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Distribution and prevalence of chloramphenicol-resistance gene in *Escherichia coli* isolated from aquaculture and other environment

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Abstract

In Malaysia, the aquaculture industry, particularly the production of freshwater aquaculture fish, is growing rapidly. Nevertheless, the illegal use of banned antimicrobial agents such as chloramphenicol in aquaculture has become a major concern in relation to the safety of consumers and also the development of drug-resistant strains in bacteria. Driven by those factors, the main intention of this study was to determine the prevalence and types of chloramphenicol-resistance genes in *E. coli* isolated from aquaculture and other environmental waters. The respective chloramphenicol-resistance genes in the isolates were detected by multiplex PCR with four sense primers C-1, C-2, C-3, C-4 and one antisense primer C-R for targeting cat I, cat II, cat III and cat IV genes, respectively. Out of 27 *E. coli* isolated, 19 were resistant to chloramphenicol. *Cat* I, *cat* II, *cat* III and *cat* IV genes were detected in 19, 13, 10, and 6 of the *E. coli* isolates, respectively. The results of this study revealed that chloramphenicol-resistance *E. coli* is present in aquaculture and environmental waters, in the study area. This finding suggested that although banned, there could be illegal usage of chloramphenicol antibiotic in local aquaculture. The bacteria in aquaculture may have spread to other environmental water through disposal of aquaculture waste water to other environments.

Introduction

Chloramphenicol is a broad spectrum antibiotic that is effective against both gram-positive and gram-negative bacteria (Sorensen *et al*., 2003). It is commonly used in several fields, especially in the medical field for therapeutic purposes. Chloramphenicol is inexpensive to produce, and it is usually utilize widely in the Third World for the treatment of a variety of gram-negative pathogens, such as *Salmonella*, *Vibrio* and *Rickettsia* (Davies and Webb, 1998). However, chloramphenicol has decreased rapidly as the drug of choice due to the chronic toxicity, in other words, depression of bone marrow function causing blood disorders such as aplastic anemia (Davies and Webb, 1998).

Apart from medical field, chloramphenicol is also used in aquaculture, in which chloramphenicol is used either as a chemotherapeutic agent to control diseases, or as a disinfectant to prevent diseases (Lu *et al.*, 2009). Chloramphenicol can be spread directly to the environment by filtering from uneaten feeds or from the waste products of aquatic animals (Cravedi *et al.*, 1987; Ervik *et al.*, 1994). A selective pressure in favour of antimicrobial-resistant bacteria could be established when antimicrobial residues are exposed to the environment (Lu *et al.*, 2009). The bacteria in environmental water could possibly develop antimicrobial-resistant due to the used of antimicrobial, such as chloramphenicol in aquaculture to control or to prevent diseases.

As an important antibiotic in the treatment of central nervous system infections and some epidemic diseases in humans and none food producing animals (Chinabut *et al.*, 2005), chloramphenicol has become one of the banned antibiotics in animal production in a number of Asian countries (Huys *et al*., 2007). Although it has been banned in the aquaculture producing countries of Asia and South East Asia (SEA), there is still reported case for the rejection of Asian aquaculture products by the European Union (EU) due to the detection of chloramphenicol residues in the importation of some Asian aquaculture products (Chinabut *et al*., 2005).

In fact, any presence of antibiotics in aquaculture products signifies their use on the farm, which may result in the development of antibiotic resistance and dissemination in the aquatic environment (Chinabut *et al*., 2005). Besides, the rising of the resistance in the farmed species may further cease the therapeutic value of the antibiotic to the farmer, whether it is used legally or illegally (Chinabut *et al*., 2005). Therefore, this study was undertaken to determine the prevalence and distribution of chloramphenicol resistance and the *cat* genes among *E. coli* from the aquaculture and other environmental waters.

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