Lawsonia Intracellularis: A Constant Challenge to Modern Swine Production


DOI: 10.5455/jva.20150531041541

Online version is available on: www.grjournals.com
Lawsonia Intracellularis: A Constant Challenge to Modern Swine Production

*1Oliveira L. G., 2Oliveira M. E. F., 3Franciscato D. A., 3Nociti R. P., 4Mechler M. L. and 3Almeida H. M. D. S.

1Department of Veterinary Clinic and Surgery, College of Agricultural and Veterinary Sciences, São Paulo State University (UNESP), Jaboticabal, São Paulo, Brazil.
2Department of Preventive Veterinary Medicine and Animal Reproduction, College of Agricultural and Veterinary Sciences, São Paulo State University (UNESP), Jaboticabal, São Paulo, Brazil.
3MSc student in Veterinary Medicine, College of Agricultural and Veterinary Sciences, São Paulo State University (UNESP), Jaboticabal, São Paulo, Brazil.
4Graduate student in Veterinary Medicine, College of Veterinary Sciences, Federal University of Lavras, Minas Gerais Brazil.

Abstract

Lawsonia intracellularis (LI) is an obligate intracellular proteobacteria that causes porcine proliferative enteritis. The disease affects mainly piglets and has an important role in economic losses in the swine breeding chain, chiefly because it is usually hardly noticed swine herds. Being a disease with cosmopolitan distribution it triggers reduction in average daily gain of weight and feed conversion efficiency. Its transmission is closely linked to the presence of infected animals in the herd and direct contact between contaminated faeces and susceptible hosts. A striking feature of LI is the ability to proliferate and stay hidden inside intestinal cells, which protects the agent from inflammatory reaction. Thus, all these peculiarities are aggravating to perform direct diagnosis and subsequent treatment effectiveness.

Keywords: Intestinal adenomatosis, proliferative enteritis, infections, pigs.
**Introduction**

*Lawsonia intracellularis* (LI) is an S-shaped bacillus bacterium, gram-negative, flagellate and obligate intracellular, worldwide distribution, and it is one of the most important causes of losses in world swine production (Kroll *et al.*, 2005). In swine, it is responsible for causing a disease named Porcine Proliferative Enteritis (PPS) also known by Porcine Intestinal Adenomatosis (PIA) which can be presented in acute or chronic forms, affecting mainly piglets (Lawson & Gebhart *et al.*, 2000).

The PPS was first described in 1931, despite its etiological agent was only confirmed in 1995 by molecular biology techniques (McOrist *et al.*, 1995a). Although the high prevalence, this disease is not always diagnosed and noticed in the routine of swine farms (Smith *et al.*, 1998), which makes the performance loss of the animal the main sign of the occurrence of the disease in pig herds (Paradis *et al.*, 2012).

The LI affects mostly swine (Lawson & Gebhart, 2000), however it has been found in various species such as hares, skunks, possums, coyotes (Purstela *et al.*, 2008), wild boars, deer (*Dama dama*) (Dezorzova-Tomanova *et al.*, 2006), *Rhesus monkeys* (Klein *et al.*, 1999), mice, cats, rabbits (Purstela *et al.*, 2012), and dogs (Feary *et al.*, 2007).

**Updates on the Epidemiological Agent**

The PPS has worldwide high prevalence. Based on serology, McOrist *et al.*, (2003) estimated a prevalence of 96% in the USA. Stege *et al.*, (2000) found a prevalence of 93.7% in Denmark using the PCR technique in faeces. Other studies showed a prevalence of 93.55% in Hungary herds (Biksi *et al.*, 2007), 46.5% in Korea (Dong & Jae, 2005), 16% in the United Kingdom (Thonson *et al.*, 2001). In Brazil, also using the PCR technique, the estimated prevalence is 30%, with 37% in São Paulo, 35% in Santa Catarina, 20% in Paraná, 16% in Minas Gerais, 40% in Goiás, 40% in Mato Grosso do Sul and 25% in Rio Grande do Sul (Moreno *et al.*, 2002). In other regions such as Distrito Federal, Pernambuco, Ceará and Rio de Janeiro, positive samples were not found (Moreno *et al.*, 2002).

