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SOURCES OF ANTIBIOTICS IN WATER ENVIRONMENTS AND THEIR IMPACT ON HEALTH

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Abstract: This article analyzes the impact of antibiotics in the water environment on human health and the ecological environment, and points out the main sources of antibiotics in the water environment. It is wastewater from the breeding industry, medical industry, and pharmaceutical industry. Sewage in the water environment can make the resident flora of the human body acquire drug resistance, leading to long-term consumption of antibiotics. People with polluted water have reduced immunity, severe allergic reactions and chronic toxic effects, and can also have toxic effects on certain aquatic organisms. This article is the same as It also elaborated on the migration and transformation process of antibiotics in the environment and the impact of current conventional treatment processes on antibiotics. Finally, for our country's purpose Based on the current situation, this article proposes the future research direction and work direction of antibiotics in water environment.
Keywords: Antibiotic water environment; LIVESTOCK and poultry waste; Drug-resistant bacteria

1 SOURCES AND CURRENT USE OF ANTIBIOTICS

Antibiotic (antibiotics) is caused by microorganisms (Including bacteria, true bacteria, Actinomycetes) or higher animals and plants produced in the course of their lives A class of secondary metabolites with antipathogenic or other activities, Chemicals that can interfere with the developmental functions of other living cells. Some APIs (active pharmaceutical ingredients) and its metabolites in wastewater treatment systems have not been completely removed from the system and can exist in the drinking water system for a long time. The human body is affected by drinking water or eating aquatic organisms (like: drug residues in fish) And in the body Internal accumulation [1]. At present, there is serious abuse of antibiotics in the world, not only in the medical industry, but also in agriculture and breeding. The situation is not optimistic either. People also add large amounts of
Antibiotics are used to improve the immunity of livestock. After livestock eat them, most of the drugs will be in their original form or oxidized to synthesize other products and be excreted through the livestock's excretory organs. If these excretions are not handled properly, antibiotics may enter the ecosystem. environment and become pollutants in water. United States Geological Survey (USGS) Tracking levels in the environment have been mentioned in some recent surface water survey reports. APIs Potential effects on human health exist and have been evaluated in several surface and drinking water A- PIs The impact on human health was found to have no significant impact [2]. However, in recent years, small amounts of antibiotics have been detected in the lower reaches of major rivers in China. Although the residual antibiotic content is not high, most antibiotics have a biomagnification effect. Even small doses of antibiotics remaining in the water environment will pass through The amplification effect of the food chain affects water Living animals cause certain harm, and after layers of accumulation, they reach the point where food The highest level of the chain, endangering human health.
Antibiotics are produced by some microorganisms or certain animals and plants The metabolites produced in them are effective against various or specific pathogenic microorganisms. It has a strong inhibitory or killing effect and is a natural or semi-artificial Synthetic compounds, the current classification of antibiotics can be divided into the top ten kind. From the pollution situation of the surface water environment throughout China, See, the antibiotics with the highest levels detected are fluoroquinolones and sulfonate Amine antibiotics [3]. According to statistics, my country's annual antibiotic production is approximately for 210,000 tons, of which 48% Used in livestock and poultry breeding industry, 42% used in medicine Pharmaceutical industry [4]. The extensive use of antibiotics in China has led to increasingly serious antibiotic pollution of the water environment and increasingly damaged ecological environment, which has become dangerous. Harmful to people's health. In the breeding industry, the use of antibiotics There are serious problems with drug use, mainly blind and random use of drugs, long-term and excessive excessive use of antibiotics, even those that are prohibited by state law Vitamins, and its middle 90% of antibiotics used as feed additives element, its function is only to improve the feed conversion rate, it can be seen from this that It has been revealed that the abuse of antibiotics in China has become very serious, while in the United States, veterinary The annual use of antibiotics is only about 1. 60,000 tons [5-6].
In recent years, there have been reports at home and abroad that the water environment is contaminated by antibiotics incidents, and the reported presence of antibiotics in the water environment has been confirmed Sugouda 30 species, even found to contain antibiotics in drinking water Vitamins. Currently, sources of antibiotics in water environments mainly include medical Improper discharge of industrial, aquaculture and pharmaceutical industry effluents.

