



Coccidial Infection in Mouflon, *Ovis musimon*, in Central Spain

Authors: Gómez-Bautista, Mercedes, Luzón-Peña, Mónica, Santiago-Moreno, Julian, de Bulnes, Antonio G., and Meana, Aránzazu

Source: Journal of Wildlife Diseases, 32(1) : 125-129

Published By: Wildlife Disease Association

URL: <https://doi.org/10.7589/0090-3558-32.1.125>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Coccidial Infection in Mouflon, *Ovis musimon*, in Central Spain

Mercedes Gómez-Bautista,¹ Mónica Luzón-Peña,¹ Julian Santiago-Moreno,² Antonio G. de Bulnes,² and Aránzazu Meana,¹ Departamento de Patología Animal I (Sanidad Animal), Facultad de Veterinaria, Universidad Complutense de Madrid, 28040 Madrid, Spain; ² Departamento de Producción Animal, Centro de Investigaciones Tecnológicas/Instituto Nacional de Investigaciones Agrarias, Ministerio de Agricultura Pesca y Alimentación, Madrid, Spain

ABSTRACT: From February to September 1993, ten adult female mouflons (*Ovis musimon*) and their five offspring from central Spain were examined weekly for coccidial infection. All adult mouflons had *Eimeria* spp. infections with mean (\pm SD) intensity of 1,869 (\pm 1,264) oocysts per gram of feces the day of capture, increasing progressively during the first two months in captivity and later returning to the initial values ($1,869 \pm 1,547$). The mean (\pm SD) oocyst shedding in young animals was 16,800 (\pm 966) oocysts per gram at 1 mo and 18,796 (\pm 1,220) at 1.5 mo of age and more than 40,000 (40,250 to 52,000) at 3 mo of age; this high intensity was associated with a transient diarrhea. The species involved, in order of frequency, were *E. bakuensis* (syn. *Eimeria ovina*), *E. ovinoidalis*, *E. crandallis*, *E. caprovina*, *E. parva*, *E. faurei*, *E. granulosa* and *E. intricata*, and one more not previously described and recorded as *Eimeria* sp.. The predominant species for both age groups was *E. bakuensis*.

Key words: *Eimeria* spp., mouflon, *Ovis musimon*, intensity of infection.

Little information is available concerning *Eimeria* spp. infection in mouflon (*Ovis musimon*) and other game species (Levine, 1988). Coccidiosis is very common in sheep and goats, including in Spain (Hidalgo Arguello and Cordero del Campillo, 1987b; De la Fuente and Alunda, 1992). Animal husbandry procedures and other environmental conditions are responsible for epizootics of coccidial diarrhea and for high losses in small ruminant productivity (Foreyt, 1990). Domestic sheep usually have multispecific coccidial infections and most of the species can be clearly differentiated by the morphological characteristics of the sporulated oocysts (Catchpole et al., 1975). In spite of the high host specificity of *Eimeria* spp., cross-transmission between ovine and caprine species is recognized for *E. pallida*, *E. cap-*

rovina and for the controversial species *E. punctata* (Levine, 1985). Our objective was to determine the intensity of infection supported by young and adult mouflons and the *Eimeria* spp. involved in it.

Adult mouflons came from a wildlife reserve (400 ha) located in central Spain (El Hosquillo, Cuenca; 2°00'N, 40°30'W, 800 m above sea level), where they coexist with Spanish red deer (*Cervus elaphus hispanicus*) and fallow deer (*Dama dama*). In February 1993, five pregnant (3 to 4-yr-old) and five nonpregnant (1 to 2-yr-old) female mouflons were isolated from the other species. Along the study period they were maintained indoors in a sand floor stable, 200 m² in size, and fed with a controlled quantity of a complete ration (Ovinanta®, Nanta S. A., Madrid, Spain) supplemented with barley grain, barley straw, and dry alfalfa. Five offspring of both sexes were born in March 1993. From February to September 1993, fresh fecal samples from these ten adult females and from their offspring were individually collected at 7-day intervals and analyzed by a McMaster modified method as recommended by the British Ministry of Agriculture, Fisheries and Food (1977). After the determination of *Eimeria* spp. oocyst shedding by each animal, fecal samples were incubated in a shallow layer of 2.5% (w/v) aqueous potassium dichromate solution, kept at 18 to 20 C and examined periodically to identify species and to determine sporulation times. When possible, 100 sporulated oocysts from each species were measured with a 40 \times objective and 10 \times ocular lens. At least 50 oocysts were observed from each species found in low numbers. Species were identified on the

