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A Study of the Impact of Antibiotic Pollution and the Types of Environmental Pollution It Causes

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Abstract

Antibiotics are essential biological drugs for human health and are the cornerstone of treating infections caused by various bacteria and viruses. However, they also pose a significant risk if misused, as each antibiotic is designed for a specific type of bacteria. Sometimes, due to the evolution of bacteria, many antibiotics have become ineffective and resistant to contamination and infection. Therefore, they can have the opposite effect, polluting the environment instead of eliminating bacteria, thus increasing the risk of antibiotic-associated contamination. Environmental scientists and chemists have warned that chemical pollution poses a threat to human well-being and nature, a threat comparable to global warming and climate change, yet it receives less public attention and awareness, and serious measures to contain it are not being taken. Chemical, biological, and viral-bacterial pollution has become widespread in the environment. This research examines methods for eliminating chemical and biological pollutants from the environment, which involve using chemical blocking agents known in analytical chemistry, as well as chemical separation and extraction methods for pollutants. Some environmental studies indicate that the industrial economy has created more than 100 million new chemicals, meaning they do not exist in nature – of these, between 40,000 and 350,000 are in widespread commercial use and production. Chemical pollution is linked to biological pollution, as aquatic organisms – plants, animals, and microorganisms – are affected by the forms of chemical pollution present in the aquatic environment. Chemical pollutants, in all forms and types, affect the growth, reproduction, and spread of aquatic organisms within their habitats.

Keywords: Antibiotics, bacteria, economy, environment, pollution

INTRODUCTION

Bacterial infections are the primary reason why many researchers have developed numerous methods to find modern ways to manufacture new antibiotic derivatives that can counteract and resist the continuous growth of bacteria and diminish their resistance rates. It is worth noting that some ineffective antibiotics pose a real threat to the environment due to their dispersal in hospital waste, leading to increased environmental pollution. Antibiotics vary according to their manufacturing methods; some are natural, others are synthetically produced chemically, others are biological, and so on.

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Antibiotics are chemical compounds that are tangible manifestations of human progress, development, and scientific, technological, and agricultural innovation. The use of elements in fertilizers allows farmers to foster larger capacities of nutrition gathers. However, with chemical pollutants permeating many aspects of our daily lives, we have reached a point where the limits of our planet's resilience are being tested, as the overuse of some chemicals causes far more harm than good. When toxic chemicals are mismanaged, they cause an alarming number of premature deaths and inflict serious damage on both human health and the planet. Research highlights the serious risks posed by widespread chemical pollution. Records and explorers specify that dominant revealing triggered the previous deceases of more than 5.5 million anybody in 2019; 90% of these deaths appeared in low- and middle-income territories. Research also found that children under the age of five experienced a drop in IQ scores of approximately 765 million points due to lead poisoning in the same year.

Nitrogen fertilizers, often used to enrich agricultural soil, are another example of chemicals that have a detrimental impact on both people and the planet. Crops actually absorb only 40% of the nitrogen, while the remaining 60% is released into the air or dissolved and leached into water [1, 2].

EXPERIMENTAL PATH

We conducted a statistical study on methods of removing pollutants, whether biological, antibiotic, or other biochemical pollutants. Then, another statistical study was conducted on the most polluting and environmentally widespread antibiotics. The results are shown in Table 1 and Figure 1 in the study. It was discovered that these substances contradict the conventional assumption that lower doses inevitably reduce their effects. Chemical toxicity is not given the attention it deserves as environmental issue or compared to climate change funding – a disparity that McPherson believes needs to change [3].

Table 1. Ratio of antibiotic pollution.

Antibiotics	**Amoxil**	**Trimethoprim**	**Cefixime**	**Tetracycline**
Percentage %	60%	55%	30%	10%

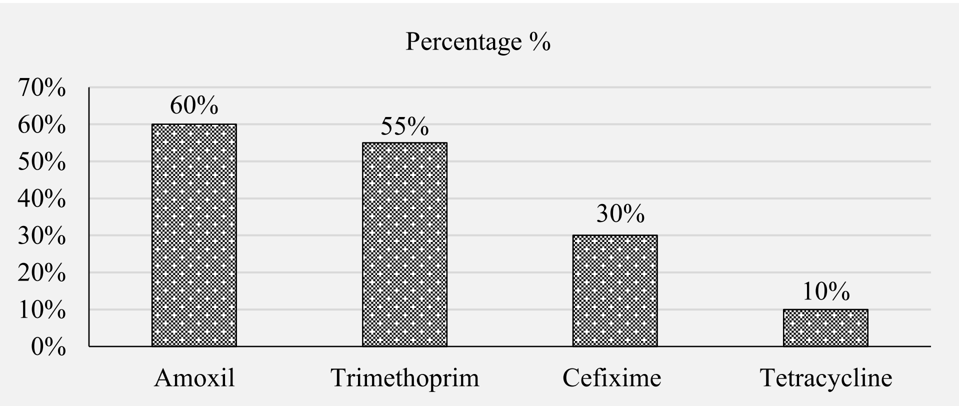

Figure 1. Ratio of pollution by antibiotics.

