

Mimicking the Eat Process and Measuring Mouthfeel in the Laboratory

Marc Ingram - March 2026

Ingram Tribology Ltd

Introduction

Mouthfeel is a critical sensory attribute of foods, strongly influencing consumer perception and enjoyment. Even when flavour is similar, foods can produce dramatically different eating experiences depending on their composition and structure.

Traditionally, mouthfeel has been assessed using trained sensory panels. While extremely valuable, sensory testing can be subjective, time-consuming, and sometimes insensitive to small formulation changes. Modern Biotribology laboratory techniques allow scientists to quantify aspects of mouthfeel by replicating the mechanical and lubrication conditions that occur in the mouth during eating.

At Ingram Tribology, we use advanced tribological methods to simulate the oral environment and measure the frictional behaviour of foods during the eating process.

The Eating Process

The eating process involves several distinct physical stages, each contributing to the sensory perception of food.

During the initial stages of chewing, the structure and mechanical properties of the food dominate the sensory response. The mouthfeel is controlled by descriptors such as:

- Crunchiness
- Hardness
- Texture

As chewing continues, the food is broken down and mixed with saliva to form a bolus suitable for swallowing. At this stage, the bulk rheological properties of the bolus become more important. These sensations can be described as:

- Thickness

- Viscosity
- Creaminess

As mixing with saliva continues, the viscosity of the bolus often decreases due to both dilution and shear-thinning behaviour. Eventually the bolus forms a thin lubricating film between the tongue and palate, and tribological effects begin to dominate the sensory perception. The consumer perceives the frictional behaviour between oral surfaces. These thin-film lubrication effects strongly influence sensations such as:

- Smoothness
- Slipperiness
- Astringency

This stage occurs towards the end of the eat process just before swallowing. A thin residue remains in the mouth after swallowing, which also contributes to the mouthfeel.

Laboratory Test Methods

To study these lubrication effects in a controlled way, we replicate key aspects of the oral environment using specialised tribology equipment.

Our testing approach typically includes:

- Textured elastomer surfaces that mimic the mechanical properties of oral tissues
- Artificial saliva formulations designed to replicate the physical and chemical behaviour of human saliva
- Food-saliva bolus preparation to represent the mixture present during chewing
- Multi-directional tribometers to reproduce realistic oral motion

In a typical experiment, an elastomer ball slides against a textured elastomer plate designed to simulate oral soft tissues.

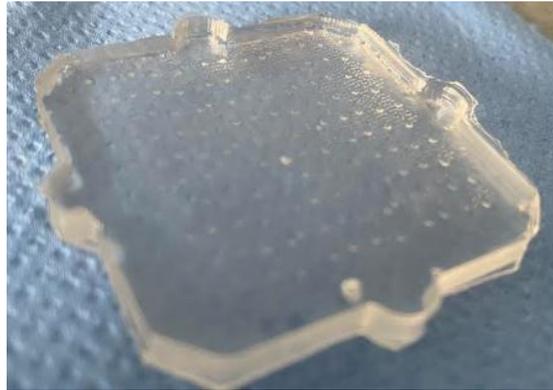


Figure 1: PDMS oral-surface mimic and tribology test configuration.

The motion of the ball across the plate combines multiple movements to replicate the complex motion of the tongue against the palate during eating:

- A reciprocating sliding motion in one direction
- A secondary perpendicular oscillation ("wiggle") following a sine-wave path

This creates a multi-directional sliding trajectory similar to real oral movement.

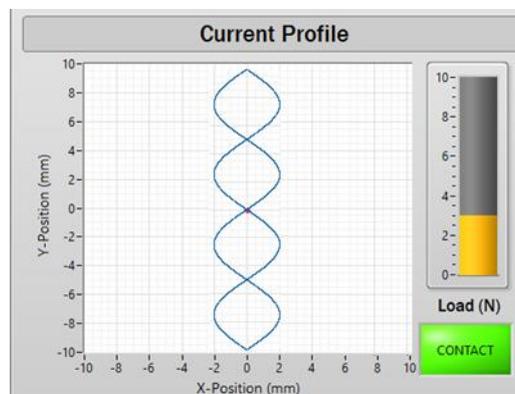


Figure 2: Example motion path used during the tribology test.

In addition to sliding motion, the test can include:

- Periodic lifting of the contact, allowing the bolus to re-enter the contact zone
- Cyclic loading, which varies the contact size and pressure during the test

These test sequences are important because they reproduce the type of fluid entrainment that occurs in oral lubrication where the food bolus is continuously drawn into the contact between tongue and palate.

Together, these elements allow the tribometer to mimic the dynamic and complex mechanical conditions that occur during the eating process.

Example Results

Typical results from these experiments show how the friction coefficient evolves during the simulated eating cycle. In the example below, we vary the ratio between the food product and the artificial saliva to mimic different points of the eat process.

