10 chapter

Moisture Content Determination

S.Suzanne Nielsen
Department of Food Science, Purdue University, West Lafayette, IN, USA
e-mail: nielsens@purdue.edu

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10.1 INTRODUCTION

10.1.1 Background

The moisture (or total solids) content of foods is important to food manufacturers for a variety of reasons. Moisture is an important factor in food quality, preservation, and resistance to deterioration. Determination of moisture content also is necessary to calculate the content of other food constituents on a uniform basis (i.e., dry weight basis). The dry matter that remains after moisture analysis is commonly referred to as total solids.

While moisture content is not given on a nutrition label, it must be determined to calculate total carbohydrate content. Moisture content of foods can be determined by a variety of methods, but obtaining accurate and precise data is commonly a challenge. The various methods of analysis have different applications, advantages, and disadvantages (see Sect. 10.1.2). If the ash content also is to be determined, it is often convenient to combine the moisture and ash determinations. In this experiment several methods to determine the moisture content of foods will be used and the results compared. Note that in some cases, the method is not ideal for the sample type (e.g., moisture content of corn syrup or basil by forced draft oven), but the intent is to compare results to those obtained using more appropriate methods (i.e., vacuum oven for corn syrup, toluene distillation for basil). Summarized below are the food samples proposed for analysis and the methods used. However, note that other types of food samples could be analyzed, and groups of students could analyze different types of food samples. It is recommended that all analyses be performed in triplicate, as time permits.

	Corn syrup	*Corn flour*	*Milk (liquid)*	*Nonfat dry milk*	*Basil*
Forced draft oven	X	X	X	X	X
Vacuum oven	X				
Microwave drying	X		X		
Rapid moisture analyzer		X			
Toluene distillation				X	X
Karl Fischer method		X		X	
Near-infrared analyzer		X			

10.1.2 Reading Assignment

Mauer, L.J., and Bradley, R.L., Jr. 2017. Moisture and total solids analysis, Ch. 15, in *Food Analysis*, 5th ed. S.S. Nielsen (Ed.), Springer, New York.

10.1.3 Overall Objective

The objective of this experiment is to determine and compare the moisture contents of foods by various methods of analysis.

10.2 FORCED DRAFT OVEN

10.2.1 Objective

Determine the moisture content of corn syrup and corn flour using a forced draft oven method.

10.2.2 Principle of Method

The sample is heated under specified conditions, and the loss of weight is used to calculate the moisture content of the sample.

10.2.3 Supplies

(*Note*: Samples for moisture analysis could be the same products tested also for ash, fat, and protein analysis, by procedures in respective chapters. Content of ash, fat, and protein could then be expressed on both a wet weight basis and dry weight basis.)

- Beaker, 20–30 mL (for corn syrup)
- Basil (fresh), 15 g (ground)
- Beaker, 25–50 mL (to pour corn syrup into pans)
- Corn flour, 10 g
- Corn syrup, 15 g
- 3 Crucibles (preheated at 550 °C for 24 h)
- 2 Desiccators (with dried desiccant)
- Liquid milk, 20 mL
- Nonfat dry milk (NFDM), 10 g
- Plastic gloves (or tongs)
- 2 Spatulas
- 5 Trays (to hold/transfer samples)
- 2 Volumetric pipettes, 5 mL
- 6 Weighing pans – disposable aluminum open pans (for use with corn syrup) (predried at 100 °C for 24 h)
- 6 Weighing pans – metal pans with lids [for use with corn flour and nonfat dry milk (NFDM)] (predried at 100 °C for 24 h)

10.2.4 Equipment

- Analytical balance, 0.1 mg sensitivity
- Forced draft oven
- Hot plate

10.2.5 Note

Glass microfiber filters (e.g., GF/A, Whatman, Newton, MA), predried for 1 h at 100 °C, can be used to cover samples to prevent splattering in the forced draft oven and the vacuum oven. Instructors may want to have students compare results with and without these fiberglass covers.

