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«ЭВОЛЮЦИЯ БИОСФЕРЫ, БИОГЕОХИМИЧЕСКИЕ ЦИКЛЫ И БИОГЕОХИМИЧЕСКИЕ ТЕХНОЛОГИИ: СВЯЗЬ ФУНДАМЕНТАЛЬНЫХ И ПРИКЛАДНЫХ ИССЛЕДОВАНИЙ»

МАТЕРИАЛЫ

XIII МЕЖДУНАРОДНОЙ БИОГЕОХИМИЧЕСКОЙ ШКОЛЫ-КОНФЕРЕНЦИИ, ПОСВЯЩЕННОЙ 160-ЛЕТИЮ СО ДНЯ РОЖДЕНИЯ ВЛАДИМИРА ИВАНОВИЧА ВЕРНАДСКОГО

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Материалы XIII Международной биогеохимической школы-конференции «Эволюция биосферы, биогеохимические циклы и биогеохимические технологии: связь фундаментальных и прикладных исследований», посвященной 160-летию со дня рождения В.И. Вернадского / Товарищество научных изданий КМК. – Пущино: 2023. – 324 с.

Сборник «Эволюция биосферы, биогеохимические циклы и биогеохимические технологии» содержит материалы XIII Международной биогеохимической школы-конференции, проходившей в г. Пущино 25-29 сентября 2023 г. Сборник дает представление о современном уровне и тенденциях в биогеохимии. Показано влияние основополагающих идей В.И. Вернадского на развитие как фундаментальных, так и прикладных биогеохимических исследований. Приведены результаты палеобиогеохимических и эволюционных работ, охарактеризованы биогеохимические циклы углерода и азота, их трансформация и влияние на продуктивность растений. Много внимания уделено биогеохимии почвы как основного компонента биосферы, также, как и биогеохимическим исследованиям в области экологии и медицины. Даны примеры моделирования биогеохимических циклов. Отдельно раскрыта роль биогеохимии в развитии биотехнологий, включая описание нового направления прикладных исследований – инженерной биогеохимии. Показаны инновационные природоподобные биогеохимические технологии для управления рисками экологической безопасности.
Сборник будет полезен широкому кругу ученых и практиков, связанных как с традиционными, так и с перспективными направлениями биогеохимических исследований, а также студентам, аспирантам и преподавателям естественно-научных специальностей высших учебных заведений.

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ASSESSMENT OF SIGNIFICANCE OF AERIAL TECHNOGENIC CONTAMINATION TO CANCER RISK IN THE URBAN POPULATION OF THE BRYANSK REGION

V.S. Baranchukov, E.M. Korobova, A.V. Silenok, I.V. Kurnosova

Correlation between medical data on cancer incidence localized in thyroid gland, breast, and stomach among citizens of 29 urban settlements of Bryansk region and geochemical data on radioisotope iodine pollution and some other atmospheric emissions of industrial enterprises was evaluated to assess possible contribution of pollutants in spatial distribution of density of urban residents' morbidity rate. Significant correlations of standardized morbidity indexes of thyroid cancer with radioactive pollution (R=0.357; p=0.057) and atmospheric air pollution by suspended particles (R=0.326; p=0.084); stomach cancer with emissions of volatile organic compounds (R=0.528; p=0.003), and breast cancer with integral air pollution by industrial enterprises emissions (R=0.434; p=0.019) were revealed. These estimates seem to be worth considering when developing measures to reduce the incidence of cancer in the corresponding localizations.

Keywords: cancer, iodine, air pollution, Bryansk oblast.

УДК [614] 623.454

CONSERVATION OF BIOLOGICAL AND FOSSIL RESOURCES FOR THE SUSTAINABLE DEVELOPMENT OF CHEMICALLY AND RADIATION-CONTAMINATED TERRITORIES OF THE CASPIAN SEA REGION

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The environmental problems of the oil and gas complex of Western Kazakhstan pose a serious threat to the entire Caspian region. The progressive impact of technogenic factors on the natural populations of animals and plants has set the goal of a detailed ecological and genetic analysis. Marine worms (Nereis diversicolor) and wild rodents (R.opimus) in the study area were used as test objects. The quantitative and qualitative composition of cytogenetic disturbances was revealed with increasing distance from the pollution source at the studied points. The level of genetic damage in wild rodents with appropriate extrapolation can be considered as the real maximum mutagenic effect of environmental factors in relation to people inhabiting these areas.

