



Ciliate protozoa of the forestomach of llamas (*Lama glama*) and alpacas (*Vicugna pacos*) from the Bolivian Altiplano

IGNACIO DEL VALLE¹, GABRIEL DE LA FUENTE² & MANUEL FONDEVILA^{2,3}

¹Departamento de Bioquímica y Biología Molecular, Universidad de Zaragoza, Miguel Servet 177, 50013 Zaragoza, Spain

²Departamento de Producción Animal y Ciencia de los Alimentos, Universidad de Zaragoza, Miguel Servet 177, 50013 Zaragoza, Spain

³Corresponding author. E-mail: mfonde@unizar.es

Abstract

Protozoal diversity in the forestomach of South American camelids (SAC) was studied in eight llamas and six alpacas from the Parque Natural Condoriri (3900 to 4100 m altitude, Departamento La Paz, Bolivia). Total protozoal concentrations were 3.6 times higher ($P < 0.001$) in the stomach contents of alpacas ($39.6 \times 10^4 \text{ ml}^{-1}$ and $143.8 \times 10^4 \text{ ml}^{-1}$ in llamas and alpacas, respectively). Four to 11 species, all from the genus *Entodinium*, were observed in llamas, whereas from eight to nine species of *Entodinium* and minor proportions of *Diplodinium* (*D. anisacanthum*, *D. dogieli*, *D. rangiferi*), *Eudiplodinium* (*E. bovis*, *E. maggii*, *E. neglectum*) and *Epidinium* (*E. ecaudatum*) were observed in alpacas. The presence of *Epidinium* species in the alpaca is a new host record. The vestibuliferids, *Dasytricha* and *Isotricha* were absent from the forestomach of SAC, as well as other species such as *Caloscolex* genus, *Diplodinium cameli* and *Entodinium ovumrajae*, commonly found in Old World camelids.

Key words: forestomach protozoa, South American camelids

Introduction

Llamas (*Lama glama*) and alpacas (*Vicugna pacos*; Kadwell et al. 2001) are two domesticated species of South American camelids (SAC) from the Andean Altiplano (3500 to 4500 m altitude). They have been traditionally used for labour, meat, leather and wool, accounting for up to 75% of cash income in more than half of the Bolivian households in this area (Tichit and Genin 1997). Alpacas (50 to 70 kg live weight) are highly adaptable grazers that preferably feed a wide range of herbage species from humid areas, whereas llamas (110 to 140 kg) are prone to consume tall and coarse bunchgrasses from the drier areas (San Martín and Bryant 1989; Tichit and Genin 1997; Castellaro et al. 2004).

Several papers have studied the digestive tract of SAC in terms of anatomy (Vallenas et al. 1971; Engelhart et al. 1988) and digestion processes (Sponheimer et al. 2003; Davies et al. 2007), but information about their rumen microbial population is scarce. In their reviews, Dehority (1986) and Jouany (2000) indicated that rumen protozoal counts of dromedaries and SAC were similar to those of ruminants. They also reported that the protozoal population in camelids is only type B (Eadie 1962), and the family Isotrichidae was always absent from these animals. However, neither of them presented data supporting this conclusion. A classical reference of protozoal biodiversity of SAC is the description by Lubinsky (1964) of a guanaco (a wild SAC) from the Winnipeg Zoo. However, these data should probably be viewed with caution since there was only one animal and the possible cross-inoculation from individuals of another species in the zoo (Kubikova 1935). SAC differ from dromedaries and bactrian camels in their protozoal population, because they apparently do