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FRICTION MEASUREMENTS WITH YOGHURT IN A MODEL TONGUE-PALATE CONTACT

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ABSTRACT

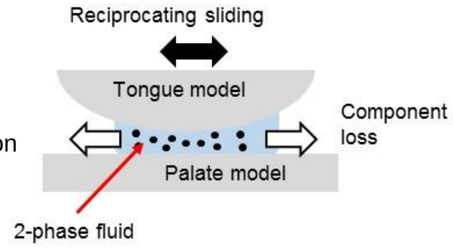
The perception of many food attributes (creaminess, smoothness) is related to mechanical stimulation and friction experienced in the tongue-palate contact during mastication. Friction in the tongue-palate is determined by the changing film properties (composition, component distribution, thickness)as it is mechanically degraded in the conjunction. We suggest this evolution is essentially determined by tongue-palate film loss rather than shear flow entrainment which predominates in conventional bearing lubrication. A reciprocating, sliding contact with restricted stroke length (<contact width) was used; under these conditions there is negligible shear-entrainment of fluid from outside the contact area. Friction was measured over 60 seconds rubbing for different fat content yoghurts (0, 4.2, 9.5%wt fat).

MOUTHFEEL OF FOODS AND ORAL FRICTION

Many semi-solid dairy foods (cream, butter, yoghurt) have a multi-phase structure (oil/water/solids) which breaks down in the mouth during mastication. The mechanisms of degradation, component loss and distribution in the mouth will determine mouthfeel as the food film is sheared. The challenge is to develop a tribology test which simulates the tongue-palate contact and measure friction change as the food is mechanically degraded. This would provide a screening test to aid the development of low fat foods.

Test to simulate oral conditions:

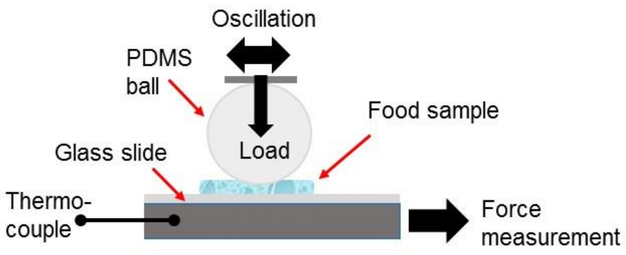
- Specimens: tongue/palate mimics, saliva
- Correct contact pressures/motion
- Single addition of food
- Measure friction change with time following food film degradation
- Relate friction to changes in food composition and mouthfeel



PROJECT AIMS and EXPERIMENTAL

Develop HFRR bench test to simulate tongue (PDMS) rubbing against the palate(glass slide) during mastication

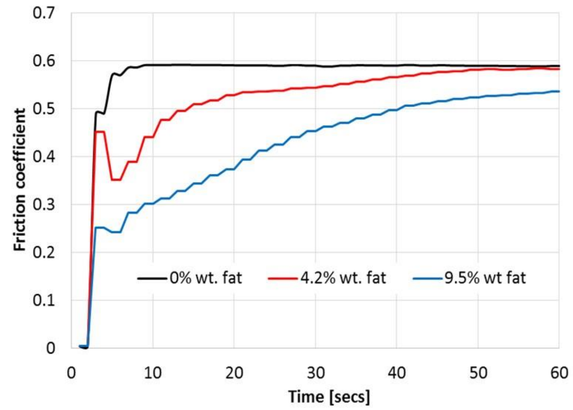
- Reciprocating sliding to simulate tongue motion against the palate
- Single charge of food at start of test
- Friction measured with rubbing time to follow film thinning and breakdown
- Post test examination of rubbed films: component breakdown and deposition



Test condition	
Specimens	PDMS 19 mm dia ball Glass microscope slide
Test fluids	Yoghurt: 0, 4.2, 9.5 wt. % fat
Reciprocating sliding test	2N load 10 Hz, 1 mm stroke length, 60 secs rubbing

High Frequency Reciprocating Rig (HFRR PCS Instrument, London UK) .

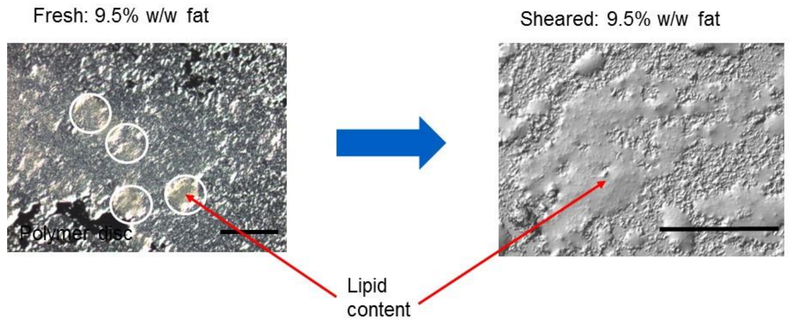
RESULTS



Friction increase as the film breaks down: delayed for higher fat content

Enhanced mouthfeel attributes?

Friction change with rubbing time for different fat-content yoghurts



Changes to the structure and distribution of dairy food components

DIC optical images of fresh and rubbed yoghurt films

CONCLUSIONS.

- Semi-solid food is trapped within the tongue-palate contact and undergoes mechanical degradation and film-thinning due to shear and loading forces. Friction is time/loss dependent rather than speed .
- Differences were observed in the friction change with time for different fat contents (μ 9.5<4.2<0 wt%)
- Low friction coefficient associated with a thin, coherent oil film spread on deposited dairy solids.

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