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Fermentation Technology in the Development of Functional Foods for Human Health: Where We Should Head

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Microbes used for fermentation process of food products develop flavor. Indeed, they also generate bioactive components that enhance the biofunctionality of food products and these foods called functional foods. Increasing prevalence of various chronic diseases i.e. obesity, diabetes, cardiovascular diseases and cancer that are associated with poor food habits, demands to develop new microbes for fermented food production that can enhance biofunctionality of foods against these life threatening health ailments.

Fermentation process is a process which involves the conversion of large molecules to small molecules or molecular oxidation/ reduction mechanisms mediated by selected micro-organisms. The fermentation technology depends on the microbial components and produces different molecules from small laboratory scale to large industrial scale. During this process various bioactive molecules also be produced, that can exert excellent health benefits for consumers [1]. For example various bacteria and yeast have been used to produce conjugated linolenic acid (CLA), folate, vitamins and other bioactive components [2-5]. Probiotic organisms are one of the important groups of such micro-organisms that participates in fermentation process of various food products i.e. dairy products [6]. Probiotics are defined as live micro-organisms that exert health beneficial effects to host when administered on sufficient amount. Probiotic have been considered Generally Recognized As Safe for human consumption and known to exhibit various health beneficial effects i.e. anti-cancer, immunomodulatory, anti-oxidant, cardio protective and anti-obese/ diabetic [7-9]. There are various mechanisms have been proposed for the bioactivity of the probiotics on human health, and one of them is the probiotics mediated production of bioactive components during fermentation process of foods (Figure 1).

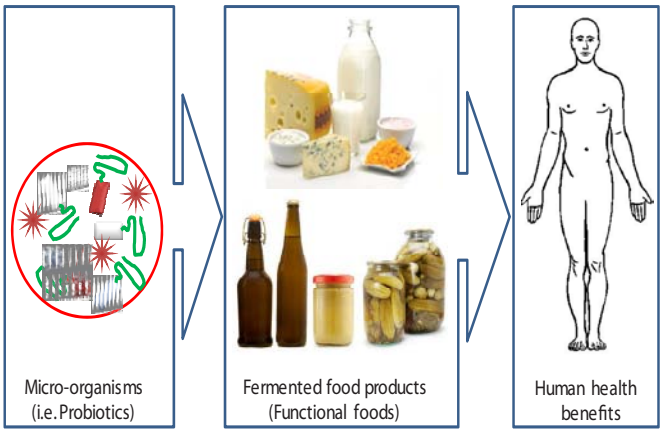

Figure 1: Development of fermented foods for human health: a projected future approach

Various chronic disease i.e. cardiovascular diseases, obesity, diabetes, cancer and auto-immune diseases are closely related to the food habits and quality of food. High energy diet/ fat consumption is one of the importance risk factor associated with obesity, diabetes and cancer [10,11]. Fat is a basic unit of our cellular structure, therefore it is one of the essential components of our diet. Hence not all fats are detrimental for human health and can't be cut-down completely from diet. Excess saturated fatty acids are not considered good for health whilst unsaturated fatty acids are comparatively health beneficial [12]. High fat foods and raw dairy products are one of the major sources for saturated fatty acids and if these products can be enriched with micro-organisms that can convert saturated fat to unsaturated fat should be one of the promising areas for fermentation technology. Although there are still a number of limitations in incorporating microbes in all kind of high fat foods, common food products such as ice cream, muffins, donuts, dairy products and other fermented foods can be enriched with such microbes that are able to convert most of the saturated fat into unsaturated fat and other bioactive fats i.e. CLA. Another kind of bioactive components produced by microbes during fermentation process of foods are bioactive peptides [13,14]. Various probiotics and other microbes have been known for production of bioactive peptides from milk proteins, wheat protein and various other plant and meat proteins, that exert various health beneficial effects i.e. anti-hypertensive, immunomodulatory and anti-cancer [12,13]. Supplementation of such microbes during the production process of foods that involve processing steps of fermentation can give promising fermented products or functional foods that can exhibit important biological activities to the consumers. In addition various microbes have been reported to produces short chain fatty acids from dietary fats, carbohydrates, proteins and fibers i.e. butyrate that provides vital anti-obese and cardio protective effects [15,16]. In this regard, pilot ongoing studies targeting specific cardiovascular-metabolic pro-inflammatory polymorphisms clusters (Cardiovascular-Metabolic panel, Next Genomics, Prato, Italy) are preliminarily proving to be useful predictor to help physicians identifying those subjects with a more consistent clinical response to an integrated gut ecology- and

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nutritional-targeted intervention (Marotta F, Personal communication-Study in progress, International Symposium on "Innovations in age-management medicine", Dec. 2-3, 2011, Warshaw, Poland). If dairy products and other fat enriched foods can be supplemented with such micro-organisms during development, then fermentation process for development for functional foods can be of high importance in fermentation technology and food industry. The limitation in this direction might be the incorporation of these microbes may change in taste and flavor of the final food products. However, these limitations can also be omitted by carefully standardizing the amount of microbes, time and temperature of fermentation process. In addition, the original taste and flavor can also be maintained by incorporating the bioactive microbes with original cultures that are responsible for flavor and taste i.e. yogurt cultures and cheese cultures with probiotic microbes. Also, original cultures can be genetically modified to incorporate the bioactive molecule production metabolic pathways along with intact flavor producing metabolic pathways; can be one of attractive areas of intensive research. Using such microbes will provide double edged beneficial effects i.e. microbes will produce bioactive components in foods that will be absorbed immediately after food consumption, and will also deliver such beneficial microbes in consumer's gastrointestinal tract, that further can produce such bioactive components into the gut and made them available to the host for long term basis. This is an active area of research and much more intensive research efforts should be directed in production of such beneficial microbes and functional foods that can ameliorate the global crisis of most prevalent chronic diseases i.e. heart diseases, obesity, diabetes, cancer and immune dysfunctions.

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