XXV INTERNATIONAL ECO-CONFERENCE® 2021
XIV ENVIRONMENTAL PROTECTION OF URBAN AND SUBURBAN SETTLEMENTS
22th–24th SEPTEMBER 2021
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PROCEEDINGS
2021

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THE ECOLOGICAL MOVEMENT OF THE CITY OF NOVI SAD: AN IMPORTANT DECISION OF ITS PROGRAMME COUNCIL

Since 1995, the Ecological Movement of the City of Novi Sad organizes "Eco-Conference® on Environmental Protection of Urban and Suburban Areas", with international participation. Seven biennial conferences have been held so far (in 1995, 1997, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013 and 2015.). Their programs included the following environmental topics:

Session 1: Environmental spheres: a) air, b) water, c) soil, d) biosphere
Session 2: Technical and technological aspects of environmental protection
Session 3: Sociological, health, cultural, educational and recreational aspects of environmental protection
Session 4: Economic aspects of environmental protection
Session 5: Legal aspects of environmental protection
Session 6: Ecological system projecting (informatics and computer applications in the field of integrated protection)
Session 7: Sustainable development of urban and suburban settlements-ecological aspects.

Conference participants have commended the scientific and organizational levels of the conferences. Conference evaluations have indicated that some aspects are missing in the conference program. In addition, since a team of conference organizers was completed, each even year between the conferences started to be viewed as an unnecessary lag in activity.

Eco-Conference® on Safe Food

With the above deliberations in mind, a decision was made that the Ecological Movement of the City of Novi Sad should embark on another project – the organization of Eco-Conferences® on Safe Food. These Conferences were planned to take place in each even year. Preparations for the first Eco-Conferences® on safe food started after the successful completion of the Eco-Conference® '99.

So far four Eco-Conferences® have been held (in 2000, 2002, 2004, 2006, 2008, 2010, 2012 and 2014.) focusing this general theme.

Theme of the Eco-Conference®

By organizing the Eco-Conference® on Safe Food, the organizer wishes to cover all factors that affect the quality of human living. Exchange of opinions and practical experiences should help in identifying and resolving the various problems associated with the production of safe food.

Since 2007 Eco-Conference gained patronship from UNESCO and became purely scientific Conference.

Objectives of the Eco-Conference®

– To acquaint participants with current problems in the production of safe food.

– To make realistic assessments of the causes of ecological imbalance in the conventional agricultural production and the impact of various pollution sources on the current agricultural production.

– Based on an exchange of opinions and available research data, to make long-term strategic programs of developing an industrialized, controlled, integral, alternative and sustainable agriculture capable of supplying sufficient quantities of quality food, free of negative side effects on human health and the environment.

Basic Topics of the Eco-Conference®

Basic topics should cover all relevant aspects of the production of safe food.

When defining the basic topics, the intention was itemize the segments of the production of safe food as well as the related factors that may affect or that already have already been identified as detrimental for food safety and quality. The topics include ecological factors of safe food production, correct choice of seed (genetic) material, status and preparation of soil as the basic substrate for the production of food and feed, use of fertilizers and pesticides in integrated plant protection, use of biologicals, food processing technology, economic aspects, marketing and packaging of safe food.

To paraphrase, the envisaged topics cover the production of safe food on the whole, individual aspects of the production and their mutual relations, and impact on food quality and safety.

Sessions of the Eco-Conference®

1. Climate and production of safe food.
2. Soil and water as the basis of agricultural production.
3. Genetics, genetic resources, breeding and genetic engineering in the function of producing safe food.
4. Fertilizers and fertilization practice in the function of producing safe food.
5. Integrated pest management and use of biologicals.

6. Agricultural production in view of sustainable development
7. Production of field and vegetable crops.
8. Production of fruits and grapes.
9. Lifestock husbandry form the aspect of safe food production.
10. Processing of agricultural products in the framework of safe food production.
11. Economic aspects and marketing as segments of the production of safe food.
12. Food storage, transportation and packaging.
13. Nutritional food value and quality nutrition.
14. Legal aspects of protecting brand names of safe food.
15. Ecological models and software in production of safe food.

Attempts will be made to make the above conference program permanent. In this way will the conference become recognizable in form, topics and quality, which should help it find its place among similar conferences on organized elsewhere in the world.

