

INTERNATIONAL JOURNAL OF INSTITUTIONAL PHARMACY AND LIFE SCIENCES

Pharmaceutical Sciences

Review Article.....!!!

Received: 01-10-2019; Revised: 23-11-2019; Accepted: 24-11-2019

VITAMIN A : A BRIEF REVIEW

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Keywords:

Vitamin A, Deficiency
disease, Research study

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ABSTRACT

Vitamins are important for human health growth, development, reproduction and maintenance, and their deficiencies are imposing serious health hazards. Thirteen vitamins are true vitamins which are further classified as water soluble and fat soluble vitamins. There are many other food components which have vitamin activity but these are not true vitamins. There are wide range of dietary sources including both plant and animal sources for these vitamins. Vitamin A is an essential micronutrient whose role in visual function has been known for thousands of years. The beneficial effects of vitamin A might have been recognized by the ancient Egyptians who treated eye disease with raw liver. They identified a connection between eye problems and the liver which is the richest source of vitamin A. Vitamin A deficiency has a plethora of clinical manifestations, ranging from xerophthalmia to disturbance in growth and susceptibility to severe infection.

INTRODUCTION

Vitamin A (called retinol in mammals) is a fat soluble vitamin. Human ingest two types of vitamin A: provitamin A from plants and preformed vitamin A from animal source. It is related to growth and differentiation of the tissues.

The main sources of preformed vitamin A or retinol are liver, whole milk, fish oil and egg. Retinoic acid (RA) is the active metabolite of vitamin A and is a critical signaling molecule for both the developing and adult central nervous system (CNS).

Vitamins are essential organic compounds required in very small amount of micrograms to milligrams to maintain the fundamental functions of the body.

The discovery of vitamin A stemmed from research dating back to 1906, indicating that factors other than carbohydrates, proteins and fats were necessary to keep cattle healthy.

Vitamin A is most complicated in nature. It can be obtained both from plant and animal sources.

Vitamin A Source:-

Different dietary sources of Vitamin A have different potencies. For example beta-carotene is less easily absorbed than retinol and must be converted to retinal and retinol by the body. One of the recent international standards of measure for vitamin A is retinol activity equivalent (RAE) which represents vitamin A activity is retinol.

Food Sources:-

Free retinol is not generally found in foods. Retinyl palmitate, a precursor and storage form of retinol, is found in foods from animals. Plants contain carotenoids, some of which are precursors for vitamin A.

Yellow and orange vegetables contain significant quantities of carotenoids. Green vegetables also contain carotenoids. Green vegetables also contain carotenoids, though the pigment is masked by the green pigment of chlorophyll. A number of good sources of vitamin A include cod liver oil, eggs, butter, milk, sweet potato, carrot, spinach and broccoli.

Dietary Sources:-

Provitamin A carotenoid sources are sweet potato, carrots, spinach, kale, mustard greens, collard greens, turnip greens, winter squash, romaine lettuce, bok choy, sea vegetables, chili peppers, tomatoes, basil, papaya, shrimp, Brussels sprouts and grapefruit.

Supplements:-

The principal forms of preformed vitamin A in supplements are retinyl palmitate and retinyl acetate. Beta carotene is also a common source of vitamin A in supplements and many supplements provide a combination of retinol and beta- Carotene.

Daily requirement:-

It should be 15 micrograms in daily basis for teenager males and females.

Vitamin A metabolism:-

Vitamin A has three active forms (retinal, retinol and retinoic acid) and a storage form (retinyl ester):

Circulating retinol is primarily bound to retinol-binding (RBP), and can enter and leave the liver several times per day in a process known as retinol recycling, which acts to relate the amount of retinol in circulation and protects cells from the damaging effects of free retinol or retinoic acid. Retinol bound to a cellular RBP (CRBP or CRBP-II) can be esterified by the enzyme lecithin: retinol acyltransferase (LCAT), the resulting retinyl ester being stored primarily in liver stellate cells. LCAT provides a readily retrievable storage form of vitamin A, as well as regulating its availability for other pathways.