1. 1 Medical Antibiotics

Medical antibiotics are currently one of the major sources of pollution in the water environment. Antibiotics enter the human body mainly through oral administration and infusion. After being absorbed by the body, a small number of antibiotics can undergo metabolic reactions to generate inorganic compounds. Antibiotics that have not undergone metabolic reactions are passed through human feces and urine in their original or active form in the form of compost. It enters the soil, enters the water environment through rainwater erosion, or is discharged to the sewage treatment system. However, many sewage treatment plants in our country have insufficient equipment, technology, and Insufficient staffing, etc., cannot completely remove antibiotic compounds in medical sewage and domestic sewage, resulting in a large amount of antibiotic residues. Some treatment methods are even completely ineffective against some antibiotics, and the effluent containing effective antibiotic bioactive compounds is discharged directly to surface waters. Zuccato [7] found some residual antibiotics in the discharge water of Italian sewage treatment plants. If biologically active active ingredients are used as the standard to estimate the residual antibiotics, it can be estimated that there are approximately 1.8 in a year. t Antibiotics enter the river water environment. Chang et al. [8] investigated hospital wastewater and sewage treatment plants in the Three Gorges Reservoir Area in China. Antibiotic residues in water environments, and the impact of sewage treatment plants on certain The removal rates of some antibiotics indicate that tylosin and tetracycline are almost Can be completely removed, and the erythromycin removal rate reaches More than 20%, different directions The removal rate of chlorotetracycline reaches More than 15%, while trimethoprim removes The rate is only at 1% up and down. Xu Weihai [9] analyzed Hong Kong, Guangzhou, etc. Drug content in the effluent from 3 sewage treatment plants, average drug content in water The average is higher than some countries in Europe and the United States.

1.2 Antibiotic Application in Breeding Industry

Currently, more than 60 antibiotics are used in the breeding industry. It is used to increase the probability of feed conversion, prevent livestock disease, and promote livestock The growth and development of poultry, etc., and the long-term and extensive use of veterinary and fish drugs are the main reasons why antibiotics Another important source of pollution in the environment.

In the livestock and poultry breeding industry, the use of antibiotics is relatively serious. The Proceedings of the National Academy of Sciences of the United States once reported that antibiotics have appeared in pig farms operating in China. 149 common antibiotic resistance genes (ARG), The extent of some antibiotic resistance genes is 192 to 28 times that of samples without antibiotics. 000 times [10]. Antibiotic drugs and unmetabolized antibiotic active substances in animal feces and urine can enter the surface water environment in the form of rainwater and surface runoff after being thrown into the soil in prototype form due to random discarding or incomplete treatment. They can also enter the surface water environment through leaching., Migration pathways such as percolation enter the water environment, polluting water quality, harming the ecosystem in the water environment, and even endangering human health.

antibiotics in aquaculture can treat various diseases of fish, shrimp and other aquatic organisms, such as red skin, body surface ulcers, tail rot, etc. Rotted gills, etc., and are often excessively added to seafood feed. Antibiotics used in fisheries include 70% to 80% will eventually enter the water environment [11]. In aquaculture farms, antibiotics that have not been absorbed by aquatic organisms and excreted into the water environment through excrement will remain in the water body in large quantities, or settle and collect in the mud. The drugs remaining in the water body will be discharged into surface runoff, and then Pollution of surface water, ocean and other water environments. The sediment at the bottom of the farm is generally used for fertilization and enters the soil, and then enters the water environment through rainwater erosion and other methods.

