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File: ■ Antioxidants
■ Food
■ Oxidative Stress

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RE: Antioxidant Content of Foods, Beverages, Spices, Herbs, and Supplements

Carlsen MH, Halvorsen BL, Holte K, et. al. The total antioxidant content of more than 3100 foods, beverages, spices, herbs and supplements used worldwide. *Nutr J.* 2010;9:3. doi:10.1186/1475-2891-9-3. Available online at: http://www.nutritionj.com/content/9/1/3.

The authors, noting that a plant-based diet protects against oxidative stress-related illnesses, and that much nutritional research is concerned with antioxidant (AO) intake, assayed over 3100 foods for total AO content, and launched an online database for this information.

The Antioxidant Food Table gives each food and food product's country of origin, brand name, and processing or harvesting information where relevant. Berries, fruits, and vegetables tested were fresh samples, unless otherwise noted. The table includes plant-, animal-derived, and mixed-origin foods. Each is assigned to only one of 24 food categories.

Results show several thousand-fold differences in foods' AO content. The categories of spices and herbs, and dietary supplements, had foods with the highest AOs. Berries, fruits, nuts, chocolate, vegetables, and items made from them, also had high AOs.

Merely knowing the AO content of a food is of little use in analyzing diet in oxidative stress-related conditions. There is no demonstrated one-to-one correlation between AO intake and subsequent AO activity in target cells. Bioactive food components interact in many ways, and bioavailability is affected by many factors. Rather than focusing on one dietary component, the authors suggest, researchers may profitably focus on total food intake; in such efforts, a consistent table of AO food values would be very useful.

Each food category had foods with almost no AO content. Plant-based foods in general had higher AO values than those from animals or mixed sources, a mean content 5 to 33 times higher for plant foods. However, the high mean value of plants is mainly due to a few products with very high values among the plant medicines, spices, and herbs.

Among beverages, unprocessed tea (*Camellia sinensis*) leaves, tea powders, and coffee (*Coffea* spp.) beans had the highest AO content. Coffee products' values varied greatly, from 0.89 mmol/100 g to 16.33 mmol/100 g. Red wine (from grapes [*Vitis* spp.]), pomegranate (*Punica granatum*) juice, prepared green tea, grape juice, prune (*Prunus domestica*) juice, and black tea each gave medium AO results. Beer, soft drinks, and ginger ale (this beverage

generally contains negligible amounts of ginger [*Zingiber officinale*]) had the least AOs of beverages assayed; drinking water has none. In a separate category of infant foods and beverages, human breast milk had a mean content of 2.0 mmol/100 g, quite a bit higher than the content in prepared infant foods.

Among breakfast cereals, grains, legumes, and nuts and seeds, buckwheat (*Polygonum fagopyrum*), millet (*Setaria macrochaeta*), and barley (*Hordeum vulgare*) flours had the highest AO levels. Crisp bread and whole meal bread with fiber were the grain products with the highest. Beans (*Phaseolus vulgaris*) had modest AOs, from 0.1-1.97 mmol/100 g.

The authors refer repeatedly to nuts having more AOs with their "pellicles" intact; a pellicle is the thin outer coating of the nutmeat. According to the authors, "walnuts, with pellicle and purchased with...shell intact" had the most AO content of this category, at 33.3 mmol/100 g, dwarfing that of poppy (*Papaver somniferum*) seeds, with 0.03 mmol/100 g. As previous studies have found, chocolate products' AO content rises with cocoa (*Theobroma cacao*) content.

Dairy products were generally low in AOs, ranging from 0.0 to 0.8 mmol/100 g. Eggs have little AO value, although egg yolks have 0.16 mmol/100 g. Among fats and oils, margarine, butter, canola (*Brassica napus*) oil, corn (*Zea mays*) oil, and soybean (*Glycine max*) oil had the most AOs of foods assayed. Meats, poultry, and fish generally had low AO content, but some products, such as liver, bacon, and some prepared meat products had content ranging from 0.5-1.0 mmol/100 g.

Of 119 berries and berry products, averaging very high AO content, 13 were especially high, including dried *amla* (*Phyllanthus emblica* syn. *Emblica officinalis*), at 261.5 mmol/100 g; wild dried dog rose (*Rosa canina*) and dog rose products, ranging from 20.8-78.1 mmol/100 g; and dried wild bilberries (*Vaccinium myrtillus*), at 48.3 mmol/100 g. Among vegetables, AO content varied from a low of 0.02 mmol/100 g for blanched celery (*Apium* spp.) to a high of 48.1 mmol/100 g in crushed African baobab tree (*Adansonia digitata*) leaves. The highest value among fruits was 55.5 mmol/100 g for the pith of Spanish pomegranate. Dried fruits often showed higher AO content than those assayed fresh.

Among herbal and traditional medicines, half of all products assayed had AO values higher than the 90th percentile of all products in the Antioxidant Food Table. Dragon's blood croton (*sangre de drago*; *Croton lechleri*) had the highest value of any substance assayed, at 2897.1 mmol/100 g. Among spices and herbs, cloves (*Syzygium aromaticum*) had the highest AO content, at 465 mmol/100 g, with peppermint (*Mentha* x *piperita*), allspice (*Pimenta dioica*), and cinnamon (*Cinnamomum* spp.), all dried and powdered, with high values also. Like fruits, dried herbs had mostly higher values than fresh samples.

—Mariann Garner-Wizard

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