organic matter but including some compounds, such as nitrates), industrial effluents (paper mills, tanneries, slaughterhouses, dairies, oil mills, sugar mills, etc.) and wastewater discharged (effluents) from collective facilities, such as hospitals, schools, shops, hotels and restaurants (Yagouba, 2005).Organic pollution has several effects on the environment. It asphyxiates the environment by consuming dissolved oxygen and stimulates the excessive production of plants and algae or seaweed (eutrophication, dystrophication) or promotes the accumulation of sludge and the development of organisms that are pathogenic to humans. The asphysification of the environment can promote the death of fish and other aquatic organisms (Hauxwell et al., 2001; Yagouba, 2005). Dystrophicationis often linked to excessive nitrate and phosphate intake. In addition, phosphates contained in household detergents have dangerous effects on the environment. (Rodier, 1996; Manahan, 2000).

Cases of pollution by nutrients, especially nitrogen and phosphorus, due to natural and/or anthropogenic causes, generate disruptions in biogeochemical cycles. The result is an undesirable accumulation of sometimes toxic intermediates of these cycles, which can lead to an ecological imbalance depending on their chemical form and concentration (Féray, 2000).Some synthetic organic molecules are poorly or not at all biodegradable by aquatic micro-organisms. They will therefore persist in the receiving environment and may bioaccumulate along the trophic chain.

3.4. Microbiological pollution

Microbiological pollution of surface water is linked to increased microbial load. This pollution develops in conjunction with organic pollution, which encourages the proliferation of germs of human or animal origin, some of which are highly pathogenic. Yet, organic waste, in particular excrement, contains pathogenic germs (viruses, faecal coliforms, streptococci, enterococci, *Escherichia coli, Pseudomonas aeruginosa, Giardia lambia, Entamoeba coli* and other parasites) carried by water. These germs can cause diseases as serious as cholera, typhoid, dysentery, etc. (Emoke et al., 2013). Viruses (poliovirus-type enteroviruses, coxsackies and echoviruses, hepatitis A viruses, corona and rotaviruses, Norwalk viruses and associated) responsible, depending on the case, for gastroenteritis, hepatitis or neuro-meningeal syndromes, are generally more persistent in the environment and more resistant to disinfection treatments than bacteria. In addition, parasites such as *Giardia lamblia* and *Cryptosporidium parvum* are considered to be formidable pathogens, especially for immunocompromised subjects; their cysts are also particularly resistant in the environment and to disinfectants. Some microscopic algae can also proliferate in the aquatic environment and create problems for drinking water through their toxins(Huang and Shih, 2015).

In general, coliforms and *Escherichia coli* in particular are considered to be the preferred indicators of microbiological water pollution (Tshibanda et al., 2014; Chevalier, 2016; Mindele, 2016), their presence predicts the presence of other enteropathogens. According to Isnard (2017), enterococci, unlike thermo-tolerant coliforms, including *E. coli*, are characterized by their particular adaptability to different environmental conditions, hence their presence in different ecological niches (wastewater, freshwater, seawater and soil). Numerous studies have revealed the existence of strains of enterococci resistant to the disinfecting agents used for the microbiological treatment of water or strains involved in various infections (Diallo, 2013; chevalier, 2016; Isnard, 2017). Other studies have also reported that aquatic ecosystems in general and freshwater (rivers, streams, lakes, etc.) in particular are reservoirs of pathogenic and/or antibiotic-resistant bacteria and antibiotic resistance genes. Water ecosystems are believed to contribute significantly to the cycles of dissemination of antimicrobial resistance genes through horizontal transfer mechanisms (Rysz and Alvarez, 2004; Pruden et al., 2006; Poté et al., 2008; Knapp et al., 2012;Bréchet et al., 2014; Czekalski et al., 2014; Laffite et al., 2016). Antibiotic-resistant bacteria can travel far and to the most remote locations. Antimicrobial resistance has now passed the stage of rarity and almost exclusive presence in hospitals (Yuo et al., 2014).

