EDITORIAL

The most significant achievements in the field of natural sciences are reached in joint collaboration, where important roles are taken by biology and chemistry. Therefore publication of a Journal, displaying results of current studies in the field of biology and chemistry, facilitates highlighting of theoretical and practical issues and distribution of scientific discoveries.

One of the basic goals of the Journal is to promote the extensive exchange of information between the scientists from all over the world. We welcome publishing original papers and materials of Biological and Chemical Conferences, held in different countries (after the process of their subsequent selection).

Creation of special International Journal of Biology and Chemistry is of great importance, because a great amount of scientists might publish their articles and it will help to widen the geography of future collaboration. We will be glad to publish also the papers of the scientists from the other continents.

The Journal aims to publish the results of the experimental and theoretical studies in the field of biology, biotechnology, chemistry and chemical technology. Among the emphasized subjects are: modern issues of technologies for organic synthesis; scientific basis of the production of physiologically active preparations; modern issues of technologies for processing of raw materials, production of new materials and technologies; study on chemical and physical properties and structure of oil and coal; theoretical and practical issues in processing of hydrocarbons; modern achievements in the field of nanotechnology; results of studies in the fields of biology, biotechnology, genetics, nanotechnology, etc.

We hope to receive papers from a number of Scientific Centers, which are involved in the application of the scientific principles of biology, biotechnology, chemistry and chemical technology on practice and carrying out research on the subject, whether it relates to the production of new materials, technology and ecological issues.

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Behaviour of some hydrobionts in experimental conditions of accidental oil pollution

Abstract: This work presents results on behavioral reactions and sensitivity of molluscs and fish to experimental modelling of accidental oil pollution during the first 72 hours. It is shown that mobile hydrobionts, such as fish attempt to escape the contaminated area during the first 24 hours after the oil spill. Benthic animals – molluscs are more susceptible to pollution, they almost instantly lose their mobility, become inert and try to escape their shells further on, which serves as an evidence of death throes. Light crude with high content of paraffin was used for the present experiment.
Key words: oil impact, molluscs, fish, experiment, behavioral reactions.

Introduction

The problem of anthropogenic contamination is currently topical for Kazakhstan, this includes contamination of aquatic and terrestrial ecosystems by hydrocarbons. This is relevant to water reservoirs with active oil extraction sights, Caspian Sea shelf, in particular, is already showing some signs of strong oil pollution, which is known to be toxic for hydrobionts when the levels of threshold limit value (TLV) are exceeded and leads to a reduction in unique biological diversity. Gas and oil extraction activities exert polluting effects on the surroundings at all stages of the production cycle – during geological surveyence works, well-boring, extraction of oil and gas, their preparation and storing, transportation and processing. From a chemical point of view, crude oil is a complex mixture of paraffin, cycloparaffin and aromatic hydrocarbons. Apart from these basic components it contains sulfuric and nitrogenous compounds, organic acids, microelements. Oil may also contain naphthenic acids and phenolic compounds, which in turn contain polyaromatic hydrocarbons – environmentally highly dangerous compounds. In soluted form oil is 80-90% aromatic hydrocarbons (benzene, toluene, ethylbenzene, xylene and others), which are highly toxic [1, 2].

The negative impact of oil pollution on biota is observed at all fresh-water and marine ecosystem links. The highest priority hazards for living organisms are water-soluble fractions of oil that contain aromatic hydrocarbons with toxic, teratogenic and mutagenic effects. Many of oil products have an ability to accumulate, retain, metabolize in the organisms of hydrobionts and can be transmitted through food nets [3, 4].

Aside from direct impact on microorganisms, vegetation, invertebrates, fish and other aquatic animals, these toxicants influence the processes of gameto and embryogenesis, development of larvae and young fish [5, 6].

Failure of separate physiological functions occurs at organism level, behavioral changes, an increase in mortality due to direct poisoning or decreases in steadiness. Considering sensitivity, fish become vulnerable due to oil pollution directly through skin and gills. At populational level the contamination may cause changes in quantity and biomass, birth rate and mortality, sexual and size structure, type of dynamics and a number of functional properties [7].

Benthic organisms are significantly more stable to oil pollution than planktonic organisms, which quickly perish from oil concentrations of about 0.01-0.001 mg/l. Contamination of bottom deposits by oil and oil products leads to a restructure of benthic communities in marine and fresh-water ecosystems [8, 9].

Thus, oil pollution impact on hydrobionts and ecosystems as a whole is a subject of observations in many researches. Review of such researches allows noting different reactions of organisms to oil pollution in post-emergency situations. However, behavior of hydrobionts during the first 24 hours of oil spill is poorly explored. In the present work an attempt to observe sensitivity and behavioral reactions during the first three days of some benthic (molluscs) and pelagic (fish) animals for modeling accidental oil pollution.

Materials and methods

Two species of hydrobionts were chosen as experimental objects: stone morocco *Pseudorasbora parva* (Temmnick et Schlegel, 1846) and pomacea bridgesii *Pomacea bridgesii* (Reeve, 1856) that belongs to gastropod (*Gastropoda*) molluscs. 6 individuals of stone morocco and 2 individuals of molluscs were used as test objects in the experiment. The objects of the observations were kept in a well-aerated fish tank with a volume of 112 L and an optimal temperature of 21°C for a long time (more than a year).

