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THE ROLE OF VITAMIN E AS AN ANTIOXIDANT AND PREVENTING DAMAGE CAUSED BY FREE RADICALS

A. Abdelqader[1]*, M. D. Obeidat[2], M. S. Al-Rawashdeh[3] and A. A. Alrazak[4]

[1] Department of Animal Production, School of Agriculture, The University of Jordan, Amman, 11942, Jordan.
[2] Department of Animal Production, Faculty of Agriculture, Jordan University of Science and Technology (JUST), Irbid 22110, Jordan.
[3] Department of Animal Production, Faculty of Agriculture, Mutah University, Al-Karak, Jordan.
[4] Department of Animal Production, Faculty of Agricultural Engineering, Aleppo University-Syria.
*** Corresponding author:** Anas Abdelqader, Department of Animal Production, School of Agriculture, University of Jordan, Amman, 11942, Jordan. Email: a.abdelqader@ju.edu.jo

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Abstract: Vitamin E is one of the four fat-soluble vitamins that is made naturally in plants. It is one of the necessary vitamins for humans and animals, and the body needs it because it cannot manufacture it. It works to preserve polyunsaturated fatty acids (PUSFA) outside and inside cells in the body and prevents free radical formation reactions resulting from respiratory and respiratory processes and through exposure to toxic external factors such as pollutants. Its deficiency leads to many, Vitamin E comes from plant elements that are in the form of tocopherols, which are compounds that possess the activity of vitamin E. They are in the form of yellow fats that do not dissolve in water, but they do dissolve in organic solvents. The name (Tocopherol) is derived from a Greek word, where "Tocos" means childbirth and Phero from Bear. These words mean the producer of offspring or offspring and are linked to his main role in reproduction in various types of animals. The OL from alcohol is evidence that it is an alcoholic substance.

Keywords: Vitamin E, Antioxidant, Free Radicals, Metabolism.

1. Introduction

Vitamin E is an important and necessary element for sustaining reproduction and growth and works to stabilize fats [1], [2]. Were the first to indicate the existence of vitamin E through a series of experiments on mice, as it was known at the time as an anti-sterility agent [3]. The toxicity of vitamin E in the kidney in human trials, even at large doses, is quite low, according to a review of the literature on the safety of oral vitamin E intake. Even at dosages higher than the ULs, there are significant differences in the effects and the dose-response relationship [4].

On the other hand, research in rats demonstrates negative effects on the kidneys at vitamin E levels far lower than those employed in human trials. Therefore, it is important to emphasize that high dosages of vitamin E that are close to the upper limit of toxicity but are nonetheless advised by manufacturers and deemed safe and

useful, have the potential to induce several negative effects in the kidneys [5], discovered the biological activity of vitamin E, which indicates that vitamin E is an antioxidant. Most sources of vitamin E are in fresh vegetable oils such as olive, coconut oil, corn, soybean, safflower, and sunflower. The least important are animal products, which are considered a poor source of vitamin E, such as eggs, fish, meat, and dairy products. Green plants are the most important source.

Tocopherols, which are dominant, are found in high concentrations in wheat germ, corn, cottonseeds, and sunflower seeds [6], [7]. Absorption of vitamin E with fat occurs in the small intestine, but it is concentrated in the duodenum depending on the functions of the pancreas and bile secretions. There is a direct relationship between the absorption of the vitamin and the absorption of fat, and most of the unabsorbed vitamin E is recovered with feces at the end of the intestine at a rate of 65-80% in humans, rabbits, and chickens [8], [9].

The chemical structure of the vitamin plays an important role in the absorption process, as the alpha-tocopheryl acetate form is absorbed better and faster than the other forms of vitamin E by the animal's intestines, The vitamin is transported by lipoproteins when it enters the chylomicron present in the blood plasma from the absorption sites (the small intestine) to the liver and then to the rest of the body's tissues. The predominant form of this vitamin in the blood and tissues is in the form of alpha-tocopherol, where it is stored mainly in adipose tissue and smaller quantities in the liver and muscles, there are appreciable quantities of vitamin E in the anterior lobe of the pituitary gland and the tissues of the kidneys and adrenal gland. Light is one of the factors that destroy vitamin E, as are oxygen and the long storage period of food. The positive interaction of vitamin E with some nutrients is the presence of other antioxidants such as vitamin C and beta-carotene that support the protective oxidative action of vitamin E. This applies to selenium as a mineral, and the negative interactions with iron, as it reduces the body's utilization of vitamin E by the body, and some medications reduce it. Vitamin E absorption [10], [11].