Keywords: Caspian zone, oil products, pollution, genetic disorders.

Introduction

In the Republic of Kazakhstan at the present stage for its sustainable development in the era of globalization, a serious danger is posed by technological disturbances of ecosystems. First of all, the Caspian zone, as an energy and life source, where the problems of preserving biological and fossil resources for the sustainable development of the region clearly arise [5]. The progressive impact of technological factors on natural populations of animals and plants requires a detailed ecological and genetic analysis. Despite the harsh climate, the Caspian region is relatively rich in flora and fauna. For example, the flora of the Mangistau region belongs to typical desert floras and includes 622 species [3]. There are significant changes in the ichthyology fauna of the Northern Caspian [1, 2, 4]. Hydrocarbons of the P-alkanes C11-36 series in the muscles of fish was found, indicating contamination of the ichthyology fauna with crude oil. In some cases, the excess of sanitary standards for heavy metals and other substances is increased. Thus, the environmental problems of the oil and gas complex of Western Kazakhstan pose a serious threat to the entire Caspian region. In the short term, the intensive development of oil and gas fields on the Caspian continental shelf (Kashagan) can dramatically increase the environmental burden not only of the kazakhstanish part of the Caspian region, but throughout the middle and northern parts of the Caspian Sea also.

Methods

Oil as an environmental pollutant is an important resource for poly aromatic hydrocarbons (PAHs). Hence, the determination of pyrene-containing components in test objects is an available method for assessing the carcinogenic risk of PAHs for the body, bioavailability and biodegradation of PAHs [1, 6, 7].

Table 1. The content of benzo(a)pyrene in the organs and tissues of polychaetes from the coastal zone of the northern Caspian

№	An object	Content of benzo(a)pyrene, mcg/kg	X_{av}, mcg/kg
1	Nereis diversicolor	1,115	1,16
2	Nereis diversicolor	0,595	
3	Nereis diversicolor	0,61	

Table 2. The content of heavy metals in marine worms – polychaetes of the species Nereis diversicolor (2009)

Sample name	Weight, g	Cu, mg/kg	Cd, mg/kg	Pb, mg/kg	Zn, mg/kg	Fe, mg/kg	Ni, mg/kg	Sr, mg/kg
Nereis diversicolor in fixed form	1, 235	7,05	0,945	1, 745	31,115	355,505	3,475	7,515

Our studies have shown that for evaluating marine worms (Nereis diversicolor) as a test object, the most sensitive and reliable method is analysis using high performance liquid chromatography with fluorescent and UV detectors. By us mainly, the technique for preparing samples for chromatography from marine polychaetes was developed and reproduced. The resulting sediment mixed with pyrene by adding the required amount of pyrene dissolved in a minimum amount of acetone and mixed in the liquid part of the sediment and artificial water of sea. The sediment mixed with pyrene on an automatic mixer, continuously for 5 hours. Then, after the sediment is settled, the water is decanted and the prepared sediment is kept at 5ºC for one week before being used in the experiment. Marine worms kept in this sediment for five days. Then the worms taken out of the sediment settled in marine water to cleanse the intestines, at least 4 hours before extraction. Intestinal tissue samples are prepared, weighed and transferred into test tubes. The samples homogenized in methanol, solicited (10 min) and centrifuged (3000 rpm, 5°C, 10 min) to pellet intestinal tissue particles. The supernatant then filtered and transferred to High Performance Liquid Chromatography (HPLC) vials, i.e. HPLC with fluorescent and UV detectors for the determination of pyrene metabolites. The results obtained presented in table 1.

The research used standard cytogenetically methods by Ford (1973). Small mammals play an important role in assessing the state of natural ecosystems. In particular, we have carried out studies to assess the genetic hazard of oil, oil products and heavy metals along trophic food chains in natural rodent communities in the "oil-soil-plants-animals" system. As noted by Andersen (1985), food chains are useful for analyzing the structure and functioning of ecosystems. In our studies, in all the studied points, S.nitraria, T.sibirica plants have the highest cumulative and stable abilities in relation to heavy metals. These plant species were used as biological indicators of environmental pollution by heavy metals [2].

