11.18	4	4.76	0	0	0	0
<i>Ostertagia</i> spp.	14	8.69	15	17.85	0	0	0	0
<i>Toxacara</i> spp.	1	0.62	0	0	0	0	0	0

In infections due to gastroenteric nematodes, there were one to five genera, with a double 71.43% and simple 28.5%.

In the Valley 2 region, the presence of PGE was not found and for protozoa, 46% (23/50) positive were obtained, the MacMaster range was 50-100 OGH.

The results for NGE of the Valle 1 and Valle 2 regions are less frequent and this may be influenced by the age of the animals in the sampling that were adults (Encalada *et al.*, 2009), the sanitary management of deworming of the herd before sampling; as well as the semi-arid climate conditions of the region (Martínez and Merino, 2011; Baumgard and Rhoads, 2013), which does not favor the formation and viability of the infecting larvae in the environment (table 2).

Table 2. Type of infection by gastroenteric nematodes in cattle four regions of southern Sonora

Type of infection	High-mountain		Low-mountain		Valley1		Valley2	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Simple	70	43.47	68	80.9	2	28.5	0	0
Double	41	25.46	16	19.04	5	71.43	0	0
Triple	33	20.49	0	0	0	0	0	0
Quadruple	16	9.93	0	0	0	0	0	0
Quintuple	1	0.62	0	0	0	0	0	0

With respect to the protozoa in the High-mountain, the three most frequent species were: *E. bovis* 69.65%, *E. alabamensis* 34.48% and *E. ellipsoidalis* 24.13%. In the Low-mountain, *E. bovis* 65.21% and *E. alabamensis* predominated 43.47%. In the Valle 1 region the most abundant was *E. bovis* with 46.5%. In Valley 2 *E. ellipsoidalis* and *E. bukidonensis* were found with 25% respectively (table 3).

Table 3. Number and percentage of Eimerias identified from cattle from four regions of southern Sonora

Protozoan	High- mountain Frequency	Percentage (%)	Sierra baja Frecuencia	Percentage (%)	Valle 1 Frecuencia	Percentage (%)	Valle 2 Frecuencia	Percentage (%)
<i>E. bovis</i>	101	69.65	13	62.21	15	46.5	1	12.5
<i>E. alabamensis</i>	50	34.48	10	43.47	2	6.25	1	12.5
<i>E. ellipsoidalis</i>	35	24.13	3	13.04	6	21.85	2	25
<i>E. auburnensis</i>	34	23.44	2	8.69	3	9.37	0	0
<i>E. bukidnonensis</i>	28	19.31	0	0	4	12.5	2	25
<i>E. subspherica</i>	26	17.93	1	4.34	7	21.85	1	12.5
<i>E. zurnii</i>	20	13.79	1	4.34	9	28.15	1	12.5

Coccidia infections in High-mountain occurred from one to six genera of *Eimeria*, the three most frequent were: single 33.10%, double 30.34% and triple 16.55%. In Low-mountain: 43.48% single and 56.52% double. Valley 1 region was simple 71.88% and double 15.63% and Valley 2 region simple 66.66% and double with 33.33% (table 4).

Table 4. Type of Eimeria infection in cattle from four regions of the southern state of Sonora

Type of infection	High- mountain Quantity	Percentage (%)	Low- mountain Quantity	Percentage (%)	Valley 1 Quantity	Percentage (%)	Valley 2 Frequency	Percentage (%)
Simple	48	33.1	10	43.48	23	71.88	4	66.66
Double	44	30.34	13	56.52	5	15.63	2	33.33
Triple	24	16.55	0	0	3	9.6	0	0
Quadruple	20	13.79	0	0	0	0	0	0
Quintuple	6	4.13	0	0	1	3.13	0	0
Sextuple	3	2.06	0	0	0	0	0	0

In this study the zones of Valley 1 and Valley 2, several species of *Eimeria* were positive; This is consistent with works that report that there are at least 13 species of *Eimeria* that infect cattle, but only some are very pathogenic such as *E. bovis* and *E. zuernii* (Das et al., 2015; Pascoti et al., 2011) and *E. alabamensis* (Das et al., 2015). In roofed pens, *E. ellipsoidalis*, *E. alabamensis* and *E. auburnensis* are reported (Mitchell et al., 2012; Forslid et al., 2015).

Eimeria infections can cause severe diarrhea, feces containing blood, fibrin and intestinal tissue; the signs are fever, pain, tenesmus, anemia, dehydration, weakness, anemia and weight loss (Pascoti et al., 2011). This complex of effects has considerable clinical and economic consequences. In endemic areas, first-year calves are at high risk of developing clinical coccidiosis, and infections by several species are common; *E. bovis*, *E. zuernii* and *E. alabamensis* being more common, during the first two weeks of life (Samson et al., 2006; Pascoti et al., 2011), and up to 12 months of age (Mitchell et al. , 2012; Forslid et al., 2015). It is estimated that losses due to reduction in feed efficiency are 25 to 60% per

calf, and a 6 to 8% annual loss due to eimeriosis was predicted with a simulator model (Lassen and Osstergaard, 2012).

Various studies have been conducted in different countries such as Peru, Brazil, the United States, India and England; where the most frequent *Eimerias* identified were: *E. bovis*, *E. zuernii*, *E. auburnensis*, *E. ellipsoidalis*; less frequently *E. subspherica*, *E. bukidnonesis*, *E. cylindrica*, *E. Canadians* and *E. alabamensis* (Pascoti *et al.*, 2011; Mitchell *et al.*, 2012; Colina *et al.*, 2013; Lucas *et al.*, 2014; Das *et al.*, 2015).

In Mexico, studies conducted on bovines in Yucatán and Guerrero, the most frequent *Eimerias* were: *E. bovis*, *E. ellipsoidalis* and *E. zuerni*; to a lesser extent, we found: *E. auburnensis* and *E. canadensis* and *E. parva* (Rodríguez *et al.*, 1996; Figueroa *et al.*, 2018).

In the present investigation, the four sectors had presence of *E. bovis*, *E. alabamensis*, *E. ellipsoidalis* and *E. auburnensis*, their frequency varies by different age groups and environmental conditions; this indicates the viability of sporulated oocysts, which is more than one year (Lucas *et al.*, 2014). Most studies of natural *Eimeria* infections in cattle confirm that calves under one year of age have a high prevalence of infection and eliminate the greatest number of oocysts by feces into the environment (Colina *et al.*, 2013; Lucas *et al.*, 2014). Transmission is influenced by adult cattle that are asymptomatic carriers, which favor frequent infection in young animals (Mitchell *et al.*, 2012; Colina *et al.*, 2013); which can occur in the rest areas or "dumps" and grazing within the summer pastures, as well as in the housing pens.

CONCLUSION

It is shown that cattle raised in the study area showed a frequency of low 17.56% to high 83.03% of gastroenteric parasites, with the presence of one to eight nematode genera; and from one to seven genera of protozoa.

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