

THE IMPORTANCE OF VITAMIN A IN THE NUTRITION

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ZNAČAJ VITAMINA A U ISHRANI

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ABSTRACT

Vitamin A is a group of molecules that are introduced into the body through food. This vitamin is present in food of vegetable and animal origin. Daily vitamin A needs depend on age and reproductive status. The lowest concentrations are required by infants and children up to 14 years of age, while pregnant women and lactating women are more likely to have the highest vitamin A needs. In the human body, vitamin A participates in numerous physiological processes. This vitamin forms the pigment rhodopsin which enables night vision. In addition to this role, vitamin A exerts its function in the immune system, where it participates in maintaining the integrity of the epithelial membranes, as well as in the proper functioning and differentiation of lymphocytes. More recent studies show that vitamin A has a protective role in the process of carcinogenesis and that its regular use prevents gastric cancer from developing. Vitamin A deficiency is a serious public health problem in certain regions of the world, so vitamin supplementation is recommended in some cases in children up to 5 years of age and in pregnant women.

Key words: vitamin A; recommended dietary allowances; vision, ocular; immunity; carcinogenesis.

INTRODUCTION

Vitamin A is a common name for a group of lipophilic biomolecules that are required at low concentrations by the human body to perform numerous functions. There are three main forms: retinal (aldehyde isoform), retinol (alcohol isoform) and retinoic acid, which represents an irreversibly oxidized form of retinol. In addition to these three main forms, the vitamin A group also includes some forms of carotenoids (α -carotene, β -carotene, β -cryptoxanthin) (1).

SOURCE OF VITAMIN A

Vitamin A compounds are essential micronutrients that cannot be synthesized in the human body, but are ingested through food. During the newborn and infant period, mother's breast milk is a rich source of both vitamin A and provitamin A carotenoids (2). Carotenoids are tetraterpene pigments that are yellow, orange and red in color. They are tetraterpene pigments that are distributed in

SAŽETAK

Vitamin A predstavlja grupu molekula koji se u organizam čoveka unose preko hrane. Ovaj vitamin je zastupljen u namirnicama biljnog i životinjskog porekla. Dnevne potrebe za vitaminom A zavise od starosne dobi i reproduktivnog perioda. Najmanje koncentracije zahtevaju odojčad i deca do 14 godina, dok veće potrebe za vitaminom A imaju trudnice i žene u periodu laktacije. U ljudskom organizmu vitamin A učestvuje u brojnim fiziološkim procesima. Ovaj vitamin obrazuje pigment rodopsin, koji omogućava noćni vid. Pored ove uloge, vitamin A svoju funkciju ostvaruje i u imunskom sistemu, gde učestvuje u održavanju integriteta epitelnih membrana, kao i u pravilnom funkcionisanju i diferencijaciji limfocita. Novija istraživanja pokazuju da vitamin A ima protektivnu ulogu u procesu kancerogeneze i da njegova redovna primena sprečava nastanak karcinoma želuca. Deficit vitamina A predstavlja ozbiljan javnozdravstveni problem u određenim regionima sveta, pa se preporučuje njegova nadoknada u određenim slučajevima kod dece uzrasta do pet godina i kod trudnica.

Cljučne reči: vitamin A, preporučeni dodaci ishrani; vid, okularni; imunost; kancerogeneza

photosynthetic bacteria, some species of archaea and fungi, algae, plants, and animals. Most carotenoids consist of eight isoprene units with a 40-carbon skeleton. Their general structures commonly consist of a polyene chain with nine conjugated double bonds. Carotenoids are divided into two groups: carotenes and xanthophylls. Carotenes and lycopene are hydrocarbons. About 50 kinds of carotenes are present in nature (3).

After the breastfeeding period, vitamin A is introduced into the body through food. Free retinol is rarely found in food (2). In food of animal origin vitamin A is present in pork liver, fish, dairy products, eggs (4). Food of vegetable origin contains a large percentage of carotenoids, which are precursors of vitamin A (α -carotene, β -carotene, β -cryptoxanthin) (5). Most carotenoids are found in red and orange fruits and vegetables, such as broccoli, carrots, spinach and sweet potatoes (4).

The World Health Organization (WHO) previously recommended vitamin A supplementation to improve vitamin A status in mothers and in newborns. However,

since 2011, vitamin A supplementation is no longer recommended for breastfeeding mothers, as a public health intervention, due to the lack of evidence that it prevents morbidity and mortality in mothers and infants (6). Vitamin A is commonly found in these products in two forms, as palmityl or retinyl acetate. In addition to these two forms, foods may also contain β -carotene and some have a combination of β -carotene and retinol. In developed countries, cereals, various types of snacks and beverages, as well as some types of margarines and dietary products, are most often fortified with vitamin A, while in developing countries, the products that are most often fortified with vitamin A include sugars, oils, margarines and some types of cereals (2).

