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PATHOMORPHOLOGICAL CHANGES IN THE BRAIN TISSUE OF 12-WEEK-OLD RATS ADMINISTERED ENERGY DRINKS

Annotation. *Energy drinks are non-alcoholic beverages that contain stimulants such as caffeine, taurine, guarana, B vitamins, and other ingredients that enhance energy, alertness, and endurance. They are popular among students, athletes, and individuals undergoing intense periods of work. This study presents the results of research into the cellular and tissue structures of the brain in rats that were administered an energy drink orally for both short-term (12 weeks) and long-term (36 weeks) periods.*

Key words: *Energy drinks, caffeine, taurine, brain, perivascular edema, pericellular edema.*

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ПАТОМОРФОЛОГИЧЕСКИЕ ИЗМЕНЕНИЯ В ТКАНЯХ ГОЛОВНОГО МОЗГА 12 – НЕДЕЛЬНЫХ КРЫС, ПОЛУЧАВШИХ ЭНЕРГЕТИЧЕСКИЕ НАПИТКИ

Аннотация. *Энергетические напитки — это безалкогольные напитки, содержащие стимуляторы, такие как кофеин, таурин, гуарана, витамины группы В и другие ингредиенты, которые повышают энергию, бодрость и выносливость. Они популярны среди студентов, спортсменов, а также людей, нуждающихся в поддержке во время напряжённых рабочих периодов. В настоящей статье приведены результаты исследования клеточно – тканевых структур головного мозга крыс, которым перорально вводился энергетический напиток в течение кратковременного (12 недель) и длительного (36 недель) приема.*

Ключевые слова: *Энергетические напитки, кофеин, таурин, головной мозг, периваскулярный и перицеллюлярный отёк.*

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ENERGETIK ICHIMLIKLAR TA'SIRI NATIJASIDA 12 -HAFTALIK KALAMUSHLAR BOSH MIYA TO'QIMASIDA PATOMORFOLOGIK O'ZGARISLAR

Annotatsiya.*Energetik ichimliklar - kofein, taurin, guarana, B vitaminlar va stimulyatorlarni o'z ichiga olgan, energiyani, hushyorlik va chidamlilikni oshiradigan alkogolsiz ichimliklar hisoblanadi. Ular talabalar, sportchilar va aqliy ish bilan band bo`lgan odamlar orasida mashhurdir. Ushbu maqolada qisqa muddatli (12 hafta) va uzoq muddatli (36 hafta) energetik ichimlikni qabul qilingan kalamushlar bosh miyasi hujayra va to'qimalar tuzilishini o'rganish natijalari keltirilgan.*

Kalit so'zlar: *Energetik ichimliklar, kofein, taurin, bosh miya, perivaskulyar va pericellular shish.*

Introduction: Energy drinks are becoming increasingly popular among adolescents and young adults in the United States and around the world [1]. Their appeal among young people, particularly students, stems not only from their pleasant taste but also from the promise of being a stimulant that keeps them awake [2]. These drinks first appeared on the market in the 1960s in Europe and Asia and have since spread globally [3].

Scientific literature reports both short - and long-term effects of energy drink consumption on the cardiovascular and central nervous systems. Studies have shown that energy drinks can cause various side effects, particularly among young individuals, including high blood pressure, serious cardiovascular disorders, kidney diseases, metabolic disturbances, poor sleep, seizures, and neuropsychiatric side effects [4,5,6,8].

Importantly, energy drinks do not provide energy per se but instead open the body's own energy channels. That is, they prompt the body to use its internal resources rather than supplying external energy.

The main active ingredients in energy drinks are caffeine and taurine. Caffeine stimulates the central nervous system, enhancing focus and reducing fatigue, while taurine helps improve metabolic processes. However, excessive consumption of energy drinks can lead to adverse effects such as dizziness, insomnia, nervousness, increased heart rate, and elevated blood pressure.

To identify the morphological aspects of the negative impact of such drinks, we conducted an experiment to examine structural changes in the cerebral cortex of rats subjected to prolonged energy drink intake.

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

- Group I (Control): Included 6 rats not given any energy drinks.

- Group II (Short-term exposure): Included 7 rats that were administered energy drinks orally through a gastric tube at a dose of 7.5 ml/kg/day for 12 weeks.

- Group III (Long-term exposure): Included 6 rats that were given the same dose of energy drink (7.5 ml/kg/day) for 36 weeks.

In the last days of the experiment, the rats were fasted overnight, then anesthetized in the morning with light inhalations of ether, and blood samples were taken directly from the heart for laboratory testing. The rats were killed by decapitation, observing all provisions of bioethics, the brain was removed, fixed in 10% neutral formalin, and the excised pieces were embedded in paraffin. Histological sections were stained with hematoxylin and eosin, according to van Gieson and Nissl, which were examined on a light microscope NLCD-307B using lenses 4, 10, 40 and microphotography of the necessary areas was performed.

Results and Discussion: Microscopic examination of the cerebral cortex in rats that received energy drinks for 12 weeks revealed uniform loosening across all brain regions, most pronounced in the upper cortical layers. Perivascular areas appeared moderately dilated, while pericellular zones were significantly more expanded.

In rats exposed to energy drinks for 36 weeks, more pronounced loosening of cellular and tissue structures was observed throughout all layers of the cerebral cortex. There was greater perivascular and markedly increased pericellular edema compared to the 12-week group. Notable features included significant swelling of neuronal nuclei and uneven staining of Nissl substance.

Comparative analysis of the vascular and tissue alterations and the cytoarchitecture of the cerebral cortex between experimental and control groups showed significant and reliable differences in the nature and extent of degenerative and necrobiotic changes in the brain’s histoarchitecture, which were absent in the control group and clearly developed in the experimental animals.

Thus, microscopic examination of the cerebral cortex of rats subjected to oral administration of energy drinks showed that the main pathomorphological changes occur in the vascular walls. Brain tissue around capillaries exhibited pronounced edematous loosening. By the end of the experimental period, brain cells appeared shrunken and sparsely distributed. Loosening of brain matter and pronounced perivascular edema, along with less marked pericellular edema, progressed over time. This edema was most prominent in the temporal and parietal cortical lobes.

Conclusion: Based on the results of histological examination, it can be concluded that prolonged consumption of energy drinks may lead to significant degenerative and reactive changes in the vessels and layers of the cerebral cortex. The adverse effects of this widely consumed beverage become more pronounced with continued exposure. The substantial, widespread, and prominent changes observed in the experimental rats, and their absence in the control group, clearly demonstrate the damaging side effects on brain structures. These findings can be used to inform social policies and regulations regarding the consumption and marketing of energy drinks in the general population.

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