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Efficacy of *Pongamia pinnata* and *Moringa oliefera* in Removal of Coliform from Potable Water

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ABSTRACT: Water is one of the most important abiotic components of the ecosystem. In every ecosystem, whether it is natural or artificial, water is indispensable for the survival of organisms. It is also known as a natural or universal solvent. Availability of freshwater is decreasing day by day and the consumption of water around the world has increased. After industrialization, the threat of pollution has increased to an alarming stage and the most affected part of the ecosystem is water as most of the industries discharge their waste material directly into the rivers. The waste material pollutes water which poses threat to living organisms by causing several diseases on them, such as Typhoid and various gastrointestinal diseases. In such a situation it is necessary to develop techniques to purify polluted water economically, especially, in developing countries like India where safe drinking water is a scarce commodity in rural as well as urban areas. In India out of various chemicals and bacterial pollutants, coliform bacteria are a major threat as it causes various types of gastrointestinal disorders. Although various sophisticated technologies are available to remove coliform bacteria but they are very expensive for the common people. The use of chemicals in conventional water treatment such as Aluminum sulfate, Chlorine, Potassium permanganate, ferric sulfate etc., lead to various health concerns when used over an extended period of time. In this paper, a cost-effective herbal technology for water purification with the help of the *Moringa oliefera* and *Pongamia pinnata* seed has been discussed. It is evident from the result that the dried seeds of *Moringa oliefera* and *Pongamia pinnata* can reduce the coliform bacteria by 96.00% and 85.40% respectively depending upon the dose and the period of the treatment. It was found that *Moringa oliefera* seed is most effective than the *Pongamia pinnata* seed in reducing the bacterial population.

Keywords: Abiotic, Indispensable, Gastrointestinal diseases, Coliform, *Moringa oliefera, Pongamia pinnata.*

INTRODUCTION

The importance of water is known for a long ago as it is the backbone of all metabolic processes. On the other hand, the increasing population and demand for freshwater respectively potable water are increasing every day because of so many reasons, rising population and urbanization are most important, and change in land use patterns as severely affected surface water as well as groundwater. Humans need to drink six to eight glasses of water a day in order to provide ample fluids for them to survive the day. The quality of water has also decreased because of the rampant discharge of sewage and other household water. Apart from various chemical pollutants coliform bacteria has also adversely affected the ground as well as surface water. In tropical countries like India, this high coliform bacteria has resulted in various types of gastrointestinal diseases which ultimately increase morbidity and motility of the Indian population. This situation is completely jeopardized our health system directly as well as indirectly, such conditions put a heavy burden on the economy as well as expenditure on medical facilities and reduced human working hour is an additional cause on society.

Various technologies are available to mitigate the population of coliform bacteria but most of them are complicated as well as costly, hence out of reach from the majority of the Indian population. In the present investigation, an attempt was made to find out a cost-effective simple, and eco-friendly technique for curbing bacterial population in potable water. Various herbal agents have been tested for their ability to act as antimicrobial agents. In the present study, two herbal agents *Pongamia pinnata* and *Moringa oliefera* were chosen for their possible use as a water purifier. Potable water, also known as drinking water, comes from surface and ground sources and is treated to levels that meet state and federal standards for consumption.

Water from natural sources is treated for microorganisms (bacteria, viruses, etc), toxic

chemicals, and fecal matter. Drinking raw, untreated water can cause gastrointestinal problems such as diarrhea, vomiting, or fever (Water Education 2016)

The safety and accessibility of drinking water are major concerns throughout the world. Health risks may arise from the consumption of water contaminated with infectious agents, toxic chemicals, and radiological hazards. Improving access to safe drinking water can result in tangible improvements to health, (WHO, 2019).

Coliform bacteria are present in the environment and feces of all warm-blooded animals and humans. Coliform bacteria are unlikely to cause illness. However, their presence in drinking water indicates that disease-causing organisms (pathogens) could be in the water system. Most pathogens that can contaminate water supplies come from the feces of humans or animals. Testing drinking water for all possible pathogens is complex, time-consuming, and expensive. It is easy and inexpensive to test for coliform bacteria. If testing detects coliform bacteria in a water sample, water systems search for the source of contamination and restore safe drinking water (DOH, 2016).

