

# METHODS

## GRADING:

Full grading was done in accordance with the Regulations relating to the grading, packing and marking of bread wheat intended for sale in the Republic of South Africa (No. R. 1186 of 17 December 2010). Please see pages 93-105.

Hectolitre mass, screenings, protein and falling number were determined. The determination of deviations relating to wheat kernels comprised foreign matter including gravel, stones, turf and glass; other grain and unthreshed ears; damaged kernels including heat-damaged kernels, immature kernels, insect-damaged kernels and sprouted kernels; heavily frost-damaged kernels; field fungi; storage fungi; ergot; noxious seeds; possible presence of undesirable odours and live insects.

**Hectolitre mass** means the mass in kilogram per hectolitre and was determined according to ISO 7971-3 by means of the Kern 222 instrument.

During earlier seasons the hectolitre mass was determined by means of the Two-level funnel method. In the 2009/2010 season the hectolitre mass value was adjusted by the addition of 2 kg/hl to all hectolitre mass values as per an Industry-wide Hectolitre Mass Dispensation published by the National Department of Agriculture.

Hectolitre mass provides a measure of the bulk density of grain and is also useful as a guide to grain soundness and potential milling extraction.

**Screenings** means all material that passes through a standard sieve. For the definition of a standard sieve please refer to the definitions of Regulation No. R. 1186 on pages 93 - 95 of this report.

**Damaged wheat** means wheat -

- (a) which have been damaged by insects;
- (b) which have been distinctly discoloured (orange-brown, dark brown or black) by external heat or as a result of heating caused by internal fermentation in wheat with an excessive

moisture content, excluding wheat kernels in respect of which the discolouration is confined to the germ end;

(c) which are immature and have a distinctly green colour; and

(d) in which germination has proceeded to such an extent that the skin covering the embryo has been broken or the developing sprouts and/or rootlets are clearly visible.

**Combined deviations** means the sum of the percentages screenings, other grain and unthreshed ears, foreign matter and damaged kernels.

## THOUSAND KERNEL MASS:

This is the weight in grams of one thousand kernels of grain and provides a measure of grain size and density. This determination does not include kernels that are broken or chipped.

## FALLING NUMBER MILLING:

At least 300 g of wheat is cleaned by using the standard 1.8 mm sieve and by removing coarser impurities by hand. The sample is then milled on the falling number hammer mill fitted with a 0.8 mm screen.

## MOISTURE:

ICC Standard No. 110/1, latest edition is used to determine the moisture content of wheat flour. This method determines moisture content as a loss in weight of a sample when dried in an oven at 130°C for 90 minutes or 2 hours for flour and whole wheat flour respectively.

## PROTEIN:

The Dumas combustion analysis technique is used, according to AACCI method 46-30.01, latest edition.

This method prescribes a generic combustion method for the determination of crude protein. Combustion at high temperature in pure oxygen sets nitrogen free, which is measured by thermal conductivity detection. The total nitrogen

content of the flour sample is determined and converted to equivalent protein by multiplication with a factor of 5.7 to obtain the protein content.

#### **FALLING NUMBER:**

This method is based upon the rapid gelatinization of an aqueous suspension of meal or flour in a boiling water bath and subsequent measurement of the liquefaction of the starch paste by the alpha-amylase in the sample. The method measures the enzyme activity, mainly the  $\alpha$ -amylase activity.

ICC Standard No. 107/1, latest edition is used to determine the falling number. Only the altitude-corrected value is reported.

#### **QUADROMAT MILLING:**

Cleaned wheat samples are conditioned by adding 3 ml water per 100 g wheat, 18 hours prior to milling. The samples are then milled on the Quadromat junior laboratory mill.

#### **MIXOGRAPH:**

A 35 g mixograph is used. The amount of flour weighed is adjusted according to the flour moisture content and the amount of water added to the flour is adjusted according to the flour protein content. Industry Accepted Method 020 based on AACCI method 54-40.02, latest edition is followed.

