

## VITAMIN A RICH FOODS AND THEIR CHEMICAL PROPERTIES

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### Abstract

Vitamin A is a fat-soluble micronutrient essential for vision, immune system function, cell differentiation, and growth. It occurs in two primary forms: preformed vitamin A found in animal products and provitamin A carotenoids found in plant sources. This article analyzes the chemical characteristics of vitamin A and evaluates major food sources rich in this vitamin. Particular attention is given to the molecular structure, chemical properties, and transformation of carotenoids into biologically active retinol in the human body. The study also discusses the nutritional importance of vitamin A-rich foods and their role in preventing vitamin A deficiency.

### Keywords

Vitamin A, retinol, carotenoids,  $\beta$ -carotene, food chemistry, nutritional biochemistry, hypervitaminosis, hypovitaminosis, carotenoids, alpha and beta carotene, retinoic acid.

**Introduction.** Vitamin A is one of the most important fat-soluble micronutrients required for normal physiological functions in humans. It plays a fundamental role in visual processes, immune defense, epithelial tissue maintenance, reproduction, and cellular differentiation[1-2]. Vitamin A deficiency remains a significant public health problem in many developing countries, particularly affecting children and pregnant women.

Chemically, vitamin A refers to a group of compounds known as retinoids, including retinol, retinal, retinoic acid, and retinyl esters. These compounds possess a characteristic polyene chain with conjugated double bonds and a  $\beta$ -ionone ring, which are responsible for their biological activity and chemical properties[3-5]. In addition to preformed vitamin A found in animal products, plants contain provitamin A carotenoids, primarily  $\beta$ -carotene, which can be enzymatically converted into retinol in the human body.

It is a pity that today, diseases caused by vitamin deficiency, growth and development defects are increasing in both adults and children. Vitamin deficiency causes not only pathological conditions, but also various changes in the appearance of a person. For example, as a result of vitamin A deficiency, the skin loses its moisture, becomes dry and flaky, and wrinkles appear on the face more easily[6-8]. Hair loses its shine and attractiveness, becomes dry, brittle, and may fall out more often. Nail plates become thinner, lines appear, and they also become brittle. Lips become dry, they crack easily and often. These conditions significantly affect not only the lifestyle of patients, but also their mental state. Vitamin deficiency in the body is generally called avitaminosis[9-11]. To prevent such situations, it is necessary to have a doctor



check you up on time and pay special attention to the rules for preparing vitamin-rich fruits and vegetables.

