Food Analysis
Master degree/ public health
1st semester
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Moisture and total solid Analysis

Moisture assays can be one of the most important analyses performed on a food product and yet one of the most difficult from which to obtain accurate and precise data. Water molecules are small and ubiquitous in the environment in which foods are produced, stored, and used. Moisture exchange between foods and the environment can lead to under- or overestimation from moisture assays, and water can be difficult to completely remove from foods.

Determining both the water content and the water activity of a food provides a complete moisture analysis. With an understanding of the techniques described, one can apply appropriate moisture analyses to a wide variety of food products.

Importance of Moisture Assays:

One of the most fundamental and important analytical procedures that can be performed on a food product is an assay for the amount of moisture, referred to as the moisture or water content of the food. In this context, the words “water” and “moisture” are generally used interchangeably. The dry matter that remains after moisture removal is commonly referred to as total solids. This analytical value is of great economic importance to a food manufacturer, and there are legal limits as to how much water must or can be present in some foods.

In addition to quantifying the amount of water in foods, it is also important to document the energy status of the water in the food by determining the water activity. It is the water activity, more so than the moisture content, that influences microbial growth, physical properties, and chemical and enzymatic reactions in foods. Additionally, it is differences in water activity, not moisture content, that drive moisture migration between different food components (such as between a crust and a filling) or between a food and the environment. Water molecules move from regions of high water activity to regions of low water activity until equilibrium water activity is reached.

Water in Foods:

The amount, physical state, and location of water in foods will affect the types of analyses best suited to a particular food product, the ease and rate of water removal, the time required for assay equilibration, and the sample handling.

MOISTURE/WATER CONTENT

The moisture content of foods varies greatly . Water is a major constituent of many food products. The approximate, expected moisture content of a food can affect the choice of the method of measurement. It also can guide the analyst in determining the practical level of accuracy required when measuring moisture content, relative to other food constituents. The method used for determining moisture content may measure more or less of the water present. This is the reason for official methods with stated procedures. However, several official methods may exist for a particular product. For example, the AOAC International methods for cheese include Method vacuum oven; forced draft oven; microwave oven and distillation.

The different types of moisture content assays can be generally categorized into direct and indirect methods. Direct methods for moisture content are often done by removing water, although the method for moisture removal may vary. Drying, distillation, and extraction are commonly used for moisture removal followed by weighing, volumetry, or titration to determine moisture content. Indirect methods are based on properties of the food that are related to the presence of water, such as capacitance, specific gravity, density, refractive index, freezing point, and electromagnetic absorption.

