

## Table 1. Direct Food Additives

Food additives can be divided into two primary areas of direct & indirect additives. Direct additives are any ingredients used in food or beverage for a specified purpose. They are required to be labeled within the ingredients on a food or beverage package.

Additive Category	Primary Purpose to Use	Foods Where Frequently Used	Ingredient Listing Examples	Functions
<b>Acidulants &amp; Acidity Regulators</b>	To decrease or maintain the acidity of a food or create a sour taste	Mayonnaise and salad dressings, beverages, pickled foods, blended fruit drinks, dairy products, fruit fillings, jams & jellies, chocolates, baked goods	<b>Acids:</b> vinegar (acetic acid), phosphoric acid, citric acid, tartaric acid, lactic acid, malic acid, fumaric acid <b>Acidity Regulators:</b> calcium acetate, D gluconic acid, di or tri-sodium phosphate, potassium citrate, ferric ammonium citrate	<b>Acids</b> provide sour flavor, contribute to food safety by maintaining or reducing pH, and modify proteins (e.g., direct set cheeses). <b>Acidity Regulators</b> help maintain the acidity of a food in a particular range for food safety and to maintain product flavor, texture, or color.
<b>Anticaking Agents</b>	To keep foods free-flowing and to prevent moisture absorption	Spice mixes, shredded cheeses, granular cheese (e.g. dried parmesan), confectioner's sugar, baking powder, salt	calcium silicate, silicon dioxide, powdered cellulose, iron ammonium citrate	Keeps shredded cheeses from sticking together; keeps powdered and granular foods flowing, coats foods to inhibit moisture from being absorbed
<b>Foaming &amp; Anti-foaming agents</b>	Prevent foods from foaming excessively or to enable foaming to occur and be maintained	<b>De-foamers:</b> Fountain sodas, French fries, chicken nuggets, salad dressings, doughnuts, cake mixes, blended fruit juices, dry beverage mixes, dip mixes; as a processing aid in dairy, potato, sugar, and vegetable production <b>Foaming Agents:</b> Whipped toppings, dressings, beverages, cake mixes, bakery fillings, meringues, ice cream, frozen dessert products	<b>De-foamers:</b> butterfat, vegetable oil, coconut oil, corn oil, mineral oil, dimethylpolysiloxane, polysorbate, propylene glycol, sorbitan monostearate, hydroxylated lecithin <b>Foaming Agents:</b> yucca, quillaja, agar, soy lecithin, egg whites, xanthan gum, carrageenan, methyl cellulose	<b>De-foamers</b> prevent or reduce the amount of foam formed when pouring, filling, mixing, or frying foods where gas (air) entrapment can be common. <b>Foaming Agents</b> help to capture gas bubbles and maintain them at the desired size and timeframe for the food product (e.g. root beer, meringue pie)

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<b>Antioxidants</b>	Inhibit oxidation in foods	Fruits (e.g. apple slices), meats, vegetables (e.g. avocados), ready-to-eat cereals	ascorbic acid, sodium ascorbate, tocopherols, alpha tocopherol, rosemary extract, erythorbic acid, propyl gallate, EDTA (ethylene diamine tetra-acetic acid) BHA (butylated hydroxyanisole), BHT (butylated hydroxytoluene), sodium erythorbate	Generally, food antioxidants target the preservation of food from oxidation without altering its taste, texture and color.
<b>Cultures (Food Grade Bacteria, Yeasts, &amp; Molds) &amp; Enzymes</b>	Enable food fermentation or other useful modification of a food product	Dairy products, meat products, fruits & vegetables, bakery products, cereals, beans, food starches,	Cultures, Yeast, Enzymes	Cultures and enzymes create a wide variety of changes in food including natural generation of acids, softening or firming of food texture, creation of gas in food (e.g. yeast in baking), coagulation of proteins (e.g. cheesemaking); generation of beneficial nutrients
<b>Bulking Agents</b>	Non-nutritive ingredients that increase the volume or weight of a food without affecting the taste	Processed foods, including meal replacements, low-calorie & low-fat diet foods, processed meats, dairy products, pastries, desserts, cereals, condiments, seasonings,	Guar gum, psyllium husk, undigestible food starches, mannitol, polydextrose, maltitol, methyl-cellulose, pectin	Bulking agents pass through the intestines with minimal absorption and are useful in weight reduction products or for creating bulk.
<b>Food Colorings &amp; Color Retention Agents</b>	Ingredients that add color to food products or help retain food colorings from deterioration	Beverages, ready-to-eat cereals, bakery products, candies, jams & jellies, gelatin, ice cream, dressings, condiments, dips, processed cheese & dairy products,	Annatto extract, red #40, yellow #5, yellow #6, blue #1, citrus red #2, beta carotene, caramel, carmine, cochineal extract, lycopene, paprika oleoresin, saffron, turmeric oleoresin, titanium dioxide, ascorbic acid, calcium disodium EDTA, disodium EDTA	Food colorings correct and enhance natural color variations in color from light, temperature, or oxygen exposure. Color retention agents preserve the natural color in a food product from degrading

