

Significance of the Concept of Total Dietary Antioxidant Capacity for Health

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Free radicals are highly reactive chemicals that arise normally in intermediary metabolic processes. They are atoms, ions or molecules that contain unpaired electrons; thus, they are usually unstable and move toward losing or gaining an extra electron so that all electrons in the atom or molecule will be paired. Free radicals can be formed when oxygen interacts with certain molecules in the body, such as (but not limited to) singlet oxygen (O_2^-), superoxide (O_2^-), hydrogen peroxide (H_2O_2), nitric oxide (NO^-) and peroxyxynitrite ($OONO^-$). When free radicals are produced, they start chain reactions with cellular components such as DNA or cell membrane that can cause a variety of cellular dysfunction. Free radicals have been implicated in many chronic diseases; such as cancer, cardiovascular, neurodegenerative and in aging. Normally, the body has mechanisms that can combat the adverse effects of free radicals and reduce the magnitude of damage they can produce. Such defense mechanisms involve what are known as antioxidants.

Antioxidants are chemicals that have the ability to donate electrons which neutralize free radicals without forming others by terminating their chain reactions. Therefore, antioxidants became recognized as free radical scavengers. These compounds include known micronutrients, such as vitamin A, vitamin C and vitamin E - as well as other non-nutrient compounds of plant origin that are known as phytochemicals. Certain plants that are food items contain a variety of phytochemical compounds, such as (among many): alkaloids, carotenoids, flavonoids, isoflavones, organosulfides, lutein, lycopene, polyphenols and zeaxanthin. While the antioxidant roles that such vitamins play have been established, research has also shown that some known phytochemicals provide beneficial effects on health. Thus, consumed plants and others that contain these phytochemicals became known as functional foods. Many commonly-consumed food items contain such vitamins and phytochemicals, thus, emphasizing the factor of diet and its influence on general health. Clinical trials that involved supplementation with antioxidant vitamins (either singly or in combinations) in relation to cardiovascular and other chronic diseases did not produce a solid evidence of their benefits. Thus, the prevalent current nutritional and medical recommendation is to rely mainly on dietary aspects for protection and/or alleviation of health problems.

Research in the area of phytochemicals is very active and many of these compounds are being discovered. This involves identification of such compounds, testing them and assessing their ability for being antioxidants. Luckily, some or most of the known phytochemicals are responsible for the colors of many fruits and vegetables. With nutritional recommendations are to consume 5-8 servings of fruits and vegetables daily, the advice is also to vary the colors of these servings - to derive the most benefits from the phytochemicals they contain. Awareness and promotional campaigns to the public were developed to emphasize this aspect, such as "eat your colors" and "5-A-Day" programs - among others that are in different regions of the world. The literature on the benefit of consuming many food items that belong to the fruits and vegetables group is vast. Individual studies involved the health benefits of inclusion of green and colored vegetables, fruits of a variety of colors and nuts; however, without taking the overall antioxidant picture into account. Many epidemiological studies have shown that the lower incidence of cancer and cardiovascular disease were associated with diets that are high in fruits and vegetables. An example of such is the Mediterranean-type diet. Thus, current sound nutritional advice is to rely on dietary aspects for securing adequate amounts of antioxidants. However, such an advice is considered as a qualitative and a practical approach.

The concept of total antioxidant capacity (TAC) was developed nearly 15 years ago. Analytical techniques were devised to determine the TAC of many fruits, vegetables, nuts, coffee, tea and chocolate. Such methodology involves the proper preparation of the food item to

be tested and TAC to be determined by spectrophotometry. Briefly, a synthetic hydro-soluble vitamin E analogue (trolox) is used as a standard and results are expressed as *mmol* of trolox-equivalent (TE) per 100g of food or *mmol* per 100 ml of a drink. When TAC is determined for any food item, such can be expressed as a value for known standard serving or portion size - i.e., can be referenced. Ongoing research on this front is very active, with additional data being revealed on the TAC of more food items and drinks. The TAC of studied food and drinks showed that different foods and drinks vary in their antioxidant power. Thus, the available methodology for the determination of TAC provides the quantitative aspect of dietary antioxidants.

As the significant roles that dietary antioxidants play have been recognized and nutritional recommendations have been made on a qualitative basis, the time has come to rely on making such recommendations on quantitative basis. Dietary patterns among different regions and populations vary; thus, the antioxidant contents of such diets are expected to be also variable. While continued research efforts in this field are directed towards identification of more dietary antioxidants and elucidating their individual abilities and mechanisms to combat free radicals, clinical trials that involve the effect of the total dietary content of antioxidants on general health are needed. The concept of TAC is of significance in designing and conducting of such clinical trials, as the quantitative aspects of the dietary antioxidants and health outcomes are scientifically and medically available. Concerned trials ought to take all aspects of nutrition, including antioxidants, and prevalent lifestyle of the studied populations - i.e., in a collective manner. Data of such clinical trials can help all concerned to provide the public with accurate and quantifiable information on antioxidant intake. This implies nutritional guidance in the form of specified serving of a food item or drink and the antioxidant capacity of the total items being consumed. In the midst of the herein exploration of dietary antioxidants, one should never overlook following a healthy dietary pattern and lead an active lifestyle. Intense physical activity could increase the production of free radicals; thus, the recommended total dietary antioxidant content for active individuals may need to be increased accordingly. However, there is always the caution for not consuming mega doses of antioxidants as a habit - for optimum protection and general health outcomes.

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