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ЛЬВІВСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ ІМЕНІ ІВАНА ФРАНКА
МІНІСТЕРСТВО НАУКИ І ВИЩОЇ ОСВІТИ ПОЛЬЩІ
ПОМОРСЬКА АКАДЕМІЯ В СЛУПСЬКУ
ЗАХІДНИЙ НАУКОВИЙ ЦЕНТР НАН УКРАЇНИ ТА МОН УКРАЇНИ
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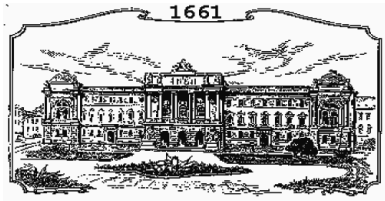
ПРОГРАМА І ТЕЗИ ДОПОВІДЕЙ



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(recently has been attracting researchers' attention for use in aquatic animals) for fish health using markers of aerobic and anaerobic capacity in the gills, muscle, hepatic, and cardiac tissues of rainbow trout. The alanine (ALT) and aspartate aminotransferases (AST), lactate dehydrogenase (LDH) activity, lactate and pyruvate levels were assessed in the gills, muscle, hepatic, and cardiac tissues of rainbow trout exposed to chlorine dioxide and compared to untreated control.

In the present study, ALT activity after chlorine dioxide exposition was significantly increased by 26.5 % (p=0.033) in the cardiac tissue compared to control value. Hepatic and gill tissues showed the decrease of ALT activity by 21.4 % (p=0.008) and 18 % (p=0.000), respectively. In case of muscle tissue, ALT activity was non-significantly decreased compared to control. AST activity was increased significantly in the cardiac tissue by 24 % (p=0.011) but decreased in the cardiac tissue by 16.7 % (p=0.002) as compared to control value during chlorine dioxide disinfection. AST activity in the muscle and hepatic tissues after chlorine dioxide exposition showed usual trend of decreased as compared to control value (by 30.7 %, p=0.033 and by 12.7 %, p=0.002, respectively). LDH activity, likewise ALT and AST in the cardiac tissue, was significantly increased after chlorine dioxide exposure. In muscle and hepatic tissues, the statistically significant decreased LDH activity was recorded by 51.6 % (p=0.000) and by 110 % (p=0.002), respectively. The recovery pattern in case of LDH activity after disinfection by chlorine dioxide was in the following order: muscle tissue > gills > cardiac tissue > hepatic tissue. Like transaminases, muscle LDH activity was also reduced during disinfection as a compensatory response to overcome the stress. Reduced activity of LDH during disinfective measurement may be due to lower synthesis rate of lactate and pyruvate and less energy demand as fishes are in recovery period after disinfection. Lactate level after exposition of chlorine dioxide was significantly decreased by 28 % (p=0.017) in the muscle tissue of the trout compared to control value. Gill tissue also showed similar results as in the muscle tissue such as decrease of lactate level by 23 % (p=0.045). In case of cardiac tissue, lactate level was significantly increased by 79 % (p=0.001) compared to control. In case of lactate level, pattern was in the following order: cardiac tissue > hepatic tissue > gills > muscle tissue. Pyruvate level was decreased significantly in the gill tissue by 35 % (p=0.033) but non-significantly decreased in the muscle and hepatic tissue as compared to control value.

The increased activities of ALT, AST, and LDH in the cardiac tissue of trout may represent a metabolic compensatory mechanism employed by cardiac tissue in an attempt to mitigate the effects of the chlorine dioxide through changes in it metabolic functions [Malarvizhi et al., 2012]. The chlorine dioxide may induce an increased metabolism of nutritional carbohydrate and protein, and the upregulation of LDH, AST and ALT may be a response to resolve such an energy crisis [De Smet, 2001; Malarvizhi et al., 2012]. Therefore, the present findings, combined with previous research, demonstrate that the increased levels of LDH, AST and ALT in the cardiac tissue of trout following disinfection to chlorine dioxide may be a response to an increase in metabolism, which may suggest structural damage and dysfunction in fish hearts [Loteste et al., 2013; Zhang de et al., 2016]. Therefore, these biochemical indices can be considered as indicators for assessment of disinfective effects, although further studies are required for investigating the mechanism involved in this pattern.

