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Research Article

COMPARATIVE ANALYSIS OF WATER QUALITY IN DIFFERENT LOCATIONS OF CANOLY CANAL AND THE EFFECT OF *MORINGA OLIFERA* SEEDS ON WATER QUALITY TREATMENT

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A B S T R A C T

We are all well aware of the importance of safe drinking water. But nowadays so many people in both rural and urban areas suffer lot due to the lack of safe drinking water. The major reason for this found to be the uncontrolled disposal of wastes and garbage's to the water sources. The present study mainly aims to determine the water quality parameters of different regions of Canoly canal, which was the most discussing and serious environmental issue nowadays. For the present study, we have collected water samples from 3 locations of Canoly canal near Chavakkad area. Even though there are many studies have been carried out regarding the water quality of various sources, comparative analysis of water quality in different locations of Canoly canal and the effect of *Moringa olifera* seeds on water quality treatment is a new attempt. From the present study, we could analyze that pollution was maximum at Chavakkad city region as compared to the other 2 locations and *Moringa olifera* seeds have an important coagulating and water purifying capacity, which reduced the turbidity, colour, electrical conductivity of water samples and help to maintain fairly good pH. So application of low coast *Moringa olifera* seeds could be a better alternative for eco-friendly, non toxic and simple water purification rather than that of much more costly chemical substance like ferrous sulphate, aluminium sulphate, alum etc.

INTRODUCTION

Water is an important resource for life. Entire living organisms on earth need water for life. However, water can be problematic if it is not available in the right conditions. It is used by human for various purposes; therefore the cleanliness of water consumed is very important since water is known to affect the health. Today, the quality of water becomes a major problem that needs serious attention. Good quality water has become an expensive item, because many water sources has been polluted by waste coming from the various human activities. This leads to declining quantity of water sources that could not meet the ever growing need. In the provision of clean drinking water, besides the quantity and continuity, the quality must meet the applied standards. The ideal water should have some characteristics such as clear, colorless, tasteless, odorless, phatogen-free, harmful chemical-free and non-corrosive. Water is also expected not to leave sediment in all distribution organs. This standard was set to prevent the occurrence and the spread of waterborne diseases. To achieve this standard, there is one common technique applied in water treatment process, which is coagulation-flocculation.

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Coagulation is the process of coagulating colloidal particles due to the addition of synthetic materials to neutralize charged particles thus forming a precipitate due to the force of gravity. Coagulant can be synthetic materials such as ferrous sulfate (Fe(SO4)), aluminum sulfate or alum (Al2(SO4)3), and Poly Aluminum Chloride (PAC) (Al2(OH)3Cl3)10.

River water is almost the exclusive drinking water source for many tropical developing countries and treatment processes heavily depend on chemical water treatment agents, which, however, must be imported using scarce convertible foreign currency (Schultz & Okun, 1983). Many water treatment plants therefore resort to under dosing of chemicals so as to meet the increasing water demand of a fast growing population. The result is the supply of low quality water, especially during the rainy season when rivers carry highly turbid water, (Muyibi & Alfugara, 2003). Beside the economic drawback, chemical water treatment agents such as metal salts, synthetic polymers and chlorine formulations are also considered to have a negative impact on the human health and the environment after long-term exposure.

The Canoly canal, which was constructed during the British rule for inland water transport is facing issues such as weed infestation, discharge of untreated effluent from the City and suburban areas, dumping of hospital waste, siltation and unprotected embankment. Besides, discharge of effluents from nearby workshops and garages and untreated waste from septic tanks add to the problem.

