EXCELLENCIA
INTERNATIONAL MULTI-DISCIPLINARY JOURNAL OF EDUCATION
Volume 02, Issue 05, 2024 ISSN (E): 2994-9521

The Effect of Titanium Dioxide on the Body, Causing Various Pathological Processes

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Abstract:

Today, the lifestyle of mankind, living conditions, increase in social well-being, improvement of working conditions, increase in annual income require the development of all areas of society. In particular, in the production industry, apart from the quality and shelf life of the product, its appearance, uniqueness, variety of colors, packaging, long-term storage are highly appreciated by consumers. These reasons force experts to improve the product processing stage. Widespread use of food additives remains the main means of meeting these demands. These additives completely change the organoleptic properties of the product and serve for long storage. The main contribution of such additives corresponds to food additives with small particles. These additives include: titanium dioxide (E171), iron oxide (172), gold (175), silver (174), silicon dioxide (E551) and others.

Keywords: Fine particulate food additives, titanium dioxide, neurotoxic, gastrotoxic, hepatotoxic effects.

Introduction:

Like other fine particulate food additives, the majority of titanium dioxide is contributed by food products. It is especially common in carbonated drinks, various colored sweets, packaged salty and fatty crackers, potato chip products, paper candies, pastries, milk and cheese products, and sausage products.[1]

Titanium dioxide is actively used not only in the food industry, but also in the pharmaceutical industry, as a bleaching agent in the production of personal hygiene products and cosmetics. Titanium dioxide is a substance that is insoluble in water and has low toxicity. [2]

In the body, titanium accumulates in combination with proteins. Enterally administered titanium dioxide interacts with the aggressive environment of the stomach and significantly changes the properties of proteins and enzymes.[3]

In laboratory conditions, chronic (90 days) enteral titanium dioxide was injected into the rat organism and it was determined that the spleen was damaged, thrombocytopenia, lymphopenia, decreased amount of hemoglobin, decreased amount of immunoglobins.[4]

In another laboratory study, the introduction of titanium dioxide at a dose of 10 mg/kg caused severe liver damage, nephron apoptosis, and impaired immune regulation.

When 100mg/kg of titanium dioxide was administered enterally (into a rat's body) for 10 days, it was found that CD4-lymphocytes increased in all areas of the intestine, secretion of cytokines IL-4, IL-12, IL-23, FNO increased mainly in the colon wall.[5]

Many studies have been devoted to the effect of titanium dioxide on the body, especially on the lungs, and the changes that occur in it. In this, a solution was sought to the questions related to the entry of small-sized titanium dioxide through the respiratory tract at the workplace and causing a pathological process. Two years of experiments with rats exposed to high levels of titanium dioxide showed that the rats developed tumors in their lungs, indicating the carcinogenic properties of titanium dioxide.[6]

Small-particle titanium dioxide entering intratracheally damages the cellular structure of alveolar macrophages and leads to their dysfunction. It also reduces the chemotoxic properties of alveolar macrophages. A small amount of titanium dioxide increases the phagocytic property of macrophages, while a large amount decreases this property. NO and FNO production increased when the amount of fine particle titanium dioxide was increased, because more pro-inflammatory mediators were synthesized by the effect of fine particle titanium dioxide than by conventional titanium dioxide.[7]

A small amount of titanium dioxide doubles the sensitivity of the upper respiratory tract, and up to three times the number of cells responsible for inflammation. Histological examination revealed swelling, epithelial destruction and inflammation. [8]

Free titanium dioxide causes denaturation of cytoplasmic proteins[9]

In patients with severe and moderate atopic bronchial asthma with sensitivity to food dyes, during the period of remission, the amount of Ig E in blood compared to titanium dioxide was determined in 37.5% of patients, Ig A in 22.9%, and Ig G in 29.1% of patients. Such high indicators indicate that white titanium dioxide has high allergic and asthmatic properties.[10]

In the US, the daily intake of titanium dioxide for adults is 0.2-0.7mg/kg. In 10-year-old children, the 1-day consumption level has reached 1-2 mg/kg. In Great Britain, this indicator has doubled to 1mg/kg for adults and 2-3mg/kg for children.[11]

In experiments conducted 10 years ago, the amount of titanium dioxide in 1 part of consumer products was 225 mg, by now this amount has reached 340 mg.[11][12]

Conclusion: Titanium dioxide remains the main source of fine particulate additives, and the rate of entry into the body with food and drugs is increasing, which indicates that the study of the effects of titanium dioxide on the body is becoming an increasingly urgent issue.

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