10.2.6 Cautions and Hazards

Be sure to label all containers used with complete information, or record container information linker to each sample. Use gloves or tongs when handling sample pans and crucibles. These pans and crucibles have been dried and stored in desiccators prior to weighing. They will pick up moisture by sitting on the counter, so remove them from the desiccator only just before use. Open desiccators slowly to avoid damage and danger from broken glass.

10.2.7 Procedure

Instructions are given for analysis in triplicate.

10.2.7.1 *Moisture in Corn Syrup*

1. Label dried pans (disposable aluminum open pans) and weigh accurately.
2. Place 5 g of sample in the pan and weigh accurately. (Because corn syrup is very hygroscopic, work quickly, using a plastic transfer pipette, as you weigh the corn syrup.)
3. Place in a forced draft oven at 98–100 °C for 24 h.
4. Store in a desiccator until samples are weighed.
5. Calculate percentage moisture (wt/wt) as described below.

10.2.7.2 *Moisture in Corn Flour (Method 44–15A of AACC International, One-Stage Procedure)*

1. Weigh accurately the dried pan with lid. (Note identifier number on pan and lid.)
2. Place 2–3 g of sample in the pan and weigh accurately.
3. Place in a forced draft oven at 130 °C for 1 h. Be sure metal covers are ajar, to allow water loss.
4. Remove from oven, realign covers to close, cool, and store in desiccator until samples are weighed.
5. Calculate percentage moisture (wt/wt) as described below.

10.2.7.3 *Moisture in Liquid Milk (AOAC Method 990.19, 990.20)*

1. Label and weigh accurately the predried crucibles (550 °C for 24 h). (Note identified number on crucible.)
2. Place 5 g of sample in the crucible and weigh accurately.
3. Evaporate a majority of water on a hot plate; do not dry the sample completely. (Gently heat the milk in the crucibles. Wear gloves as you handle the crucibles, swirling the milk to coat the sides of the crucible. Try to avoid development of a film on the surface, until most of the water has been evaporated.)
4. Place in a forced draft oven at 100 °C for 3 h.
5. Store in a desiccator until samples are weighed.
6. Calculate percentage moisture (wt/wt) as described below.

Note: Ash content of this milk sample could be determined by placing the milk sample, dried at 100 °C for 3 h, in a muffle furnace at 550 °C for 18–24 h. After cooling in a desiccator, the crucibles containing ashed milk would be weighed and the ash content calculated. See Ash Analysis laboratory in Chap. 11.

10.2.7.4 *Moisture of Nonfat Dry Milk*

1. Weigh accurately the dried pan with lid. (Note identifier number on pan and lid.)
2. Place 3 g of sample in the pan and weigh accurately.
3. Place pan in a forced draft oven at 100 °C for 24 h.
4. Store in a desiccator until samples are weighed.
5. Calculate percentage moisture (wt/wt) as described below.

10.2.7.5 *Moisture in Fresh Basil*

1. Label dried pans (disposable aluminum open pans) and weigh accurately.
2. Place 3 g of ground sample in the pan and weigh accurately.
3. Place in a forced draft oven at 98–100 °C for 24 h.
4. Store in a desiccator until samples are weighed.
5. Calculate percentage moisture (wt/wt) as described below.

10.2.8 Data and Calculations

Calculate percentage moisture (wt/wt):

$$\%\ \text{moisture} = \frac{\text{wt of } H_2O \text{ in sample}}{\text{wt of wet sample}} \times 100$$

$$\%\,\text{moisture} = \frac{\left(\begin{matrix}\text{wt of wet}\\ \text{sample+pan}\end{matrix}\right) - \left(\begin{matrix}\text{wt of dried}\\ \text{sample+pan}\end{matrix}\right)}{\left(\begin{matrix}\text{wt of wet}\\ \text{sample+pan}\end{matrix}\right) - \left(\text{wt of pan}\right)} \times 100$$

