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TREATMENT OF WATER FROM DIFFERENT SOURCES FOR SAFE DRINKING OF RURAL POULTRY AND LIVESTOCK OF BANGLADESH

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ABSTRACT

The research work was under taken to find out the effect of various treatments on water of different sources with a view to supply safe drinking water for rural poultry and livestock. For that, water of four different sources (lake, river, tap, tube well of BAU campus) were collected during the period from December 2006 to June 2007 and subjected to several treatments with physical (heat) and chemical (Hello tab, bleaching powder, potassium permanganate, alum and acetic acid) means in the Department of Microbiology and Hygiene, Bangladesh Agricultural University, Mymensingh-2202 with a view to get water free from deleterious microorganisms those are easily transmitted through drinking water of the above mentioned sources. Water of all the sources were subjected to microbiological examination before and after treatment. No bacteria was found in the water samples collected from tube well of five places of BAU campus following cultural examination. Gram positive rod shaped bacteria were isolated from the river and tap water of Ishakhan Hall Lake (IHL), Brahmaputra river (BR), Taposhi Rabeya Hall (TRH), Teacher staff quarter (TSQ), Microbiology laboratory (ML) and Bangabandhu Hall (BBH) whereas Gram negative rod shaped bacteria (*E. coli)* were isolated from the water of IHL, BR and from the tap water of ML and BBH. Gram positive cocci was found only in the tap water of ML. The pre-treatment culture of water samples revealed that the TVC (387 CFU/ml) and TCC (75 CFU/ml) were highest in the water of lake compare to those of other water samples collected from river and taps. As a physical means heat treatment (100^0C for 4 to 8 minutes) was highly effective. No single colony was found in all the water samples following treatment with heat. No changes in colour, taste and odour were noticed before and after heat treatment of all the water samples. Among the chemical agents, Hello tab (0.05 g/100 ml) was found to be the most effective to make the water free from all the microbial contamination. The taste, colour and odour of the Hello tab treated water samples were found as normal as safe drinking water. The colour, taste and odour of water treated with bleaching powder, potassium permanganate, alum and acetic acid were also examined and it was found that the colour, taste and odour were not normal after treatment of the water samples. Therefore, it may be concluded that the water treated with Hello tab was found superior compare to the water of other treatments in this study which was found free from microbial contamination and unpleasant taste and order.

Key words: Water, microorganisms, chemical agents, heat

INTRODUCTION

Water is considered as an inevitable element of life. Around 75% of the earth is surrounded by water, but only 1% of water can be used as a source of drinking water for animal and human being. Our water sources include ground water, shallow ground water and surface water like pond, lake, river, rainwater etc but they are getting polluted with various organic and inorganic matters. The water sources are mostly contaminated with faecal wastes of poultry and livestock farms, sewage, pesticides, herbicides, industrial wastes, and biological agents such as bacteria, virus, fungus, protozoa etc. In South Asian countries, the peripheral river such as Buriganga river of Dhaka is more severely polluted by urban activities (Karn *et al.,* 2001). Without treatment this contaminated water is being used for consumption of human being, poultry, and livestock which may cause various gastrointestinal diseases like diarrhoea, dysentery and other water borne diseases like cholera, typhoid of human, poultry and livestock. The World Health Organization has estimated that up to 80% of all sickness and disease in the world is caused by inadequate sanitation, polluted water or unavailability of water and at least 5 million deaths per year can be attributed to water born diseases (WHO drinking water and sanitation 1981-1990).

It is now evident that most of the enteric diseases of human and animals are transmitted through contaminated food and water (Johnson *et al.*, 2003). So to get rid from suspended biological agents and to ensure the supply of pure drinking water, prior treatment is recommended. In Bangladesh the traditional water treatment methods include auto purification by sunlight, boiling, filtration, distillation, sedimentation whereas advanced treatment processes include chlorination and iodine treatment. So the present research was undertaken to establish an easy treatment method of water from different water sources using various physical and chemical means available around us and to make this water treatment system as a popular model for supplying economically and hygienically safe drinking water for poultry and livestock both in the urban and rural areas of Bangladesh.

MATERIALS AND METHODS

Collection of water samples

Water samples were collected in sterile conical flask from various water sources (lake, river, tap and tube well) in and around Bangladesh Agricultural University, Mymensingh during the period from December 2006 to June 2007. After collection of water samples in a conical flask, the mouth and neck of flask was covered with aluminium foil and taken to the laboratory for detail microbiological investigation.

