

E Water Activity Values of Select Food Ingredients and Products

Shelly J. Schmidt and Anthony J. Fontana, Jr.

This appendix contains water activity values or ranges from various sources for select human and pet food products. The individual ingredients and products (called items) listed in the table have been organized alphabetically into main categories and then into alphabetized subcategories. The moisture content [% wet basis – (g water/g sample) × 100%] of the material and/or temperature of the a_w measurement are also given as available. If the a_w of an item was measured at more than one temperature, the a_w and temperature values are listed in corresponding order (i.e., the first a_w listed corresponds to the first temperature listed, and so on). The a_w and moisture content methods used (when known) are included either in the table or in the list of sources. Dr. Schmidt would like to acknowledge the contribution of several U.S. Army Research and Engineering Apprenticeship Program High School students who assisted in the collection of a_w and moisture content data in her lab, as well as several University of Illinois undergraduate and graduate students. Special thanks to Laura Wardwell for assistance in assembling the composite table below.

MAIN CATEGORY, Subcategory, Item	a_w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
BAKED GOODS				
Bagels				
Lender's Plain Bagels—Crumb	0.957	38.5	25	2
Lender's Plain Bagels—Crust	0.926	31.1	25	2
Batter and Dough				
Batter, Pancake (Hygrometer)	0.883		35	14
Batter, Pancake (Manometric Technique)	0.99		35	14
Batter, Pancake (Microcrystalline Cellulose Method)	0.960		35	14
Dough, Refrigerated Biscuit (Equilibrium Moisture Adsorption)	0.942–0.940		25	8
Biscuits				
Biscuit	0.630–0.605		25	19
Breads				
Bread	0.939		25	1
Bread	0.960	37		9
Bread (Hygrometer)	0.950		35	14
Bread (Manometric Technique)	0.93		35	14
Bread (Microcrystalline Cellulose Method)	0.949		35	14
Bread, White (Equilibrium Moisture Adsorption)	0.950–0.942		25	8
Bread, White (Sinascop)	0.97–0.94		25	8
Bread, White (Chilled Mirror)	0.964		25	1
Butternut Enriched Bread—Crumb	0.944; 0.955	34.0	22; 30	2
Butternut Enriched Bread—Crust	0.926; 0.919	29.5	22; 31	2
Butternut Roman Meal—Crumb	0.938; 0.947	35.2	21; 30	2

(continues)

MAIN CATEGORY, Subcategory, Item	a_w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
BAKED GOODS (continued)				
Breads (continued)				
Butternut Roman Meal—Crust	0.932; 0.908	29.0	21; 31	2
County Market Split Top Wheat Bread—Crumb	0.912; 0.929	34.6	22; 30	2
County Market Split Top Wheat Bread—Crust	0.910; 0.914	26.4	22; 30	2
County Market White Bread Enriched—Crumb	0.938; 0.941	38.1	22; 30	2
County Market White Bread Enriched—Crust	0.929; 0.899	28.7	22; 30	2
Indiana Spud Potato Bread Low Fat, Saturated Fat Free—Crumb	0.935; 0.945	36.1	21; 30	2
Indiana Spud Potato Bread Low Fat, Saturated Fat Free—Crust	0.926; 0.905	30.3	21; 31	2
Pepperidge Farm 100% Whole Wheat Thin Sliced Bread—Crumb	0.952; 0.955	40.6	21; 30	2
Pepperidge Farm 100% Whole Wheat Thin Sliced Bread—Crust	0.949; 0.944	32.1	22; 31	2
Pepperidge Farm Light Style Wheat Bread Low Fat—Crumb	0.942; 0.937	35.6	22; 31	2
Pepperidge Farm Light Style Wheat Bread Low Fat—Crust	0.929; 0.919	30.5	22; 31	2
Pepperidge Farm Original White Sandwiches and Toast—Crumb	0.944; 0.941	34.2	22; 31	2
Pepperidge Farm Original White Sandwiches and Toast—Crust	0.936; 0.938	29.4	22; 31	2
Pepperidge Farm Swirl Bread Cinnamon—Crumb	0.896; 0.900	29.3	22; 31	2
Pepperidge Farm Swirl Bread Cinnamon—Crust	0.887; 0.884	23.9	22; 31	2
Pillsbury Enriched Buttermilk Bread—Crumb	0.930; 0.932	35.5	22; 31	2
Pillsbury Enriched Buttermilk Bread—Crust	0.919; 0.904	28.0	22; 31	2
Pillsbury Enriched Wheat Bread—Crumb	0.939; 0.934	33.8	21; 31	2
Pillsbury Enriched Wheat Bread—Crust	0.915; 0.907	30.1	22; 31	2
Purity Sunbeam Enriched Bread—Crumb	0.932; 0.936	38.8	21; 30	2
Purity Sunbeam Enriched Bread—Crust	0.922; 0.910	29.2	22; 30	2
Purity Sunbeam Honey Grain Wheat Bread—Crumb	0.946; 0.945	39.7	22; 30	2
Purity Sunbeam Honey Grain Wheat Bread—Crust	0.935; 0.921	28.6	22; 30	2
Buns				
Sara Lee Heart Healthy Wheat Bakery Bun—Crumb	0.923	34.3	25	2
Sara Lee Heart Healthy Wheat Bakery Bun—Crust	0.903	26.1	25	2
Sunbeam Enriched Hamburger Bun—Crumb	0.944	35.3	25	2
Sunbeam Enriched Hamburger Bun—Crust	0.916	26.8	25	2
Cake				
Baked Cake (Equilibrium Moisture Adsorption)	0.944–0.918		25	8
Baked Cake (Sinascopie)	0.94–0.90		25	8
Cake	0.750–0.720		25	19
Fruit Cake Vanilla	0.777–0.772		25	1
Twinkie, Hostess	0.795	18.9	22	2
Twinkie, Low Fat, Hostess	0.786	21.0	22	2
Cookies				
Archway Homestyle Cookies—Oatmeal	0.517; 0.553	7.1	21; 31	2
Archway Homestyle Cookies—Sugar	0.617; 0.630	8.4	21; 31	2
Delicious Old Fashioned Goodness Lemon Sandwich Cookies—Cookie	0.245; 0.319	3.0	22; 31	2
Delicious Old Fashioned Goodness Lemon Sandwich Cookies—Filling	0.318; 0.339	2.5	22; 30	2
Delicious Skippy Peanut Butter Sandwich Cookies—Cookie	0.184; 0.245	2.3	22; 31	2

