VITAMIN E AS AN ANTI-OXIDANT SUPPLEMENT: A Double-Edged Sword?

Aparajita Neogi , R.S. Chandan*, Soumyadip Sannigrahi, Vedant Kulkarni

Department of Pharmaceutical Chemistry, JSS College of Pharmacy, JSS Academy of Higher Education and Research, Mysore, Karnataka,
India-570015

Corresponding author – R. S. Chandan
Email : rschandan@jssuni.edu.in
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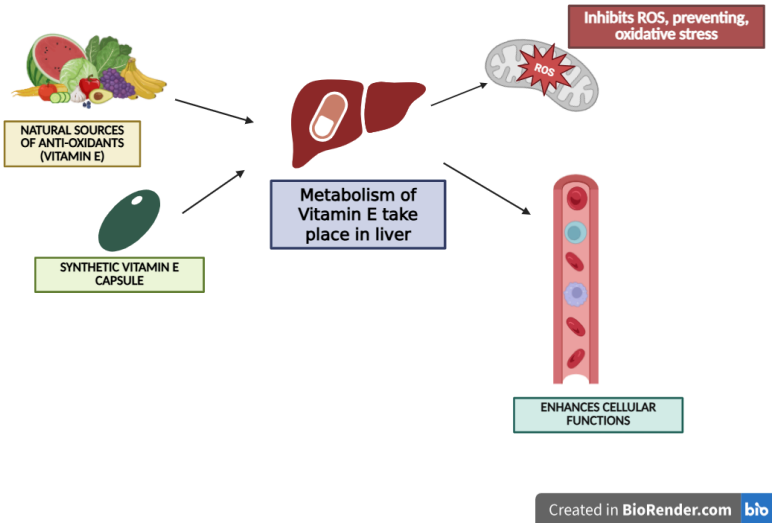
Abstract
There has been an increase in demand for health supplements in the recent years, with the increase in desire of higher quality of life. The daily nutrient consumption has been compromised in the rush, forcing individuals to directly get the required vitamins and other essential nutrients as supplements obtained naturally or semi-synthetically. This article summarises the pros and cons of the higher intake of one such supplement available in the market at large, Vitamin E. According to basic knowledge, excess intake of any nutrient can be as dangerous as their deficiency in the body. Hence, it is needed to keep in mind the way Vitamin E acts as an anti-oxidant and how it's greater or lesser intake can affect human health.

Keywords: Essential Nutrients, Deficiency,anti-oxidant

1. Introduction

1.1. Anti-oxidants: -

Antioxidants are the compounds with higher demands due to their multi-effect in the case of anti-aging or anti-inflammatory action. In current days it has vast use either in the field of pharma or food technology. Reactive oxygen species (ROS)are produced due to oxidation reaction in microorganisms.[1] This ROS will lead to destroy the biological macromolecules, includes DNA, RNA, lipid and protein which lead to cause various diseases. Antioxidants are potent compound which prevent oxidation, aiding in prevention of various diseases. Anti-oxidant rich foods to be considered are blueberries, raspberries, strawberries, walnuts, spinach, cinnamon etc. Antioxidants have high demands due to risk of aging, as, aging is also an important risk factor of many chronic diseases.[2]



Liver is the main organ in our body with more vulnerability to reactive oxygen species (ROS) attack, such as, Hydroxyl radical(-OH), Alkoxy radical, hydrogen peroxide, perhydroxyl radical. The cells present in liver like Kupffer cells, hepatic stellate cells and endothelial cells are more potent to the oxidative stress leading to liver disease while triggering hepatic damage as well, which may also cause kidney failure.[3] Antioxidants can be further divided into 3 types, depending upon the mechanism of action: –1) Primary oxidants which are essential to terminate free radical, (2) Secondary antioxidants will function in chain initiation process and (3) Tertiary antioxidants will help in the preventive action as well also .[4]

2.2 Vitamin E as an anti-oxidant: -

Vitamin E, as a potent fat-soluble anti-oxidant has proven to protect cells from damage caused by free radical scavenging, thus, preventing cancer in many cases.[5] Various studies provide evidence on the major role that vitamin E plays in the prevention of formation of blood clots, preventing heart attack, as, higher intake of vitamin E rich food has shown to decrease the mortality rate from coronary heart disease. Due to its potential benefits, there has been an upsurge in the intake of Vitamin E supplements in current days and has proven to greatly increase overall health outcomes .[6]

The vitamin E group is further categorised into sub groups namely; α-Tocopherol (αT), γ-tocopherol (γT), δ-tocopherol, and γ-tocotrienol, with each having distinct antioxidant and anti-inflammatory characteristics. The αT form is less potent than the other forms, which acts by neutralising reactive nitrogen molecules, blocks cyclooxygenase- and 5-lipoxygenase-catalysed eicosanoids, and reduces proinflammatory signals such as NF-κB and STAT3/ 6.[7] As per research, Vitamin E may significantly minimise cardiovascular risk by bringing down lipoprotein oxidation and facilitating endothelial function. Furthermore, it has proven to play an important role in neuroprotection, immunological regulation, and the treatment of chronic disorders like diabetes and arthritis, owning to their antioxidant and anti-inflammatory characteristics, thus, contributing to cellular health and function.[8]