By alternately organizing conferences on environmental protection of urban and suburban areas in odd years and conferences on safe food in even years, the Ecological Movement of the City of Novi Sad is completing its contribution to a higher quality of living of the population. Already in the 19th century, Novi Sad was a regional center of social progress and broad-mindedness. Today, owing first of all to its being a university center, Novi Sad is in the vanguard of ecological thought in this part of Europe.

It is our duty to work on the furtherance of the ecological programs of action and, by doing so, to make our contribution to the protection of the natural environment and spiritual heritage with the ultimate goal of helping the population attain e higher level of consciousness and a higher quality of living.

Director of the Ecological
Movement of Novi Sad
Nikola Aleksic

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SUSTAINABLE DEVELOPMENT OF URBAN AND SUBURBAN SETTLEMENTS – ENVIRONMENTAL ASPECTS

ECO-CONFERENCE® 2021
ECOLOGICAL MOVEMENT OF NOVI SAD

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Original Scientific paper

THE AMOUNT OF ARSENIC DEPOSITED IN THE ORGANS OF MALE MICE EXPOSED TO THE CONCENTRATION PRESENT IN THE WATER SUPPLY NETWORK OF THE MUNICIPALITY OF ZRENJANIN

Abstract

The paper presents the results of amount of arsenic deposition in the organs (liver, kidneys, testes, brain) of male mice. The concentration of arsenic used in the experiment is equivalent to the concentration of arsenic present in the water supply network of the Municipality of Zrenjanin, which was projected from human values on mice (10.6 mg / L). The amount of arsenic deposited in the organs of male mice was monitored in the experimental group for three consecutive generations. Measurement of arsenic in the organs of mice through three consecutive generations was done to determine changes in the amount of arsenic deposited in the organs.

The results indicate that arsenic is deposited in the organs and that the amount of arsenic does not decrease over the generations.

No pathological changes have been registered on the external and internal structure of the body, but that does not mean that due to the cumulative effect of arsenic, the symptoms of chronic poisoning will not manifest during later life.

Key words: *arsenic deposition in organs, groundwater, Zrenjanin*

INTRODUCTION

Arsenic (As) is a chemical element with atomic number 33, it belongs to the 5th group of the periodic table, it is a metalloid with complex chemical properties and, depending on the compound in which it is found, it can show the properties of metals or non-metals. Arsenic is present in the lithosphere atmosphere and biosphere. In na-

ture, it is found in pure, elemental states in small quantities. Occurs in oxidation states –3, +3 and +5. The most stable compounds with oxidation numbers are +3 and +5. Arsenic builds two oxides: arsenic III oxide, better known as arsenic, and arsenic oxide. From the toxicological aspect, significant compounds of arsenic are arsenic, arsenate and sulfur compounds. Toxicity depends on the chemical physical properties of the compound, route of administration, dose, time of secretion of exposure, dietary level in interaction with the elements, age and sex of the person (Kristiforovic Ilić, 2004).

Arsenic is found in the environment in air, water, soil, organisms, food (shellfish and other meats are the main sources of arsenic in the diet), items for general use (dishes, utensils and packaging for food, children's toys, personal care products), hygiene, household cleaners, tobacco products).

Sources of arsenic can be of natural or anthropogenic origin. Environmental problems related to arsenic that arise as a result of a natural process are dissolution, biological and volcanic activity. Anthropogenic sources of arsenic in the environment are the pharmaceutical industry, the chemical industry, metallurgy, mining, agriculture, fossil fuel combustion, and waste incineration.

Arsenic is in a stable state in the soil, building insoluble complexes with oxides of iron, aluminum and manganese. Under reducing conditions, arsenic is released and excreted into groundwater and surface water, where it is found in organic and inorganic forms. In natural waters, arsenic can participate in oxidative-reductive processes, bind to various inorganic and organic ligands, precipitate and biotransform. Reactions depend on pH value, concentration of metal sulfides and sulfide ions, iron concentration, temperature, salinity, microbiological factors.

The most common way of getting arsenic into the body is orally, contaminated with food and water, inhalation and absorption through the skin. There is a potentially greater danger of arsenic entering the body through contaminated water.

Water is the most important transport system of As in nature. Arsenic occurs in water in two oxidative states As (V), As (III), Pentavalent arsenic most often occurs in well-oxidized surface water. In groundwater in the sediments of deep lakes, it is most often found in the form of trivalent arsenic (Kristoforović Ilić, 2004).

