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VIBRIO SP. ATTACK ON DOMESTICATED MANTIS SHRIMP, *HARPIOSQUILLA RAPHIDEA*

Oleh:
Yusli Wardiatno[1*]

ABSTRACT

The mantis shrimp, *Harpiosquilla raphidea*, is an economically valued crustacean species caught mainly in some Indonesian coastal waters, and is the main target of fisherman in Kuala Tungkal, Province Jambi. To avoid the extinction of the species due to intensive exploitation, a domestication effort was conducted in laboratory. The domestication was aimed to observe gonad development in female shrimp. However, during domestication necrosis and some clinical signs of vibriosis occurred. Microbial isolation from hepatopancreas, intestine, gills and uropod of infected shrimps found *Vibrio* sp. The occurrence of vibriosis seems to affect gonad development in females. Besides, the *Vibrio* sp. attack caused total mortality also.

Key words: *vibrio, vibriosis, mantis shrimp, gonadal development*

INTRODUCTION

The spearer mantis shrimp, *Harpiosquilla raphidea* is a common crustacean living in muddy sediment in many coastal area of Indonesia. In an intertidal mudflat developed in the mouth of Tungkal River of Province Jambi, the shrimp is the main target of commercial fisheries, and mainly caught by small bottom-trawlers and gill net. In living condition the price of mantis shrimp could be around USD 3.5 per individual with 7–9 inch size (Wardiatno and Mashar, 2010). The maximum size of the shrimp is reported to be 335 mm (Manning, 1969; Moosa, 2000).The living shrimp is exported to fulfill the demand from mostly Hong Kong and Taiwan. However, mantis shrimp has actually been accepted in global market. It can be found on a regular basis in fish markets of several countries, such as Spain, Italy, Egypt and Morocco (Abello and Martin, 1993).

The production of the mantis shrimp, *Harpiosquilla raphidea* is solely based on capture fisheries. During the period 2006 - 2008, the production of the shrimp from Kuala Tungkal has been decreasing (Unpublished report 2009 of Fishery Agency of Tanjung Jabung Barat Regency, Province Jambi). Domestication towards mantis shrimp aquaculture would be an alternative to avoid over exploitation and extinction of the shrimp in nature. Effort of the shrimp domestication was conducted in November 2009, but during the domestication vibriosis outbreak occurred and rendered the shrimps died. This paper shows the occurrence of *Vibrio* sp. attack on the domesticated shrimps, and the possible effect of the outbreak on the gonad development of the females is high lighted.

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MATERIAL AND METHODS

Biological material

For domestication, adult *Harpiosquilla raphidea* (body length more than 19 cm) were collected using a gillnet in Kuala Tungkal, Jambi (Fig. 1). The collected mantis shrimps were dry-transported to Laboratory of Aquatic Productivity and Environment, Department of Aquatic Resources Management, Faculty of Fisheries and Marine Science, Bogor Agricultural University (IPB) in oxygenated container.

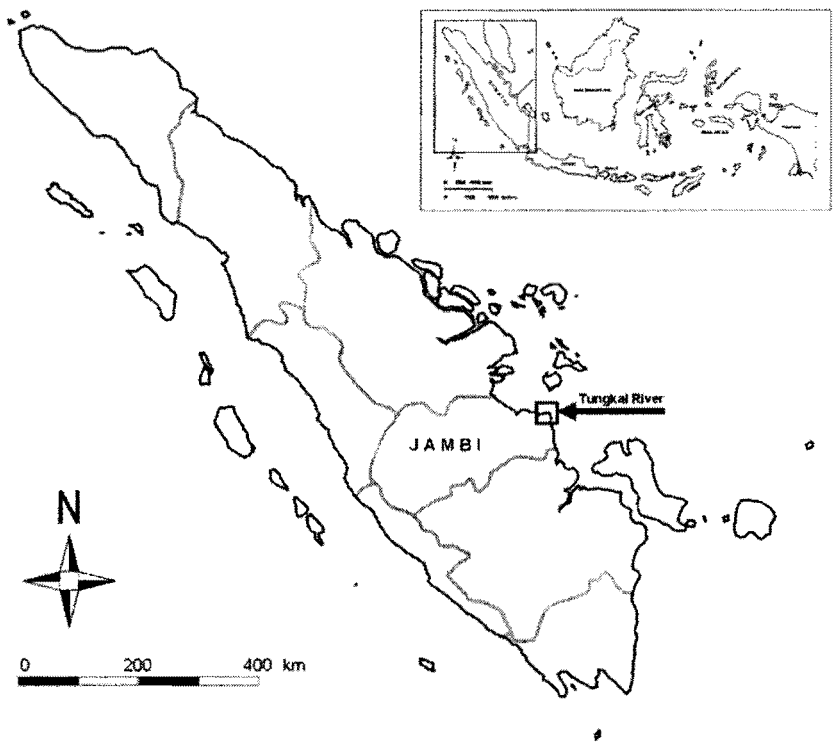

Fig. 1 Location where the shrimp, *Harpiosquilla raphidea* was collected for domestication (Adapted from Wardiatno and Mashar, 2010).

