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Infectious spleen and kidney necrosis virus (ISKNV) spillover from naturally infected tilapia to native free-living fish

Deborah Jacob Freire da Paz

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TÍTULO DA DISSERTAÇÃO: Infectious spleen and necrosis virus (ISKNV) spillover from naturally infected tilapia to native free-living fish

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EPIGRAPH

"We ourselves feel that what we are doing is just a drop in the ocean. But if the drop was not in the ocean, I think the ocean would be less because of the missing drop."

Mother Theresa

DEDICATION

I dedicate this master's degree to my mother Lourdes Jacob, the most beautiful flower in my garden.

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ABSTRACT

Viruses are responsible for high mortality rates in many freshwater and marine fish species in aquaculture. In the Brazilian scenario, the infectious spleen and kidney necrosis virus or ISKNV has been causing problems in the production of Nile tilapia. Diagnoses and research about this pathogen in the country are recent because it is an emerging virus in our territory. We know that this virus is present in most Brazilian tilapia farms, and our hypothesis is that spillover events are occurring between tilapia to native wild fishes, thus facilitating the spread of the virus to the ecosystem, potentially causing a greater permanence of viable viruses in the environment, viral outbreaks in other locations, and more frequently mortality events. This work assessed the health status of Nile tilapia from commercial fish farms and free-living fish near net cages through ectoparasite analysis, histopathology, and molecular diagnosis for ISKNV. The results demonstrated that 63.2% of tilapia were infected by ISKNV, while 1.1% of wild fish were positive for ISKNV. The ISKNV positive fish was a yellow piranha (*Serrasalmus Maculatus).* The results confirmed the infection of tilapia by the virus and confirmed the pathogen spillover hypothesis. This study provides important information about the epidemiology of the ISKNV in Brazil and its possibility to infect native wild Brazilian fish species. Future studies will have to evaluate the impact of ISKNV on wildlife and its epidemiological importance for the maintenance of the disease in Brazilian tilapia farms.

Keywords: Brazilian native fish, iridovirus, tilapia, viral ecology, viral infection.

1. INTRODUCTION

Aquaculture is the fastest-growing food-production sector in the world and its production is dominated by a small number of species, including carp and tilapia (FAO, 2021). The Nile tilapia (*Oreochromis niloticus*) is the second most cultured fish species in the world (followed after carp) and it represents one of the most important species in the aquaculture world, with a global production estimated in 4,500,000 tons in 2018 (FAO, 2020). In Brazil, this specie is the most important for aquaculture and represents 63% (approximately 758.000 tons) of fish production (Peixe BR, 2023). In the last decade, tilapia production increased from 150.000 to 400.000 tons, making Brazil the 4th largest Nile tilapia producer in the world (FAO, 2021). In the southeastern, central-western, and northeastern regions of Brazil, tilapia production is carried out intensively or super intensively, in net cages located in dikes, rivers or river branches, sharing space with other fish species, mainly native.

Consequently, the intensification of Nile tilapia production has negatively affected the sector due to the occurrence of diseases, most importantly viral diseases, such as the infectious spleen and kidney necrosis virus (ISKNV). It is an emerging pathogen that causes high mortality and morbidity in fish worldwide, affecting over 160 species of fish, including tilapia (Jung et al. 2000, Kurita et al. 2002, Girisha et al. 2021, Gibson-Kueh et al. 2003, Jeong et al. 2003, Nakajima et al. 2005, Wang et al. 2007, Song et al. 2008, Wang et al. 2009, Rimmer et al. 2015, de Lucca Maganha et al. 2018, WOAH, 2022). This virus was first identified in tilapia in Brazil in 2019, and since then, this disease has been causing significant economic losses in all states that produce tilapia (Figueiredo et al., 2021; MAPA, 2020).

The Brazilian rivers have a great diversity of fishes that are affected for various natural anthropogenic impacts or both. Amongst these factors, the spillover of disease (transmission of a pathogen from an infected species to another potential host species) negatively affects the population structure and diversity of wild fish (Lovy et al., 2018).

The fish production without the appropriate pathogen screening and quarantine serves to spread of ISKNV to other species (Rimmer et al., 2015). Therefore, we believe that the emergent viral disease ISKNV can be transmitted to wild fish from Nile tilapia production by a series of horizontal transmission mechanisms.

Hence, the objective of the study was to confirm the hypothesis of tilapia naturally infected by ISKNV, can transmit the virus to native wild Brazilian fishes that resides in rivers adjacent to commercial net caged tilapia farms.

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