1.3 Antibiotics in Pharmaceutical Factory Wastewater

The wastewater produced by pharmaceutical factories contains a large amount of chemical residues that are difficult to degrade. chemical composition, there are large amounts of antibiotics remaining in the sewage discharged from some factories. Factors and their oxidative synthesis products. The process of making antibiotics includes During the four stages of fermentation, chemical synthesis, extraction and finished medicine, the wastewater generated during the process contains several biologically toxic substances that are difficult to degrade. and high concentrations of active antibiotics. These biotoxic substances and high concentrations High levels of antibiotics inhibit the proliferation of microorganisms in wastewater biochemical treatment, leading to Making antibiotics in wastewater more difficult to degrade [11]. If pharmaceutical factories do not process according to standards and discharge illegally, residual substances containing active antibiotic ingredients will enter surface water and other water environments, seriously polluting the ecological environment. Many pharmaceutical factories still use certain traditional sewage treatment methods, which cannot completely degrade all antibiotics in the wastewater. After incompletely treated sewage is discharged, it will pollute the water environment [12].

2 THE IMPACT OF LARGE AMOUNTS OF ANTIBIOTIC RESIDUES IN WATER ENVIRONMENTS

2. 1 Influence of Microbial Flora in Water

Higher concentrations of antibiotics inhibit or kill microorganisms For use, the concentration of antibiotics in the water environment is generally relatively low and has not yet reached the appropriate level. Microorganisms have a strong killing effect, but if exposed to low doses for a long time The amount of antibiotics is likely to have a negative impact on the microbial flora in the water environment. have potential impacts, mainly leading to the emergence of drug-resistant strains, drug-resistant strains Resistance genes can be passed on to the next generation through genetic mutations Or migrate to other organisms, under the natural selection of antibiotics, After drug-resistant strains multiply in large numbers, they enter the body through human diet and other methods. body, causing the resident human flora to acquire drug resistance. Drug resistance in humans Sexual strains can accelerate the degradation of drugs and reduce the effects of drugs on pathogenic bacteria. Inhibition, weakening the effect of the drug. U.S. Environmental Protection Agency National Research Laboratory studies show that antibiotics are rarely found in high concentrations in the environment degree exceeds 1 μg/L, and there have been no reports of antibiotic resistance in a large number of microorganisms in the environment [13].

In the sewage discharged after treatment in the treatment plant, it can be detected Bacteria that are resistant to single or multiple antibiotics, if the sewage If not handled properly, these bacteria are likely to flow into the surface through fertilization and irrigation. Water may enter the human body through the food chain and other methods, harming human health. Research by Yu Daojin et al. [14] showed that in the Wenyu River zone in China, there is a single species Drug-resistant or multidrug-resistant E. coli are approx. 45%,in Resistance of drug-resistant bacteria to tetracycline, sulfa and ampicillin The strongest.

twenty two effects on aquatic life

Antibiotics not only have toxicological effects on bacteria, but also on the environment potential toxicological effects on other non-target organisms in the environment. anti- Biotin may have certain acute toxic effects and chronic Sexual toxic effects [11]. A research report once found that erythromycin and cypro Floxacin and sulfamethoxazole are three antibiotics that can inhibit menstruation The compound reaction of dental algae to light, including the inhibition of erythromycin on algae The effect is stronger than the other two, and the oxidative synthesis products of some drugs It is more toxic to some target organisms than the prototype compound, For example, amoxicillin degradation products are more harmful to macroalgae than amoxicillin itself. Has toxic effects [15]. There are many types of antibiotics, and their degradation products are even more complex. The combined toxicity of their parent and degradation products to aquatic organisms Research on its effects is still in its infancy, and more toxic effects await further study.

