

Water Activity and Growth of Microorganisms in Food*

	Range of a_w	Microorganisms Generally Inhibited by Lowest a_w in This Range	Foods Generally within This Range
	1.00–0.95	<i>Pseudomonas</i> , <i>Escherichia</i> , <i>Proteus</i> , <i>Shigella</i> , <i>Klebsiella</i> , <i>Bacillus</i> , <i>Clostridium perfringens</i> , some yeasts	Highly perishable (fresh) foods and canned fruits, vegetables, meat, fish, milk, and beverages
	0.95–0.91	<i>Salmonella</i> , <i>Vibrio parahaemolyticus</i> , <i>C. botulinum</i> , <i>Serratia</i> , <i>Lactobacillus</i> , <i>Pediococcus</i> , some molds, yeasts (<i>Rhodotorula</i> , <i>Pichia</i>)	Some cheeses (Cheddar, Swiss, Muenster, Provolone), cured meat (ham), bread, tortillas
	0.91–0.87	Many yeasts (<i>Candida</i> , <i>Torulopsis</i> , <i>Hansenula</i>), <i>Micrococcus</i>	Fermented sausage (salami), sponge cakes, dry cheeses, margarine
	0.87–0.80	Most molds (mycotoxigenic penicillia), <i>Staphylococcus aureus</i> , most <i>Saccharomyces (bailii) spp.</i> , <i>Debaryomyces</i>	Most fruit juice concentrates, sweetened condensed milk, syrups, jams, jellies, soft pet food
	0.80–0.75	Most halophilic bacteria, mycotoxigenic <i>aspergilli</i>	Marmalade, marzipan, glacé fruits, beef jerky
	0.75–0.65	Xerophilic molds (<i>Aspergillus chevalieri</i> , <i>A. candidus</i> , <i>Wallemia sebi</i>), <i>Saccharomyces bisporus</i>	Molasses, raw cane sugar, some dried fruits, nuts, snack bars, snack cakes
	0.65–0.60	Osmophilic yeasts (<i>Saccharomyces rouxii</i>), few molds (<i>Aspergillus echinulatus</i> , <i>Monascus bisporus</i>)	Dried fruits containing 15-20% moisture; some toffees and caramels; honey, candies
	0.60–0.50	No microbial proliferation	Dry pasta, spices, rice, confections, wheat
	0.50–0.40	No microbial proliferation	Whole egg powder, chewing gum, flour, beans
	0.40–0.30	No microbial proliferation	Cookies, crackers, bread crusts, breakfast cereals, dry pet food, peanut butter
	0.30–0.20	No microbial proliferation	Whole milk powder, dried vegetables, freeze dried, corn starch, potato chips, corn chips

* Adapted from L.R. Beuchat, *Cereal Foods World*, 26:345 (1981).