Determination of the Purity of Some Brands of Drinking Water in Monywa Township, Sagaing Region

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Abstract

Nowadays quality and suitability of drinking water are of great concern because of various water borne disease and fatal unhealthy impacts on human health. Such concern is one of the reasons of opening of77 purified drinking water in Monywa Township, Sagaing Region. As purified drinking water is marketed by various companies, it is essential to check whether these waters are really safe for public health or not. Convinced on it, the present study has investigated the physicochemical properties of the drinking water in Monywa Twonship. For this purpose six different brands water samples were collected from local market. The investigated parameters were mainly pH, color, odour, Total solid, Total dissolve solid (TDS), Total hardness accompanying with, Calcium (Ca^{2+}) and Magnesium (Mg^{2+}) ions, Chloride (Cl^{-}) ions, and sulphate (SO_4^{2-}) ions, Total irons and Total alkalinity by using standard analytical techniques in the laboratory. Furthermore, in this study were conducted for bacteriological analysis of drinking water (Total and fecal coliform and *E. coli*).

Keywords: Drinking water, physicochemical properties, bacteriological analysis

Introduction

The Earth can be regarded as a water planet, for it nearly covers two-third of the entire earth's surface. The Earth is often referred to as the "blue planet" because when view from space it appears blue. This blue colour is caused by reflection from the oceans which cover roughly 71% of the Earth. However, 97% of it is undrinkable seawater while the additional 2% is said to be stacked up in the polar icecaps. It means that the human environment lives on 1% of the water body.

The five essential requirements for human existence are air, water, food, heat and light. Contamination of these elements may cause serious health hazards not only to human but also to animal and plant life. The use of water by man, plants and animals is universal. Without it, there can be no life. Every living thing requires water. Water maintains an ecological balance - balance in the relationship between leaving things and environment in which they live. From the point of view of mankind, water is 7certainly the most important simple substance in the world.

Pure water, rain water, surface runoff water, river water, lake and pond water and ground water are the sources of natural water. The earth has a limited amount of water. The water keeps going around and around in Hydrologic (water) cycle. This cycle is made up of evaporation, condensation precipitation and collection. Water quality standards for surface waters vary significantly due to different environmental conditions, ecosystem, and intended human uses. Toxic substances and high population of certain microorganisms can present a health hazard for non-drinking purposes such as irrigation, swimming, fishing, boating, and industrial uses. These conditions may also affect wildlife, which use the water for drinking or as a habitat. There are different types of water from different sources, soft and hard water.

The hardness of water relates to the amount of calcium, magnesium and sometimes iron in the water. The more minerals present, the harder the water. Water quality is the physical, chemical and biological characteristic of water. The most common standards used to assess water quality related to health of ecosystems, safety of human contact and drinking water.

Therefore, the main aim of this research paper is to study the physicochemical properties and bacteriological contamination of some purified drinking water samples. From the resulting data these pure water samples may or may not be used for drinking purpose.

Materials and Method

Sample Collection

The purified drinking water samples were collected from local market in Monywa Township, Sagaing Region on July 2017. The collected samples were six different brands of plastic bottled drinking water, which are Sample 1 (S1), Sample 2 (S2), Sample 3 (S3), Sample 4 (S4), Sample 5 (S5) and Sample 6 (S6).

Determination of physicochemical parameters of drinking water

The main physicochemical parameters and microbiological were measured in Public Health Laboratory, Ministry of Health and Sport in Mandalay. Most of them, the other four parameters (pH, TDS, alkalinity, hardness) were repeatedly analyzed in common laboratory.

Determination of pH and TDS: pH of the samples were measured by using with portable Martini pH – 55 meter and the TDS values were measured by portable HM digital meter.

Determination of Total Alkalinity (TA): About 25 mL of water sample was taken in to conical flask. And then 3 drops of methyl orange indicator were added. The water samples were titrated with standard 0.01M (0.02N) of H_2SO_4 solution from the burette until the colour changes from yellow to orange colour at the end point. The four concordant readings were recorded to use for (0.01 M) mean volume of H_2SO_4 (A_1 H_2SO_4). Finally total alkalinity was calculated as follows.

