



Research Article

Disinfection of Supplied Drinking Water by Poly-Herbal Preparation

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Abstract

Disinfection of drinking water is very important to prevent the waterborne disease caused by various pathogenic infections. Dhaka is one of the most densely populated megacities in the world where safe drinking water remains as one of the major pervasive problems. Previous studies showed that both surface water, and supplied water by Dhaka Water Supply & Sewerage Authority (WASA) are heavily contaminated with a variety of pathogenic bacteria and thus, a huge number of people has been suffering from waterborne diseases round the year. Although, there are several effective modern methods for water purification but they might pose chemical threats to the human health. In the present study, we have used the ancient Ayurvedic knowledge to explore the cheap and effective methods for disinfecting commonly consumed drinking water. Accordingly, we have chosen eight different popular local herbs and prepared several poly-herbal combinations of these herbs. Interestingly, among these combinations, three poly-herbal combinations found to be very effective to disinfect the contaminated drinking water. Although, the results are promising, further research is necessary to reveal the molecular mechanism of actions of the poly-herbal combinations as potent disinfectant.

Keywords: Disinfection, drinking water, pathogenic, Ayurvedic, poly-herbal

INTRODUCTION

Dhaka, the capital of Bangladesh is now one of the most active and densely populated capital cities in the world (Banks et al., 2011) which has an annual increasing rate of over 5% (Azharul Haq 2006). To lead a healthy life, supply of safe drinking water is very important (Organization 2004). However, the surface water along the peripheral rivers are known to be highly polluted due to municipal and industrial untreated wastewaters that are discharged (Kamal et al., 1999, Subramanian 2004). Additionally the unhygienic sanitation becomes the major cause of water contamination. To meet the mass supply of drinking water in Dhaka city WASA has chosen surface water as water source (Khan 2013). But unfortunately, due to lack of proper management and inadequate infrastructure, Dhaka WASA has been failing to provide us with safe drinking water. Though they have set up several water purifying plants, but those facilities were proved insufficient and ineffective in various scientific researches (Acharjee et al., 2011). As a result, some further disinfection process takes place after receiving the water from WASA facility.

Water that has been disinfected (by UV treatment, local boiling, chlorination, micro-filtration, ozone, etc.) may still be polluted with other contaminants that are not affected by the disinfection treatment (Sadul et al., 2009). There are five types of contaminants that are found in water: particulates, bacteria, minerals, chemicals, and pharmaceuticals. Conventional water treatment methods are associated with several disadvantages; either a heavy cost is incurred or unskilled labor to handle the chemicals. Boiling the water has been the simplest and most effective to disinfect water from various pathogenic bacteria. But because of insufficient gas supply and high cost, it's becoming very difficult to purify water by boiling (Gilman and Skillicorn 1985). There are disinfecting techniques such as tablets (Clasen and Edmondson 2006) and potash-alum (Mintz et al., 1995) or several water disinfecting devices (Sears 2007). But most of them are very expensive

considering the economic condition of the majority of Bangladeshi citizens (Ahmed and Mortaza 2010). Some of these techniques are quite harmful for health eventually when is in use for long. Thus, the threat of waterborne diseases is increasing, compromising the integrity of the nation's health (Rana 2009). So, it has become an urgent need to disinfect the drinking water through a very cheap and effective method to save people from various waterborne diseases and to reduce the economic burden.

From ancient times in the Indian subcontinent Ayurveda has been providing us the cure for various diseases successfully (Mukherjee and Wahile 2006). Numerous papers have cited about the antimicrobial, antioxidant and other beneficial properties of various Ayurvedic plants (Kapoor 2000, Patwardhan et al., 2004, Sharma et al., 2000). Based on these knowledge the present work was focusing these plant inherent properties. Hence, different combinations of the local herbs were used to disinfect the drinking water from microorganisms. Among them three combinations showed remarkable and promising disinfection properties of the supplied drinking water.

MATERIALS AND METHODS

The herbs were collected from Moulovi Bazar Dhaka, then cleaned and processed at the Department of Biochemistry, Primeasia University. Water samples used in the present study were collected from house tap of the Mirpur area of Dhaka, Bangladesh. All solvents used for this study were redistilled and purified. Other chemicals, including culture media used were of analytical grade.

