Analysis of the impact of heavy metal on the Chinese aquaculture and the ecological hazard

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Abstract: This paper is an overview of Chinese aquatic products heavy metal pollution and heavy metals pollution in water of China. I have a interpretation of the toxic effects of heavy metals on aquatic organisms, and the harmful effects of heavy metals on the water environment, and induction several of heavy metal pollution technology in aquaculture ,For mitigate aquaculture heavy metal pollution and protect the water environment to achieve sustainable development provides a scientific basis.

Introduction

Aquaculture has become one of the world’s most rapidly developing areas of the food industry in the past 20 years. China, as the world’s largest aquaculture country, the aquaculture products production reached 47.62 million tons, it is 61.7% of global output. Aquaculture is environment-dependent industry, the quality of aquaculture products depends on aquatic water environment quality. Deterioration of water environment seriously affect the health and safety of aquatic products. China is a big country of Fisheries, in recent years, aquaculture has developed rapidly, and farmed fish aquatic product has reached more than half of the total. But in recent years, China's water environment has been varying degrees of damage,especially with the rapid development of industry, heavy metal in all walks of life is more widely used , so it’s pollution is increasingly serious, especially near the coast and near the mouth of the most serious ,The concentration of mercury , lead, chromium, cadmium, zinc, iron, nickel, germanium, manganese and other metal ions exceeds a certain standard in water, and most of the heavy metals have relatively strong activity of the Earth, they will migrate among the water、sediment and suspended solids,and accumulation in the food chain. It not only caused serious harm to plants and animals, but also pose a threat to human health. therefore, to understand the relationship between environmental factors and aquaculture water, and effectively reducing the environmental impacts of aquaculture safety factors is very important .This paper has a certain research and summarize on heavy metal pollution on aquatic products. in order to do some theoretical basis to enhance the quality and safety of the aquatic products .

Table 1. aquatic production in China

Year Region(part)	Total aquatic Products /104 t	Seawater Aquatic products /104 t	Naturally Grown/104 t	Artificially Cultured/104 t
2010	5373.0	2797.5	1315.2	1482.3
2011	5603.2	2908.0	1356.7	1551.3
2012	5907.7	3033.3	1389.5	1643.8
2013	6172.0	3138.8	1399.6	1739.2
2014	6461.5	3296.2	1483.6	1812.6
ShanDong	903.7	746.1	266.2	479.9
GuangDong	836.3	450.6	156.2	294.4
FuJian	695.8	603.4	224.0	379.4
ZheJiang	467.3	377.5	89.8	267.7
LiaoNing	525.7	429.7	140.6	289.1
JiangSu	518.8	150.4	56.8	93.6

Heavy metal pollution of water environment situation in China

In China, Heavy Metal pollutants of Water mainly is mercury, but such as nickel, thallium, beryllium, copper and other heavy metal pollutant is serious also. Because of urban sewage, mining mining, industrial waste and waste generated by metal smelting and other metal contaminants into the water,there are excessive levels of heavy metals and other water bodies. At present, China's major rivers, lakes and reservoirs are subject to different degrees of heavy metal pollution, especially sediment contamination rate has reached 80.1% [1], seriously affecting the quality of water. As China's largest river Yangtze, after investigation, the Three Gorges Reservoir Area section of the river sediment heavy metals like mercury was found excessive , such as ShiDongKou, since the direct discharge of pollutants, the copper, zinc, lead content has polluted the environment water [2]. As China's second largest river of the Pearl River, heavy metal pollution is increasing in recent years, according to the research, the Pearl River estuary heavy metal content of copper, lead, cadmium, arsenic and mercury were 80.77,105.88,5.55,33.13 , 0.33mg/ kg , and the cadmium pollution is most serious. The Taihu Lake has been named of “the JiangNan waters”, however with the industrial rapidly developing and population growing, heavy metal pollution has become increasingly severe, studies have shown that Cd, Cu and Zn in Sediments content is more than the secondary or the third standard of the Soil Environment Quality Standards in Taihu Lake at some of the mouth [3].Meanwhile the Huaihe [4], Yellow [5] and the Hai [6] River, also suffered varying degrees of heavy metal pollution. In 21 major cities along the Yangtze River in Panzhihua,, Nanjing, Wuhan, Yichang, Chongqing, Shanghai and other heavy metals in pollution has reached more than sixty percent. And, in some areas along the coast have also been heavy metal contamination, such as Jinzhou Bay sediments of copper, zinc, lead, cadmium, mercury, Jiaozhou Bay of cadmium, chromium, lead, zinc and arsenic Dalian Bay are all different degrees of seawater causing pollution [7].

