



Leaders In Tribology Test Equipment





**Design and manufacture
world leading tribology
test equipment**

35 + Years

3,000 + Instruments

100 + Countries

500 + Technical Papers

PCS Instruments



35 + Years

3,000 + Instruments

100 + Countries

500 + Technical Papers

MPR



MPR-GI



MTM



MTM-EC



ETM



HSD



Rolling Contact Fatigue + Surface Damage

Traction, Additive Activity & Surface Damage

EHD



EHD-HS



USV



ABS



HFRR



HPR



Lubricant Film Thickness

Viscosity

Fuel Lubricity

Friction & Wear



35 + Years

3,000 + Instruments

100 + Countries

500 + Technical Papers

8 + Industries

MTM

A ball-on-disc instrument for measuring the frictional properties of lubricated and unlubricated contacts under a wide range of rolling and sliding conditions.



HFRR

A ball-on-disc, high-frequency, reciprocating instrument for assessing the lubricity of both fuels and lubricants under boundary conditions.



Relevant Industries:



Food & Beverage



Biomedical

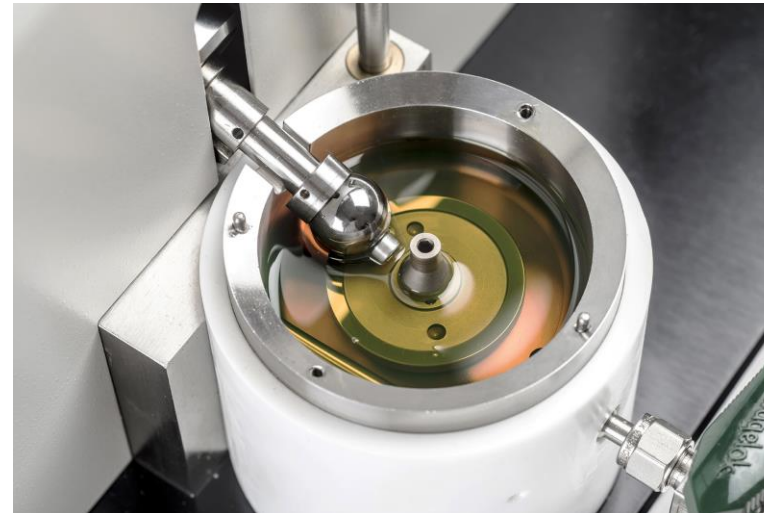


Lifestyle



MTM

A ball-on-disc instrument for measuring the frictional properties of lubricated and unlubricated contacts under a wide range of rolling and sliding conditions.



Relevant Industries:



Food & Beverage



Biomedical



Lifestyle



MTM - Instrument Overview



Repeatable and accurate

Excellent instrument-to-instrument reproducibility.



Featured in 500+ Publications

Proven instrument with over 300 systems sold worldwide.



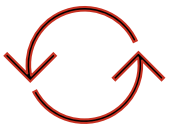
User friendly

Easy training for new users



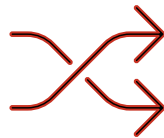
Reliable

Durable over many years of regular, daily operation



Continually improving

Ongoing R&D initiatives ensure that the MTM remains a market-leading product



Flexible

A wide range of specimen options makes the MTM a very versatile and popular options across many industries:

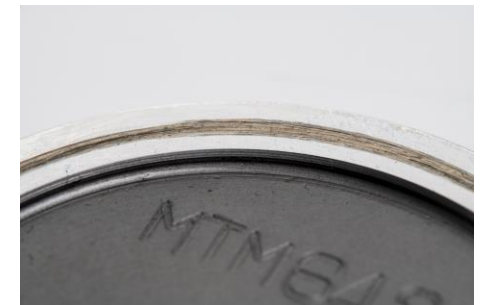
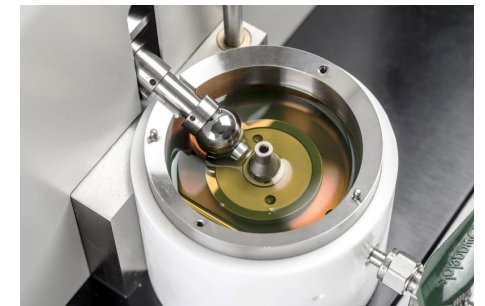
In-service Features:

- Fast to clean and easy to set-up for operators.
- Simple step-by-step calibration procedure with pre-defined limits to preventing calibration errors.
- Instrument operates on pre-defined 'test profiles', allowing the operator to simply select a profile to be executed.
- The MTM is fully automated, so can be left during testing.



MTM – Technical Specifications

Load	10 to 75 N 2 to 8 N with optional low load beam
Contact Pressures	0 to 1.25 GPa (standard specimens)
Speed	+/- 4 m/s
Slide / Roll Ratio	+/- 10,000 %
Temperature Range	Ambient to 150°C Below ambient possible with optional oil cooler
Test Sample Volume	35ml 10ml with optional pot filler
Dimensions (h x w x d)	400mm / 18" x 400mm / 18" x 600mm / 24"
Weight	30 kg / 66 lb





MTM – Food Applications

1. Oral Processing

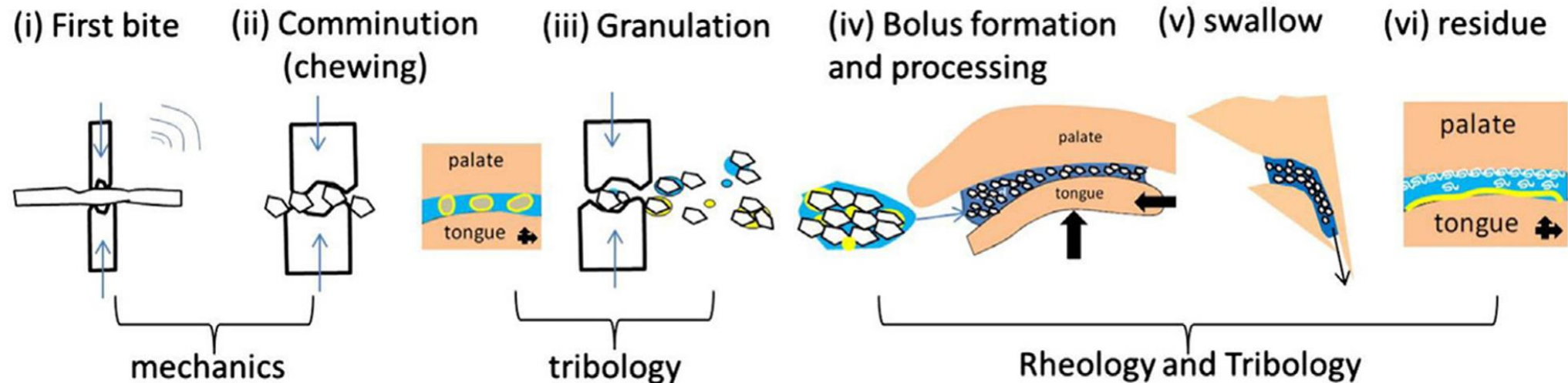
Food oral processing includes all muscle activities, jaw movements, and tongue movements that contribute to preparing food for swallowing.