MAIN CATEGORY, Subcategory, Item	a_w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
BAKED GOODS (<i>continued</i>)				
Cookies (<i>continued</i>)				
Delicious Skippy Peanut Butter Sandwich Cookies— Filling	0.261; 0.270	1.7	22; 31	2
Keebler Soft 'n Chewy Chips Deluxe	0.567; 0.575	5.9	21; 31	2
Keebler Summer E.L. Fudge Butter Sandwich Cookies w/ Fudge Crème—Cookie	0.200; 0.381	2.5	22; 31	2
Keebler Summer E.L. Fudge Butter Sandwich Cookies w/ Fudge Crème—Filling	0.314; 0.410	1.5	22; 31	2
Nabisco Chewy Chips Ahoy!	0.647; 0.633	8.6	21; 31	2
Nabisco Nutter Butter Sandwich Cookies—Cookie	0.248; 0.256	2.1	22; 31	2
Nabisco Nutter Butter Sandwich Cookies—Filling	0.265; 0.285	0.65	22; 31	2
Nabisco Nutter Butter Soft Cookies	0.649; 0.637	11.7	21; 31	2
Nabisco Oreo Chocolate Sandwich Cookies—Cookie	0.309; 0.201	1.4	22; 31	2
Nabisco Oreo Chocolate Sandwich Cookies—Filling	0.315; 0.252	0.06	22; 31	2
Snackwell's Reduced Fat Crème Sandwich Cookies— Cookie	0.310; 0.292	4.2	22; 31	2
Snackwell's Reduced Fat Crème Sandwich Cookies— Filling	0.311; 0.295	8.2	22; 31	2
Crackers				
Animal Crackers, Nabisco Barnum's	0.303; 0.346	4.6	22; 31	2
Cheese Nips Baked Snack Crackers, Nabisco	0.173; 0.203	1.8	22; 31	2
Club Crackers—Original, Keebler	0.225; 0.275	1.8	22; 31	2
Crackers	0.100	9		9
Goldfish Tiny Crackers—Cheddar Cheese, Pepperidge Farm	0.153; 0.184	1.3	23; 31	2
Graham Crackers, Honey Maid, Nabisco	0.251	3.0	29	2
Ritz Crackers, Nabisco	0.112; 0.122	1.1	23; 31	2
Saltine Crackers, Nabisco Unsalted Tops Premium	0.464; 0.536	5.4	22; 31	2
Triscuit Baked Whole Wheat Wafers—Original, Nabisco	0.132; 0.153	2.1	22; 31	2
Wheat Thins Baked Snack Crackers, Nabisco	0.164; 0.176	1.7	22; 31	2
Wheat Thins Baked Snack Crackers—Reduced Fat, Nabisco	0.147; 0.158	1.5	22; 31	2
Muffins				
Blueberry Mini—Muffins, Hostess	0.844	21.4	24	2
Master English Muffin Toasting Bread—Crumb	0.952	40.5	22	2
Master English Muffin Toasting Bread—Crust	0.947	31.9	22	2
Master Wheat English Muffin Toasting Bread—Crumb	0.945	36.7	22	2
Master Wheat English Muffin Toasting Bread—Crust	0.935	31.5	22	2
Rolls				
Wheat Dinner Roll	0.890	27.8	25	2
Tortillas				
Flour Tortilla	0.922	30.8	25	2
BEVERAGES				
Carbonated Soda				
7-Up, Regular	0.977		10	2
7-Up, Diet	0.996		10	2
Coke, Regular	0.978		10	2
C2 (Mid-calorie Coke)	0.983		10	2
Coke, Diet	0.996		10	2
Pepsi, Regular	0.982		10	2
Pepsi Edge (Mid-calorie Pepsi)	0.985		10	2
Pepsi, Diet	0.999		10	2

(continues)

