United States Department of Agriculture

Food Safety and Inspection Service

CLG-MOI.05

Quantitation of Moisture

This method describes the laboratory procedure for quantitation of moisture (water content) in meat, poultry, and processed products.

Executive Summary

This is a food chemistry method for the analysis of moisture or water content in meat, poultry, and processed products. The water content is determined through measuring the weight of products before and after the drying of food products.

Notice of Change

This method has been reformatted to a modernized design to improve accessibility and provide clarity for users. The method includes pictures that describe critical procedures for analysis. In addition to the formatting changes, the requirement of a meat recovery (safeguard) in the sample set was removed.

Table of Contents

Safety Precautions

The personnel performing the analysis are to read the Safety Data Sheets for the standards and reagents used in this method. Follow all applicable federal, state, and local regulations regarding the disposal of chemicals listed in this method.

Introduction

Moisture is the water content present in a product and it influences the physical properties of a substance, including weight, density, viscosity, conductivity, and the rate of microbial growth. Products such as jerky can use moisture content found in food for preservation. The Federal Meat Inspection Act (FMIA), the Poultry Products Inspection Act (PPIA), and the Egg Products Inspection Act (EPIA) set labeling requirements to ensure that the moisture content of products are accurately labeled and are compliant with Title 9 of the Code of Federal Regulations.

Method Overview

A sample is first weighed. The sample is then heated, cooled, and then re-weighed. The weight change is measured and the difference is calculated as moisture content.

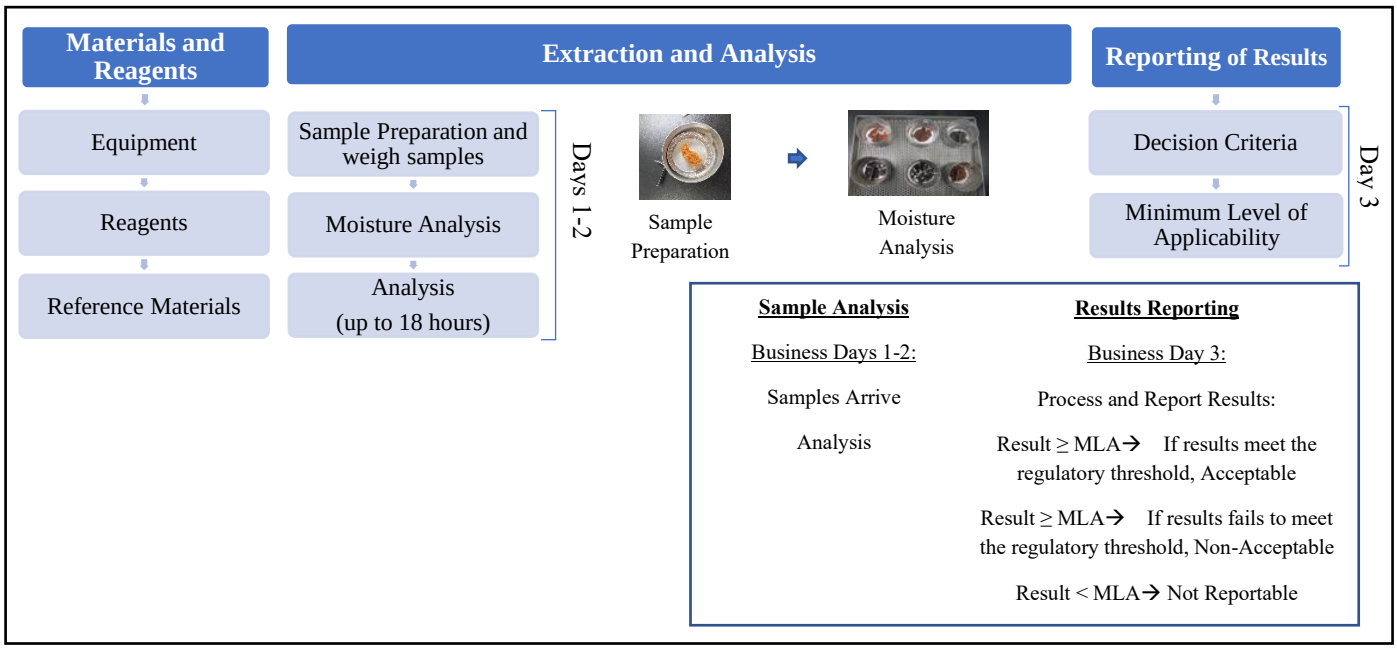

Figure 1: Overview and timeframe of moisture analysis. Samples arrive at the laboratory, are weighed, and analyzed on business days 1-2. Results are reported on business day 3. This chart represents the best-case scenario, but analyses may take longer due to analytical testing circumstances. Pictures courtesy of Hue Quach and Killani Kadri, USDA-FSIS.

