Introduction
1.0 INTRODUCTION

Foods are being consumed by human population in order to derive functional benefits which would have an impact on human health. The food processing sector is more focused on innovations that could provide these requisite functional attributes through traditional foods which are inherent with human civilization. Studies into the traditional fermented foods have established the multiple advantages with reference to nutritive values, therapeutic properties and sensory attributes. The early human civilization with no concept of microorganisms was remarkable not only in developing the products, but also safely maintaining the cultures through centuries. In all these fermented foods, the process of fermentation is mainly initiated by lactic acid bacteria (LAB), followed by yeasts in a few of them. In general, fermented foods are characterized by the accumulation of metabolites of microbial activities, both primary and secondary, which contribute to the overall functionality of products.

Research studies have given sufficient evidence for the hypothesis that diet is also instrumental in controlling and modulating various functions of the body so that good health and a disease-free life is made possible. It is this hypothesis, which is the corner stone of the concept of ‘functional foods’. A functional food is defined as a ‘food that contains in adequate concentrations one or more combinations of components which affects functions in the body so as to have positive cellular or physiological effects’. Any food may be termed “functional”, if it fulfills the requirements of (i) demonstrates an interaction with one or more functions of the body, (ii) there is some understanding of the underlying mechanism of action and (iii) the establishment of the effect in relevant biological systems.

The most important role of the gut microorganisms in human health was ignored for a long time and that of only the enteric pathogens along with the factors
that led to intestinal disorders were considered. As is established now, the gut microbial ecology is highly complex and undertakes a number of important physiological functions that include metabolic activities, which result in salvage of energy and absorbable nutrients, important tropic effects on intestinal epithelia and on immune system function and structure, protection of the colon from infection against pathogenic microbes, behave as critical factors in certain pathological disorders such as multi-system organ failure, colon cancer and Inflammatory Bowel Disease (IBD). These include age, susceptibility to infections, nutritional requirements, immunological status of the host, pH, transit time, interactions between flora components and the presence and availability of fermentable substrates in the gut. Of these, the last is considered most critical for the growth and survival of the microbial flora of the gut.

Probiotics and prebiotics fall under this category and it can be said that they are in good agreement with the above-mentioned conditions. Knowing or unknowingly, the human race has been consuming fermented products from time immemorial. Their origin has been primarily milk-based which has been the base for the many investigations on the probable health benefits of these traditional fermented foods. Although, Metchnikoff had worked upon this concept in the beginning of the 19th century as an alternative to modification of mal-functioning gastrointestinal tracts, unfortunately, it was neglected for a long period of time. It was only from early 1990s, that focused attention has increased in view of the wellness of substances of biological origin, rather than preferring those of chemical origin. The word ‘probiotic’, which is derived from two Greek words meaning “for life” was not established by definition till 1965. Any probiotic strain selected should be capable of withstanding the many unit operations of food processing such as concentration, freezing, storage
conditions, cooking conditions of temperature and pressure so that a final required count of between $10^6 - 10^8$ CFU bacteria is maintained in the product.

It is important from an industrial point of view as any industry incorporating probiotic cultures should be able to cultivate and maintain the species and required strain(s) in the purest of forms and in very high quantities so that a sufficient count can be maintained. The strain so selected should not be viable to frequent mutations as this can change the characteristics, rendering strain addition useless, if not harmful. On the other hand, it has to be amenable to molecular modification techniques so that some other desired properties may be incorporated to make the existent strain a superior one.

Owing to such varied health benefits and the age old practice of consuming these cultures through fermented foods has given it a good degree of safety, yet stringent safety and toxicity studies are being conducted, so that no aspect of the above-mentioned properties remains unproven scientifically. This implies that the addition of the probiotic cultures should not impart any undesirable taste, odour or any other sensory attribute other than that required in the food product. If a culture fails to achieve this objective, then external additive addition may be necessitated which may change other product parameters and also decrease the effectiveness of the culture added.

The major groups of probiotic bacteria are those of genera and species of lactic acid bacteria and bifidobacteria. Lactic Acid Bacteria are a group of Gram positive bacteria sharing a number of other morphological, physiological and metabolic characters. Although, there are new genera being discovered every day, the classical tests are still used for the genus and species identification. LAB can be divided into rods, which are Lactobacillus and Carnobacterium, while all the others
are cocci. The tetrad–forming genera are Aerococcus, Pediococcus and Tetragenococcus. Bifidobacteria are one of the most common bacterial species that inhabit the human intestine and are known to have a positive effect on health. The proof of this comes from the fact that consumption of traditional foods such as Kefir and Koumiss whose microbial profile showed the presence of bifidobacteria species and that products were recommended for patients suffering from a wide range of illness. Bifidobacteria are Y-shaped or bifid Gram-positive rods, which are anaerobic and non-motile in nature. The species present in humans and animals are little different. Bifidobacterium bifidum, B. longum, B. breve, B. infantis and B. adolescentis are found commonly and these are the species used as probiotics.

In this context, the concept of prebiotics has emerged with a parallel role to probiotics. A prebiotic is a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of defined type of bacteria in the colon and thus improves host health. Recent review of original research studies over a decade revealed 3 key aspects namely (i) resistance to digestion, (ii) fermentation by the large intestinal microbiota and (iii) a selective effect on the microbiota associated with health benefits. In its present state, it is now proposed ‘A prebiotic is a selectively fermented ingredient that allows specific change, both in the composition and/or activity in the gastro-intestinal microbiota that confers benefits in human health and well-being’.

Given the beneficial effects probiotics and prebiotics, it is essential that a safe mode of their administration be established. Foods are an ideal mode of probiotic administration, as they are easily incorporated in them and also reach the site of action with out many hassles. Also, the concept of fermented foods, which is one of the easiest mode of probiotics incorporation, is well established and accepted. The
great diversity in the traditional fermented food preparations give ample opportunity for the use of the many available cultures in the most suitable of the food matrices. Thus the available and novel foods that incorporate probiotics may be classified based on the substrate used for fermentation as milk-based, cereal-based, vegetable-based and meat-based. The important aspects relating to interactions between probiotics and prebiotics would provide scientific evidences for the health and nutritional benefits that are more commonly associated with such foods.