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Research article

# Histopathology of kidney and liver in the captive broodstock (*Rastrelliger brachysoma*) during its juvenile stage

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## Abstract

This is the first study which explained the histopathology in kidney and liver of the captive broodstock (*Rastrelliger brachysoma*) during its juvenile stage, to assess the health status. All fishes (n = 24) with a mean of 5.02±0.87 (SD) cm in total length, were collected during October to December 2013 and processed using standard histological protocols. Conforming to histological observation, kidney and liver parenchyma in this species were clearly altered. The most melanomacrophage center had found to be highly organized in these tissues, whereas a large number of the vacuolar structure in the hepatocyte was shown as an empty space, as also called the hepatocellular lipidosis. All lesions in the abnormal kidney and liver may be related to their reduced functions as well as health status of *R. brachysoma* under captive conditions.

**Keywords:** Captive fish, Histopathology, Kidney, Liver, Short-mackerel

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# INTRODUCTION

Histopathological biomarker is one of the most important tools to reflect the health status and assess environmental effects of fish for long periods (Fatma, 2009; Nikalje et al., 2012). This biomarker has been widely used to investigate and to predict the vital changes of specific tissues and organs (Hinton et al., 2001; Adams, 2002; Dietrich and Krieger, 2009). Among several organs, the kidney and liver tissue in fish is a key organ and very sensitive to the environmental changes (Hinton et al., 2001; Genten et al., 2008). The alteration of kidney and liver structures can hence reflect the fish health and ecosystem as a whole (Hinton et al., 2001; Adams, 2002). Similarly, evidences of the liver/kidney histopathologies of fish have been extensively investigated to evaluate the effects of organic compounds and heavy metals on teleost fish in both wild and captive fishes (Hinton et al., 1992; Senarat et al., 2015a).

The captive broodstock (*Rastrelliger brachysoma*) belongs to Family Scombridae and it is now considered to be the most important fishery resources in Thailand. At the same time, it is noted that this fish has become the endangered/threatened species (Senarat et al., 2017) due to the increase of overfishing and deterioration of its habitat causing a serious decline in its number (Senarat et al., 2015a; 2015b). To solve this problem, the aquacultural development must be developed to produce the *R. brachysoma* and subsequently, its culture project is continuously supervised by the Samut Songkhram Coastal Fisheries Research and Development Center, Samut Sakhon province, Thailand (Senarat, 2015c). Although successful fertilization of the egg and optimum offspring survival have been documented, the developmental rate of *R. brachysoma* during its juvenile stages still decreased for an unknown reason. Comprehensive evaluation of the introduced health status in the fish is here required as primary phase before entering to further studies in other factors. In this study, we assessed the health status of *R. brachysoma* during juvenile stage in captivity, using histopathological biomarker. Surely, our information is vital for the provision of scientific knowledge to health status of *R. brachysoma* juvenile in captivity, implying that can provide an early monitoring in the aquaculture system.

# MATERIALS and METHODS

Fixed twenty-four individuals' short mackerel (*R. brachysoma*) during juvenile stages were randomly collected during October to December 2013 and exclusively donated from the Samut Songkhram Marine Fisheries Research and Development Station, Samut Songkhram, Thailand. All fish were reared in a closed recirculating aquaculture system. The fishes with a mean of 5.02±0.87 (SD) cm in total length were maintained in mechanically circulated filtered seawater with constant aeration, a temperature ranging from 26-28˚C, a salinity level ranging from 25-30 ppt, and a photoperiod of 12:12 h light-dark. The short mackerel broodstock was fed with fresh squid and polychaetes, and artificial feed twice daily. The whole fish was processed using standard histological protocols (Presnell and Schreibman, 1997). The paraffin blocks were trimmed, sectioned at a thickness of 4 µm and stained with Harris's hematoxylin and eosin (H&E). Histological sections were mounted with Permount and the histopathological lesions were observed and photographed under the light microscope (Leica digital 750 Boston Industries, Inc; USA). The percent prevalence in each lesion was calculated through this experiment.

## RESULTS and DISCUSSION

A few comprehensive data are focused on the histopathological assessment of the juvenile fishes in captivity (Cusack et al., 2001; Miyazaki et al., 2011; Kizhakudan et al., 2015; Gosh et al., 2016). This study is the first to report and to increased information on the important histophatological alterations of the kidney and liver in *R. brachysoma* during juvenile stages (Figures 1A-1F).

The degeneration of renal tubule and disorganization of the hematopoietic tissue was observed and is depicted in Figure 1A. The results revealed the infiltration of the melanomacrophage center (MMC), which had been found to be highly organized in the kidney and liver tissues (n = 20 individual fishes, 83.33% prevalence) (Figures 1A-1D). In an earlier report on *Hypophthalmichthys molitrix* from farming system, the presence of MMCs were identified, suggesting to associate with the disease as well as bacterial infection (Gosh et al., 2016). Similar was reported in the kidney teleosts (Agius, 1979; Agius, 1980; Agius, 1981a) such as *Salmo gairdneri* (Agius, 1981b), *Morone saxatilis* (Harper and Wolf, 2009) and *Sparus aurata* (Meseguer et al., 1994), in *R. brachysoma* liver (Senarat et al., 2015a). Several studies have investigated that the appearance of the MMC is directly concerned with fishes after it is exposed or suffered a more severe type of stress (overcrowding, excessive noise and aggression) and that is supported by previous studies (Agius and Roberts, 2003; Alvarez-Pellitero et al., 2007; Sitja-Bobadilla, 2008). The problems in the aquaculture system (environment contaminants and poor water quality) (Patiño et al., 2003), the inflected-tissue from tuberculosis (Chinabut, 1999), nocardiosis (Chen, 1992) and antibacterial phagocytic capacity (Agius and Roberts, 2003) stimulated the occurrence of the MMC. Reports regarding the detection of the MMC indicated that if the increased MMC was detected, it could be related to a positive stimulation from the infectious diseases throughout the change of environmental quality or stress responses resulting from exposure to toxicants (Wolke, 1992; Marty et al., 2003; van Dyk et al., 2010). It could be hence mentioned that insights of the influence of microbial organisms, identification of diagnose parasitic diseases and water quality in a culture system of *R. brachysoma* are still required in further work.