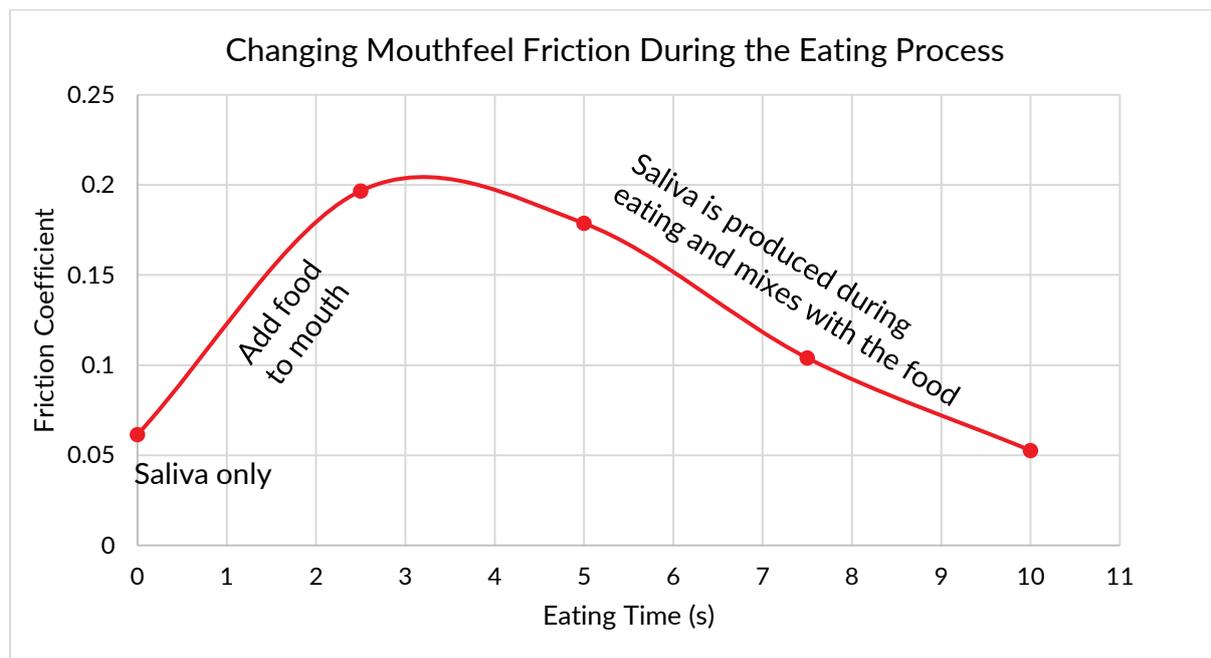


Figure 3: Example measured friction in a simulated mouthfeel experiment, using wiggle type test method

The mouthfeel friction is low when only saliva is present. Then on addition of a simulated bolus, the friction increases rapidly. During the eat process the friction will then decrease for this snack product as the saliva concentration increases. The eater will detect this change during the eat process, making it important to mimic and measure this effect.

Different commercial products are frequently measured to help baseline products against competitors. In the test below we use an artificial bolus to simulate the midpoint of the eating process. Then measure the friction over multiple cycles. One cycle is one reciprocating of our test pin – simulating the tongue motion.