MAIN CATEGORY, Subcategory, Item	a_w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
BEVERAGES (continued)				
Carbonated Soda (continued)				
RC, Regular	0.979		10	2
RC, Diet	0.996		10	2
Shasta, Regular	0.991		25	2
Shasta, Diet	0.996		25	2
Sierra Mist, Regular	0.977		10	2
Sierra Mist, Diet	0.994		10	2
Sprite, Regular	0.979		10	2
Sprite, Diet	0.999		10	2
Coffee				
Green Beans	0.5–0.6			22
Instant Coffee Crystals, Folgers	0.168	2.6	25	2
Roasted Beans	0.10–0.30			22
Soluble Powders	0.10–0.30			22
Drink Mixes				
Lemonade, Kool-Aid (Dry)	0.309	0.37	25	2
Margarita Mix—Strawberry (Liquid)	0.972		24.0	1, 2
Tea				
Tea, Instant (Beckman-Sina)	0.192		30	4
Tea, Instant (Kaymont-Rotronics)	0.174		30	4
Tea, Instant (Protimeter)	0.267		30	4
Tea, Instant (Vapor Pressure Manometric Technique)	0.130		30	4
BREAKFAST CEREALS				
Hot Cereals				
Oatmeal, Old Fashion, Quaker Oats (Dry)	0.340	8.8	25	2
Oatmeal, Quick, Quaker Oats (Dry)	0.368	9.2	25	2
Ready-to-Eat				
Flavorite Apple Dapples	0.297; 0.312	2.0	22; 31	2
Flavorite Bite Size Frosted Shredded Wheat	0.255; 0.300	4.1	22; 31	2
Flavorite Cocoa Crispy Rice	0.295; 0.271	1.7	22; 31	2
Flavorite Corn Flakes	0.357; 0.271	2.8	22; 31	2
Flavorite Crispy Hexagons	0.228; 0.237	2.1	22; 31	2
Flavorite Crispy Rice	0.266; 0.251	2.5	22; 31	2
Flavorite Frosted Flakes	0.281; 0.242	1.1	22; 31	2
Flavorite Frosted Fruit O's	0.298; 0.379	2.6	21; 31	2
Flavorite Golden Corn Nuggets	0.184; 0.223	1.0	22; 31	2
Flavorite Raisin Bran—Flakes	0.455; 0.445	6.4	22; 31	2
Flavorite Raisin Bran—Raisins	0.465; 0.439	7.2	21; 31	2
General Mills Cheerios	0.157	3.2	24	2
General Mills Cheerios, Frosted	0.186	2.2	25	2
General Mills Cheerios, Honey Nut	0.162	2.6	26	2
General Mills Cinnamon Toast Crunch	0.242	2.0	29	2
General Mills Cocoa Puffs	0.183	1.7	25	2
General Mills Golden Grahams	0.181	1.8	25	2
General Mills Lucky Charms	0.227	3.6	30	2
General Mills Trix	0.175	3.1	28	2
Kellogg's Apple Jacks	0.384; 0.385	3.0	22; 31	2
Kellogg's Cocoa Krispies	0.335; 0.364	3.0	22; 31	2
Kellogg's Corn Flakes	0.352; 0.382	3.5	22; 31	2
Kellogg's Corn Pops	0.295; 0.323	1.8	22; 31	2
Kellogg's Crispix—Corn on one side, Rice on the other	0.287; 0.322	3.0	22; 31	2
Kellogg's Fruit Loops	0.360; 0.386	2.3	22; 31	2
Kellogg's Frosted Flakes of Corn	0.425; 0.375	2.6	22; 31	2

MAIN CATEGORY, Subcategory, Item	a_w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
BREAKFAST CEREALS (<i>continued</i>)				
Ready-to-Eat (<i>continued</i>)				
Kellogg's Frosted Mini-Wheats	0.362; 0.389	5.4	22; 31	2
Kellogg's Honey Crunch Corn Flakes	0.306; 0.341	2.6	22; 31	2
Kellogg's Raisin Bran—Flakes	0.458; 0.411	6.6	22; 31	2
Kellogg's Raisin Bran—Raisins	0.472; 0.411	8.1	22; 31	2
Kellogg's Rice Krispies	0.279; 0.342	2.8	22; 31	2
Kellogg's Smacks	0.242; 0.288	1.7	22; 31	2
Malt O Meal Golden Puffs	0.200; 0.177	0.48	22; 31	2
Quaker Captain Crunch	0.422; 0.447	3.1	22; 31	2
Quaker New! Honey Crisp Corn Flakes	0.254; 0.261	1.7	22; 31	2
CEREAL GRAINS, LEGUMES, AND PRODUCTS				
Beans				
Great Northern Beans	0.475	10.1	25	2
Lupini Beans in Brine	0.945		25	20
Flour				
All-Purpose Flour, Gold Medal	0.453	13.5	20	2
Flour	0.352–0.350		25	1
Flour, Wheat	0.523		25	1
Grains				
Wheat Grains, Whole	0.700–0.675		25	19
Wheat Grains, Ground	0.696–0.675		25	19
Nuts and Seeds				
Almonds, Sliced, Diamond of California	0.476	3.1	20	2
Cashews	0.75			17
Peanuts, Dry Roasted	0.147	0.56	29	2
Peanuts, Honey Roasted, Planters	0.249; 0.323	0.84	22; 31	2
Peanuts, Salted, Planters	0.260; 0.508	1.1	22; 31	2
Peanut Butter, Reese's Creamy	0.263; 0.268	0.37	22; 31	2
Peanut Butter, Reese's Crunchy	0.230; 0.205	0.42	22; 31	2
Popcorn Seeds, Black	0.742	10.3	24	2
Sunflower Seeds, Flavorite Shelled	0.308; 0.313	0.84	22; 31	2
Sunflower Seeds	0.75			17
Walnuts, Chopped	0.58–0.57			13
Walnut, Dried Meats	0.427		25	20
Pasta				
Ditalini, Barilla 100% Selected Durum Wheat	0.334	5.4	20	2
Semolina, Dry				
Fresh Filled Pasta	0.973–0.916			6
Gnocchi	0.983–0.936			6
Lasagna, Dry	0.373	8.3	30	2
Noodle, Dry	0.570		25	1
Penne Rigate, Dry	0.386	7.9	30	2
Ravioli in Tomato Sauce	0.988		20	21
Spaghetti, Dry	0.390	6.9	30	2
Rice				
Rice	0.531		25	1
Rice	0.591		25	20
Rice, Uncle Ben's Original Enriched Parboiled	0.420	7.1	20	2
Long Grain				
Rice, Whole Grain Brown	0.491	7.0	25	2
Soy				
Soy-based Energy Bar	0.461	5.27		18