Sample	*Rep.*	*Pan (g)*	*Pan + wet sample (g)*	*Pan + dried sample (g)*	*Wet sample (g)*	*Water (g)*	*Moisture content (%)*
Corn syrup	1						
	2						
	3						
							$\bar{X}$ =
							SD =
Corn flour	1						
	2						
	3						
							$\bar{X}$ =
							SD =
Liquid milk	1						
	2						
	3						
							$\bar{X}$ =
							SD =
Nonfat dry milk	1						
	2						
	3						
							$\bar{X}$ =
							SD =
Fresh basil	1						
	2						
	3						
							$\bar{X}$ =
							SD =

10.3 VACUUM OVEN

10.3.1 Objective

Determine the moisture content of corn syrup by the vacuum oven method, with and without the addition of sand to the sample.

10.3.2 Principle

The sample is heated under conditions of reduced pressure to remove water, and the loss of weight is used to calculate the moisture content of the sample.

10.3.3 Supplies

- Corn syrup, 30 g
- Desiccator (with dried desiccant)
- 3 Glass stirring rods (ca. 2–3 cm long, predried at 100 °C for 3 h)
- Plastic gloves (or tongs)
- Pipette bulb or pump
- Sand, 30 g (predried at 100 °C for 24 h)
- 2 Spatulas
- Volumetric pipette, 5 mL
- 6 Weighing pans – disposable aluminum open pans (predried at 100 °C for 3 h)

10.3.4 Equipment

- Analytical balance, 0.1 mg sensitivity
- Vacuum oven (capable of pulling vacuum to <100 mm of mercury)

10.3.5 Cautions and Hazards

See same information in Sect. 10.2.6.

10.3.6 Procedure

10.3.6.1 *Moisture of Corn Syrup, Without the Use of Drying Sand*

1. Label weighing pans (i.e., etch identifier into tab of disposable aluminum pan) and weigh accurately.
2. Place 5 g of sample in the weighing pan and weigh accurately.
3. Dry at 70 °C and a vacuum of at least 26 in. for 24 h, but pull and release the vacuum slowly. (Note that samples without drying sand will

bubble up and mix with adjoining samples if pans are too close together.) Bleed dried air into the oven as vacuum is released.
4. Store in a desiccator until samples are cooled to ambient temperature. Weigh.

10.3.6.2 *Moisture of Corn Syrup, with the Use of Drying Sand*

1. Label weighing pan, add 10 g dried sand and stirring rod, then weigh accurately.
2. Add 5 g of sample and weigh accurately. Add 5 mL of deionized distilled (dd) water. Mix with stirring rod being careful not to spill any of the samples. Leave the stirring bar in the pan.
3. Dry at 70 °C and a vacuum of <100 mm mercury for 24 h. Bleed dried air into the oven as vacuum is released.
4. Store in a desiccator until samples are cooled to ambient temperature. Weigh.

10.3.7 Data and Calculations

Calculate percentage moisture (wt/wt) as in Sect. 10.2.8.

Sample	*Rep.*	*Pan (g)*	*Pan + wet sample (g)*	*Pan + dried sample (g)*	*Wet sample (g)*	*Water (g)*	*Moisture content (%)*
Corn syrup without sand	1						
	2						
	3						
							$\bar{X}$ =
							SD =
Corn syrup with sand	1						
	2						
	3						
							$\bar{X}$ =
							SD =

10.4 MICROWAVE DRYING OVEN

10.4.1 Objective

Determine the moisture content of corn syrup and milk (liquid) using a microwave drying oven.

10.4.2 Principle

The sample is heated using microwave energy, and the loss of weight is used to calculate the moisture content of the sample.

