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Editorial: Enhancing functional dairy foods: Bioactive compounds in fermented matrices

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Editorial on the Research Topic

Editorial: Enhancing Functional Dairy Foods: Bioactive Compounds in Fermented Matrices

Functional foods generate health benefits to consumers beyond their basic nutritional value (Granato et al., 2020). Many of them contain biologically active substances (known as bioactive compounds), that can be naturally present in the raw material, or that are formed or added during food processing. They are capable of modulating metabolic processes, resulting in the promotion of health benefits to brain, heart, immune system and reduce the risk of chronic diseases, when are consumed by human beings (Park, 2010). In current markets, technological innovation represents a competitive strategy for marketing, and in the category of functional foods, the greatest innovation occurs in dairy products (Sloan, 2020).

Dairy foods containing or enriched in bioactives like lipids, peptides, fibers, plant derived compounds (like polyphenols), among others, lead to new scenarios and challenges for food science and technology. During the development process, the quality and the sensory properties of the products should be maintained or improved, which will ultimately define consumer acceptance. Besides, a very current trend in the design of this type of food is the use of more sustainable materials, dairy and vegetable by-products, which is in line with reaching a more circular economy. Furthermore, nanotechnology is a topic with exciting opportunities. In this context, dairy matrices could bring advantages to the stability of different bioactive compounds during manufacture, storage and shelf life of food. Moreover, the use of whey and other dairy by-products offer excellent opportunities for a new generation of biomolecules and functional foods.

In this collection, we aim at gathering the latest research on the incorporation/formation of bioactive compounds in fermented dairy matrices, the employment of micro/nanostructures to design high-quality food stuff, the use of sustainable materials and how they affect the nutritional, techno-functional and sensory properties of the products. In this special e-collection, four articles covering some of the aspects related to designing functional fermented dairy products and the use of whey and dairy waste to generate bioactive compounds and products with high added value are published.

The review of Priyashantha et al., entitled “Incorporation of fruits or fruit pulp into yoghurts: recent developments, challenges, and opportunities”, makes a critical assessment

of the impact of adding fruit/pulp fruit to yoghurt, as there are not only advantageous data but also several challenges in preserving quality attributes of the products that have not been resolved yet. Fruit enriched yoghurt combines the health-promoting properties of fruits with the nutritional advantages of dairy fermented food. The incorporation of fruits or fruit pulp into yoghurt improves its sensory attributes and delivers bioactive compounds like organic acids, antioxidants (vitamin C, vitamin E), polyphenols, and dietary fiber, providing health benefits to the consumer (antioxidant, antimicrobial, anti-mutagenic, anti-carcinogenic and anti-inflammation). However, these compounds interact with macromolecules (mainly protein and fat) that play a pivotal role for physicochemical properties, texture (viscosity, consistency, firmness, syneresis), sensory (appearance, aroma, flavor, color), nutritional profile, starter viability and thus the stability of the final product. In addition, some of these bioactive compounds such as anthocyanins are highly susceptible to oxidative degradation. Therefore, encapsulation technologies have been investigated as potential strategies to prevent oxidative deterioration. In addition, yoghurt is a good matrix for delivering probiotics. The use of fruit in yoghurt making has diverse effects on probiotic viability, attributed to the type of fruit used, the rate of incorporation and the type of species and/or strain of probiotic microorganism utilized. The report of Priyashantha et al. encourages future research focused on exploring underutilized fruits and their by-products, encapsulation technologies, processing technologies and formulation techniques, to sustain or improve overall quality of yoghurts.

Regarding the use of whey and dairy waste for dairy food applications, the minireview “Conversion of whey and other dairy waste into antimicrobial and immunoregulatory compounds by fermentation” by Tunick et al. summarizes the different applications of whey and dairy waste, focusing on its utilization for designing culture medias for lactic acid bacteria (LAB) growth in order to produce bioactive compounds, especially antimicrobial and lowering blood pressure peptides and immunomodulatory molecules. Indeed, the importance of whey do not only rely on the presence of the major proteins (β -lactoglobulin, α -lactalbumin, and glycomacropeptide), whey contains also other bioactive proteins (lactoferrin, lactoperoxidase, immunoglobulins, growth factors). These proteins, in turn, contain bioactive peptides in their primary sequence, which have additional and often distinct functions from those present in the original molecule. In general, all whey proteins have been associated with a variety of nutritional and physiological effects (Madureira et al., 2010; Perotti et al., 2022), including: i) performance in sports activities, recovery after physical exercise, prevention of muscle atrophy, ii) satiety and weight control, iii) anticancer effects, iv) wound care and healing, v) infection management, vi) infant nutrition, and vii) healthy aging. While some of these effects need to be investigated in more detail, several have received scientific scrutiny and have been tested in various laboratories around the world. The minireview of Tunick et al. deals with the potential use of whey as substrate for LAB to produce peptide bioactives for food, therapeutic applications as well as edible coatings. Moreover, whey proteins have useful technological properties (gelling, foaming,

capacity to bind water and emulsifying effect), which are useful and important aspects that can be exploited for new applications as the design of micro/nanoparticles capable of protecting bioactive compounds (Vélez et al., 2017).

As for bioactive compounds formed during milk fermentation, the minireview “Bacteriocins from lactic acid bacteria: strategies for the bioprotection of dairy foods” by Pujato et al. condense scientific knowledge regarding the potential use of LAB bacteriocins as natural preservatives which could replace or diminish the use of synthetic antimicrobials. Bacteriocins involve a family of antimicrobial peptides against competing bacteria or not (spoilage or pathogenic). Bacteriocins produced by LAB are of special interest because they are considered food-grade and they can be produced *in situ* in dairy food or they can be isolated Pujato et al. Indeed, nowadays there is an increased interest in consuming more natural foods so bacteriocins could help to develop foods for current generations of consumers.

The minireview “Fermented goat milk as a functional food for obesity prevention or treatment: a narrative review” by Andrada et al. summarizes the current knowledge on the potential of fermented goat milk (FGM) products to improve different biomarkers of obesity and its comorbidities. It is known that FGM has a better nutritional profile compared to fermented cow milk with higher values of proteins, some minerals, vitamins and higher content of short and medium chain fatty acids (Chen et al., 2023). The report by Andrada et al. describes *in vitro* studies showing how some bioactive peptides or lipids obtained from FGM have functional properties. These compounds have shown potential for preventing the development of cardiovascular disease and anti-inflammatory activity, meaning they have anti-obesity properties. However, very few studies have evaluated these properties in obese animal models. In general, the observed effects of isolated compounds of goat milk (lipids, casein, peptides) in *in vitro* studies are consistent with the findings from *in vivo* models. Most of reports showed a positive impact on preventing body weight gain and various metabolic, inflammatory, and oxidative parameters. However, there are no comparisons between fermented and non-fermented products in *in vivo* studies (Lu et al., 2018). As the essential cause of obesity is a chronic energy imbalance related to dietary habits, functional foods present a high potential as a preventive strategy or therapeutic intervention.

In conclusion, the field of food science and technology is increasingly focused on the development of functional foods, taking into account the concept of circular economy. This trend is driven by consumer demand for more natural and healthier products. In this context, dairy fermented foods offer opportunities, but more research is needed, especially in the application of nanotechnologies and in the association of health benefits to food products.

Author contributions

MV: Conceptualization, Supervision, Writing – original draft, Writing – review and editing. CV: Writing – original draft,

Writing – review and editing. NR: Writing – review and editing. MP: Writing – review and editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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