Viti i XVI-të i Botimit, Nr.2
Dhjetor 2024

RËNDËSIA E ELEMENTEVE KOBALT, KROM, SELEN DHE MOLIBDEN (GJURMË) NË SHËNDETIN ORAL

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Përmbledhje

Elementet gjurmë, të rëndësishme si mikronutriente kimike, gjenden në ambiente natyrore dhe të ndryshuara në koncentracione të vogla. Ndërsa janë thelbësorë për funksione të ndryshme biologjike, sasi të tepruara të këtyre elementeve mund të jenë toksike për organizmat. Ky rishikim thekson rolet e elementeve kritike gjurmë—përfshirë kobalt, krom, selen dhe molibden—në proceset fisiologjike dhe shëndetin oral. Kobalti, i integruar në vitaminën B12, është i rëndësishëm për formimin e eritrociteve dhe funksionin neurologjik, me mungesat që çojnë në anemi dhe probleme të mundshme në shëndetin oral si glossiti. Kromi kontribuon në metabolizmin e glukozës, dhe mungesa e tij mund të përkeqësojë komplikacionet orale te pacientët diabetikë. Seleni shërben si një komponent thelbësor i enzimave antioksiduese, me mungesën e tij të lidhur me rritjen e stresit oksidativ, veçanërisht në kanceret orale dhe lezionet premalignante. Molibdeni, i njohur për rolin e tij në funksionin e enzimave, mund të ketë prona kariostatik, megjithëse provat mbeten të paqartë. Në përgjithësi, balanct e elementeve gjurmë—paqendim nga mangësitë ose tepricat toksike—theksin rëndësinë e tyre në ruajtjen e shëndetit të përgjithshëm dhe oral

Fjalë çelës: *Kobalt , Selen, Krom, Molybden, Shëndet oral*

THE IMPORTANCE OF COBALT, CHROMIUM, SELENIUM AND MOLYBDENUM TRACE ELEMENTS IN ORAL HEALTH

Abstract

Trace elements, vital as chemical micronutrients, are found in both natural and altered environments in minute concentrations. While essential for various biological functions, excessive amounts of these elements can be toxic to organisms. This review highlights the roles of critical trace elements—including cobalt, chromium, selenium, and molybdenum—in physiological processes and oral health. Cobalt, integral to vitamin B12, is significant for erythrocyte formation and neurological function,

with deficiencies leading to anemia and potential oral health issues such as glossitis. Chromium contributes to glucose metabolism, and its deficiency can exacerbate oral complications in diabetic patients. Selenium serves as a crucial component of antioxidant enzymes, with its deficiency linked to increased oxidative stress, particularly in oral cancers and premalignant lesions. Molybdenum, recognized for its role in enzyme function, may have cariostatic properties, although evidence remains inconclusive. Overall, trace element imbalances—whether from deficiencies or toxic excesses—underscore their importance in maintaining both general and oral health. This review emphasizes the necessity for ongoing research and attention to trace element status in clinical settings to optimize health outcomes.

Key Words: *Cobal, Selenium, Chrom, Molybdenum,Oral Heath*

Introduction

The word “trace elements” is used for elements existing in natural and perturbed environments in small amounts, with excess bioavailability having a toxic effect on the living organism [5]. Trace elements are chemical micronutrients which are required rather in minute quantity but play a vital role in maintaining integrity of various physiological and metabolic processes occurring within living tissues. Micronutrients, including trace elements, vitamins, and antioxidants, play a vital role in continuously occurring regenerative processes, coping with ongoing oxidative stress in the body tissues, and sustaining ample immunity against pathogens [1, 2].The deficiency of any of the trace elements may be apparent as a combination of various clinical manifestations rather than a specific presentation as each trace element is related to many enzyme systems. The manifestations of undernutrition as well overnutrition of micronutrients on the oral health are vast and can result in defects of the dental hard tissues as well as oral mucosa [3, 4].The classifications which address the presence of trace elements have been listed by WHO in 1973 and Friedsen’s laterer on 1981that give more imprittant data related health and oral one.

