Study on the Pollutants Removal Property of Watercress from Tube Well Water in Lae-BuuVillage, Taungoo Township

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Abstract

This paper deals with the investigation on the pollutants removal property of watercress from tube well water in Lae-BuuVillage, Taungoo Township by using *Ipomoea aquatica*F. (Watercress). The research was conducted at Taungoo University Campus during November to February, 2015 to investigate the removal of contaminants from tube well water by natural adsorbent, watercress roots. Treatment of tube well water was done with the utilization of watercress by observing 3 day intervals within a time frame of 3 to 9 days period. The physicochemical parameters such as pH, colour, turbidity, total hardness, total solids, chloride, iron, arsenic, BOD, COD, DO and microbiological parameter as *E.coli* of original tube well water and treated water different retention times were comparatively analysed by conventional and modern techniques. The results showed that the watercress appeared to be the best purification for polluted water after 6 days observation. In addition, watercress, semi aquatic plant is one of the effective and environmentally low cost material for treatment of tube well water.

Keywords : Watercress (*Ipomoea aquatica*F.), tube well water, physicochemical and microbiological parameters, low cost

Introduction

Water has always been an important and life-sustaining drink to human and is essential to the survival of most other organisms. Water is one of the most common and most important substances on the earth's surface. It is essential for the existence of life. Over large parts of the world, human have inadequate access to potable water and use sources contaminated with disease vectors, pathogens or unacceptable levels of toxins or suspended solids. Water purification is the process of removing undesirable chemicals, biological contaminants, suspended solids and gases from contaminated water. Water fit for human consumption is called drinking water or potable water. Water that is not potable may be made potable by filtration or distillation or by a range of other methods. Among the various methods, watercress can be used to aid the process of water purification either for drinking water or for liquid effluent from sewage systems. The present study deals with the removal of pollutants from tube well water in Lae-BuuVillage by watercress.

Materials and Methods

The chemical suppliers were from the "British Drug House (BDH) Chemicals Ltd., Poole, England" and "Kanto Chemical Co., Ltd., Japan", respectively. Various conventional and modern techniques as well as modern instruments were used throughout the experimental procedures. The following instruments were used in the experimental works: Balance Sartorius, ELB 300, China; Hot Air Oven, D 50 – 300D, max 300 °C, 200 -240 V, Capacity 30L, 700 Watt, Taiwan; pH Meter, pH 300, Singapore; Muffle Furnace, L- 3333 Australia; Spectrophotometer, Ciba- Corning 259; Atomic Absorption Spectrophotometer, Perkin Elmer Analyst- 300 AAS Germany; Turbidity Meter, Hunna Instrument for Turbidity and Arsenic Determination Kit, Palintest P 2000047, UK..

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In the experimental work, the watercress was collected from a pond in Lae-Buu Village, Taungoo Township, Bago Region (Figure 1). The collected watercress samples were washed with distilled water to remove soil and dust. Water sample was also collected from tube well water from Lae-Buu Village, Taungoo Township (Figure 2). The experimental work took place from November, 2014 to January, 2015. The ten plants of the collected watercress were placed in a plastic bowl filled with 5 L of tube well water from Lae-Buu Village (Figure 3). The experiments were conducted at contact times of 3, 6 and 9 days. After the removal of watercress from the plastic bowl containing tube well water, physicochemical properties, heavy metals and *E. coli* of tube well water were determined. The same experiment was also conducted at contact time of 6 days by using the twenty plants of watercress. And then physicochemical properties of tube well water and tube well water treated with watercress were determined.

Figure 1. Watercress fromLae-Buu Village inTaungoo Township

Figure 2. Tube well water from Lae-Buu Village in Taungoo Township

Figure 3. Tube well water with watercress treatment method

pH of tube well water and tube well water treatedwith watercress were measured by the recommended standard procedure in pH meter catalogue. Turbidity was measured by using a turbidity meter (Hanna instrument for turbidity). The contents of total hardness, chloride, chemical oxygen demand (COD), biological oxygen demand (BOD) and dissolved oxygen (DO) were determined by using titration method. The content of total solid was determined by oven method. Iron content was measured by atomic absorption spectrophotometer (Perkin Elmer Analyst – 300 AAS, Germany). Arsenic content was determined by arsenic determination kit. All the experiments were carried out in the department laboratory.

Results and Discussion

The present investigation deals withthe utilization of watercress samples as a natural adsorbent for the removal ofcontaminants from the tube well water. The results of the study on the water purification were presented as follows. The collected watercress plant samples were identified in the Department of Botany, Taungoo University.

