IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, October 2024

Exploring the Vital Role of Vitamins in Disease Prevention and Health Maintenance

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Abstract: *The human body relies on vitamins to carry out fundamental functions, yet it is unable to produce them on its own. Certain nutrients, like phytochemicals, are considered essential as the body cannot produce them in sufficient quantities. While ideally vitamins are obtained through a healthy diet, supplements are often necessary. Vitamins are crucial for growth, metabolism, and overall health, with vitamin D being the only one the body can produce. Vitamers, related molecules with similar vitamin activity, make up the bulk of vitamins. Vitamin C is a potent antioxidant drug used in dermatology to treat photoageing and hyperpigmentation. L-ascorbic acid is the active form, with limited oral absorption, making topical application more effective. Its electron-donating ability is crucial for various physiological processes, and its deficiency can lead to scurvy. Vitamin E (tocopherols and tocotrienols) has demonstrated significant biological effects on enhancing human health and play a promising role in food systems Supplementation of α-tocopherol up to 0.2% in oils provides higher oxidative stability, making vitamin E a valuable functional ingredient for food preservation and nutritional quality enhancement.This study investigates the roles of vitamins C and E in disease prevention and management, highlighting their antioxidant properties and physiological functions. Both vitamins are crucial for neutralizing free radicals, thereby reducing oxidative stress linked to various diseases, including cardiovascular conditions, cancer, and neurodegenerative disorders. Vitamin C supports immune function and collagen synthesis, while Vitamin E contributes to cellular integrity and skin health. The research underscores the synergistic effects of these vitamins, which enhance each other's antioxidant capabilities and may improve overall health outcomes. By addressing their roles in disease processes, the study emphasizes the importance of adequate vitamin intake for promoting health and preventing illness.*

Keywords: Vitamins, Supplementation, Healthy Diet, Deficiency, Daily Requirement, Biological Importance, Role in Diseases, Benefits, Adverse Effect, Interactions

I. INTRODUCTION

The human body is unable to produce the wide range of chemical compounds known as vitamins, yet it nevertheless needs them in order for its fundamental functions to be carried out. Certain nutrients, such as a number of advantageous phytochemicals, are considered essential since the human body (or other organism) is unable to produce them wholly or in sufficient quantities. As a result, these nutrients must be obtained from food. In an ideal world, we could obtain all the vitamins we need from food and a healthy diet, but in many cases, this isn't the case, therefore we need to take supplements.(VY-tuh-min) A nutrient that the body requires in trace levels in order to maintain health and function. Vitamins are essential for growth and healthy operation of the organism, as well as for metabolism. Only vitamin D is produced by the body; the other vitamins must be obtained through diet. Groups of related molecules called vitamers make up the bulk of vitamins.

Vitamers are chemically similar substances that have a qualitatively similar vitamin activity. The term ‘vitamers’ refers to any number of organic compounds with a similar molecular structure that share a vitamin function.[1]

DOI: 10.48175/IJARSCT-19974

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Types of Vitamins

There are several vitamins, including vitamin B6, vitamin B5 (Pantothenic acid), vitamin B1 (thiamin), vitamin B3 (niacin), vitamin B2 (riboflavin), vitamin A, vitamin C (ascorbic acid), vitamin D, vitamin E, and vitamin B12 (cobalamin). Flavonoids are also included in the vitamin P mix.

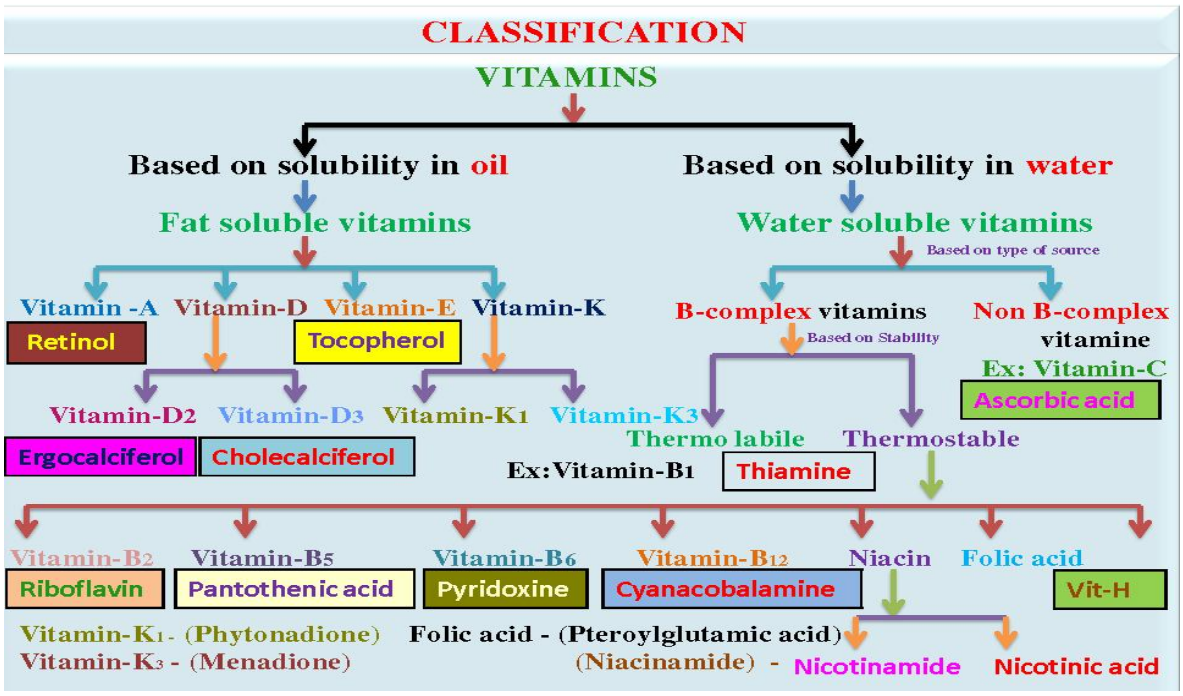

Fig 1 Classification of vitamins.

Classification of Vitamins

Regarding vitamin categorization, there are two primary categories: Water soluble and Fat soluble vitamins.

Vitamins of B complex and C are water soluble whereas, vitamin A, D, E, and K are fat soluble. Fat soluble vitamins have association with fats and absorb with dietary fats. Absorption of fat soluble vitamins follow the same mechanics as for absorption of fats. Water soluble vitamins are not associated with fats and rendered unaffected by alterations in fat absorption

Water Soluble Vitamins:

Water soluble vitamins are vitamin B1, B2, B3, B5, B6, B9, B12, Biotin and Vitamin C (Figure 1). Basic information, biological importance, daily required amount and dietary sources for these vitamins are described subsequently

Vitamin-B1 (Thiamin)

Introduction:

Thiamine, also known as thiamin and vitamin B1, is a vitamin, an essential micronutrient for humans and animals. It is found in food and commercially synthesized to be a dietary supplement or medication. Phosphorylated forms of thiamine are required for some metabolic reactions, including the breakdown of glucose and amino acids.[2]

Biological importance:

Thiamine

B1 vitamins help the body convert food (carbohydrates) into fuel (glucose), which the body uses to produce energy. These B vitamins, often referred to as B-complex vitamins, also help the body metabolize fats and protein. B-complex vitamins are needed for a healthy liver, skin, hair, and eyes. They also help the nervous system function properly and are needed for good brain function.[3]

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Daily requirement:

Daily intake requirement For females is 1 milligram whereas for males it is 1.2 Milligram.[3]

Deficiency:

Wet beriberi, affecting the cardiovascular system, dry beriberi, affecting the nerves, Wernicke-Korsakoff syndrome (WKS), which changes gait, mental status, vision and eye health, loss of appetite, irritability, difficulties with short-term memory, feelings of vertigo, double vision, memory loss, confusion or symptoms of confabulation.[4]

Vitamin B2 (riboflavin)

