Determination of Falling Number

Final approval November 2, 1972; Reapproval November 3, 1999

Objective

This method is based on the ability of α-amylase to liquefy a starch gel. The activity of the enzyme is measured by falling number (FN), defined as time in sec required to stir and allow stirrer to fall a measured distance through a hot aqueous flour or meal gel undergoing liquefaction. α-Amylase activity is associated with kernel sprouting, and both of these are inversely correlated with FN. The method is applicable to both meal and flour of small grains and to malted cereals.

Apparatus

1. Perten FN apparatus, including standardized precision viscometer tubes with close tolerances, inside diameter ±0.02 mm, outside diameter ±0.3 mm, length ±0.3 mm.

2. Thermometer, National Bureau of Standards or equivalent, calibrated in 0.1° and certified accurate to ±0.3°.

3. Sample mill, with 0.5- or 0.8-mm screen to produce meal with particle size distribution as follows: >500 μm, 0–10%; >210 but <500 μm, 25–40%; <210 μm, 75–50%.

4. Automatic pipet, should be capable of delivering 25 ± 0.3 ml.

Procedure

Water bath boiling temperature

Water bath requires distilled water or water of equivalent purity. FN value is affected by boiling temperature of water in water bath, which is a function of atmospheric pressure. Therefore, elevated locations may obtain FN values higher than those determined at sea level. No adjustment of water bath boiling temperature should be made, as this will lead to erroneous results. Instead, make the following calculations.

A. For wheat meal

If laboratory altitude is lower than 610 m (2000 ft) (bath temperature above 98° [Ref. 10]), FN determinations are made and reported without any corrections.

If laboratory altitude is higher than 610 m (2000 ft) (bath temperature below 98° [Ref. 10]), FN determinations are made and are corrected with following formula, in which FN_{alt} is original FN value as measured at specific altitude, elevation (E) is laboratory altitude in feet, and FN_{sl} is the calculated corresponding sea level FN value.

$$FN_{sl} = 10^{\log_{10}\left(FN_{sl}\right)}$$

http://dx.doi.org/10.1094/AACCIntMethod-56-81.03

Determination of Falling Number (continued)

where

$$\log_{10}(FN_{sl}) = 1.0 \times \log_{10}(FN_{alt}) - (1.63093 \times 10^{-4} \times E) + (2.63576 \times 10^{-8} \times E \times E) + [5.75030 \times 10^{-5} \times \log_{10}(FN_{alt}) \times E] - [1.06922 \times 10^{-8} \times \log_{10}(FN_{alt}) \times E \times E]$$

B. For wheat flour

If laboratory altitude is lower than 760 m (2500 ft) (bath temperature above 97.5° [Ref. 6]), FN determinations are made and reported without any corrections.

If laboratory altitude is higher than 760 m (2500 ft) (bath temperature below 97.5° [Ref. 6]), determinations are made and are corrected with following formula:

$$FN_{sl} = -849.41 + [0.4256 \times 10^{-5} \times E \times E] + [454.19 \times \log_{10}(FN_{alt})] - [0.2129 \times 10^{-5} \times \log_{10}(FN_{alt}) \times E \times E]$$

For convenience, tables with corrected values can be obtained through FN apparatus suppliers.

Preparation of meal

Moisture content of grain should be within range of approximately 8–16%. Water should be added to grain with less moisture content and air- or vacuum-drying applied to grain with more moisture content. To minimize sampling error due to sprouted kernels, grind approximately 250 g of sample.

Determination

1. Weigh 7.00 ± 0.05 g of flour or meal into dry FN tube. See Note 1. Add 25 ml water at 22 ± 2° with pipet. Insert rubber stopper and shake tube in upright position 20–30 times (up and down) or more if necessary until mixed. Make sure all flour is suspended by upending.

2. Use viscometer-stirrer to scrape down slurry coating upper part of tube, and scrape all slurry from stopper.

3. Place tube and viscometer-stirrer into water bath within 30–60 sec after mixing. Start apparatus immediately.

4. At conclusion of test, record time in sec. Remove tube; clean stirrer and tube using cold water and brush.

Determination of Falling Number (continued)

Calculation

Report FN on 14% moisture basis, using the following formula:

$$\text{FN (14\% moisture basis)} = FN_{as\ is} \times (100 - 14)/(100 - \text{moisture of sample, in \%})$$

Notes

1. If the operator prefers to adjust sample weight on 14.0% moisture basis, the following table may be used:

Weight of Sample Corrected for Moisture Content

Moisture Content (%)	Weight of Sample (14% mb) (g)	Moisture Content (%)	Weight of Sample (14% mb) (g)	Moisture Content (%)	Weight of Sample (14% mb) (g)
8.0	6.54	10.8	6.75	13.6	6.97
8.2	6.56	11.0	6.76	13.8	6.98
8.4	6.57	11.2	6.78	14.0	7.00
8.6	6.59	11.4	6.80	14.2	7.02
8.8	6.60	11.6	6.81	14.4	7.03
9.0	6.62	11.8	6.83	14.6	7.04
9.2	6.63	12.0	6.84	14.8	7.07
9.4	6.64	12.2	6.86	15.0	7.08
9.6	6.66	12.4	6.87	15.2	7.10
9.8	6.67	12.6	6.89	15.4	7.12
10.0	6.69	12.8	6.90	15.6	7.13
10.2	6.70	13.0	6.92	15.8	7.15
10.4	6.72	13.2	6.94	16.0	7.17
10.6	6.73	13.4	6.95	16.2	7.18

2. Since there is so little α-amylase in a wheat or flour sample that exceeds a (sea-level corrected) value of FN 400, it is of little value to continue the test past that point.

References

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Determination of Falling Number (continued)

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