

Understanding the Water Activity of Your Food

Water activity (a_w) refers to the amount of free water that is available in food for microbial growth. It is a measurement of the water that is not bound to components in the food, and therefore available for microbial growth. All microorganisms have a level of water activity that they prefer to grow within, and have lower limits as to how “dry” a food can be in order for them to grow. For that reason, water activity is often used as a way to preserve foods and gain a longer shelf-life.

Water activity is measured in values from 0.0 to 1.0. Water has an a_w of 1.0. Most food falls within a water activity range of 0.2 to 0.99. The lower the a_w value, the more “dry” a food item is considered. However, water activity should not be regarded as moisture content. The scientific definition of water activity refers to its measurement in equilibrium relative humidity. You can think of water activity as the humidity of a food.



Image of gooseberries in various states of a_w : Fresh gooseberries, dehydrated gooseberries, and gooseberry marmalade.

Table 1. Water activity ranges of common foods and the microorganisms of concern in those a_w range

a_w	Microorganisms of concern			Foods in this a_w range
	Bacteria	Mold	Yeast	
0.95-0.97	+	-	-	Fresh meat, fruit, vegetables, canned fruits, canned vegetables, cooked sausage
0.90-0.94	+	+	+	Some cheese, cured meat (ham), evaporated milk
0.87-0.89	+	-	+	Sweetened condensed milk, aged cheeses, dried meats,
0.80-0.85	-	+	+	bacon, chocolate syrup, fondant
0.71-0.79	-	+	-	Jam, marmalade, marzipan, molasses, dried figs
0.60-0.70	-	+	+	Dried fruit, corn syrup, marshmallow, chewing gum
0.00-0.60	-	-	-	Caramels, toffee, honey, cocoa, crackers, dry mixes, boiled sweets, milk powder

A variety of microorganisms can grow in food products, and each microorganism can survive in different water activity ranges. Bacteria require the highest amount of free water to grow, and can be found in products with a_w as low as 0.75, but most are inhibited at a_w below 0.91. One pathogenic bacteria is able to grow at a_w as low as 0.86, so foods that depend on water activity as a means of preservation should have an a_w of 0.85 or less. Some yeasts and molds are able to grow on food items with an a_w as low as 0.60. Below 0.60, yeasts, molds, and bacteria will not proliferate.

The water activity of a food product can be lowered in a variety of ways.

- Salt and/or sugar can be added. Both salt and sugar work by binding with free water in the food product, making that water no longer available to microorganisms for growth. Salt is more effective at binding water than sugar, but the influence of taste should be considered before choosing to alter your recipe.
- Water activity may also be decreased by removing water from the food product. This can be done during cooking, by “cooking down” your recipe for a longer amount of time and allowing more water to evaporate.
- Water can also be removed post-cooking through dehydration. This method is often used to preserve fruits and meats. Dehydration works by removing free water, reducing the amount that is available for microorganisms to grow.