Cooked Rice

TEST PRINCIPLE

Evaluation of the Hardness and Stickiness of Cooked Basmati Rice using a Back Extrusion Cell (TA-BEC)

BACKGROUND

It is important that the texture of rice meets consumer perception of the quality of the product. The texture of rice should also be consistent during production necessitating producers to constantly determine the quality of raw ingredients used. With a wide variety of rice breeds along with variation in harvesting times, these factors can affect the protein and carbohydrate contents of the rice which in turn influence the final texture.

There are two general categories of rice grain namely Indica (long grain) and Japonica (short grain). Rice contains starch (amylose and amylopectin), protein and fat. Starch mainly contains 20-30% of amylose and 70-80% amylopectin. The hardness and stickiness of rice grains will depend on the amount of starch and protein extracted into the cooking water of the cooked rice.

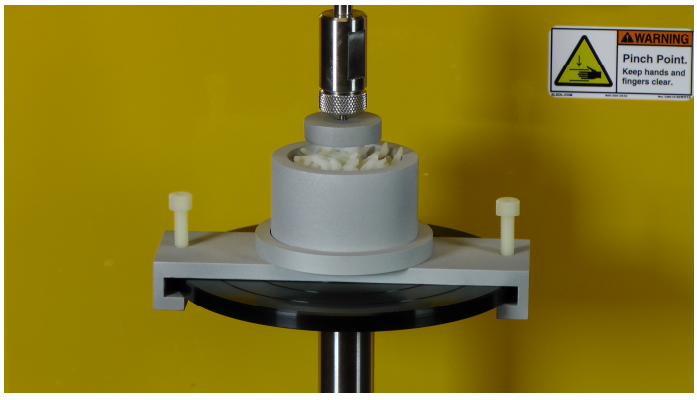
Japonica rice is generally known to be stickier than the Indica type as it contains low amylose content. It is known that the lower the amylose content extracted into the water, the stickier the rice. Indica rice on the other hand has higher amylose content in the raw rice which makes the cooked rice harder and less sticky. The textural properties of cooked rice also differ due to the amount of amylopectin extracted into the water from the cooked rice. It follows that the higher the amylopectin and the lower the amylose content in extracts on the surface of cooked rice, the more sticky the cooked rice. However the texture of rice can not be entirely attributed to the starch content but also to the protein and fat. Consequently, the higher the protein content extracted into the cooking water, the harder and less sticky the rice.

The Texture Profile Analysis test is also known as the" two bite test." This test is known to correlate well with sensory evaluation parameters such as hardness, springiness, gumminess, resilience and chewiness. Using the CT3 Texture Analyzer and the back extrusion cell, the texture Profile Analysis of rice shall be performed. This test can therefore be used to monitor the effects of cook time, change in formulation, change in process control and even shelf life studies. Overall, this is a very simple and quick test that gives measurements to ensure consistent quality and texture in production.

METHOD

EQUIPMENT

4.5 Kg Instrument
TA-BEC Back Extrusion Cell and Plunger
TA-RT-KIT Round Base Table
Texture Pro CT Software



SETTINGS

Test type:	Compression
Pre-Test Speed:	1.0 mm/s
Test Speed:	1.0 mm/s
Post-Test Speed:	1.0 mm/s
Target Type:	Deformation
Target value:	15 mm
Trigger Load:	4.5 g

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TEXTURE APPLICATION NOTE:

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SAMPLE PREPARATION

1. Boil one cup of rice in two cups of water for 20 minutes ensure the rice is cooked by pressing with a fork.
2. Transfer rice into a container and allow to cool down for five minutes
3. Weigh equal amounts of sample for testing

PROCEDURE

1. Using an adapter, attach the plunger to the probe shaft of the instrument
2. Place the round base table onto the base of the instrument and loosely tighten the thumb nuts to enable some degree of mobility
3. Loosen the screws of the extrusion cell holder and slide the holder centrally onto the round base table.
4. Fasten the extrusion cell holder to the base table using the screws on the holder
5. Raise the round base table by turning the knob on the fixture then lifting the table to a suitable height before tightening the knob to fix the table height.
6. Weigh equal amounts of cooked rice that will fill up the extrusion cell (care must be taken not to compress the rice).
7. Place the sample in the extrusion cell onto the extrusion cell holder.
8. Lower the plunger to a few millimeters from the sample surface and centrally align the extrusion cell to the plunger by re-positioning the round table.
9. Once alignment is complete, tighten the thumb nuts of the round base table to prevent further movement.
10. Commence the test
11. Once the test is complete, clean the plunger to remove traces of previous sample before proceeding to the next test

