Since most foods are relatively heterogeneous in their nature, it is important to ensure that, prior to compositional analysis, samples of the food taken for analysis are truly representative of the product to be analysed. Sampling procedures vary from food to food and ISO standards have been set out for various foodstuffs.

In general, dry foods should be brought to a powder by means of a mechanical grinder, moist solid foods should be homogenised by using equipment such as a domestic food processor, and fluid foods should be emulsified using blenders.

Once prepared, food samples should be transferred as quickly as possible to dry glass or rigid plastic containers and sealed to avoid moisture loss or gain, and then clearly labelled and stored in a cool environment.

The water content of a food is often an indication of the likely keeping qualities of that product; for example, milk, having a very high water content, is highly perishable, while dried milk powder, having most of the water removed, is much more stable. However, accurate determinations of moisture content are often difficult since the water present in foods is not all in the free state, i.e. the form in which water freezes and the form which is easily lost by evaporation. Various amounts may be present in a bound form resulting from attractions involving hydrogen bonds and ionic and polar forces of attraction between the water molecules and ionic and polar species in the food. Consequently, the moisture content of the food is often less satisfactory as a measure of the likely keeping qualities of the food than is water activity, $A_w$, whose value may range form 0 to 1, and which is defined in one of the following ways.

$$A_w = \frac{P}{P_0}$$

where $P$ is the vapour pressure of water in the food and $P_0$ is the partial pressure of pure water at the same temperature.

$$A_w = \frac{ERH}{100}$$

where ERH is the equilibrium relative humidity, at which the food neither gains nor loses water.
where \( n_1 \) is the number of moles of solute present, \( n_2 \) is the number of moles of water present and \( \gamma \) is the activity coefficient, which approximates to 1 for most situations.

Typical values for water activity range from 0.97 to 1 for foods highly susceptible to deterioration by micro-organisms, such as milk, and normal tissue foods exemplified by fruit, vegetables and meat, to values of less than 0.6 for foods stable to deterioration, such as dried milk and cereals. Intermediate moisture foods such as cheese, jams and jellies have water activities in the range 0.6 to 0.9, and are generally shelf-stable without refrigeration or heat processing, although they may still be susceptible to other deteriorative reactions such as enzymatic browning or the Maillard reaction.

4.2.1 Methods of measuring moisture

4.2.1.1 Evaporation (loss on drying) methods. These methods involve drying the food sample to constant weight using procedures such as:

- drying ovens at 100°C (for foods stable at this temperature)
- infrared drying lamps (incorporating directing reading balances)
- microwave ovens
- vacuum ovens at 70°C (for foods, such as sugars, where decomposition may occur at 100°C)
- vacuum desiccators at room temperature (for food products such as baking powders that are highly susceptible to decomposition at temperatures above room temperature).

Evaporation methods are widely used for food moisture estimations, predominantly on the basis that they are simple to perform, are reasonably accurate when performed to the stipulated procedure and require little in the way of expensive or sophisticated equipment. Their disadvantages are that they are unsuitable for products containing volatile oils (which are also driven off in the drying process) and they do not release water. Variations between samples may occur when food samples have not been properly prepared leading to variations in particle size, and also where samples are dried at different shelf heights in the drying oven thus resulting in temperature variations.

4.2.1.2 Distillation methods. These methods are well illustrated by the Dean and Stark procedure (Figure 4.1), in which a known weight of food is mixed in a distillation flask with a solvent such as xylene or toluene which:

is immiscible with water,
has a higher boiling point than water, and
has a lower density than water.