**College of Applied Medical Sciences/ Department of Environmental Health**

**Analysis of Foods**

**Lab 2 Determination of Ash Content**

The ***ash content***is a measure of the total amount of minerals present within a food, whereas the *mineral content*is a measure of the amount of specific inorganic components present within a food, such as Ca, Na, K and Cl. Determination of the ash and mineral content of foods is important for a number of reasons:

* ***Nutritional labeling****.*The concentration and type of minerals present must often be stipulated on the label of a food.
* ***Quality.***The quality of many foods depends on the concentration and type of minerals they contain, including their taste, appearance, texture and stability.
* ***Microbiological stability****.*High mineral contents are sometimes used to retard the growth of certain microorganisms.
* ***Nutrition.***Some minerals are essential to a healthy diet (*e.g.,*calcium, phosphorous, potassium and sodium) whereas others can be toxic (*e.g.,*lead, mercury, cadmium and aluminum).
* ***Processing.***It is often important to know the mineral content of foods during processing because this affects the physicochemical properties of foods.

**Determination of Ash Content**

Ash is the inorganic residue remaining after the water and organic matter have been removed by heating in the presence of oxidizing agents, which provides a measure of the total amount of minerals within a food. Analytical techniques for providing information about the total mineral content are based on the fact that the minerals (the analyte) can be distinguished from all the other components (the matrix) within a food in some measurable way. The most widely used methods are based on the fact that minerals are not destroyed by heating, and that they have a low volatility compared to other food components. The three main types of analytical procedure used to determine the ash content of foods are based on this principle: *dry*ashing, *wet*ashing and *low temperature plasma dry*ashing. The method chosen for a particular analysis depends on the reason for carrying out the analysis, the type of food analyzed and the equipment available.

**Sample Preparation :-** As with all food analysis procedures it is crucial to carefully select a sample whose composition represents that of the food being analyzed and to ensure that its composition does not change significantly prior to analysis. Typically, samples of 1-10g are used in the analysis of ash content. Solid foods are finely ground and then carefully mixed to facilitate the choice of a representative sample. Before carrying out an ash analysis, samples that are high in moisture are often dried to prevent spattering during ashing. High fat samples are usually defatted by solvent extraction, as this facilitates the release of the moisture and prevents spattering. Other possible problems include contamination of samples by minerals in grinders, glassware or crucibles which come into contact with the sample during the analysis. For the same reason, it is recommended to use deionized water when preparing samples.

**1- Dry Ashing**

Dry ashing procedures use a high temperature muffle furnace capable of maintaining temperatures of between 500 and 600 oC. Water and other volatile materials are vaporized and organic substances are burned in the presence of the oxygen in air to CO2, H2O and N2. Most minerals are converted to oxides, sulfates, phosphates, chlorides or silicates. Although most minerals have fairly low volatility at these high temperatures, some are volatile and may be partially lost, *e.g.,*iron, lead and mercury. If an analysis is being carried out to determine the concentration of one of these substances then it is advisable to use an alternative ashing method that uses lower temperatures.

The food sample is weighed before and after ashing to determine the concentration of ash present. The ash content can be expressed on either a *dry* or *wet* basis:

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where MASH refers to the mass of the ashed sample, and MDRY and MASH refer to the original masses of the dried and wet samples.

aThere are a number of different types of crucible available for ashing food samples, including quartz, Pyrex, porcelain, steel and platinum. Selection of an appropriate crucible depends on the sample being analyzed and the furnace temperature used. The most widely used crucibles are made from porcelain because it is relatively inexpensive to purchase, can be used up to high temperatures (< 1200oC) and are easy to clean. Porcelain crucibles are resistent to acids but can be corroded by alkaline samples, and therefore different types of crucible should be used to analyze this type of sample. In addition, porcelain crucibles are prone to cracking if they experience rapid temperature changes. A number of dry ashing methods have been officially recognized for the determination of the ash content of various foods. Typically, a sample is held at 500-600 oC for 24 hours.

* ***Advantages:***Safe, few reagents are required, many samples can be analyzed simultaneously, not labor intensive, and ash can be analyzed for specific mineral content.
* ***Disadvantages:***Long time required (12-24 hours), muffle furnaces are quite costly to run due to electrical costs, loss of volatile minerals at high temperatures, *e.g.,*Cu, Fe, Pb, Hg, Ni, Zn.

Recently, analytical instruments have been developed to dry ash samples based on microwave heating. These devices can be programmed to initially remove most of the moisture (using a relatively low heat) and then convert the sample to ash (using a relatively high heat). Microwave instruments greatly reduce the time required to carry out an ash analysis, with the analysis time often being less than an hour. The major disadvantage is that it is not possible to simultaneously analyze as many samples as in a muffle furnace.

**2-Wet Ashing**(oxidation): for samples with high fat content (meat and meat products) as a preparation for elemental analysis .

**3-Low Temperature Plasma Ashing**(plasma ashing/ low temperature ashing): for

preparation of samples when volatile elemental analysis are conducted .

**Procedure**

**Ash Determination using Dray Ashing**

1. Weigh the empty crucible and record its weight.

2. Add 5 g of the sample to the crucible and record the weight.

3. Put the crucible into the oven for around 3 hours until the sample become white or grey.

4. Put the crucible in the desiccators.

5. Weigh the crucible after it become cold and calculate the ash percentage according

the following equation:

**% of ash =weight of sample with crucible after ashing(ash)- weight of crucible X100**

**Weight of sample**