Isolation of bacteria and Gram's staining

After collection of water samples, 100 µl of raw water was inoculated into nutrient agar media and EMB agar media by spread plate technique. The inoculated media was incubated at 37ºC for over night in an incubator. Different types of bacterial colonies found from each water sample were selected for Gram's staining. The Gram's staining method was performed for each individual colony as per method described by Merchant and Packer (1976).

Determination of total viable count (TVC)

Hundred microliter of ten fold dilution of lake, river and tap water from original samples were transferred and spread on nutrient agar media using micro pipette for each dilution. The diluted samples were spread as quickly as possible on the surface of plate with a sterile glass spreader. Following incubation at 37ºC for 24-48 hours, plates exhibiting 30-300 colonies were counted. The average number of colonies in a particular dilution was multiplied by the dilution factor to obtain the total viable count. The total viable count was calculated according to ISO (1995). The result of total bacterial count was expressed as the number of organism or colony forming units per milliliter (CFU/ml) of water samples.

Determination of total coliform count (TCC)

Hundred microliter of ten fold dilution of lake, river and tap water from original samples were transferred and spread on Eosin Methylene Blue (EMB) agar media using micropipette for each dilution. The diluted samples were spread as quickly as possible on the surface of plate with a sterile glass spreader and then incubated at 37ºC for 24-48 hours. The total coliform count was calculated according to ISO (1995). The result of total bacterial count was expressed as the number of organism or colony forming units per milliliter (CFU/ ml) of water samples.

Treatment using physical agent (heat)

Hundred ml water samples collected from lake were taken in two sterile conical flasks and each was heated using electric heater for 5 and 8 minutes. Similarly 100 ml of river and tap water were heated for 5 and 7 minutes, and 4 and 5 minutes, respectively using electric heater. After heat treatment all the water samples were kept at room temperature for 1 hour.

Treatment using chemical agents

Hello tab and bleaching powder were used at different concentration such as 0.01g, 0.05g and 0.1 g for the treatment of 100 ml water samples of different sources. Potassium permanganate was used @ 0.01g, 0.05g, 0.1 g, 0.3 g, 0.5 g, 0.6 g and 0.7 g per 100 ml water samples. Alum was used @ 0.2 g, 0.5 g, 0.7 g, 1 g, and 1.2 g per 100 ml water samples. For the treatment of 100 ml water samples, acetic acid was used @ 15 µl, 30 µl, 50 µl, 100 µl, 200 µl, 300 µl and 400 µl.

After proper mixing of the test water with different chemical agents, it was incubated at room temperature for one hour.

Post-treatment culture of water samples

After one hour incubation, 100 µl of each treated water sample was inoculated into nutrient agar media and EMB agar media by spread plate techniques and incubated at 37ºC for over night in an incubator. Then observed for bacterial colony and TVC and TCC were calculated as before.

Testing of taste, colour and odour of water before and after treatment

Colour, odour and taste of all the water samples after treatment were tested and noted down, before and after treatment

RESULTS AND DISCUSSION

The tube well water of five different places of BAU were cultured for the presence of any bacteria and found sterile in this study. It is difficult to explain the exact reason for the absence of *E. coli* and other possible bacteria. However, the possible reason of sterility may be high depth of water source. Most tube well of BAU are found minimum depth of 150-200 feets of under ground. Absence of *E. coli* in the tube well water in our study completely differs with the findings of Kroger and Noll (1969). In their study, they found *E. coli* in tube well water, possible cause of presence of *E. coli* in tube well water may be of low depth of water source or other extraneous contamination during collection. Gram positive rod shaped bacteria were isolated from all the water samples (Table 1). Gram negative rod shaped bacteria were also isolated from almost all the water samples except tap water from TRH and TSQ. This finding coincides with the findings of Lin *et al.* (1974) and Mieres and Bastardo (1975) who isolated *E. coli* from river water. Malaney and Weiser (1962) also reported isolation of *E. coli* from pond water. All the water samples were negative for Gram positive cocci except tap water of Microbiology Laboratory of BAU.