Total alkalinity (mg/L) (as $CaCO_3$) = A_1 H_2SO_4 x 1000/ V_1 mL
A_1 = Volume of standard H_2SO_4 consumed in mL starting from titration,
V_1 = volume of sample used in mL (25 mL).

Determination of total hardness of water: 25 mL of each of the water samples was pipette out in a washed conical flask. 1 mL ammonia ammonium chloride buffer solution and 2-3 drops of Eriochrome Black-T indicator were added, the color of the solution turns wine red. This solution was titrated against standard EDTA until the color changes from wine red to sky blue which indicated the end point. The final reading of the burette was noted and the titration was repeated to get concordant value. Finally using the analytical calculation, total hardness of water sample was determined in terms of mg/L of $CaCO_3$.

Bacteriological Analysis

Colony count

Total viable count was carried out using the pour plate technique by Harrigan and MacCance. 10 mL of each sample was transferred to 90 mL of sterile diluent, as a first dilution 10^{-1}, serial dilutions were made up to 10^{-6} and 1 mL of each dilution was

transferred aseptically in duplicate into sterile petridishes. 10 to 15 mL melted plate count agar (45-46˚C) was poured into the dishes. The dishes were then thoroughly mixed to facilitate distribution of the sample throughout the medium, the medium was allowed to solidify and plates were incubated at 37˚C for 48 hours. Colony counter and hand-tally were used for the determination of the total bacterial counts in terms of colony forming units per mL (c.f.u. /mL).

Most probable number test

This test comprised three steps: (a) Presumptive test, (b) Confirmed test, and (c) Completed test. The multiple tube fermentation technique was performed as a presumptive test for total coliform using tubes containing MacConkey Broth and inverted Durham tubes.

Inoculation was carried out as: (i) To each of 3 double-strength MacConkey broth tubes, 10 mL of the original sample was added, (ii) To each of 3 single-strength MacConkey broth tubes, 1 mL of the original sample was added, and (iii) To each of 3 single-strength MacConkey broth tubes, 0.1 mL of the original sample was added.

All tubes were incubated at 37 ˚C for 48 hours for the observation of gas production. First reading was taken after 24 hours to record positive tubes, and the negative ones were incubated for another 24 hours.

Confirmed test

Each gas positive presumptive tube was inoculated into a tube containing 10 mL Brilliant green lactose broth medium. All tubes were incubated at 37 ˚C for 48 hours for the observation of gas production.

Completed test (Fecal coliform test)

At least 3 loopful of each confirmed positive tube were subcultured into EC broth medium and then incubated at 44.5˚C for 24 hours. Tubes showing any amount of gas production were considered as positive and the most probable number was recorded.

Results and discussion

Physicochemical Parameter of Drinking Water

The mean values of water quality parameters discussed on the basis of its comparison with Drinking Water Standards are presented in Table (1).

The pH values of all samples were neutral to slightly alkaline. Some water is slightly alkaline due to presence of carbonates and bicarbonates. However, the pH never exceeded the desirable limit in all samples, so samples are fit for consumption as far as pH values are concerned. Total solid indicates the general nature of salinity of water. The total solid fluctuated from 223 to 371 mg/L in all brand of drinking water samples. The presence of chloride and sulphate ions are indicated in Table (1), all resulting data of samples are satisfying the standard limit.

The study of repeated measurements in common laboratory of some physicochemical parameters are present in Table (2).

Table (1) Results of Physicochemical Parameter of Some Brands of Drinking Water Sample and WHO Standard

Parameter	Some brands of drinking water samples						Maximum permissible level (WHO)*
	S1	S2	S3	S4	S5	S6	
Appearance	Clear	Clear	Clear	Clear	Clear	Clear	
Color (Pt-Co scale)	5	5	5	5	5	5	15
pH	7.4	6.6	6.7	6.5	6.5	6.5	6.5 to 8.5
Total Solids (mg/L)	353	306	223	371	311	223	–
Total hardness (as $CaCO_3$ mg/L)	0	40	0	20	10	0	150 – 500
Calcium as Ca (mg/L)	0	8	0	0	4	0	
Magnesium as Mg (mg/L)	0	5	0	5	0	0	
Chloride as Cl^- (mg/L)	20	90	30	40	10	20	250
Sulphate as SO_4^{2-} (mg/L)	20	20	10	78	49	20	500
Total Iron as Fe (mg/L)	Nil	Nil	Nil	Nil	Nil	Nil	0.3
Remarks	Chemically potable						
* http://www.lenntech.com/WHO-EU-water-standards.htm							