A special national and world problem is the presence of arsenic in groundwater, which is a natural source of drinking water supply. The World Health Organization (WHO) has given a recommendation for a maximum permissible concentration of arsenic in drinking water of 10 μg / L, which has also been adopted by domestic legislation dealing with the safety of drinking water in public water supply systems. drinking water (*Službeni list SRJ,* 42/1998) In the territory of Serbia, arsenic is most present in the territory of Vojvodina, where the highest concentrations of arsenic were recorded in natural water sources for water supply to the population. According to the reports on monitoring of arsenic used for water supply of the population in Vojvodina from 2008, the quality of groundwater is the best in Srem where the concentration of arsenic is equal to 0.1 mg / L while the highest concentrations of arsenic are recorded in Banat (Municipality of Zrenjanin): Zrenjanin 0.315-0.580 mg / L, Elemir 0.569 / 0.586 mg / L, Taras 0.687 / 0.859 mg / L) (Jovanovic et al., 2011) There are numerous data on the relationship between the risk of cancer and water consumption with high concentrations of arsenic in water, but the risk caused by low concentrations of arsenic in drin-

king water has not yet been assessed. The maximum allowable dose of arsenic oxide for humans is 70 to 180 mg / L or about 600 μg / kg (according to the ATSDR, Agency for Toxic Substances and Disease Registry https://www.atsdr.cdc.gov).

Detection of arsenic in groundwater is performed by complex analyzes. Frequent water analyzes lead to alarming results on arsenic water pollution in a number of areas around the world. There are still not enough precise analyzes on the impact of arsenic in water. Long-term exposure to lower concentrations of arsenic is required to analyze the effects of arsenic in water in order to develop and register disease symptoms. The symptoms of chronic arsenic poisoning are similar to the symptoms of other chronic diseases, which leads to the problem of registering arsenic as the cause of the disease. The problem of groundwater pollution with arsenic is becoming global and requires a solution. Development of groundwater treatment technology. Conventional methods of groundwater treatment are insufficiently efficient and modern methods are expensive and both methods produce a large amount of liquid, solid and chemical waste which further complicates the process. There is great interest in solving the problem of groundwater pollution with arsenic.

Acute toxicity of arsenic in high concentrations has been known since the Middle Ages. Throughout history, the name arsenic has become synonymous with poison. The toxicity of arsenic has been known since ancient times. During the Middle Ages, it became synonymous with poison and became a part of social and political life. "White powder" arsenic III oxide was used for suicide, but also as the most common criminal poison in the fight for power, because white powder is odorless and tasteless, which did not affect appetite and in small doses was deadly, the effect was cumulative. Today, it is known that the symptoms of acute toxicity usually appear immediately after the intake of contaminated food, water. The most common symptoms are gastrointestinal problems, cramps, vomiting and the smell of garlic. Cardiac disorders, hypotension, ventricular tachycardia and fibrillation all the way to cardiac shock. Cerebral disorders headache, dizziness, convulsions and even coma. Hepatic and renal impairment oliguria, proteinuria and hematuria. Skin changes, dermatitis, ulcers. There is a cough, a burning sensation in the eyes, a runny nose, and chest pain.

Chronic arsenic poisoning leads to chromosomal aberrations, cancer.

The effect of arsenic in high concentrations, however low concentrations of arsenic especially present in the water to supply the population that people ingest as needed, use for daily use, hygiene, food preparation, watering plants, watering livestock has not yet been sufficiently investigated. Arsenic in low doses of 10.6 mg / L does not cause symptoms of acute poisoning. The presence of arsenic in water does not change the smell, taste, color of water. Chronic exposure to arsenic in low doses leads to the development of symptoms that are very similar to the symptoms of other organic diseases, and it is usually not noticed that arsenic is actually the real cause of the disease. Due to its cumulative effect and ability to be deposited in the body, it is a major health problem.

The recent results indicate that exposure to arsenic at low concentrations has a cumulative effect and is deposited in the body.

The aim of this paper is to show the negative effect of arsenic present in the water supply network of the Municipality of Zrenjanin. Indication of the consequences of

consuming water contaminated with arsenic in a concentration that is equivalent to the concentration of arsenic present in the water supply network of the Municipality of Zrenjanin, which is projected from the human value on the mice on which the experiment was conducted.