METHODS OF TREATING POLLUTION

- *Using Known Filtering Agents:* Analytical reagents, and complexes that reduce environmental pollution such as antibiotics.
- *Using Known Chemical Separation Methods:* To separate pollutants like antibiotics and drugs from waste in the form of colloidal particles or by precipitation techniques for other impurities.
- *Various Filtration Methods:* Including mechanical filtration using reduced pressure and conventional filtration.
- *Ion-Exchange:* This method is used to remove metals and organic matter from wastewater and to remove phosphorus and ammonia compounds. Synthetic resins are used in this method as ion exchangers, and a range of natural materials such as zeolite have also been used for the same purpose. However, the high cost of ion exchangers and their limited availability from specific sources are considered disadvantages of this method.
- *Selective Membrane (Osmosis):* This method uses semipermeable membranes to remove dissolved organic and inorganic substances from water. The semipermeable membrane is made of special fibers that have a superior ability to remove all types of pollutants, including aquatic waste.

However, one of its main drawbacks is the limited water flow, which is insufficient for the volume of industrial waste [4].

Physical Treatment Methods of Antibiotic Pollution

- Physical treatments involved filtering procedures, like superficial stained wastewater overactivated carbon or resin to eliminate pollutants (adsorption, resin adsorption).
- Other treatments may contain using gravity to detach substances from liquids by triggering them to sink (sedimentation) or glide to the surface (floatation).

RESULTS AND DISCUSSION

The study revealed a correlation or causal relationship between widely used chemicals and effects on the reproductive, immune, nervous, cardiovascular, and respiratory systems, as well as liver, kidney, and metabolic functions in humans. It also addressed environmental pollution of water, soil, and air, including heavy metal pollutants. Other chemicals found in our daily lives are equally concerning. A statistical analysis was conducted on the most contaminated and prevalent antibiotics in the environment. The results are presented in the table and figure of the study [5]. The clear results showed that amoxicillin had the highest rate of antibiotic contamination, while tetracycline had the lowest. This is well known, as amoxicillin is used for most types of infections, making it the most widespread (Table 1 and Figure 1).

Previous studies on pollution indicate human bodies contains more than 3,000 industrial chemicals from food preparation materials – those used in food processing and packaging – 100 of which are of particular concern. More than 15,000 chemicals are used in plastics, which are often used for food preservation. These include fillers, dyes, flame retardants, and stabilizers. The health damage caused by just three plastic polychlorinated biphenyls (PCBs), bisphenol A (BPA), and diethylene hydrochloride (DEHP) – is estimated around $1.5 trillion annually. Permanent chemicals (PFAs) have been found in almost all people tested and are now so pervasive that rainwater in many locations contains levels considered unsafe for drinking. According to the study, when these chemicals contaminate the air and human bodies, the results can be catastrophic [6, 7].

- Biochemical pollution can introduce new elements into the aquatic environment, potentially leading to an increase and spread of biological pollution by microorganisms and aquatic plants. A prime example is pollution by phosphate and nitrogen compounds in water bodies, which causes excessive growth of aquatic algae, potentially leading to the eventual decomposition and biological death of rivers and lakes, resulting in serious environmental damage.
- Biodegradable organic compounds serve as carbon sources for both pathogenic and non-pathogenic microorganisms, potentially causing biological pollution of the aquatic environment where these chemical pollutants are present.
- Biological pollution can add chemical toxins and harmful elements produced by microorganisms (such as some types of algae) to the aquatic environment. The accumulation and increase of these substances lead to the production of foreign elements that disrupt the aquatic environment's ecosystem.
- Chemical pollution can reduce the self-refinement methods of water bodies, potentially leading to the accumulation of pollutants that may increase the growth rates of some aquatic organisms to a degree that could cause pollution [8].