Coagulation is one of the most common ways to reduce the pollutant contents in the water body that are present as turbidity, color and organic matters. Coagulation is also used to reduce the metal ion content in water. Separation of these colloids can be done by the addition of synthetic coagulant or biocoagulant followed by slow agitation (flocculation) that causes coagulation of colloidal particles so they can be separated by sedimentation (Tebbut, 1982). The common methods of water purification using synthetic materials such as aluminum sulfate (alum) and calcium hypochlorite are not efficient, because these materials are imported and thus make the water cost becomes relatively expensive in most economically developed countries and is not affordable for most rural population. Therefore, some people try to get the water source from dams, mining, small streams, rivers and lakes. Water from these sources is usually turbid and contaminated with microorganisms that may cause various diseases. Several findings from previous research in Postnote (2002) demonstrated the use of synthetic materials for water purification can be severely hazardous to health if something goes wrong in their treatment during processing (Postnote, 2002). The report considered the high level of aluminum in the brain is a risk factor causing Alzheimer's disease. Other studies have raised doubt about the feasibility of inserting aluminum into the environment by the use of aluminum sulfate as a coagulant continuously in the water treatment process. Besides synthetic chemicals, there are natural ingredients that can be derived from tropical plants which can be used as coagulants, including moringa seeds (*Moringa oleifera*). The use of natural ingredients from local indigenous plants to clear muddy water is not a new idea (Sutherland *et al.,* 1994).

Moringa oleifera Lam. (syn. *M. ptreygosperma* Gaertn.) is one of the best known and most widely distributed and naturalized species of a monogeneric family *Moringaceae* (Ramachandran *et al.*, 1980). The tree ranges in height from 5 to 10 m (Morton, 1991). It is found wild and cultivated throughout the plains, especially in hedges and in house yards, thrives best under the tropical insular climate, and is plentiful near the sandy beds of rivers and streams (Qaiser, 1973). It can grow well in the humid tropics or hot dry lands, can survive destitute soils and is little affected by drought (Morton, 1991).

Moringa oleifera, native of the western and sub- Himalayan tracts, India, Pakistan, Asia Minor, Africa and Arabia (Mughal *et al.*, 1999) is now distributed in the Philippines, Cambodia, Central America, North and South America and the Caribbean Islands (Morton, 1991). In some parts of the world *M. oleifera* is referred to as the 'drumstick tree' or the 'horse radish tree', whereas in others it is known as the kelor tree (Anwar and Bhanger, 2003). While in the Nile valley, the name of the tree is 'Shagara al Rauwaq', which means 'tree for purifying'. In Pakistan, *M. oleifera* is locally known as 'Sohanjna' and is grown and cultivated all over the country (Qaiser, 1973; Anwar *et al.*, 2005). *M. oleifera* is an important food commodity which has had enormous attention as the 'natural nutrition of the tropics'. The leaves, fruit, flowers and immature pods of this tree are used as a highly nutritive vegetable in many countries, particularly in India, Pakistan, Philippines, Hawaii and many parts of Africa (D'souza and Kulkarni, 1993; Anwar and Bhanger, 2003; Anwar *et al.*, 2005).

MATERIALS AND METHODS

Sample collection

Water samples were collected from 3 locations of Canoli canal near Chavakkad area. First sample was from the exact city of Chavakkad. The second and third samples were collected from Blangad and Kottappuram respectively which were located 2KM away from the Chavakkad city. The study was carried out in December 2017 at Sree Krishna College, Guruvayur.

DO estimation

Procedure

A reagent bottle of 250 ml is filled with water samples of different locations. Care must be taken that no air bubble is trapped. The bottle is then stopped air tight. Allow the excess water to flow out. Now remove the stopper and add 1ml of MnSO4 solution using it, pipette well below the surface of water. In the same manner, add 1ml of alkaline iodide using another pipette. The bottle is stopped. The sample is shaken well. Allow the precipitate to settle down. Now 1ml of Con. H_2SO_4 permitting it to flow through the side of neck. The bottle is again stopped and shaken well. Keep it for 30 minutes. It is kept away from sunlight at reasonably at lower temperature.

Titration

50ml of fixed sample is transferred to conical flask and titrated against 0.01N sodium thiosulphate ($Na_2S_2O_3$) taken in the burette. Observe the initial reading and add $Na_2S_2O_3$ drops till the sample becomes yellow or straw coloured. Then add a few drops of starch indicator until the sample become blue. Continue the titration. Careful until the blue colour disappear. This is the end point. Note the value and repeat until get a concordant value.

