Functional Analyzers for Grain, Flour and other Food applications

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Complete Analysis

Functional Properties
- Gluten determination, testing functional properties of protein
- Flour & Dough testing – hydration, stickiness, elasticity, etc.
- Enzyme activity, Starch pasting
- Texture, mouth-feel
- Hardness
- Volume

Composition
- Moisture
- Ash
- Protein
- Starch
- Fiber
- Sugars
- Oil/Fat

Complete analysis of flour means knowing both:
What’s in the flour (composition)
How will the flour perform its required duties (functional)
Perten Analyzers

Compositional

DA 7250 NIR
DA 7300 In-line NIR
AM 5200 Grain Moisture Meter
IM 9500 NIR Grain Analyzer
IM 8800 Portable NIR Grain

Functional

doughLAB/mdL
Falling Number®
Glutomatic
RVA
Texture Analyzers
Volume Analyzers
SKCS
1. Rain at harvest can cause grain to sprout

2. Sprouting increases alpha-amylase
3. **Alpha-amylase** breaks down starch during baking

4. **Falling Number®** is the world standard method for detection
Only Perten Falling Number® instrument models follow all international standards.

AACC 56-81.03
ISO/DIS 3093

ICC 107/1
EEC 689/92
Effect of blending wheat or flour

When mixing wheat/flour with different FN values, the FN value of the mix will be lower than the average of the original batches.

Capture the value of high FN wheat – segregate at intake
The Falling Number Test

Whole wheat grain

Laboratory Mill 3100 or 120

Falling Number

Wheat flour
The Falling Number® Models

NEW!

**Falling Number® 1000**
Dual analysis model with many automated features

**Falling Number® 1500**
Automatic single analysis system

**Falling Number® 1310**
Value priced single analysis model
Falling Number® 1000

Faster, Safer and Easier to use

– And also
  o More accurate
  o Versatile
  o Better connected
  o Full range of accessories
  o Approved & trusted
Falling Number® 1000

• Faster
  – **Set a stop time for the test**
    At high sample load times, like during the harvest, set your target maximum FN test time. When reached the instrument will stop automatically, push down the stirrers and report the results, e.g. ”320” in red.
  – **Automatic water level control**
    A built in pump keeps the water bath at optimum fill level allowing the instrument to be operational immediately.
• Safer
  – **Isolated water bath and lid**
    FN 1000 is designed with an isolated water bath and a cooling lid with a plastic outer part, protecting operators from hot surfaces
  – **Reduced steam**
    Briefly turns off the bath heaters at the end of the test letting operators remove cassette under reduced steam
  – **Water bath auto refill**
    No need for the operator to open the steam flaps to top up water in the bath
Falling Number® 1000

• Easier to use
  – Touch screen
    Easy user interface for the operator
    Tilt adjustable
  – Atmospheric pressure measurement
    Alerts user to apply altitude correction
  – Auto-start & stop
    Test starts automatically
    Auto-stop at user set time
  – Results averaging and storage
    Left & Right FN results averaging
    USB & ethernet ports for printer and LIMS connectivity
    Old results stored in instrument
Falling Number® 1000

• Versatile and Better connected
  – All applications
    Standard FN testing of grain and flour
    Blending and Malt addition
    Moisture correction of sample weight or results
    Fungal amylase method
  – Multi connectivity
    4 USB ports and 1 Ethernet port enables simultaneous use of printers, bar code readers, data capture connection and more
  – Data security
    Review results for past results from the database
    Results include traceability information
Falling Number® accessories

- Shakematic
- Recirculation cooler
- Automatic dispenser
- Spolett tube cleaner
- Printer
Glutomatic - Protein functionality

- Form an elastic dough
- Gas retention during fermentation and baking
- Allows and carries expansion
- Retain form of bread loaf

Glutenin & Gliadin (Proteins) + Water → Energy → Gluten

Gluten mass/film
Starch granule
Air bubble
Tentative model of the gluten matrix

Disulphide bond formation

Gliadin

Glutenin

Mixing
Effect of Gluten quantity

- Gluten quantity and quality influence product quality
- Different products require different gluten levels
- Glutomatic is objective and reproducible
- Internationally standardized
Gluten Strength & Durum Quality