MATERIAL AND METODS

The experiment was designed to monitor the effect of arsenic on male mice continuously through three consecutive generations. The experiment was performed in an experimental group exposed to arsenic in arsenic concentrations equivalent to the concentration of arsenic present in the water supply network of the Municipality of Zrenjanin to the concentration projected from human value on mice on which the experiment was performed. The duration of the examination is approximately 6 months.

The animals used in the experiment were mice of regular breeding in the vivarium "Naval Medical Research Institute (NMRI) mice". Male and female, age (0 to 6 months), average body weight of (25-30 g). Animal health and welfare are monitored by a veterinarian, technician and researcher once a day following a protocol by the Public Health Service defined as a "Guide for the care and use of laboratory animals" according to the National Research Council, 2011. Accommodation of animals in the vivarium of the Pasteur Institute, cage group system at a temperature of 20-22 ^{o}C, relative humidity 50 + –5% and 12h light / dark cycle. Nutrition according to the formula (Veterinary Institute of Subotica). The average weight of food is 20% of the body weight of a mouse. Drinking water is from the Novi Sad water supply network to which arsenic III oxide (As_2O_3) has been added. The daily intake is about 7 ml. They ingest food and water *ad libitum*.

The substance arsenic oxide (As_2O_3) manufactured by "Centrohem" Stara Pazova was used for dosing.

The selected concentration of As_2O_3 dissolved in drinking water is equivalent to the human concentration of arsenic found in the water supply water of the population of Banat, Municipality of Zrenjanin (Taraš 0.687-0.859 mg / L).

The conversion of the substance concentration value from humans to mice is performed according to the protocol "A simple practice guide for dose conversion between animals and humans" (Nair et Jacob, 2016).

A value of 859 µg / L (0.859 mg / L) was taken from the following formula:

0.859 mg / L x 12.3 = 10.6 mg / L
0.859 mg / L: 0.081 = 10.6 mg / L

The formation of the experimental group of animals was carried out in the following way: cubs about 3 weeks old, after the end of the lactation period, were separated from the litter in the so-called. "Kindergarten" (5 weeks of age). Upon reaching reproductive maturity, mice are distributed in cages. The control group, the experi-

mental group (conc. As_2O_3 10.6 mg / L) have three generations of mice, each generation has three cages with mice. The number of mice in the cage is mice (4 females +2 males).

Experimental group of mice
(As_2O_3 conc. 10.6mg / L)
I generation (4♀+2 ♂) x3 cages
II generation (4♀+2 ♂) x3 cages
III generation (4♀+2 ♂) x3 cages

Control group of mice
I generation (4♀+2 ♂) x3 cages
II generation (4♀+2 ♂) x3 cages
III generation (4♀+2 ♂) x3 cages

Each group of animals was exposed to arsenic III oxide for 2 months. After which the animal was sacrificed, the organs were dissected by dissection; liver, kidneys, brain, testicles. Organs were stored at –20 °C until analysis.

The analysis of samples was performed at the Scientific Veterinary Institute "Novi Sad" by the method of inductively coupled plasma with mass detection of ICP / MS according to the protocol of Nelms (2005).

RESULTS

The animals exposed to a dose of arsenic at a concentration of 10.6 mg / L (equivalent to the concentration of arsenic present in the water supply network of the Municipality of Zrenjanin), during the experiment did not show pathological changes in the external structure of the body. Changes in the activities of mice, diet were not registered. There were no changes in the body weight of the mice. There was no mass death of animals compared to the control group. Tumor changes on internal organs were not registered by dissection and autopsy. ICP / MS analysis of samples for As content in the organs of mice measured the concentration of total As that was deposited in organs such as the liver, kidneys, brain and testes as a consequence of exposure to As_2O_3. The values shown in Table 1.

Table 1. The results of analysis of samples for the content of deposited arsenic in the organs of male mice.

Type of sample	Control group	Experimental group conc. As 10.6 mg / L As content (ng / g)
Liver I	9,8	4771,3
Liver II	9,8	1227,6
Liver III	9,8	990,3
Kidneys I	16,7	6573
Kidneys II	16,7	1603,5
Kidneys III	16,7	6328,2
Testes I	14,9	1392
Testes II	14,9	587,7
Testes III	14,9	1301,1
Brain I	29.8	587.2
Brain II	29.8	291
Brain III	29.8	787.3

An overview of total As content deposited in the organs of male mice exposed to As_2O_3 over a period of 2 months followed through three consecutive generations of mice.

