Understanding Manufacturing Processes in Prepared Foods

Prepared Consumer Foods Innovation Gateways, 3rd June 2015

Professor TJ Foster,

University of Nottingham, Division of Food Sciences

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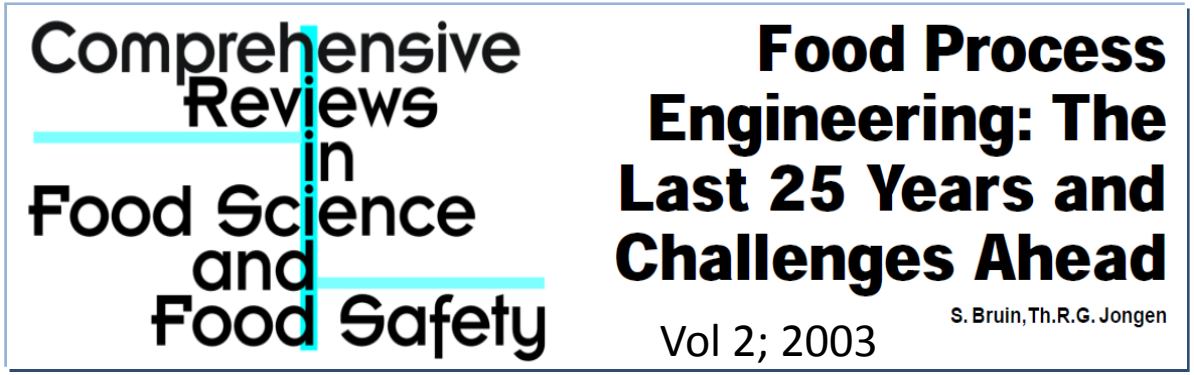
EPSRC CENTRE FOR INNOVATIVE MANUFACTURING IN Food

FOOD INNOVATION GATEWAYS

A quick look back and the present / future?




Delivered by Amazon, your food shopping: Web giant set to launch groceries service in Britain

- Internet company already offers the AmazonFresh service in Seattle
- Food wholesaler warned U.S. site now powerful enough to take on UK
- Shoppers who place an order by 10am get it delivered in time for dinner

By DAILY MAIL REPORTER

PUBLISHED: 01:38, 8 March 2014 | **UPDATED:** 12:50, 8 March 2014

- Raw material modification for functionality that matter to the consumer: nutrition, flavour, structure, colour.
- Value addition moved the industry from MAKE-SERVICE-CARE, with focus on LEAN-AGILE-VIRTUAL manufacturing
- **E-commerce**, satisfying consumer needs moving the industry more to SERVICE and CARE.
- Unit operations 'building block' approach miss opportunities for process innovation.
- Process Synthesis: Understanding data relating to raw materials and process to produce desired products at minimum cost

JM Aguilera +.....

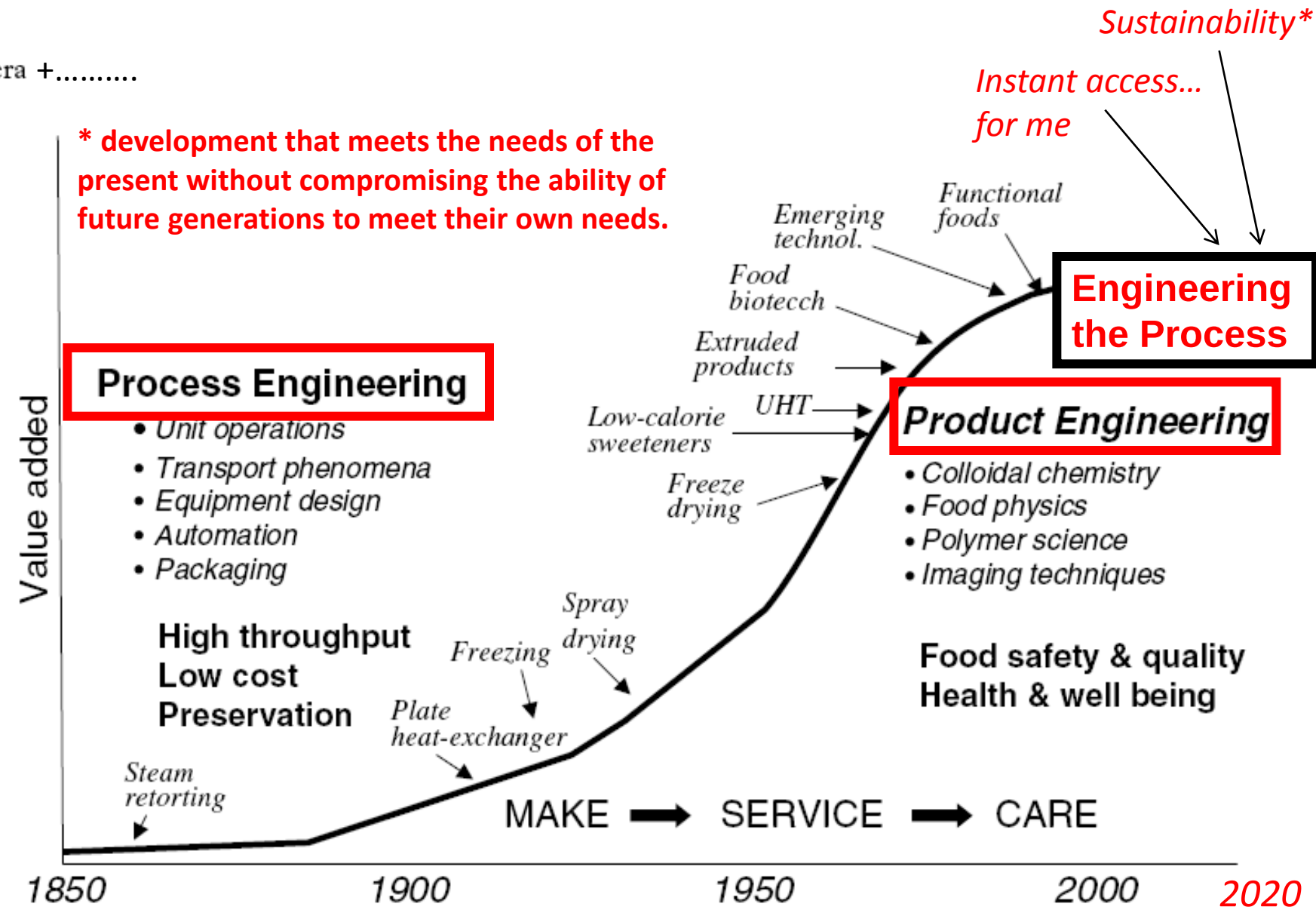
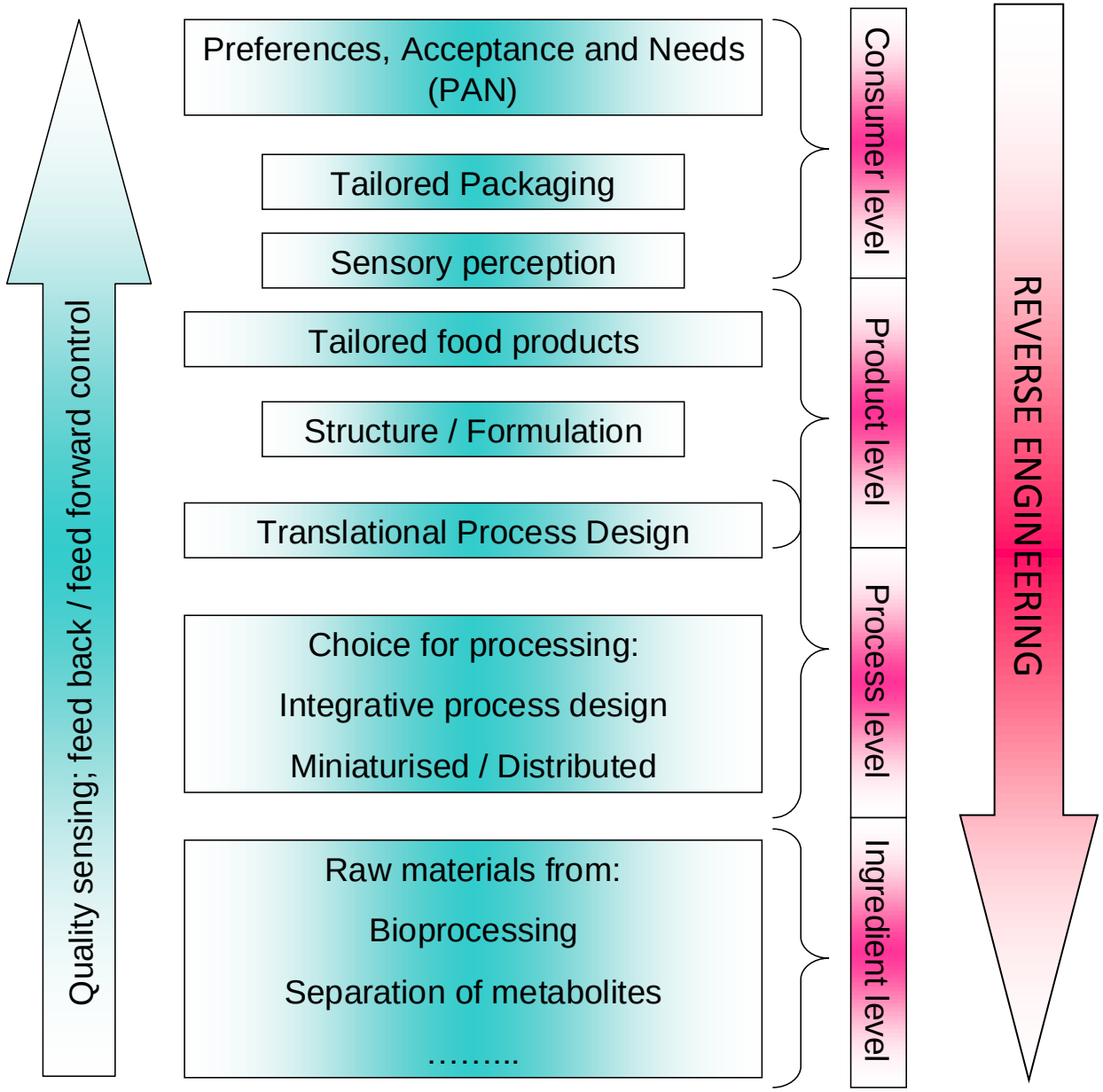


