Application Note

Instrument: TGM800

Determination of Moisture in Meat

LECO Corporation; Saint Joseph, Michigan USA

Introduction

Moisture content is a major factor controlling the quality and safety (texture, taste, and microbial stability) of meat. Moisture is also useful in determining the level of retained water, additive solutions for flavoring, and the leanness of meat. Therefore, obtaining accurate moisture values is an important quality control tool utilized during the packaging process. Meat is muscle tissue and typically contains approximately 75% water, approximately 20% protein, with the remaining approximate 5% being comprised of fats, minerals and carbohydrates. The actual moisture content of any given meat is dependent upon the type of meat, the muscle type, time of year, and the pH of the meat. Typically, leaner meats, which contain more protein and less fat, tend to contain higher moisture levels. Meats can absorb water during processing and cooling procedures. Absorbed water is sometimes referred to as "retained water." Regulations require that the percent of absorbed or retained water be stated on the product label. Meats can also be enhanced with solutions to add flavor, such as injected flavor solutions or marinades. The amount of flavoring solution that can be added to the meat is limited by regulations and must be indicated on the product label. Therefore, it is extremely important that the amount of moisture in meat be monitored by manufacturers in order to ensure that the finished product adheres to all of the necessary regulations for moisture content and label claims.

Thermogravimetric analysis (TGA) is an analytical technique in which changes in sample mass due to changes in physical and chemical properties of materials are measured as a function of temperature and/or time. TGA is commonly used to determine selected characteristics of materials that exhibit either mass loss or gain, due to decomposition, oxidation, or loss of volatile materials, such as moisture.

The TGM800 is a macro thermogravimetric analyzer designed to indirectly determine the moisture content of materials using a mass loss-on-drying technique. Mass loss of the sample is measured as a function of the oven temperature by controlling the atmosphere and ventilation rate. The instrument consists of a computer, an integrated four-place balance, and a multiple sample oven that allows up to 16 samples to be analyzed simultaneously, with a maximum oven temperature of 175 °C.

Method Reference

AOAC 950.46 Moisture in Meat*
AOAC 983.18 Meat and Meat Products (Sample Preparation)

**The AOAC Official Method 950.46 was followed to demonstrate the application capabilities of the TGM800.*

Several modifications to the AOAC Official Method 950.46 were also investigated to achieve improved precision and reduced analysis time, including decreased sample mass and the addition of quartz sand to the sample (to improve thermal transfer).

Sample Preparation

Samples should be prepared in accordance with AOAC Official Method 983.18.

Accessories

621-010-956 Large Aluminum Foil Crucibles (2.4 inch diameter) used with the 621-011-237 Carousel (11 place Carousel), 621-010-236 Small Aluminum Foil Crucibles (1.5 inch diameter) used with the 621-010-642 Carousel (16-place Carousel), 502-996 Drying Aid Quartz Sand**, 621-011-507 Double Ended Scoop, Latex or Nitrile gloves.

***Quartz Sand was dried in an oven at 105 °C for one hour prior to use.*

Sample Mass

~1.0 g or ~6.5 g

Analysis Time

~1.5 to 5.5 hours (depending on meat type and method utilized)

Methods	
1.0 g (No Sand)	~ 3.0 h
1.0 g (With ~ 0.5 g Sand)	~ 1.5 h
6.5 g (No Sand)	~ 4.5 h
6.5 g (With ~3.0 g Sand)	~ 2.5 h

General Method Parameters

	1 g (No Sand)	*1 g (With ~0.5 g Sand)*	*6.5 g (No Sand)*[†]	*6.5 g (With ~3.0 g Sand)*
Nominal Sample Mass	~1.0 g	~1.0 g	~6.5 g	~6.5 g
Crucible Type	Small Al Foil	Small Al Foil	Large Al Foil	Large Al Foil
Minimum Crucible Weight	0.8000	0.8000	1.1200	1.1200
Maximum Crucible Weight	1.2000	2.5000	1.6800	5.0000
Crucible Density	0.50	0.50	0.50	0.50
Sample Type	Other	Other	Other	Other
Sample Density	1.0	1.0	1.0	1.0
Minimum Sample Weight	0.8000	0.5000	4.0000	1.0000
Maximum Sample Weight	1.2000	1.2000	6.7500	6.7500

Method Step Parameters

	1 g (No Sand)	*1 g (With ~0.5 g Sand)*	*6.5 g (No Sand)*[†]	*6.5 g (With ~3.0 g Sand)*
Step Type	Preset	Preset	Preset	Preset
Preset Method Step	Moisture	Moisture	Moisture	Moisture
Start Temperature	25.0 °C	25.0 °C	25.0 °C	25.0 °C
End Temperature	125.0 °C	125.0 °C	125.0 °C	125 °C
Ramp Rate	20.0 °C/min	20.0 °C/min	20.0 °C/min	20.0 °C/min
Hold Time	30 min	30 min	30 min	30 min
Maximum Time	420 min	420 min	600 min	600 min
Flow Rate	5.0 LPM	5.0 LPM	5.0 LPM	5.0 LPM
Final Weight	At Constancy	At Constancy	At Constancy	At Constancy
Constancy Window	9 min	9 min	9 min	9 min
Constancy Level	0.0005 g	0.0020 g	0.0020 g	0.0100 g

[†]*This method meets the requirements of AOAC Official Method 950.46 Moisture in Meat.*

Method Step Calculations

Calculation Type	Preset
Calculation Name	Moisture
Measurement Type	Mass Ratio
Calculation Equation	(((Initial Mass – Moisture Mass)) ÷ Initial Mass)

Procedure

Analysis without Quartz Sand

1. Create a method using the Method Step Parameters listed above, following the procedure outlined in the TGM800 Instruction Manual.
2. Log in and load samples (~1.0 g or ~6.5 g) following the procedure outlined in the TGM800 Instruction Manual.

