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The intestinal health of silver catfish *Rhamdia quelen* can be changed by organic acid salts, independent of the chelating minerals

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ABSTRACT

Food additives based on organic acids or their salts promote numerous improvements in zootechnical parameters, digestive enzymatic activities, resistance to diseases and intestinal health. This study aimed to evaluate the influence of calcium and sodium chelated to propionic acid on the digestive enzymes activities, intestinal microbial community and histological alterations in the liver and intestine of the silver catfish *Rhamdia quelen*. Fish with an initial mean weight of 8.43 ± 0.18 g were divided into a control and four treatments, with 15 fish in each replicate, and fed the following supplemented diets for 60 days, four times per day: unsupplemented control, Ca-propionate 0.25% ($Ca_{0.25\%}$), Ca-propionate 1% ($Ca_{1\%}$), Na-propionate 0.25% ($Na_{0.25\%}$) and Na-propionate 1% ($Na_{1\%}$). At the end of the assay, digestive enzymes activities in the gastrointestinal tract (GIT) was not affected by the chelating mineral, nor by its concentration to propionic acid. On the other hand, the most important digestive enzymes for silver catfish were lipase and acid protease. Regarding the intestinal microbial community, fish fed $Ca_{0.25\%}$ showed a lower concentration of total heterotrophic bacteria and a higher lactic acid bacteria count, compared to $Na_{1\%}$-supplemented fish, in addition to the maintenance of cordonal features and liver cholestasis. Fish fed a $Ca_{0.25\%}$ or $Na_{0.25\%}$ supplemented diet presented the best histomorphometry parameters, such as the greatest width and number of villi, a lower number of eosinophilic infiltrates and the absence of lymphocytic infiltrates. The organic acid propionate chelated to calcium at 0.25% improved the microbial composition and intestinal health of silver catfish, with no effects on the liver, the most important organ for depuration, and could be indicated as a feed additive for silver catfish.

1. Introduction

Aquaculture is a promising agricultural activity for the production of protein of an animal origin. Among the aquaculture sectors, freshwater fish farming accounted for 93.8% of the total world fish production in 2016 (FAO, 2017). In continental waters, the most produced fish are tilapia and cyprinids, with a production of > 45 million tons in 2016 (FAO, 2017). To diversify production, new species like native fish have gained ground in continental fish farming. Among the most cultured fish in southern Brazil, the native species silver catfish *Rhamdia quelen* (Quoy and Gaimard, 1824), commonly known as "jundiá" or silver catfish, has good zootechnical characteristics and market acceptance (Gomes et al., 2000).

Of the 39.86 thousand tons of fish produced *via* continental Brazilian fish farming in 2013, 743.9 tons were silver catfish. According to the last survey, this species is the third most important for the state of Santa Catarina, after the production of tilapia and carp (Silva et al., 2017); for this reason, silver catfish was used as a model in this study.

For the expansion of fish farming, there is a need for high-quality feed additives that provide better productive performance and disease resistance since silver catfish suffer from several bacterial and parasitic diseases. For many years, agricultural activities used growth promoters based on antibiotics; however, the indiscriminate use of this chemotherapeutic agent led to the contamination of the meat being

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