INTRODUCTION
1. INTRODUCTION

India's status in dairying is characterized by the fact that this country has emerged to be the largest milk producer in the world and enjoying this status since last one decade with a record production level of about 110 million tones. The present thrust of milk products manufactured in India is generally confined to the market milk processing and western-type dairy product manufacture. Whey is a major dairy by-product, which is receiving increasing attention for its proper utilization by the research workers throughout the world. Production of cheese, chhana, Paneer and other coagulated dairy products is steadily increasing leading to generation of huge amount of whey. Its composition varies widely depending upon the variety and method from which it results (Kosikowski, 1979). Whey is a good source of lactose, minerals, whey proteins and also rich in minor components like calcium, phosphorous, essential amino acids and most water soluble vitamins (Zadow, 1986; Horton, 1995). Roughly, the whey constitutes about half the total solids of milk out of
which 70% represents lactose, 20% milk proteins and 7-9% milk minerals.

Whey proteins contain about 2.5 g cystine and 2.8 g cysteine per 100 g of protein. Whey proteins have shown higher biological value (BV-104), protein efficiency ratio (PER-3.6) and net protein utilization (NPU-95) than other protein sources, namely egg, beef, soya protein and casein (Renner, 1983; Renner and Abd-El-Salem, 1991). These proteins are also most effective in meeting the body's energy and amino acid requirements and in this respect, it is superior over the above mentioned animal origin proteins, widely recognized as nutritious (Werner, 1981; Belem et al., 1999). The total solids, fat and protein contents of cheese whey is more than that of acid whey, but there is higher amount of calcium, phosphorous and lactic acid in acid whey as compared to sweet whey.

The most valuable component of whey is the whey proteins, which have long been recognized by nutritionists as one of the best proteins available for human needs. The high nutritional value of whey
proteins can be attributed to its higher concentration of essential amino acids eg. Isoleucine, phenyl alanine, lysine etc. than that of other common dietary protein sources, particularly egg, meat and soy proteins.

It has been estimated that more than 125 million tones of whey is produced annually in the world, out of which 5 million tones is produced in India (Gupta, 2000). The high perishability of whey components is responsible for excessive biological oxygen demand (BOD) of whey, which renders it the most potent pollutant of all dairy wastes. One hundred kg of liquid whey containing approximately 3.5 kg BOD and 6.8 kg chemical oxygen demand (COD) has the polluting strength equivalent to sewage produced by 45 people (Web and Whitter, 1970). This high BOD poses a major worldwide disposal/pollution problem equal in magnitude to that of whey.

Most of developed countries have stringent laws for the treatment of whey prior to disposal in to sewage system. In India also the more recent enforcement of strict environmental regulations has compelled dairy
industry to reappraise waste management in general, especially in whey disposal (Gandhi, 1989; Khamrui and Rajorhia, 1998a). It also acts as a source of bacteriophage contamination leading to failure of starter cultures in cheese manufacture and other fermented products. Therefore, many dairy organizations treat the whey before disposal. A study of Durham et al. (1997) indicated that treating 5 lakh liter of whey in sewage would cost $10,000 (Rs. 4,70,000/-) per day for primary treatment and $145,000 (Rs. 68,15,000/-) for tertiary treatment (Khamrui and Rajorhia, 1998a). To overcome these problems, efforts have been made to develop new processes for effective utilization of whey.

Diversion of whey solids to human chain by employing cost effective technologies, appears to be the best alternative for salvaging problems associated with the whey disposal. Exhaustive research investigations have been taken up in the past to explore the ways of utilization in various forms (Holsinger et al., 1974). Today modern industrial processing techniques such as Ultrafiltration (UF), Reverse osmosis (RO), Microfiltration (MF), Nanofiltration (NF), Electrodialysis
(ED), ion-exchange, new drying technologies, hydrolysis of lactose, fermentation of protein fractions etc. offer possibilities of using whey into major source of ingredients with different functional and nutritional properties, which could be used in food and dairy industry. Unfortunately, none of these technologies have been well caught up by the Indian dairy industry for the reasons best known to the industry.

Among the different ways of whey utilization, conversion of fluid whey as such or as permeates after UF into whey beverage is one of the promising ways to utilize whey. Various kinds of whey beverages with or without fermentation are thought in commercial operation in developed countries like the United States and New Zealand (Zadow, 1986). Whey-based fruit drinks are thirst quenching, light and refreshing, healthful and nutritious, but less acidic than fruit juices and offer good potential profit margins (Gandhi, 1989; Mandal et al., 1997; Khamrui and Rajorhia, 1998b). Beverages made from either whey or whey permeate are clear, transparent liquids, closed to traditional soft drinks.
India has not only made great progress in milk production but has also emerged as a major fruit producer in the world. Citriculture is third largest fruit industry in India after mango and banana and collectively citrus fruits contribute to 11.53% of total area under fruits with an annual production of 3.0 million tones (Ghorai and Khurdiya, 1998). India is one of the largest and most varied fruit producing nations in the world, accounting for 10 percent of all fruits and nearly 40 percent of tropical fruits produced globally (Negi, 2001).