(continues)

MAIN CATEGORY, Subcategory, Item	a_w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
CEREAL GRAINS, LEGUMES, AND PRODUCTS (<i>continued</i>)				
Starch				
Corn Starch, Argo 100%	0.287	8.7	20	2
Wheat Starch	0.56		25	19
CONDIMENTS				
Ketchup				
Ketchup	0.933		25	1
Mustard				
Mustard, Cognac Type	0.938		25	1
Salad Dressings				
French Dressing	0.924		25	1
Ranch Dressing, Fat Free, Hidden Valley	0.977	74.7	24	2
Ranch Dressing, Light Hidden Valley	0.972	61.1	24	2
Ranch Dressing, Regular, Hidden Valley	0.965	44.9	24	2
Salsa				
Salsa, Medium, Tostitos	0.985	86.8	25	2
Sauces				
Cocktail Sauce	0.947		20	21
Fudge Sauce	0.795		25	12
Fudge Sauce	0.85			17
Fudge Sauce	0.834		25	20
Molho Sauce (Hot Sauce)	0.956		25	1
Soy Sauce	0.810		25	20
Soya Sauce	0.98			17
Soybean Sauce	0.917		25	1
Worcestershire Sauce	0.967		25	1
CONFECTIONERY				
Candies				
Jolly Rancher—Watermelon	0.393	4.7	21	2
Marshmallows	0.629; 0.635	15.6	21; 30	2
Starburst Original Fruits Fruit Chews—Cherry	0.597; 0.485	7.0	21; 31	2
Starburst Original Fruits Fruit Chews—Lemon	0.588; 0.482	6.7	21; 31	2
Starlight Mints	0.413	4.7	21	2
Twizzlers Strawberry Twists	0.657; 0.677	9.6	21; 31	2
Chocolate				
Milk Chocolate Bar	0.60			17
Milk Chocolate Bar, Hershey's	0.557; 0.428	1.2	21; 30	2
Gum (Chewing)				
Wrigley's Doublemint Chewing Gum	0.498; 0.529	4.4	22; 31	2
Wrigley's Coated Pellet Gum	0.462		23	1, 2
Wrigley's Juicy Fruit Gum	0.300		25	1, 2
Wrigley's Spearmint Chewing Gum	0.486; 0.514	4.4	22; 31	2
Wrigley's Winter Fresh Chewing Gum	0.492; 0.542	4.5	22; 31	2
Icing and Frosting				
Icing, Cake (Equilibrium Moisture Adsorption)	0.841–0.805		25	8
Icing, Cake (Sinascopie)	0.79–0.76		25	8
Icing, Vanilla	0.795	15	20	2
Frosting, Chocolate	0.816		25	12
Syrups				
Chocolate Syrup	0.862		25	1
Glucose/Fructose Syrup	0.729		25	1
High Fructose Corn Syrup, IsoSweet. A.E. Staley	0.738	28.2	25	2
Maize Syrup Solids	0.60			17

MAIN CATEGORY, Subcategory, Item	a_w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
CONFECTIONERY (<i>continued</i>)				
Syrups (<i>continued</i>)				
Maple Syrup	0.956		25	1
Maple Syrup	0.90	29		9
Sweeteners				
Corn Sweet	0.994			15
Honey	0.552		25	1
Honey, Argentine	0.638–0.530	21–15	25	10
Honey, German Floral	0.608–0.482	21.5–14.0		11
Honey, German Honeydew	0.602–0.477	18.4–12.6		11
Honey, SueBee Clover	0.517	16.7	20	2
Sucrose, Crystalline	0.227	0.04	25	2
DAIRY				
Butter				
Butter, Salted	0.894	15.9	24	2
Butter, Salted	0.91		25	2
Butter, Salted	0.952–0.827	17.0–11.7		16
Butter, Salted	0.949		20	21
Butter, Unsalted	0.961		24	2
Butter, Unsalted	0.98		25	2
Butter, Unsalted	0.976		20	21
Cheese				
Cheese	0.96	40		9
Cheese, Spread	0.965		25	12
Cheese, Spread	0.946		25	20
Colby Jack Cheese, Sargento	0.967; 0.966	44.4	20; 30	2
Cheddar Cheese	0.95			17
Cheddar Cheese, Mild, Sargento	0.953; 0.957	43.8	20; 30	2
Cheddar Cheese, Sharp, Kraft	0.975	43.4	22	2
Cream Cheese, Philadelphia Original	0.991	53.4	24	2
Parmesan Cheese, Frigo	0.881	33.9	25	2
Parmesan Cheese (Beckman-Sina)	0.713		30	4
Parmesan Cheese (Kaymont-Rotronics)	0.725		30	4
Parmesan Cheese (Protimeter)	0.721		30	4
Parmesan Cheese (Vapor Pressure Manometric)	0.693		30	4
Processed Cheese	0.969–0.930			1
Processed Cheese	0.93–0.91			13
Processed Cheese Spread	0.96			17
Swiss Cheese	0.96			17
Swiss Cheese, Kraft Singles	0.946; 0.946	41.9	20; 30	2
Cream				
Cream, 25% Fat, Canned	0.973		25	3
Cream, 40 % Fat	0.979			15
Daisy Light Sour Cream	0.996; 0.991	82.2	21; 29	2
Daisy Sour Cream	0.994; 0.990	75.0	21; 30	2
Prairie Farms Lite Sour Cream	0.993; 0.990	78.4	21; 30	2
Prairie Farms No Fat Sour Cream	0.990; 0.986	82.8	21; 28	2
Margarine				
Margarine, Liquid	0.88			13
Margarine, Salted	0.897–0.885	17.1–16.6		16
Margarine, Unsalted	0.951–0.936	17.5–16.9		16
Mayonnaises				
Mayonnaises	0.960–0.930	29.2–14.4		16