Vitamin A deficiency is a prominent and widespread public health problem in developing countries. Many developing countries have developed various programs to prevent vitamin A deficiency (7). In the United States, available dietary supplements contain 1500 mcg of vitamin A, which is slightly more than a person's daily needs. Some pharmaceutical companies have limited their daily retinol intake via dietary supplements to 750 mcg because it has been shown that long-term, increased vitamin A intake may be associated with the onset of osteoporosis (8).

VITAMIN A DAILY NEEDS

The concentration of vitamin A required by the body for numerous physiological processes depends on age and reproductive status. The recommended doses for children above 14 years of age and elderly persons are 700 to 900 μcg of retinol equivalents per day. Slightly lower concentrations are recommended for children under 14 and nursing infants, 400 to 600 μcg per day. During pregnancy and breastfeeding, there is an increased need for vitamin A, so for the pregnant and lactating women are advised to take daily vitamin A of 900 to 1300 μcg (9). Data received from 9 European countries show that the average daily intake in children under 3 years of age ranges between 409 - 651 μcg of retinol equivalents. In children between 3 and 10 years, the average daily intake is 607 - 889 μcg of retinol equivalents, while in children between 10 and 18 years the average daily intake is between 597 and 1 078 μcg of retinol equivalents. In adults, the average daily intake is between 816 and 1 498 μcg of retinol equivalents (10).

PHYSIOLOGICAL ROLE OF VITAMIN A

Vitamin A and vision

Retinol is transported via circulation to the retina where it is accumulated in epithelial cells. In retinal cells, retinol is esterified and can be stored in such form. When

the need arises, the esterified form undergoes numerous reactions (hydroxylation, isomerization, oxidation) and as such participates in the composition of rhodopsin, a pigment that enables the binding of small amounts of light and night vision (11). Retinoids are defined as synthetic or natural derivatives of vitamin A. They were first discovered in 1913. Retinol and retinyl ester are dietary forms of what is commonly known as vitamin A (12).

Vitamin A and immunity

Vitamin A is essential for normal functioning of the immune system. The cells found in the skin, as well as the mucous membranes of the respiratory, digestive, and urinary tract, function as a natural barrier and prevent the entry of microorganisms. Retinol and its metabolites are necessary to maintain the integrity and function of these cells. In addition, vitamin A is essential for proper development and differentiation of white blood cells, such as lymphocytes, which are necessary for an adequate immune response (13). Vitamin A (retinol) enters the body as either preformed vitamin A or provitamin A carotenoids. Preformed vitamin A is hydrolyzed and taken up by enterocytes of the intestinal lumen. Once inside the cell, it is esterified and packaged into chylomicrons that are secreted into circulation. A large proportion of the retinol within these chylomicrons is acquired by liver hepatocytes and stored as retinyl esters in hepatic stellate cells. Stores of retinyl esters can then be mobilized when needed via hydrolysis back to retinol, which is transported throughout the vasculature by retinol binding protein. Target cells express the stimulation by retinoic acid 6 receptor, which binds to circulating RBP4-retinol complexes, internalizing retinol for conversion to retinoic acid. Once inside a cell, retinol is bound by cellular retinol binding proteins (14).

Vitamin A metabolites significantly affect some aspects of the adaptive immune response. Retinoic acid enhances cytotoxicity and T-cell proliferation, by enhancing IL-2 secretion and signaling in T cells. Consistent with an *in vivo* role for vitamin A in T-cell function, vitamin A deficiency has resulted in numerous deficiencies in TH-cell activity (15).

Vitamin A and growth and development

Retinol and retinoic acid are essential for embryonic development. During fetal development, retinoic acid participates in the proper formation of the extremities, as well as the heart, eyes and ears. Vitamin A has also been shown to play a role in the regulation of the gene that encodes growth hormone (16).

Vitamin A and suppression of cancerogenesis

Retinol and its metabolites (retinoids) play a crucial role in regulating cell proliferation and differentiation and also have an immunomodulatory effect (2). Retinoic acid, an active metabolite of vitamin A, accomplishes most of its function by binding to RA and X receptors that are expressed on gastric mucosal epithelial cells. Vitamin A administration is thought to lead to re-epithelialization of gastric mucosa in people with ulcer disease, and ulcer is known to be one of the greatest risk factors for gastric cancer development (17). There are three types of retinoic acid-related orphans: RAR-related orphan receptor- α /NR1F1, RAR-related orphan receptor- β /NR1F2, RAR-related orphan receptor- γ /NR1F3 (18).