basis of morphological and morphometric characteristics described for oocysts of ovine species and for caprine species cross-transmitted to sheep (Pellérdy, 1974; Norton and Catchpole, 1976; Lima, 1980; Levine, 1985).

All adult mouflons were infected by *Eimeria* spp., with a mean (\pm SD) intensity of 1,874 (\pm 1,264) (range: 466 to 3,900) oocysts per gram of feces (opg) the day of capture. After the first sampling, the intensity increased in all animals to a mean (\pm SD) of 7,410 (\pm 7,738), ranging from 500 to 25,000 opg. Two months later oocyst output decreased to 2,250 (\pm 2,999) opg (range: 300 to 9,000 opg), stabilizing to 1,869 (\pm 1,547) opg (range: 250 to 4,800) thereafter. Oocyst production was not related to age or time of gestation. In the five pregnant mouflons, no increase was detected 15 days after parturition. Newborn animals were positive at 1 mo of age, shedding a mean (\pm SD) of 16,800 (\pm 966) and 18,796 (\pm 1,220) opg at 5 and 7 wk of age, respectively, and ranging from 40,250 to 52,000 opg at 3 mo of age. Afterwards, intensities decreased in all young animals and stabilized at 1,783 (\pm 1,014) opg (range: 350 to 2,500) at 6 mo of age. High oocyst intensities ($>10,000$ opg) were associated with transient diarrhea in young animals but were not found in adults.

The intensity of infection supported by mouflons seemed similar to that reported in sheep and goats in Spain (Hidalgo Argüello and Cordero del Campillo, 1987b; De la Fuente and Alunda, 1992). A post-partum rise in the adults was not detected but oocyst production seemed to be affected by transport and change in breeding conditions as evidenced by the increase detected during the first 2 mo they were maintained in captivity. High intensity following changes in social environment, nutrition, or travel stress has been reported in other host species (Gregory, 1990) and higher incidence of coccidial infection and reinfection is associated with indoor housing (Foreyt, 1990). The rate of

oocyst production in young mouflons was similar to that observed in naturally acquired infections in lambs but with intensities ten times lower in mouflon (Pout, 1973). As observed in domestic sheep (Pout et al., 1966), parent mouflons do not reflect in their feces the high environmental contamination produced by young mouflons.

We observed nine species of *Eimeria* as identified by their morphological characteristics: *E. ahsata*, *E. bakuensis* (syn. *E. ovina*), *E. granulosa*, *E. crandallis*, *E. intricata*, *E. faurei*, *E. ovinoidalis*, *E. parva* and *E. caprovina* (Table 1). Oocysts with morphological characteristics not previously described in sheep or goats were detected in adult mouflons and recorded as oocysts of *Eimeria* sp. (Figs. 1 and 2). Although in a very low intensity (1% of total population of oocysts), they were detected in fecal samples of all adult mouflons and throughout the whole study period. These oocysts measured 31 to 34 μ m by 19 to 24 μ m (mean: 32 by 23 μ m), they were ovoid or ellipsoid, with a 5 to 6 μ m wide micropyle covered by a 7 to 8.5 μ m wide by 0.6 to 1.5 μ m long (mean: 1 by 8 μ m) transparent cap (Fig. 1). Sporulated oocysts possessed an oocyst residuum, about 2 μ m in diameter (Fig. 1). Sporocysts measured 12 to 13 μ m by 7 to 8 μ m. The sporocyst residuum consisted of a compact group of granules and the sporozoites enclosed one or two clear globules.