Species of studied aquatic plant

- Botanical name - *Ipomoea aquatica*Forsk.
- Myanmar name - Kan-zun
- English name -Watercress
- Kingdom - Plantae
- Family - Convolvulaceae
- Genus - *Ipomoea*

The empirical data pointed out that tube well water in Lae-BuuVillage was turbid and alkaline (pH ~ 7.8). According to Table 1, the values of colour, turbidity, total hardness, total solids, chloride, iron and arsenic were 30 TCU, 32 NTU, 46 mgL^{-1}, 210 mgL^{-1}, 12 mgL^{-1}, 0.92 mgL^{-1} and 0μgL^{-1}. From these data, colour, turbidity and iron contents were higher than WHO drinking water guideline (WHO, 2004). This fact suggested the impurities such as clay, silt, organic material dissolved or suspended in water may give water colored appearances. Moreover, the presence of the higher content of iron in water is objectionable owing to the production of discoloration, turbidity, deposit, taste and it also stains on clothing and plumbing fixtures.The ferruginous water has an astringent and bitter taste.

The resultant data of COD, BOD and DO were described in Table 3. From the experimental data, it was observed that the value of COD and BOD were higher than WHO standard. This fact, if there is a large quantity of organic waste in the water supply, there will also be a lot of bacteria present working to decompose this waste. So, the demand for oxygen will be high (due to all the bacteria) so that BOD level will be high. In addition, the chemical oxygen demand (COD) test is commonly used to indirectly measure the amount of organic compounds in water. The higher amount of COD indicated that the larger amount of organic pollutants in the water.

Fecal contamination of water was routinely detected by microbiological analysis. Table 4 showed that the measured value of *E.coli* was positive and unsatisfactory water *E.coli* being found in drinking water, which are not themselves harmful, but indicate the water is contaminated. It might be caused by entry of soil or organic matter into the water or by conditions suitable for the growth of other types of coliform. So, this tube well water that is not fit for drinking. Treatment process also leads to the removal of pollutants from water.

The measured physicochemical values of tube well water before and after watercress treatment were shown in Table 1.

Table 1 shows the changes of pH in the tube well water before and after watercress treatment were found to be 7.8, 7.4, 7.2 and 7.2 respectively. The empirical data pointed out that these values showed in necessary with the acceptable range for WHO standard values. The comparative results were significant that it decreases in pH values by the absorption of watercress roots after 6 days compared to original tube well

water and other watercress treatment water. According to Table 1, the measured values of colour and turbidity were 30 TCU, 20TCU, 10 TCU, 35 TCU and 32 NTU, 30 NTU, 22

NTU, 28 NTU in tube well water before and after using 10 plants of watercress samples treatment. After 6 days treatment, the colour value was in accordance with the acceptable range for drinking water (WHO, 2004). The turbidity value decreased in tube well water after 6 days when compared to original and other watercress treatment water. In a drinking water treatment, watercress has been incorporated into water clarifiers and help with the removal of small flocs that remain after initial coagulation and flocs removal. The result was a significant decrease in colour and turbidity due to the removal of flocs and also slight reduction in organic matter in the water by watercress treatment. Watercress leaves started drying up after 9 days in the bowl and the values of colour and turbidity increased in the water onwards 9 days.

From Table 1, the values of total hardness and total dissolved solids of tube well water before and after watercress treatment fell in the WHO standard values (WHO, 2004). The comparative results indicated that the decrease in these values after 6 days when compared to original tube well water and other watercress treatment water. Table 1 showed that the contents of chloride and arsenic except iron in tube well water before and after watercress treatment were in accordance with the acceptable range for WHO drinking water guideline (WHO, 2004). The necessary intake of arsenic content for human may be as low as 0.01 mg per day. The empirical data pointed out that the iron content of tube well water before and after watercress treatment was higher than WHO standard values. After 3 and 6 days of observation, the results were a significant decrease in chloride, iron and arsenic contents due to the absorption of watercress. In view of this, watercress has purifying effect that can stretch 10 or more inches. Each of these individual roots has thousands of root hairs which increase the root surface area. Root epidermis consists of single layered compactly arranged rectangular cells which facilitate steady absorption of nutrients, heavy metals, organic compounds and pathogens from tube well water.

In fact, the watercress is valuable as a filter in purifying water. But watercress samples leave started drying up after 9 days in the bowl and they all turn yellowish brown. Yellowing watercress is a common problem and it is caused by lack of nutrients. The indicated that the physicochemical values increased in the water onwards 9 days. The findings indicate that the water treated with watercress for 6 days was used to be a good choice for domestic water from Lae-Buu Village.

The comparison of physicochemical parameters was shown in Table 2. In spite of the decrease in pH, colour, total hardness, total solids, chloride and arsenic in tube well water by using ten plants of watercress treatment after 6 days, these are a slightly increase in turbidity and iron in tube well water when compared to WHO standard values. The same experiment was also conducted by using twenty plants of watercress at contact time of 6 days. After 6 days, the effect of twenty plants watercress treatment process was evident by sharp drops in these values except iron content. It is because each of the individual roots has thousands of root hairs which increase the root surface area. The sorption properties increase as the watercress roots increase. In view of this, water treated with twenty plants of watercress was chosen to be an optimal treatment for domestic water in Lae-buuVillage.