2. Sensory Perception

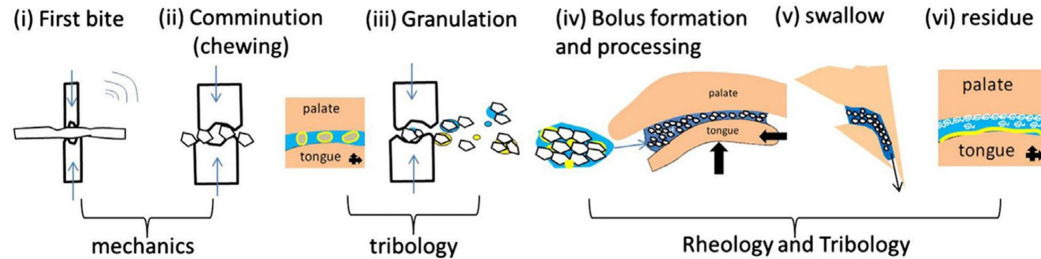
Sensory perception determines how you experience different flavours and textures in food.

MTM – Oral Processing



Jason R. Stokes, Michael W. Boehm, Stefan K. Baier,
Oral processing, texture and mouthfeel: From rheology to tribology and beyond,
Current Opinion in Colloid & Interface Science,
Volume 18, Issue 4, 2013, Pages 349-359, ISSN 1359-0294,
<https://doi.org/10.1016/j.cocis.2013.04.010>.

MTM – Oral Processing



Interactions occur between:

Teeth – Teeth

Tongue Palate

Tongue – Teeth

Teeth – Food

Tongue - Food

Tongue – Bolus

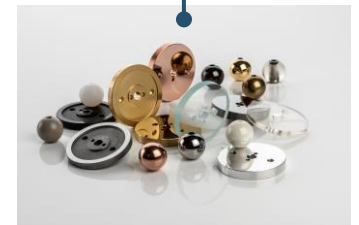
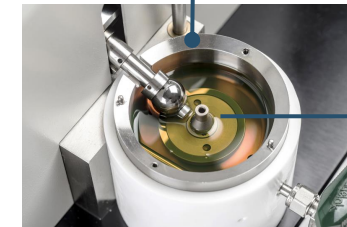
Lips

Lips – Food

Bolus – Palate

Food Particles – Oral Surfaces

PCS Instruments can supply a wide range of specimens to allow different oral interactions to be studied



Including:

- PDMS (Duro 30)
- PDMS (Duro 50)
- Glass
- + ...



MTM – Oral Processing

Google Scholar:

“PCS Instruments” + “Mini Traction Machine” + “Oral Processing”

= 110 results

Google Scholar

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Any time

Since 2025

Since 2024

Since 2021

Custom range...

Sort by relevance

Sort by date

Any type

Review articles

☐ include patents

☒ include citations

☒ Create alert

"PCS Instruments" + "Mini Traction Machine" + "Oral Processing"

About 110 results (0.07 sec)

Surface texture modifications for **oral processing** applications
BL Taylor, [TB Mills](#) - *Biotribology*, 2020 - Elsevier
... The surfaces currently used in soft tribology when assessing **oral processing** in-vitro are not yet fully representative of the oral cavity. Surface topography, among other physical and ...
☆ Save ⓘ Cite Cited by 12 Related articles All 5 versions

[PDF] bham.ac.uk

[\[HTML\]](#) Tribology–Novel **oral processing** tool for sensory evaluation of food
[V Paul](#), [AD Tripathi](#), [A Aggarwal](#), P Kumar, [DC Rai](#) - *Lwt*, 2022 - Elsevier
... Food **oral processing** is a study of mastication that involves food-saliva interaction. ... This review summarizes the role of tribology as a novel **oral processing** tool for the sensory evaluation ...
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[HTML] sciencedirect.com

Tribology and its growing use toward the study of food **oral processing** and sensory perception
[HM Shewan](#), [C Pradal](#), [JR Stokes](#) - *Journal of texture studies*, 2020 - Wiley Online Library
... based on soft contacts in the **Mini-traction machine** with rolling ball on disk configuration, ...) is the commercially available MTM Tribometer (**PCS Instruments**). The usual configuration is a ...
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[PDF] core.ac.uk

Applications of tribology in studying food **oral processing** and texture perception
[S Prakash](#), DDY Tan, [J Chen](#) - *Food Research International*, 2013 - Elsevier
... **Oral processing** of food is intricate and involves a series of processes—Ingestion, ... However, as the **oral processing** continues and food particle size reduces, rheology alone is no longer ...
☆ Save ⓘ Cite Cited by 221 Related articles All 4 versions

Development of in-vitro mouth methods for studying oral phenomena
[TB Mills](#) - 2012 - [etheses.bham.ac.uk](#)
... understanding of both **oral processing** and our perception of ... The study of **oral processing** has been ongoing for many ... is that of a **mini traction machine** (MTM, **PCS Instruments**, London), ...
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[PDF] bham.ac.uk

[\[HTML\]](#) Mechanical cleaning of food soil from a solid surface: A tribological perspective
P Beste, PA Cabedo, S Bakalis, M Groombridge... - *Journal of Food* ..., 2024 - Elsevier
... the synergistic effects of mechanical removal and chemical removal (ie dissolution) of a layer of representative food soil from a solid surface, using a tribometer, **Mini Traction Machine** (...
☆ Save ⓘ Cite Cited by 2 Related articles All 4 versions