(continues)

MAIN CATEGORY, Subcategory, Item	a_w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
DAIRY (continued)				
Milk				
Milk, 1.5%	0.995			15
Milk, 2%	0.988	89.2	22	2
Milk, Evaporated	0.983		20	21
Milk, Fat Free	0.990	90.9	21	2
Milk, Jam (Dulce de Leche)	0.789		25	1
Milk, Jam	0.842		25	7
Milk, Nonfat Dry (Beckman-Sina)	0.272		30	4
Milk, Nonfat Dry (Katmont-Rotronics)	0.203		30	4
Milk, Nonfat Dry (Protimeter)	0.277		30	4
Milk, Nonfat Dry (Vapor Pressure Manometric)	0.137		30	4
Milk, Skim	0.996		20	21
Milk, Skim, Dried (Dewpoint)	0.75			17
Milk, Sweetened Condensed	0.833		25	7
Milk, Whole	0.988	88.1	22	2
Milk, Whole	0.995–0.994			15
Milk Proteins				
Whey Concentrate (Dewpoint)	0.83			17
Whey Concentrate (Hygrometer)	0.815		35	14
Whey Concentrate (Manometric Technique)	0.88		35	14
Whey Concentrate (Microcrystalline Cellulose Method)	0.820		35	14
Yogurt				
Breyers 99% Fat Free Strawberry	0.980; 0.977	74.7	21; 30	2
Breyers Light Fat Free Raspberries 'n Cream	0.988; 0.978	85.9	21; 30	2
Breyers Smooth and Creamy Classic 99% Fat Free Strawberry	0.984; 0.977	73.9	21; 30	2
Dannon 99% Fat Free Raspberry	0.974; 0.973	74.5	20; 30	2
Dannon Light Fat Free Raspberry	0.998; 0.993	88.5	20; 30	2
Flavorite Lowfat Strawberry	0.983; 0.979	78.7	20; 30	2
Yoplait Light Fat Free Strawberry	0.992; 0.987	83.1	20; 30	2
Yoplait Original 99% Fat Free Strawberry	0.985; 0.980	74.8	21; 30	2
DEHYDRATED/DRY PRODUCTS				
Flavors				
Grill Flavor, Spray Dried	0.173		23.0	1, 2
Orange Flavor, Drum Dried	0.262		25.4	1, 2
Orange Flavor, Spray Dried	0.206		24.4	1, 2
Smoke Flavor, Spray Dried	0.170		24.8	1, 2
Powders				
Chocolate Powder	0.258–0.251		25	1
Malted Milk	0.194	2.0	25	2
Spices/Seasonings				
Black Pepper, Pure Ground	0.715	10.3	25	2
Cinnamon, Whole Ground	0.587	10.9	25	2
FRUITS, VEGETABLES, AND PRODUCTS				
Fruits (Fresh and Processed)				
Apples	0.988–0.975			15
Apples	0.988		20	21
Apple, Gala	0.985	84.6	25	2
Apple, Red Delicious	0.984	85.3	20	2
Apples, Puree with Sugar, Canned	0.974		25	3
Apple Sauce, Musselmans	0.976	81.8	22	2
Apple Sauce, Natural, Musselmans	0.983	87.8	21	2

MAIN CATEGORY, Subcategory, Item	a_w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
FRUITS, VEGETABLES, AND PRODUCTS (<i>continued</i>)				
Fruits (Fresh and Processed) (<i>continued</i>)				
Apple, Slices in Light Syrup	0.981		25	3
Apricots	0.985–0.977			15
Apricots, Halves in Light Syrup	0.992		25	3
Baby Food, Mixed Fruit	0.974		25	3
Bananas	0.987–0.964			15
Bananas	0.979		20	21
Bilberries	0.989			15
Blackberries	0.989–0.986			15
Blueberries	0.982			15
Cherries	0.986–0.959			15
Cherries, Sour	0.983–0.971			15
Cherries, Sweet	0.975			15
Cherries, Maraschino, Canned	0.905		25	3
Cherries, in Syrup, Canned	0.973		25	3
Cranberries	0.989			15
Coconut, Flavorite Flake	0.834; 0.851	12.3	22; 31	2
Coconut, Flavorite Shred	0.839; 0.850	12.2	22; 31	2
Currants	0.990			15
Dates	0.974			15
Dewberries	0.985			15
Figs	0.974			15
Fruit Cocktail, Canned	0.988–0.982			3
Fruits	0.97	94		9
Fruits, Dried	0.80–0.72	20		9
Gooseberries	0.989			15
Grapefruit	0.985–0.980			15
Grapes	0.986–0.963			15
Lemon, Fresh	0.998	90.8	20	2
Lemons	0.989–0.982			15
Lime, Fresh	0.998	91.5	20	2
Limes	0.980			15
Mangoes	0.986			15
Melon	0.991–0.970			15
Nectarines	0.984			15
Oranges	0.987–0.979			15
Papaya	0.990			15
Peach, Fresh	0.998	84.6	20	2
Peaches	0.989–0.979			15
Peach, Yellow Cling in Syrup, Canned	0.986–0.980		25	3
Pears	0.989–0.979			15
Pear, Halves in Syrup, Canned	0.992–0.986		25	3
Persimmons	0.976			15
Pineapple	0.988–0.985			15
Pineapple, Slices in Syrup	0.976–0.965		25	3
Plums	0.982–0.969			15
Quinces	0.981–0.972			15
Raisins	0.54–0.51			13
Raisins, Sun Maid California, Whole	0.526; 0.506	10.3	22; 31	2
Raisins, Sun Maid California, Cut	0.529; 0.535	12.6	22; 31	2
Raspberries	0.994–0.984			15