Figure 1. Evolution of the food industry in terms of value added to products and shift in emphasis from process engineering to product engineering. This transition has implied a change in concepts and techniques that support each approach.

Food Quality & Manufacturing



European Technology Platform on Food for Life

Strategic Research Agenda 2007-2020

High Value Manufacturing Landscape

- Trends & Drivers:
  - Increasing cost and scarcity driving importance of **security of supply**, use of fewer materials and less energy including water for all outputs as well as more reliance on **renewable resources**.
  - The rise of the **digital economy** and an associated increase in **customised products** will have an impact on traditional products. Integration is expected to have more of an influence on innovation than will new R&D.

- National Competencies (2025)
  - **Understanding designing and manufacturing formulated products**
  - 'Plug and play' manufacturing
  - Design & manufacture for small-scale & miniaturisation
  - **Systems modelling & integrated design/simulation**
  - Flexible and adaptive manufacturing
  - Combining product development steps in parallel / concurrent engineering

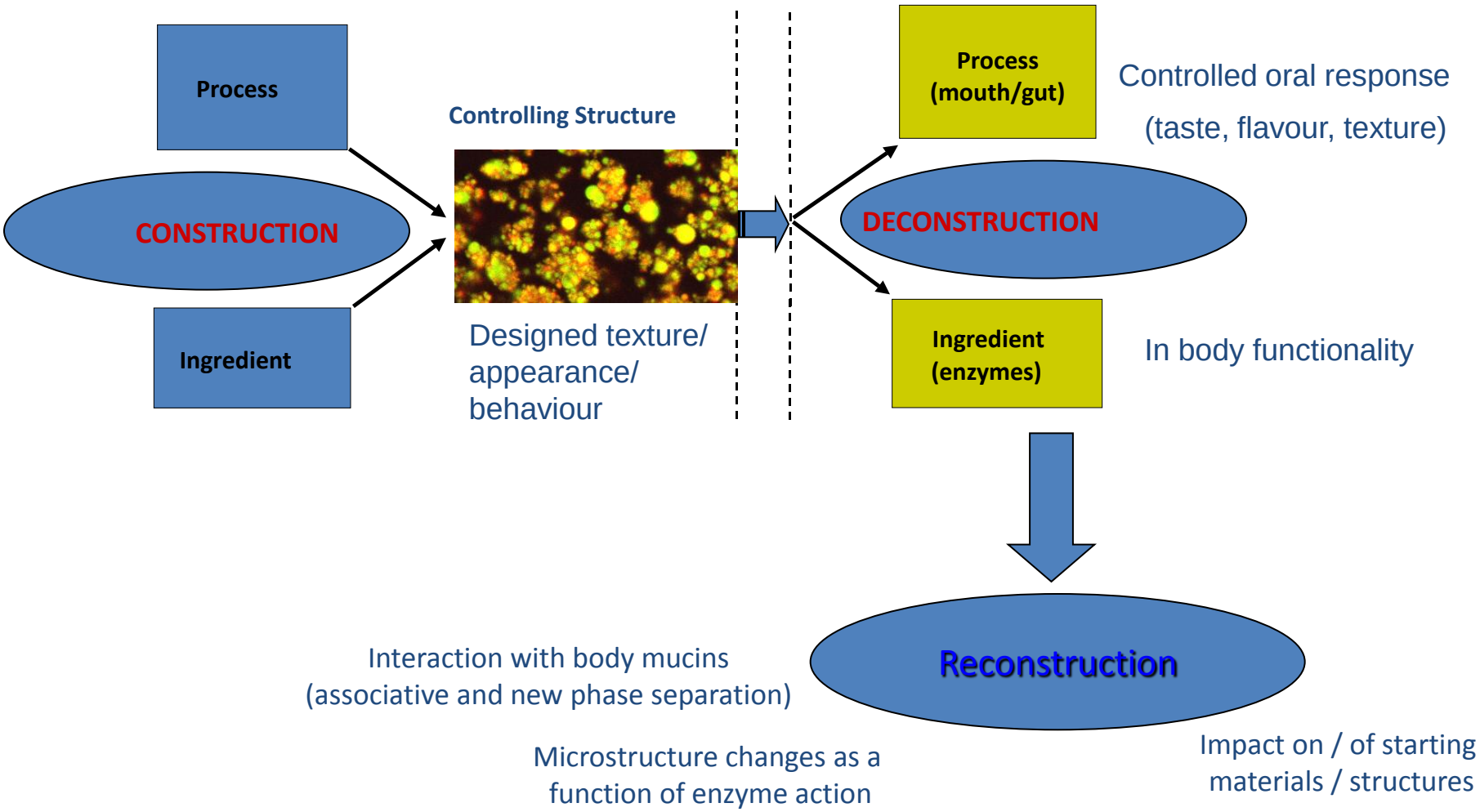
Foresight Report

Foresight (2013). The Future of Manufacturing: A new era of opportunity and challenge for the UK ; Summary Report; The Government Office for Science, London

"Manufacturing in 2050 will look very different from today, and will be virtually unrecognisable from that of 30 years ago….as manufacturing becomes faster, more responsive to changing global markets and closer to customers…exposed to new market opportunities and more sustainable"

- **Mass personalisation of low-cost products, on demand**
  - "Direct customer input to design will increasingly enable companies to produce customised products"
- **Distributed production**
  - The **production landscape** will include capital intensive **super factories** producing complex products; **reconfigurable units** integrated with the fluid requirements of their supply chain partners; and **local, mobile and domestic production** sites for some products.
  - **The factory of the future may be at the bedside, in the home, in the field, in the office and on the battlefield**.
- **Digitised manufacturing value chains**
  - they will create new ways to bring customers into design and suppliers into complex production processes.

