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Biochemistry

Effect of Combined Pesticide Lambda-Cyhalothrin on Hydrobionts

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ABSTRACT. While monitoring waters of Alazani river, Eastern Georgia, it was found that some pesticide products used in the fields to protect agricultural crops and grapes from pests get into water. We studied the effect of the combined pesticide lambda-cyhalothrin on quantitative distribution of lipids in tissues, gills and liver of fish. The study was conducted on fish mursa (*Barbus mursa*) inhabiting Alazani river, which is characterized by slow zonal movement and is easy to fish. Biochemical processes occurring in fish due to water contamination with mineral fertilizers and pesticides were investigated. Some uncharacteristic processes in fish organism and changes in lipid concentration caused by pesticide effect were revealed. The level of changes in lipid components and fatty acids in the fish organs are determined. *© 2013 Bull. Georg. Natl. Acad. Sci.*

Key words: *toxic compounds, pesticides, lambda-cyhalothrin, lipid components.*

Pesticides as complex organic compounds are the source of pollution of water objects. Most pesticides are high-toxic compounds for the ecological system. Concentration of mercury-containing and chlorinated pesticides in hydrobionts may be 10,000 times more than in the water as a result of cumulation processes and transfer with food chains [1,2]. As a result of environmental pollution a large amount of pesticides and other organic compounds used as fertilizers get into water consumed by man [3,4].

In Kakheti region, Eastern Georgia, waters of the Alazani river are used for irrigation of the fields and vineyards and water is contaminated with mineral fertilizers and pesticides. Combined pesticide lambda-cyhalothrin, which represents pyretroid insecticide containing icon, karate, commandor, samurai, is used more often than others; that is why we decided to study quantitative distribution of these pesticides on hydrobionts and structural lipid modifications of tissues of fish mursa (*Barbus mursa*). The Alazani river is differently contaminated and therefore the investigations were carried out in different parts of the riverbed.

Materials and Methods. Lambda-cyhalothrin is a neural-paralytic toxin for digestive system. The effect of this toxin was studied on fishes, which are

Table 1. Quantitative change of lipid components in the gills and liver (M±m, n=10 mg per 1g tissue)

Organs of fishes	Phosphatidyl-choline		Lysophosphatidyl-choline		Stearins		Phosphatidyl-ethanolamine		Glycerides	
	Contr.	exp.	Contr.	exp.	Contr.	exp.	Contr.	exp.		exp.
Gills	20±0.001	23±0.001 p<0.001	15±0.003	18±0.001 p<0.001	20±0.001	25±0.001 p<0.001	22±0.001	27±0.003 p<0.001	16±0.001	20±0.002 p<0.001
Liver	26±0.001	30±0.001 p<0.001	20±0.002	25±0.002 p<0.001	27±0.001	35±0.004 p<0.001	25±0.003	37.5±0.001 p<0.001	23±0.001	33±0.002 p<0.001

one of the important links of a food chain of hydrobionts. Mursa of Alazani is characterized by slow zonal movement and is easy to fish. Samples of fishes were chosen every day in the upper and middle reaches of the Alazani river (control and experimental samples). Experiments were carried out in summer by the method of liquid chromatography using the Waters HPLC System (Milford, MA, USA). The data were divided on the analytic axis of the Waters Nova-Park C-18 (100 mm, 83.2 mm, 5 mkm in granules) by fluorescent detector (270 nm excitation, 350 nm emission).

Results and discussion. Lambda-cyhalothrin is adsorptive poison. It damages not single organs but the whole organism [1,2,5]. Therefore we have studied the process of intoxication with lambda-cyhalothrin in gills and liver, which is the most loaded organ with structural lipid components. These components: phosphatidylcholine**,** lysophosphatidylcholine, stearins, sphingomyelin, phosphatidylethanolamines, glycerides in the gills, and fatty acids, glycerides, stearins, sphingomyelin, phosphatidylcholine in the liver reveal different sensitiveness in the intoxication process. One can see that lipid components are characteristic of all organs, but in spite of this, certain regularity for lambda-cyhalothrin is seen: amount of fatty acids, stearins, phospfatidylethanolamine and phospatidylcholine increases in both gills and liver (Table 1).

Based on the data obtained we can conclude that at intoxication with lambda-cyhalothrin the process of lipid modification is not limited to a target of one organ only, but it represents an adaptation reaction of the organism. Taking into consideration that saturated and unsaturated fatty acids participate in the processes of free radicals oxidation we decided to study relative changes in saturated and unsaturated fatty acids during intoxication of fishes with phenol. As seen from Table 2 the amount of unsaturated fatty acids increases and that of saturated fatty acids decreases. As is known, unsaturated fatty acids are unstable structurally and are easily exposed to free radical oxidation, as a result of which lipid peroxides are produced. Their amount increases 1.8-times in the gills and 2-times in the liver. Such increase causes periodical convulsions and partial loss of orientation reflexes, etc. Thus, we can state that during the intoxication by lambda-cyhalothrin initiators of phospholipid peroxidation become more active. It is quite possible for superoxide forms of oxygen to be initiators of cytomembrane lipid peroxidation.