Table 1. Total number of bacterial colony after culturing of 0.1 ml of raw water samples

Source of water	No. of Gram positive rod	No. of Gram negative rod	No. of Gram positive cocci	TVC (CFU/ml)	TCC (CFU/ml)
Lake water (IHL)	303	75	0	378	75
River water (BR)	143	33	0	176	33
Tap water (TRH)	157	0	0	157	0
Tap water (TSQ)	132	0	0	132	0
Tap water (ML)	145	3	6	154	3
Tap water (BBH)	66	18	0	84	18

IHL = Ishakhan Hall Lake, BR = Brahmaputra river, TRH = Taposhi Rabeya Hall, TSQ = Teacher staff quarter, ML = Microbiology laboratory and BBH = Bangabandhu Hall.

In this study, it was found that TVC and TCC were highest (387 CFU/ml and 75 CFU/ml) in water of lake compare to other water samples collected from river and different taps (Table 1). The main source of tap water is deep tube well so presence of bacteria is not acceptable but here in this study, the presence of bacteria in tap water might be due to contamination in tank where it is stored. Usually, river water would have higher bacterial load but due to continuous water flow in the river, the bacterial load was less than lake water. Again, as lake contains stagnant water, the water may also be contaminated by many ways. That is why, higher bacterial load was recorded in the lake water.

Heat treatment of water was the highly effective physical means of destroying bacteria. In this study, it was found that treatment with heat for 4 to 5 minutes killed almost all the bacteria of different water samples (Table 2). When the duration of heat treatment extended to 8 minutes, no bacterial growth was observed in cultural examination. The colour, taste and odour were found same before and after heat treatment in case of all the water samples.

After treatment of water samples with different doses of Hello tab for one hour, it was found that all the water samples except from Ishakhan Hall of BAU required minimum 0.05 g of Hello tab for complete destruction of bacteria per 100 ml of water (Table 3). The taste, colour and odour of the Hello tab treated water samples were found normal.

Table 2. Effect of heat treatment of water of different water sources

Source of water	Time of heating (minutes)	TVC (CFU/ml)		TCC (CFU/ml)	
		Before treatment	After treatment	Before treatment	After treatment
Lake water (IHL)	5	378	52	75	0
	8		0		
River water (BR)	5	176	27	33	0
	7		0		
Tap water (TRH)	4	157	1	0	0
	5		0		
Tap water (TSQ)	4	132	0	0	0
Tap water (ML)	4	154	0	3	0
Tap water (BBH)	4	84	0	18	0

IHL = Ishakhan Hall Lake, BR = Brahmaputra river, TRH = Taposhi Rabeya Hall, TSQ = Teacher staff quarter, ML = Microbiology laboratory and BBH = Bangabandhu Hall.

Table 3. Antibacterial activity of Hello tab following 1hour treatment of water of different sources

Source of water	Dose (g/100 ml water)	TVC (CFU/ml)		TCC (CFU/ml)	
		Before treatment	After treatment	Before treatment	After treatment
Lake water (IHL)	0.01		25	75	0
	0.05	378	5		
	0.1		0		
River water (BR)	0.01		18	33	0
	0.05	176	0		
	0.1		0		
Tap water (TRH)	0.01		7	0	0
	0.05	157	0		
	0.1		0		
Tap water (TSQ)	0.05	132	0	0	0
Tap water (ML)	0.05	154	0	3	0
Tap water (BBH)	0.05	84	0	18	0

IHL = Ishakhan Hall Lake, BR = Brahmaputra river, TRH = Taposhi Rabeya Hall, TSQ = Teacher staff quarter, ML = Microbiology laboratory and BBH = Bangabandhu Hall.

The water samples (100 ml) were treated with 0.01 g, 0.05 g and 0.1 g of bleaching powder and 0.1g was found sufficient enough to kill all the bacteria (Table 4). Similarly, depending on the sources of water, different doses of potassium permanganate (0.3 to 0.7 g), alum (1.0 g to 1.2 g) and acetic acid (100µl to 400µl) were required for sufficient killing of the bacterial (Table 5-7). The variation in doses of different chemicals may be due to the water sources and bacterial load present in the water. Berkowitz *et al.* (2006), Bonadonna *et al.* (1999), Monarca *et al.* (2002), Veschetti *et al.* (2003), Koivunen and Heinonen-Tanski (2005) also used different types of chemicals with different doses for the treatment of water of different sources to make it bacteria free.