Eimeria bakuensis was the predominant species in the two groups of age (67% and 57% of total oocysts in adult and in young animals, respectively) followed by *E. ovinoidalis* in adult (18% of total oocysts) and *E. ahsata* in young mouflons (21% of total oocysts). *Eimeria crandallis* was more frequent in young than in adult mouflons (12% versus 5% of total oocysts). Neither *E. ahsata* in adult animals, nor *Eimeria* sp. in young mouflons were detected. *Eimeria intricata* was detected only in the fecal samples of one adult animal and not until reaching 3 mo of age in young ones. *Eimeria faurei* and *E. parva* were detected

TABLE 1. Morphometric characteristics of the oocysts of nine *Eimeria* spp. detected in fecal samples of mouflons from central Spain, 1993.

Species	Oocyst (μm)	Shape index	Sporont (range μm)	Micropyle	Micropyle cap (μm)	Sporocyst (μm)	Sporulation time (hr)
<i>E. ahsata</i>	42 × 25 ^a (40–43 × 22.5–28)	1.49 ± 0.1 ^b	19–20 ^c	+ ^d	2.7 × 10 ^a (2–3.5 × 8–11)	20 × 8.6 ^a (18–21 × 7–10)	72–96
<i>E. bakuensis</i>	31 × 21.8 (30–35 × 17.5–22)	1.68 ± 0.1	15–17	+	2 × 7 (1.5–3 × 5–8)	16.5 × 7 (13–18 × 6–8)	48–72
<i>E. faurei</i>	32 × 23 (25–38 × 20–27)	1.38 ± 0.1	15–17	+	–	13.9 × 9.2 (11–15 × 8–9)	72–96
<i>E. granulosa</i>	29 × 20 (28–31 × 19–22)	1.44 ± 0.1	15–16	+	2 × 7 (1.5–3 × 5–8)	13 × 8.6 (12–15 × 7–9.5)	72–96
<i>E. intricata</i>	50 × 40.3 (48–52 × 39–42)	1.25 ± 0.08	22–24	+	4 × 14 (3–4.5 × 13–15)	20 × 11 (18–22 × 13–10)	120–144
<i>E. crandallis</i>	22 × 18 (20–26.5 × 15–20)	1.25 ± 0.07	14–15	+	0.8 × 4.6 (0.7–1 × 4.6)	10.6 × 7.3	72–96
<i>E. ovinoidalis</i>	25 × 20.8 (27–28 × 18.7–22.5)	1.20 ± 0.07	16–18	+	–	12.5 × 7.9 (10–15 × 6–8)	72–96
<i>E. parva</i>	17.8 × 16.5 (17.5–22.5 × 15–18)	1.26 ± 0.1	12	–	–	10 × 7	48
<i>E. caprovina</i>	27.7 × 22.4 (28–31 × 20–23)	ND ^e	17	+	–	12.5 × 7.9	72–96

^a Mean (ranges).^b Mean ± SD.^c Range.^d +, present (size); –, absent.^e ND, not done.

