Antioxidant Comparison Chart

Antioxidant	Percentage Commonly Used[1,2]	Solubility	pH efficacy range	Temperature Stability	Other considerations
Alpha Tocopherol (Vitamin E)	Topical: 0.001-0.05% (as an antioxidant) Oral: 0.001-0.05% Intravenous: 0.02%	Soluble in acetone, ethanol, and vegetable oils[2]	Some forms of vitamin E may be unstable in alkaline solution[2]	Explicit information not available, some sources recommend not heating above 40C[3] and others have documented degradation above 90C[4]	Also has some nonionic surfactant properties[2] Efficacy is increased in the presence of ascorbyl palmitate and lecithin[2] High concentrations can cause autooxidation[2] Acceptable oral amount 0.15-2mg/kg per WHO (generally well tolerated)
Ascorbic Acid	Parenteral (as an antioxidant): 0.2% Inhalation: 0.1% Topical: 0.3-3%	Soluble in water, propylene glycol, some solubility in ethanol. Poorly soluble in glycerin, insoluble in oils[2]	Unstable in alkaline solution, maximum stability around pH 5.4[2]	Light and heat can accelerate oxidative degradation[2] Dry solid ascorbic acid is stable up to ~190C[5]	Ascorbic acid (A.K.A. vitamin C) is generally regarded as safe[2] WHO set limit at 15mg/kg per day in addition to normal amounts in food[2]
Ascorbyl Palmitate	Topical: 0.02-1%	Insoluble in water, soluble in ethyl alcohol, propanediol, propylene glycol, some limited solubility in oils[2]	Optimal pH is lightly acidic pH[2]	Light and heat can accelerate degradation, avoid temperatures greater than 65C[2]	Ascorbyl palmitate is synergistic with alpha tocopherol (vitamin E) WHO set limit at 1.25mg/kg, though it is generally regarded as nontoxic and nonirritating[2]
Butylated Hydroxyanisole (BHA)	Nasal: 0.1-1% Oral: 0.01 -0.05% Topical: 0.01-0.02% Intramuscular: 0.03%	Practically insoluble in water, soluble in aqueous ethanol, propylene glycol, some solubility in oils such as	Stable at a wide range of pH less than 9[6]	Exposure to light and heat can cause discoloration and loss of activity[2]	BHA may be irritating to the eyes and skin or if inhaled The WHO acceptable daily intake of BHA is 500mcg/kg[2]

		cottonseed and soybean oil[2]			
Butylated Hydroxytoluene (BHT)	Nasal: 0.01% Oral: 0.01-0.02% Intramuscular: 0.03% Intravenous: 0.0009-0.002% Topical: 0.02-0.5%	Practically insoluble in water, glycerin, and propylene glycol, soluble in ethyl alcohol, fixed oils, and mineral oil, generally more soluble in food oils and fats than BHA[2]	Stable at a wide range of pH less than 9[6]	Exposure to light, heat, and moisture can cause loss of activity[2]	BHT is generally considered nonirritating and nonsensitizing at concentrations typically used to confer antioxidant activity The WHO acceptable daily intake of BHA is 125mcg/kg[2]
Citric Acid	Injection: 0.25-1% Intramuscular: 0.05-0.3% Nasal: 0.045% - 0.06% Ophthalmic: 0.01-0.09% Oral: 0.2-0.5% (for antioxidant effect) Topical: 0.05-2%	Soluble in water and ethanol[2]	Stable at a wide pH range from highly to lightly acidic, will lower the pH of the preparation it has been added to[2]	Fairly stable to light and heat[2]	Citric acid is generally recognized as safe and is a common food additive In addition to its antioxidant effects and effects on pH, citric acid is also added to improve and modify flavor of oral preparations[2]
Malic Acid	Oral: 0.4%	Freely soluble in water and ethanol, soluble in propylene glycol as well[2]	Stable at a wide pH range from highly to lightly acidic, will lower the pH of the preparation it has been added to[2]	Stable at temperatures up to 150C[2]	Malic acid, in addition to its activity as an antioxidant, is also used as a flavoring agent to mask bitter tastes and to provide tartness. It is said to have a slight apple flavor Malic acid is sometimes used synergistically with BHT to slow oxidation in vegetable oils

					Generally considered nontoxic and nonirritant, commonly used in oral, topical, and even parenteral formulations[2]
Sodium Ascorbate	Intravenous: 1-2% Oral: 0.3-0.4%	Freely soluble in water, poorly soluble in ethyl alcohol[2]	Unstable at pH greater than 6[2]	Darkens on exposure to light, avoid exposure to heat[2]	Commonly used as a source of vitamin C in tablets and parenteral preparations The WHO has set an acceptable daily intake of sodium ascorbate as an antioxidant in food at up to 15mg/kg in addition to that naturally present in food[2]
Sodium Metabisulfite	Epidural: 0.05% Intramuscular: 0.6% Intravenous: 0.03-0.6% Iontophoresis: 0.05% Ophthalmic: 0.1-0.2% Oral: 0.01-0.2% Inhalation: 0.3% Topical: 0.1-0.3%	Freely soluble in water and glycerin, slightly soluble in ethyl alcohol[2]	Use as an antioxidant at acidic pH, solutions of sodium metabisulfite are pH 3.5-5[2]	Unstable when exposed to heat and air, autoclave sterilization is possible if air is removed prior to heating[2]	Dextrose decreases the stability of aqueous sodium metabisulfite solutions Used extensively in a variety of preparations, there have been rare hypersensitivity type reactions to sulfite antioxidants reported The WHO has set an acceptable daily intake of sodium metabisulfite and other sulfites at up to 7mg/kg calculated as sulfur dioxide[2]
Sodium Bisulfite	Otic: 0.08% Ophthalmic: 0.06-0.1%	Freely soluble in water and glycerin, some solubility in ethyl alcohol[2]	Sodium bisulfite is typically used as an antioxidant around intermediate/neutral pH, higher than that of sodium	Unstable when exposed to heat and air[2]	The WHO has set an acceptable daily intake of sodium metabisulfite and other sulfites at up to 7mg/kg calculated as sulfur dioxide[2]

	Intra-articular: 0.32% Intramuscular: 0.66% Intravenous: 0.05% Inhalation: 0.3% Oral: 0.05%		metabisulfite, which is typically used at acidic pH[2]		

Sources:

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