Gastrointestinal diseases are basic health problem in tropical countries like India, although various techniques are available for the purification of water but clean potable water is still not available to nearly 78% of the people of India, especially those who are from rural backgrounds

Medicinal plants have been identified and used throughout human history. Plants make chemical compounds that are used for many biological functions like defense against insects (Insecticides), and fungi (Fungicides), antibiotic potency against microorganisms, and as therapeutic agents for diseases in herbivorous mammals & humans. At least 12,000 such compounds have been isolated so far; a number estimated to be less than 10% of the total (Tapsell, 2016).

Undesirable water turbidity not only causes public health problems but also creates an inadequate budget for water treatment processes because the safe drinking water supply should be free of turbidity (Anthony *et al.,* 2021).

Various conventional methods, such as precipitation, adsorption, flotation, ion exchange, membrane filtration, and biological and electrolytic process, have been utilized to reduce and remove turbidity from water (Rajoria *et al.,* 2022).

Aluminum sulfate is the most widely used coagulant in water treatment because of its proven capability and lower cost. However, it creates byproducts that harm human health (Wu *et al.,* 2012); (Elsayed *et al.,* 2021).

The coagulant of *Moringa oleifera* seed extract (MOSE) is an alternative and is commonly used in less developed communities since it is easily biodegradable (Yamaguchi *et al.,* 2021).

The MOSE is feasible and applicable in separating colloidal particles because the extract components contain soluble cationic proteins, peptides, calcium, iron, vitamin C, and tocopherol that function as a cationic polyelectrolyte (Dzuvor *et al.,* 2022).

MATERIALS AND METHODS

Test material *Moringa oliefera* and *Pongamia pinnata* seeds were obtained from different locations of the Hazaribag district and air dried in the shed for further treatment. Supply water from Hazaribag, near Chhat Talab, was collected and used to observe total coliform, fecal coliform, *E. coli*, and fecal streptococci. Apart from that some normal Physio-chemical parameters like pH, Temperature, Turbidity, COD, and BOD, were also investigated.

Ten replicas of the test were set for every parameter and the final conclusion was made on the basis of their average.

The serial dilution method (MPN) was followed to study the bacterial population whereas the chemical parameters were investigated following the apha method.

RESULTS AND DISCUSSION

At the time of collection of the water, sample pH was 6.78 at 32º C temperature, turbidity was recorded at 5.50, COD was 116.0 and BOD was 53.3.

The control water sample exhibited an MPN count of 542 when treated with dried powder of *Moringa oliefera* seed, reduction was observed 345 in number after 12hrs and 278 after 24hrs.When the treatment period was further increased to 36hrs & 48hrs, reduction in coliform bacteria was recorded 94 and 21 respectively. No significant reduction was observed in the case of fecal coliform after 12hrs whereas after 24hrs it reduced to 13 & after 36hrs value was 4 for fecal coliform and after 48 hrs and the value was reduced to only two. *E. coli* in the control sample was 148 whereas it reduced to 84 after 12 hrs of treatment with *Moringa oliefera* powdered seed, when the treatment period was enhanced to 36hrs & 48 hrs, the fecal coliform bacterial count reduced to 26& 08 respectively. Fecal streptococci in the control sample were 4, when the treatment period was increased to 12 hrs, 24 hrs,36 hrs., and 48 hrs. The fecal streptococci value was found less than 0.5 in this time period.

Same as *Moringa oliefera, Pongamia pinnata* also exhibited the best result in 48 hrs of dried seed powder treatment. Control of total coliform was 542 in MPN count, which reduced to 348 in 12 hrs, 240 in 24 hrs, 172 in 36 hrs, and 79 in 48 hrs of treatment whereas control of fecal coliform was 17 and there is no change in 12 hrs, but after increasing the time period it reduced to 13 in 24 hrs and 36 hrs and best reduction was <2 in 48 hrs. Control of *E. coli* in MPN count was 148, after 12 hrs of treatment it was 130, after 24 hrs and 36 hrs it reduced to 94 and 25 respectively, again 48 hrs shows efficient reduction which is only 10. Control of Fecal streptococci, MPN count was 4 and there is no significant change in 12 hrs and 24 hrs but when time increased to 36 hrs and 48 hrs the no was reduced to less than 2.

