## TEST PRINCIPLE

Comparison of the hardness, crispiness, and fracturability of cookies by penetration.

## BACKGROUND

For this test, two cookies were tested: Sugar and Shortbread.

This test compresses the cookies to a set distance and measures the amount of force required to penetrate the surface of the cookie.  This simulates the amount of force needed for a human to bite a cookie. In some instances, when the surface is penetrated, the cookie may fracture or break.

Cookies will be placed between the TA39 probe and the Fixture Base Table (TA-BT-KIT).  As the probe is lowered toward the sample, it will eventually break through the surface and penetrate into the cookie.  This will provide data on the hardness and fracturability of the sample.  As the probe retracts, the fracturability of the cookie will be measured.

There are numerous types of cookies that have a wide range of properties, including hardness, crispiness, and fracturability. Structurally, not all cookies are the same.  This test will measure and compare the hardness and fracturability of cookies.





## METHOD

EQUIPMENT:  Texture Analyzer with 5000g load cell
Fixture Base Table (TA-BT-KIT)
2mm Flat Cylindrical Probe (TA39)
Texture Pro Software

SETTINGS:
| | | |
|---|---|---|
| Test Type: | Compression |
| Target Type: | Distance |
| Target Value: | 3mm |
| Trigger Load: | 15g |
| Pre-Test Speed: | 0.5mm/s |
| Test Speed: | 0.5mm/s |

## PROCEDURE

1. Attach the TA39 probe to the Texture Analyzer.
2. Insert two table bolts into the slots on analyzer base.
3. Place the Fixture Base Table on Texture Analyzer and lightly screw in the bolt nuts.
4. Adjust the table so that the probe is centered over the table.
5. Once alignment is complete, secure the base table by tightening the bolt nuts.

6. Place one cookie on the table.
7. Align the sample under the probe as centrally as possible.
8. Slowly adjust the probe to about 3.0mm above the cookie sample.
9. Set the Test Parameters using the Texture Pro software.
10. Commence the test.
11. Wipe the probe with a dry cloth after testing each cookie.
12. Repeat steps 1-11 for all samples.

## OBSERVATION

When a trigger load of 15g is detected at the sample surface, the probe penetrates the cookie at a test speed of 0.5mm/s over a specified distance of 3mm. Once the 3mm distance is met, the probe returns to its starting position.

Each cookie was tested four times. These results were averaged together. The graph and table below report data concerning these averages. To show the difference between cookies, these values have been marked on the graph for both cookies.
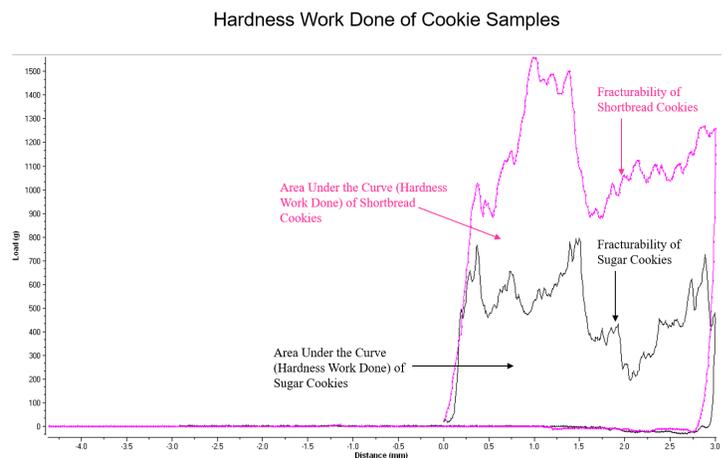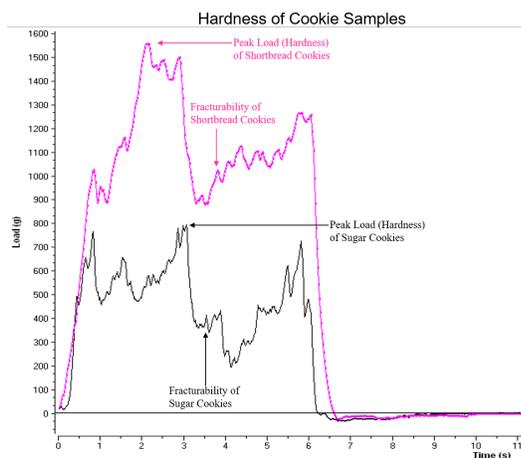


## DISCUSSION

The hardness work done, which is the calculated area under the positive curve, indicates the sample hardness or "toughness". A higher value implies that more work is required to chew the cookie.

A fracture occurs when there is a sharp decrease in load. The quantity of fracture describes the crispiness and crunchiness of the cookie when bitten, and is shown by the jagged fluctuations. These fluctuations are a result of the cookie fracturing. Quantity of fracture corresponds to the crunchiness of a cookie by indicating its brittleness.

As shown in the above graph, the Shortbread cookie had a higher mean load between 1 and 15 seconds, indicating that overall, it requires more work to chew and break down.

Although not shown on the graph, the mean peak load, or average hardness of the cookies, is shown in the data report below.

If multiple tests are being performed on the same cookie, caution should be used regarding proximity between test holes and cracks from previous tests.

## DATA REPORT

Texture Pro Software is used to program and control the Texture Analyzer during experimental tests.  It automatically calculates peak load values, hardness work done, averages, and standard deviations.  Multiple samples can be run if desired, and calculated values can be reported.

| # | Sample Description<br>Product Name | Batch Name | Results<br>Hardness Cycle 1 (g) | Quantity of Fractures | Mean Load (g) |
|---|---|---|---|---|---|
| 1 | Cookie | Shortbread | 1115.00 | 23.00 | 291.50 |
| 2 | Cookie | Sugar | 1077.50 | 23.00 | 205.80 |

## CONCLUSION

The test results can be used to determine the ideal hardness or crunchiness/crispiness for various types of cookies.  Test procedure, sample preparation, and equipment setup must be adhered to for reproducible and repeatable test results.