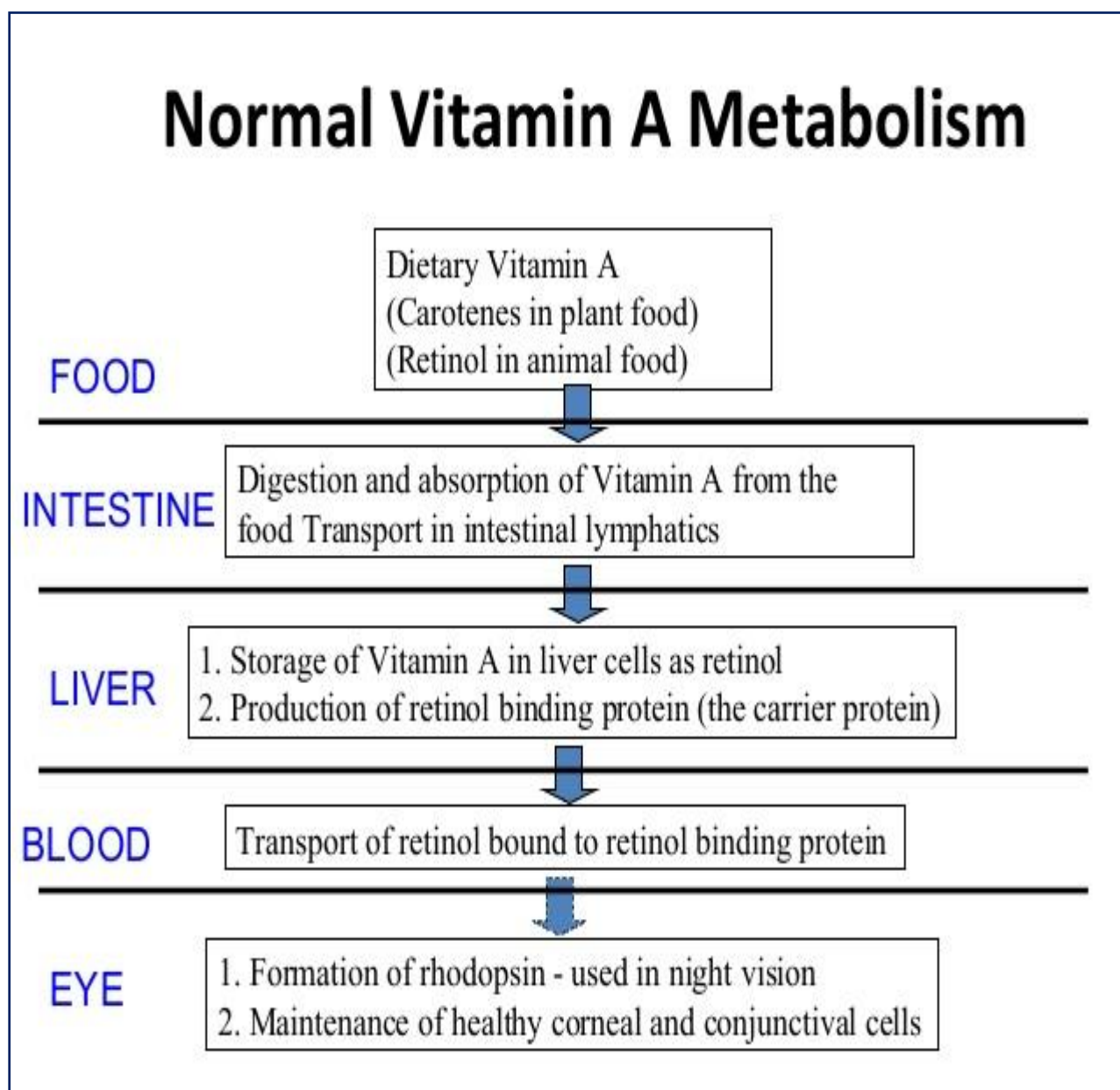
Vitamin A is required throughout life and participates in numerous cellular activities involved in reproduction, embryonic development, vision, growth, cellular differentiation and proliferation, tissue maintenance and lipid metabolism. The three active forms of vitamin A each serve different overlapping functions for rhodopsin formation and vision, while retinoic acid is the principal hormonal metabolite required for proper growth and differentiation of epithelial cells.

Vision and Vitamin A:-

Vitamin A is required for the formation of the photoreceptor rhodopsin, which is a complex of retinal and the vision protein opsin, where retinal functions as the chromophore. Rhodopsins are found in animals and green algae where they act as regulators of light-activated photochannels and in archaea where they act as light-driven ion pumps. In animals, the light-sensitive pigment rhodopsin occurs embedded in the membrane of rod cells in the retina at the back of the eye. When light passes through the lens, it is sensed in the retina by both rod cells (black and white vision) and cone cells (colour vision). In rod cells, the exposure of rhodopsin to light causes 11-cis-retinal to be released from opsin, resulting in a conformational change in the photoreceptor that activates the G-protein transducin. Transducin activation leads to the closure of the sodium channel in the membrane and the hyperpolarisation of the rod cell, which propagates a nerve impulse to the brain that is perceived as light. Rod cells are especially important for night vision as they can detect very small amount of light. Inadequate amounts of retinol can lead to Night Blindness and a corneal malformation, therefore eating carrots does let you see better in the dark.

