ABSTRACT

Fish is an important source of nutrition in many people's diets around the world. Fish and fish products are regularly consumed by people of various ethnicities in North Bengal. The current study examines the various types of fish consumed in North Bengal. During the survey, three types of locally prepared fish products were documented: *Loah ko Dalla*, *Sidol*, and *Jhinghe Maacha*. Among the three fish products, *Loah ko Dalla* was primarily consumed in parts of the Darjeeling and Kalimpong districts of North Bengal, particularly in villages along the river Rangeet, Balasan and Relli. Only the Rajbanshi tribes of North Bengal plains were found to consume the product *Sidol*. *Jhinghe Maacha*, on the other hand, was a popular fish product consumed widely throughout North Bengal. The fish products *Loah ko Dalla* and *Sidol* were rarely sold in the open market and were only produced for domestic consumption, whereas *Jhinghe Maacha* was readily available in all of North Bengal's fish markets.

Four *Loah ko Dalla* sample batches, three *Sidol* sample batches, and four *Jhinghe Maacha* sample batches were collected from various parts of North Bengal. A total of 219 isolates of microorganisms were isolated from the eleven samples. All of the samples collected were found to have a 100% prevalence of LAB (Lactic acid Bacteria). All of the fish products had a microbial load of LAB ranging from 10^3 to 10^5 cfu/g. From the 148 LAB strains isolated from all of the fish products, 113 were cocci and were identified as *Lactococcus plantarum*, *Leuconostoc mesenteroides*, *Pediococcus pentosaceus*, *Enterococcus faecium*, and *Enterococcus faecalis*, while the remaining 35 were non-spore forming rods and were identified as *Lactobacillus fructosus* and *Lactobacillus plantarum*.

A total of 62 spore former strains were isolated from the 11 samples of fish products collected, out of which 42 strains were endospore forming rods and 20 strains were aerobic cocci. The prevalence of endospore forming rods in all the fish samples were 91% and aerobic cocci 64%.

The microbial load of the spore formers was found to be < 10^3 cfu/gm with values ranging from 10^1 to 10^4 cfu/g. The isolated strains of endospore forming rods were identified as *Bacillus subtilis* and *Bacillus pumilus*. The isolated 20 strains of aerobic cocci were all identified as *Micrococcus sp*. The *Micrococcus* had a prevalence of 64% in all the samples analysed. The microbial load of yeast in all the samples were found to be <1 cfu/g and no mould could be ascertained from all the products analysed. All 9 strains of yeast were isolated from only *Loah ko Dalla* and were identified as *Candida sp*. The prevalence of the yeast in all the samples was found to be 27%. The total viable count of the 11 samples was found between 10^3 to 10^5 cfu/g.

The major food pathogens *Bacillus cereus*, *Staphylococcus aureus* and Enterobacteriaceae were isolated from all the fish products. *Bacillus cereus* has a prevalence of 73% in all the fish products analysed with microbial load ranging between 10^2 to 10^3 cfu/g. *Staphylococcus aureus* was also isolated from all the fish samples with a prevalence of 64% and microbial load ranging between 10^2 to 10^3 cfu/g. Enterobacteriaceae was also isolated from all the fish samples with a prevalence of 82% and microbial load of 10^3 cfu/g in all the fish samples.

The proximate analysis of all the fish samples revealed the pH of 6 to7 in all the samples with no detectable acidity. *Sidol* had the highest moisture content of 50%, and *Jhinghe maacha* had the highest ash content of 82.44 %. The protein content was highest in *Jhinghe Maacha* and lowest in *Loah ko Dalla* with 54.55% and 9.27% respectively. The fat content was highest with 50% in *Loah ko Dalla* and lowest in *Sidol* with 21.75%.

All fish samples were tested for mineral content, specifically calcium, iron, magnesium, manganese, and zinc. The calcium content in *Loah ko dalla, Sidol,* and *Jhinghe maacha* was 38.42 mg/1000g, 50.24 mg/1000g, and 129.65 mg/1000g, respectively. The iron content in *Loah ko dalla, Sidol,* and *Jhinghe maacha* was 56.51 mg/1000g, 41.28 mg/1000g, and 35.50 mg/1000g, respectively. The magnesium content in *Loah ko dalla, Sidol,* and *Jhinghe maacha*

was 77.25 mg/1000g, 129.63 mg/1000g, and 137.95 mg/1000g, respectively. Manganese content in *Loah ko dalla* was 2.41 mg/1000g, *Sidol* 3.99 mg/1000g, and *Jhinghe maacha* 1.2 mg/1000g. The zinc content in *Loah ko dalla* was 4.13 mg/1000g, *Sidol* 8.25 mg/1000g, and *Jhinghe Maacha* 3.60 mg/1000g.

The findings of the research indicate the presence of LAB, spore formers, and yeast in all of the fish products. Although none of the pathogens exceeded the hazard limit, the presence of pathogenic bacteria *Bacillus cereus*, *Staphylococcus aureus*, and Enterobacteriaceae in the entire fish sample indicates poor handling and preservation practices. The research finding also indicates the fish products contain substantial amount of food value in terms of protein, fat and nutrient content.