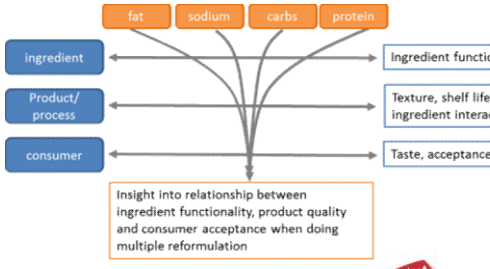
MULTIPLE REFORMULATION, AN OPEN INNOVATION PLATFORM, REACHING FROM INGREDIENT TO CONSUMER 2013-2016



Type	a_w	Products	Multiple reformulation	Model system ingredients
I	$a_w < 0.3$	biscuit	fat, fibers, sugar	flour, fat, sugar, water
II	a_w 0.7-0.9	cake, honey cake	fat, protein, sugar, fiber	tbd, wheat & rye
III	a_w 0.7-0.9	vegetarian product, filet	protein, salt, (fat)	plant protein, gluten/fibers, water, salt
IV	a_w >0.9	ragout	fat, salt, starch	water, flour, salt, fat

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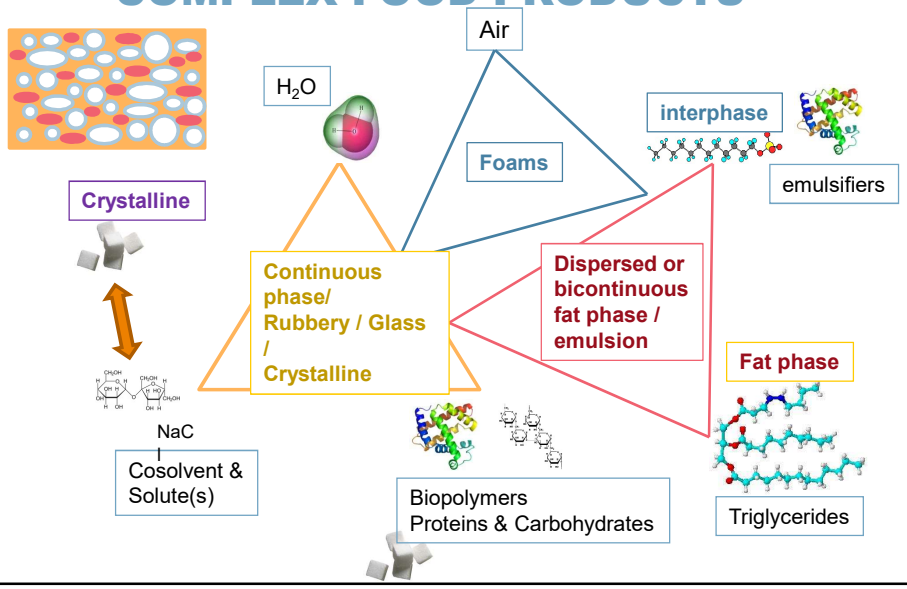
COMPLEX FOOD PRODUCTS



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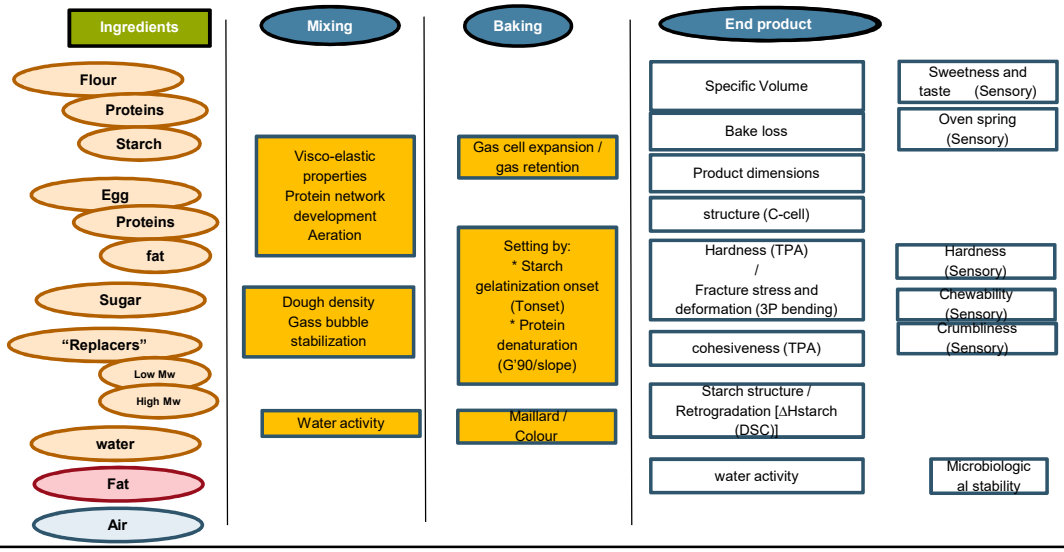
PHYSICAL AND MICROSTRUCTURAL CHARACTERISTICS IN THE DIFFERENT STAGES FROM INGREDIENT TO END PRODUCT



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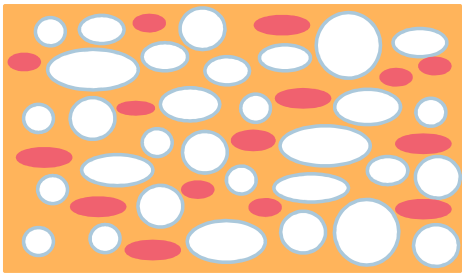
MODELLING COMPLEX FOOD COMPOSITIONS