Table (2) Results of Physicochemical Parameter of Drinking Water Samples

Parameter	Some brands of drinking water samples					
	S1	S2	S3	S4	S5	S6
Total Hardness, as $CaCO_3$ mg/L	26.98	72.52	18.55	23.60	30.35	25.29
Total Alkalinity, as $CaCO_3$ mg/L	23	61	42	67	63	30
pH (T = 28±2 ˚C)	7.5	6.9	6.7	7.4	7.1	6.4
TDS (T= 28±2 ˚C)	9	205	18	80	49	18

From Table (2) the TDS values are fluctuated from 9 to 205 mg/L in all brands of drinking water samples. The total hardness of all brands of drinking water samples are present in Table (2) under 80 mg/L, it is satisfying the standard limit. The pH value of all water samples was 6.4 to 7.5. Mostly water is neutral and some are slightly alkaline, it is also represent the carbonates and bicarbonates.

Bacteriological Analysis of Drinking Water

Microbiological parameters were analyzed include Coliform bacteria and *E. coli* by standard plate count method. Microbiological parameters of obtaining results of some drinking water sample are listed in Table (3).

Table (3) The Results of Microbiological Analysis of Some Brands of Drinking Water Samples

Parameter	Some brands of drinking water sample					
	S1	S2	S3	S4	S5	S6
Standard Plate Count	> 300 cfu/mL	> 300 cfu/mL	> 300 cfu/mL	> 300 cfu/mL	> 25 cfu/mL	> 150 cfu/mL
Probable Coliform Count	5/5	5/5	5/5	5/5	0/5	0/5
E. coli Count	Isolated	Isolated	Isolated	Isolated	Not-isolated	Not-isolated
Remarks	Un-satisfactory	Un-satisfactory	Un-satisfactory	Un-satisfactory	satisfactory	satisfactory

Conclusion

Drinking water represents an important source of human life and its quality is currently threatened by a combination of microbiological and physicochemical contamination. The pH values range of all samples was 6.4 to 7.5. Some of the drinking water samples were presented the pH values more than or under about 7 to indicate the alkalinity or acidity condition. However, the measured pH values of all samples were obtained between standard limited values.

The hardness of drinking water were obtained in the range of 10 to 72 mg/L as $CaCO_3$, and also the alkalinity of water sample was contain from 23 to 67 mg/L as $CaCO_3$. The alkalinity of all drinking water samples were contaminated in different values. The TDS values were detected in all samples any more or any less. Chloride (Cl^-) and sulphate (SO_4^{2-}) anions were also measured in different values. By the comparison of standard guideline, all physicochemical parameters of experimental data were indicated that under the maximum permissible level. It should be noted that all analyzed drinking water samples are chemically potable.

Furthermore, all drinking water samples were analyzed the microbiological parameters including Coliform bacteria and *E. coli.* All samples were analyzed by standard plate count and probable coliform count. From the analyzed result most of samples were counted more than 300 cfu/mL, but one sample of them was contained 150 cfu/mL and the only one sample about 25 cfu/mL. The isolation of *E. Coli* were analyzed in all samples. From these, four samples were isolated by test tube method, and two samples of them were not-isolated.

The most commonly used indicators for bacteriological contamination are the coliforms: total and fecal coliforms and fecal streptococci. *E. coli* is a subgroup of fecal coliform group, and its presence indicates the fecal pollution of groundwater.

Most of the gastrointestinal infections that may be transmitted through drinking water are transmitted via fecal–oral pathway. Hence, the effects of improvements in the quality of groundwater were felt on the combat against endemic diseases such as typhoid and cholera in adults, and diarrhea in children.

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