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<b>Nutritional Fortifying Agents (e.g., vitamins &amp; minerals)</b>	Replacement of vitamins and minerals lost in processing or lacking in the diet	Milk, flour, bread, cereal, rice, salt, fruit beverages, diet & meal replacement products	Thiamin hydrochloride, riboflavin, niacin, vitamin A palmitate, vitamin D, vitamin B12, iodide, zinc oxide, beta carotene, ferrous sulfate, ascorbic acid, amino acids, soy protein isolate, whey protein isolate, milk protein isolate	Nutritional fortifying agents help ensure nutritional adequacy in populations, serving as a public health tool to eliminate deficiencies. Nutritional fortifying agents also enable creation of custom formulated foods for meal replacements and specific dietary needs.
<b>Emulsifiers &amp; Emulsifying Agents</b>	Prevent separation of ingredients (e.g., oil & water) and crystallization, enable better dissolving and mixing of ingredients	Salad Dressings, processed cheeses, dips and sauces, margarine and butter replacements, baking dough, chocolates, peanut butter, ice cream, frozen desserts, meal replacement beverages	Egg yolks, mono & diglycerides, sodium phosphate & hexametaphosphate, caseinate, polysorbate 60, polysorbate 80, soy lecithin, stearyl lactylate, sorbitan monostearate, polyglycerol esters (PGE), propylene glycol esters, polyglycerol polyricinoleate (PGPR), DATEM (Diacetyl Tartaric Acid Ester of Mono & Diglycerides)	Emulsifiers help lengthen food shelf-life, enable fats & oils to stay stable in water-based products (e.g., salad dressings), or water stable in oil-based products (e.g., chocolates). They keep sauces smooth, help manufacturing processes reduce stickiness, and prevent fats from crystallizing (e.g., shortenings)
<b>Flavors &amp; Flavor Enhancers</b>	Either create or enhance specific flavors (e.g., fruit flavors, cheese flavors) or enhance the flavors already existing in the food	Soft drinks, ice cream, pie fillings, cake and gelatin mixes, dressings & sauces, soups, candies, ready-to-eat cereals, baked goods, processed meats, baking ingredients (e.g., imitation vanilla flavor)	<p><b>Flavors:</b> Natural flavoring, natural &amp; artificial flavoring, artificial flavoring, fruit extracts, spice extracts</p> <p><b>Flavor Enhancers:</b> Salt, monosodium glutamate, autolyzed yeast extract, hydrolyzed soy protein, disodium guanylate or inosinate</p>	<p><b>Flavors</b> bring variety to many foods to enhance enjoyment of food consumption. They enable creation of designed foods and beverages to meet tastes (e.g., cheese flavor on potato chips or cherry cola soda) or needs (vanilla flavored meal replacement shakes).</p> <p><b>Flavor enhancers</b> elevate flavor intensity, reducing the need for the natural flavor to be present.</p>