Plant selections. The herbs were carefully selected from the vast number of herbs based on their availability and price to make the method economical and commercially viable. Eight different local herbs Amla (*Phyllanthus emblica*), Naga (*Mesua ferrea*), Coriander seed (*Coriandrum sativum*), Cardamom

(*Elattariascardamomum*), Tulsi(*Ocimum sanctum*), Neem(*Azadirachta indica*), Labanga(*Syzygium aromaticum*) and Basak (*Adhatodavasicawere*) were selected based on their various medicinal properties (Almas 1998, Deans et al., 1995, Kubo et al., 1991, Liu et al., 2009, Lo Cantore et al., 2004, Singh Bharat and Sharma 2013, Singh Surender et al., 2005, Sohel and Yeasmin 2004).

Plant materials processing. The plant materials of *Phyllanthusemblica*, *Mesuaferrea*,

Coriandrumsativum, *Elattariascardamomum*, *Ocimum sanctum*, *Azadirachta indica*, *Syzygium aromaticum* and *Adhatodavasicawere* individually washed with water, dried and pulverized into fine powder and then stored in the airtight containers in presence of silica gel. Different polyherbal combinations of these plant samples were made. Three combinations showed promising results (Table 1).

Table 1. Details of three Poly-Herbal Combinations.

Combination 1	Combination 2	Combination 3
Naga 1.8mg	Naga 1.8mg	Cardamom 1.5mg
Tulsi 1.8mg	Tulsi 1.8mg	Clove 1.5mg
Neem 1.8mg	Neem 1.8mg	Coriander seed 3mg
Basak 1.8mg	Amla 1.8mg	
Coriander seed 1.8mg	Cardamom 0.9mg	
	Clove 0.9mg	
Total = 0.9mg	=0.9mg	=0.9mg

Water sample. All the water samples were collected from house tap of the Mirpur area of Dhaka. Experiments were carried out within 1-5 hours after collecting the samples. 10^{-3} times diluted 1ml Dhaka WASA supplied drinking water was used as a positive control in the investigation. All the samples were taken for microbial culture right after the treatment with poly-herbal preparation. The samples were kept at 4°C until these were analysed.

Water sample treatment. 300ml of WASA supplied drinking water was taken in several sterile plastic containers. Different bags (sachet) like tea bag were prepared with different polyherbal combinations. Each bag contains exactly 0.9mg of polyherbal preparations. The bags were submerged in the water of the container treating for three hours without agitation. The control one and the effective three polyherbal combinations containing containers are shown in **Figure 1**.

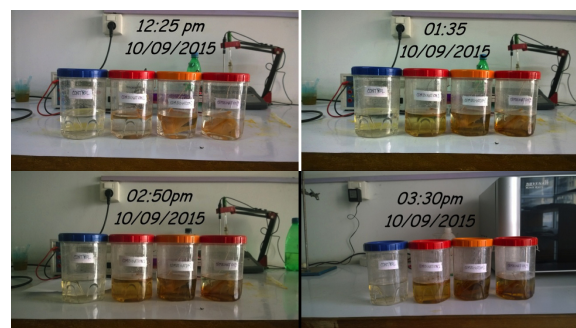


Figure 1: WASA water treatment using three poly-herbal combinations.

Antimicrobial screening. *In vitro* antibacterial screening were performed using the EMB media, a selective and a differential medium (Horvath and Ropp 1974, Mac Faddin 1985). Treated sample water and positive control were diluted up to 10^{-3} times. One millilitre (1ml) of each sample were spread on EMB agar plate then kept in the incubator for overnight incubation at 37°C . The bacterial growth for the treated sample water were

compared with the bacterial growth of the positive control.

RESULTS

The three polyherbal combinations described in materials and methods showed strong activity against the bacteria present in the supplied drinking water of WASA. The results were compared with the positive control and the observed results of microbial growth on EMB media from supplied drinking water by WASA and the sample water treated with poly-herbal preparations are showed in **Figure 2**.

