CHE2810: At-home Laboratory Series

Experiment 1: Analysing Moisture Content of Food

Polly Burey

Table of Contents

Interpreting AOAC (Association of Analytical Communities) Official Method 925.45 for determining loss of moisture (i.e. moisture content) of food

Why use AOAC methods?

AOAC methods are validated methods that laboratories can use to compare their experimental results with other scientists. These methods have been proven to be reliable and repeatable

Safety Precautions

This experiment will involve placing items in a hot oven and removing them.

1. **Read ALL instructions before commencing.**
2. **Please ensure you wear protective gloves (e.g. oven mitts) while handling hot items.**
3. **Also you ensure you have a clear space to manoeuvre while transferring hot items to and from the oven, to avoid slips, trips and falls.**

Methodology

For analysing moisture content in food we will be using the method of drying at atmospheric pressure (Part B below) as I hope many of you have an oven or microwave oven at home.

44.1.03

AOAC Official Method 925.45
Loss on Drying (Moisture) in Sugars
First Action 1925

A. Vacuum Drying (Final Action)

(Applicable to cane and beet, raw and refined sugars.)

Dry 2–5 g test portion, 920.175(**a**) (*see* 44.1.01), in flat dish (Ni, Pt, or Al with tight-fit cover), 2 h at ≤70°C (preferably 60°C), under pressure ≤50 mm Hg (6.7 kPa). Bleed oven with current of air (dried by passing through anhydrous $CaSO_4$, P_2O_5, or other efficient desiccant) during drying to remove water vapor. Remove dish from oven, cover, cool in desiccator, and weigh. Redry 1 h and repeat process until change in weight between successive dryings at 1 h intervals is ≤2 mg.

B. Drying at Atmospheric Pressure (Procedure 1960)

(Applicable to cane and beet, raw and refined sugars.)

Dry ca 5 g test portion, 920.175(**a**) (*see* 44.1.01), in flat dish (Ni, Pt, or Al with tight-fit cover), 3 h at 100°C. Remove dish, cover, cool in desiccator, and weigh. Redry 1 h and repeat process until change in weight between successive dryings at 1 h intervals is ≤2 mg. For large-grain sugars, increase temperature to 105°–110°C in final heating periods to expel last traces of occluded water. Report loss in weight as H_2O.

C. Drying on Pumice Stone (Final Action)

(Applicable to massecuites, molasses, and other liquid and semiliquid products.)

Prepare pumice stone of 2 grades of fineness, one to pass through 1 mm sieve, other through 6 mm but not 1 mm sieve. Digest each 8 h with H_2SO_4 (1 + 4) on steam bath. Wash acid-free and heat to 525°C. Make determination in flat metal dish 60 mm diameter. Place 3 mm layer of the fine pumice stone on bottom of dish, then 6–10 mm layer of course pumice stone; dry and weigh. Dilute sample with weighed portion of H_2O so that diluted material contains 20–30% solid matter. Weigh, into prepared dish, amount of diluted sample to yield ca 1 g dry matter. If this weighing cannot be made rapidly, use weighing bottle provided with cork through which pipet passes. Dry at 70°C under pressure ≤50 mm Hg (6.7kPa), bleeding with dry air as in **A**. Make trial weighings at 2 h intervals toward end of drying period until change in weight is ≤2 mg. Report loss in weight as H_2O. Substances containing little or no fructose or other readily decomposable substance may be dried in oven at 100°C.

D. Drying on Quartz Sand (Final Action)

(Applicable to massecuites, molasses, and other liquid and semiliquid products.)

Digest pure quartz sand that passes No. 40 but not No. 60 sieve with HCl, wash acid-free, dry, and ignite. Preserve in stoppered bottle. Place 25–30 g prepared sand and short stirring rod in dish ca 55 mm diameter and 40 mm deep, fitted with cover. Dry thoroughly, cover dish, cool in desiccator, and weigh immediately. Add enough diluted product of known weight to yield ca 1 g dry matter and mix thoroughly with sand. Heat on steam bath 15–20 min, stirring at 2–3 min intervals, or until mass becomes too stiff to manipulate readily. Dry at <70°C (preferably 60°C) under pressure ≤50 mm Hg (6.7 kPa), bleeding with dry air as in **A**. Make trial weighings at 2 h intervals toward end of drying period (ca 18 h) until change in weight is ≤2 mg.

For materials containing no fructose or other readily decomposable substance, dry 8–10 h at atmospheric pressure in oven at 100°C, cool in desiccator, and weigh, repeating heating and weighing until loss in 1 h heating is ≤2 mg. Report loss in weight as H_2O.

As dry sand, as well as dried residue, absorbs appreciable moisture on standing over most desiccating agents, make all weighings as quickly as possible after cooling in desiccator.

Reference: *JAOAC* **8,** 255(1925).

