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PharmacologyJournal homepage: <https://www.ijcap.in/>**Review Article****Traditional plant and herbs used in rural area for prevention of disease caused by water pollution****Pankaj Kashyap¹, Saraswati Prasad Mishra², Shweta Dutta¹, Rajni Yadav³,
Koushlesh Mishra⁴, Anil Kumar Sahu¹, Anil Kumar Sahu^{1,*}**¹Royal College of Pharmacy, Raipur, Chhattisgarh, India²RITTE College of Pharmacy, Raipur, Chhattisgarh, India³Kalinga University Raipur, Raipur, Chhattisgarh, India⁴Raigarh College of Pharmacy, Raigarh, Chhattisgarh, India**ARTICLE INFO***Article history:*

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ABSTRACT

Water being the most vital requirement for the survival of the life in the planet becomes even more vital when its demand increases due to increase in population as well as due to scarcity of consumable water. This chapter explains about water pollution and the causes of it. It also elaborates about type of water pollution and water borne diseases like diarrhea, cancer, hepatitis and many more that affects the world immensely. Furthermore, it explains about different types of herbs and plants that is used by people of rural area to tackle the problem of water pollution and effectively manage the diseases caused by the same. Examples of herb or plant derived substances utilized for water borne diseases include malvaceae and amaranthaceae, to name a few.

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For reprints contact: reprint@ipinnovative.com**1. Introduction**

Existence of life in this planet depends on three boons that nature has bestowed on us. The three boons are air, soil and water. Among these three water is most vital because it is basis of origination of life. As water is one of the most vital entity for survival, its demand has rose to many fold because of the increase in the population around the world. It has become an environmental issue, however there was no serious steps taken towards it till 1972 when at U.N. Conference that was held at Stockholm concepts such as sustainability, environment, and capacity of earth were introduced to common people and after that at world stage policies were made with having environment as a central theme.¹ Although planet earth has 71% water in it but out of this 71% only 2% can be used for consumption

remaining 98% are found in water body like sea. Moreover from the consumable 2%, 1.6% are in the form of ice and glaciers in the poles. In addition to this only 0.36% are underground water therefore only around 0.036% water are accessible and are found as lakes or rivers.² Water follows a cycle path to remain in this planet. It evaporates then precipitates and finally runoff to get to the sea. As demand of water as increased many fold, some of the observers have predicted that by the year 2025 water will be tackling a situation called as water crisis.³ Further according to a report of November 2009, it was suggested that in all the developing nation the water demand will be 50% then its supply by the year 2030.⁴ In addition to the increase water demand other major reason of concern in this context is that the consumable water is getting contaminated by the contaminants and toxins releasing from the industries. Water has some threshold to which it should not get contaminated otherwise it will not be

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fit for human consumption or even for the purpose of irrigation or ecosystem at large.⁵ Nature does not produce contaminated water. Water gets contaminated when due to presence of some harmful substances undesirable changes take place in it. After air pollution, it is the most significant issue that environment is facing. According to WHO “Any kind of changes that occurs in the physical properties, chemical properties or biological properties of water that can cause ill effect on the living organisms is called as water pollution”. Industrialization is one of the major cause of water pollution in developing countries. Agents such as bacteria, protozoa or viruses are the cause of water pollution and even lead to disease born out of water pollution.⁴ When industries discharge their waste into water bodies such as river, ocean, lakes or ground water then the water bodies get contaminated. Water pollution affects all biosphere involving plants and organisms that lives in water. It also damages other plants and animals which are in contact with these contaminated water bodies.⁶ Water pollution affects the current population as well as the generations yet to come as its ill effects stays for a long time. Polluted water can have damaging effects on the organs such as brain, liver, skin and moreover it can be a reason for cancers and few other diseases even conditions like birth defects.² Water borne diseases claims around 50,000 lives globally on daily basis. In developing nations majority of people do not have access to consumable water. In South Africa, a population around 12 million do not have access to potable water to their access.⁷ Polluted water are major causes of diseases such as dysentery, typhoid or diarrhea. Moreover it is a major source of condition like hepatitis in patients with low immunity such as people suffering from HIV/AIDS. (UNICEF 2011). Cholera is one of the major concern in 50 countries and more who report it to WHO. Contaminated water containing elements like arsenic or fluoride is a major cause for damaging tooth and skeletons.²

2. Source of Water Pollution

There are broadly two kind of sources that can be reason for water contamination. The source are direct source and indirect source. In direct source releasing toxins directly into the water bodies are included such as expels of industries that is discharged directly into the water bodies. These contaminated water bodies becomes the major source of diseases in the animals and human who consume water from these kind of water bodies. In some countries swimming or doing any kind of water sports in this types of water bodies is seen as dangerous and can even considered to be fatal.⁸ In case of indirect source the contaminants are not released directly into the water bodies but they reach their indirectly like the fertilizers that reaches to the soil and because of rain it is washed off and reaches the water bodies. Even air pollution that is the major cause of acid rain also causes water pollution as indirect sources.^{8–14} Details about the

various sources of water pollution along with the potential pollutant and their effects are mentioned in Table 1.