Treatment of water of different sources

Table 4. Antibacterial activity of bleaching powder following 1hour treatment of water of different sources

Source of water	Dose (g/100 ml water)	TVC (CFU/ml)		TCC (CFU/ml)	
		Before treatment	After treatment	Before treatment	After treatment
Lake water (IHL)	0.01		12	75	0
	0.05	378	1		
	0.1		0		
River water (BR)	0.01		9	33	0
	0.05	176	1		
	0.1		0		
Tap water (TRH)	0.01		7	0	0
	0.05	157	1		
	0.1		0		
Tap water (TSQ)	0.05	132	1	0	0
	0.1		0		
Tap water (ML)	0.05	154	1	3	0
	0.1		0		
Tap water (BBH)	0.05	84	0	18	0

IHL = Ishakhan Hall Lake, BR = Brahmaputra river, TRH = Taposhi Rabeya Hall, TSQ = Teacher staff quarter, ML = Microbiology laboratory and BBH = Bangabandhu Hall.

Table 5. Antibacterial activity of potassium permanganate following 1hour treatment of water of different sources

Source of water	Dose (g/100 ml water)	TVC (CFU/ml)		TCC (CFU/ml)	
		Before treatment	After treatment	Before treatment	After treatment
Lake water (IHL)	0.01	378	24	75	0
	0.05		19		
	0.1		17		
	0.3		12		
	0.5		4		
	0.7		2		
River water (BR)	0.1	176	28	33	0
	0.3		10		
	0.5		1		
Tap water (TRH)	0.1	157	1	0	0
	0.3		0		
Tap water (TSQ)	0.1	132	1	0	0
	0.3		0		
Tap water (ML)	0.1	154	0	3	0
Tap water (BBH)	0.1	84	0	18	0

IHL = Ishakhan Hall Lake, BR = Brahmaputra river, TRH = Taposhi Rabeya Hall, TSQ = Teacher staff quarter, ML = Microbiology laboratory and BBH = Bangabandhu Hall.

Table 6. Antibacterial activity of alum following 1hour treatment of water of different sources

Source of water	Dose (g/100 ml water)	TVC (CFU/ml)		TCC (CFU/ml)	
		Before treatment	After treatment	Before treatment	After treatment
Lake water (IHL)	0.2	378	88	75	0
	0.5		16		
	0.7		9		
	1.0		7		
	1.2		1		
River water (BR)	0.7	176	8	33	0
	1.0		5		
	1.2		1		
Tap water (TRH)	1.0	157	0	0	0
Tap water (TSQ)	1.0	132	2	0	0
Tap water (ML)	1.0	154	0	3	0
Tap water (BBH)	1.0	84	0	18	0

IHL = Ishakhan Hall Lake, BR = Brahmaputra river, TRH = Taposhi Rabeya Hall, TSQ = Teacher staff quarter, ML = Microbiology laboratory and BBH = Bangabandhu Hall.

Table 7. Antibacterial activity of acetic acid following 1hour treatment of water of different sources

Source of water	Dose (µl /100ml water)	TVC (CFU/ml)		TCC (CFU/ml)	
		Before treatment	After treatment	Before treatment	After treatment
Lake water (IHL)	15	378	146	75	0
	30		40		
	50		38		
	100		35		
	200		11		
	300		8		
	400		2		
River water (BR)	100	176	27	33	0
	200		9		
	300		2		
Tap water (TRH)	100	157	0	0	0
Tap water (TSQ)	100	132	0	0	0
.Tap water (ML)	100	154	0	3	0
Tap water (BBH)	100	84	0	18	0

IHL = Ishakhan Hall Lake, BR = Brahmaputra river, TRH = Taposhi Rabeya Hall, TSQ = Teacher staff quarter, ML = Microbiology laboratory and BBH = Bangabandhu Hall.

In this study, it was observed that the dose requirements of various chemical agents were higher for killing the bacteria present in lake water. This may be due to the highest TVC and TCC of the lake water compare to other water samples. It is clear that bacterial load in water plays a vital role, which must be considered during treatment of water with chemicals. The colour, taste and odour of the treated water with minimum concentration of bleaching powder, potassium permanganate, alum and acetic acid were not normal.

From the above findings of the study, it may be suggested that tube well water may be the first priority for livestock and poultry. Alternatively, surface water after proper treatment with either heat (physical agent) or Hello tab (chemical agent) will be the second priority for consumption. But, heat treatment of water followed by cooling is somewhat cumbersome and costly compare to the treatment with Hello tab. Therefore, it may be concluded that treatment of water with Hello tab is more convenient, effective and reasonable compare to the other treatments in this study. That is why, Hello tab treated water can safely be used for the livestock and poultry at the farm level.

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