

Article

The Relevance of the Use of Natural Astaxanthin in the Prevention and Treatment of Inflammatory Periodontal Diseases

Mariana Samoilova ^{1*}, Tamara Kosyreva ¹, Nikolay Tutyrov ¹, Daria Erzhova ¹, Angelina Kozhokar ¹, Olga Voeykova ¹, Svetlana Dragunova ¹, Zarina Mamasaidova ¹, Veronika Klimovskaya ¹, Margarita Sakanyan ¹

¹ Federal State Autonomous Educational Institution of Higher Education 'Patrice Lumumba Peoples' Friendship University of Russia' Department of Pediatric Dentistry and Orthodontics; Miklukho-Maklaya str., 10/2; Moscow, Russia, 117198

*Correspondence: marsamoylova@gmail.com; Tel.: +89166052828; marsamoylova@gmail.com, <https://orcid.org/0000-0001-6771-919X> (M.S.); kosyreva-tf@rudn.ru, <https://orcid.org/0000-0003-4333-5735> (T.K.); voeykova-ov@rudn.ru, <https://orcid.org/0000-0003-2935-8965> (O.V.); dragunova.s@bk.ru, <https://orcid.org/0000-0003-2497-2253> (S.D.); erzhova.ek4terina@yandex.ru, <https://orcid.org/0000-0001-8804-681X> (E.E.); mag.sakanyan@mail.ru, <https://orcid.org/0000-0001-8219-6358> (M.S.); kozhokarangelina@yandex.ru, <https://orcid.org/0009-0006-7792-3542> (A.K.).

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Abstract: Recent studies have shown that the development and occurrence of chronic periodontitis is associated with the state of the human immune system and its ability to adequately respond to microbial antigenic stimulation. In recent years, an increase in inflammatory periodontal diseases has been observed in the developed countries of the world. In this regard, the need for therapeutic and prophylactic agents with immunomodulatory and anti-inflammatory effects is increasing. Currently, the use of natural antioxidants as a therapeutic and prophylactic agent is becoming relevant. The article discusses the properties of natural astaxanthin as one of the most powerful natural antioxidants.

Keywords: astaxanthin, an antioxidant, inflammation, periodontitis.

1. Introduction

Inflammation is a complex, local and general pathological process that occurs in response to damage to the cellular structures of the body to the action of a pathogenic stimulus and manifests itself in reactions aimed at eliminating damage products, and if possible, agents (irritants), as well as leading to maximum recovery in the area of damage under these conditions. With inflammation, all types of metabolism are activated, pH readings decrease to 6.0 and below, osmotic pressure increases, contributing to the swelling of colloids. Inflammatory mediators such as prostaglandins, serotonin, histamine, bradykinin enhance the inflammatory response, which contributes to vasodilation and increased permeability. As a result, the amount of exudate and the level of endogenous pyrogens increases. The barrier function of the lysosome membrane is disrupted, aggressive simple- and hydrolytic enzymes that intensify the inflammatory process enter the cytosol [2].

Inflammatory periodontal diseases occupy the second place in frequency and prevalence among all dental diseases. This pathology covers 65% of the adult population of most developed countries of the world [3]. A sharp increase in the prevalence of periodontal diseases, the loss of a large number of teeth (more than with any other disease of the dental system), a violation of



chewing function and speech, the effect on the general condition of the body (decreased reactivity of the body, microbial sensitization, the development of allergic conditions, etc. D.) and the decline in the quality of human life force us to consider periodontal diseases as a special section in dentistry, and the problem is made not only general medical, but also social.

2. Purpose of work

To study the effect of astaxanthin in the prevention and treatment of inflammatory periodontal diseases.

3. Materials and methods

Conducting research at the Medical College of Hokkaido University (Japan), under the conditions of chemical experiment, natural astaxanthin suppressed nitric oxide, cell necrosis factor and Interleukin 1B.

4. Results and discussions.

In the periodontal tissues of healthy people, there is a balance of anti-inflammatory and anti-inflammatory cytokines that regulate the immune response to microbial infection. In patients with inflammatory periodontal diseases, the total amount of IL-1B, IL-5, IL-6 and IL-8, TNF- α and TGF- β and IFN- α is significantly higher than in healthy patients, while the amount of IL-4 had an inverse relationship with periodontal status. It is known that a number of cytokines have powerful anti-inflammatory and catabolic activity, which leads to damage to periodontal tissues. With an extensive intake of microbial agents, mediators go beyond the expediency and become uncontrolled. Cytokines induce epithelium, fibroblasts and macrophages to produce a large number of inflammatory mediators and neutral metalloproteinases, which leads to inhibition of the extracellular matrix and further destruction of bone tissue. A prerequisite for the development of inflammation and an inadequate immune response is the complex interaction of the leading link in the development of this pathology of the microbial factor (bacterial plaque) and periodontal tissues [1].