3. Effect of Water Pollution on Human Health

There is a strong relationship between increase in pollution and occurrence of health problem. Pollution leads to emergence of pathogens which are responsible for spread of variety of diseases in human being. Mostly the water borne diseases transfers from one person to another directly and called as man to man transmission. In many developing countries and even developed countries excessive rain fall or flood becomes the opportunity for the pathogens to spread disease. Around 10% of total population is fed from the vegetables that had been grown in the contaminated water bodies. The fecal matter of this population also leads to spread of disease through the transmission of infection from fecal oral route. Polluted water leads to disease such as cancer, diarrhea, respiratory as well as neurological diseases. Death rate due to cancer is higher in rural population as compared to rural population as rural population gets contaminated and untreated water for consumption. Low quality of water even affects the productivity of crops as well. Pollutant causes disturbance in food chain and heavy metals such as iron has ill effect on the respiratory system of aquatic animal like fish and which can in turn affect if consumed as food. Water contaminated with metals are the reason for liver cirrhosis, loss of hair and even cause renal failure.^{15–20}

3.1. Bacterial diseases

Diarrhea is caused due to consumption of water which is either contaminated with fecal matter or it is untreated. Around the globe around 4% to 15% cases of diarrhea is caused by *Campylobacter jejuni*. Diarrhea is accompanied by symptoms such as nausea, headache, fever and pain in the abdominal area. Another deadly water borne disease is cholera is caused by *Vibrio Cholerae*. It produces toxins in GIT. The symptoms seen in this disease are nausea, vomiting, watery diarrhea that eventually causes dehydration and renal failure. Shigellosis is also a bacterial disease caused by *Shigella*. In this disease lining of intestine gets damaged leading symptoms such as blood containing diarrhea, cramps in abdomen and nausea with vomiting.¹⁷

3.2. Viral diseases

Many viral diseases are also caused due to consumption of contaminated water. One such disease is hepatitis that affects liver. Symptoms that are seen with hepatitis are lack of appetite, fever, discomfort and condition like jaundice. If it is not treated on time then it can even cause death.

Contaminated water is also act as a breeding area for mosquitoes which in turn causes many diseases.

Table 1: Details of Sources of Water Pollution along with the pollutants

Sources	Components/pollutants and their effects
Domestic waste	<p>Domestic waste has increased as the population has increased. Food waste has also increased due to increase of population and this in turn leads to water pollution.</p> <p>Detergent • ‘Hard’ detergents that produces foam leads to reduction of supply of oxygen to water-borne organisms.</p> <ul style="list-style-type: none"> • Soft detergents are although biodegradable but due to the presence of phosphate it may lead to eutrophication. <p>Untreated sewage includes of human faecal matter as well as the domestic waste along with suspended solids</p> <ul style="list-style-type: none"> • These kind of pollutants leads to reduction in penetration of light <p>Pollution of ground water through drilling activities If the wells are poorly constructed and do not have a proper case and covering then this may also contaminant groundwater contamination</p>
Animal waste	<p>Presence of microorganisms like bacteria and protozoa in drinking water can lead to disease like cholera.</p>
Agricultural run-offs and mill-waste	<p>NO_3^- and PO_4^{3-} which is present in insecticides can also causes eutrophication</p> <p>Herbicide and pesticide residues</p> <ul style="list-style-type: none"> • Pesticides and herbicides imparts deadly effect on organisms that are present in water as well as affects human beings. • Pesticide build up takes place when it climbs the food chain. <p>Using High Yield Variety seed It leads to loss of biodiversity and lowers the water level.</p>
Deforestation	<p>Deforestation In case of deforestation water runoff cannot be stopped and it leads to sedimentation, soil erosion and eventually causes the water to get turbid therefore water quality decreases.</p> <p>Eroded sediments Presence of sediment in water leads to degradation of water quality that can be used for the purpose of drinking, or to be used by wildlife</p> <p>Flooding also contaminates the water bodies as it carries waste material into it during rainy season</p> <p>Soil digging inside river area Mining process if carried out in river area can be a potential cause of water contamination because of discharge or seepage of ores into the water.</p>
Effluents from industries	<p>Heavy metals such as Cu, Hg, Zn and Cr</p> <ul style="list-style-type: none"> • Presence of these heavy metals can cause serious damage to the organism consuming it. As mercury is known to cause disorder in nervous system in human beings.
Radioactive	<p>Radioactive waste is highly damaging and toxic to organism as they affect the organism at cellular level. Moreover they remain as such for centuries affecting many generation all together. Radioactive waste when not treated and disposed properly then they can affect the water quality of surface as well as ground water.</p>
Underground pipes	<p>Lead • It is highly poisonous and get stored in the tissues of organism and it is known to diminish the mental ability of children.</p>
Oil pollution	<p>Spilling of oil can be seriously contaminating water bodies and damaging organisms inhabiting it. Moreover it blocks the light that reaches the plant found under water and affect their process of photosynthesis.</p>
Acid rain pollution	<p>Air pollution that basically causes acid rain eventually leads to water pollution when the acid rain reaches the water body. Presence sulfur and nitrogen dioxides can change the pH of the water body and ultimately affects the organism living in it.</p>