Table 1: Efficacy of *Moringa oliefera* seeds in the removal of coliform bacteria from the water sample.

Treatment	Microbiological Parameters							
	Total coliform (1)		Fecal coliform (2)		E.coli (3)		Fecal Streptococci (4)	
Control	MPN count	Reduction in %	MPN count	Reduction in %	MPN count	Reduction in %	MPN count	Reduction in %
	542		17		148		4	
After 12hrs	345	36.34%	17	0%	84	43.24%	<0.5	87.5%
After 24hrs	278	48.7%	13	23.52%	58	64.28%	<0.5	87.5%
After 36hrs	94	82.65%	4	76.47%	26	82.43%	<0.5	87.59%
After 48hrs	21	96.12%	<2	88.23%	8	94.59%	<0.5	87.59%

1,2,3 p<0.01 4- p<0.1

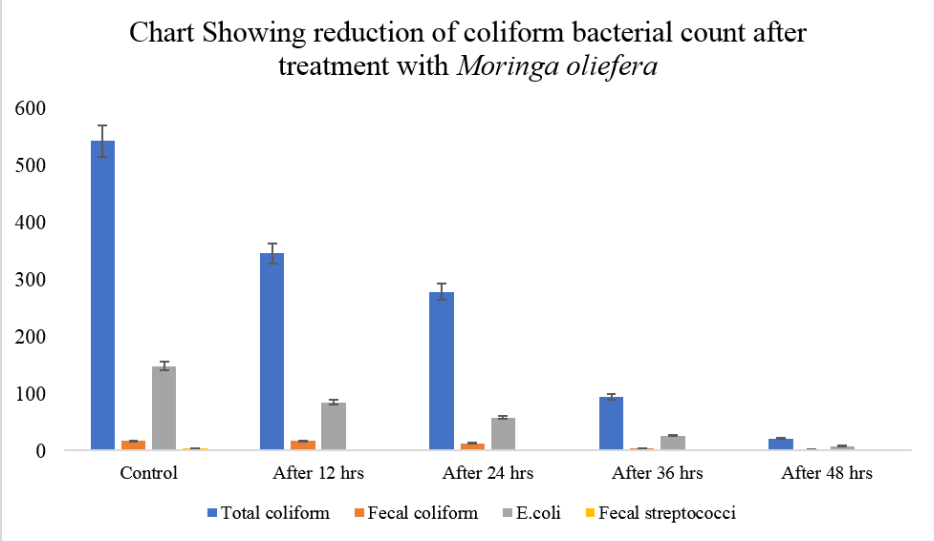

Fig. 1.

Table 2: Efficacy of *Pongamia pinnata* seeds in the removal of coliform bacteria from the water sample.

Treatment	Microbiological Parameters							
	Total coliform (1)		Fecal coliform (2)		E.coli (3)		Fecal Streptococci (4)	
Control	MPN count	Reduction in %	MPN count	Reduction in %	MPN count	Reduction in %	MPN count	Reduction in %
	542		17		148		4	
After 12hrs	348	35.79%	17	0%	130	43.24%	4	0%
After 24hrs	240	55.7%	13	23.52%	94	31.8%	4	0%
After 36hrs	172	68.2%	13	23.52%	25	83.1%	<2	<50%
After 48hrs	79	85.4%	<2	88.2%	10	93.2%	<2	<50%