[HTML] sciencedirect.com

[\[HTML\]](#) **Oral processing**, texture and mouthfeel: From rheology to tribology and beyond
[JR Stokes](#), [MY Boehm](#), [SK Balci](#) - *Current Opinion in Colloid & Interface* ..., 2013 - Elsevier
... **mini-traction machine** from **PCS Instruments**. PDMS is used because it has a low modulus, can be easily modified to be hydrophobic, hydrophilic, rough, smooth, etc. [98 ↔]; it can be ...
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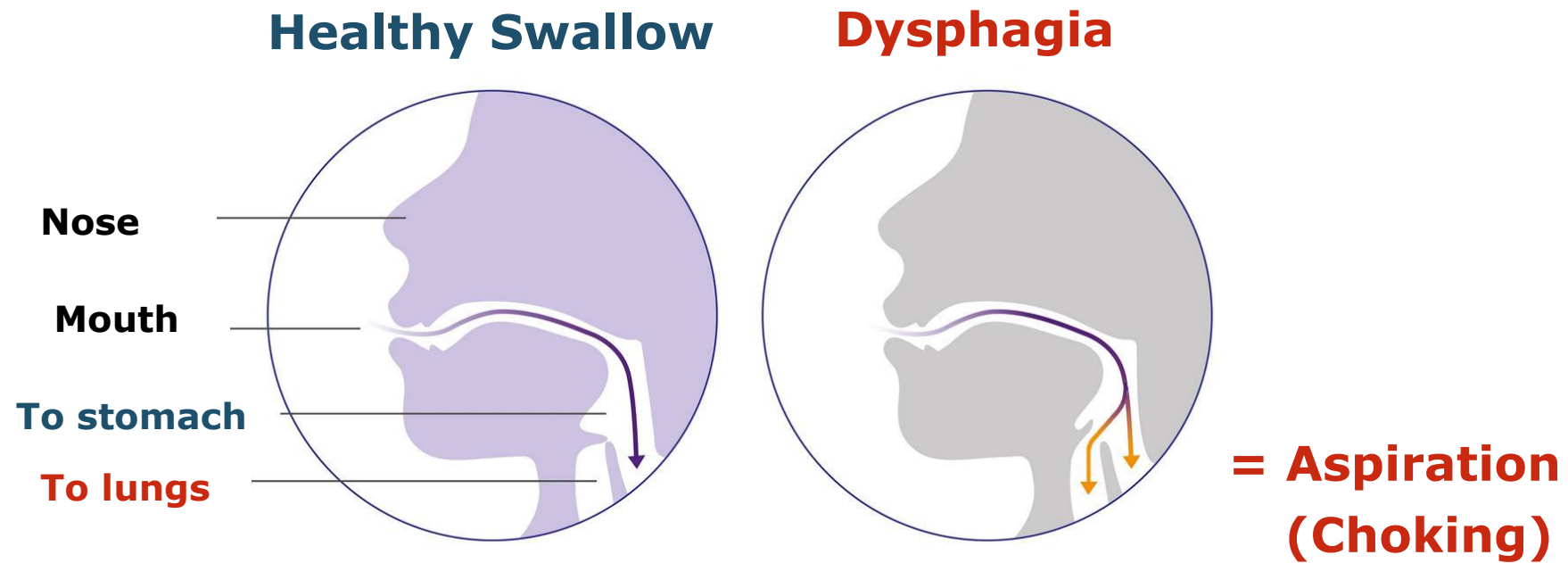
[HTML] sciencedirect.com

Lubrication of chocolate during **oral processing**
[SA Rodriguez](#), [N Selway](#), [MP Morgenstern](#), L Motil... - *Food & Function*, 2017 - [pubs.rsc.org](#)
... The lubrication of all samples was tested immediately on a **mini-traction machine** (MTM2, **PCS Instruments** Ltd, UK). A sample volume of 20 mL was used per test, with the inclusion of ...
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Tribometers for Studies of Oral Lubrication and Sensory Perception
Q Wang, Y Zhu, J Chen - ... : *Measurement and Perception of Food Textural* ..., 2023 - Springer
... **Oral processing** of food involves a series of sequential or simultaneous oral actions. ... 3.5

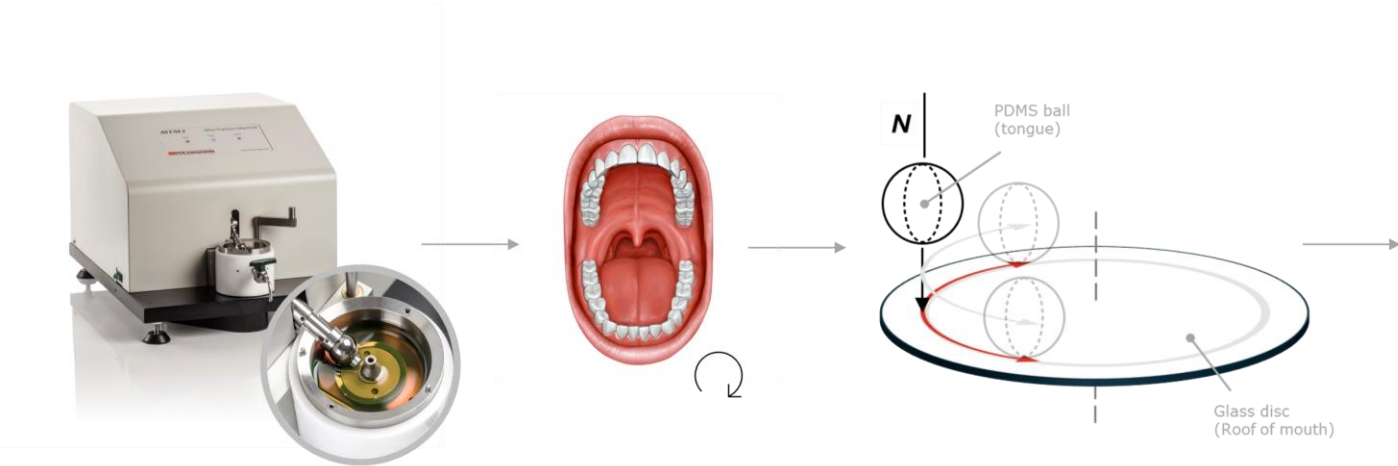


MTM – Oral Processing - Thickeners for Dysphagia





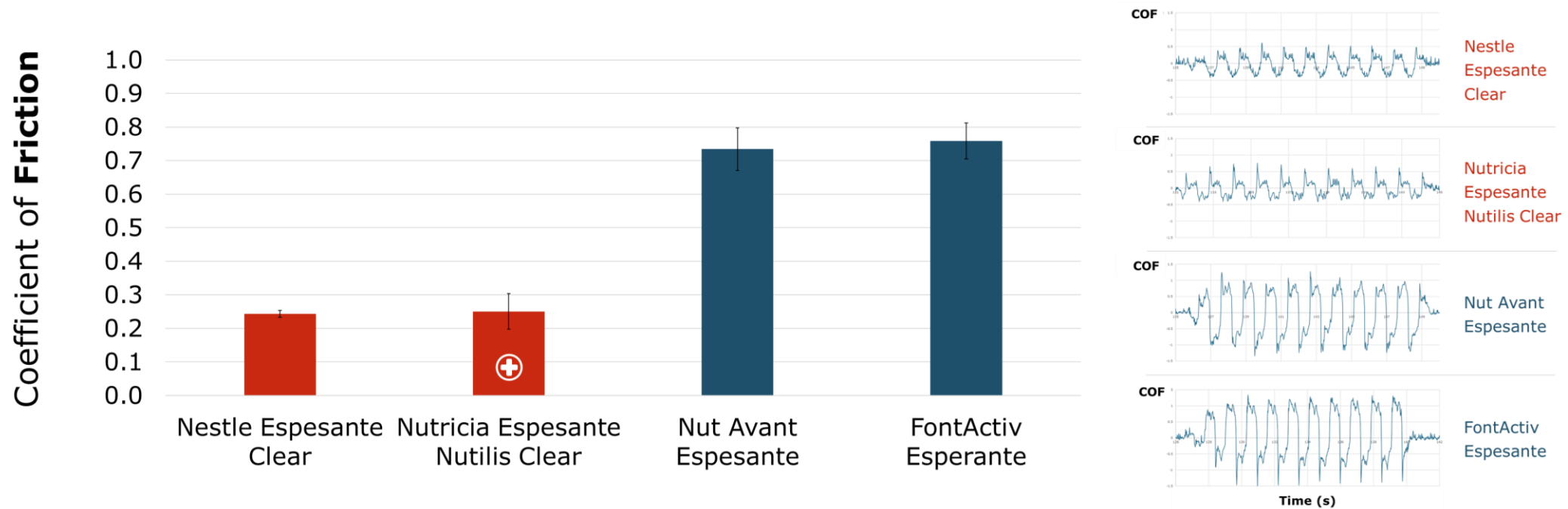
MTM – Oral Processing - Thickeners for Dysphagia