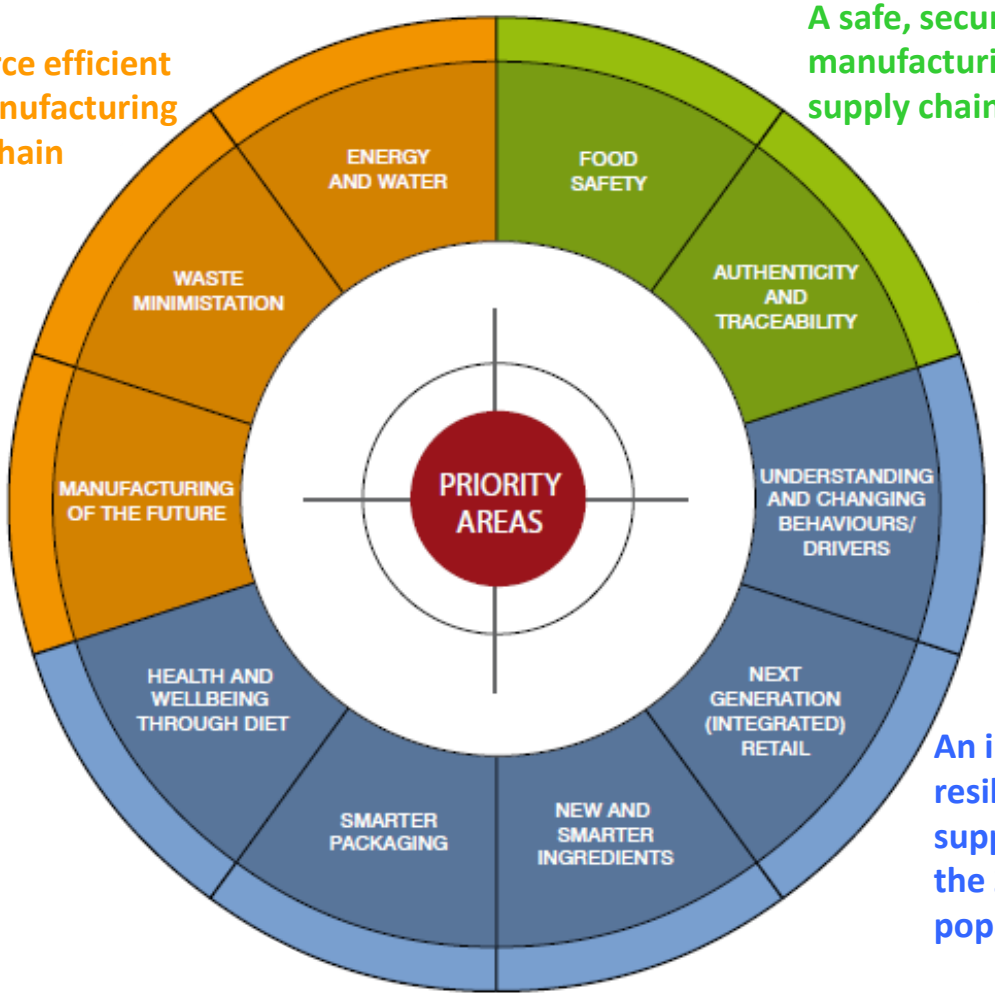
Food Microstructure Design



A Pre-Competitive vision for the Food Industry

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

PRIORITY AREAS FOR RESEARCH TO MAINTAIN AND ENHANCE THE UK'S COMPETITIVE POSITION IN GLOBAL FOOD MANUFACTURE



A resource efficient food manufacturing supply chain

A safe, secure food manufacturing supply chain

An innovative, resilient food supply chain for the 21st century populations

EPSRC Centre for Innovative Manufacturing in Food

£5.6m to be spent on Research
Started 1st December 2013
www.manufacturingfoodfutures.com

Prof Tim Foster, Prof Shahin Rahimifard and Prof Ian Norton

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Biomaterials Group

Loughborough University

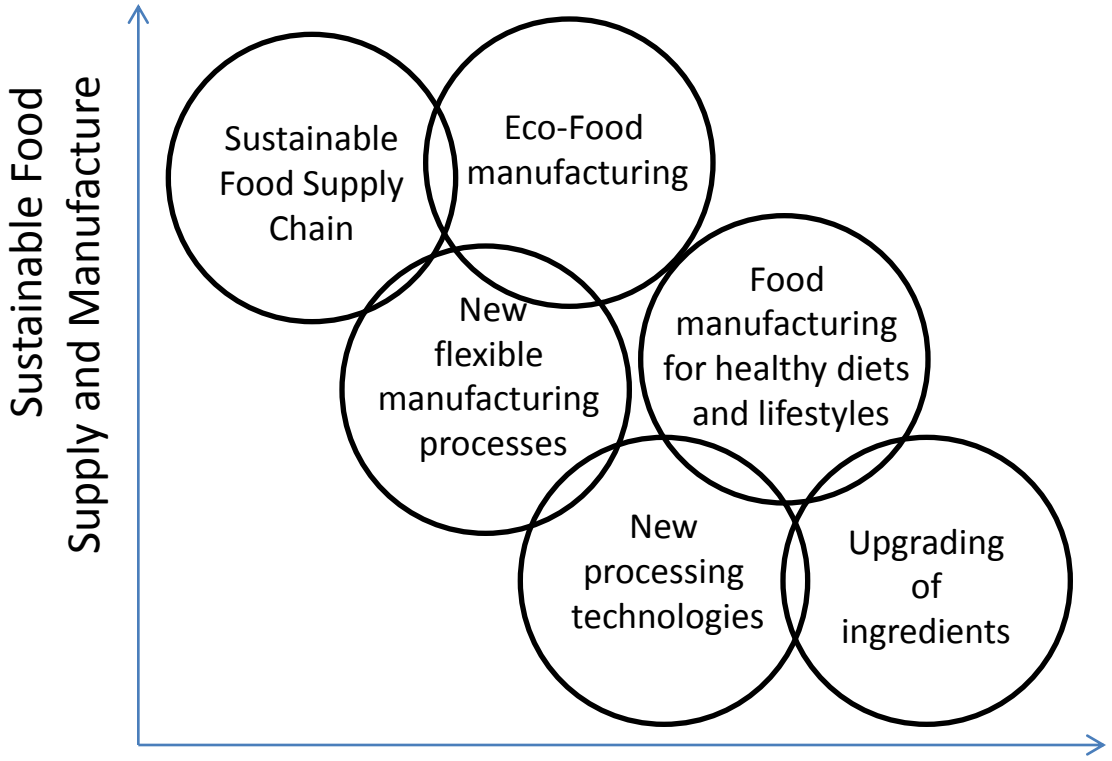
Centre for Sustainable Manufacturing and Recycling / Reuse Technologies: SMART

UNIVERSITY OF BIRMINGHAM

Centre for Formulation Engineering

EPSRC CENTRE FOR INNOVATIVE MANUFACTURING IN Food

Our Focus



The two Centre Grand Challenges and their six Research Themes

Co-creating products of the future –
With ingredient and process developments

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A resource efficient food manufacturing supply chain