Heavy Metal Toxicity to the aquatic organisms

Organisms. Due to the different types of organisms, aquatic organisms have different types of accumulation effect of different heavy metals . For example, the zoo-plankton-eating fish have a high constant of cadmium and arsenic. The algae-eating fish has a high copper, and cadmium

content, benthic invertebrates class eating fish has a higher zinc nickel and lead residue in the body. The higher nickel and lead residue are found in the body of omnivorous fish, and the fish who's main food is from sediments have a higher heavy metal content than generally fish. The accumulation of heavy metals in the same species of fish's different organs are different also. For example, in pelagic fish's muscle, mercury, zinc, cadmium, copper content is lower, but a higher amount accumulated lever in liver benthic animals of cadmium and copper. Some scholars have studied the copper, zinc, cadmium, lead, chromium accumulation in tilapia eggs, kidney, muscle, liver, gills and fins and other tissues and organs, indicating that all of the above lead and cadmium in the tissues and organs of the cumulative amount of no significant difference, and a relatively large amount of copper accumulation in the liver and eggs, zinc fins, gills, liver and eggs with higher levels [8].

Bio-accumulation . The present study shows that heavy metals into the aquatic biological pathway of epidermal cells may have the following two ways:

Soluble heavy metals and protein with high affinity binding and uptake in vivo , Soluble heavy metal combined with the epidermal cells of the organism to carrier protein, by the action of proliferation, the intracellular heavy metal having a high binding affinity deliver in cells.

Some heavy metal ions into the organism through the activity pump. Certain metal ions such as sodium ion, potassium ion, calcium ion can not be delivered to a carrier protein, will need to pass through the cell membrane active transport pump. Therefore, some heavy metal ions in this way can also be pumped into the biological activity of the cells [9].

Effect . Accumulation of heavy metals in the body after a certain amount of the biological, it will have an impact on the ultrastructure of biological cells and damage to cells. Studies have found [10], after yangtsekiense are cadmium pollution, it's nuclear membrane swelling sperm cells and cardiac cells, diffusion, disintegration, Mitochondrial swelling、vulcanization, Golgi deformed, endoplasmic reticulum expansion. Influence of heavy metals on living organisms is also reflected in the effects on biological organisms enzyme system . Certain heavy metals can be used as inhibitors of certain enzymes or activators, leading to intracellular oxidation-reduction reaction, thereby generating active oxygen,, leading to a series of chain reactions in vivo redox system is out of balance, ultimately leading to cell damage. Here are some effects of heavy metals on aquatic organisms:

Mercury is the most toxic heavy metal poison of the waters pollution , fish can be enriched thousands or even hundreds of times as much, and in biological effects mercury methylation occurs, thereby enabling toxicity strengthen, and it is not easily degradable and exclusion, but accumulation in fish store, enter the food chain, and thus is a threat to human health [11]. Such as the large pollution incident "Minamata disease" event occurred in 1956 in Japan, is due to people eating fish containing methyl-mercury caused. Once the methyl-mercury enters the body will quickly dissolve in fat, and the accumulation and the brain, serious impact on human health.Chromium can be absorbed and accumulated in aquatic organisms, the ability of certain marine bioaccumulation of cadmium is very strong, it can reach 4500 times even [12]. A certain concentration of cadmium in fish can cause cell DNA synthesis inhibition, it is also have some effect on the immune function in fish. Chromium on fishery production has a dual role, on the one hand,it can be as the organisms' auxin aquatic , and promote the growth of fish, on the other hand, chromium can also cause environmental pollution, if it exceed a certain concentration ,it will be toxic to aquatic organisms, and produce malformation effects [13].