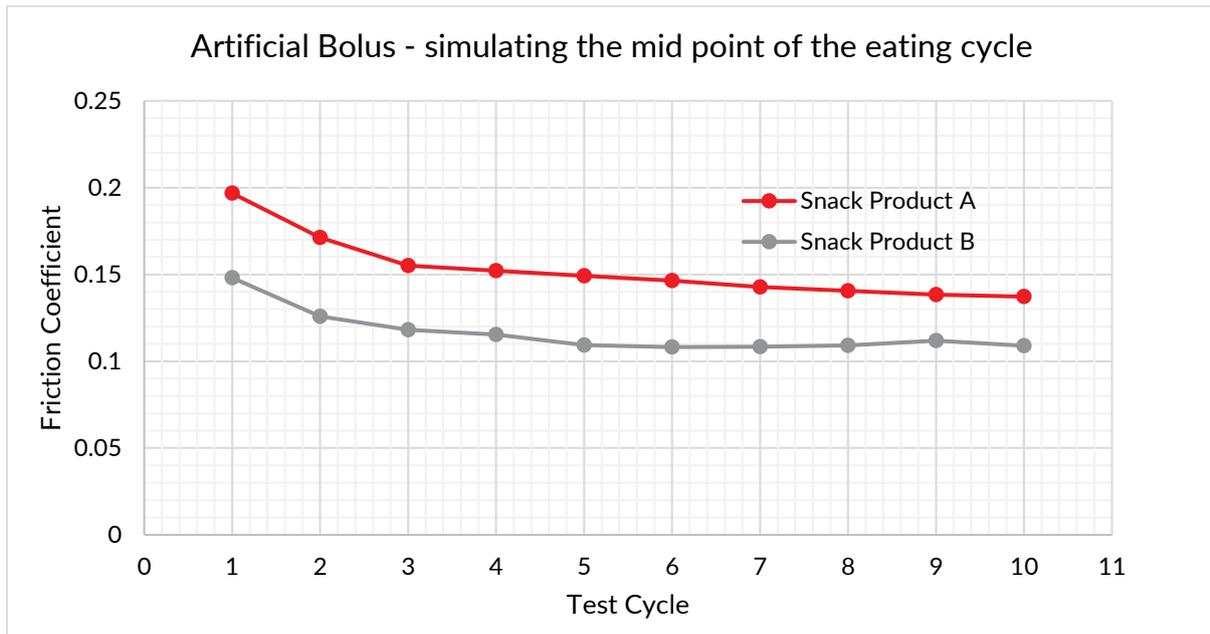


Figure 4: Mouthfeel friction measured for two competitor snack products, simulating the mid-point of the eating process

Very small changes in the product formulations can also be quantified. The graph below shows the variation in mouthfeel friction for 4 products, with small variations in their formulation.

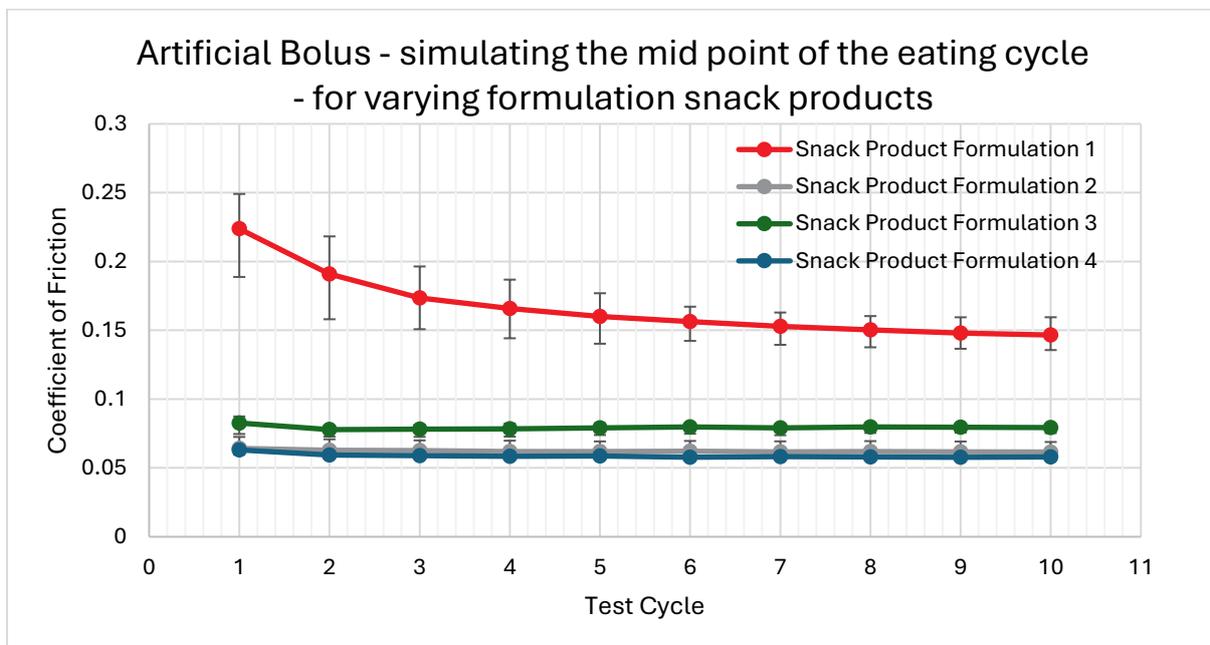


Figure 5: Mouthfeel friction measured for four different snack products formulations, simulating the mid-point of the eating process

These measurements clearly show how small changes to the formulation can affect mouthfeel – it can also be used to see when formulation changes have limited effects – i.e. between Snack Product 2 and 4.

Insights for Food Formulation

Tribological measurements provide a powerful tool for food scientists working to optimise texture and mouthfeel.

At a basic level, the method allows direct comparison of commercial products, helping to benchmark mouthfeel against competitor products.

More importantly, the technique allows formulators to detect subtle changes in mouthfeel caused by small formulation adjustments. In many cases, these differences may be difficult to isolate using sensory panels alone.

Tribology testing provides:

- Quantitative measurements of mouthfeel-related friction
- High sensitivity to formulation changes
- Insight into lubrication behaviour during different stages of eating

By tailoring test conditions, it is also possible to study specific phases of the eating process, helping scientists understand exactly when a formulation change influences the consumer experience.

This makes tribology a valuable complement to rheology and sensory testing when developing foods with targeted texture and mouthfeel characteristics.

Next Steps

If you think we can help you with your food tribology projects, please get in touch. We will happily demonstrate our capabilities and discuss how we can help your projects.