МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ`Я УКРАЇНИ
БУКОВИНСЬКИЙ ДЕРЖАВНИЙ МЕДИЧНИЙ УНІВЕРСИТЕТ

МАТЕРІАЛИ

ІІ науково-практичної інтернет-конференції

РОЗВИТОК ПРИРОДНИЧИХ НАУК ЯК ОСНОВА НОВІТНІХ ДОСЯГНЕНЬ У МЕДИЦИНІ

м.Чернівці

22 червня 2022 року

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
MINISTRY OF HEALTH OF UKRAINE
BUKOVINIAN STATE MEDICAL UNIVERSITY

CONFERENCE PROCEEDINGS

II Scientific and Practical Internet Conference

DEVELOPMENT OF NATURAL SCIENCES AS A BASIS OF NEW ACHIEVEMENTS IN MEDICINE

Chernivtsi, Ukraine
June 22, 2022

УДК 5-027.1:61(063)

Р 64

Медицина є прикладом інтеграції багатьох наук. Наукові дослідження у сучасній медицині на основі досягнень фізики, хімії, біології, інформатики та інших наук відкривають нові можливості для вивчення процесів, які відбуваються в живих організмах, та вимагають якісних змін у підготовці медиків. Науково-практична інтернет-конференція «**Розвиток природничих наук як основа новітніх досягнень у медицині**» покликана змінювати свідомость людей, характер їхньої діяльності та стимулювати зміни у підготовці медичних кадрів. Вміле застосування сучасних природничо-наукових досягнень є запорукою подальшого розвитку медицини як галузі знань.

Конференція присвячена висвітленню нових теоретичних і прикладних результатів у галузі природничих наук та інформаційних технологій, що є важливими для розвитку медицини та стимулювання взаємодії між науковцями природничих та медичних наук.

Комп'ютерна верстка:
Марія ІВАНЧУК

Розвиток природничих наук як основа новітніх досягнень у медицині: матеріали ІІ науково-практичної інтернет-конференції, м. Чернівці, 22 червня 2022 р. / за ред. В. І. Федіва – Чернівці: БДМУ, 2022. – 489 с.

У збірнику подані матеріали науково-практичної інтернет-конференції «Розвиток природничих наук як основа новітніх досягнень у медицині». У статтях та тезах представлені результати теоретичних і експериментальних досліджень.

Матеріали подаються в авторській редакції. Відповідальність за достовірність інформації, правильність фактів, цитат та посилань несуть автори.

Для наукових та науково-педагогічних співробітників, викладачів закладів вищої освіти, аспірантів та студентів.

Рекомендовано до друку Вченою Радою Буковинського державного медичного університету (Протокол №11 від 22.06.2022 р.)

ISBN 978-966-697-983-7

ВПЛИВ ТЕХНОГЕННИХ ЧИННИКІВ НА ЗДОРОВ'Я ЛЮДИНИ

UDC : 577.175.3:612.014.44:613.81-099

Davydova N.V., Salekhi D.D.

Influence of Constant Lighting on Free Radical Oxidation of Biomolecules in Rats Exposed to Ethanol Intoxication

Bukovinian State Medical University, Chernivtsi, Ukraine

davydova.nataliia@bsmu.edu.ua

Abstract. The aim of the research *was* to investigate the effects of constant lighting on oxidative stress biomarkers malonic aldehyde (MA) and oxidatively modified proteins (OMP) in blood and liver of rats exposed to alcohol intoxication. It was revealed that ethanol poisoning resulted in increase in MA and OMP, and liver was the most affected (by 90% and 42% higher than control). The increase in MA and OMP in the liver of rats exposed to combination of alcohol intoxication and constant light was more significant (by 139% and 88% above control respectively) than in alcohol treated animals kept under normal light conditions.

Key words: ethanol, caffeine, light exposure, melatonin, rats.

Introduction. In the 80's of last century WHO experts established an approximate ratio of various factors in ensuring the health of modern people, identifying four main factors. It was shown that more than 50% of human health depends on living conditions and lifestyle (the rest of the impact is divided between heredity (20%), the environmental conditions (20%), and health care (10%). [7]. Thus, the diseases of modern people are primarily due to their lifestyle and daily behavior.

Modern society under the influence of new technologies and globalization ignores the systemic biorhythmic organization formed during evolution [7]. Light accompanies a human almost around the clock. Natural change of daylight by night darkness is almost inaccessible for the people from the big cities. Night shift, flights with changing time zones, active night life of modern man contribute to the violation of circadian rhythms, reducing the duration of sleep, especially its darkness period [5]. Many studies [6] showed an increased risk of serious diseases caused by light disorders.

According to WHO, alcohol abuse contributes to three million deaths per year globally and millions of people's disabilities and organ damage. Reduction of lifespan due to alcoholism is more significant than that due to cardiovascular diseases. The combination of health, psychological and social problems associated with alcoholism and alcohol abuse is a major public health problem [4].