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<b>Glazing Agents</b>	Create a protective coating on foods or create an enhanced appearance (sheen)	Fruit peels, vegetable skins, chocolates, seafood, candies, desserts	Beeswax, carnauba wax, candelilla wax, shellac, petrolatum wax, stearic acid, paraffin,	Protective coatings on fruits and vegetables protect them from surface damage, mold and insects during delivery to stores and provide a shiny appearance; chocolates and other candies can be given a glossy appearance
<b>Humectants</b>	Water absorbing and binding ingredients that keep foods moistened	Cereal and fruit bars, raisins and other dried fruits, liquid filled solid outside foods (e.g., candy, pies, cakes, cheese filled snacks), fermented meats, sausages & jerky, pizza crust, evaporated milk	Salt, sugar, honey, fructose, glucose, sorbitol, glycerol, maltitol, propylene glycol, sodium lactate, sodium tripolyphosphate, glycerol acetate, sodium hexametaphosphate	Humectants bind moisture that might enable microbes to grow, maintain moisture and therefore texture in foods despite changes in the food environment due to transport & storage, food temperature and loss of water through packaging
<b>Leavening Agents</b>	Cause baked goods to rise	Breads, cakes, pizza, cookies, and other baked goods	Baking soda (sodium bicarbonate), baking powder (sodium bicarbonate & potassium bitartrate), monocalcium phosphate, calcium carbonate	Leavening agents are chemicals that generate gas (usually carbon dioxide) in a baked good to modify the texture to contain gas bubbles and are less dense to consume
<b>Preservatives (Synthetic, Natural &amp; Microbial)</b>	Protect foods from microbial spoilage, and negative flavor, color or texture changes.	Fruit sauces & jellies, beverages, cured meat, cheeses, oils & butter spreads & margarines, dressings, sauces, dips, cereals, snacks, baked goods, syrups	Salt, sugars, sodium benzoate, benzoic acid, potassium sorbate, sorbic acid, lysozyme, natamycin, nisin, sodium nitrite, sodium nitrate, sodium sulfite, sulfur dioxide, potassium propionate, propionic acid, ethyl lauryl arginate, acetic acid, boric acid, sodium metabisulfite, antioxidants such as BHT, BHA, ascorbic acid, tocopherols, and EDTA also can act as preservatives	Preservatives inhibit pathogenic microorganisms from growing in foods and causing illness. They keep foods from spoiling quickly, extending shelf-life. Preservatives keep flavors from deteriorating and colors from fading and keep texture from degrading (thickness or smoothness). Some preservatives occur naturally in food products (e.g., benzoic acid in cranberries and lysozyme in egg whites)

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<b>Stabilizers &amp; Thickeners</b>	Create and maintain consistent texture in foods (usually thicker) and smoothness when consumed	Prepared frozen foods (meals, ice creams, desserts), dairy products (e.g., cream cheese, sour cream, yogurt), dips, sauces, fruit jams & jellies, salad dressings, spreads, prepared gravy & gravy mixes, icing, candies and confections, powdered beverage mixes, some baked goods	Pectin, carrageenan, corn starch, modified corn starch, modified potato starch, wheat starch, rice starch, carboxymethylcellulose, guar gum, xanthan gum, locust bean gum, gum arabic/acacia gum, whey protein concentrate, egg whites, sodium caseinate	<b>Stabilizers</b> help maintain the texture of a food product in a consistent range over time when prepared.  <b>Thickeners</b> add viscosity to products to make them more pourable or firm for improved use (e.g., gums help salad dressing cling to the lettuce and other vegetables)
<b>Sweeteners and Sweetening Agents (Nutritive/ Non-nutritive)</b>	Increase sweetness of a food with or without adding calories	Beverages, candies & confections, sweet baked goods, jams & jellies, ready-to-eat cereals, sauces, cereal & fruit bars, ice cream and frozen desserts, syrups, table sweeteners, fruit rolls	<b>Nutritive:</b> Sugar, sucrose, glucose, dextrose, brown sugar, invert sugar, fructose, corn syrup, high fructose corn syrup, honey, allulose, tagatose, sugar alcohols (erythritol, maltitol, sorbitol, xylitol)  <b>Non-nutritive:</b> aspartame, saccharin, sucralose (Splenda), acesulfame potassium, neotame, monk fruit, stevia & steviolosides	Sweeteners & sweetening agents are used to create or enhance the sweetness of foods. Some add caloric content to food, others do not. Some have high sweetness levels and require only a small amount to increase a food's sweetness. Table sugar, or sucrose, is the primary sweetener used by humans