Introduction:

B2 is a water-soluble vitamin, so it dissolves in water. All vitamins are either water soluble or fat soluble.Vitamin B2, or riboflavin, is an essential vitamin that the human body needs. It is a vital component of several key enzymes in the body and is involved in metabolism, growth and development, and the synthesis of energy.Riboflavin occurs naturally in some foods and is added to some food products. It is also available in supplement form.[5]

Biological importance:

Vitamin B2 helps break down proteins, fats, and carbohydrates. It plays a vital role in maintaining the body's energy supply. Riboflavin helps convert carbohydrates into adenosine triphosphate (ATP). The human body produces ATP from food, and ATP produces energy as the body requires it. The compound ATP is vital for storing energy in muscles.[3]

Daily requirement:

About 1.3 milligram for males and 1 milligram vitamin B2 for females is needed on daily basis.[3]

Deficiency

Vitamin B2 deficiency is a significant risk when diet is poor, because the human body excretes the vitamin continuously, so it is not stored. A person who has a B2 deficiency normally lacks other vitamins too.[4]

There are two types of riboflavin deficiency:

Primary riboflavin deficiency happens when the person's diet is poor in vitamin B2

Secondary riboflavin deficiency happens for another reason, maybe because the intestines cannot absorb the vitamin properly, or the body cannot use it, or because it is being excreted too rapidly

Riboflavin deficiency is also known as ariboflavinosis.[4]

Vitamin B3 (Niacin)

Introduction

Niacinamide, alternatively known as nicotinamide, represents a water-soluble derivative of niacin, specifcallybelonging to the vitamin B3 group.One of the B vitamins (vitamin B3) required for numerous vital body processes is niacin. Niacin is necessary for healthy digestion, skin, nerves, and metabolism. Like other B vitamins, niacin is water-soluble and isn't stored for long periods in the body. This means that you need to consume niacin regularly to prevent a deficiency.[6]

Biological importance

Vitamin B-3, also known as niacin, is one of the eight B vitamins. It aids in the body's utilisation of proteins and fats and maintains the health of the skin, hair, and nervous system. It also has the potential to lower cholesterol and has antioxidant, anti-inflammatory, and anti-inflammatory properties. It is also known by the names nicotinamide, nicotinic acid, and vitamin PP because it prevents pellagra.[3]

Daily requirements:

Daily vitamin B3 requirement for males is 16 milligrams whereas, for teenager females is 14 milligrams.[3]

Deficiency

Niacin deficiency occurs when the body lacks enough vitamin B3. Low niacin levels can be due to diet, health conditions, or other factors. Severe niacin deficiency is known as pellagra and mainly occurs in areas of the world

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where there is a scarcity of foods containing niacin or the amino acid tryptophan, which can be converted to niacin in small amounts.[4]

Vitamin-B5 (Pantothenic acid)

Introduction:

Pantothenic acid (dihydroxy-b,b-dimethylbutyryl-b-alanine) is a water-soluble vitamin that belongs to the group of B-vitamins. As part of coenzyme A (CoA) and acyl carrier protein (ACP), pantothenic acid is essential to a large number of metabolic reactions. About 4% of cellular enzymes use CoA or its derivatives as a substrate. Pantothenic acid is synthesized by microbes and plants, and it is widely distributed in foods; the name derives from the Greek word 'pantos', meaning 'from everywhere'.[8]

Biological importance:

In addition to playing a role in the breakdown of fats and carbohydrates for energy, vitamin B5 is critical to the manufacture of red blood cells, as well as sex and stress-related hormones produced in the adrenal glands, small glands that sit atop the kidneys. Maintaining optimal conditions for skin, hair, and nails.[3]

Daily requirement:

Daily vitamin B5 requirement for human body is 10 milligrams. However daily intake requirement is also variable depending upon the age, gender and health conditions of the individuals.[3]

Deficiency :

Numbness and burning of the hands and feet, headache, extreme tiredness, irritability, restlessness, sleeping problems, stomach pain, heartburn, diarrhea nausea and vomiting loss of appetite.[4]

Vitamin-B6 (Pyridoxine)

Introduction:

Vitamin B6 is a unique vitamin that is involved in the metabolism of proteins, lipids and carbohydrates. The metabolism of amino acids requires enzymes that use pyridioxal phosphate as the co-factor or prosthetic group. In the amino acid decarboxylase reaction that leads to the formation of monoamine neurotransmitters, vitamin B6 is closely associated with the function of the nervous system. It also has an important role in immune and endocrine systems (Dakshinamurti et al., 2007; Sweetman, 2007). Thus, the biological role of pyridoxine in health and ailment is considered vital.[7]

Biological importance :

Vitamin B6 is needed for the proper function of sugars, fats, and proteins in the body. It's also necessary for the development of the brain, nerves, skin, and many other parts of the body. It's found in cereals, legumes, and eggs, and often used with other B vitamins in vitamin B complex products.[3]

Daily requirements:

Young males require 1.3 milligrams and young females require 1.2 milligrams on daily basis.[3]

Deficiency :

Tongue issues, such as glossitis, stomatitis, angularcheilitis, mental status changes, peripheral neuropathy, Severe deficiency may result in seborrheic dermatitis and anemia.[4]

Vitamin B7 (Biotin)

Introduction:

Biotin (also known as vitamin B7 or vitamin H) is a water-soluble vitamin that serves as an essential cofactor for carboxylase enzymes in multiple metabolic pathways. Biotin (also known as vitamin B7 or vitamin H) is one of the B

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vitamins. It is involved in a wide range of metabolic processes, both in humans and in other organisms, primarily related to the utilization of fats, carbohydrates, and amino acids. The name biotin, borrowed from the German Biotin, derives from the Ancient Greek word βίοτος (bíotos; 'life') and the suffix "-in" (a suffix used in chemistry usually to indicate 'forming'). Biotin appears as a white, needle-like crystalline solid.[9]

Biological importance:
Synthesizing, or creating, fatty acids synthesizing the amino acids isoleucine and valine.
It also helps maintain a healthy nervous system, nails, hair and skin, among other functions.[3]

Daily requirements:
For men and women 19 years and older and for pregnant women is 30 micrograms daily. Lactating women need 35 micrograms daily.[3]

Deficiency:
Hypotonia or weak muscles, seizures, alopecia or hair loss, eczema, delay ataxia or poor coordination, conjunctivitis or red eye, hearingloss, lethargy and drowsiness.[4]

Vitamin B9 (Folate)
Introduction:
Folate is a generic term that typically refers to a group of water-soluble compounds that play an essential role in deoxyribonucleic acid (DNA) biosynthesis. Folate, also known as vitamin B9 and folacin, is one of the B vitamins. Manufactured folic acid, which is converted into folate by the body, is used as a dietary supplement and in food fortification as it is more stable during processing and storage.[10]

Biological importance:
When cells and tissues are growing quickly, as they do throughout infancy, adolescence, and pregnancy, it plays a crucial role in the creation of DNA and RNA, the body's genetic material. Along with helping to form red blood cells and support the body's proper use of iron, folic acid and vitamin B12 function closely together.[3]

Daily requirements:
Young males and females are requiring 400 microgram folates on daily basis.[3]

Deficiency :
Weakness, fatigue, difficulty concentrating ,heart palpitations, headache shortness of breath, soreness and ulcers on the tongue, GIsymptoms, changes in hair and nail pigmentation.[4]

Vitamin B12 (Cobalamin)
Introduction:
Vitamin B12 is a water-soluble vitamin that is naturally present in some foods, added to others, and available as a dietary supplement and a prescription medication. Because vitamin B12 contains the mineral cobalt, compounds with vitamin B12 activity are collectively called cobalamins. Cobalamin is another name for vitamin B12.Animals need it because they use it as a cofactor in the creation of DNA and in the metabolism of both fatty acids and amino acids. Due to its involvement in the production of myelin and the maturation of red blood cells in the bone marrow, it is critical for the proper operation of the circulatory and neurological systems. Vitamin B12 (B12; also known as cobalamin) is one of eight B vitamins and its role in cellular metabolism is closely intertwined with that of folate, another B vitamin.[17]