Numerous laboratory and clinical studies have shown that the basis of ethanol toxic effects is the activation of biomolecules free radical oxidation [1]. Ethanol detoxification occurs mainly in the liver with the formation of acetaldehyde and associated with increased generation of free radicals, free radical oxidation of unsaturated fatty acids, proteins, nucleic acids, depletion of antioxidant reserves, which defines the concept of oxidative stress and leads to irreversible molecular changes in cells [1].

The aim of research was to investigate the effects constant lighting on oxidative stress biomarkers malonic aldehyde (MA) and oxidatively modified proteins (OMP) in blood and liver of rats exposed to alcohol intoxication,

Materials and methods. The study was performed in compliance with the Rules of the work using experimental animals (1977) and

JE), as well as "Bioethical expertise of preclinical and other scientific research performed on animals" (Kyiv, 2006).

Experiments were performed on 30 male Wistar rats weighing 180-200 g which were randomly grouped and kept in polycarbonate cages (3-4 rats per cage) in a room under controlled environmental condition (temperature 21±1 °C and 12:12 h light/dark cycle, with lights on 8:00 a.m.). Animals received food and water ad libitum.

Subacute alcohol intoxication was induced by intragastric administration 40 % ethanol at a dose of 7 ml/kg of body weight for 7 days. The control group of animals received equivolume amount of water. The light exposure was caused by a constant fluorescent light of 1500 lux intensity for 24 hours a day.

Rats were randomly assigned into groups: group 1 - control; group 2 - induced subacute alcohol intoxication; group 3 - alcohol intoxication + constant light exposure.

Animals were decapitated under light ether anesthesia on the 7^{th} day after beginning of the experiment. Blood samples were collected in presence of anticoagulant EDTA (1 mg/ml of blood). Erythrocytes were washed three times with five volumes of saline solution and centrifuged at 3000 rpm for 10 min and used for the determination of 2-thiobarbituric acid reactive substances. Blood plasma was used to measure oxidative protein modification.

The liver samples were excised, minced, rinsed with cold 50 mm Tris-HCl buffer (pH=7.4) to remove blood, and homogenized in a glass homogenizer with a motor-driven Teflon pestle on ice to prepare 5 % homogenates. The homogenates were centrifuged for 10 min at 900g.

Malonic aldehyde (MA) content was assayed in erythrocytes, liver homogenates based on spectrophotometric measurement of trimethine colored complex formed in reaction with thiobarbituric acid at high temperature and acidic pH [3]. The content of oxidatively modified proteins (OMP) in blood plasma, liver and kidneys homogenates was assayed by reaction of the resultant carbonyl derivatives of amino acids with 2.4-dinitrophenyl hydrazine which results in formation of hydrazones having specific absorption spectrum [3]. The value of OMP is quantified by the number of aldehyde and ketone groups formed. Aldehydes derivates were determined at 370 nm.

The results were statistically processed using the STATISTICA 10 software (StatSoft Inc.). A Shapiro-Wilk test was performed to verify normality of data distribution and then Mann-Whitney test was used to considered sufficient for valid conclusions to be made. Data are illustrated as mean±SEM (n=6 animals per group). $P<0.05$ was considered as statistically significant differences.

Results. Reactive oxygen species cause oxidation of membrane phospholipids to form fatty acid radicals, hydroperoxides, and secondary molecular products of lipid peroxidation, such as malonic aldehyde. The content of malonic aldehyde can be indirect evidence of intensity free radical oxidation in tissues.

In this study, we demonstrated that subacute ethanol stress caused an increase in maloaldehyde content in rats' blood by 38 % (table 1). The value of MA in the liver was by 90 % higher vs. control group, indicating a much greater oxidative stress in hepatocytes, which are directly involved in ethanol biotransformation.

Table 1

The content of MA and OMP in rats in terms of alcohol intoxication
and its combination with constant light exposure (M±m)

	Malonic aldehyde		**Oxidatively modified proteins (370 nm)**	
Groups/ Indices	**RBCs, nMol/ml**	**Liver, µMol/g tissue**	**Blood plasma, mMol/g protein**	**Liver, mMol/g protein**
Control	11.6±1.2	28.0±2.5	0.76±0.06	2.16±0.11
Ethanol	16.0±1.6*	53.3±4.9*	1.07±0.08*	3.07±0.23*
Ethanol + light	18.1±2.2*	66.9±5.5*#	1.31±0.22*#	4.07±0.48*#

Note: * – statistically significant difference compared to the control group (p≤0,05);

Along with the increase in lipid peroxidation, there was an intensification of free radical oxidative modification of proteins evidenced by increase in the content of OMP aldehyde derivates in rats' blood plasma and liver in terms of alcohol intoxication by 40 % and 42 % vs control group, respectively.

