Universe Scientific Publishing

ORIGINAL ARTICLE

Oxidate damage and interaction induced by typical heavy metals in waters on the macrobranchium Nipponense

Xiachen Hu

College of environment, University, Nanning 210098, China

Abstract: In order to systematically explore the mechanism of chronic biotoxicity of Heavy Metals in waters on a-quatic organics, biological Toxicity bioassayMacrobranchium NipponenseExposed under Cd and Pb were con-ducted in laboratory. superoxide dismutase (SOD), catalase CAT), metallothionein (MT) and malondialdehyde (MDA) were meet used as biomarkers to investigate the single and joint toxicity of Cd and Pb and their interaction on heptapancreas and museums of organics. the results indicated that CD with concentration of 1 mg • L-1Can pro-

70.02% when exposed L-1PB for 10 d. most of the CAT activity in heparin can be activated by heavy metal stress. an opportunity tendency of CAT activity change in hepatopancreas and muscle was observed after 10-day exposure. MT and MDA contents in heptapancreas were more sensitive than thought in muscle. moreover, the integrated biomarker response (IBR) reopened that the River Shrimp itself has a certain heavy metal detection function in the time scale through the regulation of enzyme activity, but the oxidative damage cause by heavy metals was not stimulated. the toxicity of single heavy metal was higher than the combined ones. the toxicity of CD to heparin and PB to muscle were the highest. the results obtained could provide the basis for the early warning of ecological risk induced by metals, Development water quality criteria and BaSin Water Environment Man-cement.

Keywords: Heavy metal;Macrobranchium Nipponense; Oxidative damage; interaction; biomarker

With the rapid development of urbanization and industrialization, a large number of surface runoff and industrial wastewater are discharged into the water body, and the load of various pollutants is increasing year by year..In recent years, emergent pollution events and ecological problems caused by heavy metals have emerged.,Huaihe River and others also suffer

Cause sudden death of fish and frequent cancer of surrounding residents..Although most of the heavy metal ions discharged into the water body can be physically,The chemical and biological pathways are transferred to the sediments, but under the condition of change of hydraulic factors, it is easy to release into the water and cause secondary pollution.[3].Aquatic organisms were exposed to polluted water for a long time, and were poisoned due to the accumulation and dissolution of heavy metal ions in the water.

At the same time, heavy metals can be transmitted through the biological amplification of the food chain, which has a huge impact on the health of the water ecosystem, and ultimately a serious threat to human health..Therefore, the chronic biological toxicity of low concentrations of heavy metals in water and the interaction mechanism of their compound pollution have gradually become a hot topic in the field of freshwater ecology..

Steamed prawns(Macrobranchium Nipponense)Also known as river shrimps, widely distributed in China's riv-

ers,Lakes and reservoirs are crustaceans with important economic value, which occupy an important position in the aquatic ecological food chain, and can be used as a bait for higher trophic organisms[7]Can also be eaten directly by people.Cadmium(Cd)And lead(PB)In our country, rivers and lakes are typical heavy metal pollutants, and the detection concentration is high, which is also internationally recognized as toxic and harmful heavy metals.1976The U.S. Environmental Protection Agency(EPA)Priority for Pollutant Control.CDIt stimulates the respiratory tract of an organism and can accumulate in the liver or kidney.

Causing toxin enrichment;PBIt is mainly toxic to the nervous system of organisms, and it is easy to accumulate in the blood or bones to produce toxic effects.

Traditional chemical monitoring can onlyCDAndPBAccurate quantification, but does not accurately reflect its biological toxicity effect..With the molecular biological technology of development biological monitoring technology gradually by researchers of favor and as an environment monitoring field in of a new technology gradually was promotion Application, its work principle is by monitoring organisms in by pollution stress when in community,Population and biological individual and cells,Molecular and level on the occurrence of abnormal change signal to characterization pollution status and poison

Harm Effect and traditional monitoring compared for it has continuity scientific,Comprehensive and advantages.