Figure 1 AOAC Method for determining moisture content in foods.

Part B states that you should:

1. "Dry ca 5 g test portion,…. in flat dish (Ni, Pt, or Al with tight-fit cover), 3 h at 100°C."
    1.1. *This means that you should weigh approximately 5 grams of your chopped test sample into a flat dish made of nickel, platinum or aluminium. The actual weight should be reported in a laboratory notebook or spreadsheet. Once weighed you should then dry the sample for 3 hours in an oven at 100°C. You should have 2-3 samples for each food type.*
2. "Remove dish, cover, cool in desiccator, and weigh. Redry 1 h and repeat process until change in weight between successive dryings at 1 h intervals is ?2 mg."
    2.1. *This means that when the 3 hours is up, you should remove your sample from the oven, cover it (Aluminium foil for your experiment should be fine) and let it cool in the dessicator (the plastic box with the silica pack). Once cooled the sample should be re-weighed. After this reweighing the sample should go back into the oven for another 1 hour and cooled and reweighed again. The 1 hour drying should be repeated until there is little change in the sample weight (the method states ≤2 milligrams difference)*
3. For large-grain sugars, increase temperature to 105°–110°C in final heating periods to expel last traces of occluded water. Report loss in weight as H_2O.
    3.1. *For specific samples, such as sugars, the temperature should be slightly increased as the final weight is approached. In this case the temperature increase is up to 110°C maximum.*

Please watch the CHE2810 laboratory demonstration video to understand more how to do this experiment before doing it.

Equipment

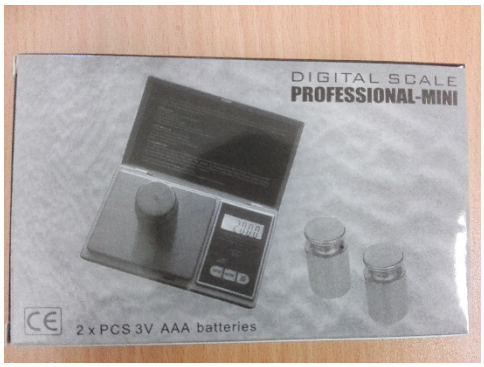
Items in your home you will need are:

1. A kitchen oven set at 100°C
2. An oven tray to rest your samples on
3. Everyday foods to use as test samples
4. A pair of oven mitts to take the tray from the oven.
5. A timer or clock to measure the time needed for each drying period.

You will also need to use items from your laboratory kit that are not everyday items that you will find in the home. Versions of these items would be found in an analytical laboratory.

For this experiment you will need the following items from your lab kit:

Safety Glasses



Precision balance for weighing samples

Aluminium pans to contain sample and spatula for weighing

Plastic box and Silica gel pack to make Dessicator

Figure 2 Laboratory kit items required for this experiment.

Check that you have all these items and then commence with your experiment. During the experiment, you will need to record data in order to determine moisture content of your food samples.

Recording of Data

The data to record in the table on the next page are:

EDW = Empty dish weight (in grams)
FDF = Full dish weight of Fresh Sample (in grams)
FDD = Full Dish weight of Dried Sample (in grams)

Through data analysis, you will then use some simple equations (Eq.) on page 6 to determine moisture content, using this data.

Table 1: Table for recording experimental data

Sample Name / ID	Repeat Number	Empty dish weight in grams	Fresh sample + Dish weight in grams	Fresh Sample weight as per Eq. 1	Fully Dried sample Dish weight in grams	Moisture Loss as per Eq. 2	Moisture content as per Eq. 3	Comments

Data Analysis

To calculate moisture content you will need to use the following equations:

$$FSW = FDF - EDW \qquad \text{Equation 1}$$

$$ML = FDF - FDD \qquad \text{Equation 2}$$

$$MC = 100 \times \frac{ML}{FSW} \qquad \text{Equation 3}$$

Where:

ML = Moisture Loss (in grams)
FDF = Full dish weight of Fresh Sample (in grams)
FSW = Fresh Sample Weight (in grams)
FDD = Full Dish weight of Dried Sample (in grams)
EDW = Empty dish weight (in grams)
MC = Moisture content on wet basis (in %)

Once you have recorded all your data and calculated moisture contents you will need to calculate the average moisture content for each food:

Average moisture content for 3 repeat samples per food type *= (Repeat 1 MC + Repeat 2 MC + Repeat 3 MC)/3* *Equation 4*

OR ***Average Moisture content for 2 repeat samples per food type*** *= (Repeat 1 MC + Repeat 2 MC)/2* *Equation 5*

Concluding Remarks: For validation, it is good to compare your experimental findings to those of other scientists. For the foods that you tested, see if your results are comparable to reported moisture contents for these samples.

Sample Type					
Average MC as per Eq. 4 or Eq. 5					
MC from literature					
Difference					