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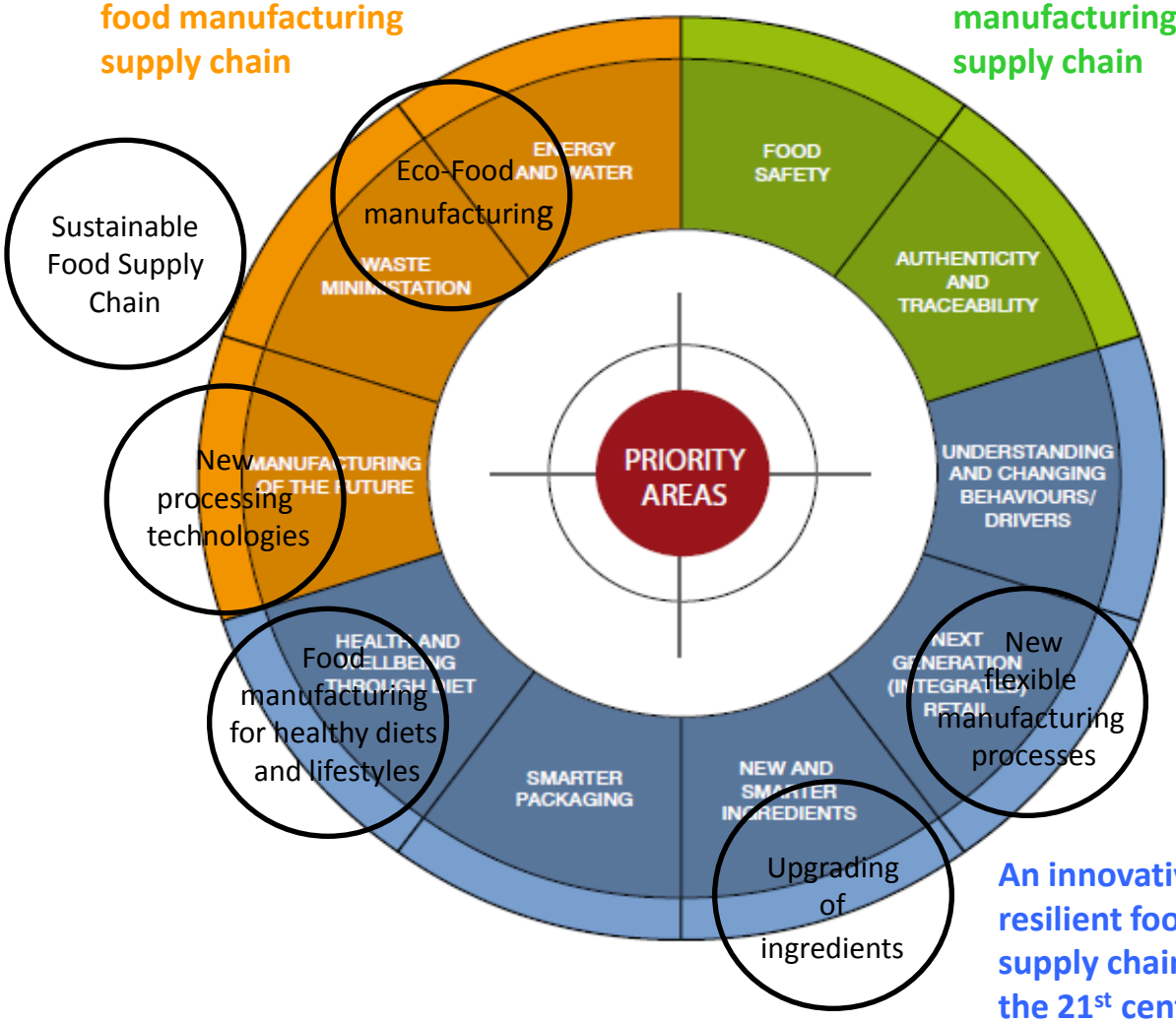
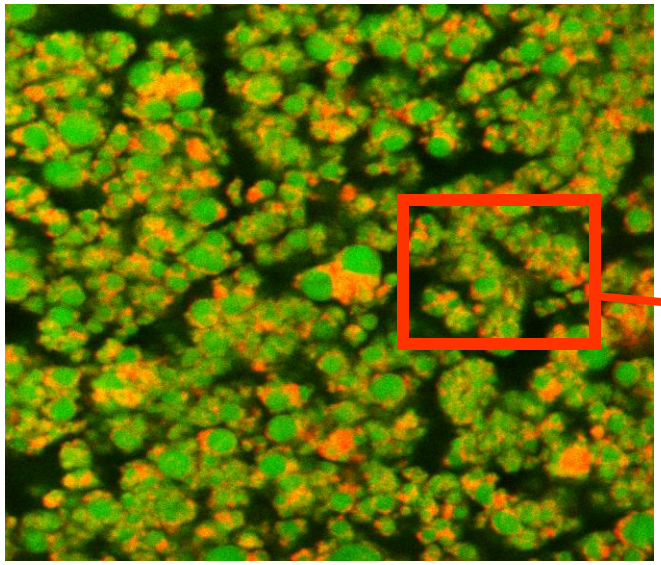
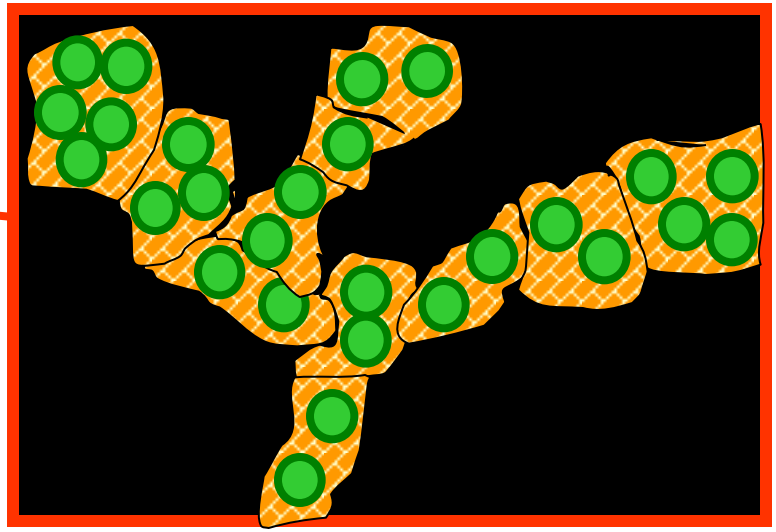


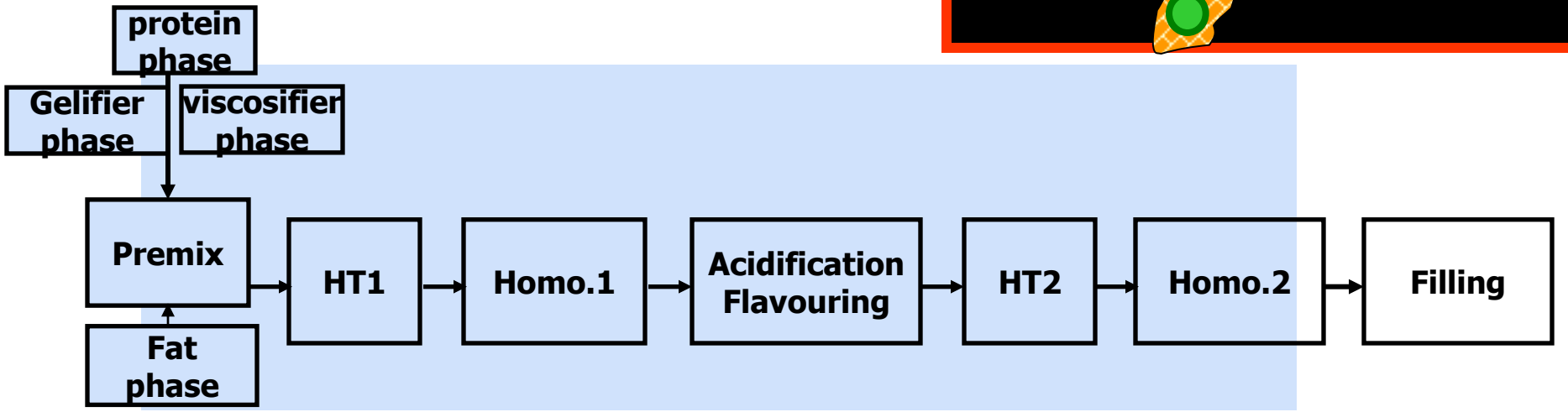
An innovative, resilient food supply chain for the 21st century populations