(continues)

MAIN CATEGORY, Subcategory, Item	a_w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
FRUITS, VEGETABLES, AND PRODUCTS (<i>continued</i>)				
Fruits (Fresh and Processed) (<i>continued</i>)				
Strawberries	0.997–0.986			15
Strawberry, with Sugar and Citric Acid	0.955–0.950		25	3
Tangerines	0.987			15
Watermelon	0.992			15
Fruit Juices				
Juices	0.97	87		9
Apple Juice	0.986			15
Cherry Juice	0.986			15
Grape Juice	0.983			15
Orange Juice	0.988			15
Orange Juice Concentrate	0.80			17
Pineapple Juice, Canned	0.990–0.988		25	3
Strawberry Juice	0.991			15
Tomato Juice, Canned	0.993		25	3
Jams/Jelly/Preserves/Spreads				
Jams and Jellies	0.94–0.82	32		9
Jam, Orange	0.839		25	1
Jam, Peach	0.833		25	1
Jam, Strawberry	0.839		25	1
Jam Strawberry, Seedless Smucker's	0.834; 0.833	29.4	21; 30	2
Jelly, Grape (Beckman-Sina)	0.818		30	4
Jelly, Grape (Kaymont-Rotronics)	0.852		30	4
Jelly, Grape (Protimeter)	0.820		30	4
Jelly, Grape (Vapor Pressure Manometric)	0.802		30	4
Jelly, Strawberry Smucker's	0.839; 0.844	34.4	21; 30	2
Jelly, Strawberry Smucker's				2
Preserves, Raspberry	0.835		25	12
Preserves, Strawberry Smucker's	0.834; 0.836	32.0	21; 30	2
Spreadable Fruit, Strawberry Smucker's Simply 100% Fruit	0.879; 0.881	46.9	21; 30	2
Vegetables (Fresh and Processed)				
Artichokes	0.987–0.976			15
Asparagus	0.994–0.992			15
Avocado	0.989			15
Beets	0.988–0.979			15
Broccoli, Sprouting	0.991			15
Brussel Sprouts	0.990			15
Cabbage	0.992–0.990			15
Carrots	0.993–0.983			15
Cauliflower	0.990–0.984			15
Celeriac	0.990			15
Celery	0.994–0.987			15
Celery Leaves	0.997–0.992			15
Corn, Sweet	0.994			15
Cucumbers	0.998–0.992			15
Eggplant	0.993–0.987			15
Endive	0.995			15
Green Beans	0.987	90.9	20	2
Green Beans	0.996–0.990			15
Green Pepper	0.998	93.3	20	2
Green Onions	0.996–0.992			15
Lima Beans	0.994			15

MAIN CATEGORY, Subcategory, Item	a _w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
FRUITS, VEGETABLES, AND PRODUCTS (<i>continued</i>)				
Vegetables (Fresh and Processed) (<i>continued</i>)				
Leeks	0.991–0.976			15
Lettuce	0.996			15
Mushrooms	0.995–0.989			15
Onions	0.990–0.974			15
Olives, Salted	0.957		25	1
Palm Heart, Canned	0.984		25	3
Parsnips	0.988			15
Peas, Green	0.990–0.980			15
Peppers	0.997–0.982			15
Potato, Russet, Baking	0.993	79.1	20	2
Potatoes	0.997–0.988			15
Potatoes, Sweet	0.985			15
Pumpkins	0.992–0.984			15
Radishes	0.990–0.980			15
Radishes, Small	0.996–0.994			15
Rhubarb	0.989			15
Rutabagas	0.988			15
Salsify	0.987			15
Spinach	0.998–0.994			15
Squash	0.994–0.996			15
Tomatoes	0.998	94.9	20	2
Tomato, Whole Peeled, Canned	0.993		25	3
Tomatoes	0.998–0.991			15
Tomatoes with Salt, Onion, Spices, Sweet Pepper, (Portuguese Sauce) Canned	0.979		25	3
Tomato Paste (16.1% solids)	0.975		25	3
Tomato Paste (28.1% solids)	0.967		25	3
Tomato Paste (Triple Concentration)	0.934		25	7
Tomato Pulp	0.993			15
Tomato Puree, Canned	0.992–0.987		25	3
Turnips	0.988			15
Vegetables	0.97	90		9
MEAT				
Fresh and Deli Meats				
Bacon	0.968		20	21
Beef	0.992–0.980			15
Carl Buddig, Beef	0.962; 0.962	66.5	20; 30	2
Carl Buddig Chicken	0.971; 0.971	66.8	20; 30	2
Carl Buddig Ham	0.967; 0.967	68.6	20; 30	2
Carl Buddig Smoked Turkey	0.976; 0.973	67.9	20; 30	2
Corned Beef, Canned	0.979–0.972		25	3
Ground Beef, 8% Fat, Lean	0.992	71.2	20	2
Ham, Cooked Canned	0.971		25	3
Ham, Deviled Canned	0.977–0.970		25	3
Lamb	0.990			15
Liverwurst	0.972		25	1
Liver Paste, Canned	0.980–0.971		25	3
Meat	0.97	67		9
Meat Paste, Canned	0.984–0.974		25	3
Pork	0.990			15
Pork Loin Roast, Center Cut, Extra Lean, Farmland	0.978	73.2	20	2