The aquatic biological for no matter is required or non-required heavily

Of when its concentration in organisms in accumulation beyond a certain threshold after will produce a large amount of active oxygen free radical(ROS)And caused by body oxidation loss

[9-10].For maintain body in free radicals and oxidation reduction between the dynamic balance organisms own can establish antioxidant defense system to protection body organization and cells from Free Radical of oxidation loss [9,11].Heavy metal of toxic effect is by activation or inhibition antioxidant defense process in enzyme or non-enzyme material interference body normal Physiological Metabolism[12-13].Original related research more focus on in sediment heavy

Metal of Form Distribution migration transformation law and ecological risk ignore the water in low concentration heavy metal and different heavy metal combined with the aquatic biological of chronic toxicity of Study.Therefore, this study based on environment level is set different concentration gradient carry out shrimp inCDAndPBSingle and combined with exposure under the chronic toxicity experimental in order to proven water solubility metal ion of toxic effect and interaction role mechanism at the same time coupling more.

1. Material and Methods (Materials, methods)

1.1 Experimental Material

This paper key research waterCDAndPBSeparate and combined with there when the shrimp of chronic biological toxicity.In test process in respectively Mining

$C_4H_6CDO_4$In 2 H_2OAndPb $(No_3)_2$(Pure Chinese medicine group Shanghai Chemical Reagent the company)With mother liquor and according to has set of concentration gradient in accordance with dilution method vote to test water in.Exposure Test bucket

Material for PVC maximum volume40 L.

Experimental with shrimp from Nanjing a shrimp culture zone experimental ago temporary

A3 DTo adapt to new environment.For avoid for shrimp individual size difference of experimental results introduced is big error for exposure experimental of shrimp average

Body Length(6.43 ± 0. 21) cmWeight(2.62 ± 0. 15) g.Experimental water selection in the sun under exposure10 dChloride extraction after the tap water to eliminate natural water in residual of trace heavy metal on experiment interference.

In addition, In order to in experimental indoor simulation reality Water Environment in each Exposure Device in training Elodea nuttallii(Elodea nuttallii)For shrimp provide attached place and as an green fodder(See figure1).

1.2 Experimental Design

This experimental of including10A exposure group respectively for control group,CDSeparate Processing Group,PBSeparate processing group andCDAndPBCombined with treatment group which contains heavy metal pollution of the treatment group sharing low(L),In(M),High(H) 3A concentration gradient.This study theCDAndPB

The pollution concentration gradient0.01,0.1,1 mg in L^{-1}2Of Heavy Metal Combined with exposure of concentration was gradient combination(0.01 0.01),(0.10.1),(1 1) Mg IN L^{-1}.Each experimental barrels in respectively dress25 LWater according to the concentration gradient set value in accordance with dilution of methods will with a good of mother liquor vote to experimental barrels in with glass rod mix water.Then will experiment with shrimp random divided10Group every group24Only vote to each experimental barrels in and add a certain amount of Elodea nuttallii.Control Water Temperature don't ultra-10.With air pump the water oxygen assurance water dissolved oxygen of concentration don't lower4 mg in L^{-1}.Every1Days feed a small wheat bran assurance shrimp basic of energy demand.Respectively in exposure3 DAnd10 dAfter parallel take shrimp Biological Samples3Only anatomy out liver pancreas and muscle organization quickly in-80Under frozen save for follow-up molecular biological markers detection analysis.

1.3 Detection Analysis

Selection super-oxide dismutase(Sod u in MG^{-1}Protein),Catalase(Cat U in MG^{-1}Protein),Metal sulfur Protein(MT ng

In mg^{-1}Protein)And lipid peroxidation product MDA(MDA nmol in MG^{-1}Protein)As an representative molecular biological markers biological samples respectively for shrimp liver pancreas and muscle organization respectively Determination4Of markers the specific operation and calculation according to the Nanjing built Biological Engineering Institute of KIT instructions.

