## Application manual No. 124

**Production:** COOKED PASTA

**Objective:** Comparison of pasta stickiness cooked in hard and soft water

**Type of action:** Adhesion test

**Test mode settings:**

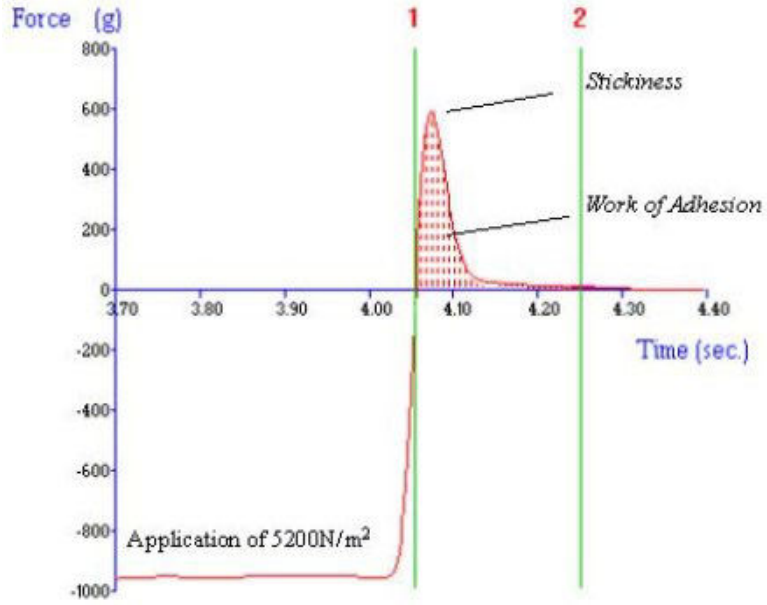
| Speed | Test mode | Target force | Target Distance | Hold |
|---|---|---|---|---|
| 0.5 mm/s | Adhesion | 1000 gf | 10 mm | 0 sec |

**Accessory:**
Noodle stickiness rig, Platform

**Sample Preparation:**
The correct cooking time for the pasta is determined by adding a 25g portion of the sample into a container of 300ml boiling distilled water. A stopwatch should be started and the pieces of pasta stirred to separate whilst maintaining a rolling boil. The cooking water should be maintained to at least 90% of its original volume (partially covering the container reduces evaporation). A piece of pasta is removed from the cooking water at 30 second intervals and squeezed between two pieces of clear plastic. When the white centre of the sample just disappears the watch is stopped. The time shown on the stopwatch is designated "cooking time". Test samples of pasta are prepared using the cooking time determined as above. After cooking the pasta is immediately drained into a funnel and rinsed with a stream of distilled water for 30 seconds. The cooked pasta is transferred into a beaker of distilled water at room temperature, prior to testing. Testing should be performed immediately following cooking to minimize changes resulting from storage in liquid medium.

**Test Set-Up**:
The pasta firmness/stickiness rig is positioned in the Heavy Duty Platform. The rectangular probe is attached to the load cell and is lowered into the retaining plate of the platform. The Platform should be re-positioned and then secured to avoid contact between the probe and retaining plate during testing. Samples should be placed under the retaining plate in as flat a position as possible (and centrally aligned if testing stranded products). Hold the locating posts against the retaining plate and tighten the screws on either side (just enough to prevent the sample from being lifted up on probe withdrawal). Avoid clamping the sample too tightly because the retaining plate may cut through the sample. Commence the adhesive test.

**Typical plots:**




left curve produced using 100% Durum wheat lasagne sheets, tested at 20C.

**Observations**:
The above plot illustrates a Force-time curve showing the characteristics of an adhesive test performed on pasta. The probe applies a compression force to the sample (recommended as 5200N/m^2, to achieve a good probe: sample contact) before withdrawing at maximum speed to measure the pasta stickiness.

Stickiness is defined as the maximum peak force to separate the probe from the sample's surface upon probe retraction (the higher the force value, the stickier is the sample). The total tensile work required to separate the probe from the sample's surface is also applicable. Units displayed can be converted automatically according to standards or other requirements.

**Data Analysis:**

**Results**

| Water Type | Mean Max. Force 'Stickiness' (+/- S.D.) (g) |
|---|---|
| Hard | 783.3 +/- 31.2 |
| Soft | 574.7 +/- 26.6 |

**Notes**:

- Although water hardness does not affect cooked pasta firmness, it has a marked effect on surface stickiness (as shown above), therefore prepared water of constant hardness and pH should be used for standard cooking tests and should be considered when distribution of pasta to soft water areas is inevitable.

- If a long contact time is required before probe withdrawal it may be preferable to use the delay acquisition feature in the software rather than compromise by reducing the data acquisition rate. When the delay acquisition feature is used the probe: product contact part of the test will be performed by the Texture Analyzer, but data will not be collected. Data will only be captured upon probe withdrawal i.e. the important section of the graph required for data analysis.

- An applied force of 1000g has been selected, in this instance, as this value was considered most suitable to achieve full contact between the sample and the probe surface. If testing samples of much firmer consistency then it may be necessary to increase the force value if full contact is not achieved. This will also be true if a cylinder of larger diameter is chosen.

