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In vitro selection of a synbiotic and *in vivo* evaluation on intestinal microbiota, performance and physiological response of rainbow trout (*Oncorhynchus mykiss*) fingerlings

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Abstract

The aim of this study was to determine the best synbiotic combination (based on growth and short chain fatty acids production) between *Pediococcus acidilactici* and five prebiotics *in vitro*, inulin, fructooligosaccharide (FOS), xylooligosaccharide (XOS), galactooligosaccharide (GOS), isomaltooligosaccharide (IMO). The best *in vitro* growth under aerobic and anaerobic culture condition was observed in the treatment, *P. acidilactici* + GOS. Furthermore, the study of short chain fatty acids (SCFA) production at the end of exponential growth phase revealed that the major SCFA produced was propionic acid in all synbiotic treatments except for the *P. acidilactici* + GOS treatment where butyric acid production was significantly higher compared with the other treatments. Based on the results of *in vitro* studies, *P. acidilactici* + GOS that were selected as synbiotic and rainbow trout fingerlings (15.04 ± 0.52 g) were fed on diet supplemented with the selected synbiotic. After 8 weeks of feeding, growth performance, intestinal microbiota and physiological responses were evaluated. Growth performance was significantly improved by synbiotic feeding. No significant differences of haematological parameters were revealed between the different treatments. Level of presumptive autochthonous lactic acid bacteria was elevated, while total autochthonous bacterial level remained unaffected. These results showed that *P. acidilactici* + GOS can be considered as an efficient synbiotic for rainbow trout.

KEY WORDS: fermentation, growth performance, prebiotic, rainbow trout, short chain fatty acid, synbiotic

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Introduction

The gut microbiota of fish plays an important role in the health and performance of fish (Ringø & Gatesoupe 1998; Merrifield *et al.* 2010; Nayak 2010; Pérez *et al.* 2010; Vadstein *et al.* 2013; Llewellyn *et al.* 2014). The fish gut microbiota is a complex and dynamic ecosystem containing a large amount of microorganism and it has been reported that genetic, nutritional and environmental factors modulate the gut microbiota (Pérez *et al.* 2010). To date, modulation of gut microbiota of fish toward beneficial communities [e.g. lactic acid bacteria (LAB)] has been studied in numerous studies (e.g. Lauzon & Ringø 2011; Merrifield *et al.* 2014; Ringø *et al.* 2014b) and it has been confirmed that administration of microbial dietary supplements like probiotics, prebiotics and synbiotics is a common tool for modulation of fish gut microbiota (Gatesoupe 1999; Merrifield *et al.* 2010; Ringø *et al.* 2010, 2014b; Dimitroglou *et al.* 2011; Daniels & Hoseinifar 2014; Newaj-Fyzul & Austin 2014). Several definitions of probiotics used in aquaculture have been proposed; Gram & Ringø (2005) defined probiotics as '*live microbial cultured added to feed or environment (water) to increase viability (survival) of the host*'. As dietary administrations of probiotics to aquatic animals have shown promising results, there has been a