

WATER ACTIVITY

IN FOOD INDUSTRY



Water activity (a_w) is a fundamental parameter that quantifies the availability of water molecules in a food product or material.



- It is defined as the ratio of the vapor pressure of water in the food to the vapor pressure of pure water at the same temperature.

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



P = Vapour pressure in food
 P_0 = Vapour pressure in pure water

- This dimensionless value, typically ranging from 0 to 1, represents the extent to which water is free and mobile within the product's matrix.
- Most foods have a water activity above 0.95 and that will provide sufficient moisture to support the growth of bacteria, yeasts, and mold.

Limit for Microorganism growth

Microorganism	Aw
Bacteria	0.91-0.86
Yeast	0.88-0.80
Molds	0.70
Osmophillic yeast	0.62
Xerophillic Molds	0.61
Absolute limit for all growth	0.60
No microbial proliferation	0.50

- Most bacteria, do not grow at water activities **below 0.91**, and most molds cease to grow at water activities **below 0.80**.



The water activity level in food directly affects its shelf life, safety, and overall quality.

1. Microbial Growth and Spoilage

The higher the water activity, the more favorable the conditions for microbial proliferation.

2. Shelf Life

Foods with lower water activity levels can slow down the rate of oxidation and enzymatic reactions reactions like, helping to maintain the quality and taste of the food.



4. Flavor Stability

- In products with high water activity, volatile flavor compounds are more likely to evaporate, leading to a loss of taste and aroma.
- This can impact the overall sensory experience of the food.

5. Nutritional Content

- Water activity can influence the stability of vitamins and other essential nutrients in food.
- High water activity may accelerate nutrient degradation, leading to reduced nutritional value in the product over time.

6. Physical Stability

- Water activity can affect the physical stability of food products.
- *For example*, certain confections and chocolate products require specific water activity levels to maintain their shape and prevent crystallization.



Factors affecting A_w :

Drying:

Water activity is decreased by physically removing water (Ex: beef jerky).

Solutes:

Water activity is decreased by adding solutes such as salt or sugar (Ex: jams, cured meats).

Freezing:

Water activity is decreased by freezing (Ex: water is removed in the form of ice).

Combination:

One or more of the above can be combined for a greater influence on water activity (Ex: salting and drying fish).