	Tongue-palate	Test Conditions
Normal Load	-	1N
Contact Pressure	5 kPa to 35 kPa	123 Kpa
Stroke Length	-	<u>16</u> mm
Frequency	-	0.8 Hz
Mid-Stroke Speed	2 mm/s to 35 mm/s	25 mm/s
Temperature	36 °C to 37.5 °C	Ambient
Sampling Rate	5 Hz to 50 Hz	50 Hz

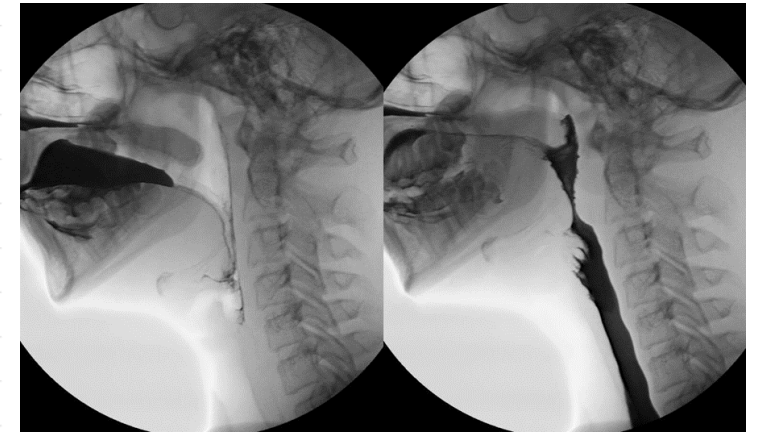
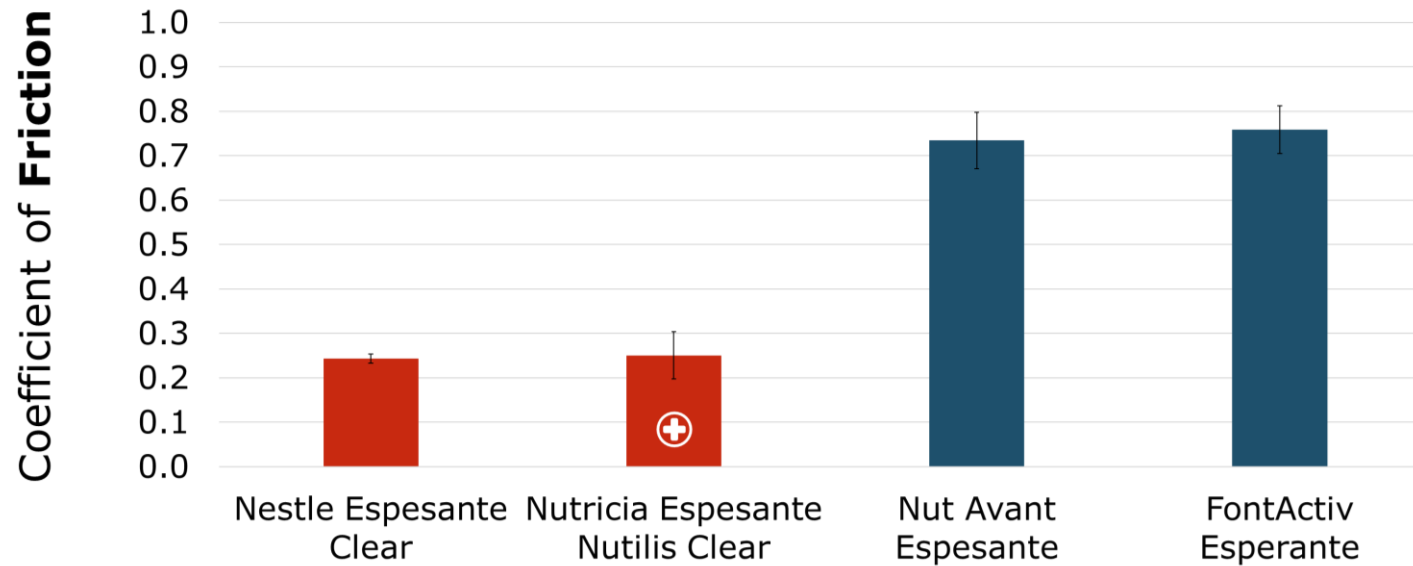


MTM – Oral Processing - Thickeners for Dysphagia





MTM – Oral Processing - Thickeners for Dysphagia





MTM – Food Applications

1. Oral Processing

Food oral processing includes all muscle activities, jaw movements, and tongue movements that contribute to preparing food for swallowing.

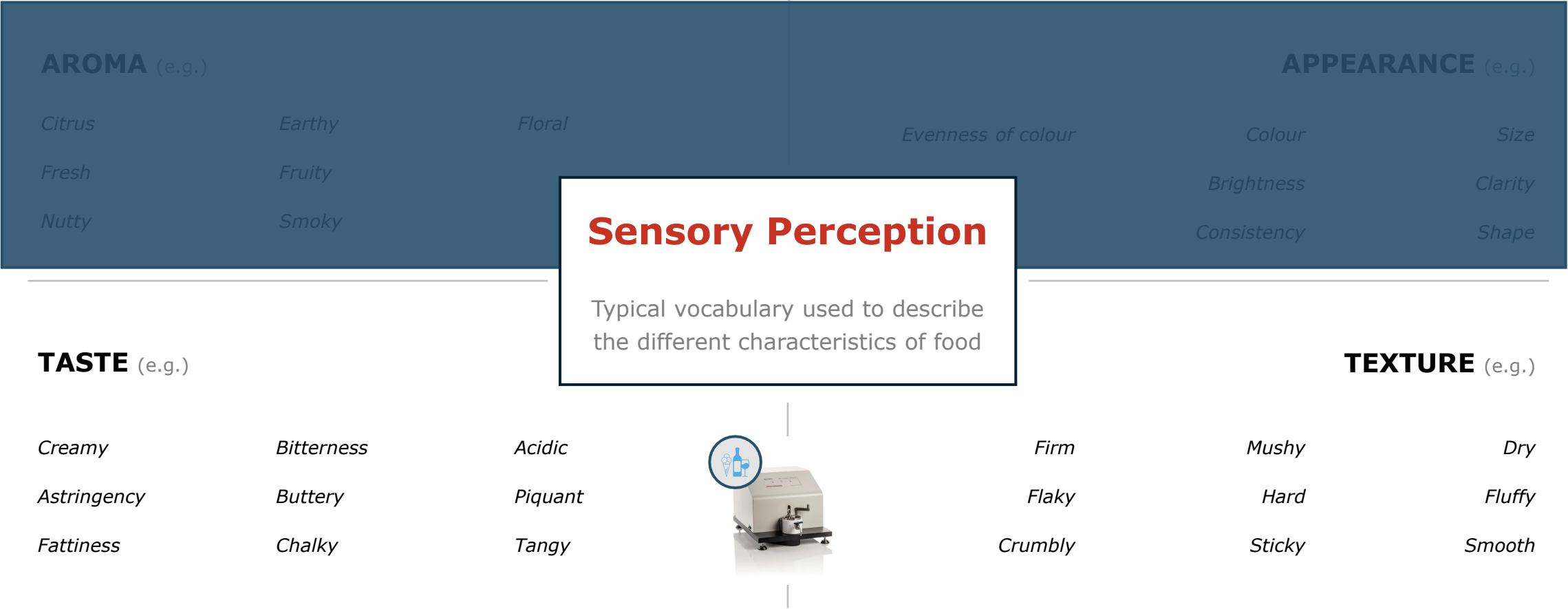


2. Sensory Perception

Sensory perception determines how you experience different flavours and textures in food.