Several dietary ingredients contain vitamin E, predominantly, seeds, fruits and green leafy vegetables. Tocopherols and tocotrienols are easily isolated, distilled, and refined from vegetable oils and other superior plant materials, due to the fact that vitamin E can only be synthesised by plants and photosynthetic organisms.[9] It can also be found in dietary supplements, wherein, most of them have significantly higher levels of vitamin E than in daily meal intake. Vitamin E in nutritional supplements and fortified meals is frequently esterified to extend its shelf life while maintaining its antioxidant capabilities.[10]

Vitamin E is widely used in pharmaceutical, culinary, and cosmetic industries, with an annual production of over 35,000 tonnes globally. The most important industrial product is all-racemic-α-tocopherol (RRR), which is an equimolar mixture of all eight stereoisomers and can be produced using semi-synthesis. Vegetable oils, containing combinations of RRR-tocopherols, are refined on a massive scale and isolated using various separation processes.[11]

2. *Evaluating impact of Vitamin E on human health: -*

As mentioned above, the active form of Vitamin E, α-tocopherol, majorly shields cells from damage caused by free radicals and oxidative stress. Vitamin E is a commonly accessible dietary supplement for general health and wellness for immune support and cellular integrity, due to its antioxidant qualities. On the other hand, excessive supplementation may cause negative effects by upsetting the body's redox balance.[12] Excessive consumption of vitamin E may cause it to lose its antioxidant properties and start functioning as a pro-oxidant [13], which would increase oxidative stress instead of decreasing it. Important physiological processes like signalling, cellular repair, and immunological regulation may be

hampered by this.[14] The accessibility of commercially advertised formulations adds to the pervasive problem of self-medication. [15] This increases the possibility of harm from unmonitored dose. Excessive vitamin E intake, especially above 400 IU/day, has been linked to higher risks of cardiovascular problems, Bladder cancer, haemorrhagic stroke, and death [16]

The anti-vitamin K action of vitamin E, which inhibits platelet aggregation and clotting factors like factor IX, is one of the main reasons. These side effects are more harmful when taken with anticoagulant medications like aspirin or warfarin [17].

High serum levels of vitamin E have also been linked in studies to a higher risk of both mild and major bleeding episodes in individuals receiving anticoagulant medication. Furthermore, too much vitamin E hinders the absorption of other fat-soluble vitamins, such as vitamin K and D, which may jeopardize calcium homeostasis and bone mineralization.[18]

Excessive vitamin E intake can also interfere with the action of the cytochrome P450 enzyme, changing how drugs are metabolized and increasing the vulnerability of cells to pro-carcinogenic substances.[19] Vitamin E intake was associated in the SELECT experiment with a 17% increased risk of prostate cancer, possibly, as a result of increased cell proliferation during the early stages of carcinogenesis [20]. Additionally, vitamin E has been demonstrated to decrease glutathione S-transferase activity and increase DNA damage, which hinders detoxification and increases cellular stress [21].

These results highlight the intricacy of vitamin E pharmacology, particularly when considering supplements that go beyond dietary requirements.

As a fat-soluble antioxidant, vitamin E is essential for preserving general health. Its antioxidant properties are one of its key advantages; by scavenging dangerous free radicals, it shields cells from oxidative stress, boosting immunity and preserving cellular integrity [22]. Topical vitamin E administration has demonstrated potential advantages in the treatment of skin disorders such as rosacea and eczema. It promotes wound healing, hydrates parched skin, and lessens inflammation. Furthermore, because of its anti-inflammatory qualities, which can lessen joint inflammation and ease pain, vitamin E may help manage arthritis.

But even with its advantages, vitamin E has some significant drawbacks, particularly when taken in large quantities. According to some research, 400 IU or more of vitamin E per day may raise the risk of death from all causes [23]. Additionally, consuming too much can harm renal function, especially in people who already have kidney disease. Large-scale randomized controlled trials and meta-analyses have produced conflicting results about the efficacy of vitamin E supplementation, despite encouraging results from in vitro and animal research [24]. As a result, although while vitamin E has a number of health benefits, it should be used with caution, especially when taking larger dosages.

3. Conclusion: -

The article brings into light, the concern of self-medication and its effects on human health associated with the same, with respect to administration of dietary supplements such as Vitamin E. Vitamin E, as an anti-oxidant, is a potent nutrient which prevents various disorders, enhances overall human health and immunity. However, when taken in quantities and dose frequencies above the therapeutic index, it may lead to the opposite effect rather than the desired effect. To put it simply, the main preventive action of Vitamin E as anti-oxidant is to prevent oxidative stress by inhibiting reactive oxidative species, however, excess intake of the same might lead to increased stress and decline the bodily cellular functions, thereby, impacting regular day to day activities. This article, therefore, summarises both the advantages and disadvantages, including the safety profile, in case of consumption of these commercially available Vitamin supplements. Last but not the least, it is emphasised that excess of any nutrient, however beneficial that might be, can cause an opposite or adverse effect.

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