The incidence of the intracytoplasmic vacuoles in the liver, also called "hepatocellular lipidosis" was recognized in *R. brachysoma* juvenile (n = 10 individual fishes, 41.66% prevalence) (Figures 1E-1F). The above-described results indicated that we observed liver pathology in this fish and, to the best of our knowledge, this is the first report. Major degenerative changes including hepatocellular lipidosis and cellular degeneration were recorded (Figure 1F), which were probably related to liver damage, as similarly suggested by Greenfield et al. (2008). Hinton and Laurén (1990) speculated that a derangement in lipid and protein metabolism (lipidosis) is related to abnormal accumulating triglycerides in hepatocytes. Moreover, malnourishment may also raise fat mobilization and impair apoprotein synthesis. In actual fact, the occurrence of the hepatocellular lipidosis was associated with exposure to chlorinated hydrocarbons and other contaminants (Hendricks et al., 1984; Hinton et al., 1992; Robertson and Bradley 1992; Schrank et al., 1997), including polychlorinated biphenyls (Teh et al., 1997; Anderson et al., 2003). Therefore, it is possible that *R. brachysoma* juvenile might be contaminated by the pollutants as mentioned above (Hinton and Laurén 1990). However, several factors involving hepatic effects have been reported to cause high mortality rate in fishes in captivity. It might be caused by ageing, nutritional value and other environmental conditions (Hinton et al., 1992; Robertson and Bradley, 1992).

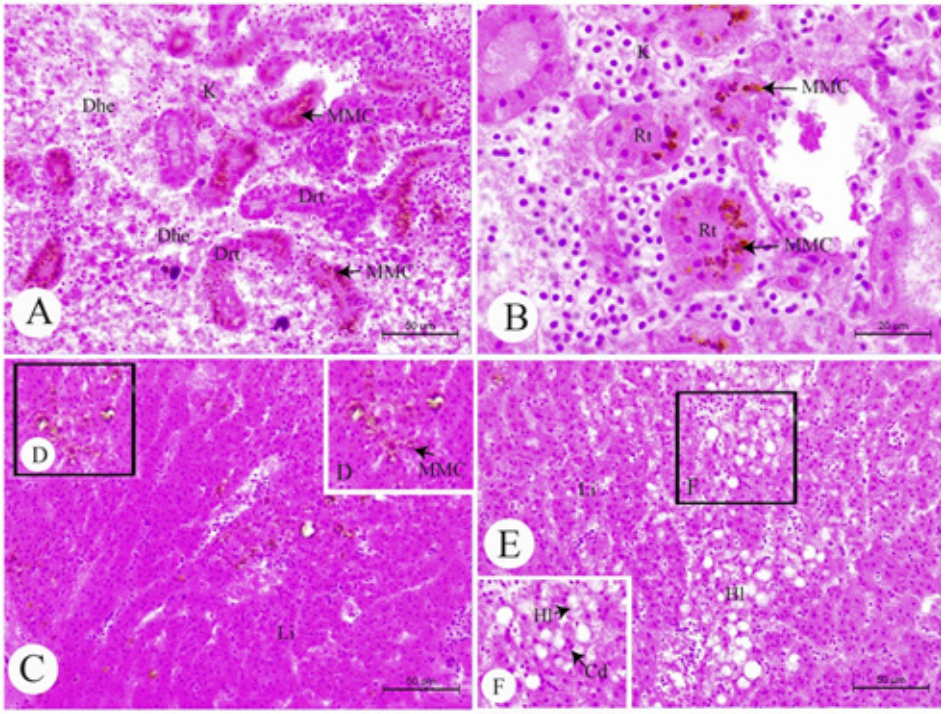


**Figure 1** Light photomicrograph of histopathological lesions in the kidney (A-B) and liver (C-F) of *Rastrelliger brachysoma* during juvenile stage. A: The degeneration of renal tubule (Drt) and disorganization of the hematopoietic tissue (Dhe) in the kidney (K) were observed. A-D: Several melanomacrophage centers (MMCs) were widely distributed in the kidney (K) and liver (Li). E-F: The hepatocellular lipidosis (HI) and cellular degeneration (Cd) appeared in the liver. Note: Rt = renal tubule.

## CONCLUSION

For the current data, we did not have any robust information to support the cause of kidney and liver histopathology of this fish; however, it is plausible to conclude that all histopathological observations including MMC and hepatocellular lipidosis might provide more information on the total loss of the function of both organs. Our observation could be helpful to imply histopathological changes in liver and kidney may be an early event from culture system, suggesting that this situation may be related a decreased growth rate and a reduced health of *R. brachysoma* during juvenile stage. To fulfill other information regarding the histopathological effects, a part of our results could also be incorporated into quality monitoring in the aquaculture system.

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