3.5. Micropollutants

The term "micropollutants" refers to a set of substances, whether mineral (metals and metalloids) or organic (hydrocarbons, benzene derivatives, polychlorinated biphenyls or PCBs, phthalates, bisphenols, organochlorines, pesticides, biocides, detergents, drug residues, etc.) which, even at very low concentrations, of the order of µg/L or ng/L, can be toxic and cause harm in aquatic environments.Briand et al. (2018), defined micropollutants as a set of substances that originate at least in part from human activities and that have proven or suspected adverse effects even at the low concentrations (ng/L to µg/L) at which they are present in the environment. Micropollutantsare considered new or emerging pollutants. Their appearance is not new; the phenomenon is accelerating with the constant evolution of analytical methods, which are efficient and make it possible to detect pollutants even at low doses. In addition to their toxicity, they are persistent and/or bioaccumulative. There is no fixed list including all micropollutants, as this list evolves as knowledge of the effects of the substances studied evolves. Some authors group micropollutants according to their uses: plasticizers, detergents, pesticides, biocides; pharmaceuticals (Gavrilescu et al., 2014).

Others group them into 3 categories:

- organic micropollutants: phytosanitary products (pesticides: triazines, organochlorines, organophosphates, substituted ureas, herbicides, fungicides, rodenticides, etc.), pesticides (pesticides: triazines, organochlorines, organophosphates, substituted ureas, herbicides, fungicides, rodenticides, etc.), pesticides (pesticides: triazines, organophosphates, organophosphates, substituted ureas, herbicides, fungicides, rodenticides, etc.), pesticides (pesticides: triazines, organochlorines, organophosphates, substituted ureas, herbicides, fungicides, rodenticides, etc.), pesticides (pesticides: triazines, organophosphates, organophosphates, substituted ureas, herbicides, fungicides, rodenticides, etc.).), hydrocarbons, polychlorinated biphenyls or PCBs, polybrominated biphenyls or PBBs, polychlorinated dibenzodioxins (PCDDs) or dioxins, polychlorinated dibenzofurans (PCDFs), detergents (or surfactants), phthalate esters, various medicinal substances: hormones (oestrogen, testosterone...), antibiotics, anaesthetics, anxiolytics, disinfection by-products (especially chlorination), etc.
- mineralmicropollutants (Cd, Pb, Cr, Hg, As, Cu, Zn, Ni, etc.), and
- organometallicmicropollutants: results from the association of a metal ion with an organic group (Tri, di, Mono Butyltins, etc.).

The contamination of natural aquatic ecosystems by micropollutants is a growing concern that is receiving increasing attention from policy makers and researchers. Several authors have reported that these compounds can harm aquatic organisms and threaten drinking water resources. Although strongly suspected, the health risks associated with chronic exposure to micropollutantsare still poorly documented.Among the effects of these environmental pollutants on exposed organisms are carcinogenic, mutagenic, reprotoxic (toxic to reproduction: sterility, fertility), neurotoxic (disruption of the functioning or development of nerve cells, teratogenic, appearance of birth defects; disturbance of intellectual quotient, and callergenic, immunotoxic (reduced immune protection: infections, allergies) or endocrine disruption and so on.

Some sources report that the main effects observed after exposure to micropollutantsare: free radical formation, altered gene expression, tissue or organ toxicity, endocrine deregulation and mutagenicity. These effects result in the appearance of various pathologies: cancers, immunodeficiency, infertility, growth problems, Alzheimer's disease, malformations in newborns(Agarwal et al., 2006; Hoo et al., 2016). The toxicity of micropollutants depends on several factors such as the type of micropollutant, the dose received and the route of exposure (dietary, inhalation, skin passage).The literature also indicates that micropollutants present in surface waters affect aquatic organisms. For example, feminisation (sex hormone disorders) and developmental inhibition in fish, a significant number of morphological deformities and abnormalities in the reproductive process in invertebrates and early mortality are observed. (Theunis, 2011).

As regards to medicines, once ingested, they are found in the faeces and urine and reach the sewage treatment plants. However, sewage treatment plants do not totally degrade the drugs and some of them end up in rivers and then in the water we drink (Theunis, 2011). Many African countries do not have sewage treatment plants. This predicts a significant pollution of drug residues in the water reserves present in this country. Drugs are consideredmicropollutants for the environment because they were developed with the intention of producing a biological effect on the organism and their presence in aquatic ecosystems is in itself a danger to organisms (Halling-Sorensen et al., 1998).Several scientific studies have revealed the presence of a wide range of pharmaceutical molecules in surface water and/or drinking or tap water. (Rodil et al., 2009; Gros et al., 2009; Pailler et al., 2009; Trenholm et al., 2009). One study showed that drug residues are present at very low doses in surface or groundwater (less than 100 ng/L) and in treated water (less than 50 ng/L).

