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Title:

Replicating animal-based food properties using plant-based double-network emulsion gels

Authors & affiliations:

Name and surname *Institution/ Department, University, Country*
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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text into it.)

Preparation of Your Abstract

1. The title should be as brief as possible but long enough to indicate clearly the nature of the study. Capitalise the first letter of the first word ONLY (place names excluded). No full stop at the end.
2. Abstracts should state briefly and clearly the purpose, methods, results and conclusions of the work.

Introduction: Clearly state the purpose of the abstract
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Results: Present your results in a logical sequence
Discussion: Emphasize new and important aspects of the study and conclusions that are drawn from them

Recreating the texture and thermal behaviour of animal-derived foods in plant-based alternatives remains a significant challenge, largely due to the complex interactions and unique properties of animal proteins and lipids, such as cheese melt-stretch and fat rendering during cooking. Single-network plant-based systems often fall short in mimicking these properties. To address this, double-network emulsion gels were engineered to enhance sensory qualities and consumer acceptance of novel plant-based foods.

Under this design, two polysaccharide-based systems were developed: curdlan/konjac glucomannan (CUD/KGM) to simulate animal fat, and kappa-carrageenan/glutinous rice flour (κC/GRF) to replicate mozzarella cheese. The thermal-irreversible nature of curdlan enabled structural integrity under heat, with a 6% (w/w) CUD/KGM gel (30–40% (w/w) oil) closely matching pork fat behaviour at 180°C. For cheese analogues, κC's thermal reversibility combined with high-amylopectin starch enabled a sequential gel-sol-gel transition, delivering superior melt-stretch characteristics. The κC/GRF system demonstrated significantly improved meltiness (+12.4–115.8%) compared to commercial plant-based cheeses (−3.9%).

Additionally, a protein-polysaccharide network using wheat gluten/curdlan (WG/CUD) was explored to enhance nutritional value, texture, and stability. This composite system outperformed individual networks in terms of rheological and structural properties. A partial replacement of WG (20% to 17..5% (w/w)) with CUD (2.5% (w/w)) was found to enhance the storage modulus (G') by 290% (0.1 rad/s). These findings highlight the potential of synergistic double-network systems to emulate traditional food textures and behaviours, while offering opportunities for nutritional enhancement and controlled flavour/nutrient release during digestion.