DISCUSSION

The aim of this study was to determine the effect of arsenic and the amount of total arsenic deposited in organs through three consecutive generations of mice in order to determine whether the amount of arsenic decreases or increases during generations, the existence of adaptation to stress caused by the arsenic effect.

The research can continue in this direction through a number of consecutive generations and additional measurements of the weight of individual organs and thus more accurate results.

The effects of arsenic on the body is still insufficiently investigated. The effect of arsenic at a dose equivalent to the concentration of arsenic in the water supply network of the municipality of Zrenjanin is relatively low to manifest the symptoms of acute arsenic poisoning. The ability of arsenic to be deposited in the organs and has a cumulative effect enables the symptoms of the disease to develop during exposure to the stated doses of arsenic.

The animals used in the experiment during the experiment in the experimental group in all three generations did not show signs of disease, their daily activity, diet,

water intake did not differ from the control group. There were no changes in body weight. There were no mass deaths during the experiment, the number of deaths did not differ from the number of deaths in the control group. No changes in the form of ulcers, wounds, hair loss, anomalies on the limbs were noticed on the outer structure of the body. No tumor changes were observed by dissection and autopsy of the body, the organs were healthy. By measuring the arsenic content, it was determined that arsenic was deposited in the organs and that the concentration of arsenic was higher in relation to the control group. The results indicate that the animals are physically healthy, there are no acute symptoms of arsenic poisoning, but that a large amount of arsenic is deposited in the organs.

CONCLUSIONS

Arsenic is one of the significant polluters of the environment. A special problem is the presence of arsenic in groundwater, which is also used to supply water to the population. Legislation allows the concentration of arsenic in water up to 10 μg/L In a large number of wells in Vojvodina, the value of arsenic in water exceeds the permissible value. The low values of arsenic in water do not cause symptoms of acute poisoning, however, this study shows that arsenic is deposited at low doses in quantities significantly higher than the control group. By monitoring through three consecutive generations of mice, it was determined that in each generation it is deposited in the organs, the organism does not adapt over the generations to the effect of arsenic. Given the cumulative ability to act on arsenic and the amount of arsenic deposited in the organs over a long period of exposure to these doses of arsenic, the development of chronic symptoms of the disease is possible. The symptoms of the disease that occur do not differ from other organic diseases, so they are treated that way and the cause of the disease remains undiscovered, exposure to the negative effects of arsenic continues during treatment.

The results of arsenic deposition in the organs (liver, kidneys, testes, brain) of male mice are presented. The concentration of arsenic used in the experiment is equivalent to the concentration of arsenic present in the water supply network of the Municipality of Zrenjanin from the human value projected on mice (10.6 mg / L). The amount of arsenic deposited in the organs of male mice was monitored in the experimental group for three consecutive generations. Measurement of arsenic in the organs of mice through three consecutive generations was done to determine the amount of arsenic deposited in the organs.

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Оригинални научни рад

КОЛИЧИНА ДЕПОНОВАНОГ АРСЕНА У ОРГАНИМА МУЖЈАКА МИШЕВА ИЗЛОЖЕНИХ КОНЦЕНТРАЦИЈИ ПРИСУТНОЈ У ВОДОВОДНОЈ МРЕЖИ ОПШТИНЕ ЗРЕЊАНИН

Апстракт

У раду су приказани резултати количине депонованог арсена у органима (јетра, бубрези, тестис, мозак) мужјака мишева. Концентрација арсена коришћена у експерименту је еквивалентна концентрацији арсена присутног у водоводној мрежи Општине Зрењанин, која је са хумане вредности пројектована на мишеве (10,6 mg/L). Количина депонованог арсена у органима мужјака мишева је праћена у огледну групу кроз три узастопне генерације. Мерење арсена у органима мишева кроз три узастопне генерације је рађено ради утврђивања промена у количини депонованог арсена у органима.

Резултати указују да се арсен депонује у органима и да количина арсена током генерација не опада.

Нису регистроване патолошке промене на спољашњој и унутрашњој грађи тела, али то не значи да због кумулативног ефекта арсена неће током даљег живота манифестовати симптоми хроничног тровања.

Кључне речи: *таложење арсена у органима, подземне воде, Зрењанин*

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