1.4 Data Processing

Experimental results usingIbm spss statistics 22Multiple comparison test for the significance of difference between groups(LSD)And2x2Factorial Design

Variance analysis.The interaction in factorial analysis refers to synergy or antagonism in the joint action. If there is no interaction, the joint action is additive action..Average for biomarker data±Standard Deviation(Mean ± SD)Indicates that all results are takenShapiro-WilkAnd

LeveneMethods The normality and the same variance test were carried out.(ANOVA)Statistical analysis was carried out among the groups.Dunnett T3The significance level of the difference was analyzed.PLess than 0.05Considered significant and marked with different letters.

Comprehensive biomarker Index(IBR)Computing reference[14]The method described in the calculation formula is as follows.Finally,IBRValues are drawn into a visualized star chart, accordingIBRThe greater the value, the greater the biological impact of the principle can be intuitively seenCDAndPBBiological toxicity of shrimp exposed to different concentration gradients.

Average;XAndSThe mean and standard deviation of the results measured by some marker in all treatment groups were respectively;Y_IThe standardized value of a marker;If the activity of the marker is activated,$Z_I=Y_I$On the contrary, order$Z_I=-Y_I$;$|Y_{Min}|$It is the absolute value of the minimum value of the data after the homogenization of the markers in all the treatment groups;B_IFor the mark score;N

Number of selected biomarkers.

2. Results and Analysis (REsults, analysis)

2.1 CDAndPBSeparate and combined with exposure underSODAndCatOf response

Exposure Test results show that:Water inCDConcentration1 mg in L^{-1}When Will will the shrimp produce death

toxicity(36 h?After all death); WhenCDAndPBHigh Concentration combined with role when death toxicity enhanced(24 h?After all death)Performance for collaborative role so in this2A processing

Group in no collection of to living biological samples for markers of analysis.The same organisms different organization organ of Metal Pollutants of response also there significant difference($P<0.05$)CDAndPBSeparate and combined with exposure under shrimp liver pancreas and muscle organization inSODActivity with concentration and time of change as shown in Figure2 ()Shown in.From the can see liver pancreas inSODActivity was significantly higher than that of muscle($P<0.05$)Compared in control group liver pancreas and muscle inSODActivity were by heavy metal different degree of suppression role.Exposure3 DWhen liver pancreas inSODActivity were with the dose increase and reduce whichCDSeparate exposure on liver PancreasSODActivity of suppression effect more significant($P<0.05$)InCD (m)-3 DAn arcaneSODValue(67.03 ± 5. 44) U in MG^{-1}ProteinInhibition Rate65.61%10 dAfter Liver PancreasSODActivity were has improve but still lower than that of the control group,PBHigh Concentration separate exposure3 DOf inhibition rate54.08%And10 dOf inhibition rate29.11%Medium concentration combined with exposure3 DOf inhibition rate

66.57%And10 dOf inhibition rate44.13%.However for muscle inSODActivity were with the dose and time of increase and reduce in processing groupPb (M)-10 dThe to the lowest value(3.61 ± 0. 47) U in ·

MG^{-1}ProteinInhibition Rate70.02%.

CDAndPBSeparate and combined with exposure under shrimp liver pancreas and muscle organization inCatActivity with concentration and time of change as shown in Figure2 (B)Shown in.From the can see heavy metal pollution of shrimp inCatActivity has induced effect.CDSeparate exposure when liver PancreasCatActivity with the concentration increase and increase but no significant time effect($P<0.05$)InCD (m)Exposure3 DAnd10 dOfCatValue respectively(0.46 ± 0.07) U in MG^{-1}ProteinAnd(0.44 ± 0.04) U in MG^{-1}

Protein;PBSeparate exposure when no matter3 DOr10 dLiver PancreasCatActivity in low-, medium-, and high-3A exposure gradient under were first increase after drop trend and in concentration under no time effect;Combined with exposure when,CatActivity is higher than that of the control group level($P<0.05$)But no significant dose and time effect($P<0.05$).Exposure3 DWhen muscle inCatActivity were by induced by and show weak of dose effect inPb (H)-3

Under to maximum(0.48 ± 0. 04) U in MG^{-1}Protein;But exposure10 dAfter,CatActivity were decreased especially inCDSeparate exposure under performance significantly($P<0.05$)However compared with the control group for overall on the or was induced by Trend.