1,2- p< 0.01 3- p<0.1 4- p<0.5

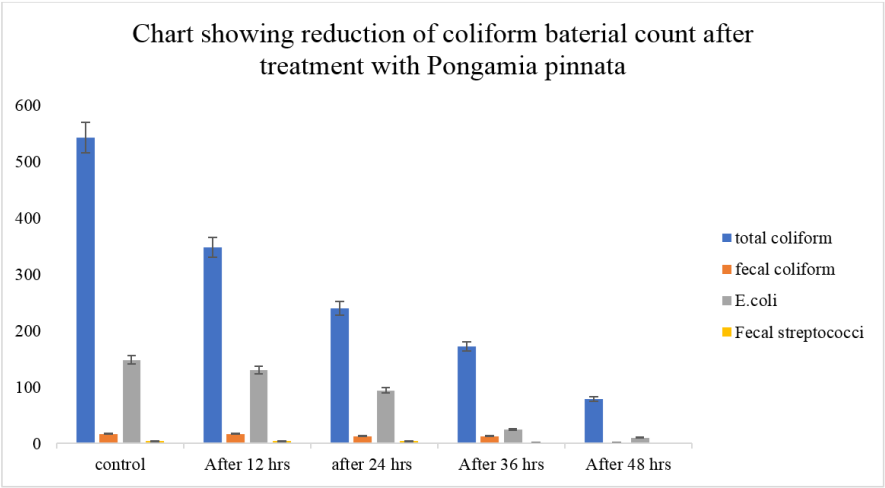

Fig. 2.

Table 1 depicts the impact of *Moringa oliefera* seeds on different microbiological parameters whereas Table 2 shows the efficacy of *Pongamia pinnata* on various microbiological parameters of sample water.

Results obtained during the present study, clearly indicate that treatment with *Moringa oliefera* seeds is helpful in removing total coliform bacteria from polluted water. Time of treatment has got a profound effect on percent reduction. Reduction in the population of coliform bacteria was not very significant after 12 hours and 24 hours. A significant reduction was observed after 36 hrs treatment whereas maximum reduction was observed after 48 hrs. Further, an increase in treatment time period to show any significant change. An almost similar pattern of reduction was observed in the case of fecal coliform bacteria. *E. coli* also exhibited observable reduction after 36 hrs and 48 hrs. So far fecal streptococci is concerned, it showed a highly significant reduction even after 12hrs and the value remained unchanged when the treatment period increased further.

Coming to the efficacy of *Pongamia pinnata*, the most significant reduction in total coliform bacteria was noticed after 48hrs of treatment, but the impact of *Pongamia pinnata* seed was less than observed in case of *Moringa oliefera* seed treatment. Reduction in fecal coliform and *E. coli* was also observed highest after 48hrs. Values obtained after 12hrs, 24hrs, and 36hrs were not significant enough. In the case of fecal coliform, treatment up to 24hrs was totally ineffective. Although after 36hrs and 48hrs fecal streptococci count reduced but, the reduction was less than 50% in both cases.

Various previous results like Satish *et al*. (2014); Battu *et al*. (2018); Meera *et al.* (2003) etc. have previously reported anti-microbial and anti-oxidant properties of *Pongamia pinnata.*

Proper utilization of this herbal agent for getting rid of the bacterial population in potable water is still to be investigated properly and not enough references are available.

So far *Moringa oliefera* is concerned, a large number of literature and earlier works are available and the present investigation further authenticates the possible use of this plant material for purifying potable water.

Adeniran *et al.* (2017); Baptista *et al*. (2017); Barrado-Moreno *et al*. (2016); Bichi (2013); Brilhante *et al.* (2017); Camacho *et al.* (2017); Cao *et al.* (2017); Choy *et al*. (2014); Dasgupta *et al.* (2016); Eilert *et al.* (1981); Eri *et al.* (2018); Galal-Gorchev *et al.* (1998); Ganatra, *et al.* (2012); Garcia-Fayos *et al.* (2016); Garde *et al.* (2017); Ghebremichael *et al*. (2005); Grabow *et al.* (1985); Gregory, and many other workers have also studied various aspects of *Moringa olifera* as a water purifier and water coagulants. They have also approved use of this plant material to remove or at least mitigate the population of coliform bacteria from drinking water.

M. oleifera can be used as an alternative for environmental chemicals (e.g., synthetic aluminum) to reduce the turbidity of the water and ensure the human health. This leads to the increased efficiency in clarifying low turbidity water for domestic water supply purposes in the rural areas of difficulties, especially the rural areas in the emergency of flooding suffering (Nhut and Hung 2020).

CONCLUSION

Keeping the results obtained during the study and some other available references, it is clear that herbal agents can be used for cleaning water and avoiding the ill effect of bacterial contamination. This technique is cost-effective, simple, and within reach of common people.

Conflict of Interest. None.

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