Recent research has focused on the toxicity of these compounds of pharmaceutical interest. Some authors have reported that the accumulation of micropollutants such as pharmaceuticals (pharmaceutical pollution) such as antibiotics and contributes to the emergence of antibiotic-resistant strains of bacteria. Actually, manufacturers emit significant quantities of antibiotics, which frequently end up in wastewater and mix with effluents from agricultural and human activities, forming an environment conducive to the multiplication of resistant bacteria. These bacteria may in turn exchange or share their genetic characteristics with other bacterial strains either by the horizontal transmission or by the vertical transmission (Larsson et al., 2007; Yuo et al., 2014; AMR, 2015; Ågerstrand et al., 2015). Pollution by antibiotic residues in this way is an unexplored cause of antibiotic resistance.Some sex hormones have effects on aquatic organisms at concentrations below 1µg/L. For example, estradiol, the female sex hormone (and a hormonal marker of aquatic pollution), can alter the sexual characteristics of some fish at concentrations of 20 ng/L.As regards to anti-tumour agents, their mutagenic, carcinogenic and teratogenic properties have been demonstrated and they are considered as the most toxic(Skov et al., 1990).

4. Sources or origins of surface water pollution

There are three main sources of surface and groundwater pollution: industry, agriculture and settlements (domestic pollution, pollution from economic activities, etc.) (Nader et al., 2002; Ghrabi et al., 2002; Battle et al., 2007 ; Yé, 2008;).The pollution of water resources can also result from several other activities. We can mention among others: oil extraction, aquaculture, landfill or wild dumps (polluted soils), maritime transport and ports, construction sites, urban discharges in rainy weather or atmospheric fallout, etc. (Hamatoukour et al., 2010; Nakié, 2011; Bauma, 2017).

Conclusion

Pollution of the world's water supplies has impacts on human health, aquatic and terrestrial ecosystems. The socio-economic life and development of nations and the survival of biodiversity depend on these reserves. Thus, the preservation of various water resources is of paramount importance. Nevertheless, the control of pollution of water resources is not always obvious given the diversity of sources of pollution and contaminants.

Given that the major source of pollution of water resources is human activities, the most decisive action to reduce this scourge lies in changing consumption habits. Moreover, integrated waste management, particularly of micropollutants, which gives responsibility to different stakeholders (industrialists, craftsmen, consumers, communities, scientific and political institutions), is one of the ways to ensure good waste management.

Some pollutants, particularly micropollutants, are difficult to detect and yet have significant consequences. It is necessary to develop not only effective detection techniques but also waste treatment methods that take these contaminants into account.

Other measures, such as the establishment of effective environmental remediation programmes in general, combined with binding legislation, especially in the countries of the South, will enable waste to be collected at source and properly stored and treated. It would also be advisable to :

- Promote the creation of wastewater treatment plants, particularly in the southern countries and/or and to set up in this plant a technology likely to take into account various types of waste including micropollutants;
- Reinforce the control of the use of plant protection products,
- Promote upstream studies on the use of chemical inputs for agriculture,
- Promote the development of biological crop protection techniques (use of bio-pesticides, intercropping practices, etc.), or the use of bio-fertilizers,
- Raise farmers' awareness of the dangers associated with certain substances used in plant protection products and encourage them to choose less harmful products,
- To control and reduce industrial discharges or to raise the awareness of industrialists about environmental problems and the impact of their activities on the sanitation system,
- Promote the introduction of pollutaxes (taxes linked to polluting activities). This consists of applying the polluter pays principle and sanctions to certain industries in order to restrict the use of certain pollutants considered to be ecotoxic or that may harm human health,
- Monitor mining activities and control mining effluents by conducting regular analyses,
- Update research on the toxicology of pollutants in general and micropollutants (drugs, etc.) in particular (found in surface water or beverages) on the health of aquatic and human organisms,
- Promote research aimed at developing tools capable of completely eliminating micropollutants in drinking water,
- Encourage research related to water quality monitoring,
- Raising awareness for a good management of hospital waste and pharmaceutical industries,
- Prohibit the discharge of effluents from pharmaceutical industries into water,
- Raise awareness among manufacturers, prescribers, distributors and consumers about the consequences of pollution by pharmaceutical residues,
- Create specific collection channels for harmful products in order to avoid their discharge into the sewerage system (collection of used batteries, paint residues, solvents, etc.),
- Promote the marketing and use of green products or eco-products, i.e. products that are the least harmful possible from an environmental point of view,

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