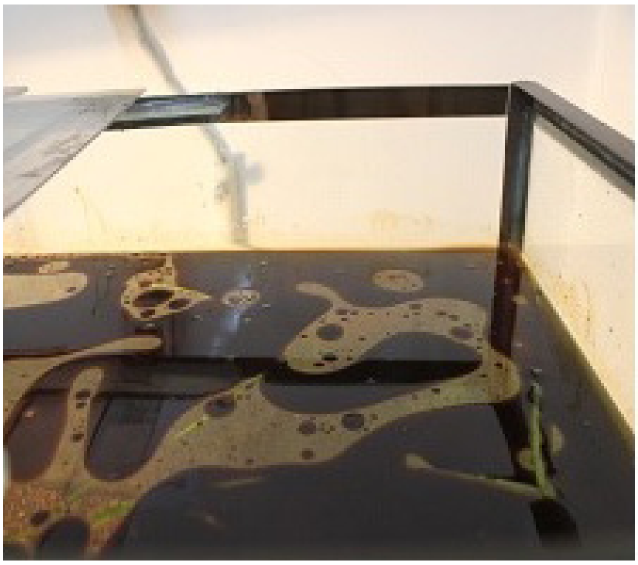
The hydrobionts received a sufficient amount of nutrients and were not exposed to external stress factors for the whole period of time. To determine the hydrobionts' sensitivity to oil pollution, crude oil from Kumkol oilfield of Kyzylorda region with the following characteristics: light (density 0.82- 0.83% g/cm^3), low-sulphur (0.33-0.55%), with a high paraffin content (11%) was added into the tank [10]. TLV of oil products for reservoirs with commercial fishing purposes equates to 0.005 kg/m^3 [5], in terms of the fish tank volume an amount of 150 ml of oil with a concentration of 0.7 mg/L was added, this exceeds TLV by 300 times. Influence of oil on the hydrobionts was observed for 72 hours.

Results and their discussion

In the beginning of the experiment a dense oil slick was dispersed over the surface, but due to the presence of an active aerator consequently disintegrated into separate stains (Figure 1A).

The fish were concentrated near the aerator, however irregularities in the behavior could be observed after 60 minutes. Active movements of the fish were noted, they were avoiding contaminated by oil surface areas of water (Figure 1B).

The molluscs stopped to be active and started to fall down to the bottom of the tank after 3 hours. Weak attempts to turn over to the abdomen were observed, their movements were reminiscent of the attempts to "crawl out of their shells" (Figure 2A). After 8-10 hours and until the end of the experiment the molluscs were laying on the bottom of the tank "without signs of life".



A

B

Figure 1 – A – oil film on the water surface; B **–** avoiding of the contaminated surface areas of water

After 4 hours from the start of the experiment obvious changes of a dorsal fin of one individual were noted: darkening and compression of the interradial space, inert behavior.

After 19 hours several individuals showed some signs of change of the pectoral fins, an obvious reddening that was characterized by hemorrhage at the basis of the fin, darkening of the scale and its "mashing" were noted.

After 24 hours the fish stopped to swim actively, were partly concentrated on the surface of the tank, which is related to oxygen deficiency as a result of the formation of a dense oil slick (Figure 2B).

A B

Figure 2-A – Mollusc after several hours of poisoning; B – Impairment of respiratory mechanisms

By the end of the first 48 hours the oil slick disintegrated into separate stains. The fish moved to the bottom of the tank, where they concentrated near water plants. They behaved passively and almost did not perform any swimming activities, but showed no signs of complete asphyxia.

The process of adaptation to unusual, extreme (severe) conditions occurs in several stages or phases: at first decompensation events (impairment of functions) are prevalent, then events of partial adaptation – the organism is actively searching for stable states, which correspond to the new conditions and finally phase of relatively stable adaptation takes place [11].

After 48 hours molluscs and fish were transferred into a clean, well-aerated aquarium, in which they slowly started to regain their activeness. Notably, the molluscs stayed immobile for more than 48 hours and reanimated for significantly longer than the fish. The molluscs like many benthic sedentary hydrobionts are more vulnerable during accidental oil pollution. Precipitation of the oil slick, aggregation of its components in the bottom sediments during prolonged exposure in natural settings may lead to their death.

The fish that belong to a pelago-benthic ecological group do not tend to perish during the first 24 hours after the oil spill and attempt to escape the affected area such that, they express behavioral reactions by trying to escape from polluted areas [12].

It is known that depending on duration and scale of pollution a wide range of damaging effects can be observed – from behavioral anomalies, which was observed in our experiment, death of organisms at early stages of the spill and to structural and functional changes in response to chronicle influence.

Remote consequences of the pollution were also observed in our experiment. In 2-3 months after the experiment all the fish have died. Autopsy of the fish has showed disfunctions in the organs of the digestive and respiratory systems: decay of the liver tissue, formation of tumors on digestive organs and gills.

Conclusion

Thus, results of the experiment on the influence of Kumkol oil, allow us to make the following assumption: during an accidental oil spill in natural surroundings mobile pelago-benthic hydrobionts are practically not prone to dying during the first several days. Sedimentary benthic animals – molluscs, worms, and some crustaceans are more sensitive and possibility of their death in the first 24 hours is considerably high.

At the same time, oil from different oilfields is different in chemical composition. For instance, upper Paleozoic oil of Tengiz and Kashagan oilfields is characterized by aggressive features, due to a significantly large content of hydrogen sulfide (up to 20-25%) [13].

Impact of such oil on behavioral reactions of aquatic organisms immediately after its spill requires additional experimental research. In case of spills and catastrophic releases of such sulfur oil, it will probably disastrously affect the biodiversity of Caspian Sea.

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