MTM – Sensory Perception





MTM – Sensory Perception

Google Scholar:

“PCS Instruments” + “Mini Traction Machine” + “Sensory Perception”

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☐ Include patents
☒ Include citations

☒ Create alert

"PCS Instruments" + "Mini Traction Machine" + "Sensory Perception"

About 110 results (0.03 sec)

Tribology and its growing use toward the study of food oral processing and **sensory perception**
HM Shewan, C Pradal, JR Stokes - Journal of texture studies, 2020 - Wiley Online Library
... soft contacts in the **Mini-traction machine** with rolling ball on ... to provide insights into the **sensory perception** of foods in ... available MTM Tribometer (**PCS Instruments**). The usual ...
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Tribometers for Studies of Oral Lubrication and **Sensory Perception**
Q Wang, Y Zhu, J Chen - Measurement and Perception of Food Textural ..., 2023 - Springer
... 3.5 **Mini-Traction Machine** (MTM) The **mini-traction machine** (**PCS Instruments**) is probably one of the most commonly used tribometers in food applications. The instrument was ...
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Oral tribology: Bridging the gap between physical measurements and sensory experience
C Pradal, JR Stokes - Current Opinion In Food Science, 2016 - Elsevier
... Tribology and **sensory perception** are affected by multiple physico-chemical properties, and ... used device is the **Mini-Traction-Machine** (MTM) tribometer (**PCS Instruments**) that features ...
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[HTML] Tribology--Novel oral processing tool for sensory evaluation of food
V Paul, AD Tripathi, A Agarwal, P Kumar, DC Rai, 2022 - Elsevier
Food oral processing is a study of mastication that involves food-saliva interaction. Instrumental approaches have improved sensorial attributes like texture by stimulating the oral ...
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Astringency of tea catechins: More than an oral lubrication tactile percept
D Rossetti, JHH Bongaerts, E Wantling, JR Stokes - Food ..., 2009 - Elsevier
Oral astringency is the dry sensation experienced in the mouth on consumption of plant-based polyphenols (catechins) found in wine and tea as well as certain fruits and vegetables. It ...
☆ Save 90 Cite Cited by 235 Related articles All 6 versions

[HTML] Marrying oral tribology to **sensory perception**: A systematic review
A Sarkar, EM Krog - Current Opinion In Food Science, 2019 - Elsevier
... Schematic illustration of different tribometers that are used in the area of food research (a) showing a **Mini-traction-machine** (MTM) with PDMS ball-on-PDMS disc set-up, where U B and ...
☆ Save 90 Cite Cited by 133 Related articles All 11 versions

Relating rheology and tribology of commercial dairy colloids to **sensory perception**
L Laguna, G Farrell, M Bryant, A Morina, A Sarkar - Food & Function, 2017 - pubs.rsc.org
... The tribological properties of all the commercial dairy products was assessed using a **Mini Traction Machine** (MTM, **PCS Instruments**, UK) to facilitate a mixed rolling and sliding contact. ...
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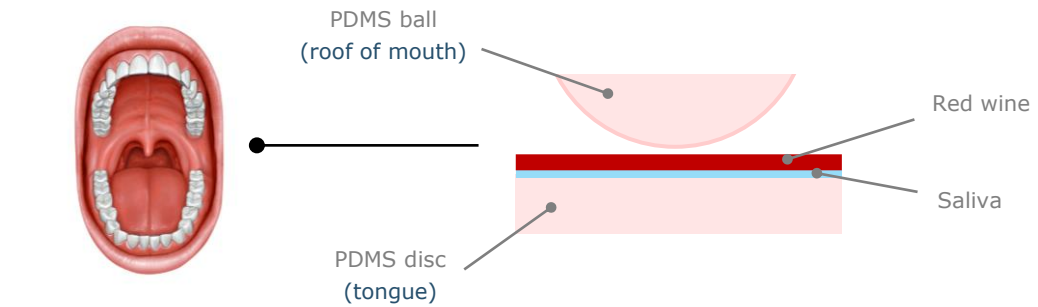
Soft Tribology and Its Relationship With the **Sensory Perception** in Dairy
B Ubadhyay - Methods in food chemistry and food science ..., 2023 - books.google.com
... (A) **Mini-traction machine** in a ball on disk configuration (MTM); (B) Optical tribometer configuration (OTC); (C) Anton-Paar ball on three pins rheometer attachment and (D) High-...
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[PDF] Fact or friction: characterizing food by tribology
NH Mermelstein - Food Technol, 2016 - ift.org

©PCS Instruments Ltd. 2025



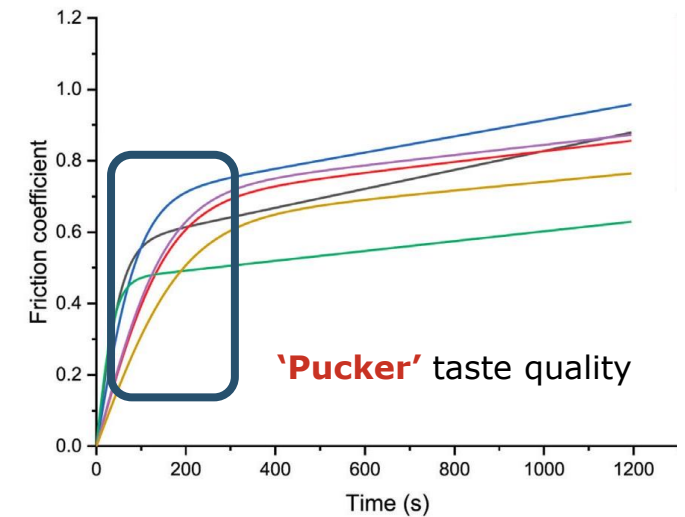
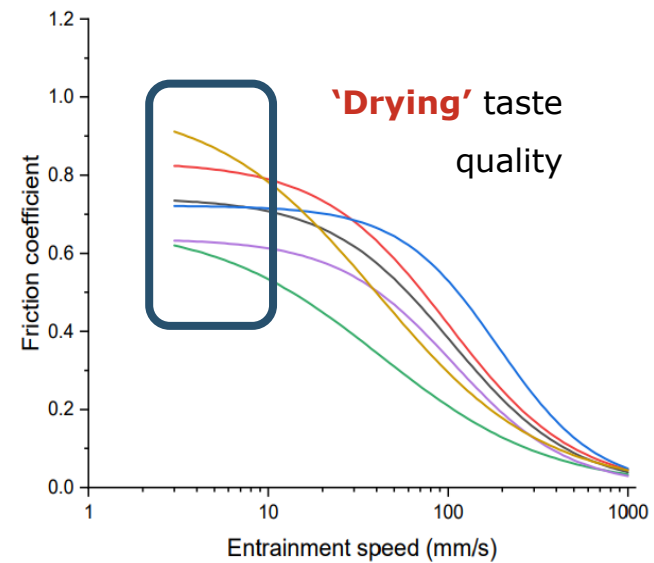
MTM – Sensory Perception - Wine