The Symptoms of vitamin E deficiency rarely appear in old birds because it is stored for very long periods in adipose tissue, so its permeation from tissue stores is slow. Symptoms of its deficiency appear as a result of its lack of presence in diets, and this may be primary, or secondary due to its lack of absorption and assimilation in the intestines as a result of the presence of vitamin E deficiency. Impairment in the processes of digestion and absorption of fats [12].

Chemical structure of vitamin E: Vitamin E has a ring structure consisting of 16 carbon atoms and contains three double bonds, Figure 1 [10], [13]. The term vitamin E includes eight fat-soluble compounds, the first four of which are in the form of tocopherols, which are alpha (α), beta (β), gamma (γ), and delta (Δ). As for the second four, they are in the form of tocotrienols, which are Epsilon (Є), Zeta (Z) Eta (h), and (8-Methyltocotrieol), The difference between these two types of forms is in the saturation of the carbon side chain (R), α-tocopherol is considered the most active form among the rest of the tocopherols and the most widespread because it contains three methyl groups in the benzene ring [14].

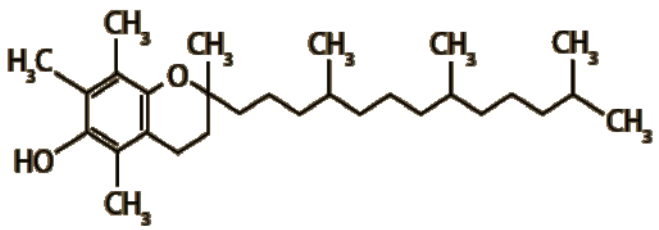

Fig. 1. The general structure of vitamin E.

As for the rest, they contain less than three methyl groups, such as beta and gamma-tocopherol, which contain two groups, while delta-tocopherol which contains only one group, α-tocopherol is also found either in free form (d-form) or in the form of salts or esters such as α-tocopherol acetate, and the effectiveness of alpha-

tocopherol is estimated at 100% compared to the other forms. The effectiveness of beta-tocopherol is 50%, gamma-tocopherol is 20%, and delta-tocopherol is 10% [15].

Effect of vitamin E as an antioxidant: Vitamin E's primary function is as an antioxidant, as it prevents the formation of free radical peroxide in fat cells by inhibiting the beginning of the formation of free radicals. Its presence between and within the cells of the body works to prevent the oxidation of unsaturated fatty acids (PUFA). It also prevents the breakdown of the lipid structure in the mitochondria by oxidation. It helps in the synthesis of ascorbic acid and the metabolism of amino acids containing a sulfur group, such as methionine, and it preserves vitamins A and D2 from oxidation and tissue damage, its presence between and within the cells of the body works to prevent the oxidation of unsaturated fatty acids (PUFA). It also prevents the breakdown of the lipid synthesis in the mitochondria by oxidation. It helps in the synthesis of ascorbic acid and the metabolism of amino acids containing a sulfur group, such as methionine. It also preserves vitamins A and D3 from oxidation and damage in tissues [11].

The role of vitamin E in protecting unsaturated fatty acids and cholesterol comes through its work in breaking the chain of fat oxidation reactions by suppressing the peroxyl radical by giving it a hydrogen atom and thus leading to the reduction of the formation of hydroperoxide, As for the vitamin E radical (Toco Peroxyl radical - T0), it has high stability and does not interact with unsaturated fatty acids (PUFA), This radical may interact with other radicals during the chain of reactions, ultimately leading to the oxidation of fats in the absence of vitamin E, thus preventing the peroxidation process of PUFA from occurring through its interaction with the free radicals formed as a result of the continuous reactions of oxygen within the body or peroxides. Which directly leads to the oxidation of lipids, including phospholipids, which are involved in the composition of the plasma membranes of cells [16].

