

Antioxidant Nutrients: Beneficial or Harmful

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Summary

The paper review various agents that inhibit oxidation, any of numerous chemical substances, including certain natural body products and nutrient that can neutralize the oxidant effect of free radicals and other substances. Ageing and a variety of age-related conditions may be linked to oxidation processes resulting from an excess of reactive molecules. Many compounds in food have antioxidant properties by interacting with the reactive molecules. Antioxidants from food include both vitamins and minerals such as Vitamin C, E and beta-carotene, also some element such as selenium and other compounds found in plant foods such as polyphenols and flavonoids. A diet with a high content and wide variety appears to offer some health advantage. While taken a narrow range of antioxidant supplements may be ill-advised when they are of unproven efficacy and of possible harm. Regularly eating of a wide variety of plant food is better than relying on a few antioxidant supplements.

Introduction

In the body, certain molecules called reactive oxygen species (ROS) and reactive nitrogen species (RNS) are normally produced as part of the defence system and as the by-products of cellular metabolic processes-utilizing oxygen¹. These reactive species include free radicals or certain molecules which may be oxidizing agent or convertible to free radicals.

Many factors can cause the body to produce more reactive species than are needed. These include smoking, drinking, alcohol, too much fat in the diet, too much sun exposure, too many pollutants in the air and even too much exercise. Antioxidants are substances that reduce oxidation and so counteract the reactive species. If ROS or RNS outnumber the antioxidant stores in the body, they can inactivate enzymes oxidize lipids and damage genetic materials (DNA). These processes have been linked to aging and a variety of age-related conditions, including heart disease and cancer.

There are many compounds with so-called antioxidant properties that are derived from food (Table 1). However, a food or food, with antioxidant potential may or may not realize that potential *in vivo* for various reasons.

Naturally-occurring antioxidant vitamins include carotenoids (which may also be pro-vitamin A), the vitamin E family of compounds (tocopherols and tocotrienols) and vitamin C. Some elements found in the diet exert their *in vivo* antioxidant effects as metallo-enzymes such as selenium (as part of glutathione peroxidase. Some compounds found in fruits and vegetables that may promote health (phytochemicals) are powerful antioxidants. Based on this fact, the paper aims at the benefits and/or harmful effects of antioxidant nutrients.

Table 1: Antioxidant Components in Food

Components	Compounds	Food sources
Vitamins	Vitamin C (ascorbic acid)	Citrus fruit, berries, papaya
	Vitamin E (tocopherol and tocotrienols)	Seed-like cereal grains, nuts and oils derived from plants
	Beta carotene and other carotenoids	Orange pigmented, and green leafy vegetable
Elements	Copper (as part of superoxide dismutases)	Cocoa, wheat bran, yeast
	Selenium (as part of glutathione peroxidase)	Grains, meats.
Macronutrient derived	Peptides e.g. glutathione	Whey protein
Phytochemicals (food components of plant origin)	Isoflavone e.g. genistein and daidzen	Soy
	Flavonols e.g. quercetin and kaempferol.	Tea, red wine, onions, apples.
	Polyphenols e.g. rosmarinic acid	herbs, oregano, thyme.
	Catechins e.g. epigallocatechin gallate	green tea, meats
Zoochemicals (food components of animal origin)	Ubiquinone (coenzyme Q ₁₀)	Meats especially meat organs, fish

Do antioxidants delay ageing or prevent age-related diseases

One of the major theories about biological ageing is that it depends on oxidation processes. For this reason, there is great interest in the antioxidant capacity of the human diet and of nutrient supplements. So far most evidence suggests that plant-derived food is protective against age-related diseases like cardiovascular disease and cancer, rather than ageing itself.

Many epidemiological studies have linked diets containing moderate to high populations of fruits and vegetables to lower mortality and to a reduced risk of developing cardiovascular disease, cancers, cataracts and macular degeneration, cognitive impairment and Alzheimer's disease.²⁻⁵ Although clear cause and effect relationships are difficult to establish, these protective effects are probably due to combinations of

nutrients and also to the non-nutritive substances found in these foods. In cohort studies, a survival advantage can be predicted if the diet contains a variety of food, principally from plant sources.⁶

Can we get enough antioxidant nutrients from food

Any factors such as excessive dietary, fat intake, smoking or alcohol consumption, leading to an increase in oxidation, could increase the requirement for antioxidant nutrient above that usually obtainable from food.