Carotenoids have an antioxidant effect and can reduce the risk of gastric cancer development by reducing the concentration of free radicals produced by various factors (Haelicobacter pylori infection) that lead to DNA damage (17).

The results of studies to date that have examined the concentrations of vitamin A and β -carotene, affecting the prevention of gastric cancer, are quite controversial. Most case studies and controls have shown a significant inverse association between vitamin A, β -carotene intake and the risk of gastric cancer (19). Meta-analysis has also shown that very small doses of vitamin A can reduce the risk of stomach cancer (20).

In these results, a study by Larsen et al, which followed 82 002 adults from Sweden over a seven-year period, showed that high intakes of vitamin A, retinol and provitamin A may reduce the risk of gastric cancer development (17).

VITAMIN A DEFICIT PREVENTION

The consequences of vitamin A deficiency are reflected in all organs and organ systems. Vitamin A deficiency causes vision impairment and night blindness. Vitamin deficiency in the eye also causes a decrease in the moisture of the mucous membranes of the eye, thus developing xerophthalmia (dry eye). People with vitamin A deficiency are more prone to developing systemic infections. In the nervous system, insufficient amounts of vitamin A factor neuropsychiatric illnesses (Alzheimer's disease, schizophrenia, depression) (8).

In order to prevent vitamin A deficiency and serious complications development due to damage to the immune system, numerous programs and guides have been created around the world, covering the most vulnerable groups. The WHO has published a guideline to vitamin A supplementation in children aged from 6 to 59 months, as well as in women during pregnancy and after childbirth. Vitamin A supplementation is recommended for all

children aged from 6 to 59 months, living in environments where vitamin A deficiency is a major public health problem (risk of developing night blindness of 1% or more), or in which the prevalence of vitamin A deficiency is 20% or more (serum retinol less than 0.70 μ mol/L). Supplements implementation is also recommended if there is a high risk of developing HIV infection at this age (21). Supplementation of large doses of vitamin A significantly reduced childhood morbidity and mortality (22).

In pregnancy, vitamin A supplementation is recommended only for those pregnant women who live in areas where vitamin A deficiency is a severe and serious public health problem. The degree of deficiency is considered severe if there are 5% or more women in a given area whose night blindness has developed in one of the previous pregnancies in the last 3 to 5 years, and which ended in live birth. In addition, severe deficiency is also considered if pregnant women have a serum retinol level of less than 0.70 μ mol/L (23). The use of vitamin A supplements in HIV-positive pregnant women to reduce the risk of mother-to-child transmission, is not recommended (24), nor is supplementation of vitamin A postpartum (25).

Caution should be exercised when supplementing vitamin A in pregnancy, excessive vitamin intake in pregnancy can be a concern. In the first 60 days of pregnancy, excessive intake of vitamin A can have a teratogenic effect (26).

HYPERVITAMINOSIS A

Vitamin A hypervitaminosis is a very rare condition. But there is a possibility of hypervitaminosis due to the use of vitamin A preparations for therapeutic purposes. Chronic toxicity may occur after long-term intake of vitamin A at a dose of 10 mg / day in adults, and 7.5–15 mg / day in children. Acute poisoning occurs if children take 100 mg / day, and adults 500mg / day. Symptoms of acute poisoning are: nausea, irritability, decreased appetite, vomiting, blurred vision, headaches, hair loss, muscle pain, etc., while in chronic In cases of vitamin A toxicity we can notice the following symptoms: insomnia, hypothyroidism, anemia, fatigue, diarrhea, dry and itchy skin, desquamation of the skin and mucous membranes, hepatosplenomegaly, liver hypertrophy, hypertension, fibrosis (4).

RECOMMENDATIONS

In their revision of the Nordic Nutrition Recommendations (NNR), the Nordic countries decided to maintain their earlier recommendations of 900 μ g RE / day for men and 700 μ g RE / day for women. But the American Medical Institute of the National Academy of

Sciences also gave its recommendations. The recommended dietary supplement (RDA) based on the estimated half-life of vitamin A is an RDA of 900 µg RAE (retinol activity equivalent) / day for men and 700 µg RAE / day for women (27). Content of vitamin A in foods (in µg/100 g) is as follows (28): fish oil (100000), animal liver (10000), egg (200), yolk (3000), milk (40), cheese (300), margarine (vit.) (3000), carrot (5000), tomato (100) and apricot (260).

CONCLUSION

Vitamin A is a group of molecules that play an extremely important role in physiological processes in the body. It is present in many foodstuffs of animal and vegetable origin, so a balanced diet is sufficient to ensure an adequate daily intake of this vitamin. This vitamin enables normal night vision, has a defensive role in the onset of infections, as well as an antioxidant effect that prevents cancer from developing and growing.

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