



## Antibiotic Resistance in Pathogenic Bacteria, the Causative Agents of Bacterial Diseases in Farmed Rainbow Trout (*Onchorhynchus mykiss*) in Iran

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### Abstract

**BACKGROUND:** Infectious diseases and microbial antibiotic resistance are the major problems of fish farming industry annually causing remarkable losses. Apart from the economic losses caused by these infections, some of these agents are zoonotic and may be transmitted to humans.

**OBJECTIVES:** This study was aimed to identify the common causative agents of infections in rainbow trout farms and to determine their antibiotic resistance toward some common antibiotics.

**METHODS:** Sampling was performed during a nine-month period between March and December 2021 by visiting and inspecting rainbow trout farms and the affected fish with disease symptoms were obtained from the farmed fish in Mazandaran, Lorestan, Chaharmahal and Bakhtiari and Zanjan provinces. Bacterial culture was undertaken from anterior kidney or spleen organs and the isolated bacterial strains were identified by phenotyping, biochemical and molecular assays. Antibiotic resistance pattern was evaluated by disk diffusion method (DDM) and minimum inhibition concentration against erythromycin, oxytetracycline, florfenicol, enrofloxacin and nitrofurantoin.

**RESULTS:** Seventy-four bacterial isolates of Gram-positive cocci or Gram-negative coccobacilli were isolated. In phenotyping, biochemical and molecular (PCR) assays *Lactococcus garvieae* (12 isolates, 16.2 %), *Aeromonas hydrophila* (9 isolates, 12.2 %), *Streptococcus iniae* (17 isolates, 23 %), *Streptococcus agalactiae* (20 isolates, 27 %), and *Yersinia ruckeri* (16 isolates, 21.7 %) were identified. The majority of these isolates were obtained from the fish farms in Mazandaran province. Erythromycin and oxytetracycline with 87.8 % resistance were antibiotics with the highest resistance, while enrofloxacin with 24.3 % resistance revealed the lowest level of resistance. Antibiotic resistance rates for florfenicol and nitrofurantoin were also 43.2 % and 44.4 %, respectively. The highest antibiotic resistance was detected in the bacterial isolates of *Lactococcus garvieae*, *Aeromonas hydrophila*, *Streptococcus iniae*, *Streptococcus agalactiae* and *Yersinia ruckeri*, respectively.

**CONCLUSIONS:** This study shows that the spread of streptococcosis, lactococcosis, yersiniosis and *Aeromonas* septicemia and their frequent treatments has led to an increase in antibiotic resistance, especially against commonly used drugs such as erythromycin and oxytetracycline.

**Keywords:** Aeromonas, Lactococcosis, Streptococcosis, Trout, Yersiniosis

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### Figure Legends and Table Captions

Table 1. Primers used for PCR assay.

Table 2. Phenotypic and biochemical characteristics for diagnosis of isolated bacteria from diseased fish.

Table 3. Geographical distribution of bacterial species isolated in the present study.

Table 4. Number and percentage of isolated bacteria from the provinces in the present study.

Table 5. Antibiotic resistance of isolated bacteria using disk diffusion assay.

Table 6. The minimum inhibitory concentration of the isolated bacteria.

Table 7. Antibiotic resistance of the isolated bacteria based on the minimum inhibitory concentration.

Figure 1. Electrophoresis image of *Streptococcus agalactiae*, *Yersinia ruckeri*, and *Aeromonas hydrophila*.

Figure 2. Electrophoresis image of *Streptococcus iniae*.

Figure 3. Electrophoresis image of *Lactococcus garvieae*.