INTRODUCTION

Milk is a universal food and is polyphasic emulsion having a range of physical, chemical and biological properties (Huria, 2002). Fermented milk products are prepared from whole milk, or partially or fully skimmed milk, or concentrated milk by microbial fermentation mainly by lactic acid bacteria (Oberman, 1985). Fermented milk products account for about 20% of all fermented food production (Campbell-Platt, 1987). Popularity of fermented milk is attributed to its taste as well as its extended shelf-life, played by pure or mixed cultures of lactic acid bacteria which are used to produce the proper amount of diacetyl and other desirable flavour (Steinkraus, 1994). In fermented milk products, lactic acid bacteria largely convert the lactose into more digestible lactate and proteins into free amino acids imparting digestibility to the product (Tamang and Holzapfel, 1999).

Studies on microbiology and biochemistry of some common indigenous fermented milk products of India such as misti dahi (Ray and Srinivasan 1972, Gupta *et al.*, 2000), dahi (Ramakrishnan, 1979; Misra 1992), shrikhand (Patel and Chakraborty, 1985; Sarkar and Misra, 1997) have been carried. Production statistics, microbial biodiversity, nutritive value, development of starter culture(s), antimicrobial activities of cultures, of some common fermented milk products such as cheese (Galloway and Crawford, 1985), yoghurt (Pazakova *et al.*, 1997; Robinson, 1999), kefir and koumiss (Kosikowski, 1977), and probiotics properties of some lactic acid bacteria isolated from fermented milk products (Holzapfel *et al.*, 1997) have been well documented and investigated.

Food fermentation is one of the oldest 'biotechnological processes' from which development of fermented foods and beverages,

based on trial and error, has been rooted in the cultural history of human being (Geisen and Holzapfel, 1996). Fermented foods are prepared by the action of microorganism(s), either spontaneously or by adding starter culture(s), which modify the substrates biochemically and organoleptically into edible products, and are thus generally palatable, safe and nutritious (Kwon, 1994; Campbell-Platt, 1994). 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).

Sikkim, a tiny Himalayan state of India, with an area of 7096 sq. km and altitudes ranging from 300 m to 8500 m is bounded in the north by the Tibetan Plateau, in the east by the Chumbi Valley of Tibet and Bhutan, in the west by Nepal and in the south by the Darjeeling hills of West Bengal. The state comprises four districts viz.North, East, South and West. Three major ethnic groups of people the Nepali, the Bhutia and the Lepcha comprise the population of Sikkim. Agriculture forms a major component of the mixed farming system and is the main economy of the state. Livestock mostly plays a subsidiary role in this mixed farming set up. Cattle rearing are common practice in the mixed agricultural farming system in Sikkim. The important domestic livestock

of Sikkim are cattle, buffaloes, yaks, sheep, goats, pigs, etc. (Balaraman and Golay, 1991). Cow milk is consumed and is particularly fermented into a number of indigenous milk products. In the alpine and sub-alpine regions between 2100 m to 4500 m altitudes, yak (*Bos grunniens*) is also reared mostly for milk and its fermented products, meats, skin and hairs. Inter-specific crossing between yak and cattle called 'Joe' gives better yield in milk production and work capacity, and can tolerate warmer weather conditions.

The *Bhat-dal-tharkari-achar* (rice-legume soup-curry-pickle) followed by milk products and meat constitute the daily basic diet of the people in Sikkim (Tamang *et al.*, 1988; Tamang, 2001). Milk and its fermented products form an important part of food consumption. Some of the common fermented milk products of these regions are chhurpi, dahi, mohi, philu, chhu, etc., and their documentation may be worthwhile after thorough survey. Information in the literature related to few milk products of Sikkim has been limited to its traditional preparation and consumption pattern (Tamang *et al.*, 1988; Yonzan and Tamang, 1998), compositional and sensory characteristics of chhurpi (Katiyar *et al.*, 1991) and optimisation of process parameters of chhurpi (Pal *et al.*, 1993, 1994, 1995, 1996). Production of indigenous fermented milk products is mainly confined to the unorganised sector as well as individual household levels in the Sikkim Himalayas. Preliminary data on production statistics of common and lesser-known traditional milk products, information on microbiology and on economical aspects are not available. The proposed dissertation is aimed to study in depth the microbiological evaluation of common as well as lesser-known indigenous fermented milk 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 indigenous fermented milk products of the Sikkim Himalayas, may contribute a significant unknown microbial gene pool, which should be preserved.

Objectives

The proposed research is aimed at the achievement of the following objectives →

- Documentation of indigenous knowledge of traditional processing of milk: common as well as lesser-known fermented milk products of the Sikkim Himalayas.
- Analysis of food value of the products such as protein, fat, carbohydrate, caloric content, minerals.
- Isolation, characterization and identification of predominant microorganisms associated with the indigenous fermented milk products.
- Study of microbial population, enzymatic activities of major microbial groups.
- Study of pathogenic contaminants, and the potential of fermentative bacteria to produce biogenic amines.
- Study of antimicrobial activities of dominating microorganisms.
- Determination of degree of hydrophobicity, as presumptive probiotic properties of dominant microorganisms.