Biological importance:
Vitamin B12 plays a crucial role in the synthesis of DNA and RNA, the body's genetic material, and is particularly necessary for the maintenance of healthy nerve cells. Together, vitamin B9, commonly known as folate or folic acid,

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and vitamin B12 help the body produce red blood cells and improve the way iron functions. Folate and B12 combine to form S-adenosylmethionine (SAMe), a substance that affects mood and the immune system.[3]

Daily requirement:
Youngster either males or females needs 2.4 microgram vitamin B12 on daily basis.[3]

Deficiency:
People can develop B12 deficiency through a lack of B12 in the diet, a condition called pernicious anemia, or when taking certain medications. Fatigue, heart palpitations, pale skin weight loss, numbness and tingling in the extremities.[4]

Vitamin C (Ascorbic acid)
Introduction:
Ascorbic acid, also known as vitamin C is a powerful antioxidant and a micronutrient. Vitamin C is present in higher concentrations in normal human skin, however, various studies indicated that vitamin C levels drastically dropped in naturally aged and/or photoaged skin. Vitamin C (also known as ascorbic acid and ascorbate) is a water-soluble vitamin found in citrus and other fruits, berries and vegetables. It is also a generic prescription medication and in some countries is sold as a non-prescription dietary supplement. As a therapy, it is used to prevent and treat scurvy, a disease caused by vitamin C deficiency.[12]

Biological importance:
Antioxidants, Boosts immunity, Cardiovascular disease Vitamin C is needed for the growth and repair of tissues in all parts of your body. It is used to Form an important protein called collagen, used to make skin, tendons, ligaments, and blood vessels. Heal wounds and form scar tissue.
Repair and maintain cartilage, bones, and teeth ,Aid in the absorption of iron.[3]

Daily requirement:
Dietary recommended intake for youngster males and females are 75 milligrams on daily basis.[3]

Deficiency:
Gingivitis (inflammation of the gums) with bleeding, periodontal (gum) disease, tooth loss mucocutaneouspetechiae, ecchymoses, or bleeding into the skin, hyperkeratosis, or skin thickening, alopecia, also known as hair loss, joint pain, muscle aches, hemarthroses, or bleeding in joint, muscle hemorrhages, bone bruising.[4]

Fat soluble vitamins:
Vitamins A, D, E, and K are called the fat-soluble vitamins, because they are soluble in organic solvents and are absorbed and transported in a manner similar to that of fats.

Vitamin A
Introduction:
Though vitamin A is often considered a singular nutrient, it's really a group of fat-soluble compounds, As a set of chemically related organic substances, "vitamin A" contains retinol, retinoic acid, retinal (sometimes called retinaldehyde), and various provitamin (precursor) carotenoids, most notably beta-carotene.[13]

Biological importance:
Vitamin A helps form and maintain healthy teeth, skeletal and soft tissue, mucus membranes, and skin. It is also known as retinol because it produces the pigments in the retina of the eye. Promotes good eyesight, especially in low light. It also has a role in healthy pregnancy and breastfeeding.[3]

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Daily requirement:
Daily intake requirement of vitamin A for young males is 900 micrograms, for females 700 micrograms and for children 300-400 micrograms.[3]

Deficiency:
Xerophthalmia, which results in dry eye, Bitot spots which cause dried conjunctiva on the eye, night blindness, keratomalacia (cornea cloudiness) and permanent blindness, inflammatory bowel disease, chronic gastrointestinal infection, cirrhosis, pancre aticinsufficiency, rubeola infection (measles), anemia.[4,13]

Vitamin D

Introduction:
Vitamin D is a group of fat-soluble secosteroids responsible for increasing intestinal absorption of calcium, magnesium, and phosphate, and for many other biological effects. In humans, the most important compounds in this group are vitamin D3 (cholecalciferol) and vitamin D2 (ergocalciferol).Vitamin D supplementation can prevent and cure nutritional rickets in infants and children. Preclinical and observational data suggest that the vitamin D endocrine system has a wide spectrum of skeletal and extra-skeletal activities.[14]

Biological importance:
Vitamin D plays an important role in calcium homeostasis and bone metabolism, with the capacity to modulate innate and adaptive immune function, cardiovascular function, and proliferation and differentiation of both normal and malignant keratinocytes.[3]

Daily requirement:
Dietary intake should be 15 micrograms (600 International Unit) in daily basis for teenager males and females.[3]

Deficiency:
Low calcium levels called hypocalcemia, hyperparathyroidism, or too much parathyroid hormones, which can increase the risk of: Osteoporosis, fractures, bonepain, joint pain, Muscle aches,fatigue,muscletwitching,weakness.[4]

Vitamin E

Introduction :
Vitamin E is a group of eight fat soluble compounds that include four tocopherols and four tocotrienols. Vitamin E is a lipid-soluble vitamin . It is a generic term that describes compounds with a chromanol ring present in most edible oils, such as wheat germ, barley, oats, coconut, and palm oil .These phenolic lipo-philic compounds that constitute vitamin E are divided into two analogue species and four homologs each: to copherols, which comprise four saturated analogues, alpha (a), beta (b), gamma (g)and delta (d); and tocotrienols as four unsaturated analogues.[16]

Biological importance:
Antioxidant, It helps keep the immune system strong against viruses and bacteria.
It helps form red blood cells and widen blood vessels to keep blood from clotting inside them.
It helps the body use vitamin K.Cells also use vitamin E to interact with each other. It helps them carry out many important functions.[3]

Daily requirement:
Daily recommended intake of vitamin E is 15 milligrams for males and females of adult age while 5 milligrams for children.[3]

Deficiency:
Ataxia, difficulty with upward gaze, hyporeflexia, which is the loss of skeletal muscle reflexes

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Severe symptoms include: blindness, dementia, heartarrhythmias. Its deficiency is uncommon, is mainly related to fat absorption or metabolic complications, and is associated with neuromuscular symptoms.[4,16]

Vitamin K

Introduction:

For the post-synthesis alteration of several proteins necessary for blood coagulation and the regulation of calcium binding in bones and other tissues, vitamin K is needed. The complete synthesis involves final modification of these so-called "Gla proteins" by the enzyme gamma-glutamyl carboxylase that uses vitamin K as a cofactor. Vitamin K is well known as an essential factor in blood coagulation. Hence its name, vitamin K, which is derived from the German term for coagulation (Koagulation)[15]

Biological importance:

The body needs vitamin K to produce prothrombin, a protein and clotting factor that is important in blood clotting and bone metabolism. Vitamin K is a group of compounds essential for blood clotting, bone health, and possibly heart health.[3]

Daily requirement:

Daily value for vitamin K intake is 80 micrograms. WHFoods recommended the 90 micrograms daily required intake for females and 120 micrograms for males while 55 micrograms for children.[3]

Deficiency:

Vitamin K deficiency may cause bleeding at venipuncture sites. This is where a person gets blood drawn. Newborn babies with low vitamin K levels who do not receive prompt treatment are at risk of vitamin K deficiency bleeding, which causes excessive bleeding, bleeding disorders impaired bone development, cardiovascular diseases.[4]

Role of Vitamin C:-

Vitamin C is a potent antioxidant drug that can be used topically in dermatology to treat and prevent changes associated with photoageing. It can also be used for the treatment of hyper pigmentation.

Vitamin C is also very powerful water-soluble antioxidant with various potential benefits for patients with skin diseases.L-ascorbic acid is the form of vitamin C that is chemically active (LAA)Vitamin C is chemically active in the form of L-ascorbic acid (LAA). Vitamin C is present in nature in equivalent amounts to both D-ascorbic acid and LAA. These molecules can be swapped out for one another since they are basically isomeric. But only LAA is physiologically active, making it valuable in the practice of medicine. is therefore often employed in medical procedures. Owing to an active transport mechanism, the gut's ability to absorb vitamin C is restricted. This means that even at large dosages, the amount of medicine absorbed orally is reduced, which therefore lowers the vitamin's skin bioavailability.