10.4.3 Supplies

- Corn syrup, 4 g
- Glass stirring rod (to spread corn syrup)
- Milk (liquid), 4 g
- 6 Paper pads (for use in microwave oven)
- Pasteur pipette and bulb (to spread milk sample)
- Plastic gloves

10.4.4 Equipment

- Microwave drying oven (e.g., from CEM Corporation, Matthew, NC)

10.4.5 Procedure

Follow instructions from the manufacturer for the use of the microwave drying oven, regarding the following:

- Turning on instrument and warming up
- Loading method for specific application (i.e., sets time, power, etc.)
- Taring instrument
- Testing sample
- Obtaining results

10.4.6 Data and Calculations

Sample	*Rep.*	*Moisture content (%)*	*Water/dry matter (g/g)*
Corn syrup	1		
	2		
	3		
		$\bar{X}$ =	$\bar{X}$ =
		SD =	SD =
Milk (liquid)	1		
	2		
	3		
		$\bar{X}$ =	$\bar{X}$ =
		SD =	SD =

10.5 RAPID MOISTURE ANALYZER

10.5.1 Objective

Determine the moisture content of corn flour using a rapid moisture analyzer.

10.5.2 Principle

The sample placed on a digital balance is heated under controlled high-heat conditions, and the instrument automatically measures the loss of weight to calculate the percentage moisture or solids.

10.5.3 Supplies

- Corn flour, 10 g
- Plastic gloves
- Spatula

10.5.4 Equipment

- Rapid moisture analyzer (e.g., from Computrac®, Arizona Instrument LLC., Chandler, AZ)

10.5.5 Procedure

Follow instructions from the manufacturer for the use of the rapid moisture analyzer, regarding the following:

- Turning on instrument and warming up
- Select test material
- Taring instrument
- Testing sample
- Obtaining results

10.5.6 Data and Calculations

	Moisture content (%)			
Sample	*1*	*2*	*3*	*Mean*
Corn flour				

10.6 TOLUENE DISTILLATION

10.6.1 Objective

Determine the moisture content of basil by the toluene distillation method.

10.6.2 Principle

The moisture in the sample is codistilled with toluene, which is immiscible in water. The mixture that distills off is collected, and the volume of water removed is measured.

10.6.3 Chemicals

	CAS no.	*Hazards*
Toluene	108-88-3	Harmful, highly flammable

10.6.4 Hazards, Cautions, and Waste Disposal

Toluene is highly flammable and is harmful if inhaled. Use adequate ventilation. Wear safety glasses and gloves at all times. For disposal of toluene waste, follow good laboratory practices outlined by environmental health and safety protocols at your institution.

10.6.5 Supplies

- Fresh basil, 40–50 g
- NFDM, 40–50 g
- Toluene, ACS grade

10.6.6 Equipment

- Analytical balance, 0.1 mg sensitivity.
- Glass distillation apparatus with ground glass joints: (1) boiling flask, 250 mL or 300 mL, round-bottom, short-neck flask with a TS 24/40 joint; (2) West condenser with drip tip, 400 mm in length with a TS 24/40 joint; (3) Bidwell-Sterling trap, TS 24/40 joint, 3-mL capacity graduated in 0.1-mL intervals.
- Heat source, capable of refluxing toluene in the apparatus above (e.g., heating mantle connected to voltage controller). No open flame!
- Nylon bristle buret brush, ½ in. in diameter, and a wire loop. (It should be long enough to extend through the condenser, ca. 450 mm. Flatten the loop on the buret brush and use this brush, inverted, as a wire to dislodge moisture drops in the moisture trap.)