MICROSTRUCTURAL AND RHEOLOGY AND TEXTURE



Air phase

Fat phase (particles/globules)

Continuous hydrophilic phase "matrix", carbohydrates, protein, sugar, salt)

$$Rheology, Texture = \{G/E_{matrix}, \Phi_{air}, \Phi_{fat}, G/Efat\}$$

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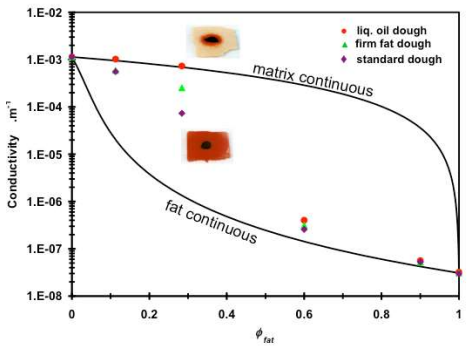
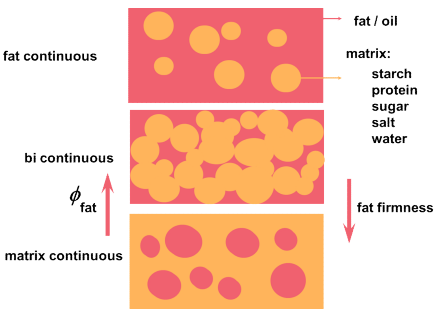
PHASE BEHAVIOUR OF HIGH FAT IN BISCUIT DOUGH MATRICES THE EFFECT OF FAT VOLUME FRACTION (BRUGGEMAN MODEL)

$$\left(\frac{\kappa - \kappa_d}{\kappa_c - \kappa_d}\right)\left(\frac{\kappa_c}{\kappa}\right)^{1/3} = 1 - \phi$$





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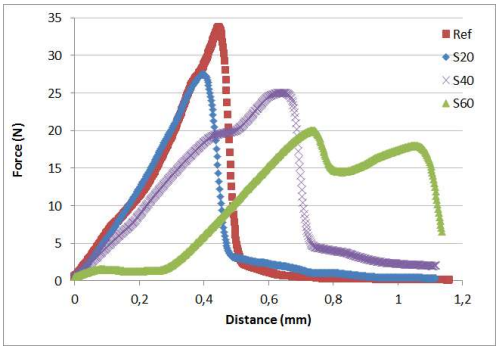
BISCUIT TEXTURAL PROPERTIES



- Stress: $\sigma(F) = \frac{3FL}{2db^2}$
- Strain: $\epsilon(y) = \frac{6by}{L^2}$
- Young's modulus

$$E = \frac{L^3}{4db^3}\left(\frac{dF}{dy}\right)_{y\to 0}$$

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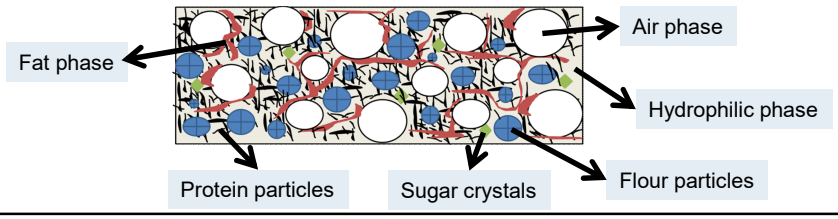
HYPOTHESIS BISCUIT FRACTURE STRESS

From a physical-microstructural viewpoint fracture will depend on

1.Fat volume fraction: dispersed fat in the biscuit weakens the structure, as the fat is softer than the continuous hydrophilic matrix

2.Strength of the hydrophilic phase is affected by the moisture content and sugar and replacers

3.Air volume fraction, expressed in SV. This will be affected by the fat, which is known to stabilize the air bubbles, and by the dough rheology.



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FAT AND SUGAR IN SHORT DOUGH BISCUITS

Lubricator: reducing the mixing time to a workable dough

Mixing

Plasticizer/Anti-plasticizer

Shaper: Increasing spread during baking

Baking

Shaper: Increasing spread during baking

Colorant: Browning

Tenderizer: Leads to shorter, softer texture

Cooling

Texturizer: Leads to harder, crisper biscuits

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MULTIPLE REFORMULATION: *RESULTS*

- Translation to simplified model system
- Quantifying key parameters
- Insights in ingredient-functionality-process interactions
- Predictive modelling
- Select suitable reformulation strategy
- Evaluate the quality effects
- Complexify to real systems

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MUTIPLE REFORMULATION *ACHIEVEMENTS*

30% less salt, 20% less fat, 50% less SAFA

40% less sugar AND 40% less fat
50% less sugar AND 30% less egg

50% sugar reduction AND fiber enrichment

30% sugar reduction AND fiber enrichment

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BEYOND THE EXPECTED

EARTO
IMPACT DELIVERED

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FINALIST EARTO INNOVATION AWARD

EARTO
IMPACT DELIVERED

11 October 2017, Brussels

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AND ALL OTHER COLLEAGUES

TIME.TNO.NL
E-mail: ronald.visschers@tno.nl