

# NON-DAIRY FUNCTIONAL FOOD PRODUCTS ENRICHED PROBIOTIC MICROORGANISMS AS AN ALTERNATIVE WAY DELIVERY OF PROBIOTICS TO MACROORGANISMS

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Non-dairy probiotic products are of great importance due to the current trend of vegetarianism and the high prevalence of lactose intolerance in many populations around the world. There is no doubt that the dairy sector, which is closely associated with probiotics, is the largest functional food, accounting for almost 33% of the market, while cereals have just over 22%. Currently, 78% of the current worldwide sales of probiotics are through yogurt. Fruit juices, desserts, and cereal-based foods may be other suitable delivery vehicles for probiotics.

Technological progress has made it possible to change some of the structural characteristics of fruit and vegetable matrices by modifying food components in a controlled manner, such as changing pH, enriching nutrient media, etc. This may make them ideal substrates for probiotic crops, as they already contain beneficial nutrients such as minerals, vitamins, dietary fibres and antioxidants, while free of dairy allergens that may inhibit consumption by some populations. Allergy to dairy products negatively affects many people around the world, whose number is steadily increasing. Traditions and economic reasons limiting the use of dairy products in developing countries such as Japan, China and some African favour the idea of reducing milk constituents as a means, for probiotic agents, or even replacing other media such as cereals, fruits and vegetables. Lactose intolerance, cholesterol content and allergenic milk proteins are the main disadvantages associated with dairy consumption, necessitating the development of new non-dairy probiotic products.

The consumption of beverages and foods containing probiotic microorganisms is a growing global trend. Although fermented dairy products are generally good matrices for delivering probiotics to consumers, other products have been investigated for their potential as carriers of probiotics. Mayonnaise, soy milk, meat, baby food, ice cream, fruit drinks, vegetable drinks and more have already been offered.

There is a wide variety of traditional non-dairy foods developed around the world. Many of them are non-alcoholic beverages manufactured with cereals as main raw materials. For example, *Boza* (made from fermented cereals) is a cold beverage consumed in Bulgaria, Albania, Turkey, and Romania. *Bushera* is the most common traditional cereal-based beverage prepared in the Western highlands of Uganda. *Mahewu* (amahewu) is a sour beverage made from corn meal, found in Africa and some Persian Gulf countries. *Pozol* is a refreshing beverage, widely produced in the South-eastern Mexico, made with cocoa and cornmeal. *Togwa* is a starch-saccharified traditional beverage consumed in Africa that has been used as a probiotic medium.

Other non-dairy products available in the marketplace are effervescent tablets, chewable tablets, and drinking straws. Some researches pointed out the potential of root crops, legumes, shrimp, cassava, different types of vegetable flours, fish, fruit seeds, meats, fungi-based substrates, as well as milk from a variety of animals for the

development of new probiotic foods. These foods can be used as templates for innovation, where traditional starter cultures can be replaced by probiotic ones.

Bifidobacterium and lactic acid bacteria are widely used in food, and not only in the fermentation of vegetables, sausages and milk, but also fruits and plant-based products (carrots, beets, celery, garlic, green olives, green cucumber juice, onions, peas, alfalfa, clover, galega and cereals).

Fruit juices have been suggested as an ideal growth medium for probiotics because they naturally contain essential nutrients and taste good. Fruits and vegetables are rich in minerals, vitamins, dietary fibres, antioxidants and do not contain any dairy allergens that may discourage consumption by certain segments of the population. The use of probiotic cultures in non-dairy products is a serious problem. The viability of a probiotic in a food matrix depends on factors such as pH, storage temperature, oxygen levels, and the presence of competing microorganisms and inhibitors. It is important that the formulation maintains the potency and stability of the probiotic over long periods of time. Factors such as water activity, oxygen tension and temperature are becoming more and more important when working with these types of products. Storage at room temperature, which is common in many types of non-dairy products such as cereals, beverages, confectionery, etc., can pose a serious problem to the stability of probiotics.

Scientific research has shown that yogurts and water-soluble soy-containing-fermented beverages present a good sensory acceptance by potential consumers: soy fermented yogurts garnered high scores of appearance, texture, and flavor, with sensory acceptance of 82.5%; water-soluble soy extract fermented beverages with bifidobacteria showed superior acceptability compared to that fermented with *Lactobacillus casei*.

Adding probiotics to cereal and cereal-based fruit matrices is more difficult than formulating dairy products because bacteria need protection from acidic conditions in these environments.

Microencapsulation technologies have been developed and successfully applied using various matrices to protect bacterial cells from environmental damage. Thus, encapsulation preserved probiotic bacterial viability and activity; the addition of prebiotic components could enhance the functional properties of food products containing this formulation. Indeed, data by some world-known researches showed that lactobacilli bacterial cells survive much better an acid environment if they have a carbohydrate such as fructans that can be assimilated and metabolized.

Thus, non-dairy functional foods enriched with appropriate probiotic microorganisms can complement, and in some cases even completely replace, traditional functional milk-based foods. Given the growing number of consumers with complete or partial lactase deficiency, such functional food products can become an alternative for the prevention and treatment of various pathological conditions of the host organism associated with violations of the qualitative or quantitative composition of the microbiota.