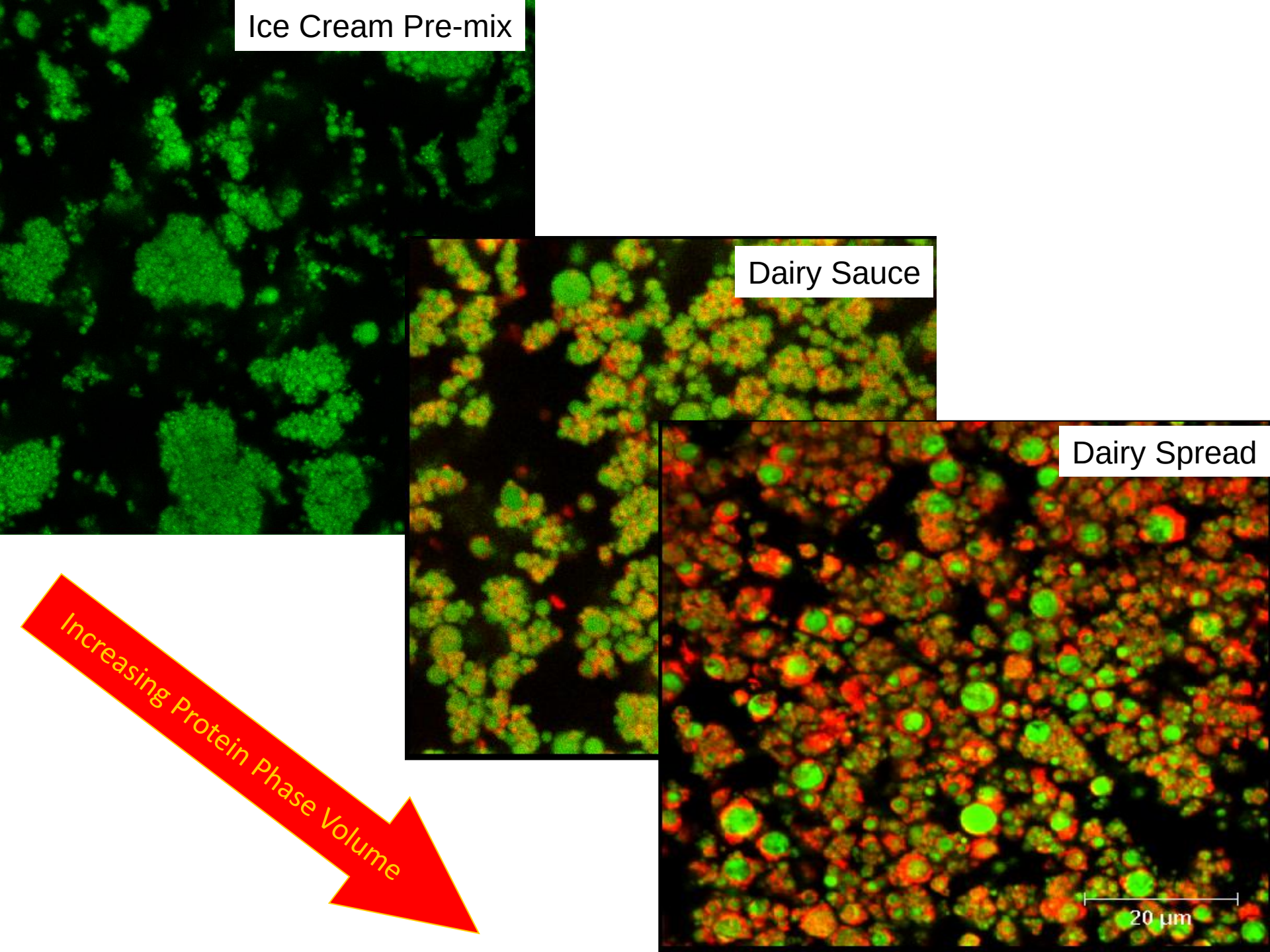
Microstructure & Processing



Black: LBG / water phase
Orange: milk protein phase
Green: fat phase

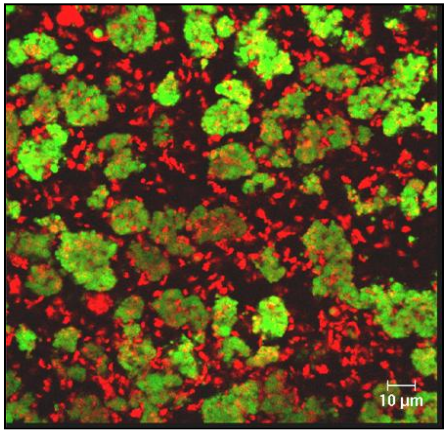


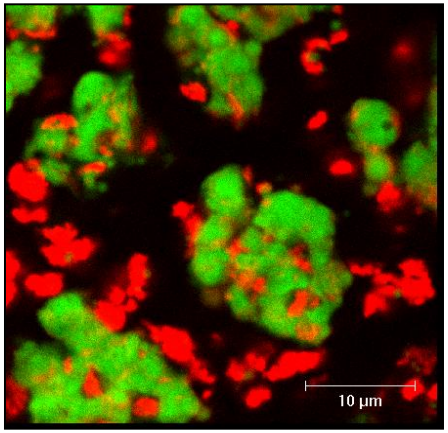



Ice Cream Pre-mix
Dairy Sauce
Dairy Spread
Increasing Protein Phase Volume
20 µm

New Textures

LBG
↓
BMP +Fat
↓
Heat
↓
Acidify
↓
Homogenise 200 Bar
↓
Salt
↓
Fill

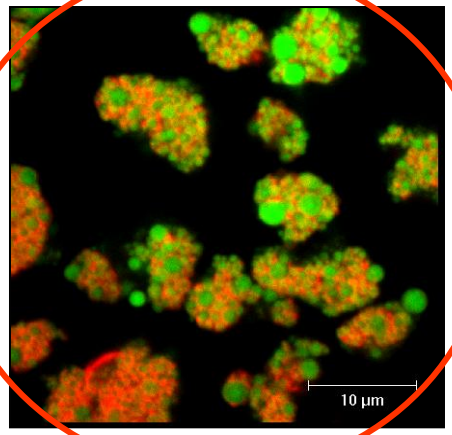




Hardness

80

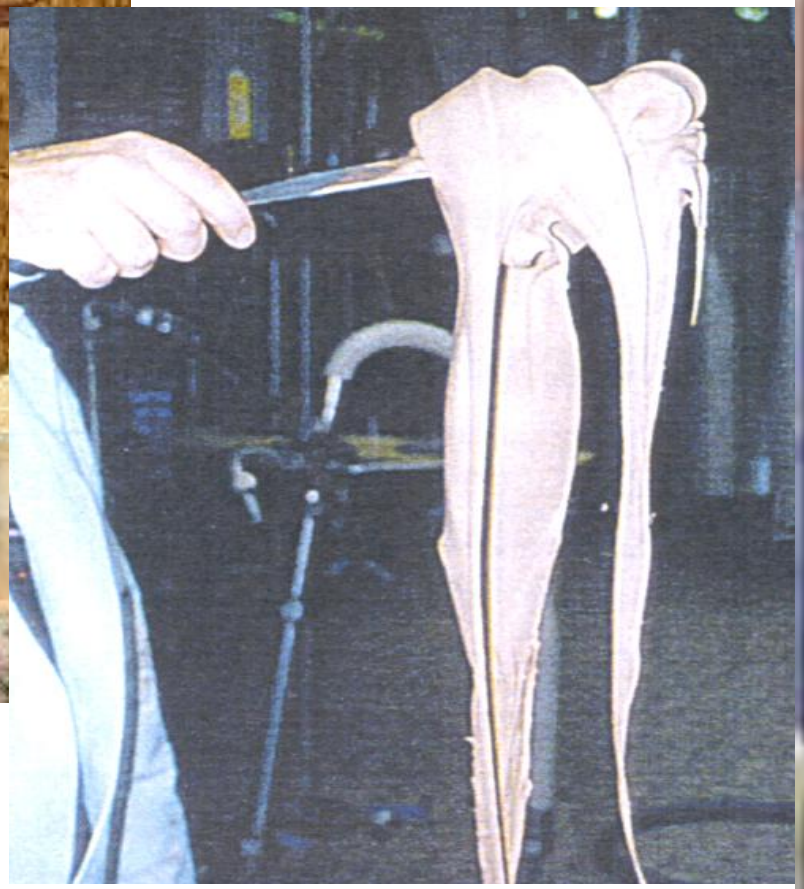
LBG
↓
BMP +Fat
↓
Heat
↓
Homogenise 200 Bar
↓
Acidify
↓
Salt
↓
Fill