10.6.7 Procedure

1. Grind the fresh basil with a small tabletop food grinder. Pulse grind the sample in 5–10 s intervals. Avoid long pulses and excessive grinding to prevent frictional heat.
2. Weigh approximately 40 g of sample (basil or NFDM) accurately (amount chosen to yield 2–5 mL water).
3. Transfer sample quantitatively to distilling flask. Add sufficient toluene to cover the sample completely (not less than 75 mL).
4. Assemble the apparatus appropriate. Fill the trap with toluene by pouring it through the condenser until it just fills the trap and begins to flow into the flask. Insert a loose nonabsorbing

cotton plug into the top of the condenser to prevent condensation of atmospheric moisture in the condenser.
5. Bring to boil and reflux at about two drops per second until most of the water has been collected in the trap and then increase the reflux rate to ca. four drops per second.
6. Continue refluxing until two consecutive readings 15 min apart show no change. Dislodge any water held up in the condenser with a brush or wire loop. Rinse the condenser carefully with ca. 5 mL toluene. Dislodge any moisture droplets adhering to the Bidwell-Sterling trap or toluene trapped under the collected moisture. For this, use the wire. Rinse wire with a small amount (10 mL) of toluene before removing from the apparatus.
7. Continue refluxing for 3–5 min, remove the heat, and cool the trap to 20 °C in a suitable water bath.
8. Calculate the moisture content of the sample:

$$\%\,\text{Moisture} = \left[\text{vol. of water}(\text{mL})/\text{wt of sample}(\text{g})\right] \times 100$$

10.6.8 Notes

1. Flask, condenser, and receiver must be scrupulously clean and dry. For example, the apparatus, including the condenser, could be cleaned with potassium dichromate-sulfuric acid cleaning solution, rinsed with water, rinsed with 0.05 *N* potassium hydroxide solution, rinsed with alcohol, and then allowed to drain for 10 min. This procedure will minimize the adherence of water droplets to the surfaces of the condenser and the Bidwell-Sterling trap.
2. A correction blank for toluene must be conducted periodically by adding 2–3 mL of distilled water to 100 mL of toluene in the distillation flask and then following the procedure in Steps 2–6 in Sect. 10.6.7.

10.6.9 Data and Calculations

Wt. sample (g)	*Vol. water removed (mL)*	*Moisture content (%)*

10.7 KARL FISCHER METHOD

10.7.1 Objective

Determine the moisture content of NFDM and corn flour by the Karl Fischer (KF) method.

10.7.2 Principle

When the sample is titrated with the KF reagent, which contains iodine and sulfur dioxide, the iodine is reduced by sulfur dioxide in the presence of water from the sample. The water reacts stoichiometrically with the KF reagent. The volume of KF reagent required to reach the endpoint of the titration (visual, conductometric, or coulometric) is directly related to the amount of water in the sample.

10.7.3 Chemicals

	CAS no.	*Hazards*
Karl Fischer reagent		Toxic
2-Methoxyethanol	109-86-4	
Pyridine	110-86-1	
Sulfur dioxide	7446-09-5	
Iodine	7553-56-2	Harmful, dangerous to the environment
Methanol, anhydrous	67-56-1	Extremely flammable
Sodium tartrate dihydrate ($Na_2C_4H_4O_6 \cdot 2H_2O$)	868-18-8	

10.7.4 Reagents

- KF reagent
- Methanol, anhydrous
- Sodium tartrate dihydrate, 1 g, dried at 150 °C for 2 h

10.7.5 Hazards, Cautions, and Waste Disposal

Use the anhydrous methanol in an operating hood, since the vapors are harmful and are toxic. Otherwise, adhere to normal laboratory safety procedures. Use appropriate eye and skin protection. The KF reagent and anhydrous methanol should be disposed of as hazardous wastes.

10.7.6 Supplies

- Corn flour
- Graduated cylinder, 50 mL
- NFDM
- 2 Spatulas
- Weighing paper

10.7.7 Equipment

- Analytical balance, 0.1 g sensitivity
- KF titration unit, nonautomated unit (e.g., from Barnsted Themaline, Berkeley, CA, Aquametry Apparatus) or automated unit

10.7.8 Procedure

Instructions are given as for a nonautomated unit and for analysis in triplicate. If using an automated unit, follow instructions of the manufacturer.