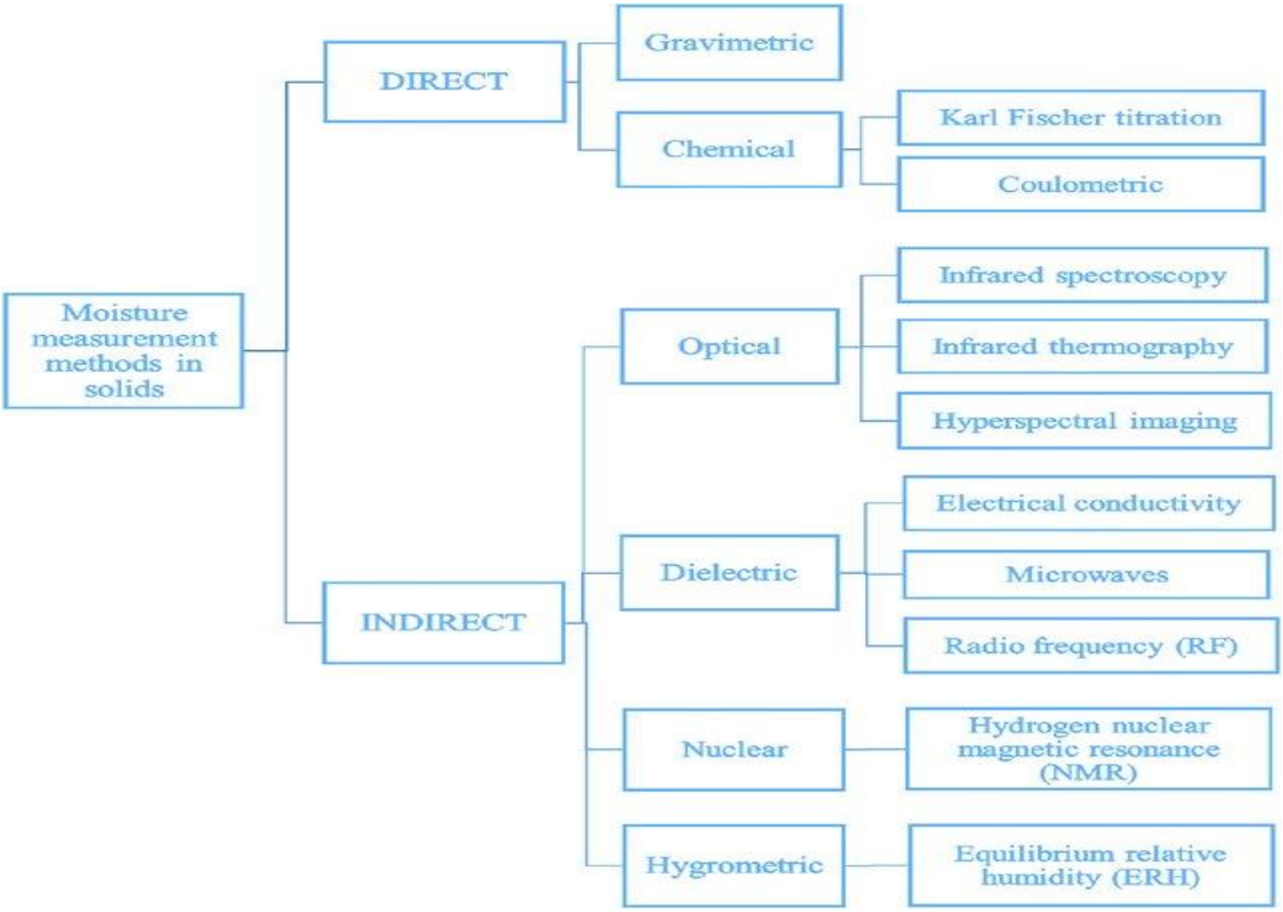

Fig. 1. Classification of moisture content measurement methods for solids.

WATER ACTIVITY

The water activity (a w) of a food is the ratio between the vapor pressure of the food itself, when in a completely undisturbed balance with the surrounding air media, and the vapor pressure of distilled water under identical conditions. A water activity of 0.80 means the vapor pressure is 80 percent of that of pure water. The water activity increases with temperature. The moisture condition of a product can be measured as the equilibrium relative humidity (ERH) expressed in percentage or as the water activity expressed as a decimal.

Most foods have a water activity above 0.95 and that will provide sufficient moisture to support the growth of bacteria, yeasts, and mold. The amount of available moisture can be reduced to a point which will inhibit the growth of the organisms. If the water activity of food is controlled to 0.85 or less in the finished product.

Water content alone is not a reliable indicator of food stability, since foods with the same water content differ in their perishability. It is the water activity (aw) of foods that has been correlated to microbial growth, physical properties, and chemical and enzymatic reactions. The water activity (aw) of foods varies greatly .For referring to water activity, the a is lower case and the w is a subscript because an activity coefficient of water is being used to describe its energy state. Generally, foods with higher moisture contents also have higher aws, although the relationship between moisture content and aw is not linear. Water activity is a thermodynamic property of water in foods defined as the ratio of the fugacity (or escaping tendency) of water in the food to the fugacity of pure water at the same temperature and pressure. Because fugacity cannot be directly measured, aw is more commonly determined as the ratio of the vapor pressure of water in a food (p) to the vapor pressure of water (po) at the same temperature and barometric pressure. Water activity is a dimensionless number between 0 (absolute no water) and 1 (pure water). There are fewer official methods for determining the aw of foods than there are for determining the moisture content . AOAC Method 978.18 describes techniques to determine the aw of canned vegetables: in the regulation of acidified foods, an aw of 0.85 is used as the cutoff for pathogen growth. low-acid foods are defined as foods with an equilibrium pH of >4.6 and aw >0.85, and acidified foods are defined as low-acid foods to which acid has been added to create a finished equilibrium pH of ≤4.6 and that have an aw >0.85. Foods with aw.

MOISTURE SORPTION ISOTHERMS

The food sorption isotherm describes the thermodynamic relationship between water activity and the equilibrium of the moisture content of a food product at constant temperature and pressure. The knowledge and understanding of sorption isotherms is highly important in food science and technology for the design and optimization of drying equipment, design of packages, predictions of quality, stability, shelf-life and for calculating moisture changes that may occur during storage. Several preservation processes have been developed in order to prolong the shelf-life of food products by lowering the availability of water to micro-organisms and inhibiting some chemical reactions . The typical shape of an isotherm reflects the way in which the water binds the system. Weaker water molecule interactions generate a greater water activity, thus, the product becomes more unstable. Water activity depends on the composition, temperature and physical state of the compounds.

Moisture Sorption Behavioral

The bacterial cell can only transfer nutrients in and waste materials out through the cell wall. The materials, therefore, must be in soluble form to permeate the cell wall. A portion of the total water content present in food is strongly bound to specific sites and does not act as a solvent. These sites include the hydroxyl groups of polysaccharides, the carbonyl and amino groups of proteins, and others on which water can be held by hydrogen bonding, by ion-dipole bonds, or by other strong interactions. The binding action is referred to as the sorption behavior of the food. The most successful method for studying the sorption properties of water in food products has been the preparation of "Sorption Isotherms," or curves relating the partial pressure of water in the food to its water content at constant temperature. The same practice is followed to study curves relating water activity under equilibrium conditions to water content.