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Quantification of Dietary Antioxidant Capacity for Better Nutritional Guidance

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Normal human metabolism involves the production of what are known as free radicals, which are highly reactive and unstable chemicals. Free radicals can be atoms, ions or molecules with unpaired electrons; thus, they either lose or gain electrons to make all electrons in the atom or molecule paired. Free radicals have different nitrogen, oxygen and chloride species; such as (but not limited to) hydrogen peroxide, nitric oxide, peroxynitrite, singlet oxygen, and superoxide. These radicals can start chain reactions with some components of the cell and cause a variety of cellular damage. Mechanisms of the development of many chronic diseases; such as cancer, cardiovascular, neurodegenerative, as well as aging implicate free radicals. Usually, the body is able to combat the adverse effects of free radicals, with mechanisms that involve what are known as antioxidants. These antioxidants are chemical compounds that can donate electrons which neutralize free radicals without forming others – thus, terminating their chain reactions. Because of this ability, antioxidants are recognized as free radical scavengers.

Dietary antioxidants can be known micronutrients, such as vitamins A, C, and E and others that are non-nutrient classified compounds of plant origin known as phytochemicals. Certain plant-based food items and common beverages contain a variety of phytochemical compounds, such as (among many): alkaloids, carotenoids, flavonoids, isoflavones, organosulfides, lutein, lycopene, polyphenols and zeaxanthin. Modern analytical methods are utilized in the discovery of more compounds that have antioxidant capacity. The roles of known vitamins as antioxidants and of some known phytochemicals have been elucidated. As antioxidants have beneficial effects on health, consumed plants and others that contain phytochemicals are known as functional foods. Mechanisms by which antioxidants can provide protection against chronic diseases have been postulated [1].

Clinical trials that involve supplementation of known antioxidant vitamins were not many and yielded inconclusive results; i.e., did not provide strong evidence [2]. Thus, a common consensus was reached which entails that prescribing such antioxidant vitamins, either singly or in combinations, for protection from chronic diseases would not be recommended. Meanwhile, current recommendations are to rely on dietary antioxidants, which derive mostly from plant-based food items and beverages. Thus, types of diets that typically entail consumption of large amounts of fruits and vegetables, such the Mediterranean [2] and Brazilian [1] diets are considered beneficial to general health because of the variety of antioxidants that they provide.

Antioxidant research became accelerated in the last two decades and was stimulated by the development of a method for determining the total antioxidant capacity (TAC) in dietary items about 16 years ago [3, 4]. In this method, a synthetic hydro-soluble vitamin E analogue (trolox) is used as a standard and results are expressed in mmol of torlox-equivalent (TE) per 100 g of food or mmol per 100 ml of a drink. When TAC is determined for any food item or drink, such can be referenced to a known standard of its serving or portion size.

Data of TAC for many commonly-consumed food items and beverages were reported [1]. While the TAC values for a specific item can vary among different studies, there seems to be some food items and drinks that provide higher TAC's than others. Among all nuts, Brazil nuts provide the highest TAC value. Among the fruits, apples have the highest TAC value; followed by bananas, oranges, lemons, watermelon, and papaya. Meanwhile; commonly-consumed vegetables provide moderate levels of TAC values - with green collards, red beets, cooked beans, onion, tomato, and carrots being among the highest. As a vegetable, garlic has been extensively-studied and its benefits to health were elucidated [5]. Among beverages, espresso coffee has the highest TAC value per 100 ml, with boiled coffee slightly lower and grape juice providing a very modest amount of antioxidant capacity. Among other food items, dark chocolates provide a high TAC value and such depends on the percentage of cocoa included in their overall ingredients.

The accumulation of information on TAC of as many as food and drink items is undoubtedly valuable; however, there still a need to implement such data and translate them into practice. Firstly, a value that can be considered collective in the daily diet of humans (as a dose) ought to be established. Naturally, such an "optimum dose" would be variable and according to requirements based on the physiological states of the different segments of society. Cohort clinical studies are needed to be carried out with different levels of dietary TAC values to assess their impact on prevention or reduction of the severity of chronic disease. Also, these trials need to quantify what can be considered as therapeutic daily doses of antioxidants for the reduction of different chronic diseases. Meanwhile, until such clinical trials are conducted and their outcomes become known, reliance on dietary antioxidants would be the best available advice. Nutritional guidelines and recommendations are to be followed for preservation of health, while taking into account expert views [6]. The TAC's of dietary items can be calculated in a collective fashion for daily intakes and ought to be incorporated into existing nutritional guidelines, for the general health and well-being of all. This translates to promoting diets that are characterized by high consumption of fruits and vegetables worldwide.

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