2.2 CDAndPBSeparate and combined with exposure underMTAndMDAOf response

CDAndPBSeparate and combined with exposure under shrimp liver pancreas and muscle organization inMTContent with concentration and time of change as shown in Figure3 ()Shown in.From the can see liver pancreas inMTContent with different heavy metal concentration change different of suppression or induced by effect compared in muscle organization its sensitivity higher.CDSeparate exposure3 DWhen liver PancreasMTContent was significantly higher than that of the control group($P<0.05$)And with concentration increase and in low concentration under exposure10 dWhen,MTContent significantly reduce($P<0.05$);PBSeparate exposure3 DWhen liver PancreasMTContent was significantly higher than that of the control group($P<0.05$)And in medium concentration under to maximum exposure10 dAfter,MTContent in high concentration under continue to be induced by to the whole group maximum(0.60 ± 0. 06) ng in MG^{-1}ProteinAnd in medium concentration under was significant suppression;Combined with exposure when,MTContent show dose and time effect.However for muscle inMTContent Change overall no significant change only in combined with exposure under shows a significant of time and dose effect($P<0.05$)In high concentration under Combined with exposure10 dAfter to the whole group maximum(0.31 ± 0. 03) ng in MG^{-1}Protein.

CDAndPBSeparate and combined with exposure under shrimp liver pancreas and muscle organization inMDAContent with concentration and time of change as shown in Figure3 (B)Shown in.From the can see Water Heavy Metal Pollution of shrimp liver pancreas of oxidation damage to was significantly higher than that of tail muscle,MDAContent there order of magnitude difference.CDSeparate exposure3 DWhen liver pancreas inMDAContent

was significantly higher than that of the control group(P<0.05)And significant dose effect,10 dAfter low concentration groupMDAContent significantly reduce(P<0.05)And high concentration groupMDAContent significantly increased(16.50 ± 1.02) mmol in MG^{-1}Protein;PBSeparate exposure when,MDAContent Change andMTContent Change present same of law inPb (H)-10The cause of lipid peroxidation injury maximum(P<0.05)MDAWith

Of(20.01 ± 1.27) mmol in MG^{-1}Protein;Combined with exposure when,MDAContent Change no significant time and dose effect and overall lower than the single metal exposure when the cause of lipid peroxidation injury

Still significantly higher than that of the control group(P<0.05).However for muscle organization for only inPb (H)-10 dTheMDAContent relative is high its

More than change not.

2.3 CDAndPBCombined with Effect Analysis

The2 × 2Analysis for design variance analysisCDAndPBDifferent Concentration combined with the shrimp liver PancreasSOD,Cat,MTAndMDAOf interaction role the research results display2Of pollutants combined with role most show antagonistic role(Figure4).CDAndPBAt the same time don't add that for the control group,CDAddPBDon't add theCDSeparate exposure group,CDDon't addPBAdd thePBSeparate exposure group,CDAndPBAt the same time add the for combined with exposure group.In exposure3 DWhen,CDAndPBLow Concentration combined withMDAOf interaction role strongest(Figure4A)Partial ETA^2Value display the exposure groupMDAChange of contribution size orderCd Pb (l)> Cd (l);In exposure10

When low concentration combined with still showMDAOf interaction role strongest and contribution size order keep constant butSODAndMTOf interaction role were weakened,Partial ETA^2Value display the exposure groupSODActivity change of contribution size orderCD (l)>

CDAndPBMedium concentration combined with the shrimp liver PancreasSOD,Cat,MTAndMDAOf interaction role as shown in Figure4 (B)Shown in.From the can see heavy metal combined with the shrimp liver pancreas in molecular markers were produce interaction role.In exposure3 DWhen,CDAndPBMedium concentration combined withMDAOf interaction role strongest,Partial ETA^2Value display combined with exposureCatAndMDAChange of contribution size order areCd Pb (m)> Cd (m)OnMTContent Change of contribution size order isCd Pb (m)> Cd (m)> Pb

(M);In exposure10 dWhen combined with exposureCatOf interaction role strongest,Partial ETA^2Value display,CDAndPBSingle and combined with underCatActivity change of contribution size orderCd Pb (m)> Cd (m)AndSOD,MTAndMDAChange of contribution size areCD (m)> Cd Pb (m)> Pb (m).