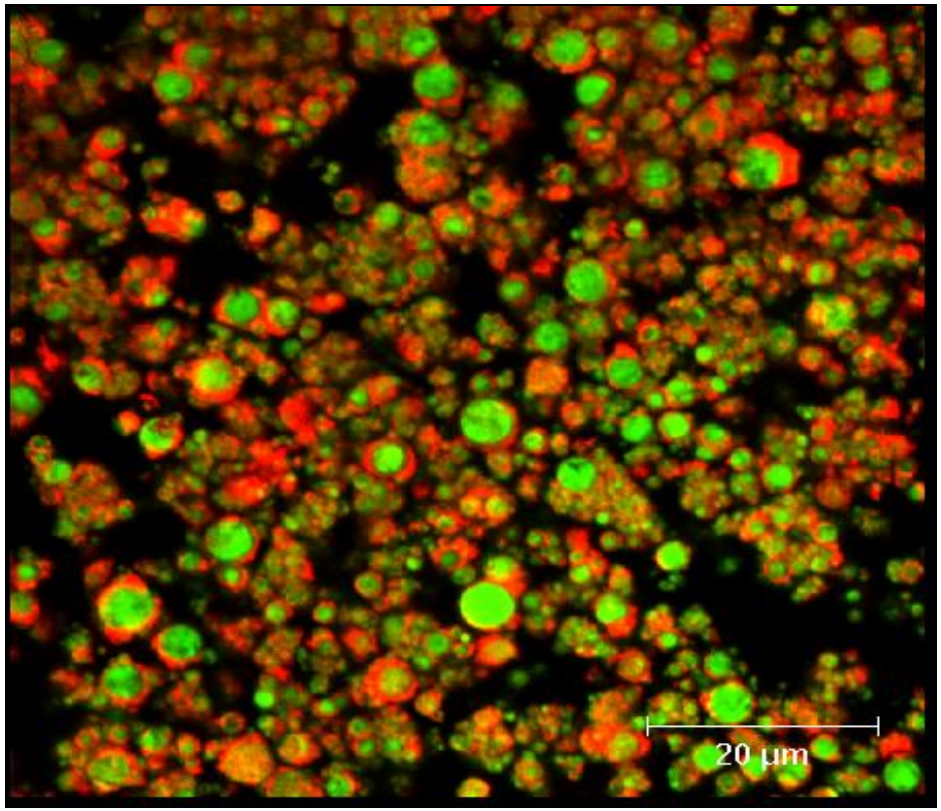
‘Stretchy’

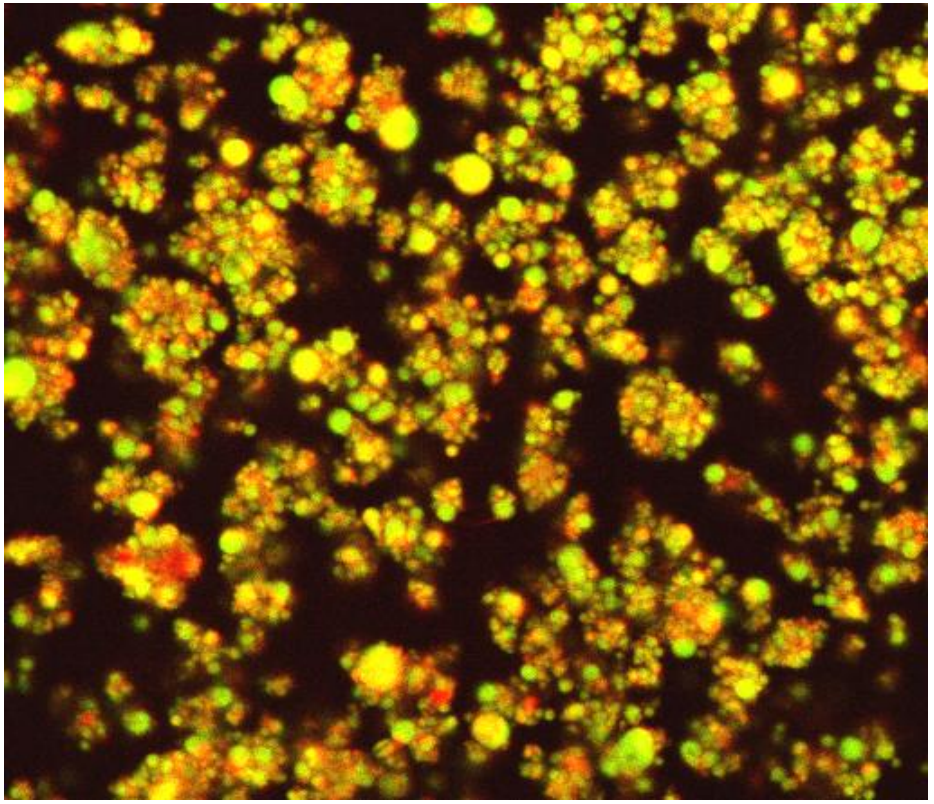
25

New Textures



Ingredient Interchangeability: Proteins

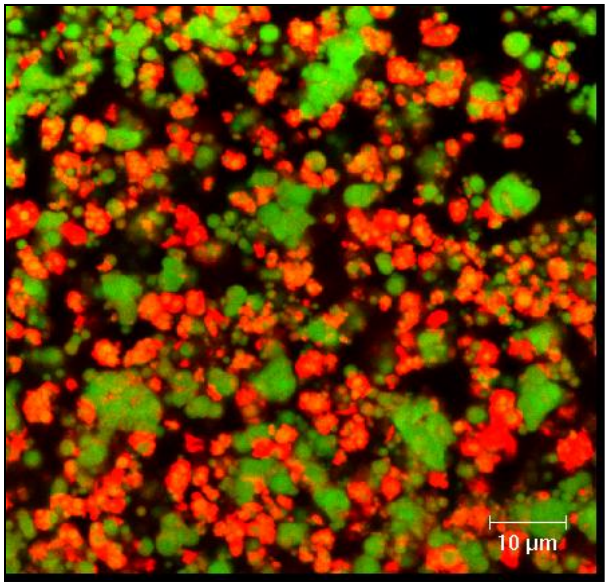




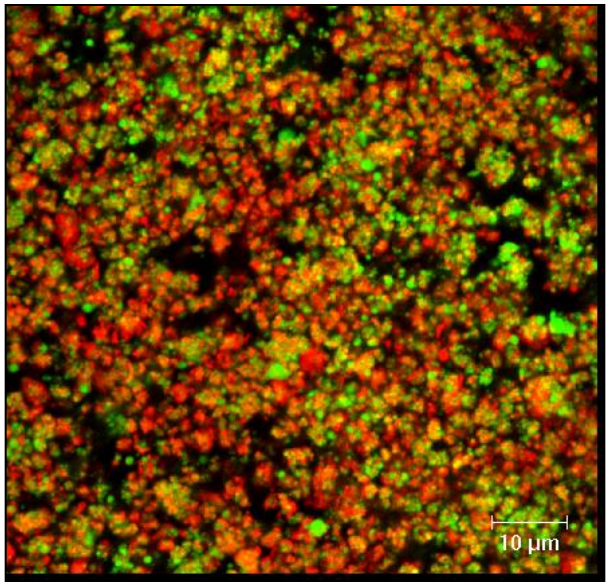
x% LBG
x% Gelatin
x% Milk Protein
22% Fat