The measured values of COD, BOD and DO in tube well water before and after twenty plants watercress treatment were described in Table 3. From the resulting data, a significant decrease in COD, BOD and a slightly increase in DO contents in tube well water after 6 days observation. Decreasing of COD and BOD may be due to the presence of less quantity of organic waste in the water. The demand for oxygen will be low due to all the bacteria. The most pronounced anatomical feature of this plant is the presence of gas filled chambers and passages in roots, leaves and rhizome. Air chambers are large, usually regular intercellular spaces extending through leaf and long distances through stem. In these spaces, oxygen emitted during photosynthesis which increases dissolved oxygen in the water.

Table 4 showed that the measured values of *E.coli* in tube well water were positive and unsatisfactory for drinking water.The tube well water should not have *E.coli* but the presence of *E.coli* was observed due to environmental effect and water container. After 6 days treatment with twenty plants watercress, a sharp drop of *E.coli* value was found to be observed in tube well water.

After 9 days observation, the influence is expected to be negative due to an internal increase of color, turbidity, solids, nutrients and metals due to plant decay.

Table 1. Comparison of Physicochemical Parameters of Tube Well Water before and after Treatment Using Watercress

Parameter	Tube Well Water	After 3 days	After 6 days	After 9 days	WHO Drinking Water Guideline*
pH	7.8	7.4	7.2	7.2	6.5-8.5
Colour (True), TCU	30	20	10	35	15
Turbidity, NTU	32	30	22	28	5
Total Hardness, mg L^{-1}as $CaCO_3$	46	76	58	78	500 as $CaCO_3$
Total solids, mgL^{-1}	210	182	124	250	1000
Chloride (as Cl^-), mg L^{-1}	12	8	6	20	250
Iron, mg L^{-1}	0.92	0.72	0.65	1.12	0.3
Arsenic, μgL^{-1}	Nil	Nil	Nil	Nil	10

* WHO (2004)

Table 2. Comparison of Physicochemical Parameters of Tube Well Water before and after Treatment Using 10 and 20 Plants of Watercress

Parameter	Tube Well Water	After 6 days (10 plants)	After 6 days (20 plants)	WHO Drinking Water Guideline*
pH	7.8	7.2	6.9	6.5-8.5
Colour (True), TCU	30	10	Nil	15
Turbidity, NTU	32	22	4	5
Total Hardness, mgL^{-1}	46	58	34	500 as $CaCO_3$
Total solids, mgL^{-1}	210	124	84	1000
Chloride (as Cl^-), mgL^{-1}	12	6	4	250
Iron, mgL^{-1}	0.92	0.65	0.28	0.3
Arsenic, μgL^{-1}	Nil	Nil	Nil	10

* WHO (2004)

Table 3.Comparison of COD, BOD and DO of Tube Well Water Before and After Treatment Using 20 Plants of Watercress

Parameter	Tube Well Water	After 6 days (20 Plants)	WHO standard*
COD	64	32	5.0
BOD(5 days at 20ºC)	9	6	5.0
DO	6.6	7.2	4-6

* WHO (2004)

Table 4. Comparison of Microbiological Parameter of Tube Well Water before and after Treatment Using 20 Plants of Watercress

Parameter	Tube Well Water	After 6 days (20 plants)
Standard Plate Count (S.P.C)	>300	>300
Most Probable Number (M.P.N)	180	10
E.coli	Positive	Positive
Remark	Unsatisfactory	-

Conclusion

Water pollution is one of the biggest problems in the world. Water purification is the process of removing undesirable chemicals, biological contaminants, suspended solids and gases from contaminated water. In this research, the watercress was used as a natural adsorbent. Since it grows naturally in the ponds in Myanmar, it has a very low cost in treating water.

From the resulting data, it can be seen lower pH (7.2), colour (10 TCU), turbidity (22 NTU), total hardness (58 mgL^{-1}), total solids (124 mgL^{-1}), chloride (6 mgL^{-1}), iron (0.65 mgL^{-1}) and arsenic (Nil) in tube well water after 6 days treatment with ten plants of watercress compared to those after 3 and 9 days treatment. These values except turbidity and iron content are within the range of WHO standard values.

The experiment was also conducted by using twentyplants of watercress at contact time of 6 days for the optimal water treatment. By using twenty plants, the lower pH (6.9),colour (Nil), turbidity (4 NTU), total hardness (34 mgL^{-1}), total solids (84 mgL^{-1}), chloride (4 mgL^{-1}), iron (0.28 mgL^{-1}), arsenic (Nil), COD (32 mgL^{-1}), BOD (6 mgL^{-1}) and DO (7.2 mgL^{-1}) were observed in tube well water compared to those treated with ten plants of watercress. The empirical data pointed out that these values were in accordance within the WHO drinking water guideline. In addition, for 6 days treatment with twenty plants watercress, a sharp dropsof *E. coli* value was found to be observed in tube well water.

In conclusion, this tube well water is not suitable for drinking but is not harmful for humans when used for washing or bathing. Potable water can be maintained in satisfactory microbiological condition using chemical disinfectants such as chlorine or ozone.

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