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Chlamydiaceae and chlamydial infections in sheep or goats

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ABSTRACT

Chlamydiae induce a range of pathological syndromes in small ruminants. Abortion is the most common clinical expression of the infection that causes important economic losses and presents a risk to human health, particularly in pregnant women. The present paper gives an overview of chlamydial infections in sheep and goats, focusing specifically on abortion and on recent data brought by cellular and genomic approaches regarding genotyping, virulence of strains, epidemiology, diagnosis, pathogenesis and control of the disease.

Keywords: abortion, *Chlamydia*, control, diagnosis, small ruminants, typing, virulence

1. Introduction

Chlamydiae are obligate intracellular bacteria, which have an increased presence and prevalence in animals. They infect ocular, genital and respiratory tissues, leading to a variety of diseases, including abortion, pneumonia, gastroenteritis, encephalomyelitis, keratoconjunctivitis, arthritis, orchitis, seminal vesiculitis and epididymitis (Storz, 1971; Shewen, 1980; Longbottom and Coulter, 2003; Yousef Mohamad and Rodolakis, 2010). However, not all animals carrying the organisms develop clinical disease (Rank and Yeruva, 2014).

All *Chlamydiae* share a unique biphasic developmental cycle, involving an infectious, but metabolically inactive form, the elementary body (EB), which invades the host cell, and a non-infectious metabolically active form, the reticulate body (RB), which resides and multiplies within a non-fusogenic vacuole-like cytoplasmic inclusion. The elementary bodies escape from the host cells' natural defence mechanisms, because the inclusions evade fusion with lysosomes, and go into the exocytic pathway, appearing as secretory vacuoles to the host cells (Hackstadt et al., 1997). The developmental cycle is completed when the reticulate bodies convert back to elementary bodies, which are released by host cell lysis or exocytosis in order to start a new round of infection.

The classification of bacteria in the order Chlamydiales underwent many modifications. After several names, *Chlamydiae* responsible for abortions in ruminants had been grouped under the name of *Chlamydia psittaci* serovar 1 until 1999, date from which the *Chlamydiaceae* family has been divided into two genera. Thus, the genus *Chlamydia* comprised three species: *Chlamydia trachomatis*, pathogen of humans, *C. suis*, mainly infecting pigs, and *C. muridarum*, infecting mice and hamsters. The genus *Chlamydophila* grouped together six species: *Chlamydophila abortus* and *Chlamydophila pecorum* that infect primarily ruminants, *C. psittaci*, pathogenic for birds, *C. pneumoniae*, pathogenic

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