Vitamin E can also return to its effective reduced state in the presence of vitamin C and the enzyme GSH-PX. These compounds are water-soluble antioxidants, and they are reducing agents that lead to the production of vitamin E in a stable reduced state (Figure 2). This reaction depends on the concentration of antioxidants that support the reduced formula for vitamin E [17], [18]. The ability of vitamin E to stop the chain of free radical reactions in the initiation stage is due to its containment of hydroxyl groups that work to donate hydrogen atoms to the active free radicals and render them ineffective, thus inhibiting the production of peroxide, impeding the formation of malondialdehyde, and controlling the stability of fats by limiting the decomposition of free fatty acids. As well as its ability to restrict metal ions that stimulate oxidation reactions by inhibiting the release of iron from liver tissue pigments. This is evidenced by an increase in the concentration of bound iron in the meat tissue, The ability of vitamin E to inhibit the formation of free radicals within the body by enhancing the activity of antioxidants of body origin, such as increasing the enzymatic activity of CAT and GSH-PX in blood plasma and increasing the level of GSH in liver tissue, which works to remove free radicals by donating hydrogen and increasing the decomposition of H2O2 and restricting it. For metal ions, thus protecting the coverings of liver cells and the membranes of their internal cell structures (hepatocytes), and thus their ability to maintain the manufacturing function of liver cells, which causes an enhancement of the antioxidant state, This can be inferred from an increase in the activity of the ALP enzyme and a decrease in the activity of the enzymes AST and ALT in the blood plasma as a result of adding Antioxidants in food, as well as the high activity of the ALP enzyme in blood plasma are considered an indicator of the synthetic ability of liver cells to increase the assimilation of calcium and phosphorus from the bones into the blood. Also, the decrease in the activity of the enzymes ALT and AST in the blood plasma reduces the process of building glucose from non-carbohydrate sources such as proteins.

Which reduces the process of catabolism of blood proteins and body cells and thus their ability to maintain the levels of blood proteins and glucose within normal levels. The role of antioxidants in maintaining the level

of fats in the blood and around the organs does not increase, as the glucose over the body's needs turns into fat. The decrease in the level of blood glucose as a result of adding antioxidants to food is considered evidence of the ability of antioxidants to maintain the manufacturing function of the liver by increasing the process of glucose assimilation and withdrawing it from the blood to the cells in the liver to oxidize it to release the energy necessary to meet the needs for sustainment and growth, The role of vitamin E in protecting liver tissues from the effects of free radicals has led to increased stimulation of liver cells to manufacture proteins, as a high total protein concentration is considered a good indicator of health status and evidence of egg formation because most of the components of the egg are transferred from the liver to the ovary through the blood in the form of lipoproteins. This confirms that a high concentration of protein in blood plasma is accompanied by an increase in the number of eggs.

Vitamin E also plays an important role in reducing the lipid profile in blood plasma through: Its ability to raise HDL levels, which works to remove cholesterol and fats from cells and blood vessel walls through a reverse transfer process to the liver, thus converting them into bile acids or excreting them outside the body, Its ability to protect LDL from oxidation resulting from the action of free radicals, as LDL represents the main carrier of cholesterol, triglycerides, and all fats containing phosphorus, as it works to remove these molecules from various cells of the body to use them in the process of biosynthesis of fats in the liver. They are used in the formation of yolk fats, which consist of VLDL, triglycerides, and cholesterol. Here comes the role of antioxidants in stimulating liver cells and membranes by protecting them from oxidation and encouraging the release of yolk precursors from the liver to the ovarian follicles. This increases the speed of the process of yolk deposition in developing eggs and thus increases the relative weight of the yolk and its maturation in a faster time, which is reflected in an increase in egg production and egg mass [19].