Domestication set

In laboratory, the shrimps were placed into aquaria equipped with 6 (six) artificial burrows made of PVC pipes for three females and three males (Fig. 2). Ten replicates (means 30 females, 30 males) were used in the experiment. All females used were on the stage 1– no gland development and no ventral "stripes" (Wortham-Neal, 2002). Some shrimps immediately entered the artificial burrows, but some took time to use them. During observation the shrimps were fed by peeled penaeid shrimp. Long observation showed that most shrimp treated the pipe like a natural burrow (*i.e.*, stayed in it, returned food to it, and cleaned it of excess food), and no cannibalism occurred if the food was sufficient. Females were monitored every day, and the presence of late-stage cement-gland development and ovaries that fuse in the telson, forming a "triangle" on the ventral surface was recorded (Deecaraman & Subramoniam, 1980, 1983; stage 2 and 3 of gonad development in accordance to Wortham-Neal, 2002).

Fig. 2 Aquarium arrayed in artificial burrows for domestication of *Harpiosquilla raphidea* (Adapted from Wardiatno and Mashar, 2010).

Vibrio isolation

Vibrio isolation was made from the two specimens of infected female shrimps. Isolation processes were done by The Laboratory of Fish Disease in Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Bogor Agricultural University following the method by Cowan (1974).

RESULTS AND DISCUSSION

In this experiment, observation was primarily made to study the gonad development in females. The topic of reproductive biology of mantis shrimp have received increasing amount of attention in these two decades. In their experiments, Hamano and Matsuura (1984) observed the behavior of *Oratosquilla oratoria* when it laid eggs and guarded the mass eggs. The results of their experiment showed that *O. oratoria* never laid their eggs out of the artificial burrow. Christy and Salmon (1991) have reviewed and compared the reproductive behavior of mantis shrimps and fiddler crabs, whilst Wortham-Neal (2002) carried out a study on reproductive morphology and biology of male and female *Squillaempusa*. In this research, females were monitored every day, and the presence of late-stage cement-gland development and ovaries that fuse in the telson, forming a "triangle" on the ventral surface was recorded (Deecaraman and Subramoniam, 1980, 1983; Stage 2 and 3 of gonad development in accordance to Wortham-Neal, 2002).

Since two weeks after being domesticated most of the domesticated shrimps showed necrosis and some clinical signs of vibriosis (Fig. 3), accordingly microbial isolation from hepatopancreas, intestine, gills, and uropod of infected shrimps were made. The clinical signs include red spot in abdomen and pleopods. Necrosis was indicated by white color in parts of the shrimp body. All shrimps died one month after being domesticated in the aquaria. The results of isolation are presented in Table 1.

Table 1 Results of microbial isolation from died female mantis shrimps, *Harpiosquillaraphidea.*

Examined organ	Specimen 1	Specimen 2
Hepatopancreas	*Vibrio* sp.	*Vibrio* sp.
Intestine	*Vibrio* sp.	*Vibrio* sp.
Gills	*Vibrio* sp.	*Vibrio* sp.
Uropod	*Vibrio* sp.	Undetected

As seen in Table 1, microbial isolation indicated that *Vibrio* sp. was the cause of necrosis, vibriosis clinical signs and the mortality in the domesticated shrimps. From aquaculture aspect, vibriosis has been known as one of the major disease problems in shellfish and finfish aquaculture. The most common worldwide problem of vibriosis bacterial disease occurred in penaeid shrimp aquaculture, and it caused mass mortality (Lightner and Lewis, 1975; Adams, 1991; Lightner*et al.*, 1992; Lavilla-Pitogo*et al.*, 1996; Lavilla-Pitogo*et al.*, 1998; Moriarty, 1999; Chen *et al.*, 2000; Hettiarachchi*et al.*, 2005; Adeleye*et al.*, 2010).

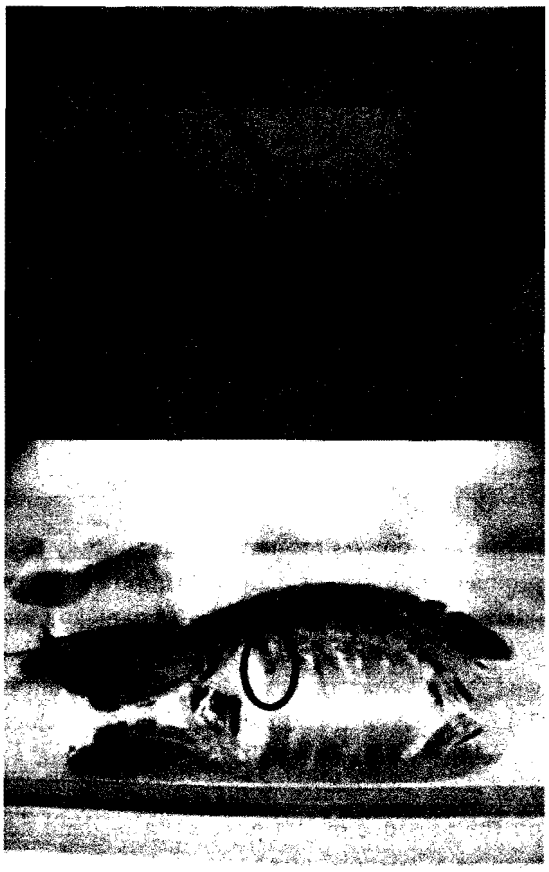

Fig. 3 Necrosis and some clinical signs indicating vibriosis during domestication of the mantis shrimp, *Harpiosquilla raphidea* (a: red spot in the abdomen, b: necrosis,c: reddening pleopod)