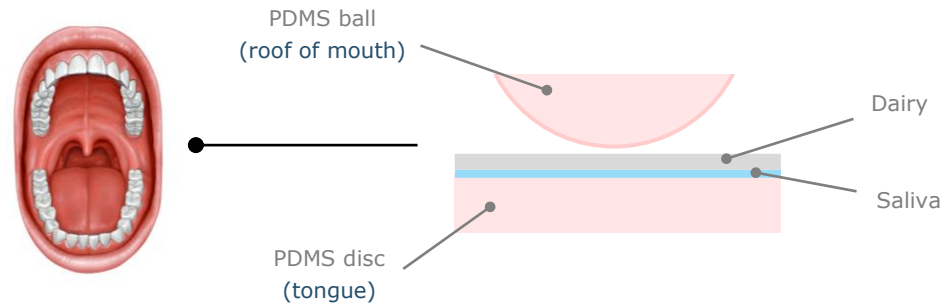
Wang, S., Olarte Mantilla, S. M., Smith, P. A., Stokes, J. R., & Smyth, H. E. (2020).

Astringency sub-qualities drying and pucker are driven by tannin and pH—insights from sensory and tribology of a model wine system.

Food Hydrocolloids.



MTM – Sensory Perception – Dairy Products

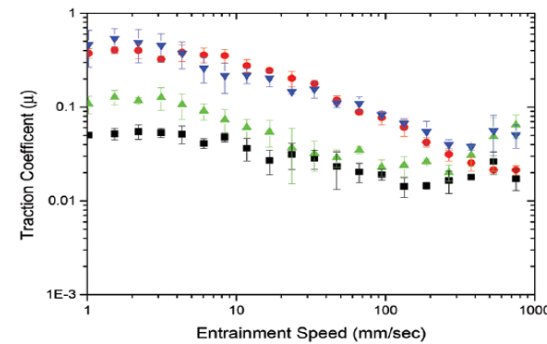


Laguna, L., Farrell, G., Bryant, M., Morina, A. and Sarkar, A. (2017).

Relating rheology and tribology of commercial dairy colloids to sensory perception

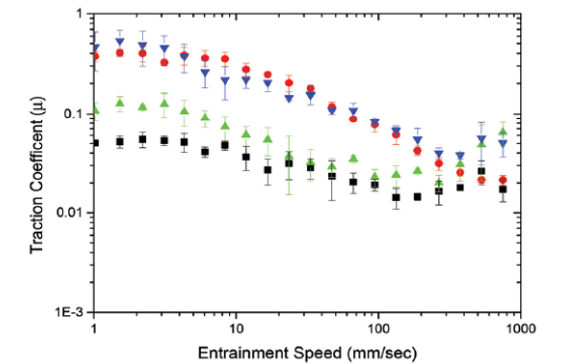
Food & Function

Yoghurt



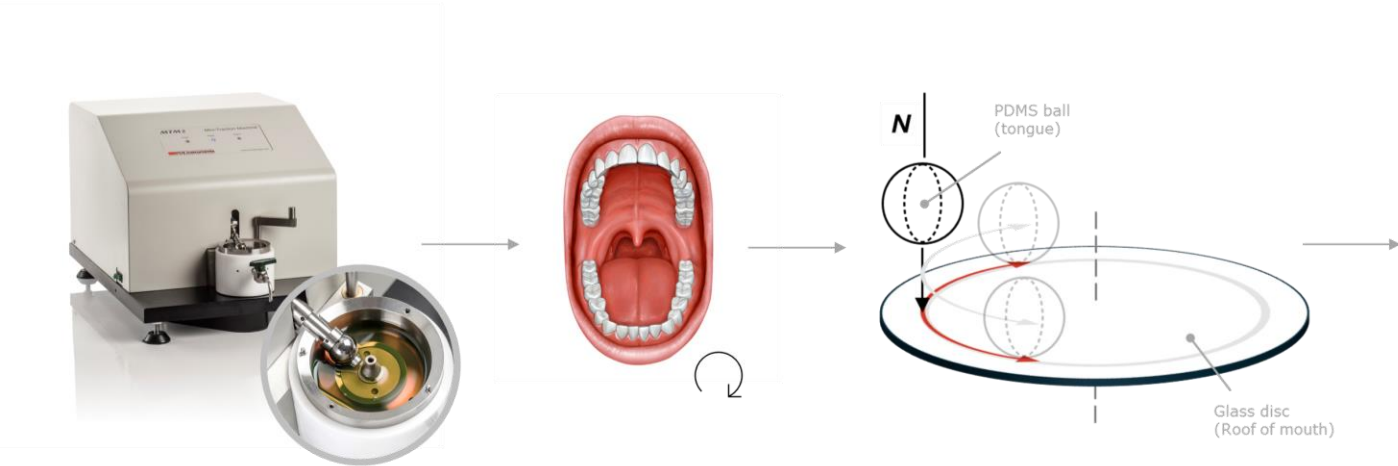
- Full Fat
- Fat Free
- ▲ Full Fat + Saliva
- ▼ Fat Free + Saliva