2.4 Different metal and combined with biological toxicity evaluation

This experiment in different exposure time,Different Heavy Metal processing. The comprehensive biological markers Index analysis results as shown in Figure5.Study found:CDAndPBSeparate exposure on liver pancreas of toxicity is big especiallyCDOf Poison Effect prominent inCD (m)Under exposure3 DIBRValue up3.2710 dAfter,IBRValue still keeping the maximum2.66;For muscle,PBSeparate exposure of toxic effect was significantly higher than that of other treatment group especially inPb (h)Under exposure3 DAfter biological toxicity maximum,IBRValue3.1710 dAfter,IBRStill keep maximum2.00.In addition shrimp exposure inCDAndPBCoexistence of water in with the exposure time of extended body own show certain of detoxification mechanism but toxicity still higher than that of the control group.No matter is liver pancreatic or muscle organization exposure10 dAfterIBRValue overall were less3 DWhenIBR

Value show that shrimp ownCDAndPBHas certain of toxicity regulation ability but and can't completely against heavy metal the produce of toxicity.

3. Discussion (Discussion)

3.1 Heavy metal single and combined with role

Natural water in often is many kinds of heavy metal exist at the same time for a biological for often joint interaction role.So far water environment ecological toxicology in the mentioned of interaction role main including collaborative role,Add role,Independent role and antagonistic role[12].However water in toxic harmful heavy metal of aquatic biological of combined with role is a very complex of problems its combined with toxicity type not only and pollutants of composition about and target biological,Exposure concentration and time and other closely related.Study found that in certain concentration of heavy metal stress under heavy metal can and organisms protein and polymer material combined with influence protein of decomposition and synthesis and disrupt normal metabolism[9,20].

This study for further know water in Typical Heavy MetalCDAndPBThe shrimp of toxicity mechanism from metal single and combined with exposure start consider different concentration gradient and exposure time of influence the indoor exposure experimental.Experimental results show:When shrimp exposure inCDConcentration1 mg in L^{-1}Of Water in shrimp will in36 hIn all death especiallyCDAndPBHigh Concentration combined with under toxicity enhance this main becauseCDIn shrimp in accumulation to a certain degree after cells in accumulationCDContent more than the organisms inMTThe IT of chelating rate when excessCDIt will in vivo of other biological molecular including enzyme and nucleic acid and Biological Macromolecules each other role and caused by poisoning death phenomenon;Wu feng chang and[15]In study in pointed out that water inCDConcentration more

MuG In L^{-1}When the Roche Macrobrachium will acute toxicity this a results show that Roche Macrobrachium on WaterCDThe tolerance ability to lower than Japanese Macrobrachium.Study show that water inCDThe crustaceans of death toxicity about

PBOf50Times[16].However, the main reason for the increase of High Concentration combined toxicity isPBCan increase the permeability of the body's cell membrane, resulting in moreCDExcess accumulation into cells, resulting in increased toxicity[12].

Response to changes based on typical molecular biomarkers in the remaining treatment group(Figure2.,3),CDWithPBThe toxicity was higher than the joint toxicity, and the combined effect was mainly antagonistic..This can be done using the competitive point theory.(Competitive site Co., theory)To explain:Before metal ions enter the cell, they must be combined with the acceptance point of the cell surface.CDWithPBWhen coexisting at low or medium concentrations,PBDoes not play a role in increasing cell membrane permeability, butCDCompete together to accept the point, so it produces Antagonistic Effect.

3.2 Typical molecular biomarker response

Before the organism is damaged by exogenous pollutant stress,Abnormal signal indicators produced on the cells, which can provide early warning for severe toxic injury and reveal the changes in a certain life cycle or the production of abnormal metabolites.