Decision Criteria

Quantitative results are reported for all samples. Sample results are compared to the regulatory thresholds found in the 9 CFR for the particular product of interest and the Minimum Level of Applicability (MLA). A sample is considered "Acceptable" if the results meet the regulations. A sample is considered "Non-Acceptable" if the results fail to meet the regulations.

KEY DEFINITIONS

MLA: Lowest level at which an FSIS method has been successfully validated for a residue in each matrix. Full definition is on the CLG website here.

Disclosure Statement

The Food Safety and Inspection Service (FSIS) does not specifically endorse any test products listed in this method. FSIS acknowledges that equivalent equipment, reagents, or solutions may be suitable for laboratory use. The FSIS laboratory system uses method performance requirements when evaluating the equivalence of an alternative equipment, reagent, or solution for a given analyte and sample matrix pair. Significant equivalence changes would require FSIS laboratory leadership approval.

Materials and Reagents

Equipment

Table 1: Equipment Required to Perform CLG-MOI

Equipment	Supplier and Part Number	Purpose
Food Processor	Robot Coupe USA Inc.	Homogenize sample
Cutting board and knives	General lab supplier	Preparation of sample
Mechanical convection oven capable of 101 ± 1 °C for 16 -18 hours or 125 ± 1 °C for 4 hours ± 10 minutes and returning to temperature within 10 minutes of door closing	General lab supplier	Drying sample
Covered aluminum dishes - 2-1/2" (63mm) dia, 1-3/4" (44mm) depth, 141 mL capacity	Catalog No. 1183C43, Thomas Scientific.	Holding sample for drying
Aluminum weighing dish with tab, 57 mm, ≥ 50 mm diameter, ≤ 40 mm deep	Catalog No. 25433-008, VWR International.	Liner for covered aluminum dish
Aluminum weighing paddles - L-shaped, approximately 25 mm long, 12.5 mm wide	General lab supplier	Spreading sample
Freezer, -10 °C	General lab supplier	Storage of sample
Analytical balance, capable of reading 0.1 mg	General lab supplier	Weighing sample
Desiccator	General lab supplier	Cooling samples

Extraction and Analysis

Sample Preparation

Samples must be kept cold and sealed from the air before and during shipping to the laboratory. Handle samples in a way to avoid evaporation and condensation. An example of the type of sample is shown in Figure 2, with an example of a prepared sample in Figure 3.

Figure 2: Processed meat product. Photo courtesy of Getty Images.

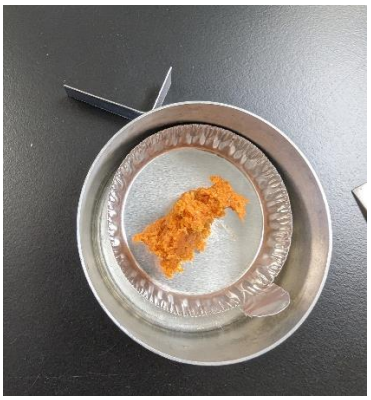

Figure 3: Homogenized sample. Photo courtesy of Raymond Allen Williams, USDA FSIS

Moisture analysis

Samples

1) Prior to weighing, samples should be thoroughly mixed by squeezing and palpating the sample bags to ensure that the samples are homogenous. This ensures that the sample is representative of the food product being analyzed.

2) Accurately weigh 3 to 6 g of sample (representing approximately 2 g of dry material) as rapidly as possible to minimize loss of moisture into a pre-weighed covered aluminum dish with (optional) aluminum weighing dish liner (Shown in Figures 4 and 5).

3) To achieve uniform evaporation and ensure accurate determination of moisture content, spread the sample across the bottom of the pan to provide a greater sample surface area.

4) Include the paddle used in spreading the sample across the bottom of the pan in the weight of the pan. Stand the paddles on edge when drying to minimize the amount of sample blocked from evaporation.

QUALITY CONTROL

1) Prepare one control sample from previously analyzed samples or from samples with a known value as a recovery with each set of samples.
2) Weigh an intra-laboratory check sample, if necessary.

KEY DEFINITIONS

Reference value: The value of the known concentration of moisture in the meat recovery.

Meat Recovery: A sample with a known concentration of moisture.