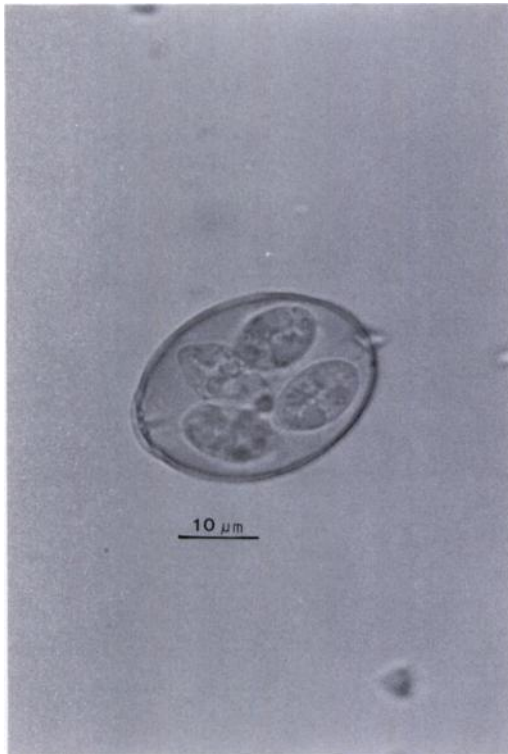


FIGURE 1. Photomicrograph of the oocyst of *Eimeria* sp. detected in fecal samples of mouflon from Central Spain, 1993.

in all animals but in a low intensity (1% and 3% of total oocysts, respectively).

Of interest is the detection in fecal samples of young and adult mouflons of *E. granulosa* (1 to 4% of total oocysts) and *E. caprovina* (1 to 3% of total oocysts), species not previously described in mouflon (Levine, 1988). *Eimeria caprovina* has been identified as a goat species (Lima, 1980) and, although experimentally transmitted to domestic sheep, it has not been reported in natural infections in *Ovis* spp. (Levine, 1988).

Eimeria bakuensis and *E. ovinoidalis* also were the predominant species detected in adult mouflons in Bulgaria (Golemanski and Yusev, 1977) and in natural infection in domestic sheep (Catchpole et al., 1975). *Eimeria ahsata*, *E. faurei* and *E. parva* accidentally were detected in mouflon in Bulgaria (Golemanski and Yusev,

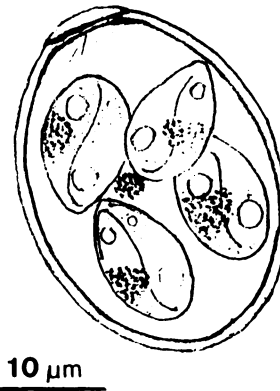


FIGURE 2. One drawing of oocyst from Figure 1.

1977), whereas similar parasite intensity to that detected in young mouflons has been reported for *E. ahsata* in adult sheep in Spain (Hidalgo-Argüello and Cordero del Campillo, 1988). In contrast to what was observed in mouflon, *E. faurei* and *E. parva* are very common in domestic sheep (Catchpole et al., 1975; Hidalgo-Argüello and Cordero del Campillo, 1985). *Eimeria crandallis*, *E. granulosa* and *E. intricata* intensities detected in mouflon were quite similar to those reported in domestic sheep in Spain (Hidalgo-Argüello and Cordero del Campillo, 1984, 1986, 1987a).

In spite of the great number of species identified, *E. pallida* and *E. weybridgeensis*, which are common in domestic sheep (Pout et al., 1973; Catchpole et al., 1975), were not detected in mouflon sheep. Also, oocysts with the morphological characteristics described for the ovine coccidial species *E. gonzalezi* or *E. marsica* were not detected in fecal samples of mouflon.

Of interest is the detection of oocysts with a partial similarity to *E. bakuensis*, but with a lower and transparent micropyle cap and oocyst residuum. Other structural characteristics, as the size of sporocysts and the sporocyst residuum, also are quite different from *E. bakuensis* (Table 1, Figs. 1 and 2). We have not found reports about an *Eimeria* sp. with similar characteristics in small ruminant species. Although oocyst morphologic characteristics can be a variable according

to the status of the host, the high differences between these oocysts and those previously described point to the possibility of a new species whose identity will be further investigated. A type specimens was deposited as phototypes with the reference MNCN No. 35.01/1 into the Museo Nacional de Ciencias Naturales, Madrid.