Status of Heavy Metal Pollution in Aquatic parts of China

According to the survey research on the study of carp crucian carp and other breeding farms in

the northeastern provinces section, indicating that the three fish fish intramuscular, and the exceeded level and exceeded rate of lead is higher, at 9.0%, the zinc, arsenic,and cadmium exceeded rates is 0%,0.6% and 1.1%. Heavy metal contamination is lower than the Taihu Lake and the Pearl River Delta [14]. In Fujian, Haitan Strait shellfish aquaculture monitoring areas waters 58% of the samples exceeded the mercury content. According to Wu Kunjie and others detect heavy metal content on the main parts of Henan province's aquatic in Henan Province, showed that all samples the major farmed aquatic products are detected lead and cadmium, and some aquatic products content exceeds the standard value, which Procambrus shrimp high levels of lead.In carp, carp, Procambarus clarkii, shrimp, silver carp, bighead carp were detected in arsenic, but none exceeded. According to Xie Wenping and others' heavy metal content in the sediment and water in parts of the Pearl River Delta Region aquaculture survey showed that pond water samples cadmium, copper, arsenic, mercury and lead content exceeded the rates were 7.1%, 64.3%, 21.4% , 35.7% and 14.28%. Cadmium, copper, arsenic, mercury, lead, chromium content in sediment exceeded the national standard of marine sediment quality standard Class I,mercury exceed Class II of the standard.

Ecological Risk of Heavy Metal Pollution in aquaculture

Ecological Risk of Heavy Metal Pollution in aquaculture mainly has two aspects, The first is the growth and reproduction of aquatic own hazards, studies have shown that heavy metal contamination of aquatic body peroxidase, catalase, metallothionein protease, Valley GSH enzymes are changed, affecting the health and quality of aquatic products. And Aquatic organisms can be enriched heavy metal,the heavy metal will remain in the aquatic food chain and into the food web through bioaccumulation amplification effect, eventually enter the human body, posing a serious threat to human health. For example mercury contamination caused Minamata disease, Itai-itai disease caused by cadmium contamination. In recent years, also found some heavy metals have carcinogenic, teratogenic, mutagenic effect , it is not only affect the body's immune system, but also may increase the specificity of certain diseases.

Heavy metal pollution in Control Technology

Currently research for aquaculture heavy metal pollution is seldom, mainly in the following four processing technology.

(1)chemical precipitation method: chemical precipitation method is the use of sulfides, hydroxides, carbonates, phosphorus compounds and other heavy metal contaminated water bodies combine to generate a precipitate, and then achieve the purpose of removal of heavy metals by precipitation.

(2)Physical adsorption: physical adsorption method is the use of natural minerals, synthetic zeolites, activated carbon and other solid adsorbent metal ions in the water adsorbed on the surface of the adsorbent further method for removing heavy metals adsorbents renewable and does not cause secondary pollution, at present more research.

(3) biological assay: adsorption method is the use of biological accumulation of animals, plants and microorganisms to heavy metals and heavy metal contamination removal process by the water.

(4)ecological restoration method: ecological restoration method refers to the use of artificial ecosystem to handle heavy metals in water, and in this ecosystem, including biological adsorption and role of physical adsorption, chemical adsorption, such as constructed wetlands, ecological pond Wait.

Conclusion

With the rapid industrial development, environmental pollution has become increasingly severe, food quality and safety requirements are also increasing, but in recent years our aquatic environment and water polluted by heavy metals the situation is not optimistic, and some aquatic products exceeding the national standard, even to enter the market for people's health threat and damage. Thus aquaculture heavy pollution will be more and more attention. The relevant departments should strengthen supervision of aquatic products, strengthen aquaculture heavy metal pollution control work. Improve the quality and safety of aquatic products fundamentally.

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