CNS FARNELL

REVIEW OF SOLID CHOCOLATE TABLET AT AMBIENT TEMPERATURE

PRODUCT: Cadburys Dairy Milk (single chunk 27.25mm x 17.82mm x 7.92mm)

OBJECTIVE: To determine the optimum penetration distance to detect hardness of a solid chocolate tablet through the employment of penetration forces.

BACKGROUND: The LFRA is restricted to maximum force generation in the region of 1kg thus the relatively solid consistency of chocolate determined that a very small $\varnothing$ probe was utilised at minimal test speed. This permitted the flow of molecules within the tablet and minimised the forces generated whilst maximising the force:deformation profile of the product.

LFRA SETTINGS:
MODE: Measure force in compression
PLOT: Final
SPEED: 0.1mm s^{-1}
DISTANCE: 2; 4; 6mm
OPTION: Normal
TRIGGER: Auto 4g pre-set

PROBE REF: Stainless Steel Needle Probe 10^0 Taper (Ref: TA9)
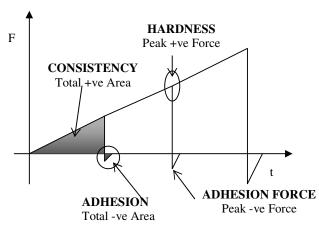Confectionery holding rig

METHOD: Samples were removed from wrappers and broken into individual chunks. The individual chocolate piece was then held within jaws of confectionery holder clamped to adjustable bed of LFRA approximately 2mm below surface of probe.

READING:

Note: Graph shows continuation of penetration at 2mm, 4mm and 6mm parameter values are recorded at set points for each penetration depth

This application note should be used as a template guide to the development of empirical techniques specific to your own application and requirements. The note is empirical in nature where deviation from test configuration in relation to test settings, sample size, shape, formulation etc. will result in deviations from observations discussed.

CNS FARNELL

DISCUSSION: Force:deformation curves generated indicate a linear relationship between forces generated and depth of penetration. It is therefore recommended that the 4mm mid penetration value is utilised to permit evaluation of a range of chocolate types thus enabling comparison of a range of results.

PARAMETER COLLECTION: All parameters are automatically calculated within the *Analyse a test with tables window.* Thus calculate parameters for each curve individually and record results.

PARAMETERS:

HARDNESS	Force necessary to attain a given deformation
CONSISTENCY	Internal strength of bonds within product
ADHESION	Work necessary to overcome attractive forces between surface of the food and materials with which it comes into contact.

RESULTS:

PARAMETER	UNIT	2mm	4mm	6mm
HARDESS	(g)	334	722	1159
CONSISTENCY	(gs)	3192.3	1278.6	23878.9
ADHESION FORCE	(g)	-18	-60	-15.1
ADHESIVENESS	(gs)	-0.4	-4.1	-180

WHERE: gs = work
NOTE: Adhesion Forces give greatest differentiation.

CONCLUSIONS: This empirical procedure generates key information related to the parameters of chocolate hardness and consistency, whilst additional information relating to adhesion is also formed. Adhesion forces were not considered paramount to the investigation due to difficulties in imitating oral mastication properties. A penetration depth of 4mm (approx. 50% deformation or strain) was considered optimum in generating key profile data and is recommended for future investigation using the 1kg LFRA TA apparatus, where prevention of upload forces is critical.

EMPIRICAL FACTORS: Test conditions will be affected by:
1. Sample temperature
2. Proximity of test holes within sample
3. Ambient temperatures
4. Base effects where probe compresses against analyser test bed

Rheology of chocolate is influenced by:
1. Cocoa solids content
2. Cocoa butter content
3. Sold fat content
4. Crystal modification (acting as an indication of temperature abuse).

This application note should be used as a template guide to the development of empirical techniques specific to your own application and requirements. The note is empirical in nature where deviation from test configuration in relation to test settings, sample size, shape, formulation etc. will result in deviations from observations discussed.