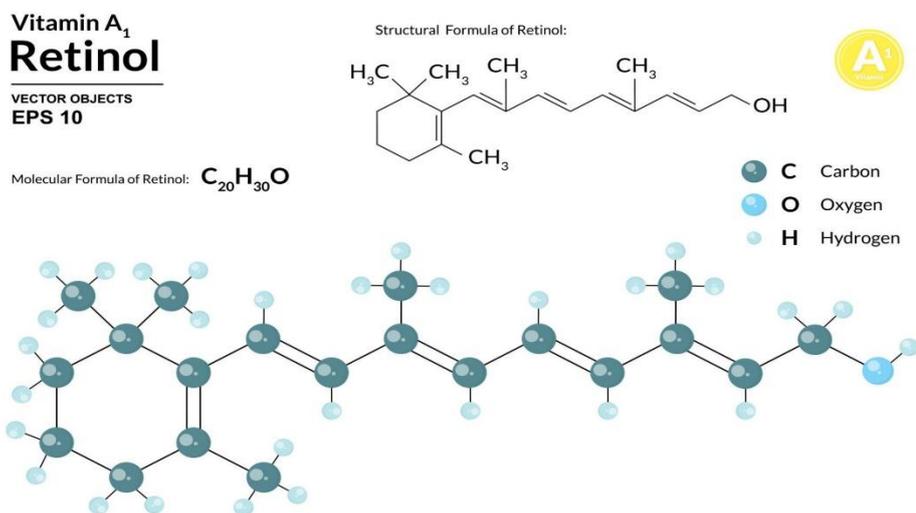


Figure 1. Chemical structures of major vitamin A compounds

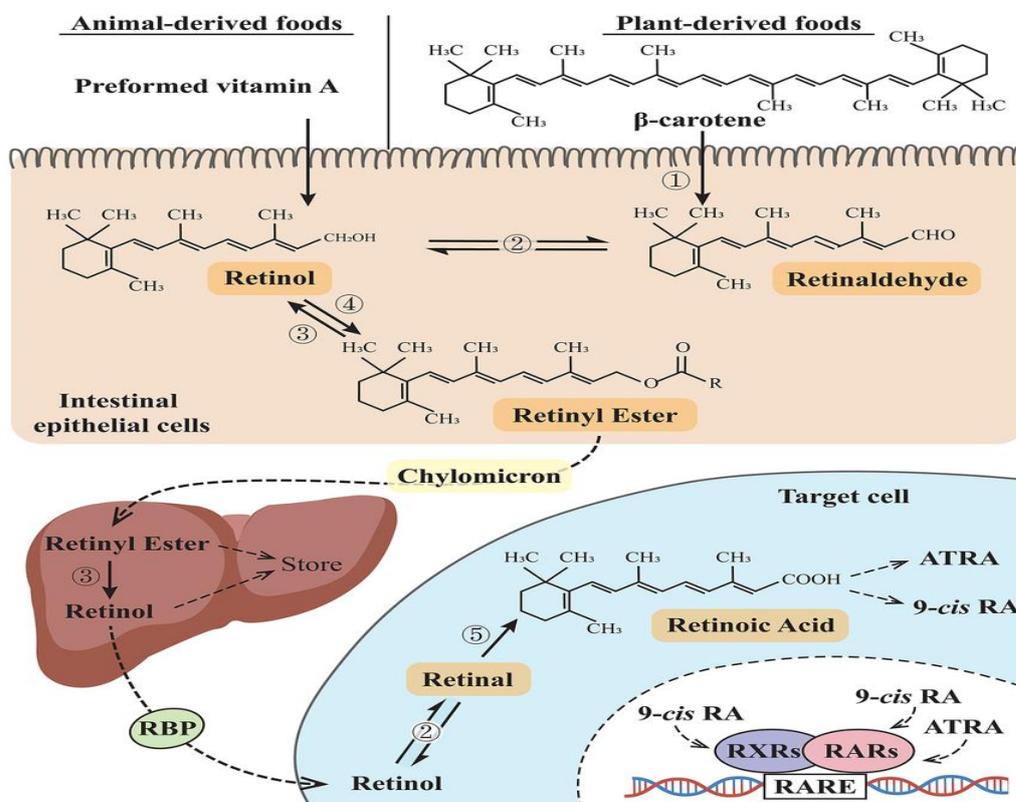


Figure 2. Biochemical conversion of  $\beta$ -carotene to vitamin A in the human body

Dietary sources of vitamin A include liver, dairy products, eggs, and fish oils, while provitamin A carotenoids are abundant in vegetables and fruits such as carrots, spinach, pumpkin,



sweet potatoes, and apricots[12-14]. The chemical nature of these compounds determines their stability, bioavailability, and metabolic transformations.

Understanding the chemical characteristics of vitamin A and identifying foods rich in this vitamin are essential for improving nutritional strategies and preventing deficiency-related diseases such as night blindness, xerophthalmia, and impaired immune function. Therefore, the purpose of this study is to analyze vitamin A-rich foods and discuss the chemical properties of vitamin A compounds from a food chemistry perspective.

**Materials and methods.** The research was conducted using a literature analysis and comparative evaluation method based on published scientific studies in food chemistry, nutritional biochemistry, and medical nutrition.

**Purpose of the article:** Analysis and tasks. Study of products rich in vitamin A and the criteria for their consumption.

The study was conducted online and offline. A questionnaire consisting of 10 questions was conducted. The online survey was conducted through the “survey” website. The offline survey was conducted in the form of a question and answer.

120 people participated in the survey. The survey was voluntary. We used the 4 main questions to justify the study. Question 1: “Do you know that reheating food reduces the amount of vitamin A in it?” Yes, so I cook it so that it is enough for one meal - 10%, I know, but I still reheat it several times and eat it - 59%, No, I haven’t thought about it - 23%, I partially follow it - 8%. Question 2: “Do you add spinach and greens at the end of cooking or do you boil them with the food for a long time?” I add them only at the end (to preserve vitamins) - 20%, I add them at the beginning and boil them together - 40%, I eat the greens raw without cooking them - 40%. Question 3: “When cooking liver, do you try to simmer it for a short time to preserve vitamins?” Yes, of course, I simmer it for 20 minutes - 25%, No, I fry it thoroughly - 55%, I do not eat liver - 20%. Question 4: “In what way do you mainly prepare products rich in vitamin A (for example, carrots, liver)?” The answers given were: Roasting (over high heat) - 60%, Steaming or simmering - 15%, Raw (in salads) - 25%.