Gluten Index a standard for Durum quality

- Gluten strength affects
  - pasta texture - “al dente” bite
  - cooking quality - cooking residue
  - cracking or stretching of strands during drying
Glutomatic world standards

International standard methods for gluten content and Gluten Index:

**ICC 137/1**  Approved 1982, revised 1994
**ICC 155**  Approved 1994 (revised 2001)
**ICC 158**  Approved 1995

**AACC 38-12.02**  Approved 1995, revised 2001

**ISO 21415-2/4**  Approved 1990

**GAFTA 34:2**
Glutomatic method

Laboratory mill
LM 3100 or
LM 120

Glutomatic system
The Glutomatic System

Glutomatic 2200
and Centrifuge 2015
For Wet Gluten Content
and Gluten Index.

Glutork 2020
For Dry Gluten Content.
Two types of Laboratory Mills from Perten:

- For fine, homogeneous grind:
  Hammer mill with sieve.
  LM 3100 & LM 120

- For milling without moisture loss:
  Disc mill.
  LM 3310 & LM 3610
doughLAB – flour testing

Determine flour properties:
Water absorption, Dough Development Time and more

New High-speed mixing method

Improved peak resolution in strong doughs

Faster

Better emulates modern commercial dough mixers

10min
Standard Flour Rheological Measurements

AACCI and BIPEA check sample services for flour water absorption, dough development time & others, following AACCI method 54-21.02

The Perten doughLAB has never been an outlier within the population of instrumentation

Majority of the instruments tested are Farinographs
Shortfalls of AACC 54-21.02 method

- **Slow**
  - 1 – 2 samples / hour

- **Not process relevant**
  - 63 rpm = 1 watt.hr/kg, 20 min mix
  - Modern mixers = 2 – 4 watt.hr/kg, 2 – 5 min mix
  - Poor correlation to baking requirements

- **Produces misleading results**
  - Wrong peak detected for strong flours and reduction flour streams used in breadmaking
  - Misleads bakers on water addition and mixing time
  - Lower bread quality and loss of production
New and improved AACCI method

Correct information
Resolves and detects the true dough development peak
Gives the baker the correct water addition and mix time information

Twice as fast
10 minute test

Process relevant
Work rate 3 watt.hr/kg
Similar to modern bakery mixers

Approved
AACCI Method 54-70.01
Blending Decisions

**Blend streams** virtually in doughLAB software

**Try out** different mix ratios and instantly see results

**Identify** optimal mix ratio to meet end-use requirements

**Save lab time** and reduce the risk of blending mistakes
micro-doughLAB

- Wheat breeders need simple and rapid methods using small samples to screen large numbers of early generation material
- Cereal researchers need flexibility and innovation
- Flour mills need new methods that provide better measures of flour quality
Rapid Visco Analyser

- Rapid heating & cooling rotational viscometer
- Determines starch pasting properties
- Temperature control/Shear control
RVA - What it measures

- Pastes of plant polymers and associated enzymes
- Starch and starchy products eg. grains, flour
  - Food (thickener, binder, stabilizer)
  - Industrial (paper, adhesives, textiles)
  - Alpha-amylase (sprouting, malting, fungal)
- Protein
  - Dairy, soy, gluten, gelatine
  - Protease, TG
- Gum
  - Carrageenans, Xanthan, Pectin, Arabinoxylan
  - Xylanase
RVA - What it measures

• The RVA measures and characterizes ingredient performance.
• By subjecting a sample to a reproducible program of heating, cooling, and shear, the RVA provides an apples-to-apples comparison of different samples within each product type.
• Easily and quickly characterize *ideal* ingredients for a given product, and compare all future samples directly to that standard.
Native Starches

- STD1 most commonly used
- Cereal
  - Higher pasting temp re lipids
  - Strong setback due to amylose
- Root & tuber
  - Higher peaks, lower PT
  - Inhibited setback – phosphorylation in potatoes
- Waxy
  - Lower PT, no lipid binding
  - Low setback, no amylose network
- High amylose
  - Require temp >100°C to paste
RVA for cookie, cake and noodle flours

**Starch** pasting characteristics of flour are key to its suitability for cookies, crackers and noodles.

The RVA clearly distinguishes flours with different starch properties.

