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Advances in yoghurt production: processing, functionality and diversity

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Editorial

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Yoghurt is one of the most widely consumed fermented dairy products. Its nutritional, functional and technological versatility continues to attract significant scientific attention from many dairy researchers. Yoghurt has grown into a dynamic research topic shaped by consumer demand for healthier and more sustainable processing approaches. Coinciding with the publication of this issue, we are highlighting a collection of recently published yoghurt-focused papers reflects that evolution, bringing together research that touches nutrient bioavailability, physical and chemical characterisation as functions of processing innovations, microbial functionality, fortification strategies and sustainability challenges. Together, these works offer a rich and integrated understanding of yoghurt systems and highlight where the field should progress in future.

The physical, chemical and functional characteristics of yoghurts still need optimisation based on a variety of external factors, to better understand how structure influences sensory experience and functionality. Variations in thermal treatment, protein composition, milk solids, fermentation rate and mechanical treatments such as homogenisation and the use of non-thermal technologies contribute to differences in viscosity, firmness, syneresis and microstructure of yoghurts. Understanding how whey protein denaturation, casein micelle rearrangement, fat globule size modification and fermentation kinetics individually and collectively shape the yoghurt matrix is vital. The findings described in the collection highlight opportunities to optimise sensory characteristics while supporting desirable nutritional outcomes, such as improved mineral retention, higher probiotic viability and targeted release of bioactive compounds. Advances in rheology, microscopy and microstructural modelling will continue to deepen our understanding of structure–function relationships in fermented dairy systems.

An emerging theme within yoghurt research is the fortification of yoghurts with oligosaccharides, particularly prebiotics such as galactooligosaccharides (GOS) and fructooligosaccharides (FOS). These compounds are incorporated to support gut health, promote beneficial microbial populations and enhance physiological functions. However, their inclusion presents formulation challenges, as oligosaccharides can alter osmotic balance, water-holding capacity, sweetness perception and the integrity of the gel structure. Studies in this collection examine how oligosaccharide structure, concentration and interaction with milk proteins influence yoghurt stability and fermentation behaviour. These areas of research highlight the need for systematic investigations of prebiotic functionality in dairy matrices, with particular attention to how fortification interacts with both fermentation microflora and consumer acceptance.

Another central area that should be explored within yoghurt research is the bioavailability of calcium, as yoghurt is widely recognised as a calcium-rich food. The nutritional value lies not within the amount of total calcium present, but how accessible calcium becomes within the digestive tract. Factors such as pH reduction during fermentation, lactic acid production, casein micelle disruption and the formation of soluble mineral–protein complexes influence the calcium uptake. Processing conditions including heat treatment, homogenisation and ingredient addition further modify these interactions by altering protein structure and the overall dairy matrix. These insights are critically important for formulating yoghurts aimed at children, elderly populations and individuals with specific bone health requirements.

Yoghurt processing conditions such as heating, homogenisation and high intensity ultrasound play a key role affecting yoghurt texture, and thereby consumer acceptance. Heat treatments modify protein conformations, promote whey protein–casein interactions and in turn influence gel strength and mineral distribution. Homogenisation disrupts fat globule structures, improving stability and mouthfeel. Fermentation temperature and time affect microbial dynamics, acidification rates, proteolysis patterns and flavour development. Ultrasound disrupts the protein and fat particles, which can stabilise or destabilise the yoghurt structure over storage based on the ultrasonic conditions used, with power density being the major contributor. These approaches demonstrate how controlled processing can be used to tailor yoghurt texture, nutritional properties and functional performance while meeting clean-label and health-driven consumer demands.

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Sustainability, particularly relating to acid whey management, is another important theme, as acid whey poses a major environmental challenge for the dairy sector, given its high organic load and limited commercial outlets. Thus, some studies investigate ways to reduce syneresis, valorise whey components and integrate whey into new ingredient streams. This area will remain a priority as the industry moves towards circular, resource-efficient dairy systems and some works showcased feasible technological and biological solutions.

Yoghurt quality and sensory appeal should not be avoided within yoghurt research. Consumers increasingly seek high-protein, low-sugar, probiotic-rich and clean-label yoghurts without compromising taste and texture. Thus, how ingredient choice, fermentation behaviour, matrix structure, prebiotic additions and lactose hydrolysis influence sensory outcomes such as thickness, mouthfeel, acidity balance and flavour complexity. Integration of sensory science with microstructural and metabolomic data represents a valuable future direction for the field. Furthermore, probiotic incorporation and lactose hydrolysis are also key features for consumer appeal. Probiotic viability depends on multiple factors, including matrix composition, fermentation conditions, oxygen exposure and storage stability. Lactose hydrolysis, achieved enzymatically or through extended fermentation, not only improves digestibility for lactose-intolerant consumers but also modifies sweetness, viscosity and gel characteristics. Probiotics interact with oligosaccharides, milk proteins and processing conditions, and lactose hydrolysis alters the physicochemical landscape of yoghurt. These findings illustrate both the potential and the challenges associated with designing health-enhancing fermented dairy foods.

Underlying all these novel themes, it is important to understand the role of bacterial identification and microbial ecology. Accurate characterisation of starter cultures and adjunct probiotics, using novel tools such as culture-based methods, MALDI-TOF, 16S sequencing and metagenomics. This is fundamental to ensuring safety, consistency and intended functionality. Moreover, when yoghurt research moves towards precision fermentation and designer cultures tailored for specific health, functional or sensory outcomes, microbial mapping will play a major role.

In conclusion, this series of collected yoghurt papers provides a forward-looking exploration of the scientific, technological, nutritional and sensory dimensions of yoghurt research. Together, they highlight the importance of understanding mineral bioavailability, refining structure–function relationships, optimising processing conditions, advancing probiotic and prebiotic integration, reducing waste and characterising fermentation microbiomes. They further highlight the opportunities and pave the way for future innovation in health, sustainability and product development for consumer-focused yoghurt products. The collection can be found at https://www.cambridge.org/core/journals/journal-of-dairy-research/collections/yoghurt-research.

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