The epidemiology of the disease is based on faecal-oral propagation, and found as important sources of transmission of the disease the direct contact between healthy animals and infected animals, contaminated faeces, fomites or carried by vectors. The type of installation also facilitates the propagation as dirty floors, mainly with wooden slats, which difficults the cleaning and shelter traces of faeces (Guedes, 2004).

After the infection, the bacterium can be found in proliferative development in the intestine tissue and faeces 1-3 weeks after contagion, with a peak of infection and injuries between 3-4 weeks of contamination (Kroll *et al.*, 2005). According to Vannucci *et al.*, (2013), in an experiment with 34 three weeks old piglets, experimentally infected, the clinical diarrheal condition initiated on the second and third weeks after infection.

The persistent excretion of the bacterium occurs in most of contaminated animals, which lasts from four to ten weeks after infection (Kroll *et al.*, 2005). Collins *et al.*, (2011) showed that the quantity of *Lawsonia intracellularis* isolated in one gram of wild rat faeces is sufficient to cause infection and, consequently, clinical signs of disease in piglets; highlighting the risks of the interaction between these two species.

**Pathogenesis and Injuries Associated with Infection by Lawsonia Intracellularis**

The intestinal injuries start after adhesion and invasion of the enteric cells by the bacteria, that while staying within the epithelium, avoid the occurrence of inflammatory reaction, which could eradicate the infection. Then, the epithelial injuries lead to the progressive development of immature intestinal cells, which has reduced absorptive capacity (McOrist *et al.*, 1996). In some severe cases of the disease, the agent can be observed in lymph nodes of mesenteric region and tonsils, with the last as secondary infection sites (Jensen *et al.*, 2000).

The etiologal agent rapidly inserts itself in enterocytes through the formation of an entry vacuole, after it has associated to the cell membrane (McOrist *et al.*, 1995b) by specific interactions (McOrist *et al.*, 1997). The phagocytosis is induced by the presence of a bacterial cell, not being
dependent on its feasibility, but the occurrence of activity in the host cell (Lawson et al., 1993). Nuntprasert et al., (2004) considers the presence of polar flagellum in the bacterial cell an important factor to facilitate the invasion of the intestinal epithelium.

After entering the cell, occurs the disruption of the entry vacuole and the bacterium freely multiplies in the apical cytoplasm, escaping to be destroyed by proteolytic enzymes released by lysosomes (McOrist et al., 1995b). Other intracellular bacteria such as Listeria spp., Shigella spp., and some species of Rickettsia spp. use the same mechanism to enter the cell cytoplasm (Gaillard et al., 1987; Sansonetti, 1992). The infected cells continue multiplying and consequently transferring bacteria to the daughter cells (Lawson et al., 1993), which by continuing the mitosis process will originate hyperplasic crypts through the large intestine (McOrist et al., 1996). Studies have indicated that dividing cells propagate the bacteria better than mature cells that are not in dividing phase (Lawson et al., 1993; McOrist et al., 1995b). Alterations in gut epithelial tissue architecture reduce the absorption of nutrients and increase mucosal protein loss of amino acid, which is the probable cause of the reduction in average daily gain and feed conversion efficiency observed in animals with chronic disease (McOrist & Gebhart, 1999). It shows that PPS is one of the high importance diseases in swine production (Stege et al., 2004; Paradis et al., 2012).

Young animals (weaning to growth) show the ileum as a primary site of infection and, less commonly, the large intestine. Injuries such as irregular swelling of the subserosal layer, small areas of necrotic material, and thickening of the mucosa and epithelium are observed on histological examination due to an expansion and extension of the crypts (Lawson & Gebhart, 2000). On the other hand, in animals in the finishing phase, PPS is observed more acutely, with thickening of the mucosa, proliferative lesions, clots in fibrin form and vessels congestion (Lawson & Gebhart, 2000).