**Verify flour quality** prior to load-out with a simple test.

**Standard starch pasting methods:**
AACC 76-21.02, ICC 162
Rice - Quality

• Rapid Rice method (AACC 61-02)
  - 3.0 g, 12.5 min pasting profile
  - Setback correlates to cooked rice texture
  - Detect effects of variety, aging, particle size, lipid binding

• Japanese method
  - Japanese prefer soft, cohesive rice
  - 3.5g, 19 min method for greater discrimination

• Rice GT method (AACC 61-04)
  - 6.0 g, slow temperature ramp (3°C/min)
  - More accurately determines gelatinisation temperature
Degree of Cook and RVA Curves

- As degree of cook increases
  - Cold viscosity first rises then falls
  - Peak viscosity and final viscosity decrease
- Interpreting RVA curves
  - More difficult than raw starch
  - Cold viscosity
    - First rises due to pregelling the starch, making it cold soluble
    - Then falls due to dextrinisation and retrogradation
  - Peak and final viscosity
    - Fall due to granule degradation and starch hydrolysis
RVA - Application Example

- Reverse engineering
- Original cornflakes
  - Batch cook & flake process, slow & costly
  - Low cold viscosity – good bowl life
- “Copy” product
  - High shear process, ie. extrusion
  - Cold swelling – poor bowl life
  - Could be fixed eg. add surfactant!
RVA - Approved Methods

• General pasting
  – AACCI 76-21, ICC 162, China FPS LS/T 6101-2002, GB/T 24853-2010
• Stirring Number
  – AACCI 22-08, ICC 161, RACI 05-05, ASBC Barley-12
• Rice pasting
  – AACCI 61-02, RACI 06-05, GB/T 24852-2010
• Rice gelatinisation temperature
  – AACCI 61-04
• Oat pasting
  – AACCI 76-22
• Brewing
  – Mebak II 2.7
• Heat damage in flour
  – FTWG 23
RVA models

**RVA 4500**
Widest viscosity range (10-25000 cP) and best precision (+/- 2%).
TCW controlled

**RVA-TecMaster**
Viscosity range (20-8000 cP), precision (+/- 3%).
TCW controlled or stand-alone

**RVA-StarchMaster2**
Viscosity range (20-8000 cP), precision (+/- 3%).
Stand-alone (3 methods)
The RVA is the food labs best friend!
TVT 6700 texture analyzer

- Test Hardness, Springiness, Stickiness, Fracturability, Crispness, Tensile test and much more.
- Monitor staling process
**Texture**

**Fracturability** = F1 break (brittle products)

**Adhesiveness** = A3 (sticky products)

**Gumminess** = hardness × cohesiveness (solids)

**Chewiness** = gumminess × springiness (semi-solids)

Graph and definitions courtesy of Dr. Martin Whitworth – Campden BRI
Starter Methods & Method descriptions

AACC 74-09 Bread Crumb Compression Method

Scope
- Bread crumbs are compressed to measure the firmness.

TVT Texture Analyzer
The TVT Texture Analyzer offers rapid and objective analysis of key characteristics, including firmness, crispness, cutting force and elasticity. The instrument includes international standard methods as well as full flexibility for customer tailor-made profiles. Combining speed, precision, flexibility and automation, the TVT is a unique tool for product development, quality and process control and quality assurance.

Description
The bread crumbs are compressed to measure the firmness. When the probe reaches the trigger force the test commences. The probe will compress the sample to 40% of its height and then the compression stops. The irregularity in the slope of the graphs shows that there have been harder parts in the slices.
TVT – Large range of Probes and Rigs for a large variation of applications
BVM volume measurement

**BVM**: Laser topography analyzer for volume and dimensions of bread and other products.

**Official Method**: AACC 10-14.01
BVM volume measurement

Length
Width
Depth
Weight
Volume
Density
Comparison trial between Water Displacement – BVM - Seed

<table>
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<th>Sample</th>
<th>Water</th>
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Software – VolCalc

The diagram and the results are displayed on screen after the measurement and as 3-D Graph. It is possible to rotate and zoom in and out the diagram.
Questions
Thank you!

BREAD IS LIFE