An advantage in getting antioxidants from food is that there are literally thousands of different antioxidants in the human diet⁷ and they are numerous in chemical types (Table 1). They may therefore act in integrated systems or cascades in which antioxidants may free radicals within the biological system to safer destinations. For example ROS or RNS may be dissipated from lipid soluble environment without lipid peroxide formation, to a water soluble environment through the availability of in sequence, Ubiquinone (coenzyme Q₁₀) Vitamin E and Vitamin C. Upon oxidation, these micronutrients need to be regenerated in the biological setting, hence the need for further coupling to other reducing systems such as glutathione/glutathione disulfide, dihydrolipoate/lipoate, or NADPH/NADP⁺ and NADH/NAD⁺. No one antioxidant can achieve this outcome alone.

Some actually work better when co-ingested in a group of antioxidant. The mix of antioxidants may also facilitate absorption. An example of this is the enhancement of lycopene absorption after taking a combination of beta-carotene and lycopene^{8,9}

People eating a good diet that included breads and cereals, vegetables and fruits, meat or meat substitutes and dairy products do not require vitamin and mineral supplements. These foods, whether fresh or processed provide a balanced source of vitamins and minerals¹⁰. There is, however, a question as to whether this statement is valid. This is not because the Nigeria diet cannot provide enough antioxidant nutrient, but rather whether or not it provides the range and amounts of these nutrients required for optimal health given the current food choices by some groups.

Antioxidant nutrient supplements

Many believe that if enough of an essential nutrient is good, then more is better. However, when large amounts of antioxidant nutrients are taken, they can also act as pro-oxidants by inducing oxidative stress^{11,12}. Further more pro-oxidant activity can induce either beneficial or harmful effects in biologic system¹².

From available evidence, we cannot yet answer the question as to whether micronutrient supplements actually improve health or decrease risk of disease where food cannot^{13,14}. In addition, whilst there are areas of health promise for some antioxidants presently available, there are conflicting data in relation to their adverse effects. For example, favourable effects of Vitamin E have been observed in relation to Alzheimer's disease and prostate cancer, but the use of high doses of vitamin E is also associated with increased risk of mortality from some cancers, possibly fatal as opposed to non fatal myocardial infarction, and haemorrhagic stroke¹⁵. Beta-carotene supplements, whether on account of the isomers used or because they have been used in isolation, have increased the incidence of tumours; they should no longer be used¹⁶. Another area of

concern about supplements is how much suppression of oxidation may be compatible with good health as toxic free radicals are required for defence mechanisms.

High intakes of antioxidant nutrients from food sources appear to offer some health advantages. In addition, a diet high in fruit and vegetable often means a lower intake of fat and a higher intake of fibre, which may also protect against many diseases. Vitamin and mineral supplements do not necessarily make up for poor food habits or unhealthy lifestyle practices¹⁰. It is advisable to eat a wide variety of cereals, fruits and vegetables in reasonable amount rather than rely on supplementation with a few antioxidants.

Claims that antioxidants supplements have therapeutic benefits are scientifically unjustified at present. Antioxidants activity determined *in vitro* may not be relevant *in vivo*, antioxidant nutrients have many functions, and may act through other mechanisms rather than as antioxidants. Prevention of disease through dietary supplementation may be a worthwhile objective, but dose response data are required to evaluate pharmacologic and toxicologic effects. The promotion of antioxidants as therapeutic agents is inappropriate when their efficacy is unproven and their toxicology uncertain. It is much more realistic to envisage claims that a wide variety of plant derived food might be protective against excess oxidant activity whilst retaining the required level of such activity for defence against infection.

Conclusion

Basic food condiments like herbs and spices are extensive sources of antioxidants. The benefits of antioxidants may depend on their variety and interaction. We know that we can optimize health by encouraging the consumption of a wide variety of nutritious foods, but we cannot, so far, be such about the risks and benefits of taking antioxidants supplements.

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