Diagnostic Methods

In livestock, the diagnosis can be made by serology, faecal smear by immunoperoxidase technique and PCR of faecal samples (McOrist & Gebhart, 1999, Lawson, 2000). A study shows that using the PCR technique it was possible to find genetic material of Lawsonia intracellularis in piglets faeces 4 weeks after weaning, with a peak of bacteria elimination via excreta by the eight week after weaning. However, after the week 14th post-weaning, it was not possible to find in the stool any more agent signal in any animal (Stege et al., 2004). Nevertheless, the use of PCR to analyse the excretion of the etiologic agent showed low sensitivity (Guedes et al., 2002; Paradis et al., 2012); fact that can be attributed to inhibiting factors present in stool that hinder the DNA extraction process (Guedes et al., 2002). Regarding the serological tests, it can be used indirect immunofluorescence and immunoperoxidase plate monolayer (IPMC). Both present similar results, but the IPMC test can be stored for long periods and it is more easily interpreted, besides being highly specific and great support to the diagnosis of herd (Guedes et al., 2002).

The immunohistochemistry made possible the specific detection of LI in affected tissue sections (Knittel et al., 1997). The bacterium can be identified in faecal smears using specific monoclonal antibodies, especially in cases which there are high levels of the etiologic agent in excreta (McOrist et al., 1987; Guedes & Gebhart, 2003). In a comparative study it was proved that the immunohistochemistry was more sensitive than both Haematoxylin-Eosin (HE) and silver staining (Guedes et al., 2002). It is possible to observe on the slides, beyond the location of intraepithelial bacteria, microorganism within macrophages in the lamina propria of ileum and proximal colon. Moreover, low concentrations of bacteria can also be located aggregated in the enterocyte surface. Even 14 days after infection occurs it may be noted large number of infected crypts in several sites (MacIntyre et al., 2003). In addition to the diagnosis methods, Paradis et al., (2012) showed that monitoring daily weight gain and other performance parameters is helpful to detect the disease in its chronic status in the herd.
**Alternatives for Controlling and Treating**

The individual treatment of affected animals is not frequently used but rather the treatment of the herd with antibiotics that have good efficacy against *Lawsonia intracellularis*, which are tetracycline, penicillin, fluoroquinolones, macrolides and tiamulin (Sobestiansky et al., 1998; Radostitis et al., 2002 e Kroll et al., 2005). Boesen et al., (2004) demonstrated that the fermented liquid diet supplemented with lactic acid, even without addition of antibiotics, delayed bacteria excretion in the faeces, decreased the intestinal lesions, the prevalence and severity of diarrhoea. The live attenuated vaccine is already used in some parts of the world and does not interfere with serological test as ELISA (Nathues & Beilage, 2008). When applied through drinking water, vaccination has resulted in significant immune protection (Kroll et al., 2004). Also showed increase in the average daily gain of weight and it was suggested that it not only leads to immunity to PPS, but also increases the resistance and tolerance to other infectious agents of the digestive tract (Almond & Bilkei, 2006).

In a case study, Bak & Rathkjen (2009), in a farm containing 15.656 swine with a non-vaccinated control group of 7.756 animals and a group of 7.900 vaccinated animals, it was shown that the vaccine was responsible for decreasing the use of oxytetracycline for LI control in 79%. Weibel et al., (2012) studied the association of vaccination against LI and circovirosis and concluded that the vaccination against LI was sufficient to reduce mortality from the farm and increase average daily gain. However, the use in association with the vaccine against circovirosis presented greater benefits. If one takes into consideration the disease epidemiology, which demonstrates that the transmission is made by direct contact between animals and faeces (Guedes, 2004), the best alternative would be by cleaning and using of disinfectants. In this case, the best option is the quaternary ammonium solution of 3% (Collins et al., 2000).

**Final Considerations**

It is possible to observe that the PPS is a disease which is widespread in swine herds in the main producing regions of Brazil. Especially because it is a disease that easily passes unnoticed in animals, it is directly related to the producer losses due to the delay in growth, reduction in daily weight gain and, in cases which the disease is detected, there are other costs with treatment and control. It is extremely important that producer establishments are always attentive to the health of animals and practice rigorously the proposed prevention measures, such as: vaccination, quarantine, sanitary depopulation and disinfection of stalls in which were housed infected batches. Therefore the aim is to avoid yield losses, increasing the stability, profitability and robustness of the national swine.

**References**


Oliveira ET AL.