Thus, a local imbalance of cytokine production at the level of the damaged organ determines the mechanism of development of a chronic inflammatory process in periodontal tissues, which necessitates immunotherapy with drugs that have both corrective and antibacterial effects on the cytokine status in the damaged periodontal [4].

Most of the currently existing antibacterial drugs are products of synthetic origin. They have a high therapeutic effect, however, with prolonged use of such funds, the appearance of resistant strains of microorganisms may occur, leading to a decrease in the effectiveness of treatment and prevention of periodontal diseases. In addition, the range of medicines developed on the basis of domestic medicines is insufficient [5,6].

It would seem that the most effective means of preventing the formation of dental deposits is their mechanical removal from the surface of the teeth using brushes and threads. However, a significant part of the population (30%) is not able to clean their teeth on their own. That is why therapeutic and prophylactic agents require enhanced antimicrobial, immunomodulatory and anti-inflammatory action, without the risk of complications [6].



Modern dentistry offers the treatment of periodontal diseases with antioxidants by introducing them into toothpastes and therapeutic and prophylactic gels and adhesive films. Antioxidants are substances that protect the cells of our body from external and internal toxic effects. Thanks to the antioxidant protection system, the level of tissue damage is reduced, the recovery process is accelerated. The strongest natural antioxidant is astaxanthin. It is superior in power to other natural antioxidants. Astaxanthin belongs to the group of carotenoids. Carotenoids are pigments that give some foods a rich bright color. A significant amount of astaxanthin is found in algae and plankton, which are the basis of many food chains, so it can be found in the organisms of various animals. For example, red fish, crustaceans. The rich and beautiful color of flamingos also provides astaxanthin. Most of it is contained in the algae *Hematococcus pluvialis* (*Haematococcus Pluvialis*) [9].

Many dietary supplements and even food products are considered antioxidants, but only natural astaxanthin prevails over others in its properties. Here are just some of the properties that other carotenoids do not possess, but are inherent in natural astaxanthin:

1. Overcoming the blood-brain barrier. Supplying the brain and central nervous system with an antioxidant, providing an anti-inflammatory effect.
2. Penetrates into the retina of the eye, providing the eyes with an antioxidant and having an anti-inflammatory effect.
3. It spreads throughout the body, exerting an anti-inflammatory effect on all organs and skin, while simultaneously supplying them with an antioxidant.
4. Penetrates the cell membrane.
5. Interacts with muscle tissues.
6. Acts as the strongest antioxidant, quickly catches free radicals and extinguishes singlet oxygen.

The peculiarity of the molecular structure of natural astaxanthin is that it never turns into a prooxidant and does not harm the body.

One of the most important properties of natural astaxanthin is its anti-inflammatory effect. It fights inflammation in various ways that are closely related to its antioxidant capabilities. The mechanism of anti-inflammatory activity consists in the suppression of various inflammatory mediators, such as cell death factor (FOC), Prostaglandin E2 (PE-2), Interleukin 1B (IL-1B), nitric oxide (OA), reducing the effect of C-reactive protein [7,9].

Unlike other beta-carotenes and vitamin E, astaxanthin contains two additional groups of oxygen molecules, giving it the ability not only to neutralize free radicals, but to stop destructive chain reactions that cause cell death. Due to its special chemical structure, this antioxidant is one of the unique carotenoids - xanthophylls, which are very powerful antioxidants. Studies have shown that natural astaxanthin is 10 times more effective than beta-carotene and 100 times more effective than vitamin E. In addition, astaxanthin not only neutralizes free radicals, but also interacts with vitamins C and E, contributing to their effectiveness. Due to its unique biochemical structure, astaxanthin protects the cell membranes of all organs. Unlike beta-carotene, vitamin C and other antioxidants, which are either inside or outside the bilipid membrane, astaxanthin molecules have the ability to localize inside and outside the bilipid membrane, thereby providing an additional protective function of cells. A study was also conducted on rats, which showed the



anti-inflammatory effect of astaxanthin on the eyes of animals, suppressing the effect of inflammatory mediators [8,9].

The introduction of natural astaxanthin into preventive and therapeutic oral hygiene products has a directed antioxidant effect on the oral mucosa and periodontal tissues, thereby preventing their damage. Due to a powerful natural antioxidant, the antimicrobial properties of preventive hygiene products are significantly increased, as well as the restoration of intracellular metabolism is accelerated. Astaxanthin has a local immunomodulatory, anti-inflammatory and keratoplastic effect.

5. Conclusion.

Therapeutic and prophylactic agents for inflammatory periodontal diseases are becoming an increasingly urgent issue today in dentistry. More and more, funds with a powerful immunomodulatory and anti-inflammatory effect are required without side effects and complications. Modern innovative biotechnologies of production make it possible to obtain stable astaxanthin that does not break down under the influence of environmental factors. Modern science continues to study the properties of the release of this strong natural antioxidant. In the near future, natural astaxanthin will be used more widely.

Application of artificial intelligence: The article is written without the use of artificial intelligence technologies.

Conflicts of Interest: The authors declare no conflict of interest

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