Consequently, in dermatological treatment, topical vitamin C use is typically recommended. The ability of vitamin C to donate electrons is largely responsible for its activity. The body uses vitamin C actively in a number of processes, including the gastrointestinal tract's reduction of iron, the synthesis of carnitine, gene transcription, defence against reactive oxygen species (ROS), DNA demethylation, hydroxylation of transcription factors, tRNA, and ribosomal proteins, collagen, and the synthesis of hormones.

Scurvy typically arises from the body's incapacity to absorb vitamin C or from consuming insufficient amounts of the vitamin through a normal diet. Consuming fresh fruits and vegetables provides 90% of ascorbic acid; failing to do so can result in scurvy.[18]

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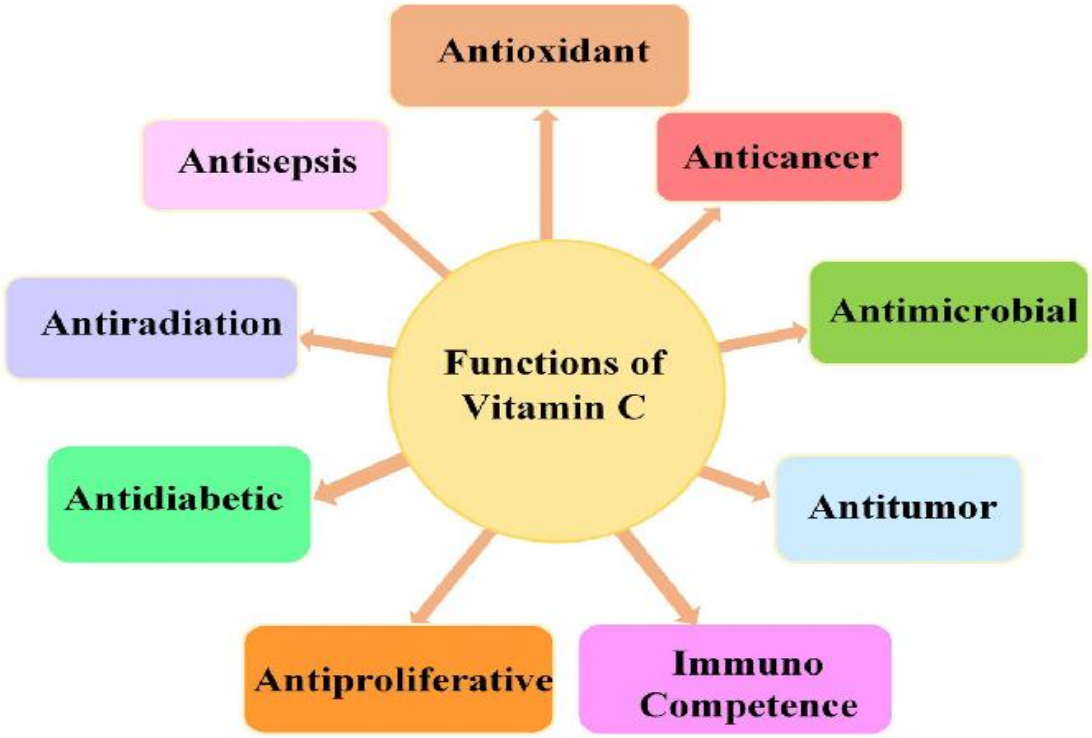

Fig 2 Role of vitamin c

BIOCHEMISTRY OF VITAMIN C

Vit. C has a 5-hydrocarbon ring similar to that of glucose. With an attached hydrogen ion, LAA becomes a weak sugar acid, similar to other alfahydroxy acids used in dermatology. With a metal ion, it forms a mineral ascorbate. There is a marked interest in synthesis of physiologically active and chemically stable ascorbate molecules as LAA is unstable in nature, especially when exposed to light.[19]

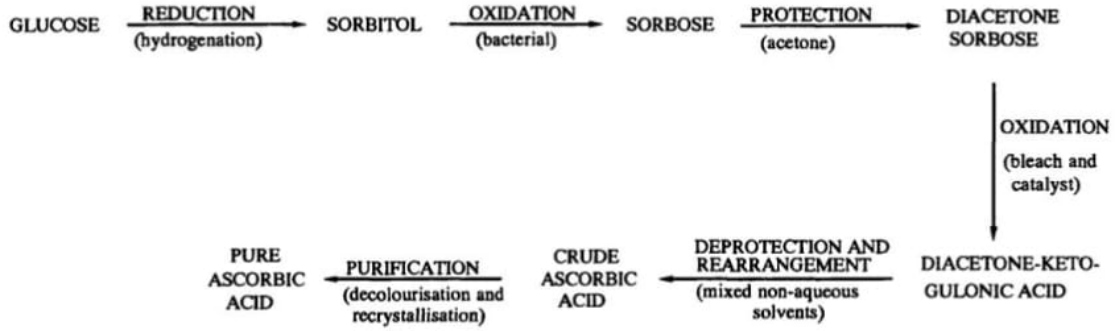

Fig 3 Synthesis of vitamin E

MECHANISM OF ACTION OF VITAMINC

Vitamin C as an anti-oxidant:

Vitamin C is susceptible to autoxidative degradation, particularly when certain transition metal ions are present. Any polyunsaturated lipid material present may experience an acceleration and encouragement of autoxidation as a result. Lipid peroxidation has been experimentally triggered in vitro by vitamin C in the presence of iron. However, there isn't much proof that this "pro-oxidant" activity matters in vivo.Although many biochemical agents have the antioxidant function of protecting against free radicals generated in vivo (eg., superoxide dismutase, uric acid and glutathione, as

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well as vitamin C, vitamin E, and beta-carotene) , there are many external sources of free radicals that can shift the balance between the flux of free radicals generated and the inherent antioxidant protection. Environmental pollutants, including cigarette smoke and car exhaust fumes, contain free radicals. Free radicals can also be generated within the body following exposure to infectious organisms, radiation, harmful chemicals or consumption of certain drugs.Enzymes, genetic material (DNA), and lipid membranes can all sustain significant harm from free radicals. Typically, the rate at which free radicals are generated is low enough that the antioxidant content is adequate to guard against the possible harm that these reactive molecules may cause. Ascorbic acid may well play an important protective role in the body against the damaging effects of free radicals through its ability as an antioxidant to scavenge free radicals and to regenerate vitamin E.[20]

Vitamin C as Dipigmenting agent:

It's critical to distinguish between agents that disrupt the essential processes of melanogenesis and those that are toxic to the melanocyte when selecting a depigmenting agent. Vitamin C is classified as a depigmenting agent in the latter category. Vit. C interacts with copper ions at the tyrosinase-active site and inhibits action of the enzyme tyrosinase, thereby decreasing the melanin formation. Vit. C also acts on the perifollicular pigment. However, Vit. C is an unstable compound. It is therefore often combined with other depigmenting agents such as soy and liquorice for better depigmenting effect.[21]

Antiaging effect of Vitamin C:

Vitamin C is essential for collagen biosynthesis and is thought to have an antiaging effect. More importantly, it serves as a cofactor for prolyl and lysyl hydroxylase, key enzymes that cross-link and stabilize collagen fibers.Additionally, vitamin C stabilises pro-collagen messenger RNA (mRNA), which controls the production of Type I and Type III collagen, and directly activates the transcription factors involved in collagen synthesis. Furthermore, vitamin C promotes the production of the tissue inhibitor of MMP-1 and collagen gene expression, both of which reduce the breakdown of collagen. A clinical study showed that daily application of three-percent topical vitamin C over a four-month period led to a significant increase in the density of dermal papillae.[22]

