WATER ACTIVITY

In general, there is a relationship between the moisture content of a food product and its rate of spoilage. However, there are also cases where foods with the same moisture content have different spoilage rates. One of the reasons this occurs is that there are differences in the water's association with the nonaqueous components of the food products. If there are strong interactions between the water and nonaqueous components, the water is less available to participate in activities such as microbial growth and hydrolytic chemical reactions.

The term water activity was developed to take into account the associations between water and nonaqueous constituents in food products. It is more accurate as an indicator of food perishability than water content alone. Water activity ($A_w$) is defined as the ratio of the vapor pressure of water in a solution ($P_s$) to the vapor pressure of pure water ($P_w$):

$$A_w = \frac{P_s}{P_w}$$

The concentration and type of solutes in a food sample has an effect on the water activity. For example, high concentrations of solutes, such as sugar in jams and honey or salt in pickling solutions, lower the activity of water enough so that it can no longer support the growth of microorganisms which cause the food to spoil. Various solutes have different affects on water activity. For example, salt lowers the activity of water more effectively than does sucrose, and sodium caseinate, derived from milk protein, has no appreciable effect on water activity.

Food processing methods may also affect water activity. Products such as meats, fruits and vegetables are usually susceptible to rapid spoilage. However, when these foods are dehydrated for the production of beef jerky and dehydrated fruits and vegetables, the shelf life of the product has been effectively increased. Dehydration decreases the moisture content and increases the solute concentration so that the food is no longer susceptible to spoilage.

Water activity is measured on a scale from 0 to 1. A water activity of 1 corresponds to that of pure water. Generally, microorganisms will not grow below a water activity of 0.5. Yeasts and molds will grow in products that have water activities above 0.60. Bacteria can grow above water activities of approximately 0.90. The maximum rates of many chemical reactions typically occur in intermediate moisture foods with water activities of 0.7-0.9.

Foods with a water activity of 0 to 0.5 include dried vegetables, crackers, cereals, cookies, pasta, and spices. Dried fruits, marshmallows, jelly and jam, nuts, caramels, and honey have a water activity typically in the 0.6 to 0.8 range. Chocolate syrup, salami, margarine, fruit cake, rice, and flour are typically found in the 0.8 to 0.9 range of water activity. Fresh foods such as meats, fruits and vegetables, breads, and some cheeses are typically at a water activity of 0.9 to 1.0.

Midwest Laboratories can help you determine the water activity of your food product or set up an accelerated shelf life test. Please call for the current rate or a copy of our testing and fee schedule.

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