Results and discussion

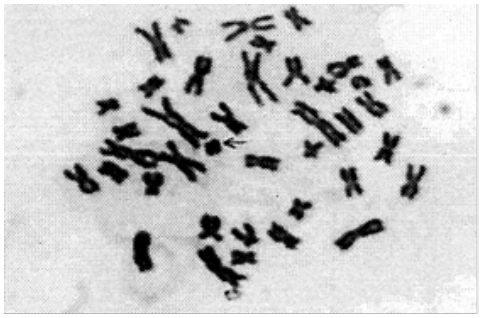
The content of heavy metals associated with oil in the body of marine worms (Nereis diversicolor) was determined, the results are shown in Table 2.

As follows from the data in the table 2, iron, lead, zinc and copper showed the greatest ability to accumulate in the body of polychaetes.

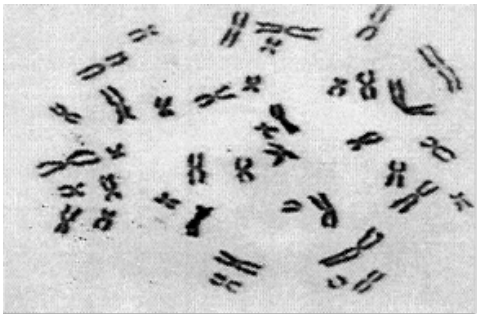
According to the literature, in plants in the oil-contaminated ecological topes of natural populations, the level of lead content exceeds background values from 2.5 to 5 times, and in our studies on the territory of oil fields and in the vicinity of the city along the road, the level of lead concentration exceeds from 1.65 to 13.8 times. As noted by A.B. Bigaliyev (3,9), screening methods for studying the biology systems of rodents to identify mutagenic substances in the environment make it possible to take into account the induction of genetic disorders in the cells of small mammals in vitro and in vivo. Thus, the frequency of cells with chromosomal aberrations in the bone marrow of R.opimus rodents is an important characteristic of the genotoxic properties of environmental pollution with oil, oil products and heavy metals and the intensity of the mutation process. Therefore, the results of our studies on the assessment of the potential mutagenic hazard of contamination of the Tengiz and Kulsary oil fields with oil and oil products using the great gerbil (R.opimus) as a test object are of intrest. It has showed that in all four points in the studied rodents there are changes in both the frequency of aberrant cells, and types of chromosomal disorders. The maximum values of the studied cytogenetic parameters were noted in heavily polluted areas. At the oilfields in Kulsary (6.93±1.3) %, the frequency of chromosome aberrations in the bone marrow of the great gerbil exceeds the control value by 3.9 times. The level of cytogenetic disorders in R.opimus inhabiting the Tengiz oil field is 1.5 times lower than in the rodents of the Kulsary site (fig. 1).

Conclusion

The quantitative and qualitative composition of cytogenetic disturbances revealed in this work with increasing distance from the pollution source at the studied points indicates the presence of strong clastogenic



Metaphase plate with deletion and paired fragment



Metaphase plate (normal)

Fig. 1. The level of cytogenetic disorders.

effects of oil and oil products here, possibly from the sulfur content. Thus, the level of genetic damage in wild rodents with appropriate extrapolation can be considered as the real maximum mutagenic effect of environmental factors in relation to people inhabiting these areas. In particular, the data obtained showed that oil and oil products are highly toxic and complex substances that affect the heredity of living organisms. This is reflected in the ecosystem of the Zhylyoi district of the Atyrau region, as well as the entire Northern Caspian region: individual genotypes disappear from the existing populations of plant and animal species. Every year, the transgression and regression of the Caspian Sea affects the vast coastal landscapes. Therefore, at present there is a problem of preserving sustainable biodiversity, genetic resources and ecosystems, not only local, but also regional. Taking into account the special ecological danger of the region, such studies are necessary not only to assess the state of natural complexes under anthropogenic stress, but also to predict the mutagenic and carcinogenic danger of environmental factors for people living in these territories.

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ХАРАКТЕРИСТИКА ЭКОЛОГИЧЕСКОГО СОСТОЯНИЯ АМУРСКОГО ЗАЛИВА (ЗАЛ. ПЕТРА ВЕЛИКОГО, ЯПОНСКОЕ МОРЕ) ПО СОДЕРЖАНИЮ ЭКОЛОГО-ТРОФИЧЕСКИХ И МЕТАЛЛ-РЕЗИСТЕНТНЫХ ГРУПП МИКРООРГАНИЗМОВ

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