Weight of O_2 present in 1L of different water samples were calculated from the observations made using the formula;

$$\frac{V1N1}{V2} \times eq.wt\ of\ O2\ \times 1000$$

Physical quality analysis

The study also indented to investigate the efficiency of *Moringa oleifera* seed powder as a coagulant for the purification of polluted water samples. For this, sufficient quantity of dried Moringa seeds were collected and made in to fine powder. 0.5g of Moringa seed powder were treated with 1L of water samples (control as well as treated) collected from the 3 localities in order to estimate the physical parameters such as turbidity, colour, odour, pH, electrical conductivity, total dissolved solids etc. Altogether 6 water samples including 3 control samples and 3 treatment samples were analyzed using standard protocols.

RESULTS

Dissolved Oxygen Content

The result obtained from the present study shows that Dissolved Oxygen content of the 3 study area was different from each other, even though the water samples were collected from different localities of "Canoly canal". Different study area selected for our study include Chavakkad city, Blangad and Kottappuram. Analysis of DO content from 3 localities was represented in Table 1.

Table 1 Dissolved Oxygen Content in different study area (mg/L)

Study Area	Dissolved Oxygen (mg/L)
Chavakkad city	5.20
Blangad	6.88
Kottappuram	7.68

The study reveals that dissolved oxygen content was least in Chavakkad city area. This may be due to issues such as weed infestation, discharge of untreated effluent from the City and suburban areas, dumping of hospital waste, siltation and unprotected embankment. Besides, discharge of effluents from nearby workshops and garages and untreated waste from septic tanks add to the problem. Because of this less DO, this water was not in use for none of the purpose of nearby peoples. DO content was 6.88mg/L for the water sample collected from Blangad, which was greater than Chavakkad city region. In Blangad, the major reason of pollution was the dumping of waste materials towards the canal, because of this problem, nearby peoples couldn't use it for the domestic activities like washing, bathing etc.

As compared to the water samples of Chavakkad city and Blangad, the third locality (Kottappuram) showed much better DO content and which was 7.68mg/L. The water collected from this location was found to be much clear than other two locations. This water was the major source for domestic activities in the nearby peoples.

Physical quality analysis

Physical water quality analysis was carried for the water samples collected from three localities (C1, C2 and C3 respectively)and also for the *Moringa olifera* seed treated water samples from these 3 areas (T1, T2 and T3 respectively). The result obtained by water quality analysis was represented in table 2-7.

Table 2 Physical water quality analysis of Chavakkad city (C1-control of the 1st sample)

SI No.	Characteristics	Unit	Method	Desirable limits	Permissible limit	Actual Contents
1	Turbidity	NTU	IS 3.25/2488	5	10	10
2	Colour	Hazen	IS 3.25/2488	5	-	5
3	Odour		IS 3.25/2488	-	-	Not Agreeable
4	P^H Value		IS 3.25/2488	6.50 –8.50	6.50 – 8.50	5.6
5	Electrical Conductivity	µs/cm		800	-	51240
6	Total Dissolved Solids	mg/L	IS 3.25/2488	500	2000	26520

Table 3 Physical water quality analysis of Chavakkad city after moringa seed treatment (T1-treatment of the 1st sample)

SI No.	Characteristics	Unit	Method	Desirable limits	Permissible limit	Actual Contents
1	Turbidity	NTU	IS 3.25/2488	5	10	4.8
2	Colour	Hazen	IS 3.25/2488	5	-	3
3	Odour		IS 3.25/2488	-	-	Not Agreeable
4	P^H Value		IS 3.25/2488	6.50 –8.50	6.50 – 8.50	6.34
5	Electrical Conductivity	µs/cm		800	-	32700
6	Total Dissolved Solids	mg/L	IS 3.25/2488	500	2000	22835

Table 4 Physical water quality analysis of Blangad (C2-control of the 2nd sample)

