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Report on intussusception in channel catfish *Ictalurus punctatus* (Rafinesque, 1818) from commercial farms in Mexico: A case study

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ABSTRACT

Intussusception is a rare condition in fish, mainly reported from Asian countries and it is considered an emergent disease in China. This is the first report on intussusception case in channel catfish *Ictalurus punctatus*, cultured in floating cages in Mexico. Fishes were sampled during an outbreak with daily mortalities above 1.14%. Necropsy revealed intestinal intussusception, pale liver and hemorrhagic mesentery. Bacteriological analyses showed presence of *Aeromonas* sp. in internal organs and it is suggested that the presence of *Aeromonas* sp. is probably responsible for the observed condition.

Keywords: *Aeromonas*, Bacterial toxins, Channel catfish, Intussusception

Intussusception is a rare condition in humans and other mammals (Alvarez *et al.*, 2000; Castro-Medina *et al.*, 2015), which can be defined as the inversion (invagination) of one intestine portion within another (Byrne *et al.*, 2005). In most cases, intussusception occurs in the same direction of peristalsis (Lideo *et al.*, 2010), probably due to an increment in peristalsis, abscesses or enteric tumors (Okamoto *et al.*, 2007); however, the cause of this condition in fish is not clear. Intussusception results in the obstruction to the passage of intestinal contents, vascular compression, edema and eventually ischemic necrosis (Castro-Medina *et al.*, 2015). Fish intussusception has been reported mainly in cultured fish species like tilapia *Oreochromis* spp. and channel catfish *Ictalurus punctatus* (Gaunt *et al.*, 2007; Liu *et al.*, 2008; Rey *et al.*, 2009; Cao *et al.*, 2016) and it is considered as an emerging disease in the latter (Seafood Watch, 2017). A correlation of this condition with bacterial infection (Vazquez-Pineiros *et al.*, 2010; Wang *et al.*, 2011) or exposure to type E botulin toxin (Gaunt *et al.*, 2007; Khoo *et al.*, 2011) has also been reported. Most intussusception cases reported are from Chinese catfish farms (Liu *et al.*, 2008; Geng *et al.*, 2010; Cao *et al.*, 2016) where it is a frequent condition that results in mortalities, thus representing an important production risk (Liu *et al.*, 2008). Bacteria such as *Aeromonas hydrophila*, *Hafnia alvei*, *Pseudomonas fluorescens* and *Stenotrophomonas maltophilia* have been isolated from the above incidences, suggesting an infectious origin, but other factors as contaminated feed or incorrect use

of feed additives are also suggested (Cao *et al.*, 2016). An early case of intestinal intussusception in channel catfish was reported in fish experimentally exposed to saponified castor oil (Tucker *et al.*, 1986). Durborow and Hanson (1988) reported presence of *Aeromonas* spp. in channel catfish fingerlings with severed intestine, suggesting intussusception among the possible etiologies. Intussusception has also been reported in outbreaks caused by *Edwardsiella ictaluri* in the catfish *Ameiurus nebulosus*, which also presented red and white mottling in the liver (Iwanowicz *et al.*, 2006). All these observations suggest that intussusception may be associated to toxins or bacterial infections. Channel catfish is an important fish species cultured in Mexico, with the state of Tamaulipas as the main supplier of catfish fingerlings for production farms, providing 61% of the channel catfish broodstock in Mexico and producing 50% of the catfish for national consumption (Lara-Rivera *et al.*, 2015).

The case took place in a catfish farm located in Tamaulipas, Mexico. Catfish were stocked at 15 cm length and reared in floating cages (7 m³) @ 250 fish m⁻³. Fish were fed with commercial extruded feed (Bagre engorda Purina® # 4, minimum protein 32%, minimum fat 3.5%, maximum fiber 7%). Towards final phase of production, dead or moribund fishes were found floating in water surface, with a daily mortality rate of 1.14%. Floating cages with the highest mortalities were sampled and necropsies were carried out in six fish (mean weight 729.2 ± 64.1 g). Fishes appeared normal externally. Internal lesions

were noticed in one fish, which showed a 15 cm long intussusception in the distal portion of the intestine (Fig. 1) in the direction of peristalsis; with pale liver and a swollen and hemorrhagic spleen (Fig. 1). Obstruction to blood flow was also noticed in the proximal part of the invaginated intestine, which exhibited a thicker diameter as well as venous congestion on the invaginated portion (Fig. 1). Parasitological analyses showed only a moderate level infection of the monogenean (*Ligictaluridus floridanus*) on gills (Jimenez *et al.*, 2010). Samples of liver, intestine, trunk kidney and gills were taken for bacteriological (Castro Escarpulli *et al.*, 2003) and histopathological investigations (Bernet *et al.*, 1999; Rosenthal *et al.*, 2013). Results of bacteriology showed presence of *Aeromonas* sp. in liver and kidney. Histopathology revealed distension and fatty degeneration in liver (Fig. 2) which could be attributed to metabolic causes (Rosenthal *et al.*, 2013); lumen obliteration, tissue compression and mucous hyperplasia in intestine indicating intussusception (Fig. 3) as well as



Fig. 1. Catfish, *Ictalurus punctatus*. Pale liver (—), congestion of blood vessels (—); intussusception (—). Bar 1.0 cm (Photograph by I. O.)