Replenisher of Vitamin E:

In addition to its anti-aging and photoprotective properties, vitamin C is recognised as the main source of vitamin E replenishment. As a lipophilic antioxidant, vitamin E is primarily responsible for preserving the skin's collagen network and shielding cell membranes from oxidative damage. Like vitamin C, exposure to UV light quickly depletes its levels. Several clinical studies have proved the synergistic antioxidant effect of vitamins C and E in photoprotection.[22]

Vitamin C in Collagen synthesis:

L-Ascorbic acid stimulates procollagen synthesis in cultured human skin fibroblasts without appreciably altering noncollagen protein synthesis. The effect is unrelated to intracellular degradation of newly synthesized procollagen. Levels of mRNA for pro α_1(I), pro α_2(I), and pro α_1(III), measured by hybridization with the corresponding cDNA probes, are elevated in the presence of ascorbic acid, whereas the level of mRNA for fibronectin is unchanged. Levels of functional mRNA for procollagen, measured in a cell-free translation assay, are specifically increased in the presence of ascorbic acid. Thus, ascorbic acid appears to control the expression of three different procollagen genes, each of which is located on a separate chromosome. It is proposed that intracellularly accumulated procollagen in ascorbate deficiency may lead to a translational repression of procollagen synthesis. Ascorbic acid may relieve this block by promoting hydroxyproline formation and, consequently, secretion of procollagen from the cell. The increased level of procollagen mRNA under the influence of ascorbic acid may be secondary to increased synthesis of procollagen polypeptides; the control point may be gene transcription or mRNA degradation.[23]

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BENEFITS OF VITAMIN C :

1] Protect Against Sun Damage

The antioxidants in vitamin C may help defend against the damage that UV light can cause. That doesn't mean that you can use a vitamin C skin serum in place of sunscreen. It can't replace SPF since it doesn't absorb UVA or UVB rays. But if UV light does get into your skin, some research suggests that vitamin C can help blunt the harm.

2] Lighten Dark Spots

Vitamin C-based skin care products may lighten patches that are darker than the rest of your skin, called hyperpigmentation. In one study, vitamin C applied to the skin for 16 weeks significantly cut down on these spots. But experts say it will take more research to confirm how well vitamin C creams work.

3]Smooth Wrinkles

Vitamin C is a powerful ingredient in many anti-aging products. Some studies show that it can reduce the appearance of wrinkles. Research suggests that people who eat more vitamin C have fewer wrinkles. It's not limited to citrus fruits. Broccoli, red peppers, and spinach are chock full of it, too

4]Boosts Collagen

This protein is naturally present in your skin and helps keep it from sagging. But your body slows down collagen production as you age. Vitamin C applied to the skin can encourage new collagen to grow. It also helps maintain the collagen you do have and protects the precious protein from damage.

5] Promotes Healing

Vitamin C can help wounds heal more quickly. You could take supplements, get more of the nutrient in your diet, or apply it to your skin. All help close open sores – especially in people who don't already get enough of the stuff. The vitamin helps the body produce the collagen necessary to resolve this type of injury.

6]Diminishes Scars

In one study, vitamin C gel applied to the skin made surgical scars less noticeable. In the experiment that included 80 people, half of them put the vitamin-infused silicon gel on their wound daily for 6 months after their stitches were removed. Afterward, their scars were less visible than those of the people who had not used the product.[24]

ADVERSE EFFECT OF VITAMIN C

When taken by mouth: Vitamin C is likely safe for most people. In some people, vitamin C might cause side effects such as stomach cramps, nausea, heartburn, and headache. The chance of getting these side effects increases with higher doses. Taking more than 2000 mg daily is possibly unsafe and may cause kidney stones and severe diarrhea. In people who have had a kidney stone, taking amounts greater than 1000 mg daily increases the risk of getting more kidney stones.[25]

When applied to the skin: Vitamin C is likely safe for most people. It might cause irritation and tingling. [25]

Taking too much vitamin C can cause side effects, including:

Nausea, vomiting and diarrhea.
Heartburn.
Stomach cramps or bloating.
Fatigue and sleepiness, or sometimes insomnia.
Headache.
Skin flushing.

Interactions:

Possible interactions include:

Aluminum. Taking vitamin C can increase your absorption of aluminum from medications containing aluminum, such as phosphate binders. This can be harmful for people with kidney problems.

Chemotherapy. There is concern that use of antioxidants, such as vitamin C, during chemotherapy might reduce the effect of chemotherapy drugs.

Estrogen. Taking vitamin C with oral contraceptives or hormone replacement therapy might increase your estrogen levels.

Protease inhibitors. Oral use of vitamin C might reduce the effect of these antiviral drugs.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, October 2024

Statins and niacin. When taken with vitamin C, the effects of niacin and statins, which might benefit people with high cholesterol, could be reduced.
Warfarin (Jantoven). High doses of vitamin C might reduce your response to this anticoagulant.

Research on the use of vitamin C for specific conditions shows:
Cancer. Eating a diet rich in fruits and vegetables might lower your risk of many types of cancer, such as breast, colon and lung cancers. However, it's not clear whether this protective effect is related to the vitamin C content in the food. Taking oral vitamin C supplements doesn't appear to offer the same benefit.
Common cold. Taking oral vitamin C supplements won't prevent the common cold. Evidence also shows that the benefits of regularly taking vitamin C supplements to reduce the duration or severity of a cold are minimal.
Eye diseases. Taking oral vitamin C supplements in combination with other vitamins and minerals seems to prevent age-related macular degeneration (AMD) from worsening. Some studies also suggest that people who have higher levels of vitamin C in their diets have a lower risk of developing cataracts.

Role of Vitamin E:
Vitamin E (tocopherols and tocotrienols) has demonstrated significant biological effects on enhancing human health and play a promising role in food systems. Studies have shown the relative antioxidant activity of vitamin E contributes to food preservation. It can reduce the negative impact of chemical reactions on food systems by improving their safety, nutritional value, and shelf-life. Vitamin E has been found to act on cellular signaling pathways, effectively combating oxidative stress which benefits for anti-inflammation, anti-cancer, cardioprotection, neuroprotection, skin health, and other degenerative conditions. The functions of γ- and δ- tocotrienol and tocopherol have been found to exhibit anti-inflammation and anti-cancer properties. Vitamin E also contributes to cardio health via cardiomyocyte anti-apoptosis. Additionally, vitamin E offers good protection against lipid peroxidation under food processing and storage conditions. Vitamin E works in oils, fats, and active packaging by stabilizing their lipid components to prevent off-flavours and changes in the colour of the food constituents. Supplementation of α-tocopherol up to 0.2% in oils is able provide higher oxidative stability. Therefore, it can be inferred that vitamin E could be utilized as a functional ingredient in food preservation and for enhancing nutritional quality.[25]