**Mixogram peak time** is the time measured in minutes that a dough takes to reach its maximum consistency or first indication of dough weakening. The peak time is a measure of optimum dough development and thus a measure of protein quality.

**Mixogram tail height** at 6 minutes is the distance in millimetres measured from the base line of the paper at 6 minutes to the graph centre point at 6 minutes. This figure is an indication of the weakening effect of the dough. Higher values indicate flours that are more tolerant to mixing.

#### **RAPID VISCO ANALYSER:**

AACCI method 76-21.01, latest edition, is followed to prepare a complete pasting curve

by means of the Rapid Visco Analyser (RVA). The RVA is a rotational viscometer that is able to continuously record the viscosity of a sample (under controlled temperature conditions) as the starch granules hydrate, swell and disintegrate (gelatinization and pasting), followed by possible realignment of the starch molecules during cooling (retrogradation).

Maximum viscosity before the onset of cooling (**peak viscosity**), **time to peak** viscosity, **minimum viscosity** after peak (trough) and **final viscosity** are measured and provide indications of the pasting properties of the samples and therefore its processing value for baking and other applications.

The results are reported in centipoise (cP). Results can also be converted to RVU (rapid visco unit), 1 RVU = 12 cP.

#### **BÜHLER MILLING:**

Cleaned wheat samples are damped to between 15.0% and 16.0% moisture according to the wheat moisture and kernel hardness and allowed to stand for 20 hours. Samples are then milled on a standard Bühler MLU 202 mill and passed through a bran finisher.

#### **BÜHLER EXTRACTION:**

The extraction represents the flour yield after milling plus flour obtained from bran that passed through a bran finisher. Flour extraction is calculated from the mass of the total products. Bühler MLU 202 mill set for South African wheat, mill settings and sieve sizes deviate from AACCI method 26-21.02, latest edition.

#### **COLOUR:**

Colour is one of the important properties of milled grains and the colour of wheat flour often affects the colour of the finished product. Generally speaking, a bright white colour flour is more desirable for most products.

The **Kent Jones** colour (so called wet colour) is determined by following FTP Method No. 0007/3, 7/1991. This method determines the influence of the branny material present in flour by measuring reflectance with

a light source in the green band of the light spectrum. The lower the Kent Jones colour, the lighter the flour.

The dry colour of wheat flour can be measured accurately and precisely with the **Minolta CM-5** spectrophotometer. CIE  $L^*a^*b^*$  (CIELAB) is a colour model using lightness ( $L^*$ ) and two colour values ( $a^*$  and  $b^*$ ). The colour coordinates define where a specific colour lies in a Cartesian graph.  $L^*$  represents lightness (100 being white and 0 being black),  $a^*$  represents green to red variation and  $b^*$  represents variation from blue to yellow. The results reported are for the 10° observer and D65 illuminant.

#### **GLUTEN:**

Wheat gluten is the water-insoluble complex protein fraction separated from wheat flours. The ability of wheat flour to produce dough with good gas retaining properties is attributed to gluten.

The gluten content of wheat flour is determined by means of AACCI Method 38-12.02, latest edition. **Wet gluten** is washed from meal or flour by an automatic washing apparatus (Glutomatic). Wet gluten is a plastic elastic substance composed principally of two protein fractions. Glutenin, the higher molecular weight fraction, contributes elasticity and Gliadin, the lower molecular weight fraction, provides extensibility.

The wet gluten is dried under standardized conditions in a Glutork to obtain the **dry gluten**. The total wet and total dry gluten contents are expressed as percentages of the sample on a 14% moisture basis.

Wet gluten content correlates to loaf volume and dry gluten content to the crude protein content. The difference between the wet and dry gluten contents is an indication of the water-holding capacity of the gluten proteins, which is in turn, related to flour water absorption.

The **gluten index** is the ratio of the wet gluten remaining on the sieve (after centrifugation) to the total wet gluten. The gluten index provides an indication of the gluten strength and is not

influenced by the protein content.