(*continues*)

MAIN CATEGORY, Subcategory, Item	a _w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
MEAT (continued)				
Fresh and Deli Meats (continued)				
Roast Beef, Canned	0.982		25	3
Jerky				
Beef Jerky, Russler's	0.691	16.6	20	2
Beef Jerky, various	0.65–0.92		20–25	1
Pepperoni/Salami/Sausages				
Pepperoni (Italian Style), Armour Premium	0.878	31.6	21	2
Pepperoni, Hormel	0.860; 0.857	31.2	21; 30	2
Salami, Dry	0.875		25	1
Salami (Dewpoint)	0.96			17
Salami (Hygrometer)	0.968		35	14
Salami (Manometric Technique)	0.99		35	14
Salami (Microcrystalline Cellulose Method)	0.969		35	14
Sausage	0.740–0.667		25	19
Sausage	0.975		20	21
Sausage in Lard, Canned	0.896		25	3
Sausage, Pork (Equilibrium Moisture Adsorption)	0.973		25	8
Sausage, Pork (Sinascopie)	0.99–0.97		25	8
Sausage, Snack, Fully Dry	0.87–0.66	29.0–10.6		5
Sausage, Snack, Medium Dry	0.83	38.7		5
Sausage, Snack, Semi Dry	0.88	49.1		5
PET FOOD				
Canned				
Alpo Gourmet Dinner Prime Cuts in Gravy	0.994	79.6	19	2
Cat Food, Moist	0.881		25	1
Dry				
Cat Chow, Purina	0.236	4.4	25	2
Intermediate Moisture				
Dog Food, IMF (Beckman-Sina)	0.749		30	4
Dog Food, IMF (Kaymont-Rotronics)	0.800		30	4
Dog Food, IMF (Protimeter)	0.815		30	4
Dog Food, IMF (Vapor Pressure Manometric)	0.814		30	4
Pet Food Burgers	0.842–0.869		25	1
Pet Food, Soft Moist	0.83	24		9
Pet Food Special Cuts	0.835–0.855		25	1
POULTRY AND PRODUCTS				
Poultry				
Chicken, Boned, Canned	0.982		25	3
Chicken Breast, Boneless Skinless With Rib Meat, Tyson	0.979	74.6	20	2
Pheasant Puree, Canned	0.983		25	3
Eggs				
Eggs	0.97	75		9
SEAFOOD				
Anchovies	0.938		20	21
Anchovies, Salted in Oil	0.875		25	1
Fish, Cod	0.994–0.990			15
Fish, Various Species	0.989			15
Mackerel, Canned	0.974		20	21
Salmon Fillet, Fresh Chilean Raised	0.985	68.3	20	2
Salmon Paste, Canned	0.970		25	3
Salmon, Smoked	0.965		20	21
Salmon Pate, Smoked	0.993		20	21
Sardines, Canned	0.969		20	21

MAIN CATEGORY, Subcategory, Item	a_w Value or Range	M.C. (% w.b.)	Temperature (°C)	Source
SEAFOOD (continued)				
Trout, Smoked	0.948		20	21
Tuna, Canned	0.968		20	21
Tuna Pate	0.951		20	21
SNACK FOODS				
Fruit Snacks and Leathers				
Betty Crocker Fruit Roll-Ups—Electric Yellow	0.568; 0.548	10.0	22; 31	2
Betty Crocker Fruit Roll-Ups—Sizzling Red	0.519; 0.540	9.3	22; 31	2
Betty Crocker Fruit String Thing Chewy Snack— Cherry	0.594; 0.576	8.6	22; 31	2
Brach's Supersour Dinosaur Snacks—Green	0.596; 0.566	13.9	22; 30	2
Brach's Supersour Dinosaur Snacks—Red	0.607; 0.567	12.5	22; 31	2
Farley's Troll Fruit Snacks—Red/Yellow	0.643; 0.602	16.6	22; 31	2
Grist Mill Variety Pack Fruit Snacks—Grape	0.586; 0.574	4.2	22; 31	2
Grist Mill Variety Pack Fruit Snacks—Strawberry	0.576; 0.575	7.0	22; 31	2
Gelatin				
Jell-O Gelatin Snacks—Strawberry	0.981	79.9	20	2
Jell-O Gelatin Dessert—Peach (Dry)	0.281	1.7	25	2
Granola Bars				
Nature Valley Crunchy Granola Bar	0.214	1.5	25	2
Popcorn				
Popcorn, White, Jays	0.071	0.28	25	2
Potato Chips and Other Crunchy Snacks				
Cheetos Crunchy	0.091; 0.114	0.32	22; 31	2
Doritos Nacho Cheesier!	0.118; 0.092	0.95	22; 31	2
Lay's Classic Potato Chips	0.165; 0.267	1.1	23; 31	2
Ruffles Potato Chip	0.182; 0.178	1.3	22; 31	2
Shoestring Potatoes	0.080	1.1	25	2
Pretzels				
Baked Pretzel Stix	0.049	1.8	25	2
Puddings				
Jell-O Pudding Snacks—Chocolate	0.979	73.1	25	2
My-T-Fine Pudding and Pie Filling—Chocolate—Dry Mix	0.345	1.6	27	2
Pudding, Vanilla (Equilibrium Moisture Adsorption)	0.991		25	8
Pudding, Vanilla (Sinascopie)	0.97		25	8
Rice Cakes				
Quaker Fat Free Caramel Corn Mini Rice Cakes	0.220; 0.277	2.9	22; 31	2
Quaker Fat Free Honey Nut Mini Rice Cakes	0.269; 0.362	3.9	22; 31	2
SOUPS				
Seafood Soup	0.978		20	21