- The test may be modified to contact the sample with a greater force or for a longer probe contact duration. This will subsequently increase both the Stickiness and Work of Adhesion values. Any values obtained are only relative at the specified contact force and time for which they are tested. The speed of probe: pasta separation (i.e. the Post-Test Speed) will also greatly affect the magnitude of the adhesive parameters. Again any comparisons made between test results can only be based on the same testing conditions.

- When attempting to optimize test settings it is suggested that the first tests are performed on the hardest samples to anticipate the maximum testing range required and ensure that the force capacity allows testing of all future samples.

**Technical Background**:
The apparent stickiness of a given sample is strongly influenced by the amount of unabsorbed water associated with the cooked spaghetti following drainage, the length of time between drainage and testing, and the relative humidity of the testing area (Dexter *et al*., 1983b). Dexter *et al*. (1983b) has also found that stickiness is influenced by cultivar, wheat class, raw material granulation and protein content, but was not related to sprout damage.
Instrumental measurement of stickiness is complicated by a number of factors of which meaningful sample comparisons can only be made if the following are controlled:

*Water present on a product's surface* - samples tested immediately after removal from cooling water give little or no stickiness values due to lubrication.

*Changing properties of the cooked pasta as it ages*, especially under ambient conditions. It has been reported that, up to 20min, surface stickiness increases as the elapsed time between draining and measuring increases (Dexter *et al*., 1983a). It is reasoned that as water is lost from the surface of the strands lubrication is lost and the surface becomes stickier. The precision of the stickiness measurement decreases as elapsed time increases. Therefore, the time for stickiness measurement is recommended to be set at 10 min after draining.

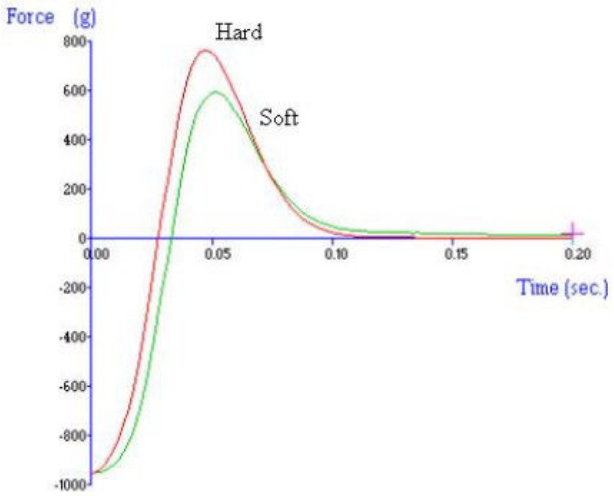
*The restraining of the sample for measurement*. When measuring the adhesive force between the probe and the sample, the sample must be firmly anchored to a base to avoid confusion of measurement between the sample and the base. Extra water collects at the bottom of a strand as it rests on a base, which results in increased lubrication at the bottom of a strand. The lubrication reduces stickiness and causes slippage of the sample (Guan & Seib, 1994).

*Choosing the correct compression force*. Voisey *et al*. (1978) and Dexter *et al*. (1983a) showed that the maximum tensile force from stickiness (adhesion) was independent of the applied compression force over a fairly wide range. Too low a compression force, however, gives reduced stickiness values, probably because of poor contact between the strands and the plate. Too high a compression force gives elevated stickiness values, probably because of extensive deformation of the strands.

*Choosing the correct probe retraction speed*. The higher the speed of probe retraction, the higher the maximum force, and the lower the area (Guan and Seib, 1994).

An example of the use of this test is shown below highlighting the difference of pasta stickiness depending upon the hardness of the cooking water. Some researchers have demonstrated that as cooking water becomes harder (CaCO3 increases) cooked spaghetti becomes stickier (Alary *et al*., 1979; D'Egidio *et al*., 1981; Menger, 1980). Others have reported that processing spaghetti under high temperature drying conditions may partly overcome cooked spaghetti stickiness (Dexter *et al*., 1981b, Manser, 1981).

**Typical plots:**




Left curves produced from 100% Durum wheat lasagne sheets cooked for 11 mins in hard and soft water, cooled in 300ml for 2mins (ambient temp.) and drained for 10 mins before testing at 20C.

**References**:

DEXTER, J. E., KILBORN, R. H., MORGAN, B. C. & MATSUO, R. R. (1983a). Grain Research Laboratory compression tester: Instrumental measurement of cooked spaghetti stickiness. *Cereal Chemistry*, 60, 139.

DEXTER, J. E., MATSUO, R. R. & MORGAN, B. C. (1983b). Spaghetti stickiness: Some factors influencing stickiness and relationship to other cooking quality characteristics. *J. Food Science*, 48, 1545.

GUAN, F. & SEIB, P. A. (1994). Instrumental probe and method to measure stickiness of cooked spaghetti and noodles. *Cereal Chemistry*, 71 (4), 330-337.

VOISEY, P. W., WASIK, R. J. & LOUGHHEED, T. C. (1978). Measuring the texture of cooked spaghetti. 2. Exploratory work on instrumental assessment of stickiness and its relationship to microstructure. *J. Inst. Can. Sci. Technol. Aliment*., 11, 180.