SI No.	Characteristics	Unit	Method	Desirable limits	Permissible limit	Actual Contents
1	Turbidity	NTU	IS 3.25/2488	5	10	9.3
2	Colour	Hazen	IS 3.25/2488	5	-	5
3	Odour		IS 3.25/2488	-	-	Not Agreeable
4	P^H Value		IS 3.25/2488	6.50 –8.50	6.50 – 8.50	8.45
5	Electrical Conductivity	µs/cm		800	-	49920
6	Total Dissolved Solids	mg/L	IS 3.25/2488	500	2000	24490

Table 5 Physical water quality analysis of Blangad after moringa seed treatment (T2-treatment of the 2nd sample)

SI No.	Characteristics	Unit	Method	Desirable limits	Permissible limit	Actual Contents
1	Turbidity	NTU	IS 3.25/2488	5	10	4.5
2	Colour	Hazen	IS 3.25/2488	5	-	3
3	Odour		IS 3.25/2488	-	-	Not Agreeable
4	P^H Value		IS 3.25/2488	6.50 –8.50	6.50 – 8.50	6.30
5	Electrical Conductivity	µs/cm		800	-	45250
6	Total Dissolved Solids	mg/litre	IS 3.25/2488	500	2000	22740

Table 6 Physical water quality analysis of Kottappuram (C3-control of the 3rd sample)

SI No.	Characteristics	Unit	Method	Desirable limits	Permissible limit	Actual Contents
1	Turbidity	NTU	IS 3.25/2488	5	10	5
2	Colour	Hazen	IS 3.25/2488	5	-	4
3	Odour		IS 3.25/2488	-	-	Not Agreeable
4	P^H Value		IS 3.25/2488	6.50 –8.50	6.50 – 8.50	8.43
5	Electrical Conductivity	µs/cm		800	-	47400
6	Total Dissolved Solids	mg/L	IS 3.25/2488	500	2000	25362

Table 7 Physical water quality analysis of Kottappuram after moringa seed treatment (T3- treatment of the 3rd sample)

SI No.	Characteristics	Unit	Method	Desirable limits	Permissible limit	Actual Contents
1	Turbidity	NTU	IS 3.25/2488	5	10	1.8
2	Colour	Hazen	IS 3.25/2488	5	-	2
3	Odour		IS 3.25/2488	-	-	Not Agreeable
4	P^H Value		IS 3.25/2488	6.50 –8.50	6.50 – 8.50	6.34
5	Electrical Conductivity	µs/cm		800	-	38150
6	Total Dissolved Solids	mg/litre	IS 3.25/2488	500	2000	23420

Comparative analysis of turbidity in the control as well as treatments showed very drastic change. It was found that turbidity of moringa seed treated samples had less turbidity as compared to the control samples (Fig.1).

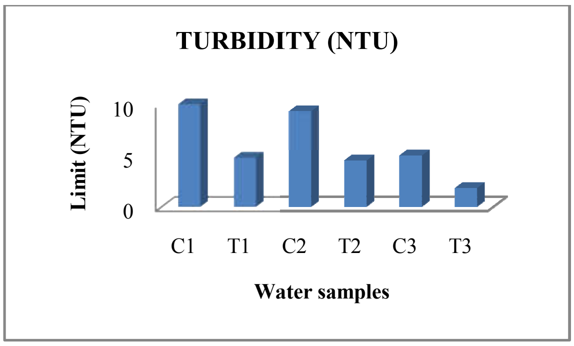

Fig 1 Comparative analysis of Turbidity (NTU) of control as well as treatment samples

This can be concluded that moringa seed powder has very strong activity to reduce the turbidity. Similar studies conducted by many researchers also suggest that moringa seed powder has the ability to reduce turbidity in waste water.

As considered to the colour of the water, it also showed remarkable difference among the control and treatments (Fig. 2). Colour of control samples was found to be greater than that of the treatment. This also suggests that natural coagulant like moringa seed has a potential effect to reduce the colour of waste water.

