

INTRODUCTION

Fish is extremely perishable proteinaceous food that spoils rapidly (Barile *et al.*, 1985). Traditional processing of fish such as fermentation, salting, drying and smoking are the principal methods of fish preservation without refrigeration in South-East Asia (Cooke *et al.*, 1993). Traditional fermented fish products are of two major types: fish-salt formulation, e.g. fish sauce/paste, and fish-salt-carbohydrate mixture eg. pla-ra in Thailand and burong-isda in the Philippines (Adams, 1998; Adams *et al.*, 1985). Fermented fish products contribute significantly to the diet by increasing protein intake to a larger population of the world (Beddows, 1984).

In Asia, traditionally processed fish products which are prepared by fermentation, drying, salting in vast quantities for human consumption for long centuries (Hesseltine, 1979; Steinkraus, 1983; Campbell-Platt, 1987). Fish fermentation technology is home-based traditional technique where varieties of fermented fish products mostly fish-sauce are prepared and used as staple foods, side-dishes and condiments in Asia (Lee *et al.*, 1993). Some of these traditional fish products include patis of the Philippines (Arroyo *et al.*, 1978; Sakai *et al.*, 1983a,b), nam-pla and plaa-raa of Thailand (Phithakpol, 1993), shottsuru and shiokara of Japan (Itoh *et al.*, 1993), jeot of Korea (Lee, 1993; Mheen, 1993), pindang of Indonesia (Putro, 1993), budu of Malaysia (Merican, 1977) and nga-pi of Myanmar (Tyn, 1993).

Microorganisms bring about some biochemical changes in the substrates during fermentation such as enrichment of human diet with acceptable flavour, texture and aroma, biopreservation of perishable foods, bioenrichment of substrates with vitamins, protein and essential amino acids, and detoxification of undesirable components (Campbell-Platt, 1994;

Steinkraus; 1994; Stiles and Holzapfel, 1997). Bacteria, mostly lactic acid bacteria, yeasts and filamentous fungi constitute the microflora associated with the traditional fermented foods which are present in or on the ingredients, utensils, environment, and are selected through adaptation to the substrate (Hesseltine, 1983; Tamang, 1998). Interest in using biological system for preserving foods is increasing and has been mainly directed at lactic acid bacteria (Jeppesen and Huss, 1993). Variety of indigenous fermented foods including fermented leafy vegetable, fermented soybeans, fermented milk products, as well as alcoholic beverages are prepared and consumed by different ethnic groups of people living in the Eastern Himalayan regions and its adjoining North-Eastern hills (Tamang *et al.*, 1988; Tamang, 2001).

The Teesta and Rangit river system alongwith their tributaries in Sikkim and the Darjeeling hills exhibit wide range of gradients from sub-tropical to alpine zone. Altogether 44 species of fish have been reported from the Sikkim river system (Tamang, 1992). The river system in Assam and Arunachal Pradesh consists of the River Brahmaputra and its tributaries where 126 species of fish belonging to 26 families are reported (Motwani *et al.*, 1962; Jhingran, 1977). Logtake lake in Manipur which provides the main fishery resources in the state has varieties of ichthyofauna mostly dominated by species of *Puntius*, *Channa*, *Anabas*, etc. (Chaudhuri and Banerjea, 1965).

Seafood is uncommon to the Eastern Himalayan regions. The people of these regions catch the available fishes from the various sources mainly from hill rivers, streams and lakes, and majority of fish is consumed as

fresh. Some of these fishes are preserved or processed using indigenous knowledge of fermentation/drying/smoking for consumption. Preparation of traditional foods has been mainly influenced by the agro-climatic conditions, ethnic preference, socio-economy and cultural ethos in the Eastern Himalayas. Modern methods of preservation are still uncommon to majority of people, traditional way of preservation of locally available fish by fermentation, smoking, drying is the common practice.

Traditionally processed lesser-known fish products are consumed by different ethnic groups of people living in the Eastern Himalayan regions including Eastern Nepal; the Darjeeling hills, Sikkim, Assam, Meghalaya and Manipur in India, and Bhutan. Literature on traditionally processed fish products for human consumption in the Eastern Himalayas is lacking. Documentation on production statistics of common and lesser-known traditional fish products of the Eastern Himalayas, and information on microbiology and safety are not available. The proposed dissertation is aimed to study in depth the microbial diversity associated with some traditionally processed fish products, their identity and characteristic properties of few selected strains such as antimicrobial activity, enzymatic activity, ability to produce biogenic amines and hydrophobicity. Study of microbial diversity in the lesser-known fish products of the Eastern Himalayas, may contribute a significant unknown microbial gene pool, which should be preserved.

OBJECTIVES

- ❖ Documentation of types of fish products (fermented, smoked, dried), indigenous knowledge of preparation and preservation of locally available fish, and consumption pattern.
- ❖ Collection of fish products from different regions of the Eastern Himalayas.
- ❖ Isolation, enrichment and purification of microorganisms.
- ❖ Characterization and identification of isolates using conventional and modern biochemical techniques.
- ❖ Study of microbial population of major microbial groups.
- ❖ Study of enumeration of pathogenic contaminants in the products.
- ❖ Screening of predominant fermentative bacteria to produce biogenic amines.
- ❖ Enzymatic and antimicrobial properties of some of the isolated strains to know their role in processing.
- ❖ Analysis of food value of products.