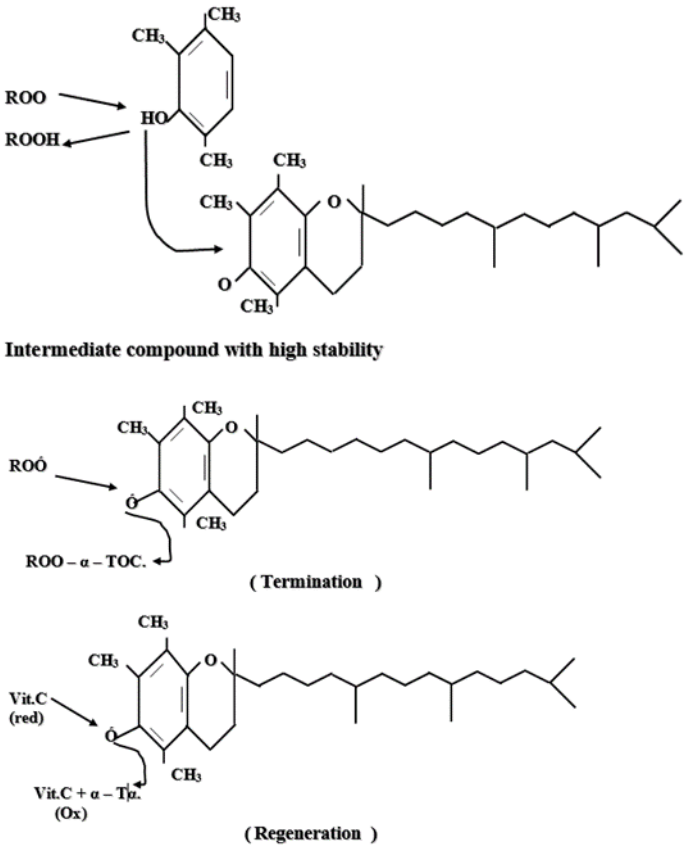

Fig. 2. Effect of vitamin E as an antioxidant.

To replenish and release vitamin E within the body: Vitamin C also maintains the antioxidant properties of vitamin E and helps regenerate and release vitamin E within the body by stimulating tocopherol radicals and

by using the liposomal membrane system. This conclusion is based on the study conducted on guinea pigs. Which was given 15% oxidized fat in the feed while giving different levels of vitamin C. It was observed that a significant decrease in the concentration of vitamin E in the body tissues occurred when low levels of vitamin C were given. However, when these levels in the feed increased, an increase in the concentration of vitamin E in the plasma was observed in the blood as well as in both the brain and liver [20].

During the development of chick embryos, vitamin E is essential for maintaining healthy cell proliferation and guarding against oxidative stress. Some of the most important roles that vitamin E plays in chick embryos are as follows:

Antioxidant Protection: In chick embryos, vitamin E acts as the main antioxidant, protecting cells from damage brought on by dangerous free radicals. These free radicals can cause oxidative stress, break cell membranes, damage DNA, and change the way proteins function. They are produced by both environmental stressors and regular biological processes. These free radicals are efficiently neutralized by vitamin E, preventing oxidative damage to the vulnerable embryonic tissues [21].

In addition, vitamin E is especially abundant in cell membranes, where it maintains the stability of the phospholipid bilayer, which serves as the structural basis of cells. Vitamin E ensures that cellular activities, such as waste disposal, communication with other cells, and nutrition transfer, operate properly by shielding cell membranes from oxidative damage [22].

Support for the immunological System: Vitamin E helps chick embryos' immunological response. It aids in the growth and operation of immune cells, including lymphocytes and macrophages, which are in charge of warding off infections and preserving immune system integrity. Hatchability and Chick Quality: Successful hatchability and the production of healthy chicks depend on adequate vitamin E consumption throughout embryonic development. Supplementing with vitamin E has been demonstrated in studies to increase hatching rates, decrease embryo mortality, and improve chick quality metrics like weight and body composition [23].

All things considered, vitamin E is a crucial component for the development of chick embryos because it supports cell membrane integrity, boosts immunity, offers critical antioxidant protection, and aids in normal growth and development. Increasing the amount of vitamin E that a mother consumes through food or supplements can greatly enhance the health and hatchability of her embryos.

2. Conclusion

The term vitamin E includes eight fat-soluble compounds, the first four of which are in the form of tocopherols, which are alpha (α), beta (β), gamma (γ), and delta (Δ). As for the second four, they are in the form of tocotrienols, which are Epsilon (Є), Zeta (Z) Eta (◎), and (8-Methyltocotrieol). The difference between these two types of forms is in the saturation of the carbon side chain (R). The role of vitamin E in inhibiting the formation of free radicals and protecting against damage resulting from the effect of oxidative stress in liver tissues and cells leads to the maintenance of the vital metabolic functions of liver cells in the representation of biomolecules (glucose, proteins, and fats) necessary for the formation of yolk precursor components and the protection of the main carriers (LDL, HDL). To transport fats (triglycerides, cholesterol, phosphorylated fats) from the blood to the liver to manufacture yolk components and the role of antioxidants in the rapid deposition of yolk precursors from the liver to the ovary.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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