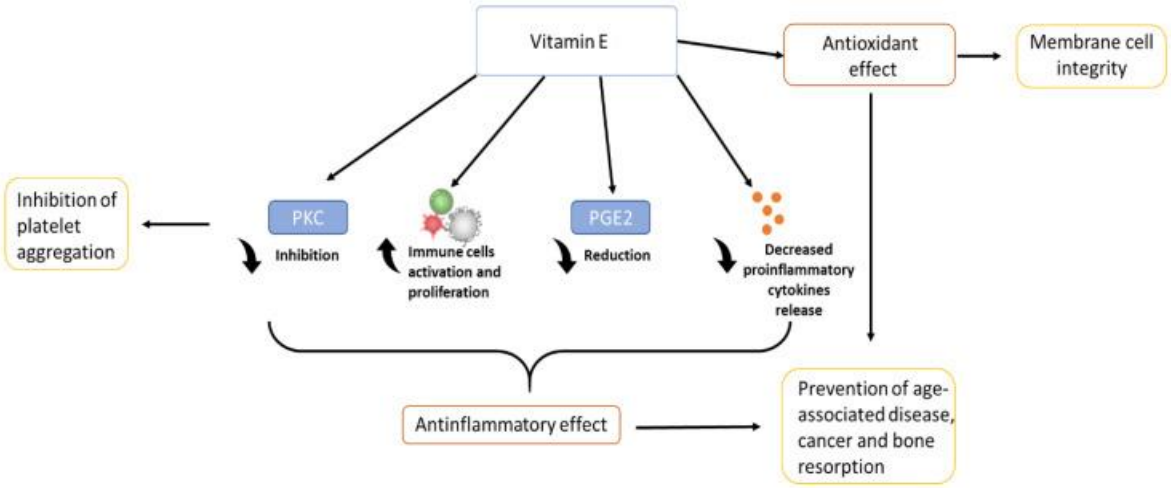

Fig 4 Role of Vitamin E

Biochemistry of Vitamin E:
The large-scale industrial synthesis of (all-rac)-a-tocopherol (synthetic vitamin E) consists of three major parts which have been reviewed, for example, by Baldenius et al. (1996), Mayer and Isler (1971), Schudel et al. (1972), and Bonrath and Netscher (2005): the preparation of the aromatic building block (trimethylhydroquinone, 10), the production of the side chain component [(all-rac)-isophytol, (all-rac)-11, or a corresponding C20 derivative] and condensation reaction.[26]

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Volume 4, Issue 3, October 2024

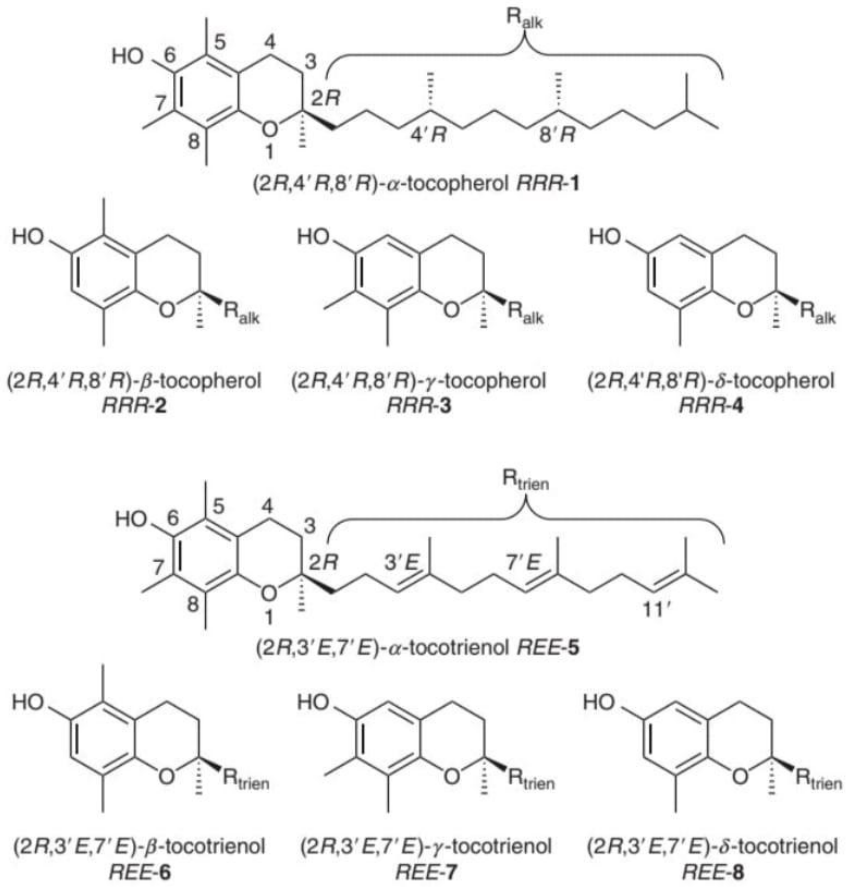

Fig.5 Naturally Occuring Tocopherols and Tocotrienols

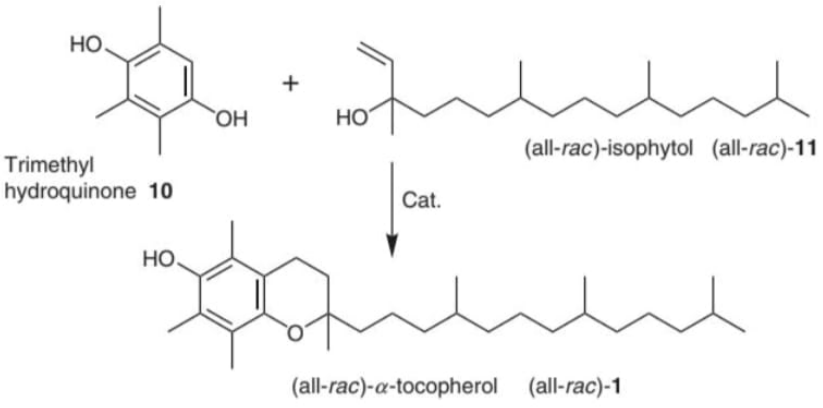

Fig.6 Tocopherol and tocopheryl acetate.

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International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
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Volume 4, Issue 3, October 2024

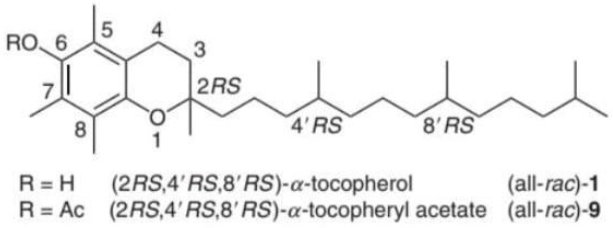

Fig.7Synthesis of Vitamin E

Benefits of Vitamin E :

Antioxidant properties of vitamin E:

Vitamin E is a potent antioxidant compound essential for preventing the oxidation of cell membrane polyunsaturated fatty acids (PUFA). During the formation of lipid peroxides, α-tocopherol delivers hydrogen ions to the lipid peroxyl radical, interrupting the oxidation cascade, avoiding PUFA and lipoproteins oxidation, and providing tissue protection by reducing free radicals . The final step is the production of lipid hydroperoxide, a less reactive radical.[27]

Anti-Inflamatory effect of Vitamin e:

Both in vitro and in vivo studies have documented the anti-inflammatory effects of vitamin E, particularly tocopherol and tocotrienol. One of the most important elements in the development of acute and chronic inflammation, NF-κB, is activated by a number of pathways that vitamin E disrupts. Vitamin E may suppress nuclear activation of the factor nuclear kB (NF-κB)/p105 transcription factor and reduce NF-κB gene expression, according to in vitro studies. This could be connected to the stimulation of IkB-α expression, a signal for NF-κB suppression, which lowers the levels of inflammatory cytokines like TNF-α, IL-1β, and IL6. [27]

Skin Cancer prevention:

Mouse studies reported inhibition of UV-induced tumors in mice fed with α-tocopherol acetate.[27] Multiple human studies have shown no effects of vitamin E on the prevention or development of skin cancers.[28]

Wound healing:

Vitamin E along with zinc and vitamin C, is included in oral therapies for pressure ulcers and burns.The antioxidant supplementation through vitamins E and C and the mineral zinc has been seen to apparently enhance the antioxidant protection against oxidative stress and allow less time for wound healing[28]

Melasma:

Vitamin E alone has shown minimal efficacy in the treatment of melasma.[32] It has been shown to cause depigmentation by interference with lipid peroxidation of melanocyte membranes, increase in intracellular glutathione content, and inhibition of tyrosinase.[28]

Acne Vulgaris:

In one of the studies conducted in a series of 98 patients, the emphasis was based on the correction of the defective keratinization of sebaceous follicles with a combination of vitamin E and vitamin C. This was seen to prevent the formation of comedones, thus depriving the *Propionibacterium acnes* of a culture medium. Vitamin E prevents lipid peroxidation of serum from bacterial-induced leakage through follicles and sebaceous glands, thus preventing inflammation due to peroxide irritation.[28]

Yellow Nail Syndrome:

The yellow nail syndrome includes slow growing, opaque yellow nails with exaggerated yellow curvature, lymphedema, and chronic respiratory disorders such as chronic bronchitis, pleural effusions, and chronic sinusitis.