It is generally believed that exogenous toxic and harmful substances mainly affect or block the respiratory chain.,Electron Transfer chain,Enzymatic reactions are normal in vivo

Physiological Metabolism, resulting in the increase of reactive oxygen species and the body in oxygen

However, in order to eliminate or mitigate oxidative damage caused by the accumulation of reactive oxygen species, various enzymes and non-enzymatic antioxidants in vivo can form an antioxidant defense system.SODAndCatIt is an important antioxidant for organisms to tolerate pollution stress.

Enzyme[20],MtIt is a typical molecular marker of heavy metals, which can maintain the dynamic balance of metal content in organisms and detoxification of heavy metals.

Dual mechanism usedMDAIs reflect the body lipid peroxidation damage the most with representative of biological markers its content change can directly show that biological by injury size[5].So to antioxidant biological markers of activity and content for test end not only can indirect to reflect River Water Heavy Metal of there and Its Potential of chronic biological toxicity and can make up for the original chemical monitoring of defects, science to the heavy metal pollutants of early diagnosis and Water Environment Health Evaluation.

Shrimp belongs to typical of crustaceans own don't has immune globulin the body of protection role main by blood

cells to take; shrimp liver pancreas in Containing Ion Transfer Enzyme,Detoxification enzyme and resistance enzyme is the main body of detoxification organ.Experimental results show that liver pancreas inSODActivity and sensitivity were higher than that of muscle this main due to its physiological function different caused.In the whole defense system in,SODIs first and Reactive Oxygen Species Free Radical role of enzyme and main distribution in liver pancreas in it can fast will superoxide anion decompositionH_2O_2AndO_2.Has been study table

[21]When biological body by mild pollution stress when,SODActivity often was activation instead can inference whenSODThe activity of suppression effect the show that the body of this stress of discomfort of or has there poisoning

Reaction.This studyCDAndPBSingle and combined with exposure on liver pancreas and muscle organization inSODActivities of suppression effect show that heavy metal of shrimp has caused by chronic toxic effect especiallyCDThe liver PancreasSODActivity of suppression most prominent.Many scholars think this a kind of results of reason may is:CD^2Ion are more likely to replaceCu/Zn-SODInZn^2OrMn-SODInMn^2LeadSODStructure Change and activity reduce;Secondly,CD^2May and enzyme molecular in-ShGroups were combined with is alsoSODActivity reduce of a important reason[22];In addition,CDAlso can andSODEach other role the protein modified and change its activity[23].However because shrimp liver pancreatic own containing some detoxification enzyme in exposure10 dAfterCDAndPBAlso show certain of Adaptability,SODActivity enhanced but still lower than that of the control group.For muscle Organization,PBOkaySODOf Activity Inhibition relative significantly this May and different organ implementation different of physiological function about andPBMore easy access to blood and transfer to muscle organization in.CatIt is a terminal heme oxidase, which plays a major role in the antioxidant defense system.H_2O_2Break downH_2OAndO_2., Prevent

$_2O_2$Excessive volume caused damage to the body tissue[24].In this studyCatActive in heavy metalsCDAndPBInduction effect under stress(Figure2b), Mainly becauseCDAndPBIon into the hepatopancreas cells, resulting in a large number of reactive oxygen species in the cells, resulting in

Oxidative stress, to protect the body's cells,CatActivity is activated, however,CatActive inPBLow mid high3.The main reason is that the antioxidant defense system of the organism itself can resist this process through its own regulation in the early stage of exposure.

Partially caused by heavy metalsROSAnd as the outside worldPBThe concentration continued to increase within the hepatopancreas CellsPBThe concentration of ions increased dramatically.

SuppressedCatOn the other hand, the cells are damaged, and the balance of reactive oxygen species in the cells is destroyed.CatReduced activity[25].

MtIs a low molecular weight,A protein rich in cysteine,MtOnCysResidues contain hydrophobic groups that are easy to bind to heavy metals.