The evidence of published literature indicates that ready-to-drink whey-based fruit flavoured drinks have been studied by various workers in different parts of the world. A variety of whey beverages consisting of plain, carbonated, alcoholic, soy, and fruits have been successfully developed and marketed all over the world because they hold great potential for meaningful disposal of whey solids. Kravchenko (1988) reported that at least 21 whey-based drinks are available in European
market. On the contrary, there is hardly any such whey-based fruit drink available commercially in Indian market even today.

Consumers are usually looking for ways to improve their health by changing their diet and lifestyle. Whey is enriched by biologically active ingredients or valuable organic complements gained from nature's resources (not using chemical synthesis) e.g., nutritious source of high-quality proteins that contains all the essential amino acids necessary for good health (Kimball and Jefferson, 2001; Layman, 2002). On the other hand, mango and fig fruits contains essential vitamins and dietary minerals besides other phytonutrients such as antioxidant pigments (Rocha Ribeiro et al., 2007; Ajila and Rao, 2008), carotenoids like provitamin-A, beta-carotene, lutein and alpha-carotene (Gouado et al., 2007). Addition of the tropical fruit pulp improves the nutritional value of whey and exhibit excellent flavor derived from these fruits. Additionally, enrichment of beverage with probiotic organisms gives functional features for a final product for health promotion.
The term “Probiotic” is derived from a Greek word meaning “for life”. The probiotic foods are defined as “foods containing live microorganisms, which actively enhance health of consumers by improving ecological balance of microflora in gut when ingested in sufficient numbers” (Fuller, 1992). Probiotics can also be defined more fully as “live supplements, which affect the host animal by improving its intestinal microbial balance”.

The most widely used probiotic lactic acid bacteria (LAB) are lactobacilli and bifidobacteria, which have been isolated from the human body sources like gastrointestinal/urogenital tract and extensive studies have been conducted on the beneficial effects on human health of these species. The LAB plays an essential role in manufacturing fermented milk products. Applications of these organisms are now being extended to the area of health improvement, which is known as probiotic activity. Dairy foods appear to be preferred medium for the probiotic consumption but probiotic foods should be viewed as part of overall healthy diet. Another interest in development of probiotic products is to find
alternative/parallel to antibiotic therapy. The viability and quality of probiotic culture is taken in account while incorporating it in the product. The harsh acidic pH of the stomach does not allow the development of the profuse microbiota, whilst in the small intestine, a rapid transit time and input of bile salts maintains populations at relatively low numbers. About 100 g/d material, which escapes digestion and absorption in the upper gastro-intestinal tract is fermented by microorganisms present in the colon. Its members are all capable of survival and growth under strictly anaerobic condition. Bacteroides, bifidobacteria, clostridia, eubacteria, lactobacilli, Gram-positive cocci, coliforms, methanogens and sulphate-reducing bacteria are of numerical significance.

Scientific investigations have proved that fermented milks are more easily digested and assimilated by virtue of its buffering action and supply more nutrients than milk. Tri-calcium phosphate is converted into monocalcium phosphate and many insoluble minerals rendered more soluble due to lactic acid production. Many workers have found an increase in the riboflavin
(Vitamin B2) and thiamine (Vitamin B1) contents of this product which are so essential for the utilization of carbohydrates and amino acids in the body, maintaining the health of mucous membranes, skin, nerve tissues and eyes and formation of hemoglobin in the blood. Converting milk into these products also tends to stabilize the Vitamin C potency more than fresh milk which is vitally important for the growth and repair of tissues in bones, teeth and blood vessels, health of gums and teeth, overall body growth and resistance to infection (Bajad, 2004).

Diet plays an important role in the maintenance and improvement of human health through the provision of growth substrates for the microbiota. A range of substrates of dietary origin are produced by the host, are available for fermentation by the colonic microflora. Starch and non-starch polysaccharides form the next largest contribution and include plant-derived substrates such as pectin, cellulose, hemicellulose, guar gum and xylan. It is possible to categorize the gut microbiota components on the basis of whether they exert potentially pathogenic or health promoting
aspects. Lactic acid producing genera such as the bifidobacteria or lactobacilli have a long standing 'health image'.

Whey-based tropical fruit beverages/drinks containing probiotic organisms shall prove very much useful for geriatrics because of maximum biological value and low calories. It has several beneficial effects to treat wide variety of ailments such as gastrointestinal and related disorders, arthritis, anemia and liver complaints. The health benefits of consumption of probiotics are widely validated and it is proved that the probiotic organisms are of immense help in getting rid off the gastrointestinal and related ailments, atopic, uro-genital and immunological problems. Therefore, utilization of whey for preparation of tropical fruit beverages containing probiotic organisms has great scope in our country to solve the problems of whey disposal and value-addition of the tropical fruit beverages.
Therefore, the present investigation is aimed at the following objectives:

1. To standardize a method for preparation of whey-based tropical fruit beverages containing probiotic organisms.

2. To assess the compositional, microbiological and quality attributes of the acceptable whey-based probiotic tropical fruit beverages.

3. To study the *in vitro* antimicrobial properties of such beverages.

4. To study the effect of feeding whey-based tropical fruit beverages on the gastrointestinal microflora of randomly selected children of 1-5 years.

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