1. Cobalt and oral heath

Bertrand and Macheboeuf find the presence of cobalt in animal tissues in 1925 which was later confirmed by various researches using spectrographic methods [5-6]. Cobalt is an essential trace element for the human body and can occur in organic and inorganic forms. In organic form, it forms an integral part of vitamin B_{12} and has a substantial role in the formation of amino acids and neurotransmitters. Inorganic forms of cobalt are toxic to the human body, and the longer they stay in the body, the more the detrimental effects they cause in cells. Cobalt ions are absorbed within the human body through several pathways: firstly, with food; secondly, by the respiratory system; thirdly, by the skin; and finally, as a component of biomaterials. The cobalt ions enter the body through any of the abovementioned routes and bind with proteins within the bloodstream and get transported with blood to be deposited in tissues and cells. The total body content of cobalt has been estimated between 80 and 300 mcg of vitamin B12 [7–9].

1.1 Biological Functions

Vitamin B12, also known as cobalamin, is a water soluble vitamin and contains the biochemically rare element cobalt in the center of a planar tetrapyrrole corrin ring. Vitamin B12 is produced as hydroxocobalamin within bacteria and conversion to methylcobalamin and 5′-deoxyadenosylcobal-

amin, enzymatically active cofactor forms, occurs within the body. Cyanocobalamin, the fourth vitamer of vitamin B_{12}, can be metabolized in the body to an active coenzyme form and used in food supplements. Erythropoietin, essential for formation of erythrocytes, stimulation is performed by vitamin B12 containing cobalt salts, and thus the deficiency of cobalt is strongly related to disturbances in vitamin B_{12} synthesis resulting in anemia and hypofunction of thyroid with increased risk of developmental abnormalities and failure in infants. Apart from being an important constituent of these various forms of vitamin B12, the presence of cobalt is necessary for the efficient formation of amino acids and various proteins for myelin sheath generation. Cobalt also plays a decisive role in generating neurotransmitters, which are requisite for proper operation of an organism. On the other hand, excess of cobalt ions within the body might increase the action of thyroid and bone marrow resulting in overproduction of erythrocytes, fibrosis in lungs, and asthma [5, 10-13]

1.2 Role in Oral Health

The roles of cobalt in oral health are :

1. Cobalt, part of vitamin B12 also referred to as extrinsic factor, is essential for formation of erythrocytes. The cobalt deficiency in oral cavity is pernicious anemia which is characterized by glossitis, burning sensation, beefy red tongue present in the form of patches or completely red tongue which is also referred to as Hunters' or Moeller's glossitis, and rarely shallow ulcers

2. Vitamin B12 also plays a significant role in nerve repair and regeneration. Hence, deficiency of cobalt can have adverse effects such as peripheral neuropathy.

3. The exposure to Cr, Co, Ni, and amalgam alloys that are released from metal alloys commonly used in dentistry in the oral cavity. These trace metals when released from the metal alloys come into direct contact with oral mucosa, leading to immune mediated damage of basal epithelial keratinocytes and subsequently inducing sensitivity reactions in the form of OLR. Some studies have linked OLR to risk of malignant transformation [14-17].

2. **Chromium**

The word "chrome" is a Greek word which means "color." Chromium exists in divalent [Cr(II)], trivalent [Cr(III)], and hexavalent [Cr(VI)] oxidation states. Cr(III) and Cr(VI) are insoluble and soluble forms, respectively. The total body content of chromium is relatively low and is about 0.006 g in an average healthy human adult. Trivalent Cr is an essential trace element and plays an important role in glucose metabolism by serving as a cofactor for insulin action.