Food products were categorized into two groups:

1. Animal sources containing preformed vitamin A (retinol)
2. Plant sources containing provitamin A carotenoids

Chemical analysis. The study evaluated chemical properties of vitamin A compounds including:

- ✚ molecular structure
- ✚ oxidation reactions
- ✚ isomerization
- ✚ esterification processes

### Chemical structure of vitamin A

Retinol is an unsaturated isoprenoid alcohol with the molecular formula:  $C_{20}H_{30}O$

The molecule consists of:

- ✚  $\beta$ -ionone ring
- ✚ conjugated polyene chain
- ✚ terminal hydroxyl group ( $-OH$ )

This conjugated double-bond system gives vitamin A:

- ✚ high reactivity
- ✚ antioxidant properties
- ✚ sensitivity to oxygen and light.

Deficiency of vitamins in the body or their excessive consumption can cause various diseases and pathological conditions, so it is necessary to receive them in sufficient quantities. Insufficient vitamins in the body - hypovitaminosis - result in constant fatigue, weakness, dry



and cracked skin, weakened immunity, frequent illnesses. Their excess in the body - hypervitaminosis - causes symptoms such as inflammation of the cornea, loss of appetite, nausea, enlarged liver, pain in the joints. In some cases, the body needs additional vitamins. Such conditions include pregnancy, old age, and certain diseases.

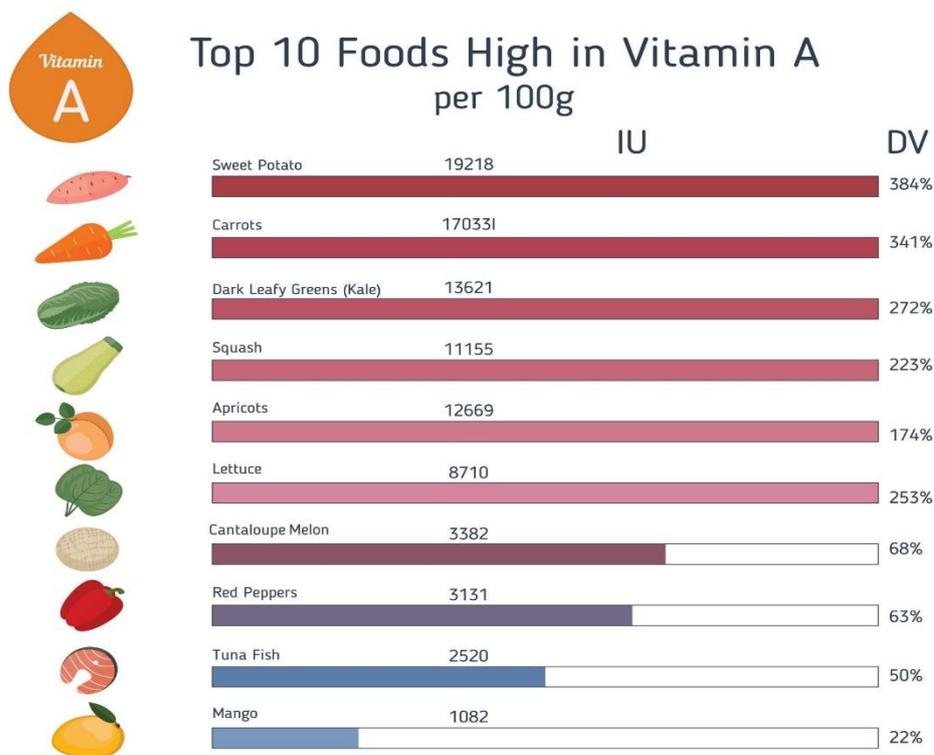


Figure 3. Vitamin A content in selected foods

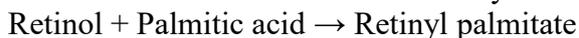
Vitamin A is a fat-soluble vitamin and is stored in the liver. There are 2 types of vitamin A in food. The first of these is retinol, which is the active form of vitamin A. It is found in animal products such as meat, fish oil, butter, egg yolk, cheese, cream, liver, and milk. The second type of vitamin A is provitamin A, which is found in fruits and vegetables such as pumpkin, carrots, greens, red peppers, and cabbage. The second type is also called carotenoids. This type can be converted into the active form of vitamin A. Vitamin A is one of the essential nutrients for the body. Beta-carotene is its provitamin form, and the body converts it into the active vitamin A retinol when it needs it. Therefore, even when beta-carotene is consumed in excess, the body converts the required amount into active vitamin A and stores or excretes the rest as a reserve.

**Chemical transformations.** Vitamin A participates in several important chemical reactions.

**Oxidation.** Retinol can be oxidized to form retinal and retinoic acid.

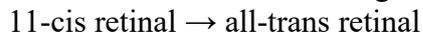


**Esterification.** Retinol reacts with fatty acids forming retinyl esters such as:



These esters are the main storage form of vitamin A in the liver.

