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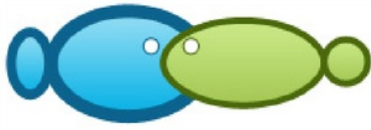
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Immunomodulatory and antibacterial effects of *Boesenbergia pandurata*, *Solanum ferox*, and *Zingiber zerumbet* on tilapia, *Oreochromis niloticus*

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Abstract. The aims of the study were to evaluate the potency of antibacterial and immunostimulant effects of some herbs extract, that is, *Boesenbergia pandurata*, *Solanum ferox*, and *Zingiber zerumbet* from East Kalimantan on tilapia *Oreochromis niloticus* infected by *Aeromonas hydrophila* and *Pseudomonas* sp. The focus of this study was to determine the most effective dosage and method of administration to prevent the bacterial infection by in vivo test. Thirty tilapias with the average weight of 15 g were used in this experiment. The tested dosages extracts were 600 ppm *B. pandurata*, 900 ppm *S. ferox*, and 200 ppm *Z. zerumbet*. Meanwhile, three administration methods were applied, that is, injection method, feeding and bath immersion. The results showed that the extract of *B. pandurata*, *S. ferox*, and *Z. zerumbet* can be used as an antibacterial and immunostimulant compound in tilapia. The *B. pandurata* and *Z. zerumbet* extracts effectively were used to prevent *A. hydrophila* infection using the feed method while *S. ferox* extract effectively prevented *Pseudomonas* sp. infection by bath immersion.

Key Words: antibacterial, immunostimulant, *Oreochromis niloticus*, herb plant.

Introduction. The organic compound from plants extract has been commonly used as an antibacterial and immunostimulant to control fish diseases (Cuesta et al 2004; Findlay & Munday 2000; Ratnawati et al 2013; Karina et al 2015; Hardi et al 2016a; Karina et al 2016). In the recent decade, there has been increasing interest in the modulation of the nonspecific immune system of fish using plant extracts or organic matters (Alambra et al 2012; Elkamel & Mosaad 2012; Harikrishnan et al 2011; Menanteau-Ledouble et al 2015; Misra et al 2006; Zokaeifar et al 2012; Satyantini et al 2014). Several studies showed that *Boesenbergia pandurata*, *Zingiber zerumbet* and *Solanum ferox* have the ability to suppress the *Aeromonas hydrophila* and *Pseudomonas* sp. bacteria growth (Hardi et al 2016a; Hardi et al 2016b) and methanol extract.

According to Siwichi et al (1994) some materials such as β -glucan, lipopolysaccharide, levamisole, chitin, fungi, yeast, mannose, peptidoglycan, microsporidian, and seaweed can be used as immunostimulant in fish culture. Furthermore, Galindo-Villegas & Hosokawa (2004) have evaluated several immunostimulant compounds from animals and plant extract for fish, for example, Tunicate, Abalone, *Quillaja saponaria*, glycyrrhizin, *Laminaria* (seaweed), a ³bacteria substance; there are peptidoglycan, β -glucan, lipopolysaccharide (LPS), *Clostridium butyricum* cells, *Achromobacter stenohalis* cells, and *Vibrio anguillarum* cells. Based on Hardi et al (2016c) and Hardi & Saptiani (2015) protein fractions of the extracellular product of *Pseudomonas* sp. bacteria were found to be the most effective to inhibit *Aeromonas hydrophila* growth.

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