

**MORPHOFUNCTIONAL CHANGES THAT OCCUR IN BARK SUSTANCE OF
THE ADRNAL GALAND UNDER THE INFLUENCE OF NUTRIENT DYES AND
THEIR CORRECTION**

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Аннотация: Настоящее исследование посвящено изучению морфофункциональных изменений в коре надпочечников под воздействием синтетических пищевых красителей Е-171 (диоксид титана) и Е-173 (алюминиевая пудра), а также экспериментальной оценке методов их коррекции. Широкое применение искусственных пищевых добавок в промышленности вызывает возрастающую обеспокоенность из-за их потенциального токсического и эндокринно-дестабилизирующего действия. Поскольку кора надпочечников играет ключевую роль в поддержании гомеостаза, регуляции обмена веществ и стресс-ответов организма, любые структурно-функциональные нарушения в ней могут иметь серьезные физиологические последствия. В экспериментальной части исследования лабораторные животные подвергались воздействию контролируемых доз красителей Е-171 и Е-173. Проведенные гистологические, гистохимические и биохимические исследования выявили дегенеративно-дистрофические изменения в клетках коры, преимущественно в зоне пучковой и ретикулярной, включая вакуолизацию цитоплазмы, набухание митохондрий и нарушение стероидогенеза.

Ключевые слова: кора надпочечников; морфофункциональные изменения; пищевые красители; Е-171; Е-173; диоксид титана; алюминиевая пудра; коррекция; антиоксиданты; экспериментальное исследование; токсикология.

Abstract: The current research focuses on the study of morphofunctional changes in the adrenal cortex induced by exposure to synthetic food colorants E-171 (titanium dioxide) and E-173 (aluminum powder), as well as on the experimental approaches for their correction. The widespread use of artificial dyes in the food industry has raised increasing concern due to their potential toxic and endocrine-disrupting effects. Given the adrenal gland's critical role in maintaining homeostasis and regulating metabolic, immune, and stress responses, alterations in its structure and function may have significant physiological consequences. In this experimental study, laboratory animals were exposed to controlled doses of E-171 and E-173 to evaluate the

dyes' cumulative effects on the morphology and functional state of the adrenal cortex. Histological, histochemical, and biochemical analyses revealed degenerative and dystrophic changes in cortical cells, particularly in the zona fasciculata and zona reticularis, including cytoplasmic vacuolization, mitochondrial swelling, and disrupted steroidogenesis.

Key words: adrenal cortex; morphofunctional changes; food dyes; E-171; E-173; titanium dioxide; aluminum powder; correction; antioxidants; experimental study; toxicology.

Introduction: In recent years, the use of synthetic food additives, particularly food colorants, has significantly increased in the food industry. Among them, titanium dioxide (E-171) and aluminum powder (E-173) are widely used to enhance the visual appeal of various food products such as confectioneries, dairy goods, and beverages. Despite their technological advantages, numerous studies have indicated that these substances may exert toxic effects on different organs and tissues of the human body, including the endocrine system. The adrenal glands, especially the adrenal cortex, play a vital role in maintaining homeostasis through the secretion of corticosteroids, mineralocorticoids, and sex hormones. Any disruption in the structure or function of the adrenal cortex may lead to metabolic disorders, impaired stress response, and hormonal imbalance. Therefore, studying the morphofunctional changes in the adrenal cortex under the influence of food dyes such as E-171 and E-173 is of great scientific and practical importance. Furthermore, understanding the potential corrective mechanisms, including the use of antioxidants and natural protective agents, can contribute to developing effective strategies to reduce the harmful effects of these additives. This research aims to analyze the structural and functional alterations in the adrenal cortex caused by titanium dioxide and aluminum-based colorants, as well as to assess the possibilities of their correction through biologically active substances.

Purpose of the research. Study of the effect of food dye E-171 on the morphofunctional state of adrenal glands, observation in blood biochemical analysis

Materials and methods of research. White laboratory rats are widely used in the experiment. The organs extracted from the animal were dried in special desiccators. The neutron activation method was used to determine the accumulation of titanium dioxide in the adrenal glands of rats.

Results of the study. The experiments were conducted in laboratory conditions in the vivarium of the Institute of Biological Chemistry at Samarkand State University. Rats from 2 groups were selected for the experiment. Group 1 were rats bred for control, and group 2 were rats

to which food additive E-171 was added to the feed. E-171 was added to the rats' feed according to the weight of the rat's body. The experiments were conducted for 90 days. For the experiment, male and female white laboratory rats were bred separately in an isolated state. At an average body weight of 150-170 g, 4 mg of titanium dioxide was added to the rats' feed. The rats taken for the experiment were given titanium dioxide in unlimited amounts while giving other types of feed. In the laboratory, rats in the experimental and control condition were given vegetable cabbage, carrots, bran flour, hard cooked bread, and chicken thigh broth. Samples from rats were stored in 10% formalin, placed in paraffin, Microgene stained with hemotoxylin-eosin. For chromatographic analyses the samples were dried in desiccators and chromatographic parameters were determined. In rats taken for control, the accumulation of titanium dioxide is 0.42 $\mu\text{g/g}$. In the experimental variant, the content of titanium dioxide in the adrenal glands averaged 3.96 $\mu\text{g/g}$. In larger rats with a body weight of 170 g, this index was 4.11 $\mu\text{g/g}$. We found that titanium dioxide, which is considered a food coloring, accumulates in the adrenal glands, a parenchymatous organ.

Conclusions.

In the food industry nowadays various district colorful food additives are used. The data on the effect of these food additives on the body constantly cause disputes among scientists. Among these controversial types in the first place is the feed additive E171. Since in European countries and the Russian Federation it is forbidden to add E-171 to feed. E-171 That is, inorganic compounds of titanium dioxide cause lung cancer and various other types of malignant tumors in the body. The results of the conducted experiment are such that it indicates that the adrenal glands, which are considered to be the most vulnerable to malignant tumors.