Conceptual Editorial

Innovations in gut-healthy food products

Health fanaticism and functional foods and beverages are much debated issues in the food world today. And under the umbrella of functional foods, the probiotic, prebiotic and synbiotic foods have been gaining tremendous popularity over the years especially in gut-healthy food segment. In past decades, several dairy based products have been introduced in the market. One of the reasons for rapid development in dairy sector was probably the lucky coincidence that dairy matrix was inherently supportive of the probiotic members. However, in recent years, one of the most exciting as well as challenging developments in this field is the development of new-age probiotic products based on non-dairy and non-conventional food matrices. The inspiration for this may have come from the plethora of fermented foods available globally. Scientific evaluations have long since confirmed that some lactic acid bacteria (LAB) can perform the double task of a starter culture and a probiotic culture. This and the fact that plant carbohydrates along with phenolics may act synergistically with probiotics, have shaped and oriented today's innovation in this field. The second generation probiotic products are now being etched out of fruits, vegetables, cereals and meat matrix. Some interesting reports of non-conventional fruits and vegetable matrices which are worth mentioning here are for instance, probiotic fortification in pumpkin tissue or probiotic fermentation of button mushroom (*Agaricus bisporus*), in mung bean milk, in Andean tubers, and in coconut water. Among cereals, the most popular and successful matrices are oat, wheat, barley and malt. Compared to fruits and vegetables and cereals, the meat matrix is still in the early stage of development. A few potential matrices that have been investigated in past are Scandinavian-type fermented sausage and Iberian dry fermented sausage. Current research focus is on evaluation and screening of meat matrices suitable for probiotic fortification.

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While newer food formats herald exciting new products and greater shelf-diversity, it is also expected to pose its own set of challenges with respect to the sensory, physical and chemical characteristics, extended shelf life, chemical stability and the cost of development. The uniqueness of each matrix necessitates individual standardization and optimization for each product. Factors like pH, ionic strength, macro and micro structure, water activity, oxygen level, presence of competing microorganisms, and inhibitors in food matrices will strongly influence the product attribute. For instance in acidic matrices like fruits and cereals, there is a need for protection of probiotics. Similarly in case of beverages and cereal desserts, refrigerated storing becomes mandatory because room temperature may affect the probiotic survival and sensory qualities of the product. Using meat matrix for probiotic delivery is not a new concept since in past LAB cultures have been used but more as a protective culture barrier against pathogens and spoilage organisms. Thus, creating second generation gut-healthy probiotic product will require rigorous and multi-disciplinary research efforts to cross over the technological roadblocks. Along with probiotic survival, designers of new food matrices should be able to capitalize on synergistic interaction of probiotic and antimicrobial food phenolics. The product developed should aim at enhancing the efficiency of probiotics and phytochemicals without limiting the accessibility of phenolics and nutraceuticals that are inherently present in the food matrix. A goldmine of information can be unearthed from explorations of synergized combinations of phytochemicals with probiotic strains.

Our group has been evaluating different aspects related to designs of fruit-based probiotic products with respect to its functionality; its shelf life extension, its barrier capacity against spoilage organisms, its pathogen eliminating capacity, its rheological properties its predicted fluid behavior during processing. We are also evaluating the bioactivity of the designed matrix with respect to anti-inflammatory potential in animal models. Some very promising results have emerged from our investigations. We have been able to select fruit beverage matrices which not only show higher bio-efficacy but are also technologically efficient with respect to higher shelf life and may provide processing advantages in terms of better mass and heat transfer.

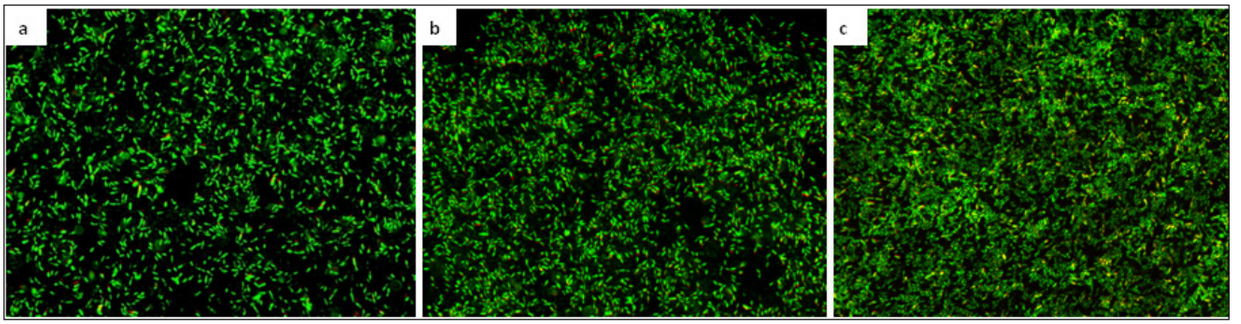

Fig 1: Fluorescence microscopy images of *Lactobacillus plantarum* (ATCC 8014) in seabuckthorn-malt beverage matrix exhibiting survival and auto-aggregation at a) day 0 b) day 7 c) day 14

It is encouraging to see that in spite of technological bottlenecks, a survey of the commercially available non-dairy probiotic products indicates a successful and growing market presence worldwide. Currently, USA is the largest producer of non-dairy probiotic products. Some of the popular juice products are Goodbelly, Raw Pressery's Organic, Garden of probiotic juice, Tropicana essential probiotics, Love Grace probiotic smoothies, Suja probiotic waters, RAW Organic kids probiotic, Naked juice. A few Canadian products have also been introduced in the market like the Vita Biosa, Oasis health break, Welo Probiotic fermented turmeric and ginger extracts. Probioticated cereal products that are found in the global market are mainly in the form of cereal bar (Truth Bars, Vega One, EffiFood, Good! Green bars Swanson Green Food Formula) or in the form of Museli products (Nutrus Slim Museli, Something to crow about probiotic, New Zealand).

In future, success of gut-healthy food innovations will depend on consumer awareness and their faith on the efficacy and safety. A joint venture between the key actors viz., food producer and researchers will pave way for the successful strategy development to improve consumer appeal and trust, and to establish appropriate scientific evidences so as to enable rational health claims about the probiotic products.

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