IJARSCT
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International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
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Volume 4, Issue 3, October 2024

Vitamin E is one of the treatment modalities for yellow nail syndrome,in a dosage of 1000 IU once a day for a period of 6 months.[28]

Adverse Effects of Vitamin E:

When taken by mouth: Vitamin E is likely safe for most people when taken in doses lower than 1000 mg daily. This is the same as 1100 IU of synthetic vitamin E (all-rac-alpha-tocopherol) or 1500 IU of natural vitamin E (RRR-alpha-tocopherol). The risk of side effects increases with higher doses. Side effects can include nausea, fatigue, headache, and bleeding. Vitamin E is possibly unsafe when taken in doses greater than 1000 mg daily.

Use of vitamin E can interact with many conditions. For example, research suggests that oral use of vitamin E might increase the risk of prostate cancer. Other research suggests that vitamin E use might increase the risk of death in people with a severe history of heart disease, such as heart attack or stroke.

When applied to the skin: Vitamin E is likely safe for most people.

When inhaled: Vitamin E is possibly unsafe. Use of e-cigarettes and other vaping products containing vitamin E acetate has been linked to serious lung injury in some people.

Interactions:

Use of some drugs can affect your vitamin E levels. Possible interactions include:

1] Antitumor antibiotics and alkylating agents:

High vitamin E dosages are thought to have an impact on how certain chemotherapy medications are used.

2] Anticoagulants and anti-platelet medications, herbs, and supplements: Using vitamin E in conjunction with these medications, herbs, and supplements that lower blood clotting may make bleeding more likely.

3] Substrates of cytochrome P450 3A4 (CYP3A4): Steer clear of vitamin E and other medications that interfere with these enzymes, like omeprazole (Prilosec, Zegerid).

4] Statins and niacin: Taking vitamin E with statins or niacin, which might benefit people with high cholesterol, could reduce niacin's effect.

Vitamin K: Taking vitamin E with vitamin K might decrease the effects of vitamin K.

Research on the use of vitamin E for specific conditions has shown mixed results, including:

1] Alzheimer's disease:

Some research suggests that high doses of vitamin E may slow the progression of Alzheimer's disease in people with mild to moderate Alzheimer's. However, other studies have not shown this benefit.

2] Liver disease:

Vitamin E may improve symptoms of nonalcoholic fatty liver disease, but taking oral vitamin E for two years may lead to insulin resistance.

3] Preeclampsia:

Increasing vitamin E intake has not been shown to prevent preeclampsia, a pregnancy condition that affects blood pressure.

4] Prostate cancer:

Vitamin E and selenium supplements don't prevent prostate cancer, and may increase the risk of prostate cancer.

5] Cardiovascular disease:

Vitamin E has been studied for its role in preventing cardiovascular disease, such as stroke, coronary heart disease, and myocardial infarction.

6] Dysmenorrhea:

Vitamin E supplements may help reduce menstrual pain in women with dysmenorrhea.

7] Yellow nail syndrome:

Vitamin E is one of the treatment modalities for yellow nail syndrome.

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Volume 4, Issue 3, October 2024

Role of Vitamin C and Vitamin E in Diseases:

Cancer: Some experimental and epidemiologic studies have suggested that both vitamins E and C may reduce the risk of various types of cancer. However, the evidence remains controversial either because of the nutrient source (diet or supplement) or the cancer site studied. Both nutrients, via their antioxidant function, may eliminate free radicals and decrease DNA damage by reducing mutagenesis and cell transformation. In addition to its role as an antioxidant, vitamin E may also directly affect various cells of the immune system (i.e., natural killer [NK] and inflammatory cells), leading to an enhanced ability to inhibit tumor production. Byers and Guerrero (1995) examined all epidemiologic studies that assessed vitamin E and cortisol intakes from fruit and vegetable consumption when discussing nutrition and cancer prevention. The findings indicated that a diet rich in fruits and vegetables (> 5 servings/d) and, consequently, rich in vitamin C, is linked to a lower risk of lung, stomach, colon, and oral cavity cancer.The hormone-associated cancers of the breast and prostate appear to be less related to fruit and vegetable intake. Diets high in added vegetable oils, presumably high in vitamin E, have been less consistently associated with reduced cancer risk. However, when studies of vitamins E and C consumed as supplements are considered, there is little support for a protective role of either nutrient against cancer. Therefore, if vitamins E or C are protective against cancer, this effect may be due to their consumption in whole foods, where they are combined with other nutrients or bioactive compounds that together provide a protective effect against cancer. The most prudent approach seems to be one of increasing fruit and vegetable consumption in the diet, thus maximizing the potential benefits of antioxidant nutrients in terms of cancer prevention[29]

Asthma and Lung Function: It is possible that antioxidant defenses are of particular importance in the lung since a naturally high exposure to oxygen may be further increased by oxidative processes during inflammation and inhalation of oxidant air pollutants (Burney, 1995). Such damage could lead to permanent loss of lung function over time. It has, therefore, been hypothesized that vitamins E and C, acting either as antioxidants or through a direct effect on immune function, may reduce airway inflammation, thereby decreasing the severity of asthma or even preventing its occurrence in susceptible individuals. Associations between several dietary factors assessed by a semiquantitative food frequency questionnaire and the incidence of asthma over a 10-y period were evaluated as part of the Nurses' Health Study of 77,866 women 34 to 68 years of age (Troisi et al., 1995). Women in the highest quintile of vitamin E intake from diet alone had a reduced risk of asthma (relative risk 0.53, $p = 0.0005$) compared with women in the lowest quintile of dietary intake. However, the use of vitamin C or E supplements was associated with a significant increase in the risk of asthma, although this seemed to be due to women at high risk of asthma initiating the use of vitamin supplements prior to diagnosis. These data suggest that although antioxidant supplementation is not an important determinant of adult-onset asthma, dietary intake of vitamin E may have a modest protective effect.Stronger evidence that vitamin C and potentially vitamin E may affect lung function in middle and later life is presented in another epidemiologic investigation (Britton et al., 1995). Researchers discovered a correlation between enhanced lung function (as determined by spirometry) and increased dietary intakes of both vitamins C and E in a cross-sectional survey of 2,633 people in England aged 18 to 70. Nevertheless, there was a strong correlation between these two nutrients, and after correcting for the impact of vitamin C, vitamin E had no further influence on lung function.[29]

Aids: Considerable evidence has accumulated that HIV-infected patients are under chronic oxidative stress as evidenced by increased levels of hydroperoxides and malondialdehyde (MDA) in serum (Pace and Leaf, 1995). This oxidative stress may contribute to various aspects of immune dysfunction in HIV disease pathogenesis, including viral replication, inflammation, decreased immune cell proliferation, loss of immune function, and apoptosis (Pace and Leaf, 1995). Furthermore, changes in levels of antioxidant nutrients have also been observed in various tissues of these patients (Pace and Leaf, 1995). Therefore, vitamins E, C, and other antioxidants may have immunoenhancing properties that could help normalize immune dysfunctions that lead to full-blown AIDS.A number of studies by Watson and colleagues illustrate this point with regard to vitamin E (Wang et al., 1994a,b, 1995). These researchers have used C57BL/6 mice infected with LP-BM5 retrovirus to cause murine AIDS, which is functionally similar to human AIDS. Animals were supplemented with at least a 15-fold increase of vitamin E in a liquid diet (160 IU/liter). Vitamin E supplementation led to increased NK cell cytotoxicity, splenocyte proliferation, and IL-2 and interferon-y levels, all of which are suppressed by retrovirus infection. Vitamin E also led to decreased IL-6, IL-10, and tumor necrosis factor [TNF]-a production, all of which had been increased by retrovirus infection. These findings suggest that high levels of vitamin E supplementation can modulate cytokine production and normalize immune dysfunctions during the

