TYPICAL REPRESENTATIVE OF FINE PARTICULATE FOOD ADDITIVES: TITANIUM DIOXIDE AND ITS EFFECTS ON THE HUMAN BODY, INCLUDING THE INDUCTION OF VARIOUS PATHOLOGICAL PROCESSES – CONTEMPORARY PERSPECTIVES

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Abstract: *In today's world, humanity's lifestyle, living conditions, increased social welfare, improved working conditions, and higher annual incomes demand the development of all sectors of society. This includes the food production industry, where product quality, shelf life, appearance, uniqueness, color, packaging, and extended preservation characteristics are highly valued by consumers. These factors have led specialists to improve the processing stages of products. The widespread use of food additives has become the primary means to meet these demands. These additives drastically change the organoleptic properties of products and contribute to their long shelf life. The major contributors to this group of additives are fine particulate food additives, such as titanium dioxide (E171), iron oxide (E172), gold (E175), silver (E174), silicon dioxide (E551), and others.*

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

Introduction:

Like other fine particulate food additives, titanium dioxide is widely used in food products. It is particularly common in carbonated beverages, various colored sweets, packaged salty and oily crackers, potato chips, paper-wrapped candies, baked goods, dairy products, and sausages.Titanium dioxide is not only used in the food industry but also in the pharmaceutical, personal hygiene, and cosmetic industries as a whitening agent. Titanium dioxide is considered a substance with

low toxicity and is insoluble in water.In the human body, titanium dioxide accumulates by binding with proteins. When consumed orally, titanium dioxide interacts with the stomach's aggressive environment, significantly altering protein and enzyme characteristics.

In laboratory conditions, when rats were exposed to chronic oral titanium dioxide (90 days), damage to the spleen, thrombocytopenia, lymphopenia, and a decrease in hemoglobin and immunoglobulin levels were observed.In other laboratory studies, rats exposed to a dose of 10 mg/kg of titanium dioxide showed severe liver damage, nephron apoptosis, and impaired immune regulation.When a 100 mg/kg dose of titanium dioxide was administered orally for 10 days, it caused increased CD4-lymphocytes in the entire intestinal tract, with cytokine secretion IL-4, IL-12, IL-23, and TNF-α primarily elevated in the colon.Several studies have focused on the effects of titanium dioxide on the lungs, especially its impact when inhaled as fine particles, leading to pathological changes. Experiments on rats exposed to high concentrations of titanium dioxide for two years showed the development of lung cancer, indicating the carcinogenic potential of titanium dioxide.Inhaled fine titanium dioxide particles damage the cellular structure of alveolar macrophages, leading to dysfunction and a decrease in their chemotactic properties. Small amounts of titanium dioxide can increase the phagocytic activity of macrophages, while higher doses reduce it. As the amount of fine titanium dioxide increases, the production of NO and TNF increases because inflammatory mediators are synthesized in greater quantities.Low levels of titanium dioxide can increase upper airway sensitivity, with an increase in the number of inflammatory cells, which may result in swelling, epithelial destruction, and inflammation as revealed by histological studies.Free titanium dioxide can cause denaturation of cytoplasmic proteins.In patients with moderate to severe atopic bronchial asthma, blood levels of IgE, IgA, and IgG were found to be higher in response to titanium dioxide exposure, indicating a potential allergic and asthmatic response.In the U.S., the daily consumption of titanium dioxide for adults is considered safe at levels between

0.2–0.7 mg/kg. For children aged 10 years, this level can reach 1–2 mg/kg. In the UK, the allowable intake is double these amounts: 1 mg/kg for adults and 2–3 mg/kg for children.Studies conducted ten years ago showed that one serving of food contained 225 mg of titanium dioxide, while today that amount has risen to 340mg.

Conclusion: Titanium dioxide remains a significant source of fine particulate additives, and its presence in food, pharmaceutical, and personal care products is steadily increasing. This highlights the growing importance of studying titanium dioxide's effects on the human body.

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