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BIOINDICATION OF THE TOXICITY OF INDUSTRIAL EFFLUENTS BY THE APPLYING OF THE BIOCHEMICAL RESPONSES OF AQUATIC ANIMALS

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The validity of molecular biomarkers of stress and exposure to reflect the level and different types of pollution in aquatic animals is proved in a broad number of experimental exposures.

This approach is of particular importance in the complex polluted surface waters which contain a mixture of industrial, agricultural and personal care products at low ppt–ppb concentrations and in the no predictable interactions. However, their applying in the environmentally realistic situations needs further development. Paper industry is considered as one of the main polluters among different kinds of industry in the world [Hoffman, 2015]. The expertise of the toxicity of the paper mill effluents is mainly realized by the exposures either *in vivo* or *in vitro* to the extracted effluents during short period. The analysis of molecular responses in the biota subjected to the effluents in their native surrounding is rather scant [Cajaraville, 2003]. The biological responses which are specific precisely for this type of pollution are not detected.

The aim of this study was to elucidate the toxicity of the aquatic quality in the small river which is suspected to be polluted by the effluents of the cardboard-paper mill (CPM). The specimens of fish *Carassius auratus* (Cyprinidae) and mollusk *Unio tumidus* (Unionidae)from the suspected polluted area (SP) and pristine area in the upper portion of river as control (C) were compared. About 20 individuals of male specimens of fish and mollusks from each site were analyzed. The set of biomarkers of stress and toxicity was applied due to the guidelines. The fish and mollusk from SP demonstrated plural signs of toxicity and stress: 2.5−3.7 times higher levels of DNA fragmentation and frequency of nuclear abnormalities than in C-groups; low lysosomal membrane stability (in hemocytes of mollusks); higher levels of the lipid peroxidation products (by 2.23 times in the digestive gland of mollusk) and lipofuscin (determined only in fish) in comparison with C-groups. The exposure to the certain xenobiotics was confirmed by two- to-threefold increase of metallothionein levels (response to toxic metals), CYP450-related activity (EROD) and alkaline-labile proteins (responses to endocrine disrupters in male specimens, in particular, to chlorinated organic substances). All these kinds of pollution are typical for the CPM industry. Particularly, even the wastewater treatment can not totally remove this endocrine effect of effluents [Waye, 2014]. Cholinesterase activity in the brain of fish was the same in the C- and SP-groups proving the low evidence of typical agricultural pollution [Van der Oost, 2003]. The chemical analysis of water was not so sensitive. These results prove the molecular bioindication to be the most valid approach to assess the toxicity of CPM effluents. Moreover, the comparison with the previous results confirms that this adverse effect is prominently higher than the typical pressure in the agricultural and municipal sites and could be regarded as the consequence of emergency situation [Falfushynska, 2010; 2012].

To summarize, at the first time, the multi-marker molecular approach of CPM effluents was realized. Only the combination of the indices of stress and specific kinds of pollution allowed distinguishing between CPM effluents and non-pointed sources of pollution typical for the rural area. The utilisation of the vertebrate animal model allowed to distinguish better the type of pollution, whereas the indices of mollusk attested better the severity of lesions.

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HYPOGLYCEMIC EFFECT OF CORNELIAN CHERRY (*CORNUS MAS* L.) EXTRACTS UNDER STREPTOZOTOCIN INDUCED DIABETES MELLITUS IN RATS

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Hyperglycemia develops in conditions of diabetes and leads to disturbance of protein, carbohydrate and lipid metabolism. Excessive accumulation of glucose is accompanied by the ap-

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