Removal of Pollutants by Adsorption

This is the development of atoms, molecules, or particles of a substance adsorbing from the gaseous or liquid state onto the surface of a solid. It is a physical or chemical bonding of a substance's molecules to the active sites of a surface through various forces, such as weak van der Waals forces, or through the formation of chemical bonds with the active sites on the surface [9]. The substance that undergoes adsorption onto the surface is called the adsorbate, while the surface on which the adsorption occurs is called the adsorbent, such as silica gel, resins, activated charcoal, and porous clays [10]. Adsorption may result in the formation of a single molecular layer on the surface, in which case it is called unimolecular adsorption. Sometimes it may lead to the formation of multiple molecular layers on the adsorbent surface, and this is called multimolecular adsorption [11]. Adsorption can be local, in which the adsorbed particle does not have the ability to move, or it can be mobile [12]. The opposite process of adsorption is desorption, which is the separation of the particles attached to the alumina surface and their return to the phase in which they are dispersed. This process usually occurs when the temperature rises to a level sufficient to break the bonding force between the alumina surface and the adsorbent material [13]. The process of the adsorbed particle dispersing into the phase of the alumina surface and dispersing in it is called absorption. Adsorption and adsorption often occur together, and this is called absorption [14]. This process often occurs on porous surfaces, and its enthalpy is generally positive because the diffusion process within the adsorbent phase requires energy, making it an endothermic process [15, 16].

Natural Adsorption of Antibiotics

This type of adsorption is called chemical adsorption. This type of adsorption occurs on certain surfaces under specific conditions and may not occur on other surfaces when those conditions are met, or even on the same surface when those conditions are changed [17].

In this type of adsorption, molecules adhere to the surface chemically through covalent bonds, attempting to establish specific positions with the adsorbent surface and forming a single adsorbed layer.

Physical Adsorption of Antibiotics

The surfaces of selected materials are inactive in the adsorption route due to the electron dissemination of their atoms, as well as the bonds that persist these atoms together within the substantial itself. Adsorption on these surfaces occurs through natural attractive forces. This type of adsorption is called physical or natural adsorption, and sometimes it is called van der Waals adsorption [16]. This type of molecular interaction involving the adsorbent surface and the adsorbed material is like dispersion forces, dipole interface forces, or van der Waals forces. This adsorption occurs on all surfaces; there are no surfaces specifically designed for it. For example, nitrogen gas can undertake physical adsorption on the surface of any solid material, provided the temperature is below the boiling point of the adsorbed material.

Contaminant Removers from Samples

- *Reverse Osmosis:* This is the most common technique for desalinating brackish water. It involves using high pressure to force water through a semipermeable membrane with a micro-array to remove chemical impurities, organic matter, viruses, germs, and bacteria.
- *Free Flow:* This technique relies on the movement and flow of water through a system of basins and pipes. It can also be used to recycle water used in agriculture and industry.
- *Cold Evaporation:* This is a modern technique that relies on evaporating water at low temperatures ranging from 30–65 degrees Celsius. The steam is collected in special vessels and converted into purified water.
- *Pure Air Oxidation:* This technique relies on the reaction of chemical pollutants in water with oxygen in the air using specialized reactors. Organic compounds and other pollutants are removed from the water through oxidation [18–20].
- *Coagulation:* This technique uses chemical compounds or reagents to coagulate, and clump suspended particles in water. The larger particles are then removed from the water using filters.

Pollution from chemicals is extremely dangerous. The danger of chemicals lies not only in the waste generated from their manufacture or the method of disposal, but also in the entire manufacturing process and its byproducts. The chemical industry, and chemical science in general, faces a problem related to catalysts. Chemical reactions require catalysts to proceed under standard conditions, or under achievable physical conditions in the laboratory or factory. These catalysts are mostly organometallic substances, including elements and heavy metals, along with a chemical bond between the metal and other organic compounds. However, they are essential for chemistry and related industries. Here, scientists interested in green chemistry have established a set of principles. If organometallic catalysts must be used, their efficiency should be increased through research that expands the number of reactions a single catalyst molecule can produce, leading to the use of smaller quantities of catalysts. The ideal approach, however, is to avoid using this type of catalyst and instead utilize organic catalysts or enzymes [21–26].

CONCLUSIONS

Poisoning from antibiotic pollutants causes damage to the biological structure of some body organs. The results shown in this study have indicated that amoxicillin had the highest rate of antibiotic contamination, while tetracycline had the lowest. This is well-known, as amoxicillin is used for most types of infections, making it the most widespread. Humans can control solid or liquid chemical pollutants because they are easy to identify, collect, and dispose of in remote locations.

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