x% LBG
x% Gelatin
y% Soy Protein
22% Fat

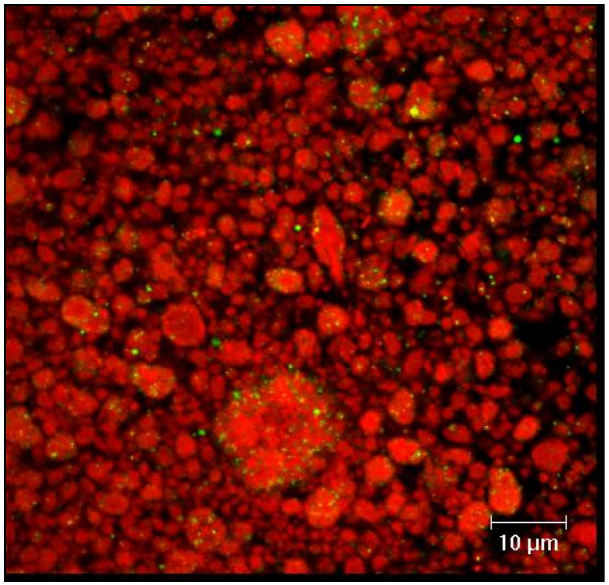
Philadelphia



Full Fat

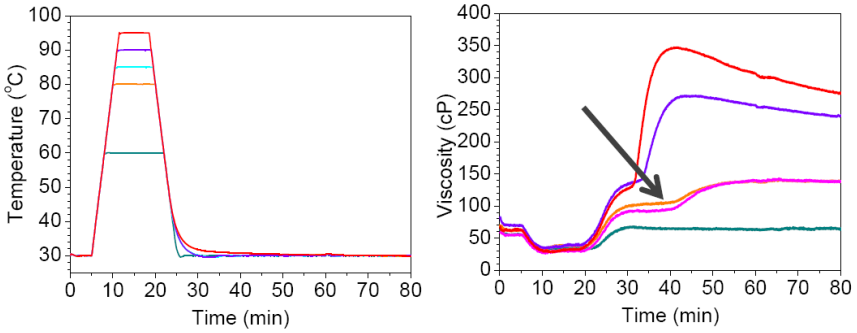


Low Fat

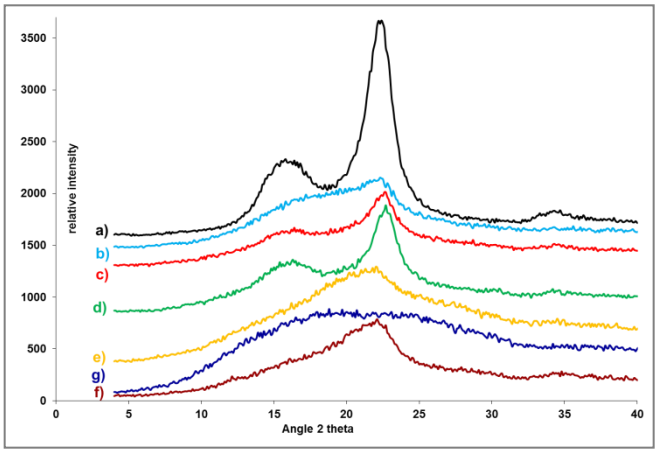


Zero Fat

New Structures from Cellulose

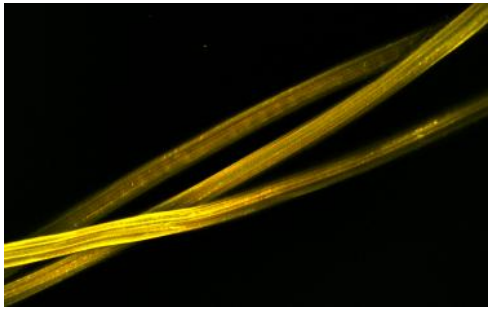


Starch-like processing histories

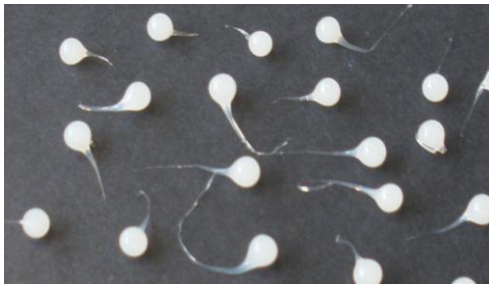


Controlled de-crystallisation and re-crystallisation

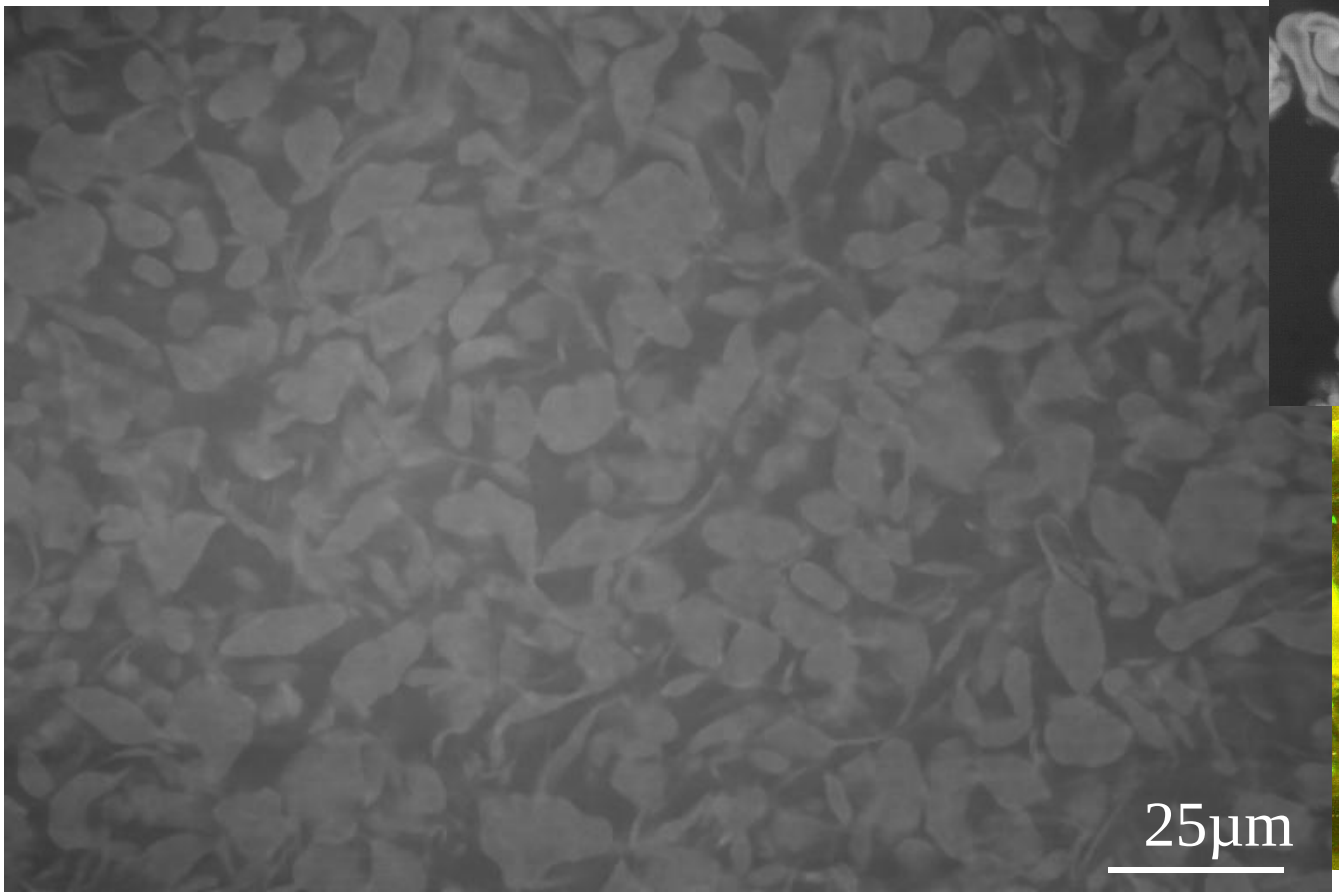
Fibrillation in high shear for new rheologies

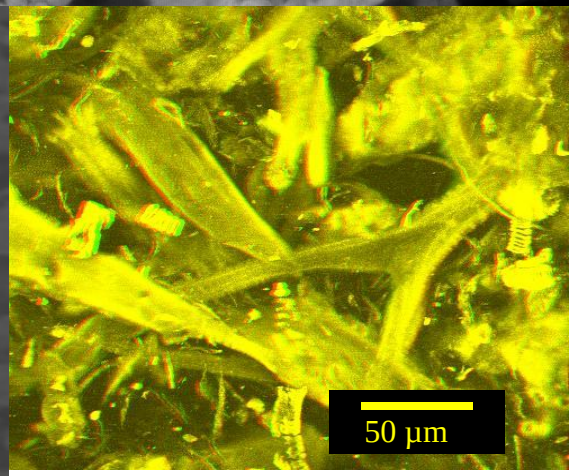


Encapsulation and functionalisation



Filler Phase Interchangeability





Precision Manufacture

- Additive manufacture

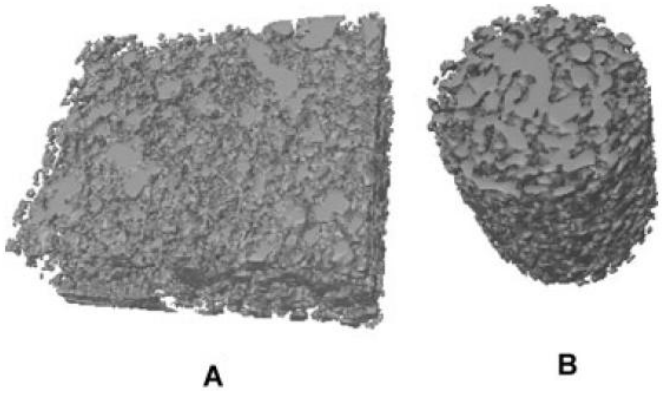
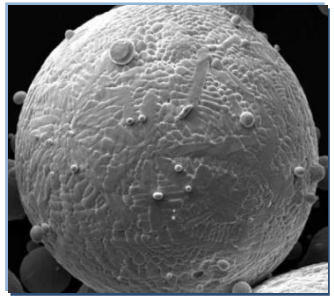


Figure 3–3-D reconstructions of (A) biscuit and (B) breadstick samples.