twenty three impact on human life

Although antibiotics remain in drinking water in very small amounts, e.g. If the body is exposed to low doses of antibiotics for a long time, it will reduce the body's immunity, and the emergence of drug-resistant strains will make most antibiotics Loss of efficacy. Study finds long-term consumption of antibiotics containing antibiotics Eggs, meat and other foods products, antibiotic resistance genes can be detected in the body Because [16 -17]. At the same time, long-term application of agricultural products such as vegetables and rice contains Antibiotics in manure or water sources, as well as livestock, poultry, aquatic products and other organisms for a long time Ingesting antibiotics so that antibiotics are present in their food products, antibiotics Vegetarians are gradually enriched through the food chain, and people at the highest level of the food chain The most enriched class can cause allergic reactions in people, and some drugs can Causes chronic poisoning in humans, and even has carcinogenic, teratogenic, and mutagenic effects. Interfering with the physiological functions of various human body systems [18]. The emergence of drug resistance makes old drugs gradually lose their effectiveness, making Human diseases cannot be cured well, and new drugs often cost Higher, which can increase the cost of treating the disease for patients. especially people The same types of antibiotics are used for livestock and poultry, and drug resistance is caused by the food of livestock and poultry. spread to humans from objects, water and other environments will directly pose a threat to the health of the population threaten.

3 MIGRATION, TRANSFORMATION AND CONVENTIONAL TREATMENT METHODS OF ANTIBIOTICS IN WATER ENVIRONMENT

3.1 Migration and Transformation of Antibiotics in Water Environment

After antibiotics enter the water environment, they will undergo adsorption, chemical A series of steps such as synthesis, hydrolysis, photodegradation and biodegradation. ①Adsorption main For sediment adsorption, Yang [19] found that in Western countries Several antibiotics used by livestock and humans have been found in the mud There are similar drugs, and the concentration of antibiotics in the mud bottom is much higher than that in the water body. This may be related to the strong adsorption capacity of the sediment to antibiotics. exist In highly weathered soils, more than 50% of the total soil can concentrate and absorb Attached to more than 90% FQs [20] _. Yu Daojin et al [14] in research Zhongfa Now, after entering the water body, most of the oxytetracycline accumulates in the surface layer of the sediment. The concentration of antibiotics on the sediment surface reached its highest level after 14 days and showed that There is an obvious downward migration phenomenon. ②Hydrolysis mainly refers to the removal of organic matter in the water environment An important degradation pathway in water, mainly affected by certain ions in water, temperature and pH Impact. Yu Daojin et al. [14] pointed out in the study that penicillin Drugs like these are susceptible to nuclear and electrophilic reagent attacks in aqueous environments, causing decomposition. The rearrangement of the sub-units, in addition to the increase in water temperature can oxygenate the penicillin drug In addition to chemical decomposition and molecular rearrangement, certain metal ions and oxidants can also cause this effect. ③Photolysis refers to the effect

of light energy on water resistance Degradation pathways of antibiotic activity, factors affecting sunlight are also resistant to antibiotics It has a certain influence on the photodecomposition rate of pigments. ④Biodegradation is mainly It refers to the chemical structure and quality of antibiotic residues that change under the action of microbial metabolism, resulting in It changes the physical and chemical properties, that is, under the action of certain bacteria, antibiotics Degradation of drugs and their metabolites from macromolecular compounds to small molecules compound, the final product is H 2 O and CO 2, that is, achieving environmental pollution Harmless treatment of objects [21]. Research at home and abroad has reported that only a few antibiotics can only be degraded by certain microorganisms even under experimental conditions. solution, most antibiotics and their residues will still remain in the water environment Medium [22]. It shows the natural migration and transformation process of antibiotics in the water environment. Only a small part of the antibiotics and their residues can be degraded, and most of them can be degraded. Some of the active ingredients remain in the water environment.