Analysis with Quartz Sand

1. Create a method using the Method Step Parameters listed above, following the procedure outlined in the TGM800 Instruction Manual.
2. Log in the appropriate number of meat samples for analysis.
3. Log in two to three quartz sand samples for analysis (this is to verify the moisture content in quartz sand).

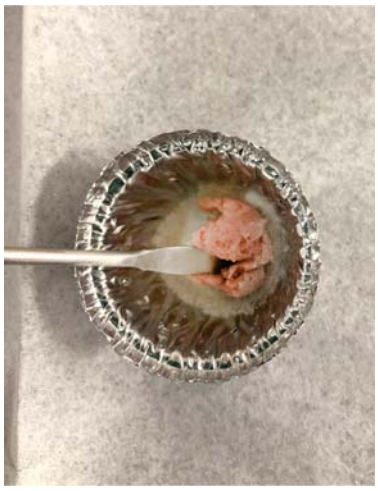
4. Using an external balance, place a crucible on the balance and tare.
5. Weigh the appropriate mass (~0.5 g or ~3.0 g) of quartz sand into the reference crucible and the crucibles for meat sample analysis.
6. Load the crucibles containing the quartz sand into the appropriate locations on the carousel. Add empty crucibles into the appropriate locations on the carousel for the two to three quartz sand analyses.
7. Initiate analysis.
8. Carefully weigh meat sample (~1.0 g or ~6.5 g) into the crucible containing quartz sand.
9. Wearing gloves, carefully remove crucible from the carousel, place on a clean surface, and mix sample with the quartz sand, making sure that all material remains in the crucible.
10. Carefully return the crucible containing sample and quartz sand to the appropriate carousel location.
11. Initiate analysis.
12. Repeat steps 7 through 11 until all meat samples have been weighed and mixed with quartz sand.
13. Weigh the same mass of quartz sand used in step 5, to the empty crucibles for quartz sand analyses.

Step 4

Step 5

Step 6

Step 8



Step 9 (before)

Step 9 (after)

Typical Results

	1.0 g (No Sand)		1.0 g (With Sand)		6.5 g (No Sand)[††]		6.5 g (With Sand)	
	Initial Mass (g)	*% Moisture*	*Initial Mass (g)*	*% Moisture*	*Initial Mass (g)*	*% Moisture*	*Initial Mass (g)*	*% Moisture*
Chicken	1.0297	73.27	1.0432	73.38	6.5265	73.08	6.5876	73.15
Boneless/Skinless	1.0782	72.95	1.0589	73.22	6.5443	73.04	6.5797	73.24
Thigh Meat	1.0604	73.07	1.0670	73.12	6.5757	73.10	6.5203	73.19
	1.0028	73.23	1.0863	73.11	6.5141	72.94	6.5213	73.23
	1.0713	73.15	1.0660	73.04	6.5196	73.11	6.5262	73.23
	1.0135	73.21	1.0129	73.31	6.5177	73.00	6.5607	73.19
	1.0559	73.05	1.0317	73.11	6.5831	72.99	6.5539	73.25
	Avg =	***73.13***	***Avg =***	***73.18***	***Avg =***	***73.04***	***Avg =***	***73.21***
	s =	***0.11***	***s =***	***0.12***	***s =***	***0.06***	***s =***	***0.03***
Beef	1.0213	67.95	1.0469	68.19	6.6182	67.95	6.5920	68.14
Eye of Round	1.0635	67.99	1.0255	68.18	6.6106	67.92	6.5808	68.15
Lean Meat	1.0057	68.11	1.0113	68.12	6.6205	67.91	6.5435	68.14
	1.0018	67.89	1.0782	68.09	6.5670	67.86	6.5539	68.10
	1.0613	68.26	1.0338	68.01	6.5751	67.86	6.5850	68.14
	1.0532	67.96	1.0446	68.16	6.5459	67.93	6.5294	68.08
	1.0253	68.04	1.0282	68.09	6.5924	67.95	6.5580	68.08
	Avg =	***68.03***	***Avg =***	***68.12***	***Avg =***	***67.91***	***Avg =***	***68.12***
	s =	***0.12***	***s =***	***0.06***	***s =***	***0.04***	***s =***	***0.03***
Fish	1.0562	72.54	1.0338	73.02	6.4960	72.68	6.5453	73.26
Sockeye Salmon	1.0132	72.64	1.0185	73.12	6.5835	72.66	6.5111	73.36
Lean Meat	1.0313	72.91	1.0261	72.93	6.5473	72.68	6.5263	73.33
	1.0785	72.50	1.0531	73.05	6.5038	72.71	6.5423	73.31
	1.0552	72.64	1.0256	72.90	6.5523	72.75	6.5054	73.26
	1.0608	72.65	1.0269	73.00	6.5839	72.58	6.5492	73.26
	1.0702	72.37	1.0361	73.10	6.6071	72.64	6.5302	73.29
	Avg =	***72.61***	***Avg =***	***73.02***	***Avg =***	***72.67***	***Avg =***	***73.29***
	s =	***0.17***	***s =***	***0.08***	***s =***	***0.05***	***s =***	***0.04***

[††]This method meets the requirements of AOAC Official Method 950.46 Moisture in Meat.

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