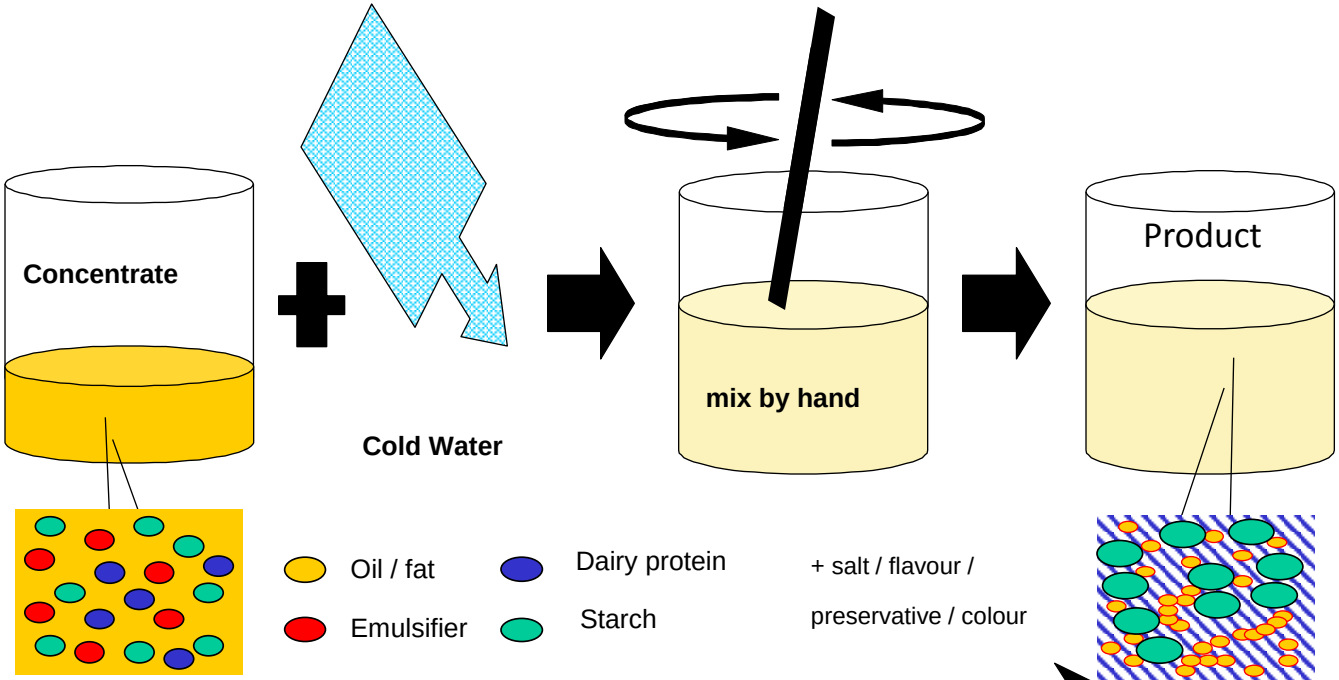
10mm

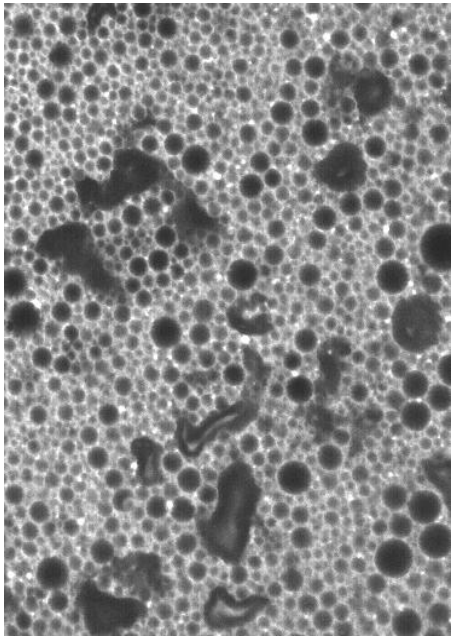
- HIP / Additive layer manufacturing & flash sintering



Melt extruded cellulose

Instant Emulsions





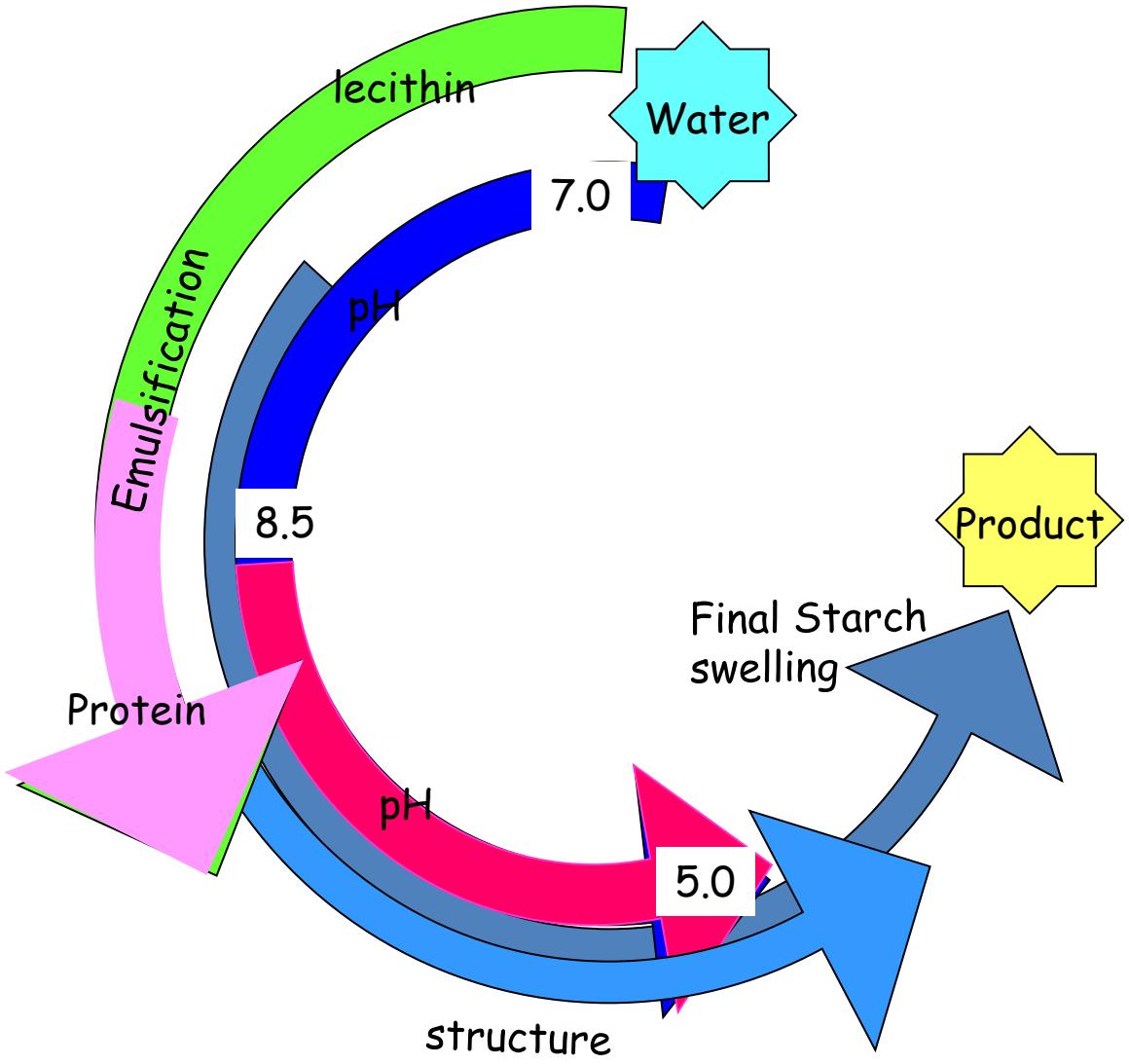
OR

Cold Water / own oil

mix by hand

Unilever Patent Protected

Instant Emulsion Process



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Industry Report

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www.disposablebiomanufacturing.com

Thank you for your attention.