# References – Food Additives

1. Overview of Food Ingredients, Additives & Colors | FDA
2. [Barrows, J. N., Lipman, A. L., & Bailey, C. J. \(2017, November 3\). Color additives history. U.S. Food And Drug Administration. https://www.fda.gov/industry/color-additives/color-additives-history](https://www.fda.gov/industry/color-additives/color-additives-history)
3. [U.S. Food and Drug Administration. \(2023, September 26\). Food additive status list. https://www.fda.gov/food/food-additives-petitions/food-additive-status-list#for](https://www.fda.gov/food/food-additives-petitions/food-additive-status-list#for)
4. <https://www.fda.gov/food/food-ingredients-packaging/overview-food-ingredients-additives-colors>
5. [U.S. Food and Drug Administration. \(2023, October 17\). Generally recognized as safe \(GRAS\). https://www.fda.gov/food/food-ingredients-packaging/generally-recognized-safe-gras](https://www.fda.gov/food/food-ingredients-packaging/generally-recognized-safe-gras)
6. [Barron, F. \(2019, June 18\). Chemical additives in food packaging materials: Importance for food processors. Food Safety Magazine. https://www.food-safety.com/articles/6256-chemical-additives-in-food-packaging-materials-importance-for-food-processors](https://www.food-safety.com/articles/6256-chemical-additives-in-food-packaging-materials-importance-for-food-processors)
7. [Food Insight. \(2022, February 10\). Everything you need to know about Stevia Sweeteners. https://foodinsight.org/everything-you-need-to-know-about-stevia-sweeteners/](https://foodinsight.org/everything-you-need-to-know-about-stevia-sweeteners/)
8. [Polynt Group. \(2017, April 6\). Organic food additives | Polynt. https://www.polynt.com/organic-food-additives/](https://www.polynt.com/organic-food-additives/)
9. [Food and Agriculture Organization of the United Nations. \(n.d.\). Food Additives DB \(GSFA Online\) | CODEXALIMENTARIUS FAO-WHO. https://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/gsfa/en/](https://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/gsfa/en/)
10. [European Food Safety Authority. \(2017, June 15\). EFSA confirms safe levels for nitrites and nitrates added to food. Codex Alimentarius International Food Standards. https://www.efsa.europa.eu/en/press/news/170615](https://www.efsa.europa.eu/en/press/news/170615)
11. [BBC News. \(2010, July 9\). China dairy products found tainted with melamine. https://www.bbc.com/news/10565838](https://www.bbc.com/news/10565838)
12. [Thinking about the future of food safety. \(2022\). In FAO eBooks. https://doi.org/10.4060/cb8667en](https://doi.org/10.4060/cb8667en)
13. [Bhunia, K., Sablani, S. S., Tang, J., & Rasco, B. \(2013\). Migration of Chemical Compounds from Packaging Polymers during Microwave, Conventional Heat Treatment, and Storage. Comprehensive Reviews in Food Science and Food Safety, 12\(5\), 523–545. https://doi.org/10.1111/1541-4337.12028](https://doi.org/10.1111/1541-4337.12028)
14. [Williamson, M. \(2019, January 14\). Food grade lubricants explained: grease and oil. Machinery Lubrication. https://www.machinerylubrication.com/Read/445/food-grade-lubricants](https://www.machinerylubrication.com/Read/445/food-grade-lubricants)
15. [U.S. Food And Drug Administration. \(n.d.\). CFR - Code of Federal Regulations Title 21. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=178.3570](https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=178.3570)
16. [Children’s Health Defense. \(2023, March 2\). Ten thousand chemicals in food and food packaging: What are these substances doing to our children? https://childrenshealthdefense.org/news/ten-thousand-chemicals-in-food-and-food-packaging-what-are-these-substances-doing-to-our-children/](https://childrenshealthdefense.org/news/ten-thousand-chemicals-in-food-and-food-packaging-what-are-these-substances-doing-to-our-children/)