#### **FARINOGRAPH:**

AACCI method 54-21.02, latest edition constant flour weight procedure is followed, using 300 g of flour on a 14% moisture basis.

The farinograph measures and records the resistance of a dough to mixing, as it is formed from flour and water, developed and broken down. The dough is subjected to a prolonged, relatively gentle mixing action at a constant temperature.

The **water absorption** is the amount of water required for a dough to reach a definite consistency (500 Brabender units). The amount of water added to the flour is expressed as a percentage of the flour mass and reported on a 14% moisture basis.

The **development time** is the time from the beginning of water addition until the dough reaches its optimum consistency and the point immediately before the first indication of weakening. A long mixing time can be associated with flours with a high percentage of gluten-forming proteins.

The **stability** is the time during which the top of the curve intercepts a horizontal line through the centre of the curve. This gives an indication of the dough's tolerance to mixing: the longer the stability, the longer the mixing time that the dough can withstand. A dough with a longer stability can also withstand a longer fermentation period.

The **mixing tolerance** index value is the difference, in Brabender units, between the top of the curve at the peak and the top of the curve measured 5 minutes after the peak is reached. The value gives an indication of the extent to which breakdown of the dough occurs. The higher the value, the more and the quicker the breakdown of the dough occurs. This value is similar to the mixogram tail height.

#### **EXTENSOGRAPH:**

ICC Standard No. 114/1, latest edition is followed.

The **strength** gives an indication of the total force (work) needed to stretch the dough and is represented by the area under the curve.

The **maximum height** gives an indication of the dough's resistance to stretching and is measured as the mean of the maximum heights of the curves of the two test pieces.

The **extensibility** is the mean length at the base of the 2 curves and indicates the stretchability of the dough.

#### **ALVEOGRAPH:**

ICC Standard No. 121, latest edition is followed.

The **alveograph** measures the resistance of the dough to stretching and also how extensible the dough is. The alveograph stretches the dough in more than one direction (as is happening during proofing), whereas the extensograph stretches the dough in only one direction.

**Strength (S):** The area under the curve gives an indication of the dough strength.

**Stability (P):** Obtained by multiplying the maximum height of the curve with a constant factor of 1.1. This value is an indication of the resistance of the dough to extension.

**Distensibility (L):** The length of the curve, measured along the base line, gives an indication of the extensibility of the dough and also predicts the handling characteristics of the dough.

**P/L-value:** This ratio is obtained by dividing the P-value by the L-value, thus providing an approximate indication of the shape of the curve that combines stability and extensibility.

#### **100 g BAKING TEST:**

This procedure, according to Industry Accepted Method 022 based on AACCI Method 10-10.03, latest edition, provides an optimized bread-making method for evaluating bread wheat flour quality and a variety of dough ingredients by a straight-dough method in which all ingredients are incorporated in the initial mixing step.

Keys for the evaluation of the 100g Baking test:

- 0 - Excellent
- 1 - Very Good
- 2 - Good
- 3 - Questionable
- 4 - Poor
- 5 - Very Poor
- 6 - Extremely Poor

#### **Please note:**

This 100 g Baking test evaluation does not give an indication of the baking quality of the flour, but refers to the relationship between the protein content and the bread volume.

#### **MYCOTOXIN ANALYSES**

Mycotoxins, produced by moulds or fungi, are natural contaminants of food and feedstuffs with serious implications for public health and economics, in particular with relation to the international food trade.

SAGL implements a validated SAGL In-house multi-mycotoxin screening method using UPLC - MS/MS. 40 of the 337 wheat crop samples were tested for Aflatoxin G<sub>1</sub>; B<sub>1</sub>; G<sub>2</sub>; B<sub>2</sub>, Fumonisin B<sub>1</sub>; B<sub>2</sub>; B<sub>3</sub>, Deoxynivalenol, 15-ADON, HT2 - Toxin, T-2 Toxin, Zearalenone and Ochratoxin A.