Cream Cheese





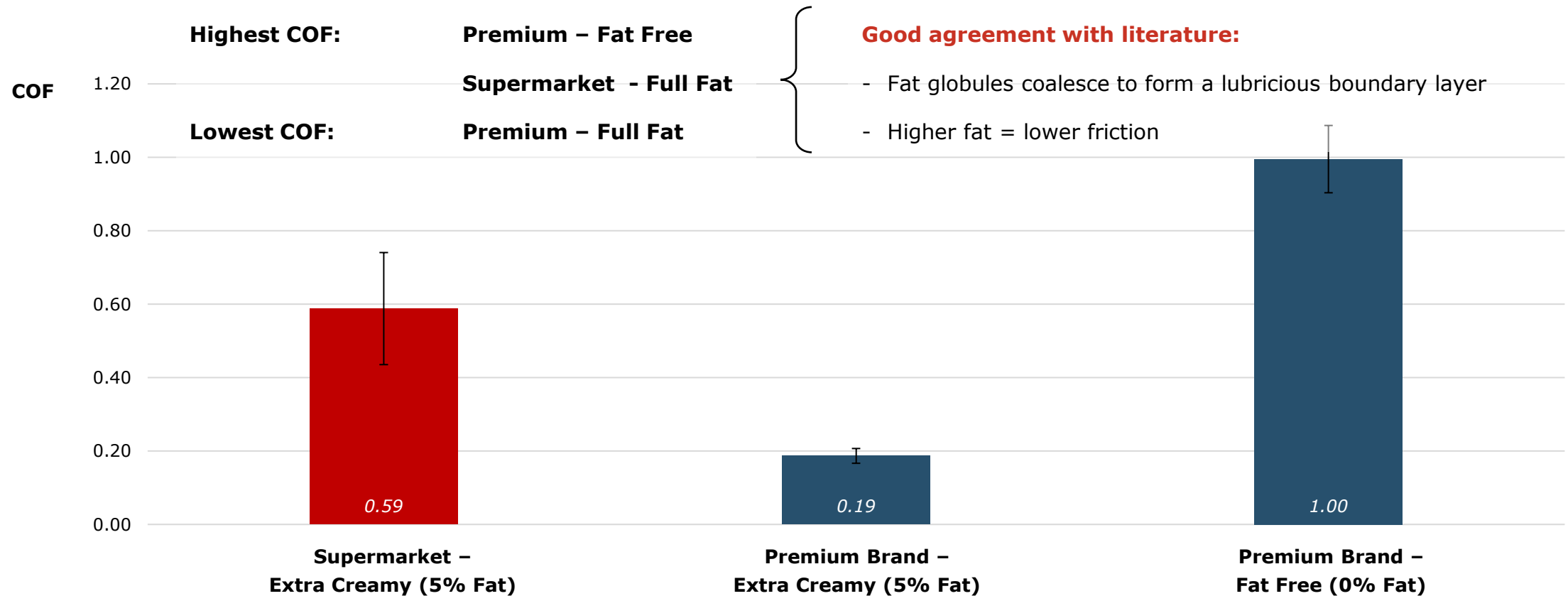
MTM – Sensory Perception - Yoghurts



	Tongue-palate	Test Conditions
Normal Load	-	1N
Contact Pressure	5 kPa to 35 kPa	123 Kpa
Stroke Length	-	<u>16</u> mm
Frequency	-	0.8 Hz
Mid-Stroke Speed	2 mm/s to 35 mm/s	25 mm/s
Temperature	36 °C to 37.5 °C	Ambient
Sampling Rate	5 Hz to 50 Hz	50 Hz

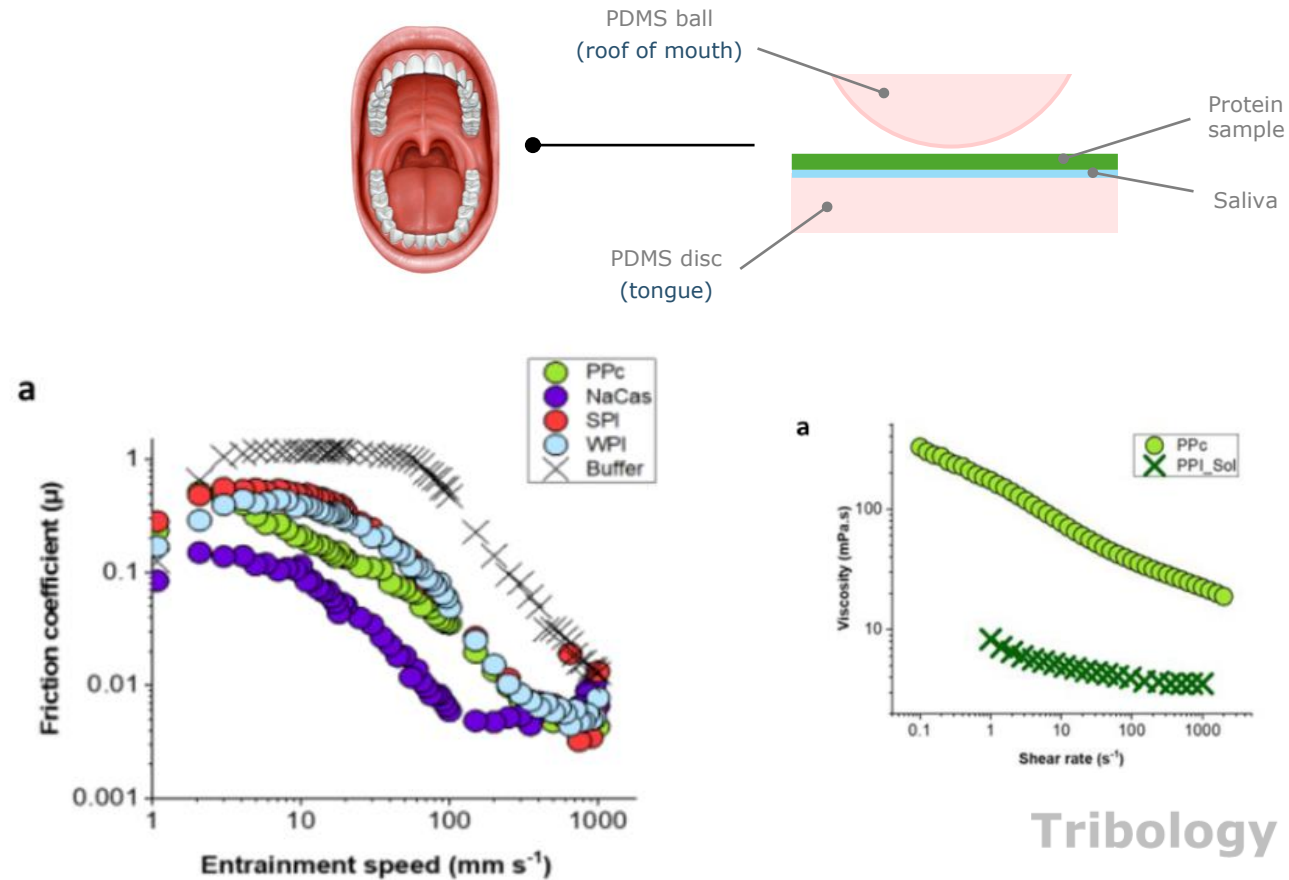
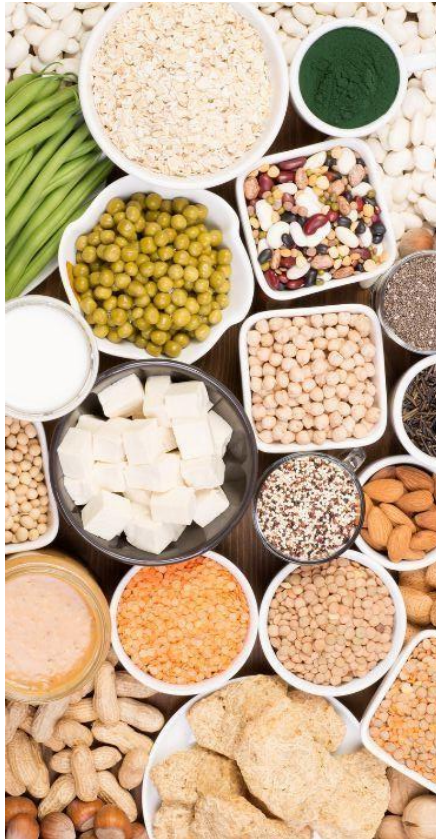


MTM – Sensory Perception - Yoghurts





MTM – Sensory Perception – Alternative Proteins



Brown. F, Soltanahmadi. S, . Mackie A.R., He. Q, Pfeifer. J, Sarkar. A, (2025).