We revealed that ethanol stress along with constant light caused a significant increase in lipid peroxidation and OMP, as evidenced by an increase in malonic aldehyde in blood, liver of rats (by 56 %, 139 % above the control) and increase in oxidatively modified proteins in blood plasma and liver of animals (by 72 % and 88 % above control, respectively). These values were significantly higher than in alcohol-treated rats under normal light conditions. The more significant free radical damage of biomolecules under the combination of alcohol intoxication with exposure to constant light is probably due to a inhibition of melatonin synthesis by constant light.

Melatonin is a pineal hormone that regulates biological rhythms. The hormone production is regulated by light period, time of year, ambient temperature and the Earth's electromagnetic field [5]. Its serum concentration at night is 30 times higher than during the day, and the peak of activity occurs at 2 o'clock at night. The maximum synthesis of melatonin is observed in young people, with age it gradually decreases until cessation in old age [2]. Melatonin is one of the most powerful endogenous antioxidants present in all cellular structures, including the nucleus. The antioxidant activity of melatonin has been proven for many free radical pathologies [2, 5]. Numerous studies have shown that melatonin is capable of scavenging free radicals and protecting tissues from damage by various toxic agents and processes such as herbicides, carcinogens, bacterial lipopolysaccharides, ischemia, and ionizing radiation.

Conclusion. Thus, ethanol intoxication and its combination with light exposure has led to a significant increase in free radical oxidation of biomolecules, which confirms the development of oxidative stress due to these factors. The combination of ethanol administration with constant lighting potentiated the toxic effects of ethanol on the liver, resulting in a greater increase in malonic aldehyde and oxidatively modified proteins in the liver compared to animals treated with ethanol alone.

References

1. Birková A. Hubková B. Cižmárová B. Bolerázska B. Current view on the mechanisms of alcohol-mediated toxicity. Int. J. Mol. Sci. 2021 Sept 7;*22*(18):9686.
2. Cipolla-Neto J, Amaral FG, Melatonin as a hormone: new physiological and clinical insights. *Endocrine Reviews.* 2018 Dec;39(6):990–1028.
3. Davydova NV. The biochemical mechanisms of antioxidative action of the Rhodiola rosea extract [dissertation]. Kyiv, Ukraine;2004. 148 p.
4. Developing a global action plan to reduce the harmful use of alcohol. World Health Organization: Newsroom; 2020 [updated 2020 Nov 16]. Available from: https://cdn.who.int/media/docs/default-source/alcohol/alcohol-action-plan/volume-i-received-submission-to-the-working-document.pdf?sfvrsn=6529388c_13

5. Galano A, Reiter RJ. Melatonin and its metabolites vs oxidative stress: from individual actions to collective protection. J Pineal Res. 2018 June 5;65(1):e12514.
6. Onaolapoa JO, Onaolapob YA, Akanmuc AM. Caffeine and sleep-deprivation mediated changes in open-field behaviours, stress response and antioxidant status in mice. Sleep Science. 2016; 9: 236-43.
7. Vajner EN. Valeologiya: Uchebnik dlya vuzov. Minsk, Flinta; 2016. 416 p.

Karucheru Oksana

Radioactivity impact on human body

Bukovinian state medical university, Chernivtsi, Ukraine
karucheru.ksenia@bsmu.edu.ua

Energy needs worldwide are expected to increase for the foreseeable future, as they have been for the past decades [1]. It would be possible for nuclear reactors to supply much of the energy demand in a safe, sustainable manner if it was not for threat of potential releases of radioactivity. As for 2017, there are 191 nuclear atomic stations in 31 countries, with 448 energy blocks. In Ukraine four are in service - Khmelnitsky, Rivne, South Ukraine and Zaporizhzhia (temporarily occupied by russian military) power plants. They are all operated due to the protocol and protected from potential catastrophes. But in the light of possible threats of air and land attacks on nuclear stations from russian federation it is mandatory to know about the risks nuclear energy possesses.

Nuclear power plants can cause a great threat to the environment they are built at, and the lack of proper treatment may lead to a catastrophe, as it happened with Chornobyl atom station. Great amounts of radiation were released, poisoning the environment, human and animal bodies, leading to deaths, multiple DNA mutations and severe health issues. As soviet government covered it up, society had no possibility to know or do their research on the topic. That is why it is important to have a vast knowledge on radiation, nuclear energy and their impact on human body and health.

As cosmic rays are naturally present on Earth surface, there is a safe dose of radiation that every human gets exposed to normally – approximately 600 mrem per year at sea level, which differs depending on region. On the other hand, there are unnatural causes that may result on abnormally large radiation emission that may deteriorate human health. Consequently, the impact radiation has on human body heavily depend on the dose of radioactive emission and the duration of exposure. Long exposure to smaller doses can potentially be more dangerous than quick exposure to high doses. Increased length of interaction is more likely to lead to severe consequences, even though any dose of radiation higher than normal may cause great harm. For instance, smaller doses of radiation do not