3.2 Routine Treatment Methods for Antibiotics in Water Environments

Conventional treatment methods for antibiotics in water mainly include disinfection, biological treatment, and sand filtration [15]. The main component of disinfection is chlorite ions (ClO_2), it can remove some sulfonamides and macrolide antibiotics, mainly because these two types of antibiotics have higher reactivity with them, and the treatment effect and speed are higher than Cl 2 Good [23]. However, under the conditions of ordinary water treatment methods, the antibiotic treatment efficiency of the above methods is not high. In order to improve the removal rate, the pH of the water body needs to be pre-treated and adjusted. Therefore, general disinfection is mostly used as a pre-treatment process and needs to be coordinated. Use other methods. Yao Hong et al. [24] found that the existing ozone treatment process has a better effect in removing antibiotics. Rooklidge et al. [22] found that for sewage The clearance rate of fluoroquinolone antibiotics in 88% ~ 91%, the clearance rate of sulfa antibiotics is 67%～94%, the clearance rate of macrolides is 45% around, while the clearance rate for trimethoprim is only 2%～32%, improving the treatment process can improve the effectiveness of the activated sludge method in treating antibiotics. The two-phase anaerobic sludge method is the main anaerobic biological treatment method. Its removal rate of residual sulfamethoxine and roxithromycin in sewage can reach 95% ~ 100% [15]. The method of mixing aerobic, anaerobic and physicochemical methods can solve the problems of low aerobic biological treatment load and poor anaerobic biological treatment effluent quality, and improve the overall removal rate. Peng Xianzhi et al. [23] studied and analyzed the effects of a certain sewage treatment plant on sulfonamides, chloramphenicol, etc. in the water body. The removal status and specific plans of 27 drugs, the conclusion shows that only chloramphenicol has been partially reduced after treatment in the sedimentation tank. After successive anaerobic, After anoxic and aerobic biological treatment, the clearance rates of sulfonamides and chloramphenicol can respectively reach 87% and 100%;After final chlorine disinfection, except for trace amounts of sulfa drugs, the 97% The above antibiotics were effectively removed.

The biofilm generated on the sand filter media can partially remove the antibiotics Filtration degradation, Rooklidge et al. [22] concluded that multi-stage sand filtration to drinking water The treatment effectiveness of 4 antibiotics, among which tyleromycin and The adsorption constant of trimethoprim is relatively high, and the drug removal rate is as high as 99.9%; Due to the low adsorption constants of sulfonamides and clindamycin, the removal rates were only 4% and 25%. It can be seen that the removal effect of sand filtration on antibiotics in water is mainly affected by the adsorption constant. In real life, it can be By improving the oxygen content, multi-level and multi-stage planning and other process processes, there are It is beneficial to the treatment effect of sand filtration, and the costs of sand filtration are lower than other processes, making it an ideal choice for rural and poorer areas [21].

It can be seen from this that although there are many methods and processes to remove Most of the antibiotics remain, but due to their high cost and technical level, It is not widely popularized, and only some sewage treatment plants can achieve this Effect.

4 RESEARCH PROSPECTS

To sum up, antibiotics are different from pesticides, productive poisons and other organic substances. Although their concentration in the water environment is very low, they pose a great threat to ecology and human health, and pose a major ecological crisis. The European Union, the United States and other Western countries have begun conducting environmental risk assessment studies of antibiotics. The use of antibiotics in China may be more serious than in the EU and the United States, but there are relatively few studies on the specific environmental pollution behaviors of antibiotics, and there is a lack of research on the treatment of trace amounts of antibiotics in the water environment. Therefore, it is necessary to study specific ecotoxicological risk assessments and investigate the environmental status of antibiotic-contaminated sites as soon as possible. The following work should be carried out first: ① According to the distribution map of antibiotic pollution in China drawn by previous scholars, for drinking water, food, etc., Evaluate the risk of antibiotic exposure for people in various places, seek and formulate measures to control the sources of antibiotics, and reduce the sources of antibiotic contamination. ②There is still little research on the impact of trace amounts of antibiotics in China's water environment on the ecological environment and human health. Although according to the report of the United States Geological Survey, the remaining antibiotics in the water environment have no significant impact on human health, they should still be Consider further conducting research on degradation, treatment and intermediate products, establishing benchmark levels, and establishing an ecological risk assessment system as soon as

possible. ③ Establish a sewage control and antibiotic content discharge standard system, strengthen supervision, and separate medical and livestock sewage treatment systems from urban domestic sewage. ④Carry out popular science propaganda about antibiotics to reduce the abuse of antibiotics.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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