10.7.8.1 *Apparatus Setup*

Assemble titration apparatus and follow instructions of the manufacturer. The titration apparatus includes the following: buret, reservoir for reagent, magnetic stirring device, reaction/titration vessel, electrodes, and circuitry for dead stop endpoint determination. Note that the reaction/titration vessel of the KF apparatus (and the anhydrous methanol within the vessel) must be changed after analyzing several samples (exact number depends on type of sample). Remember that this entire apparatus is very fragile. To prevent contamination from atmospheric moisture, all openings must be closed and protected with drying tubes.

10.7.8.2 *Standardizing Karl Fischer Reagent*

The KF reagent is standardized to determine its water equivalence. Normally, this needs to be done only once a day, or when changing the KF reagent supply.

1. Add approximately 50 mL of anhydrous methanol to reaction vessel through the sample port.
2. Put the magnetic stir bar in the vessel and turn on the magnetic stirrer.
3. Remove the caps (if any) from drying tube. Turn the buret stopcock to the *filling position*. Hold one finger on the air-release hold in the rubber bulb and pump the bulb to fill the buret. Close the stopcock when the KF reagent reaches the desired level (at position 0.00 mL) in the buret.
4. Titrate the water in the solvent (anhydrous methanol) by adding enough KF reagent to just change the color of the solution from clear or yellow to dark brown. This is known as the KF endpoint. Note and record the conductance meter reading. (You may titrate to any point in the brown KF zone on the meter, but make sure that you always titrate to that same endpoint for all subsequent samples in the series.) Allow the solution to stabilize at the endpoint on the meter for at least 1 min before proceeding to the next step.
5. Weigh, to the nearest milligram, approximately 0.3 g of sodium tartrate dihydrate, previously dried at 150 °C for 2 h.
6. Fill the buret with the KF reagent and then titrate the water in the sodium tartrate dihydrate sample as in Sect. 10.7.8.2, Step 4. Record the volume (mL) of KF reagent used.
7. Calculate the KF reagent water (moisture) equivalence (KFR_{eq}) in mg H_2O/mL:

$$KFR_{eq} = \frac{36\,g/mol \times S \times 1000}{230.08\,g/mol \times A}$$

where:

S = weight of sodium tartrate dihydrate (g)
A = mL of KF reagent required for titration of sodium tartrate dihydrate

10.7.8.3 *Titration of Sample*

1. Prepare samples for analysis and place in reaction vessel as described below.

If samples are in powder form:

- Use an analytical balance to weigh out approximately 0.3 g of sample, and record the exact sample weight (S) to the nearest milligram.
- Remove the conductance meter from the reaction vessel, and then transfer your sample to the reaction vessel through the sample port immediately. (Use an extra piece of weighing paper to form a cone-shaped funnel in the sample port, and then pour your sample through the funnel into the reaction vessel.)
- Put the conductance meter and stopper back in the reaction vessel. The color of the solution in the vessel should change to light yellow, and the meter will register below the KF zone on the meter.

If any samples analyzed are in liquid form:

- Use a 1-mL syringe to draw up about 0.1 mL of sample. Weigh the syringe with sample on an analytical balance and record the exact weight (S_1) to the nearest milligram.
- Inject 1–2 drops of sample into the reaction vessel through the sample port and then weigh the syringe again (S_0), to the nearest milligram.
- Sample weight (S) is the difference of S_1 and S_0.

$$S = S_1 - S_0$$

1. Put the stopper back in the sample port of the reaction vessel. The color of the solution in the vessel should change to light yellow, and the meter will register below the KF zone on the meter.
2. Fill the buret, then titrate the water in the sample as in Sect. 10.7.8.2, Step 4. Record the volume (mL) of KF reagent used.
3. To titrate another sample, repeat Steps 5–7 above (Sect. 10.7.8.2) with the new sample. After

titrating several samples (exact number depends on the nature of the sample), it is necessary to start with fresh methanol in a clean reaction vessel. Record the volume (mL) of KF reagent used for each titration.