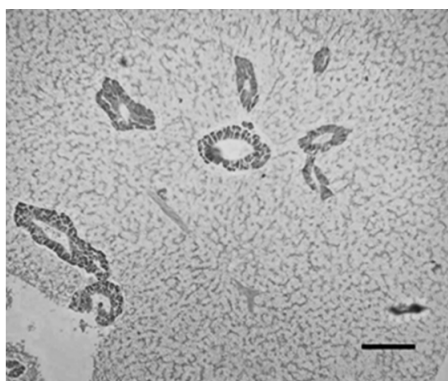


Fig. 2. Histological section of liver of *Ictalurus punctatus* showing hepatic cell distension and fatty degeneration (H & E). Bar = 20 μ m

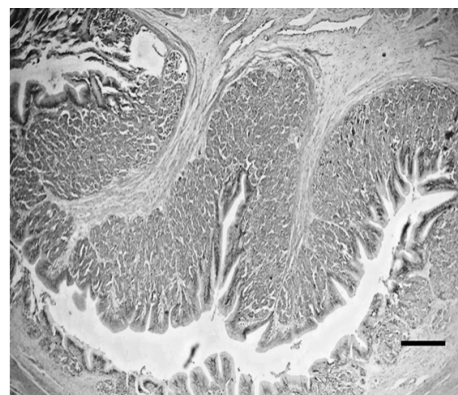


Fig. 3. Histological section of intestine of *Ictalurus punctatus* presenting intestinal intussusception. Lumen obliteration, tissue compression and mucous hyperplasia are observed (H & E) Bar = 100 μ m

a moderate inflammatory reaction and blood precipitates in trunk kidney (Fig. 4). Physicochemical parameters of the lake water recorded were also analysed during the study and the values recorded were: Temperature - 19°C; pH - 7.5; dissolved oxygen - 6.04 mg l⁻¹, total ammonia - 0; Alkalinity - 324 mg CaCO₃ l⁻¹ and hardness - 297.6 mg CaCO₃ l⁻¹. Water temperature at sampling time was 19°C (Table 1), which is consistent with Durborow *et al.* (1988) who documented intestinal alterations in cultured channel catfish when temperatures ranged from 12 to 19°C.

The presence of pathogenic bacteria is related to stress in fish (Marques *et al.*, 2016) and isolation of *S. maltophilia* has been reported in cases of intussusception in channel catfish (Geng *et al.*, 2010; Wang *et al.*, 2011). *Aeromonas* spp. in catfish (Durborow and Hanson, 1988; Liu *et al.*, 2008; Tong *et al.*, 2009), tilapia *Oreochromis* spp. (Vazquez-Pineiros, *et al.*, 2010) and the red-bellied

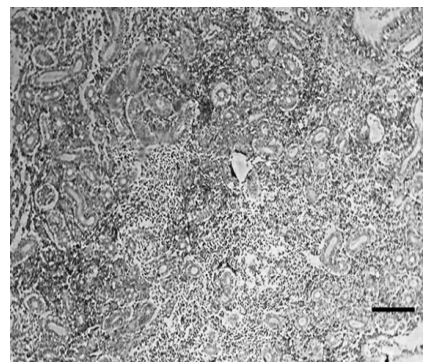


Fig. 4. Histological section of trunk kidney of *Ictalurus punctatus* showing desquamation, congestion, moderate inflammatory reaction and precipitates from blood (H & E). Bar = 20 μ m

Table 1. Water physicochemical parameters in the lake recorded during the study

pH	Total ammonia (mg l ⁻¹)	Alkalinity (CaCO ₃) (mg l ⁻¹)	Hardness (CaCO ₃) (mg l ⁻¹)	Temperature °C	Dissolved oxygen (mg l ⁻¹)
7.5	0.0	324 ±	297.6 ±	19 ±	6.04 ±

pacu *Piaractus brachypomus* (Rodriguez *et al.*, 2005; Rey *et al.*, 2009) has been commonly associated with intussusception. In the same way, Liu *et al.* (2008) reported association between *P. fluorencens* and intussusception during experimental infection in channel catfish, highlighting that this may not be the only probable cause of intussusception.

There are some studies reporting use of antibiotics as treatment to intussusception in channel catfish (Liu *et al.*, 2008; Tong *et al.*, 2009; Geng *et al.*, 2010). However, treatment for intussusception should include an integral approach considering other possible causes like toxins or stress problems induced by inadequate management. Correction of these problems would help to reduce the use of chemicals in fish culture, decreasing environmental pollution (Cabello and Godfrey, 2016). In the present case of intussusception, though the primary cause of the syndrome could not be established, it is construed that it is related to the presence of *Aeromonas* sp. and/or its toxins, as it has been already reported that the virulence factor of bacterial pathogens probably cause intussusception (Cao *et al.*, 2016). Further research is required to elucidate the exact causes of intussusception as well as to take the necessary measures for its prevention. To our knowledge, this is the first report of intussusception in commercial fish culture in Mexico.

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