Table 2. Changes of fatty acids in the fish liver

Fatty acids	Amount in mg/100g	
	Control	Experim.
Lauric acid	3.4	5.4
Myristic acid	4.4	6.3
Palmitic acid	6.4	8.1
Stearic acid	3.1	4.5
Oleic acid	18.2	21.2
Linoleic acid	42.6	51.4
Arachic acid	2.5	3.1

Based on the actual material, one can conclude that intoxication of the fish tissues with lambda-cyhalothrin processes appear which stimulate oxidation of free radicals of structural lipids. Then peroxides of the initiators of free radicals are formed (e.g. glutathione reductase-glutathione peroxidase), which stimulate lipid peroxidation. Activation of free radical oxidation takes place and as a result of decrease of the regulation system activity the

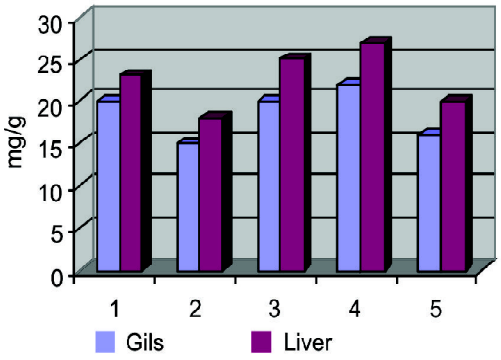

Fig.1. Quantitative change of lipid components in the gills and liver (M±m, n=10 mg per 1g tissue).
1. Phosphatidylcholine; 2. Lysophosphatidylcholine; 3. Stearins; 4. Phosphatidylethanolamine; 5. Glycerides.

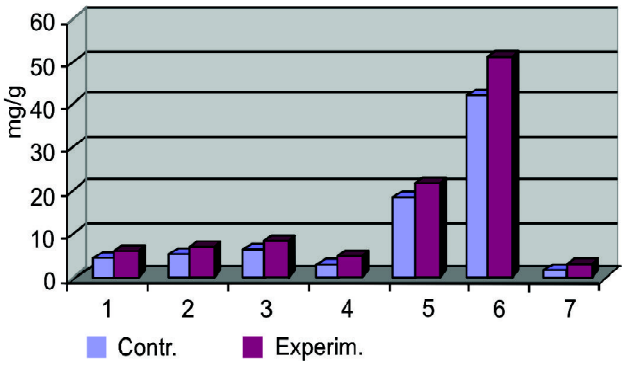

Fig.2. Quantitative change of saturated and unsaturated fatty acids in liver (contr. and experim.) (M±m, n=10 mg per 1g tissue).
1. Lauric acid; 2. Myristic acid; 3. Palmitic acid; 4. Stearic acid; 5. Oleic acid; 6. Linolenic acid; 7. Arachic acid.

lipoperoxidants are formed; they are uncharacteristic of normal vital functions, negatively affect hydrobiont metabolic processes and cause cell lysis of fish.

ბიოქიმია

კომბინირებული პესტიციდის ლამბდა-ციჰალოტრინის გავლენა ჰიდრობიონტებზე

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პესტიციდების გამოყენება ერთ-ერთი მნიშვნელოვანი საქმიანობაა მოსავლის დასაცავად. მაგრამ მიუხედავად ამისა, მათ შეუძლიათ გამოიწვიონ მნიშვნელოვანი უარყოფითი შედეგები. აქედან გამომდინარე, გადავწყვიტეთ შეგვესწავლა კომბინირებული პესტიციდის ლამბდა-ციჰალოტრინის მოქმედება (იგი წარმოადგენს პირეტროიდულ ინსექტიციდს, რომლის შემადგენლობაში შედის: იკონი, კარატე, კომანდორი, სამურაი). ლიპიდების განაწილებაზე ჰიდრობიონტებში, კერძოდ, ალაზნის თევზის ქსოვილში, ლაყუჩებსა და ღვიძლში.

წარმოდგენილი ფაქტობრივი მასალიდან შეიძლება დავასკვნათ, რომ მურწას ლამბდა-ციჰალოტრინით ინტოქსიკაციისას მის ქსოვილებში ვითარდება ისეთი პროცესები, რომლებიც

ასტიმულირებენ სტრუქტურულ ლიპიდთა თავისუფალ რადიკალთა ჟანგვას, რასაც მოსდევს თავისუფალი რადიკალების ინიციატორების ჰიდროჟანგების წარმოქმნა (მაგ. გლუტათიონრედუქტაზა-გლუტათიონპეროქსიდაზა). რომლებიც ხელს უწყობენ ლიპიდების პეროქსიდულ დაჟანგვას. ხდება თავისუფალ რადიკალთა ჟანგვითი აქტივაცია და მარეგულირებელ სისტემათა აქტივობის შემცირების შედეგად, წარმოიქმნება ნორმალური ცხოველმოქმედებისათვის არადამახასიათებელი ლიპოპეროქსიდანტები, რომლებიც უარყოფითად მოქმედებენ ჰიდრობიონტების მეტაბოლურ პროცესებზე, იწვევენ უჯრედის ლიზისს და საბოლოოდ იწვევენ თევზის დაღუპვას.

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