2.1 Biological Functions

Chromium is an important trace element for overweight people as it is one of the key minerals in controlling blood sugar and lipid levels. Chromium [Cr(III)] increases the efficacy of insulin and stimulating glucose uptake from the muscles and other tissues being the main ingredient of glucose tolerance factor (GFT). In case of low serum levels of chromium, the circulating level of (GFT) is also less, and, consequently, insulin is less effective in reducing blood sugar[5,18]. As a result, high blood sugar stimulates further release of ineffective insulin. As chromium is present in very low amounts in the body, it is difficult to ascertain the deficient state. It is believed that if concentrations of chromium are lower than the normal value of 0.14–0.15 ng/mL in serum, this will indicate the presence of a severe chromium deficiency. The concentrations of chromium in urine, hair, and body fluids could not reflect the true chromium status of the body [19]

2.2 Role in Oral Health and Diseases

The role of chromium in OLR has been know well. Hyperglycemic status of diabetic patients in undiagnosed chromium deficient state may lead to a wide spectrum of oral manifestations noted in diabetics such as delayed wound healing, suppurative periodontitis, various oral fungal infections, premature periodontal diseases, and hyposalivation .

3. Selenium

Selenium is a vital trace element which is an important component of the antioxidant enzymes such as glutathione peroxides and thioredoxin reductase. The selenium salts required for various cellular functions inside the human body are toxic in excess amounts. Microorganisms reportedly have several selenium containing enzymes, and it is most likely that selenoproteins other than glutathione peroxidase remain to be discovered in higher animals.[7, 19]. Typical manifestations were fatigue after even mild exercise, cardiac arrhythmia and palpitations, loss of appetite, cardiac insufficiency, cardiomegaly, and congestive heart failure. The disease was prevalent among people under selenium deficient diet and the patients improved rapidly on fortification[10,20].

3.1. Biological Functions

Selenium is known to possess immunomodulating and antiproliferative properties and may effect immune response by altering the expression of cytokines and their receptors or making immune cells more resistant to oxidative stress [13-17, 21] As a part of enzyme glutathione peroxidase along with vitamin E, catalase, and superoxide dismutase, selenium forms component of one of the imperative antioxidant defence systems of the body. There is also compelling evidence that an unknown selenoenzyme protein has some role in the synthesis of the triiodothyronine hormone from thyroxine[22, 23]

3.2. Role in Oral Health and Diseases

The serum levels of selenium showed progressive reduction from healthy subjects to patients having premalignant lesions like oral leukoplakia and further decrease in patients suffering from oral cancer. There was a reduction in the selenium containing glutathione peroxidase levels as well and there was a concomitant increase in the oxidative stress in the same order . [14, 24-26]Hence, it is clearly evident that decrease in the concentrations of selenium will result in increased oxidative stress inside the body tissues with inadvertent harmful effects. Thus, nutritional supplementation with trace elements such as selenium is an important rationale in the treatment of premalignant lesions like leukoplakia, conditions as OSMF, and oral cancer patients to reduce oxidative stress inside the body A lot of study shows that adequate supplementation of selenium could produce cytoprotective effects and antiulcer activity and concluded that selenium can effectively reduce the duration and severity of oral mucositis in these patients [27-31] .

4. Molybdenum

Molybdenum minerals have been known throughout history, but the element was discovered by Carl Wilhelm Scheele in 1778 and first isolated in 1781 by Peter Jacob Hjelm.

4.1. Biological Functions

Molybdenum, as a component of molybdoprotein, takes part in the formation of active sites for various enzymes. The three principal molybdenum-containing enzymes are xanthine dehydrogenase/

oxidase, aldehyde oxidase, and sulphite oxidase. A molybdenum-containing enzyme has some role to play in purine catabolism. It also influences protein synthesis and growth of the body [32-34]. Molybdenum has an antagonistic effect against copper; thus, high concentrations of molybdenum can reduce copper absorption and subsequently lead to copper deficiency

4.2. Role in Oral Health and Diseases

Boron, vanadium, and molybdenum are believed to possess a cariostatic effect. Various researches strongly suggested molybdenum-fluoride interaction to have a strong cariostatic effect. However, the cariostatic effect of molybdenum has been critically reviewed in the literature with inconclusive re

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