To predict the enrichment of heavy metals and the pollution pressure of Heavy Metals in organisms.[5].Meanwhile, dueMtCan be reduced through their own hydroxyl groups/Oxidative state transition to eliminate reactive oxygen species, to a certain extent, can replaceSODTo protect the body from oxidative damage.[4].In this studyMtContent was higher than that of muscle, indicating that the ability of the liver pancreas to accumulate heavy metals was higher than that of muscle, which indirectly reflected the main detoxification organs of the liver pancreas River Shrimp..In exposure3 DPosterior, hepatopancreasMtThe main reason is that the cells are rich in a large number of metal ions.MtUnion.However, at low concentrations, with prolonged exposure time,MtThe reason may be that the heavy metal receptor sites on the cell membrane gradually saturated, or excessive metal ions exceededMtThe ability to make the liver

MDAIt is not only an important product of lipid peroxidation in the body, but also plays a role in free amino groups of proteins, which causes intramolecular and intermolecular Crosslinking of proteins and leads to cell damage.[26].Figure3bThe results showed that0.01 mg · L^{-1}OfCDAnd0.01,0.1 mg · L^{-1}OfPBIt has certain toxicity regulation function.0.1 mg · L^{-1}OfCDAnd1 mg · L^{-1}OfPBLower exposure10 dThe liver and pancreas of the latter River Shrimp are greatly damaged by oxidative stress.MDAHigh Content(Figure3b)The results are similar to many Dynamic

Studies of pollution stress..The reason for this phenomenon may be that due to heavy metal stress, the levels of reactive oxygen species in shrimps are too high, exceeding the ability of the body's antioxidant defense system, excess Reactive Oxygen Species attack the double bond of unsaturated fatty acids in biofilm phospholipids, resulting in lipid peroxidation,MDAIncreased content.However, at low concentrations, exposure10 dAfter,MDAThe main reason is that the enzyme activity of the antioxidant enzyme system exhibits certain tolerance at low concentrations, reduce the level of reactive oxygen species, but still can not resist the oxidative damage caused by high concentration.Secondly, the lipid peroxidation level of hepatopancreas was higher than that of muscle under the same stress time, indicating that the lipid peroxidation levels of different parts of the hepatopancreas were different even under the same stress time..

3.3 IBRComprehensive Evaluation

CDAndPBThey are potentially harmful pollutants in the Water Environment. Compared with other pollutants, the risk is that they cannot be degraded by microorganisms.,Easy Bioaccumulation,Food Chain Transmission amplification, and easy to combine with biological macromolecules such as proteins in organisms, resulting in irreversible degeneration, interfere with normal physiological metabolism, and even can causeDNAMutations alter genetic characteristics[13].Therefore, the scientific and accurate biological toxicity assessment of heavy metals is the current assessment and risk assessment of river ecological health.

Basic work.The toxicity evaluation of traditional heavy metals was mostly based on semi-lethal concentrations.(LC_{50})The chronic toxicity of low concentrations of heavy metals and multiple metals is neglected. It is difficult to integrate with the current situation of river pollution..However, this study was based on the environmental level setting of different concentrations of gradient for indoor exposure experiments, by testing representative molecular markers to reveal the chronic toxicity of heavy metals..Because a single biomarker is susceptible to other factors, and the response of different biomarkers to different pollutants is different, it is difficult for a single biomarker to accurately evaluate the pollutants..This paper usesIBRThe Comprehensive Evaluation of the biological toxicity of different biomarkers to different heavy metal treatment groups can not only avoid the uncertainty of a single biomarker, but also more accurate and scientific.

The chronic toxicity of heavy metals with different concentrations gradient was compared scientifically, which provided a basis for water environment management and risk benchmark establishment..

To sum up:(1)When the waterCDConcentration reached1 mg · L^{-1}If the shrimp is poisoned, it will cause toxicity andPBIn combination, the lethal toxicity was enhanced, showing a synergistic effect,CDWithPBRespectively in0.01And0.1 mg · L^{-1}2.However, for the hepatopancreas and tail muscles4.All the markers showed antagonistic effects..