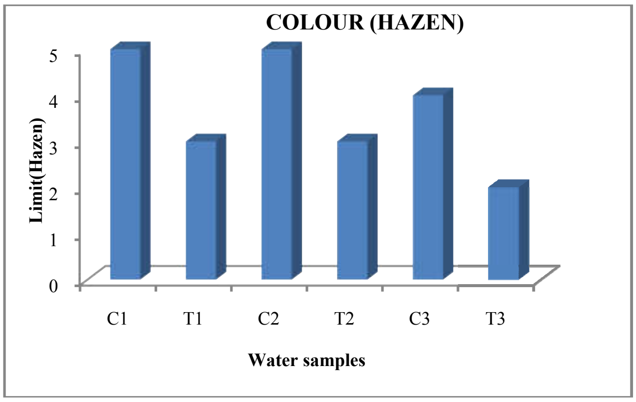

Fig 2 Comparative analysis of Colour (Hazen) of control as well as treatment samples

The study also reveals that there was no considerable variation for odour of the water samples even after treatment. So it can be assumed that moringa seed powder has no significant effect on the colour of water samples.

Comparative analysis of P^H showed a remarkable variation (Fig. 3). pH of the control samples were found to be very less which indicates the acidity of the water samples. Among the 3 different control samples, water from Chavakkad city showed high acidity. This reveals the fact that pollution rate was maximum at Chavakkad city. Dumping of hospital wastes, industrial effluents, wastes from workshops were found to be the major cause of pollution in that area. However, the study shows that moringa seed treatment have an important effect to increase the pH towards the neutral point.

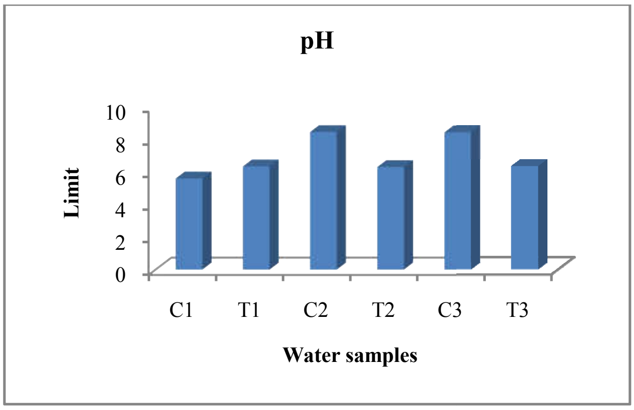

Fig 3 Comparative analysis of pH of control as well as treatment samples

Similarly electrical conductance (Fig. 4) among the different samples also showed considerable variation after treatment. Among the control samples, electrical conductance was maximum for water sample collected from Chavakkad city. This also indicates the maximum pollution at that area.

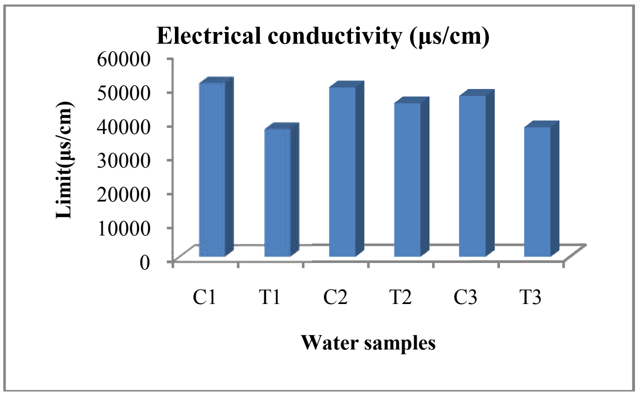

Fig 4 Comparative analysis of Electrical conductivity (µs/cm) of control as well as treatment samples

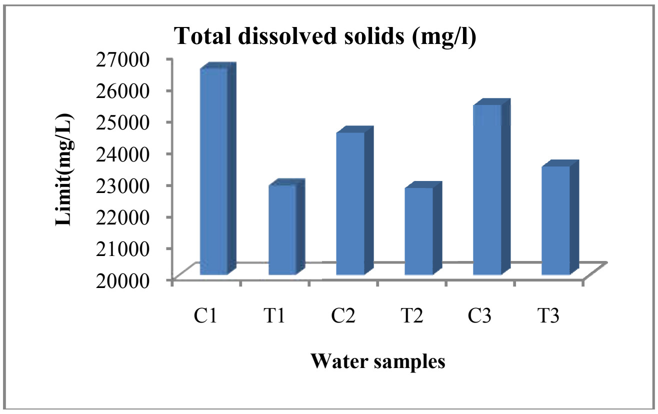

Fig 5 Comparative analysis of Total dissolved solid (mg/L) of control as well as treatment samples