Comparing frictional behaviour of plant and dairy proteins: Case study on high protein concentration

Food Research international.

Tribology \propto Viscosity



HFRR

A ball-on-disc, high-frequency, reciprocating instrument for assessing the lubricity of both fuels and lubricants under boundary conditions.



Relevant Industries:



Food & Beverage

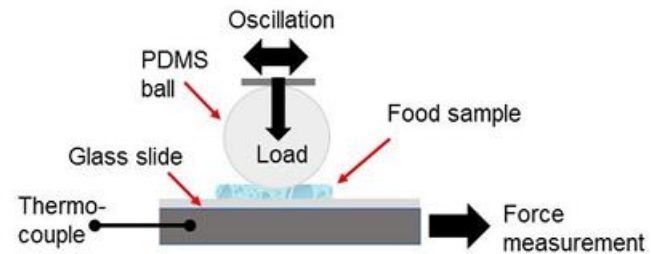


Biomedical



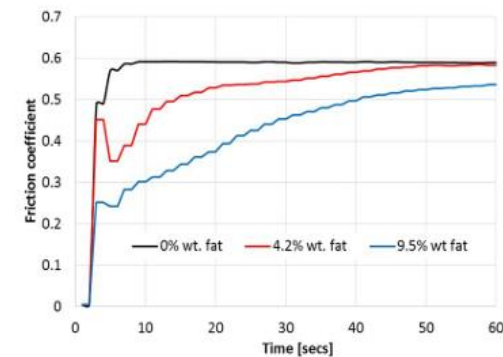
Lifestyle

HFRR – Sensory Perception - Yoghurts



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

RESULTS



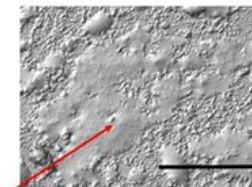
Friction increase as the film breaks down:
delayed for higher fat content
Enhanced mouthfeel attributes?

Friction change with rubbing time for
different fat-content yoghurts

Fresh: 9.5% w/w fat



Sheared: 9.5% w/w fat



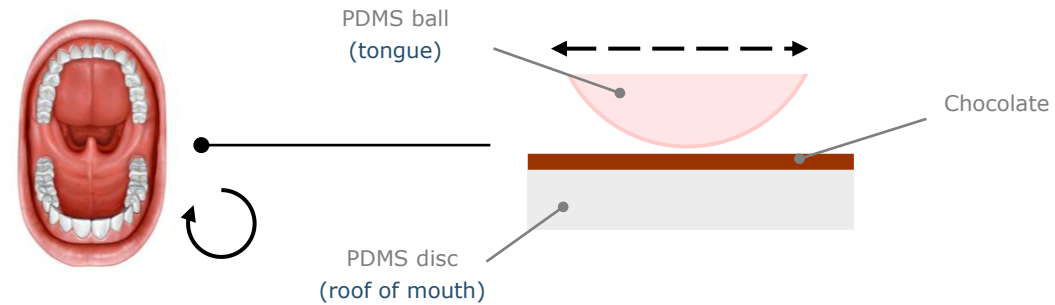
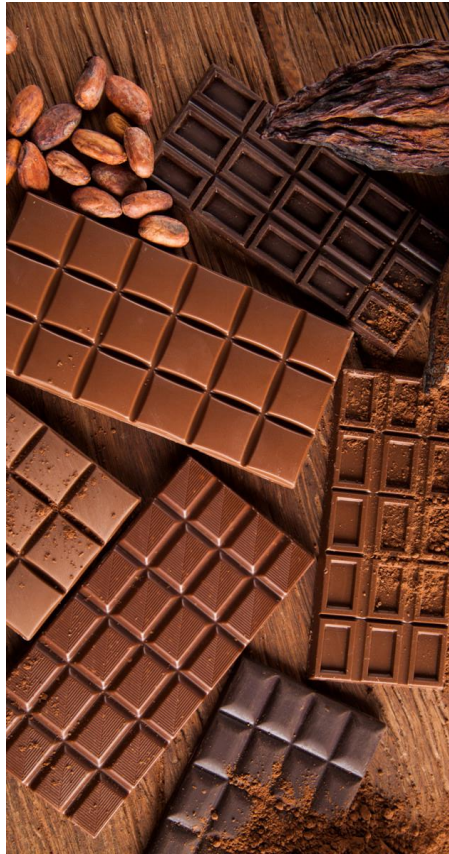
Lipid content

Changes to the structure and
distribution of dairy food
components

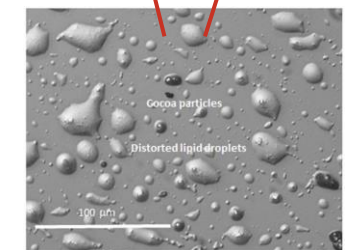
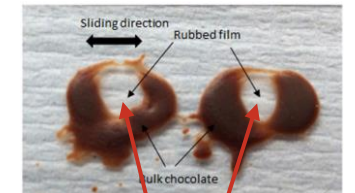
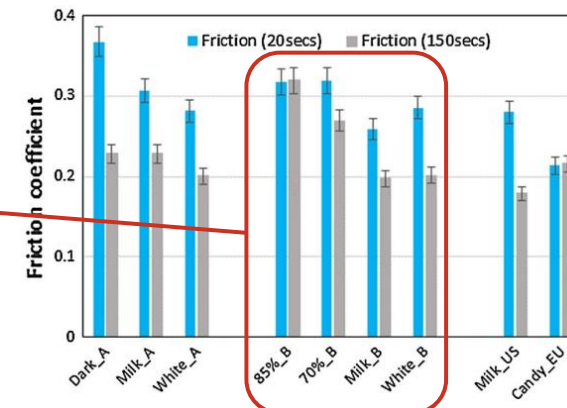
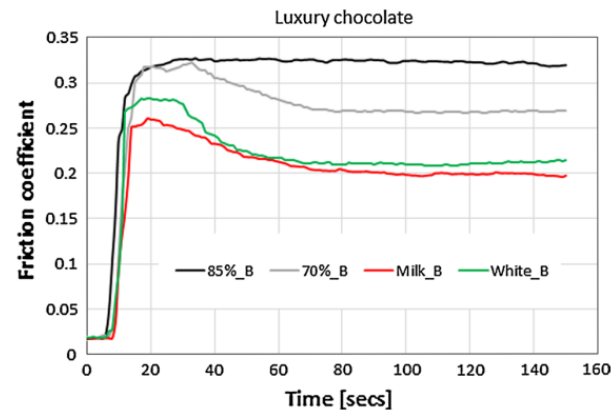
DIC optical images of fresh
and rubbed yoghurt films



HFRR – Sensory Perception – Chocolate



Masen. M, P.M.E. Cann
(2017).
Friction Measurements with Molten
Chocolate
Tribology Letters





Leaders In Tribology Test Equipment