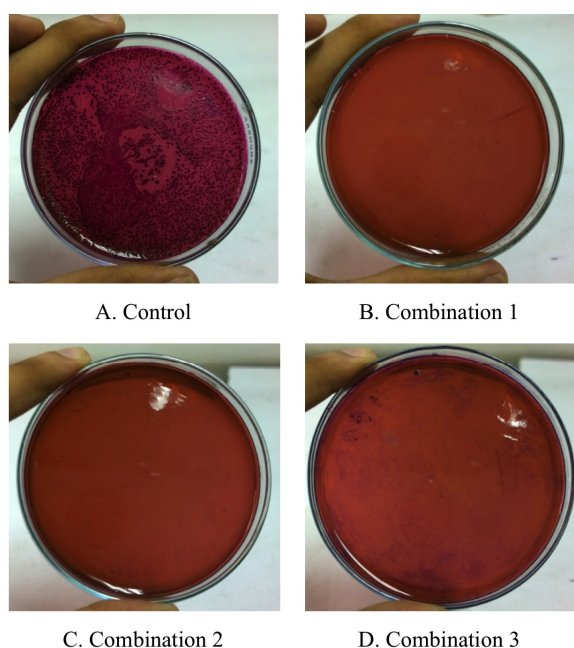


Figure 2. Observation result of microbial growth on EMB media for the control (A) and three different poly-herbal combinations: combination 1 (B), combination 2 (C) and combination 3 (D) treated sample water.

Control Petridish with diluted untreated WASA supplied drinking water showed growth of a lawn of bacteria, which was too numerous to count. Bacterial growth of the water samples treated with poly-herbal preparation 1, 2 and 3 was significantly low respectively (Figure 2). This

observation indicated that all three poly-herbal preparations are very effective in disinfecting the WASA supplied drinking water from harmful gram negative bacteria. Moreover, this disinfecting contaminated water method is very cheap as these poly-herbal ingredients can be found around the locality of Bangladesh. Though this appeared very effective but the only shortcoming of this study was that the treated sample water contains a different test and odour of the herbs after the disinfection process.

DISCUSSION

Ayurveda, a holistic form of traditional medicine has described many plants to have the antimicrobial and other health beneficial properties. Thus, the herbs used in this study were selected using these ancient Ayurvedic knowledge. The Sushruta Samhita, an Ayurveda classic has listed seven modes of purifying water (Sadul et al., 2009, Sonali et al., 2012). The wood of Amla (*Planthusemblica*) that has the antimicrobial and antioxidant activity (Liu et al., 2009) is used to clear small rain ponds (Kirtikar and Basu 1972). Sushruta Samhita (2002) had also written water purification method for drinking purpose by using flowers of Naga (*Mesuaferrea*). Coriander seed (*Coriandrumsativum*) and Cardamom (*Elattariascardamomum*) has been described to have antimicrobial activities along with their applications as medicines in different studies (Lo Cantore et al., 2004; Kubo et al., 1991). Tulsi (*Ocimum sanctum*) is also a water purifier with antibacterial and insecticidal properties (Sadul Rama et al., 2012). Recently N. Namratha and Monica P.V have synthesised silver Nanoparticles using Neem (*Azadirachtaindica*) extract and showed its usage in water purification (Namratha and Monica 2013). Essential oil from labanga (*Syzygium aromaticum*) is preferred for the disinfection of a potable liquid (Purohit and Kulkarni 2005) and leaves of Basak (*Adhatodavasica*) can be used as water clarifiers as it can eliminate the bacterial contaminants of

raw drinking water (Kumar and Gopal 1999). This is a virtually costless way to render contaminated water fit for human consumption (Sadgir et al., 2002).

In the process of developing a plant based substitute for economical safe approach for water disinfection against conventional chemical constituents, *in vitro* antibacterial studies of these plants were carried out before. But studies observing the efficacy of their combined effect are not known yet. So, in order to find the best effective water clarifier using Ayurvedic knowledge different polyherbal combinations were studied in this study. Among them three combinations are proved to be very effective.

It may, therefore, be concluded from the above investigation that the component present in various portion of *Phyllanthusemblica*, *Mesuaferrea*, *Coriandrum sativum*, *Elattariacardamomum*, *Ocimum sanctum*, *Azadirachta indica*, *Syzygium aromaticum* and *Adhatodavasicam* might be enough to treat the supplied drinking water of WASA. But for more authenticity some other study like antiviral test and improvement of the taste and odour should be carried out thereafter. The treated water has a specific taste and odour because of the herbs used in this study. However, further and specific studies are needed to better evaluate the potential effectiveness of the polyherbal combinations and improvement of the formula as the water disinfectant.

CONCLUSION

The Coliform count in WASA supplied drinking water in Dhaka area is found very high and the polyherbal water disinfection formulas might be capable of disinfecting the WASA supplied drinking water at a very successful rate.

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CONFLICT OF INTEREST

The authors disclose no conflict of interests regarding the publication of this paper.

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