The technical assistance of Tomas Merino and personal from the Cynegetic Reserve of El Hosquillo (Cuenca) is gratefully acknowledged. We also thank to the Spanish Institute for Conservation of Nature (ICONA) for the generous cession of the animals. We are very grateful to Professor J. Catchpole, she kindly read the manuscript and made some helpful comments.

LITERATURE CITED

- CATCHPOLE, J., C. C. NORTON, AND L. P. JOYNER. 1975. The occurrence of *Eimeria weybridgei* and other species of coccidia in lambs in England and Wales. *British Veterinary Journal* 133: 392–401.
- DE LA FUENTE, C., AND J. M. ALUNDA. 1992. A quantitative study of *Eimeria* infections of goats from central Spain. *Veterinary Parasitology* 41: 7–15.
- FOREYT, W. J. 1990. Coccidiosis and cryptosporidiosis in sheep and goats. *Veterinary Clinics of North America Food Animal Practice* 6: 655–670.
- GOLEMANSKI, V., AND P. YUSEV. 1977. Coccidia (Eimeriidae) of mouflon, *Ovis musimon*, in Bulgaria. [In Bulgarian with English abstract in English]. *Acta Zoologica Bulgarica* 8: 54–64.
- GREGORY, M. W. 1990. Pathology of coccidial infections. In *Coccidiosis of man and domestic animals*, P. L. Long (ed.). CRC Press, Boca Raton, Florida, pp. 235–261.
- HIDALGO ARGÜELLO, M. R., AND M. CORDERO DEL CAMPILLO. 1984. Epizootiología de las coccidiosis ovinas en la provincia de León. II. *Eimeria crandallii*. *Anales de la Facultad de Veterinaria de León* 30: 195–207.
- , AND ———. 1985. Epizootiología de las coccidiosis ovinas en la provincia de León. III. *Eimeria faurei*. *Anales de la Facultad de Veterinaria de León* 31: 221–231.
- , AND ———. 1986. Epizootiología de la coccidiosis ovina por *Eimeria granulosa* en la provincia de León. *Anales de la Facultad de Veterinaria de León* 32: 73–85.
- , AND ———. 1987a. Epizootiología de la coccidiosis ovina por *Eimeria intricata* en la provincia de León. *Revista Ibérica de Parasitología* 47: 325–333.
- , AND ———. 1987b. Quantity of *Eimeria* spp. oocysts elimination in sheep. *Angewandte Parasitologie* 28: 7–14.
- , AND ———. 1988. Epizootiology of *Eimeria ahsata* coccidiosis in León (Spain). *Veterinary Parasitology* 27: 183–191.
- LEVINE, N. D. 1985. *Veterinary protozoology*. 1st ed. Iowa State University Press, Ames, Iowa, 414 pp.
- . 1988. *The protozoan phylum Apicomplexa*, Vol. I. CRC Press, Boca Raton, Florida, 203 pp.
- LIMA, J. D. 1980. *Eimeria caprovina* sp.n. from the domestic goat, *Capra hircus*, from the U.S.A. *The Journal of Protozoology* 27: 153–154.
- MINISTRY OF AGRICULTURE, FISHERIES AND FOOD. 1977. *Manual of veterinary parasitological laboratory techniques*. Technical Bulletin No. 18. Her Majesty's Stationery Office, London, England, 131 pp.
- NORTON, C. C., AND J. CATCHPOLE. 1976. The occurrence of *Eimeria marsica* in the domestic sheep in England and Wales. *Parasitology* 72: 111–114.
- PELLÉRDY, L. P. 1974. *Coccidia and coccidiosis*. 2nd ed. Paul Parey Publishers, Berlin, Germany, 959 pp.
- POUT, D. D. 1973. Coccidiosis of lambs. I. Observations on the naturally acquired infection. *British Veterinary Journal* 129: 555–567.
- , D. C. OSTLER, L. P. JOYNER, AND C. C. NORTON. 1966. The coccidial population in clinically normal sheep. *The Veterinary Record* 78: 455–460.

Received for publication 25 March 1994.