The study also reveals that total dissolved solid content (Fig.5) was maximum for Chavakkad city, which was followed by Kottappuram and Blangad respectively. It was also surprising that moringa seed treatment reduced the total dissolved solid contents in to a considerable amount.

DISCUSSION

Water quality is a major problem, as evidenced by frequent outbreaks of waterborne diseases in both rural and urban areas. It is also reported that millions of people are at risk of cholera in Ethiopia, where acute watery diarrhea has broken out in crowded and unsanitary conditions of urban and rural areas (WHO, 2011). Conventional chemical water treatment systems which involve a series of steps are not feasible in rural areas, where a dispersed population is found. Moreover, it is extremely costly for investment in developing countries. Hence, improving drinking water quality at a household level is believed to be effective in fighting waterborne diseases (Megersa *et al.*, 2016). Although piped water is an important long-term solution in providing safe water, it is very expensive and challenging to implement in rural areas of developing countries. Hence, improving quality of drinking water at a household level is believed to be effective in fighting infectious diseases (Clasen *et al.*, 2006., Hutton *et al.*, 2007). Seed of *M.oleifera* is one of a widely studied natural coagulant and reported to be the most effective water treatment agent in treating turbidity levels of surface water and groundwater (Ndabigengesere *et al.*, 1995, Ndabigengesere and Narasiah, 1998, Ghebremichael *et al.*, 2005, Katayon *et al.*, 2006, Pritchard *et al.*, 2009 and Pritchard *et al.*, 2010). Studies also indicated that *M. oleifera* can remove bacterial load in the range of 80- 99 % (Pritchard *et al.,* 2009). Apart from the extensively studied *M. oleifera*, various other plant materials were reported to have the capability of coagulation and disinfection (Yongabi, 2010, Choy *et al*., 2014, Choy *et al*., 2015and Megersa *et al*., 2014).

The use of natural ingredients from local indigenous plants to clear muddy water is not a new idea (Sutherland *et al*., 1994). From existing reports, there were allegations that the powder of Moringa seeds has antimicrobial properties. Previous research found that Moringa is not toxic (Grabow *et al*., 1985) and recommended for use as a coagulant in developing countries. Various studies have been conducted and showed that moringa seeds are effective as biocoagulant to improve physico-chemical properties of contaminated water. *M. oleifera* functions as coagulant trough adsorption and neutralization mechanisms (Bhatia *et al*., 2007). *M. oleifera* is potential as organic pollutant absorber in simulation solution and is reported able to eliminate the turbidity and dissolved organic matters of river water (Akhtar *et al*., 2007 and Sanchez-martin *et al*., 2010).

CONCLUSION

Canoly canal was highly polluted by various human activities like domestic waste sewage and other Industrial effluents from nearby areas. Sewages from Guruvayur Corporation were dumped into the Canoly canal through the sewage pipe lines which was the major reason of high pollution in the Chavakkad city region. When going downstream to Blangad and upstream to the Kottapuram, there was a clear indication of the reduction in the rate of pollution. From our study areas, least pollution rate and highest water quality could be detected from Kottappuram as compared to Blangad and Chavakkad city. This may be due to the high tidal forces, which goes downstream flow of water to the chettuva backwaters region. The present study strongly suggests that natural coagulant like *M. olifera* seeds had an effective role in reducing the pollution rate. So application of low coast *Moringa olifera* seeds could be a better alternative for eco-friendly, non toxic and simple water purification rather than that of much more costly chemical substance like ferrous sulphate, aluminium sulphate, alum etc.

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