Soluble solids and acidity in tomato products

Food industry

::: Determination of soluble solids in tomato products by refractive measurement of °Brix and acidity by pH probe

General

Not only the Italian no.1 culinary exports pizza and pasta require tomatoes. The tasty fruits are popular ingredients for many dishes around the globe, both in their natural and processed form. The worldwide tomato production in 2010 reached almost 146 million tons, with the major producing countries being China, USA and India (Fig. 1). In the USA, 90% of all tomatoes are grown in California.

Tomatoes are mainly composed of water, soluble and insoluble solids and organic acids, making soluble solid contents and pH major quality parameters in tomato producing and processing industries. In 2005, nearly 80% of all consumed tomatoes in the US were in the processed form.

The percentage of solids in tomatoes is strongly influenced by a variety of factors, such as e.g. climate, soil type, fertilizer, irrigation, maturity at harvest and postharvest handling. The total solid content of tomatoes usually varies between 5.5 - 9.5%, of which about 1% is skins and seeds.

The total solid content in processed and especially in concentrated tomato products may be substantially higher. It is a measure of the concentration and quality of the product.

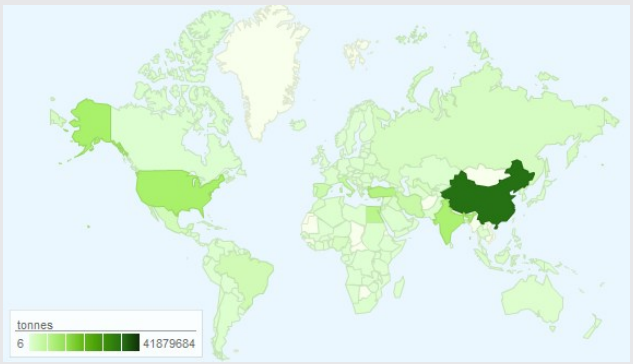

Fig. 1: Tomato production by country in tones in 2010 (Faostat3.org, retrieved 07.08.2012).

Soluble solids in tomato products are mainly composed of polysaccharides, like e.g. pectin. Treatment of samples with pectic enzyme results in the release of free sugars. Those sugars can be determined with refractive index measurements as °Brix, what expresses the mass percentage of total soluble solids in an aqueous solution.

Acidity contributes to both, taste and food safety as it hinders the spoilage of food by microorganisms. The optimum pH value for ripe tomatoes has been found to be around 4.25, the acidity being primarily caused by the citric acid content of the fruits. During ripening, pH in tomatoes increases and may exceed the recommended pH value for food safety in over-mature tomatoes. The addition of citric acid may be required to obtain the correct pH to ensure food safety and taste.

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Principle

Soluble solids are composed of polysaccharides that may be broken down enzymatically into free sugars which can be determined as °Brix with refractive index measurements. The pH value of samples may be determined in parallel with the pH sensor.

Safety Precautions

This method does not contain any safety instructions. It is in the responsibility of the user of this method to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to its use.

Materials & Apparatus

- Pectinase, also known as Pectic enzyme, e.g. Klerzyme® or Spark-L®
- Whatman filters No. 2V, 12.5 cm, or equivalent.
- Any Anton Paar Abbemat refractometer reading at least 0.0001 nD and operating at a wavelength of 589.3 nm. The instrument should be calibrated against a refractive index standard provided by Anton Paar.
- Ultracentrifuge, producing a force of at least 150,000 x g.

Method

Determination of soluble solids according to AOAC 970.59

Treatment of samples may differ depending on the soluble solid content of the sample.

(a) Samples containing < 35% solids:

Weigh 100 g sample at room temperature.

Add 0.2–1% (w/w) of dry enzyme to sample.

Mix well and filter immediately. Cover the filter to avoid evaporation. Samples that cannot be filtered within 1 h are to be rejected from the test.

In case a sample cannot be filter as described above, weigh 100 g fresh test portion and add 0.2–1% of dry enzyme. Incubate 30 – 60 min at 40°C in a sealed container.

Stir sample and transfer to filter after cooling down to room temperature. Proceed with (c).

Samples that still cannot be filtered within 60 min have to be rejected from the test. In that case, proceed with (b).

(b) Samples containing ≥ 35% solids:

Use commercially available pectinase aqueous solution or prepare 0.4 – 1 % aqueous solution of commercial pectinase, mix thoroughly and let settle. Use the clear supernatant.

Mix equal amounts of either clear enzyme-containing supernatant or ready-made aqueous enzyme solution with a fresh sample and mix immediately until homogenous. To dislodge and break up lumps sticking to container, alternately blend and shake the sample.

Transfer the homogenous sample to the filter. Cover the filter to avoid evaporation.

After filtration proceed with (c).

(c) Centrifugation

Use ultracentrifugation to obtain a clear supernatant. Do not use improper centrifuged samples as solid particles do interfere with the measurement. To reduce the centrifugation time additional dry enzyme may be added.

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Application of the Abbemat HP may supersede the centrifugation step, as the machine may be operated vertically. Therewith the sedimentation of insoluble solids on the prism can be inhibited.

Measurement procedure

Determination of soluble solids

The measuring prism of the Abbemat refractometer must be kept clean. The working surface of the prism should be free from scratches. Adjust refractometer to 20°C to determine % sucrose / °Brix of the sample (S). Replicates should give comparable sucrose contents within 0.1% sucrose or 0.0002 nD.

To correct for added enzyme proceed as follows:

(a) To correct for dry enzyme added to the solution, prepare an aqueous enzyme solution corresponding to the amount of % enzyme added to the sample. Read the aqueous enzyme solution on the refractometer as % sucrose / °Brix (A). The amount of soluble solids is calculated as follows:

Soluble solids = S - (1.15 x A)

with 1.15 correcting for insoluble solids, assuming 12.5% of total solids to be insoluble.

(b) To correct for enzymes in diluted samples, read the enzyme solution as % sucrose / °Brix (B) and subtract B x 0.55 (= Y) from the reading on the test portion (S), 0.55 being a correction factor for insoluble solids.

To calculate the amount of soluble solids, multiple the corrected reading Y by 2 and add a correction factor (C) according to table 1:

Soluble solids = 2Y + C

In case additional salt is present in the sample, the chloride content of samples needs to be determined according to established methods and subtracted from obtained values as follows:

B = (R - N) x 1.016

B = refractometer reading as °Brix corrected for added NaCl

R = total soluble solids as °Brix

N = % total chlorides expressed as NaCl

Table 1: Refractive index correction values

Natural tomato soluble solids as °Brix corrected for enzyme x 2 (2Y)	Correction (C)
25.0	0.3
30.0	0.4
35.0	0.5
40.0	0.7
45.0	0.8
50.0	0.9

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Determination of pH (Abbemat Performance Plus Line only)

The determination of pH in processed tomatoes may be determined simultaneously with refractive index measurements when using the pH ME measuring module. Measurements may be automated by using the Abbemat together with the peristaltic pump.

For convenient and fast measurements the XSample 122 sample changer may be connected to the Abbemat, allowing the automated measurements of refractive indices and pH values of up to 96 samples. Results will be shown on the Abbemat screen and summarized in one report.

Cross Reference

Food-Application note (Rheology)

Literature

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