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Bacterial diversity of tilapia (*Oreochromis niloticus*) cultured in brackish water in Saudi Arabia

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Abstract

The bacterial flora occurring in brackish pond water, sediment, gills and intestine of healthy tilapia cultured in Saudi Arabia were estimated both quantitatively and qualitatively, and the isolates were identified to genus or species level. Total viable count of bacteria ranged from $1.4\pm1.5\times10^3$ to $8.6\pm2.7\times10^3$ cfu ml^{-1}; $1.2\pm3.1\times10^6$ to $7.3\pm1.1\times10^7$ cfu g^{-1}; $8.7\pm1.9\times10^5$ to $2.1\pm0.9\times10^6$ cfu g^{-1}; and $2.8\pm2.4\times10^7$ to $1.0\pm1.6\times10^8$ cfu g^{-1} in the pond water, sediment, gills and intestine of brackish water tilapia, respectively. In total, 19 bacterial species were identified. The bacteria were predominantly Gram-negative rods (87%). Pond water and sediment bacteria influenced the bacterial composition of gills and intestine of tilapia. In contrast to gill bacteria, more diversification was observed in intestinal bacteria. The predominant (prevalence >10%) bacterial species were *Vibrio parahaemolyticus, Vibrio carchariae, Vibrio alginolyticus, Chryseomonas* sp., *Vibrio vulnificus*, and *Streptococcus* sp. in all the populations with the exception of the sediment population where *Streptococcus* sp. was replaced by *Shewanella putrefaciens*. *Vibrio* spp. (58% of the total isolates) dominated the total bacterial population.

Keywords: Bacterial flora; Tilapia; Brackish water pond; Saudi Arabia

1. Introduction

In a world where wild capture fisheries are becoming increasingly depleted, tilapia offer the possibility of commercial and home-grown protein sources because of their superior culture facilities. World tilapia aquaculture production doubled between 1986 and 1992, and followed Chinese carps and salmonids in total farm production (FAO, 1994). The more common species in brackish water ponds are mullets, tilapia and catfish, although the detailed economic viability of brackish water pond tilapia culture has yet to be determined. The omnivorous, fast growing tasty tilapia appear to be well equipped to survive in brackish water along the Gulf Coast (Peterson, 2002). Tilapia can tolerate, grow and even reproduce in saline waters, although this capacity is somewhat offset under high salinity conditions. A

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range of 10–20 ppt is optimal for growth (Suresh and Kwei Lin, 1992), although some tilapia strains can be grown well has in brackish water (Romana-Eguia and Eguia, 1999). In Saudi Arabia, tilapia culture has increased in fresh water, particularly because of its fast growth and the fact that it can be easily produced in many confined water bodies throughout the country. However, in brackish water bodies tilapia are not cultured commercially though they are available in such water. Since modern aquacultural practices are quite new in Saudi Arabia, basic information on the bacterial populations and types associated with cultured fish species are scarce. Nevertheless, this data is required for the development of preventive measures to safeguard against infectious agents which could cause disease and financial losses. Aquatic microorganisms not only influence the water quality but are also known to be closely associated with the physiological status of the fish, disease and post-harvest quality. Almost no information is available in Saudi Arabia on the bacteriology of brackish water bodies though aquatic animals take a large number of bacteria into their gut and gills from water, sediment and food. The intestinal microflora may be involved in the spread of fecal contaminants (Al-Harbi, 2003). Bowen (1976) reported the contribution of bacteria to the diet of fishes. Syvokienë and Mickënienë (1998) established that in the brackish water environment viable counts of the bacteria were many times lower than those in the digestive system of fish indicating that the digestive tract provides favourable ecological niches for these organisms. Fish with abundant and diverse microflora have considerable opportunities to adapt to changing nutritional substrates and to assimilate food better, and thus enhance their adaptive possibilities.

Although tilapias are relatively resistant to diseases compared to most other cultured fin fishes, many of pathogenic organisms still can plague them. A number of *Vibrio* species are also food poisoning bacteria which are normal habitants in estuarine and marine environments (Farmer and Hickman Brenner, 1992). By monitoring the bacterial contents of fish organs, the quality of fish can be measured since these will affect the storage life and quality of the fishery products (Kaneko, 1971). In order to provide a predictive capability for possible disease outbreaks and provide an opportunity to design preventative management actions, detailed information of the bacterial load and types of bacteria in the internal organs of apparently healthy fish is needed. An attempt is made in this paper to investigate the occurrence of bacterial populations quantitatively and qualitatively which are present in brackish pond water, sediment, tilapia gills and intestine.

2. Materials and methods

2.1. Experimental pond conditions

This study was conducted in three artificial ponds at a fish culture station located in the Al-Qassim region of Saudi Arabia. These ponds were constructed in 1995 and are completely dependent upon the supply of Reverse Osmosis Plant wastewater as a water source throughout the year. Limited vegetation exists in the shallow shore areas and there is between 6 and 8 cm of mud on the bottom. Water was added in the ponds to compensate for the loss from evaporation and seepage. Originally tilapia were received from the Al-Qassim fish culture project and held in these ponds for 1 year. No feed but fertilizers were used in the ponds. The area of each pond was 3600 m^2 with an average depth of 1.3 m.

2.2. Physicochemical characteristics

Surface water temperatures, dissolved oxygen (DO), pH and total dissolved solids (TDS) of the ponds were measured using a Universal Pocket Meter Multiline P4 (WTW, Weilheim, Germany). Salinity was determined with a refractometer (A366ATC, Japan). NO_2–N and hardness were recorded using a HACH DR/2000 analysis unit (HACH, Ames, USA). All determinations were done every 2 week interval between 0800 and 0900 h.

2.3. Bacteriological sampling and analysis

Samplings were done three times at 2 week intervals for microbiological investigations of brackish pond water, sediment, gills and intestine of tilapia