Hepatopancreas and muscle tissueSODActivity andMDAMagnitude differences in content.CDAndPBLiver pancreas and muscleSODThe activity was inhibited,10 dPosterior, hepatopancreas

SODA little enhanced in activity while in musclesSODActivity was still suppressed;CatMost of the activity is activated,10 dLater, in the hepatopancreas

CatActivity continues to be activated in the musclesCatActivity decreased, especiallyCDSignificant inhibitory effect;Muscle MediumMtAndMDAThe changes between the two groups were similar in the liver and pancreas,4.Time Effect of species markers is weak.

IBRThe biological toxicity evaluation showed that the shrimp had certain detoxification function on the time scale;By contrast,CDThe potential biological toxicity to the hepatopancreas is greater, especiallyCDConcentration is0.1 mg · L^{-1}Time,IBRThe value is always the largest, and for muscles,PBPotential biological toxicity, especiallyPBConcentration is1 mg · L^{-1}Time,10 dAfter,IBRThe value is still the largest;CDWithPBJoint toxicity is lower than single metal.

References

1. Wang Lan,Wang Yaping,Xu chunxue,Wait..Pollution Characteristics and ecological risk assessment of heavy metals

in surface sediments of Yangtze River System[J].Environmental Science, 2012, 33(8): 2599-2606
2. Liu menglinVon jing lanLiu QunSuch..In the upper reaches of the Huaihe River surface sediments heavy metal of occurrence form and its ecological risk[J].Environment chemical2014 33(7): 1235-1237
3. Li LeiJiang roseShen xin strongSuch.. Cr (VI)The caudal White Shrimp(Exopalae-mon carinicauda)Juvenile exposure and recovery period liver pancreasSODLive
4. Kang Dongsheng,Shi Xiaorong,Cui Yibin,Wait.. 3Acute Toxicity of typical pollutants to aquatic organisms and comparison of their water quality standards[J].Environmental Science, 2014, 35 (1): 279-285
5. Wang Weili,Yan zhenguang,He Li,Wait..Sensitivity Evaluation of five benthic animals to optimal control of pollutants[J].China Environmental Science, 2013, 33 (10): 1856-1862
6. Han yuwei,Zhang yanfeng,Chen Meng,Wait..Heavy metals in SedimentsPBAndCDStudy on the toxic effect of Corbicula fluminea[J].Ecological Toxicology report, 2015, 10 (4): 129-137
7. qu r j, Feng m B, Wang X h, *et al*. Metal Accumulation and oxidative stress biomarkers in liver of freshwater fishCarassius auratusFollowingIn vivoExposure to water-borne zinc under different pH values [J]. Aquatic Toxicol-ogy, 2014,150: 9-16
8. Freitas R Almeida Pires A *et al*.. effects. car-bamazepine. macroinvertebrate species: comparing bi-valves, polychaetes biochemical responses [J]. water research 2015 85: 137-147
9. PingZheng C HuiMeng Wei.Environment Pollutants of aquatic biological oxidation pressure of molecular biological markers[J].Ecological Journal2007 27 (1): 380-388
10. Zhang Rong. MacroTango.Such..Water Heavy Metal Cadmium and zinc on Large flea combined with toxicity effect of preliminary study[J].Ecological Toxicology report2008 3 (3): 286-290
11. Lee dian baoZhang WeiWang Li QingSuch..Sawtooth new shrimp onCu^2And chlorpyrifos toxicity of Physiological Response[J].Environment Science, 2015, 36 (2): 727-735
12. Beliaeff B, burgeot T. Integrated biomarker response: a useful tool for ecological risk assessment [J]. Environ-Mental Toxicology and Chemistry, 2002, 21: 1316-1322
13. Zhang R Fan w h Tang G *et al*. A preliminary study. joint toxic effects. Cd, Zn.Daphnia magna[J]. A-Sian Journal. ecotoxicology 2008 3 (3): 286-290 (. Chinese)