Role of vitamin A in regulation of physiological functions:-

The retina is located at the back of the eye. When light passes through the lens, it is sensed by the retina and converted to a nerve impulse for interpretation by the brain. Retinol is transported to the retina via the circulation and accumulates in retinal pigment epithelial cells. Here, retinol is esterified to form a retinyl ester, which can be stored. When needed, retinyl ester are broken apart and isomerized to form 11-cis-retinol; which can be oxidized to form 11-cis-retinal. The latter can be shuttled across the interphotoreceptor matrix to the rod cell where it binds to a protein called opsin to form the visual pigment, rhodopsin. Rod cells with rhodopsin can detect very small amounts of light, making them important for night vision.



Immunity:-

Vitamin A is commonly known as the anti-infective vitamin, because it is required for normal functioning of the immune system. The skin and mucosal cells (that line the airways, digestive tract, and urinary tract) function as a barrier and form the body's first line of defense against infection. Retinol and its metabolites are required to maintain the integrity and function of these cells. Vitamin A and retinoic acid play a central role in the development and differentiation of white blood cells, such as lymphocytes, which play critical roles in the immune response. Activation of T-lymphocytes, the major regulatory cells of the immune system, appears to require all Trans RA binding of RAR.

Growth and Development:-

Both vitamin A excess and deficiency are known to cause birth defects. Retinol and retinoic acid are essential for embryonic development. During fetal development, RA functions in limb development and formation of the heart, eyes, and ears. Additionally, RA has been found to regulate expression of the gene for growth hormone.

Red blood cell production:-

Red blood cells, like all blood cells, are derived from precursor cells called stem cells. Stem cells are dependent on retinoids for normal differentiation into red blood cells. Additionally, vitamin A appears to facilitate the mobilization of iron from storage sites to the developing red blood cell for incorporation into hemoglobin, the oxygen carrier in red blood cells.

Reduction of Mortality:-

Approximately a 30% reduction in child mortality results from supplements of vitamin A in areas in which vitamin A nutrients are generally inadequate. Large vitamin A supplements also tend to reduce the adverse effects of measles infections in malnourished populations.

Diseases caused by deficiency of vitamin A:-

- Night blindness.
- Conjunctival xerosis.
- Bitot spot.
- Corneal xerosis.

Night Blindness:-

Night blindness is a type of vision impairment also known as nyctalopia. People with night blindness experience poor vision at night or in dimly lit environments.

Although the term "night blindness" implies that you can't see at night, this isn't the case. You may just have more difficulty seeing or driving in darkness.

Some types of night blindness are treatable while other types aren't. See your doctor to determine the underlying cause of your vision impairment. Once you know the cause of the problem, you can take steps to correct your vision.

Causes of night blindness:-

A few eye conditions can cause night blindness, including:

- Nearsightedness or blurred vision when looking at faraway objects.
- Cataracts or clouding of the eye's lens.
- Retinitis pigmentosa, which occurs when dark pigment collects in your retina and creates tunnel vision.
- Usher syndrome, a genetic condition that affects both hearing and vision.

Vitamin A deficiency can also lead to night blindness.

Vitamin A, also called retinol, plays a role in transforming nerve impulses into images in the retina. The retina is a light-sensitive area in the back of your eye.

People who have pancreatic insufficiency, such as individuals with cystic fibrosis, have difficulty absorbing fat and are at a greater risk of having vitamin A deficiency because vitamin A is fat soluble. This puts them at greater risk for developing night blindness.

Orange colored foods are excellent sources of vitamin A, including:-

- Cantaloupes
- Sweet potatoes
- Carrots
- Pumpkins
- Mangoes

Keratomalacia:-

Keratomalacia is an eye condition in which the cornea, the clear front part of the eye, gets cloudy and softens. This eye disease often starts as xerophthalmia, which is severe dryness of the cornea and conjunctiva.

The conjunctiva is the thin mucous membrane that lines the inside of your eyelid and covers the front of your eyeball. Once your eyelid and covers the front of the eyeball. Once your conjunctiva dries, it thickens, wrinkles, and becomes cloudy while the cornea softens.

Symptoms:-

- Night blindness
- Dryness of the eyes
- Cloudiness in corneas

Treatment:-

- Increase vitamin A consumption
- Use lubricating and antibiotic eye drops or ointments

Bitot's Spots:-

Bitot's spot are the buildup of keratin located superficially in the conjunctiva of human's eyes. They can be oval, triangular or irregular in shape. The spots are a sign of vitamin A deficiency and associated with drying of the cornea.

Corneal xerosis:-

This is drying of the cornea and is a sign of sudden, acute deficiency. The cornea becomes dry because glands in the conjunctiva no longer function normally. This leads to loss of tears and also loss of mucous, which acts as a 'wetting agent'. The lack of tears not only leads to the dry appearance but also increases the risk of infection.

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