Figure 4: Empty sample pans. Photo courtesy of Killani Kadri, USDA-FSIS

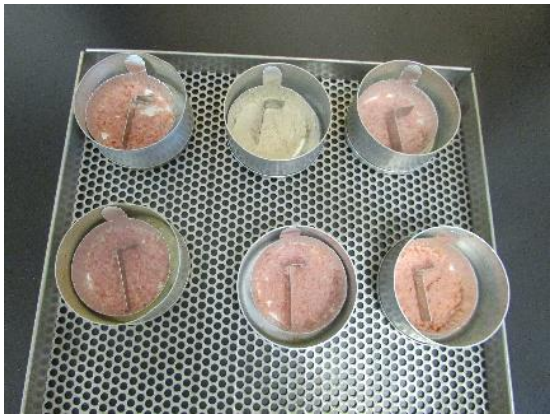

Figure 5: Samples before oven drying. Photo courtesy of Killani Kadri, USDA-FSIS

Extraction

1) As shown in Figure 6, dry samples with the cover removed, for 16 -18 hours at 100 - 102 °C, or for 4 hours ± 10 minutes at 125 ± 1 °C in a mechanical convection oven. No dishes can be touching, and the dishes cannot be placed on a solid tray in the oven.

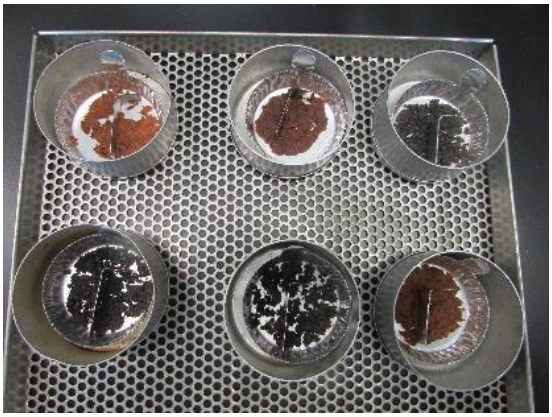

Figure 6: Samples after oven drying. Photo courtesy of Killani Kadri, USDA-FSIS

2) Remove moisture dishes from oven, cover dishes, let cool to room temperature in desiccator and weigh the moisture dish again.

Technical Notes:

1) If the sample is relatively dry when received, add a small quantity of distilled water to the pan after the sample weight is obtained. This water will help in spreading the sample across the bottom of the pan and will introduce no error since it will be evaporated when the sample is oven-dried.
2) Do not overload the drying oven or the sample may be insufficiently dried and give low results.
3) The drying time starts when the original oven temperature has been reached. Use the oven's booster heater, if equipped, to minimize recovery time.
4) High humidity may cause inaccurate results. When this occurs, desiccate dishes prior to the initial and final weighing.

Analysis

Sample Set

The sequence below can be modified, as needed, but must include required controls.

1) Meat recovery control
2) Intra-laboratory check sample (if applicable)
3) Samples up to 20 samples

INTRA-LABORATORY CHECK SAMPLE

Defined on the CLG website here.

QUALITY CONTROL

Quality Control Procedures

1) For set acceptance, the meat recovery control prepared at the beginning of the sample set must have a ≤ 0.90% moisture difference from the reference value.
2) Duplicate samples must be within ± 0.64% of each other.

Intra-laboratory Check Samples (If applicable)

1) Acceptability criteria.
   a. The check samples are to have a ≤ 0.90% difference from the reference value.
   b. FSIS Field Service Laboratories are to refer to internal FSIS Quality Control Procedures if unacceptable values are obtained:
      i. Refer to LW-Q1002, Chemistry Non-Conformance Tables, for how to proceed and whether to take corrections or corrective actions.

Reporting of Results

Decision Criteria

Calculations

$$\text{Percent} = \frac{100(B - C)}{A}$$

A = sample weight
B = weight of dish + sample prior to drying
C = weight of dish + sample after drying

Minimum Level of Applicability

Table 2: Minimum Level of Applicability for Screening level per species

	Matrix	%
Moisture	Meat, Poultry, and Processed meat	0.5

References

1) Official Methods of Analysis of the Association of Official Analytical Chemists, 15th Edition: 950.46
2) 9 CFR 319 Definitions and Standards of Identity or Composition

Contact Information and Inquiries

Inquiries about methods can be submitted through the USDA website via the "Ask USDA" portal at https://ask.usda.gov or please contact:

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This method has been validated, reviewed, approved, and deemed suitable and fit for purpose for use in the USDA FSIS Field Service Laboratories.

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