Prevalence, antibiotic resistance and plasmid profiling of *Salmonella* in catfish (*Clarias gariepinus*) and tilapia (*Tilapia mossambica*) obtained from wet markets and ponds in Malaysia

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**A B S T R A C T**

The objectives of the study were to determine the prevalence, antibiotic resistance and occurrence of plasmids in *Salmonella* isolated from catfish (*Clarias gariepinus*) and tilapia (*Tilapia mossambica*) obtained from wet markets and ponds in Malaysia. A total of 172 samples (32 catfish carcass rinse, 32 catfish intestines, 32 tilapia carcass rinse, 32 tilapia intestines, and 44 water samples) were obtained from nine wet markets and eight ponds that were fed chicken offals, spoiled eggs, and commercial fish feed from 2008 to 2009. Seven Salmonella serovars were isolated from 9/32 catfish (28.1%), 14/32 tilapia (43.8%), and 11/44 (25%) water samples. These include S. Albany, S. Agona, S. Corvallis, S. Stanley, S. Typhimurium, S. Mikawashima and S. Bovis-mobilinc. *Salmonella* isolates were resistant to chloramphenicol (C, 37.2%), clindamycin (Da, 100%), rifampicin (Rd, 90.7%), spectinomycin (Sh, 27.9%), and tetracycline (Te, 67.4%). The multiple antibiotic resistance index of *Salmonella* isolates ranged from 0.32 to 0.45 for catfish; 0.14 to 0.36 for tilapia; and 0.27 to 0.36 for water. The predominant antimicrobial resistance profiles of *Salmonella* serovars from catfish, tilapia and water were CDARdTe (4/13), DARDSh (4/19), and DaRdTe (6/11), respectively. The plasmids of *Salmonella* serovars isolated from catfish ranged from 23 to 80 kb; those for tilapia ranged from 6 to 90 kb; that for water ranged from 6 to 70 kb, respectively. The presence of plasmids represents a potential health hazard since plasmids can mediate the transfer of antibiotic resistance genes to other bacteria present in the fish, and aquaculture environment, which can also enter the food chain.

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1. **Introduction**

Freshwater fish culture in Malaysia contributes 155,398.6 t valued at RM 760.3 million, representing 26.7% of the total production and constituted 27.2% of the overall aquaculture subsector (Department of Fisheries Malaysia, 2010). In Malaysia, freshwater fish is cultured using pond culture, ex-mining pool, freshwater cage, cement tank, and freshwater pen culture systems. The highest total freshwater fish production (59.7%) has been reared in the pond culture system and the types of fish reared in this system are freshwater catfish (64.9%) and tilapia (18.2%) (Department of Fisheries Malaysia, 2010).

In the Asia–Pacific region, cultured fishes are fed by both commercial and homemade feeds (fresh feed material or farm feed material). According to FAO, homemade feeds are used to reduce cost of production (FAO, 2010a; New and Csavas, 1995). Homemade feed is usually made from chicken viscera, kitchen refuse, chicken bone, and other food waste materials (New and Csavas, 1995). Such feeds can be a source of pathogenic bacteria such as *Salmonella* spp. (Burr and Helmboldt, 1962; Lunestad et al., 2007) which can be transmitted to catfish and tilapia and ultimately to consumers.

*Salmonella* spp. are Gram-negative, rod-shape bacteria that cause salmonellosis. In humans, these pathogenic bacteria caused enteric fever (only if it is Typhi or Paratyphi) and acute gastroenteritis (Hohmann, 2001). The symptoms include mild to severe gastroenteritis, with an incubation period of 6–72 h (Hohmann, 2001). Outbreaks of salmonellosis due to fish consumption have been reported in several countries. For example, salmonellosis caused by smoked eel consumption, which was linked to fish farms in Italy has been reported in Germany (Fell et al., 2000). The U.S. Food and Drug Administration (US-FDA) has also linked the presence of *Salmonella* spp. in a variety of fishes and shellfishes (Brands et al., 2005; Duran and Marshall, 2005; Heinitz et al., 2000). Various hazards associated with cultured fish naturally originated from the environment or from human or animal activities. Fishes can serve as a vehicle of *Salmonella* transmission, which can be pathogenic to humans and have a high potential to transmit its antibiotic