

The Effect of Water Activity on Shelf Life

WATER ACTIVITY is an important means of predicting and controlling the shelf life of food products. Shelf life is the time during which a product will remain safe, maintain desired sensory, chemical, physical and microbiological properties, and comply with nutritional labeling. Many factors influence shelf life such as; water activity, pH, redox potential, oxygen, use of preservatives, and processing/ storage conditions. By measuring and controlling the water activity of foodstuffs, it is possible to; a) predict which microorganisms will be potential sources of spoilage and infection, b) maintain the chemical stability of foods, c) minimize nonenzymatic browning reactions and spontaneous autocatalytic lipid oxidation reactions, d) control the activity of enzymes, e) prolong nutrients and vitamins in food, and f) optimize the physical properties of foods.

Every microorganism has a water activity level below which it cannot grow.

Controlling water activity controls microbial growth extends shelf life and allows some products to be safely stored without refrigeration. Water activity influences deteriorative chemical reaction rates because water acts as a solvent, can be a reactant itself, or can change the mobility of reactants through viscosity. One or a combination of any of these factors can lead to faster deterioration and a shortened product shelf life. Non-enzymic browning reactions increase with increasing a_w to a maximum at 0.6 to 0.7 a_w . Lipid oxidation has a minimum at about 0.2 to 0.3 a_w . Moisture migration is a major cause of deteriorative physical changes and texture loss in food. Water activity is a function of temperature, thus shipping and storage temperature changes water activities effect on the microbial, chemical and physical properties. It is important to determine critical water activity levels for a product and how sensitive it is to changes in water activity. Optimum chemical stability is generally found near the monolayer moisture content, as determined from moisture sorption isotherms. Changes in water activity by absorption of water when a product is exposed to a high humidity environment or loss of water when placed in a low humidity environment brings about undesirable changes in products and shortens shelf life. These changes can be physical, such as loss of crispness in dry products, caking and clumping of powders, or moist products losing water to become tough and chewy. Other undesirable changes are acceleration of chemical deterioration, or potential for microbial growth.

Understanding and maintaining the critical water activity level of a product through suitable packaging will extend shelf life.

Many dry powders will eventually cake if they are stored without any moisture barrier or anticaking agent. Most breakfast cereals are less susceptible to moisture gain and do not demand high barrier levels. Moisture loss can be critical for some baked goods, but if too much moisture remains in the package then microbial growth can develop. Multi-component products may require separate packaging or barriers to prevent moisture transfer if the water activity of the individual components cannot be adjusted closer together. By knowing the critical water activity limits of a product it is possible to calculate shelf life based on the relevant barrier properties of the packaging material or dictate the barrier specifications of the package to obtain a desired shelf life.

More information and resources can be found at;

<http://www.aqualab.com/education/intro-to-water-activity/>

The Labcell range of Water Activity Instrumentation can be found at;

<http://labcell.com/food-pharmaceuticals/water-activity>