10.7.9 Data and Calculations

Calculate the moisture content of the sample as follows:

$$\%H_2O = \frac{KFR_{eq} \times K_s}{S} \times 100$$

where:

KFR_{eq} = water equivalence of KF reagent (mg H_20/mL)
K_s = mL of KF reagent required for titration of sample
S = weight of sample (mg)

Karl Fischer reagent water equivalence (KFR_{eq}):

Rep.	*Wt. sodium tartrate dihydrate (g)*	*Buret start (mL)*	*Buret end (mL)*	*Volume titrant (mL)*	*Calculated KFR_{eq}*
1					
2					
3					
					$\bar{X}$ =

Moisture content of samples by Karl Fischer method:

Sample Rep	*Wt. sample (g)*	*Buret start (mL)*	*Buret end (mL)*	*Volume titrant (mL)*	*Moisture content (%)*

10.8 NEAR-INFRARED ANALYZER

10.8.1 Objective

Determine the moisture content of corn flour using a near-infrared (NIR) analyzer.

10.8.2 Principle

Specific frequencies of infrared radiation are absorbed by the functional groups characteristic of water (i.e., the –OH stretch of the water molecule). The concentration of moisture in the sample is determined by measuring the energy that is reflected or transmitted by the sample, which is inversely proportional to the energy absorbed.

10.8.3 Supplies

- Corn flour
- Pans and sample preparation tools for near-infrared analyzer

10.8.4 Equipment

- Near-infrared analyzer

10.8.5 Procedure

Follow instructions from the manufacturer for the use of the near-infrared analyzer, regarding the following:

- Turning on instrument and warming up
- Calibrating instrument
- Testing sample
- Obtaining results

10.8.6 Data and Calculations

Corn flour % moisture			
1	*2*	*3*	*Mean*

10.9 QUESTIONS

1. In separate tables, summarize the results from the various methods used to determine the moisture content of each type of food sample analyzed: (a) corn syrup, (b) liquid milk, (c) corn flour, (d) NFDM, and (e) basil. Include in each table the following for each method: (a) data from individual determinations, (b) mean value, (c) standard deviation, (d) observed appearance of samples, (e) relative advantages of method, and (f) relative disadvantages of method.
2. Calculate the moisture content of the liquid milk samples as determined by the forced draft oven and microwave drying oven methods in terms of g H_2O/g dry matter and include this in a table of results.

	Liquid milk moisture content	
Method	*Mean % moisture*	*Mean g water/g dry matter*
Forced draft oven		
Microwave drying oven		

3. For the liquid milk sample analyzed for moisture content using a forced draft oven, why was the milk sample partially evaporated on a hot plate before being dried in the oven?

4. Of the various methods used to measure the moisture content of corn syrup, based on concerns for accuracy and precision, what method would you choose if you needed to measure moisture content again? Explain your answer.
5. What is the difference between moisture content and water activity measurements?
6. What method would you use to measure the moisture content of cornflakes for a) rapid quality control and b) a research project? Explain your answers. For each method, what would you have to do to the cornflakes before measuring the moisture content?
7. Explain the theory/principles involved in predicting the concentrations of various constituents in a food sample by NIR analysis. Why do we say "predict" and not "measure"? What assumptions are being made?
8. Your quality control lab has been using a hot air oven method to make moisture determinations on various products produced in your plant. You have been asked to evaluate the feasibility of switching to new methods (the specific one would depend on the product) for measuring moisture content.

(a) Describe how you would evaluate the accuracy and precision of any new method.
(b) What common problems or disadvantages with the hot air oven method would you seek to reduce or eliminate using any new method?
(c) You are considering the use of a toluene distillation procedure or Karl Fischer titration method for some of your products that are very low in moisture. What are the advantages of each of these methods over the hot air oven method in the proposed use? What disadvantages or potential problems might you encounter with the other two methods?

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RESOURCE MATERIALS

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