# References – Food Additives

17. Franco, R., Navarro, G., & Martínez-Pinilla, E. (2019). Antioxidants versus Food Antioxidant Additives and Food Preservatives. *Antioxidants*, 8(11), 542. <https://doi.org/10.3390/antiox8110542>
18. Gökoğlu, N. (2018, October 14). Novel natural food preservatives and applications in seafood preservation: a review. *Journal of the Science of Food and Agriculture*, 99(5), 2068–2077. <https://doi.org/10.1002/jsfa.9416>
19. Marmouzi, I., Ezzat, S. M., Kharbach, M., & Bouyahya, A. (2020). Antioxidant Food Additives. In *Food Additives and Human Health* (pp. 61–81). Bentham Science Publisher. <https://doi.org/10.2174/9789811446139120010007>
20. *Synthetic Antioxidants - Biotransformation of Waste Biomass into High Value Biochemicals*. (n.d.). Ebrary. [https://ebrary.net/17946/environment/synthetic\\_antioxidants](https://ebrary.net/17946/environment/synthetic_antioxidants)
21. Atta, E. M., Mohamed, N. H., & Abdelgawad, A. A. M. (2017). Antioxidants: An overview on the natural and synthetic types. *European Chemical Bulletin*, 6(8), 365. <https://doi.org/10.17628/ecb.2017.6.365-375>
22. U.S. Food And Drug Administration. (n.d.). CFR - Code of Federal Regulations Title 21. <https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=172.896>
23. U.S. Food And Drug Administration. (2018, January 4). Microorganisms & Microbial-Derived Ingredients used in food (Partial list). <https://www.fda.gov/food/generally-recognized-safe-gras/microorganisms-microbial-derived-ingredients-used-food-partial-list>
24. Health Canada. (2024, February 28). 5. List of permitted food enzymes (Lists of permitted food additives). Government of Canada. <https://www.canada.ca/en/health-canada/services/food-nutrition/food-safety/food-additives/lists-permitted/5-enzymes.html>
25. Persistence Market Research. (2019 January 1). Food Bulking Agents Market - Persistence Market Research. <https://www.persistencemarketresearch.com/market-research/food-bulking-agents-market.asp>
26. U.S. Food And Drug Administration. (2023, December 14). Color additive status list. <https://www.fda.gov/industry/color-additive-inventories/color-additive-status-list>
27. U.S. Food And Drug Administration. (2023, July 13). How Safe are Color Additives? <https://www.fda.gov/consumers/consumer-updates/how-safe-are-color-additives>
28. Bell, B. (2023, July 17). Food dyes: Harmless or harmful? Healthline. <https://www.healthline.com/nutrition/food-dyes>
29. Brown, M. J. (2016, August 17). Synthetic vs Natural Nutrients: Does It Matter? Healthline. <https://www.healthline.com/nutrition/synthetic-vs-natural-nutrients>
30. Partridge, D., & Johnstone, A. (2019, August 7). Are emulsifiers bad? Not enough evidence to say we should stop eating them. *Medical Xpress*. <https://medicalxpress.com/news/2019-08-emulsifiers-bad-evidence.html>

# References – Food Additives

31. Carr, R. (2023, June 26). Emulsifiers: Friend or foe? Healthy Food Guide. <https://www.healthyfood.com/advice/emulsifiers-friend-or-foe/>
32. U.S. Food And Drug Administration. (2018, October 5). FDA Removes 7 Synthetic Flavoring Substances from Food Additives List. <https://www.fda.gov/food/cfsan-constituent-updates/fda-removes-7-synthetic-flavoring-substances-food-additives-list>