References

1. Decagon Devices, Inc. (<http://www.decagon.com/>). In-house Testing, Pullman, Washington. a_w values were obtained using Decagon Aqualab Water Activity Meters, Series 3TE (chilled mirror).
2. Schmidt, S.J. Food Chemistry Laboratory, Department of Food Science and Human Nutrition, University of Illinois at Urbana-Champaign, IL, a_w values were obtained using Decagon Aqualab Water Activity Meters, Series 3TE (chilled mirror) and moisture content values obtained using vacuum oven drying (60° 29 in Hg for 24 hours), except for crystalline sucrose where the moisture content was obtained by Karl Fischer titration.
3. Alzamora, S.M., and Chirife, J. 1983. The water activity of canned foods. *Journal of Food Science* 48:1385-1387.
4. Asbi, B.A., and Baianu, I.C. 1986. An equation for fitting moisture sorption isotherms of food proteins. *Journal of Agricultural and Food Chemistry* 34:494-496.

5. Palumbo, S.A., Kissinger, J.C., Miller, A.J., Smith, J.L., and Zaika, L.L. 1979. Microbiology and composition of snack sausages. *Journal of Food Protection* 42(3):211-213.
6. Schebor, C., and Chirife, J. 2000. A survey of water activity and pH values in fresh pasta packed under modified atmosphere manufactured in Argentina and Uruguay. *Journal of Food Protection* 63(7):965-969.
7. Favetto, G., Resnik, S., Chirife, J., and Ferro-Fontan, C. 1983. Statistical evaluation of water activity measurement obtained with the Vaisala Humicap humidity meter. *Journal of Food Science* 48:534-538.
8. Fett, H.M. 1973. Water activity determination in foods in the range 0.80 to 0.99. *Journal of Food Science* 38:1097-1098.
9. Kaplow, M. 1970. Commercial development of intermediate moisture foods. *Food Technology* 24:53-57.
10. Chirife, J., Zamora, M.C., and Motto, A. 2006. The correlation between water activity and % moisture in honey: Fundamental aspects and applications to Argentine honeys. *Journal of Food Engineering* 72:287-292.
11. Schroeder, A., Horn, H., and Pieper, H.J. 2005. The correlation between moisture content and water activity (aw) in honey. *Deutsche-Lebensmittel-Rundschau* 101(4):139-142.
12. Scott, V.N., and Bernard, D.T. 1983. Influence of temperature on the measurement of water activity of food and salt systems. *Journal of Food Science* 48:552-554.
13. Troller, J.A. 1983. Water activity measurements with a capacitance manometer. *Journal of Food Science* 48:739-741.
14. Vos, P.T., and Labuza, T.P. 1974. Technique for measurements of water activity in the high a_w range. *Journal of Agricultural and Food Chemistry* 22:326-327.
15. Chirife, J., and Fontan, C.F. 1982. Water activity of fresh foods. *Journal of Food Science* 47:661-663.
16. Gomez, R., and Fernandez-Salguero, J. 1992. Water activity and chemical composition of some food emulsions. *Food Chemistry* 45:91-93.
17. Kidambi, R.N. Wiebe, H.H., Ernstrom, C.A., and Richardson, G.H. 1979. An economical dewpoint instrument for rapid measurement of water activity in foods. *Journal of Dairy Science* 62(Suppl. 1):40-41.
18. Briske, L.K., Lee, S-Y, Klein, B.P., and Cadwallader, K.R. 2004. Development of a prototype high-energy, nutrient-dense food product for emergency relief. *Journal of Food Science* 69(9):S361-367.
19. Multon, J.L., Savet, B., and Bizot, H. 1980. A fast method for measuring the activity of water in foods. *Lebensmittel-Wissenschaft-und-Technologie* 13(5):271-273.
20. Stoloff, L. 1978. Calibration of water activity measuring instruments and devices: Collaborative study. *Journal of Association of Official Analytical Chemists* 61(5):1166-1178.
21. Fernandez-Salguero, J., Gomez, R., and Carmona, M.A. 1993. Water activity in selected high-moisture foods. *Journal of Food Composition and Analysis* 6:364-369.
22. Clifford, M.N. 1986. Coffee technology outlook—Physical properties of the coffee bean. *Tea and Coffee Trade Journal* April:14-16.