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## Water Activity and Growth of Microorganisms in Food

Range of $a_w$	Microorganisms Generally Inhibited by Lowest $a_w$ in This Range	Food Generally within This Range
1.00–0.95	Proteobacteria, Actinobacteria, Firmicutes, Ascomycota, Basidiomycota, Zygomycota, Chytridiomycota, Cryptophytes, some yeasts	Highly perishable: fresh fish and seafood, dairy, vegetables, meat, fish, milk, and beverages
0.95–0.91	Lactobacilli, Weissella, Pediococcus, Leuconostoc, Streptococcus, Lactococcus, Paenibacillus, some yeasts, yeasts (Debaryomyces, Kluyver)	Semi-ferrous (Cheddar, Swiss, Mozzarella, Parmesan), dried milk (whey, cream, lactate)
0.91–0.87	Many yeasts (Candida, Saccharomyces, Kluyveromyces, Rhodospirillum) and bacteria	Fermented sausage (salami), sausage casings, dry cheese, sausage
0.87–0.80	Most yeasts (Pichia, Hansenula, Kluyveromyces, Debaryomyces, Candida, Zygosaccharomyces, Torulopsis, Hansenula, Debaryomyces)	Dried fruit and vegetables, sweetened condensed milk, yogurt, sour cream, soft gel food
0.80–0.75	Most halophilic bacteria, xerophilic yeasts (Debaryomyces)	Ham, salami, sausage, dried fruits, beef jerky
0.75–0.65	Xerophilic yeasts (Debaryomyces, Hansenula, Zygosaccharomyces, Torulopsis, Debaryomyces)	Meatballs, raw some eggs, some dried fruits, milk, some fish, some cheese
0.65–0.60	Osmophilic yeasts (Saccharomyces, Debaryomyces, Hansenula, Zygosaccharomyces)	Dried fruits containing 15–20% moisture, some softens and cereals, honey, candies
0.60–0.50	No microbial proliferation	Dry pasta, cereals, rice, carbohydrates, wheat
0.50–0.40	No microbial proliferation	Whole egg powder, chewing gum, flour, honey
0.40–0.30	No microbial proliferation	Sauces, molasses, bread crumbs, breaded cereals, dry gel food, peanut butter
0.30–0.20	No microbial proliferation	Whole milk powder, dried vegetables, freeze-dried, some starch, potato chips, corn chips

Adapted from L.R. Beuchat, *Control Food Microbiology*, 26: 245 (1987).

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