Encephalitis is a disease that transmits through mosquito bite. Eggs of this mosquito are laid in contaminated water only. Symptoms such as headache, convulsion, muscle stiffness, and even coma and paralysis are seen with encephalitis. Another virus borne disease is poliomyelitis where patient suffer from conditions like fever, sore throat, constipation and nausea.²¹

3.3. Parasitic diseases

Cryptosporidium parvum is a parasite that causes a disease called Cryptosporidiosis which has symptoms such as diarrhea, stomach cramps, and watery bowls. Cryptosporidium are not affected even by using disinfectant against them and can damage immune system. Entamoebahistolycacausas galloping amoeba where stomach lining gets affected. Entamoebahistolycais found in both as cyst and non-cyst. Contaminated water generally contains cyst of this parasite and when swallowed causes severe infection. Symptoms associated with this infection are fever, diarrhea and chills. Moreover another infection called Giardiasis is caused by Giardia lamblia where the intestinal walls get affected. Use of disinfectant has no impact on Giardia. It is known as travelers diseases and symptoms such as gas, bloating and weight loss.²²

4. Traditional Plant and Herbs used in Rural Area for Prevention of Water born Diseases

Rural areas always have herbs and traditional plants as their weapons to tackle the disease that are caused due to consumption of polluted water. This section will briefly explain about few traditional plants and herbs that are used for management of disease caused due to water pollution.

4.1. Abutilon indicum (Malvaceae)

Abutilon indicum is a small shrub belonging to the family Malvaceae. It is also known as Indian Abutilon or Indian mallow. It is a shrub native to tropical and subtropical regions and it is cultivated as an ornamental shrub. This plant also have some medicinal properties as well. It is known by different names in different regions like in places such as India, Bangladesh, khangi, atibala it is called as Jhampi. In USA it is called as Abutilon Atibala. In China it is referred to as Dong kuizi, Milancao. It is extensively produced in Asian countries like India, Pakistan, Bangladesh, and Srilanka. Plant exhibits properties such as diuretic, astringent, carminative, antibacterial and anthelmintic. Local population use them in conditions like mumps, diabetes, fever, hernia, and diarrhea and even in infections caused by worms. In traditionally it is used as aphrodisiac, laxative, diuretic, demulcent and sedative. Different parts of shrub shows different properties. Bark shows diuretic and astringent property, seeds are known to impart demulcent and expectorant whereas roots

are used as anti-leprotic. Leaves have antiulcer property and also beneficial in gonorrhoea, headache and infection of bladder. This plant is also included in Siddha system of medicine. Moreover it is also used as an adjunct in treatment of piles. Flower of the plant is known to enhance sperm count. Plant contains following chemical constituent luteolin, apigenin 7-O-beta rhamnopyranosyl, quercetin, chrysoeriol, glucopyronoside. This plant is effective against mosquito larvae Culexquinquefasciatus, Bacillus cereus, Escherichia coli, Aspergillusniger, Shigelladysenteriae, Vibrio mimicus.^{23,24}

