

PATHOMORPHOLOGICAL CHANGES IN THE BRAIN OF 12-WEEK-OLD RATS FOLLOWING THE CONSUMPTION OF ENERGY DRINKS**Rakhimov Muhammadalikhan Akmalovich**student of the medical faculty
Samarkand State Medical University (Samarkand, Uzbekistan)**Eshkabilova Surayo Turaevna**Ph.D., assistant
Samarkand State Medical University (Samarkand, Uzbekistan)**Rakhimova Saodat Shavkatovna**assistant
Gulistan Innovative Medical College (Syrdarya, Uzbekistan)

Abstract: Energy drinks are non-alcoholic beverages containing stimulant substances such as caffeine, taurine, guarana, B-group vitamins, and other components that contribute to increased energy levels, alertness, and physical endurance. These beverages are widely consumed among students, athletes, and individuals experiencing increased workloads during periods of intensive professional activity. This study presents the results of an investigation into the cellular and tissue structures of the rat brain following oral administration of an energy drink over short-term (12 weeks) and prolonged (36 weeks) periods.

Keywords: Energy drinks, caffeine, taurine, brain, perivascular and pericellular edema

Aim of the study: Energy drinks are becoming increasingly popular among adolescents and young adults both in the United States and worldwide. Their demand, particularly among students, is обусловлена their pleasant taste as well as the claimed stimulating effect that helps maintain alertness and reduce sleepiness.

The first energy drinks appeared on the market in the 1960s in European and Asian countries and have gained widespread global distribution since the late twentieth century. Scientific literature reports data on both short-term and long-term effects of energy drink consumption on the cardiovascular and central nervous systems. It has been established that energy drinks may cause a number of adverse effects, especially in young individuals, including arterial hypertension, severe cardiovascular pathologies, kidney diseases, metabolic disorders, sleep disturbances, seizure conditions, and psychoneurological complications. It should be noted that energy drinks do not provide the body with additional energy but rather activate its internal reserves, promoting more intensive utilization of endogenous energy resources.

The main biologically active components of energy drinks are caffeine and taurine. Caffeine exerts a stimulating effect on the central nervous system by increasing concentration and reducing fatigue, whereas taurine is involved in the regulation of metabolic processes. At the same time, excessive consumption of energy drinks may lead to undesirable reactions such as dizziness, insomnia, increased irritability, tachycardia, and elevated blood pressure.

In order to identify morphological manifestations of the negative effects of energy drinks, an experimental study was conducted to examine structural changes in the cerebral cortex of rats following their prolonged administration.

Materials and Methods: This report presents the results of a study of structural changes in the cerebral cortex of 22 outbred albino rats weighing 160–200 g. The animals were divided into three groups:

- **Group I (control group):** included six rats.

- **Group II (short-term energy drink administration group):** included seven rats that received an energy drink at a dose of 7.5 ml/kg/day orally via a gastric gavage for 12 weeks.

- **Group III (long-term energy drink administration group):** included six rats that received an energy drink at a dose of 7.5 ml/kg/day orally via a gastric gavage for 36 weeks.

The rats were euthanized by decapitation in compliance with bioethical standards. The brains were removed and fixed in 10% neutral formalin, after which tissue samples were processed and embedded in paraffin. Histological sections were stained with hematoxylin and eosin.

Results and Discussion: Microscopic examination of the cerebral cortex of rats that received energy drinks for 12 weeks revealed uniform loosening of the brain tissue in all regions, most pronounced in the superficial cortical layers. Perivascular spaces were moderately dilated, whereas pericellular spaces showed a significantly greater degree of expansion.

In the cerebral cortex of rats exposed to energy drinks for 36 weeks, more pronounced loosening of cellular and tissue structures was observed, extending across all cortical layers. Enhanced perivascular edema and a markedly more severe pericellular edema were noted compared to the earlier experimental period. In addition, pronounced swelling of neuronal nuclei and uneven staining of the tigroid substance were detected.

Comparative analysis of vascular-tissue changes and cytoarchitectonics of the cerebral cortex in experimental and control animals revealed significant and statistically reliable differences in both the nature and extent of alterative-dystrophic and necrobiotic processes within the brain histoarchitecture. These changes were absent in control rats and were clearly manifested in the experimental animals.

Thus, the results of the microscopic examination of the cerebral cortex of rats subjected to oral administration of energy drinks indicate that the primary pathomorphological changes involve the vascular wall. The brain tissue surrounding the capillaries undergoes marked edematous loosening. By the final stages of the experiment, cellular elements of the brain become shrunken and more sparsely distributed. Loosening of the brain substance, pronounced perivascular edema, and less intense pericellular edema progressively increase with prolonged exposure. The most prominent changes are observed in the temporal and parietal regions of the cerebral cortex.

Conclusion: Based on the results of the histological examination, it can be concluded that prolonged consumption of energy drinks is accompanied by the development of pronounced alterative–reactive changes in the vascular bed and cortical layers of the brain. The adverse side effects of this widely consumed beverage intensify with increasing duration of use. The significant, reliable, widespread, and clearly expressed changes identified in experimental rats, in contrast to their absence in control animals, provide clear evidence of the damaging effect of energy drinks on brain structures. The data obtained in this study may be used in the development and implementation of measures aimed at regulating energy drink consumption and addressing important social challenges in society.

References:

1. Лазоренко А. А. и др. Влияние энергетических напитков на здоровье молодёжи //Современные проблемы науки и образования. – 2017. – №. 6. – С. 64-64..

2. Ghozayel M. et al. Energy drinks consumption and perceptions among University Students in Beirut, Lebanon: A mixed methods approach. 2020;15:e0232199.

3. Lévy S. et al. European Cardiac Arrhythmia Society Statement on the cardiovascular events associated with the use or abuse of energy drinks //Journal of Interventional Cardiac Electrophysiology. – 2019. – T. 56. – C. 99-115.

4. Nowak D., Gośliński M., Nowatkowska K. The effect of acute consumption of energy drinks on blood pressure, heart rate and blood glucose in the group of young adults //International journal of environmental research and public health. – 2018. – T. 15. – №. 3. – C. 544.

5. Patrick M. E. et al. Energy drinks and binge drinking predict college students' sleep quantity, quality, and tiredness //Behavioral sleep medicine. – 2018. – T. 16. – №. 1. – C. 92-105.

6. Subaiea G. M., Altebainawi A. F., Alshammari T. M. Energy drinks and population health: consumption pattern and adverse effects among Saudi population //BMC Public Health. – 2019. – T. 19. – C. 1-12.

7. Toblin R. L. et al. Energy drink use in US service members after deployment: associations with mental health problems, aggression, and fatigue //Military medicine. – 2018. – T. 183. – №. 11-12. – C. e364-e370.

8. Valle M. T. C. et al. Energy drinks and their component modulate attention, memory, and antioxidant defences in rats //European journal of nutrition. – 2018. – T. 57. – C. 2501-2511.