IJARSCT
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International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
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Impact Factor: 7.53
Volume 4, Issue 3, October 2024

development of murine AIDS. It is not clear, however, whether these immunological changes alter the clinical outcome of the disease.[29]

II. CONCLUSION

In summary, the human body requires two different kinds of vitamins: fat-soluble and water-soluble vitamins. Both are essential for proper bodily function. It is indisputable that these vitamins are vital to the body at all ages, and depending on the vitamin, age, and health status of each person, a deficiency in them can seriously harm certain parts of the body. Vitamins are more powerful in smaller doses. Their total daily requirement is therefore typically quite minimal. A prolonged lack of a vitamin is known as a vitamin deficit. The definition of a primary deficit is insufficient consumption of vitamins, while a secondary deficiency is characterized as inadequate

REFERENCES

[1]. VoraAxitaP. , Patel Prachi K. , GohelPayal K. , Mistry Parth R. , RathodZalak R.*, SarafMeenu S A Review On Vitamins: It'S Biological Role And Deficiencies In Humans Vidya – A Journal of Gujarat University.Volume 1, issue 2,Page No.70

[2]. Medically relieved by... National Library of medicine Julianna L. Martel, connor C, Kernel, HarshitDoeshi: Reading f, sina David S Franklin

[3]. Muhammad Amir Maqbool1*, Muhammad Aslam1, Waseem Akbar2, Zubair Iqbal1 , Biological importance of vitamins for human health: A review Volume 2 Issue 3 2017 – Journal of Agriculture and Basic Science.

[4]. Medically reviewed by Adam Bernstein, MD, ScD — Written by Daisy Warner

[5]. Medically reviewed by Natalie Butler, R.D., L.D. — Written by Yvette Brazier — Updated on November 22, 2023

[6]. Mahika Joshi Priyanka HiremathJeena John Niraja Ranadive KrishnadasNandakumarJayeshMudgal .Modulatory role of vitamins A, B3, C, D, and E on skin health, immunity, microbiome, and diseases. Pgno :-1100

[7]. Iqbal Ahmad¹, Tania Mirza", Kiran Qadeer', Urooj Nazim² and Faiyaz HM Vaid.

[8]. Vitamin B6: Deficiency diseases and methods of analysis. Volume 26, Issue no 5 September 2013, Pak. J. Pharam . Science. pg no 1057.

[9]. RiittaFreese", Tonje E. Aarsland and Maja Bjørkevoll.Review Article Pantothenic acid - a scoping review for Nordic Nutrition. 27 September Food and Nutrition research. Pg no 1.

[10]. Deepa P. Patel Shane M. Swink Leslie Castelo-Soccio.A Review of the Use of Biotin for Hair Loss. Karger.com .Pg no 1

[11]. Medically relieved by .National Library of medicine .Brigham J. Merrell; John P. McMurry.Pg no. 1.

[12]. National Institutes of Health. Vitamin B12Fact Sheet for Health Professionals. Pg no 1

[13]. Shobhit Mohan', Neelu Singh², LalitMohan.Vitamin C in dermatology and cosmetology: a reviewInternational Journal of Research in Dermatology |March-April 2024 Vol 10 Issue 2 Page 113.

[14]. Medically reviewed by Jerlyn Jones, MS MPA RDN LD CLT, Nutrition — Written by Jillian Kubala, MS, RD — Updated on April 24, 2023.Vitamin A: Benefits, Deficiency, Toxicity, and More.Vitamin A: Benefits, Deficiency, Toxicity, and More.pg 1

[15]. Roger Bouillon, DespoinaManousaki, Cliff Rosen, Katerina Trajanoska, Fernando

[16]. Rivadeneira and J. Brent Richards.The health effects of vitamin D supplementation:

[17]. evidence from human studies.February 2022 Volume 18.pg 96

[18]. PremyslMladenka, KateřinaMacáková, LenkaKujovskáKrčmová, LenkaJavorská, KristýnaMrštná, Alejandro Carazo, Michele Protti, Fernando Remião, and Lucie Nováková, on behalf of the OEMONOM researchers and collaborators.Vitamin K - sources, physiological role, kinetics, deficiency,detection, therapeutic use, and toxicity.Nutrition Reviews® Vol. 80(4): pg no 677.

[19]. Liana Trugilho , Livia Alvarenga , Ludmila FMF. Cardozo , Isis Barboza ,MauriloLeiteJr , Denis Fouque , Denise Mafra. Vitamin E and conflicting understandings in noncommunicablediseases: Is it worth supplementing? European Society for Clinical Nutrition and Metabolism. Pg.no 343-344

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, October 2024

[20]. Ralph Green, Lindsay H. Allen, Anne-LiseBjørke-Monsen, Alex Brito, Jean-Louis Guéant, Joshua W. Miller, Anne M. Molloy, EbbaNexo, Sally Stabler, Ban-Hock Toh, Per Magne Ueland and ChittaranjanYajnik. Vitamin B12 deficiency. Nature Reviews Disease Primers · June 2017.Volume 3 , Article Number 17040 pg no. 1

[21]. Medically relieved by .National Library of medicine .Dr. SaokarPumoriTelang, .Vitamin C in dermatology.Pg no .1

[22]. MICHAEL B. DAVIES JOHN AUSTIN DAVID A. PARTRIDGE Department of Applied Science Anglia Polytechnic, Cambridg.Vitamin C Its Chemistry and Biochemistry.Pg no 73.

[23]. Medically reviewedby:- Adv. in Free Radical Biology & Medicine, Vol. 2, . Bendich, L.J. Machlin, and O. Scandurra .The Antioxidant Role of Vitamin C.Pg no 421

[24]. PumoriSaokarTelang, Vitamin C in dermatology, Indian Dermatology Online Journal - April-June 2013 - Volume 4 - Issue 2

[25]. Firas Al-Niaimi, MRCP(UK)(Derm), and Nicole Yi Zhen Chiang, MRCP(UK)(Derm), Topical Vitamin C and the Skin: Mechanisms of Action and Clinical Applications, The Journal of Clinical and Aesthetic Dermatology

[26]. Sheldon R. Pinnell, MD; Saood Murad, PhD; Douglas Darr, PhD, Induction of Collagen Synthesis

[27]. by Ascorbic Acid, Arch Dermatol Vol 123, Dec 1987

[28]. Medically Reviewed by Poonam Sachdev on September 04, 2024Written by Alicia Barney, The Benefits of Vitamin C for Your Skin.

[29]. Chee Chin Chu, Sook Chin Chew, Wen ChingLiew, Kar Lin Nyam, Review article vitamin E: a multi-functional ingredient for health enhancement and food preservation, Journal of Food Measurement and Characterization, Volume 17, pages 6144–6156, (2023)

[30]. Thomas Netscher, Synthesis of Vitamin E, Vitamins and Hormones, Volume 76 . Pg no.158-159.

[31]. L. Trugilho, L. Alvarenga, L.FMF. Cardozo et al.Vitamin E and conflicting understandings in noncommunicable diseases: Is it worth supplementing?2405-4577/© 2023 European Society for Clinical Nutrition and Metabolism. Published by Elsevier Ltd.

[32]. Mohammad Abid Keen, Iffat Hassan.Vitamin E in dermatology,Indian Dermatology Online Journal - July-August 2016 - Volume 7 - Issue 4

[33]. Laura C. Rall Simin Nikbin Meydani ,Vitamin E, Vitamin C, and Immune Response: Recent Advances Book of Military Strategies for Sustainment of Nutrition and Immune Function in the Field Article 13