4.2. Achyranthesaspera (Amaranthaceae)

Achyranthesaspera is another plant that is found in tropical region of the world. It belongs to the family Amaranthaceae. It is commonly known by different names such as Devil's Horsewhip, Prickly Chaff Flower. It grows annually and structurally it is an erect herb. It is found in India and is used as Odontalgic and in cases of skin disease, Rheumatism and Bronchitis. In Uttar Pradesh, India it has extensive use in patients of obstetrics and gynecology to carry out process like abortion or induction of labour or for cessation of postpartum bleeding. In Kenya it is differently used. It is used to get relief from the symptom of malaria. Achyranthesaspera chemically contains oleanolic acid and Ecdysterone. It act as an abortifacient in small animals like mice and rabbits. When extract of leaves of the plant are made in alcoholic or water base then it becomes antibacterial against Staphylococcus aureus and E.coli. It also shows the ability to reduce level of glucose in blood of alloxan induced diabetic rabbits. Moreover it also contains flavonoids, terpenoids, alkaloids and saponin. Flavonoid are known to slow down the growth of some kind of cancer. It also shows anti-inflammatory activity.^{25–28}

4.3. Acoruscalamus (Araceae)

Acoruscalamus Linn is a medicinal plant also known by the name sweet flag which belongs to the Araceae family. It mainly used in countries like India, China, America and even by people of Thailand in their traditional system of medicine. It is used in perfume industry because of its aroma. In Egyptian culture it is used as aphrodisiac. It is also used as stimulant by Americans. It exhibits neuroprotective efficacy against the neuro-degeneration caused due to stroke and chemical in rats. Moreover it is protective against neurotoxicity induced acrylamide.^{29,30}

4.4. Alangium salvifolium (Alangiaceae)

Alangium salvifolium is from the family Alangiaceae. It is also referred to as Ankolam. It is native to tropical and sub-tropical area. It is found in countries like India, China, Africa and Srilanka. Roots of the plant are effective against indications like diarrhea, vomiting, piles and even paralysis.

They also exhibit properties like purgative and diuretic. It is used in treatment of rheumatism, inflammation and leprosy as well. It can also be used in case of dog or rabbit bites. Flower of *Alangium salvifolium* exhibit antibacterial property. Methanolic extract of root of the plant shows analgesic and anti-inflammatory property.^{31,32}

4.5. *Allium cepa* (Alliaceae)

Allium cepa, commonly called as bulb onion or garden onion. It is known for its beneficial effect in ailments ranging from common cold to heat disease. It has quercetin as a component due to which *Allium cepa* exhibit different kind of properties such as antioxidant, anticancer, anti-inflammatory and anticholesterol. Its consumption leads to reduction in cancer of head and neck. It also has aphrodisiac property as well. In many countries around the world it is even used for healing of boils. In America extract of onion is used to treat scars present in the topical region of the body. In females near menopause it is effective in reducing the risk of osteoporosis as it destroys osteoclast cells. In India onion along with jaggery is consumed to treat sore throat. It has variety of properties such as antibacterial, antifungal, antiviral, hypoglycemic, antithrombotic and antioxidant.^{33,34}

4.6. *Allium sativum* (Liliaceae)

Allium sativum also called as garlic has many therapeutic efficacy. According to in vitro studies of garlic it exhibits a range of effects such as antibacterial, antifungal activity and anti-viral. However in vivo studies shows the results otherwise. Garlic is known to be helpful in management of heart disease such as atherosclerosis, Hypertension and they are also beneficial in cancer as well. *Allium sativum* is also known to be effective against common cold. *Allium sativum* are also effective in treatment of *Cryptosporidium* in patient suffering from AIDS.^{35–37}

4.7. *Bergenia ligulata* (Saxifragaceae)

Bergenia ligulata Wall belonging to family Saxifragaceae, a plant native to south and East Asia. In India, it is known as Paashaanbhedh which is found in Himalayas at high altitude. It is used in Indian medicine system and used to treat stones of kidney and also for treatment of influenza viruses. Chemical constituent of plant are β -sitosterol, β -sitosterol-D- glucoside, bergenin and paashaanolactone. This plant has anti-inflammatory as well as antimicrobial activity.^{38,39}

5. Conclusion

This present chapter elaborated about the effect of pollutants in causing water pollution. Human being plays a major role in degrading the quality of water and making it difficult for human consumption. Water pollution also gives rise to

many water borne diseases which claims many lives around the globe. Water borne diseases are quite prevalent in rural areas due to lack of hygiene but rural population relies on herbal and plant products to cope with various diseases that occurs due to water pollution. Plant and herbs can be potential target in future for dealing with the alarming issue of water pollution and the disease caused by it. Promising herbs that can be effectively used for management of water borne disease include, for example, Malvaceae, Amaranthaceae, Aracea, Alliaceae, Liliaceae, Saxifragaceae. Further research should be carried out to know benefits of herbs in treatment of water borne disease.

6. Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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