RESULTS

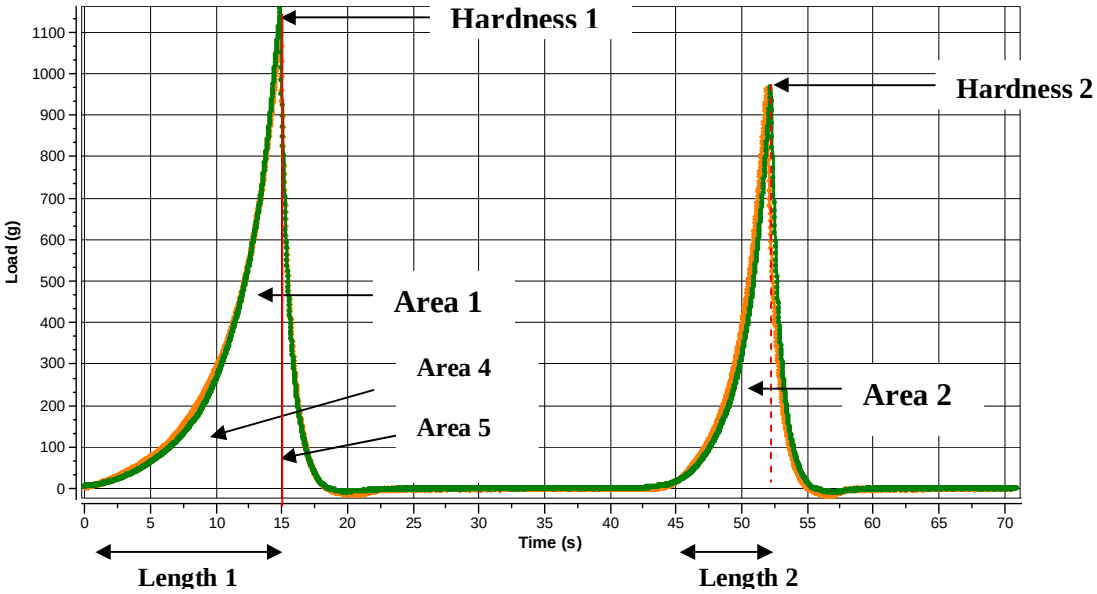

Figure 1

Test Number 2
Test Number 2

The graph for the texture profile analysis for the hardness, springiness, gumminess, resilience and chewiness of 12 g of cooked rice using a back extrusion cell

On the graph, two peak force values are generated as the rice is compressed two times to simulate a two bite action. The peak force value for the first bite is known as the hardness 1 and is the maximum force applied to compress the rice grain over the specified distance. This correlates with the force applied by the teeth (molars) over this distance. The force require to compress the sample over the same distance in the second bite is the hardness 2. The springiness of the rice is calculated as **length2/length1** which is the distance by which the rice grain is deformed at each compression cycle. Area 1 and Area 2 represent the overall area under the first and second peak respectively. Gumminess of the grains is therefore the **(Area2/Area1) x Hardness2**. The resilience is measured as **Area 5/Area 4**, and the chewiness of the grains measured as **gumminess x length2/length1**

TEXTURE APPLICATION NOTE:

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OBSERVATIONS

When a trigger of 4.5 g has been attained at the grain surface, the test begins. At the start of the test, the plunger compresses the grains over a target distance of 15 mm at test speed of 1 mm/s. The force is seen to rise with increasing distance. When the target distance has been reached, the probe withdraws from the sample and returns to its starting position. This test is repeated a second time in order to perform the two bite test. When a trigger of 4.5 g has been attained at the grain surface in the second cycle, the probe begins to compress the sample over the target distance of 15 mm at a test speed of 1mm/s before withdrawing from the sample.

The Texture Profile Analysis test measures the hardness, springiness, gumminess, resilience, and chewiness of the rice. The two maximum force values on the graph are a measure of sample hardness in the first and second bite (hardness 1 and 2)/firmness. These values correlate with the amount of force required by the teeth to compress the rice grains; the higher the value, the harder the grains (see Figure 1).

The springiness length values relate to how much the rice grains are extended as they are pulled away from the contact surfaces (plunger, teeth).

The resilience is a measure of how the food recovers from being deformed with respect to the energy required for deformation in the first and second bite.

The gumminess is a measure of how much energy would be required to disintegrate the rice grains to a state ready for swallowing and is affected by the cohesiveness of the product

The chewiness is a measure of how much energy would be required to chew/break down the rice grains to a state where it is ready for swallowing.

The table below summarises the results from five fresh tested samples from a container:

Sample	Hardness (g)	Work Done 1 (mJ)	Adhesive Force (g)	Adhesiveness (mJ)	Hardness 2 (g)	Work Done 2 (mJ)
Cooked Rice	1137.5 ± 16.1	38.80 ± 2.79	11.5 ± 2.6	0.40 ± 0.08	963.3 ± 4.2	18.78 ± 0.23

Sample	Springiness (mm)	Chewiness (mJ)	Resilience	Gumminess
Cooked Rice	8.39 5 ± 0.56	45.49 ± 5.31	0.21± 0.02	552.5 ± 41.9