Vibrio sp. is one member of gram-negative bacteria from the family Vibrionaceae. Sizemor and Davis (1985) said that outbreaks following by mass mortality may occur when environmental factors spark off fast duplication of bacteria already tolerated at low levels within shrimp blood. In addition, the outbreak may also occur by bacterial infiltration to host obstruction. Actually, shrimps have exoskeleton functioning as an effective physical barrier to pathogens trying to penetrate the external surface, foregut and hindgut. However, *Vibrio* spp.

have been proven to be among the chitinoclastic bacteria correlated with shell disease (Cook and Lofton, 1973; Baticados, 1986; Sindermann, 1989; Cobb and Castro, 2006) and may infiltrate impair exoskeleton or pores (Jiravanichpaisal and Miyazaki, 1994; Alday-Sanz*et al.*, 2002; Cobb and Castro, 2006). Although there is biological cleaning mechanisms in crustacean gills by the setobranch (Bauer, 1979, 1998; Suzuki danMcLay, 1998; Batang and Suzuki, 1999), even so it is not good enough to protect from bacterial atack (Taylor and Taylor, 1992), in view of the fact that the gills are protected only by a thin exoskeleton. In terms of immunity, by comparing with finfish and other vertebrates, the biological defense mechanism of crustaceans is less developed. In particular crustaceans do not have adaptive memory, and neither ability of producing immunoglobulins; thus, they apparently depend merely on instinctive defense systems (Roch, 1999).

Many research in penaeid shrimp show that when the shrimp are stressed due to bad environmental condition (*i.e.* high densities culture, bad water quality and low water exchange) and the outbreaks of vibriosis occur, it will be followed by the mass mortality, both in hatcheries and shrimp rearing ponds (Lewis, 1973; Lightner and Lewis, 1975; Brock and Lightner, 1990; Anderson *et al.*, 1998; Saulnier*et al.*, 2000). In their experiment, Lavilla-Pitogo*et al.* (1990) showed that *Penaeusmonodon* larvae died after 48 hr exposure to *Vibrio harveyi* and *V. splendidus.* Adult *P. monodon* distressing from vibriosis may look as if hypoxic, show reddening of the body with red to brown gills, loosing appetite and may be showed lazy swimming behavior at the edges and surface of ponds (Anderson *et al.*, 1988; Nash *et al.*, 1992). In addition, *Vibrio* spp. also behind the factor of the occurrence of red-leg disease, indicated by red coloration of the pleopods, periopods and gills, both in juvenile as well as in adult shrimps. In his study, Chen (1992) found another effect of vibriosis in penaeid shrimp is eyeball necrosis diseases causing by *V. cholera.* The eyeballs of diseased shrimps turn their color into brown and fade out, and followed by death in a very short time.

The outbreak of vibriosis in the mantis shrimp, *Squilla* sp. has been reported by Musa and Wei (2008). They collected the mantis shrimp from the nature to hatchery. After a week in the hatchery, some clinical signs of vibriosis occurred. All mantis shrimp became lethargic and reduce food intake. Hideously mantis shrimp showed black and circular wounds on the carapace and abdomen whereas melanization was found on the telson and uropod. Their eyes also became black.

In this study, vibriosis seems to affect the gonad development in females *Harpiosquilla raphidea.* The laboratory observation showed that only six of thirty of non-reproductive females *H. raphidea* collected from the field could develop their gonad only until the stage 2 within two weeks; and only one became an ovigerous female, but it died before the eggs hatched (Fig. 4). This finding is different with Hamano and Matsuura (1984) who did the similar experiment with mantis shrimp, *Oratosquillaoratoria.* They found the mantis shrimp spawned a week after collection from the field.

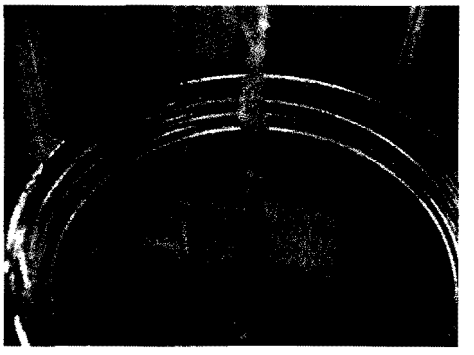

Fig. 4 The eggs of died single ovigerous female *Harpiosquilla raphidea.*

CONCLUSION

From this research it may be concluded that vibriosis causing by *Vibrio* sp. attack, firstly, might put off the development of gonad in female *Harpiosquilla raphidea*. When it is getting worst, it would cause the death of the shrimps, both female and male.

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