**Isomerization.** Retinal undergoes cis-trans isomerization during visual processes:



This reaction is essential for photoreception.

**Vitamin A rich foods**

**Animal products**

Table 1.

Food product	Vitamin A (µg/100 g)
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Beef liver	Beef liver
Fish liver oil	Fish liver oil
Egg yolk	Egg yolk
Butter	Butter
Cheese	Cheese

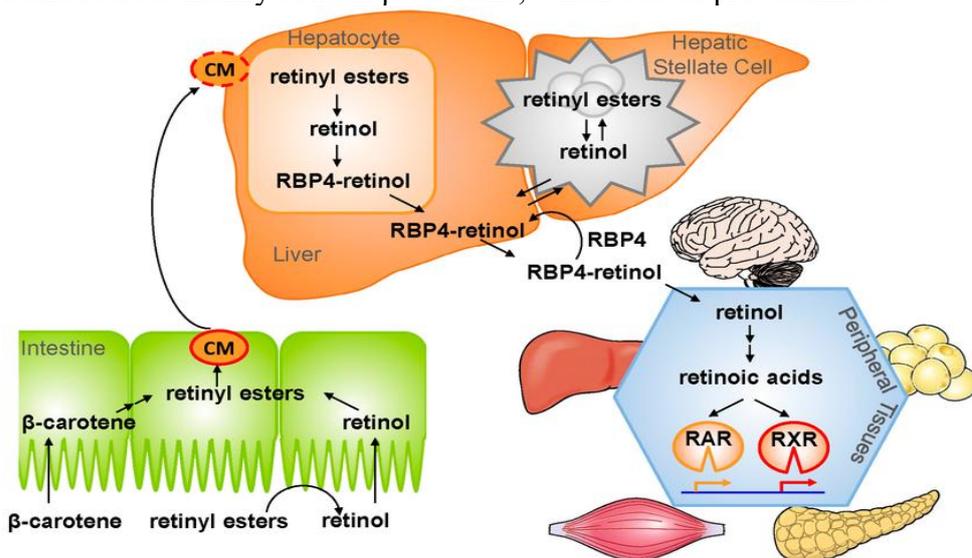
Animal foods contain vitamin A in the form of retinol or retinyl esters.

**Plant products**

**Table 2.**

Food product	$\beta$ -carotene ( $\mu\text{g}/100\text{ g}$ )
Carrot	8000–10000
Spinach	5000–7000
Pumpkin	3000–5000
Sweet potato	7000–9000
Apricot	1500–2000

Plant sources mainly contain  $\beta$ -carotene, which acts as provitamin A.



**Figure 4. Absorption and transport of vitamin A in the human body**

**Discussion.** The chemical structure of vitamin A plays a critical role in its biological activity and nutritional importance. The conjugated double-bond system present in retinoids contributes to their ability to absorb light, which is essential for vision. Moreover, the lipophilic nature of vitamin A allows it to be stored in the liver and transported through lipid-containing systems in the body.

Carotenoids found in plant foods serve as important precursors of vitamin A. Among them,  $\beta$ -carotene is considered the most efficient provitamin A compound. Enzymatic cleavage of  $\beta$ -carotene in the intestinal mucosa results in the formation of retinal, which can subsequently be converted to retinol.

Numerous studies have shown that diets rich in vegetables and fruits containing carotenoids can significantly reduce the risk of vitamin A deficiency. Additionally, these compounds exhibit antioxidant properties that help protect cells against oxidative stress.

**Conclusion.** According to the results of the survey, we studied and analyzed the products rich in vitamin A among the population and their chemical properties. The results showed that



the population made mistakes in consuming vitamin-rich products. We conducted various explanatory work among them. It was clear that the population consumed vitamin-rich products incorrectly due to negligence or lack of medical information. I came to these conclusions through this article and my research among the population. Vitamins are an integral part of our lives, and even if they are taken in small quantities, they perform very important physiological functions for our body. Their deficiency in small quantities is also dangerous for life. Since they perform various functions in the human body, the deficiency of these vitamins causes disruption of these functions. Therefore, it is advisable to consume more and correctly such vitamin-rich products. We set ourselves the goal of organizing and promoting educational activities among the population about healthy eating and adopting a healthy lifestyle.

Vitamin A is a vital micronutrient with essential roles in vision, immunity, and cellular metabolism. It exists in two main forms: preformed vitamin A in animal products and provitamin A carotenoids in plant foods. The chemical structure of vitamin A compounds determines their biological functions and metabolic transformations. Foods such as liver, fish oil, eggs, carrots, spinach, and pumpkin represent important dietary sources of vitamin A. Regular consumption of these foods contributes to maintaining optimal health and preventing vitamin A deficiency.

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