



QUALITY ASSESSMENT OF PHYSICO-CHEMICAL PARAMETERS FOR VARIOUS PACKAGED BOTTLED DRINKING WATERS

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Article Received on 12/06/2017

Article Revised on 02/07/2017

Article Accepted on 22/07/2017

ABSTRACT

Analysis of physico-chemical parameters of bottled drinking water: The six (6) brands of bottled water were selected randomly from grocery shops. Volume of the bottle is 1 (liter) and were stored in ambient conditions prior to analysis. The physico-chemical parameters of each and every brand were analyzed include: pH, electrical conductivity (EC), odour, taste, transparency and color, Oxygen (O₂), Carbon dioxide (CO₂), Nitrate (NO₃), Phosphate (PO₄), Sulphates (SO₄), Lead (Pb) and Zinc (Zn). These analyses were determined by using the Standard Laboratory Method. The results were compared with the Standard BIS and WHO limit values. Small amount of variations were found between the bottled water brands. Bottled waters recorded concentrations are within the acceptable ranges of the respective guideline.

KEYWORDS: Bottled water, water quality, physico-chemical parameters.

INTRODUCTION

Water is the most important and precious natural resources which is essential for life of all living organisms from smallest micro – organisms to the simplest plant and the most complex living organisms like animals and Human beings. It is significant due to its unique chemical and physical properties (Onifade and Ilori., 2008; Osci. Y., 2005; Obi and Okocha, 2007). Water is the basic element for live and survives on the planet earth (Petraccia et.al. 2006; Alemdar et.al. 2009) and the most abundant compound on the earth's surface. Though 71% of the earth's surface, i.e. more than two-third is covered with water, only 2.5% of that water is fresh water and only 1% is accessible for Human consumption (Lefort, 2006) as it is clean and drinkable.

The variations in the amount of drinking water for human depend on their physical activity, health issues, age and environmental conditions. It is estimated that average human beings drinks about 1 litre of water per day while 95% drinks 3 litres/day (Exposure Factors Handbook, 2011). Water makes about 60% of body weight in men and 55% weight in women, so it is necessary to have hygienic and safe drinking water.

Drinking water is also known as portable water or improved drinking water that is safe to drink or to use for food preparation, without risk of health problems. About 85% of the world population lives in the driest half of the planet. Globally, in 2012, 89% of people had access to water suitable for drinking (Water Fact Sheet, 2014).

Nearly, 4 billion accesses to tap water while 2.3 billion had access to wells and public taps (Water Fact Sheet, 2014). 1.8 billion People still use an unsafe drinking water which is contaminated by feces (water Fact Sheet, 2014) and almost 6-8 million people die annually from the consequences of disasters and water related diseases.

Typically in developing and developed countries tap water meets drinking water quality standards, even though only a small proportion is used for food preparation and drinking. Other typical uses include washing, toilets, domestic, industrial, agriculture, etc. Water may also be unacceptable due to levels of toxins or suspended solids. Reduction of water borne diseases and development of safe water resources is a major public health goal in developing countries. So, the bottled water is sold for public consumption in most parts of the world.

Bottled water is defined as any portable water that is manufactured, distributed or offered for sale, which is sealed in food- grade bottles or other containers and intended for human consumption (Warburton, 2000). The different brands of bottled water are produced by using a series of treatments and packaging. Bottled water is comprehensively regulated by the U.S. Food and Drug Administration (FDA) as packaged food products (FDA, 2015). The consumption of bottled water steadily grows from the last three decades at global level. The global market for bottled water has gained significant momentum in the past few years in contrast from 2000-

2015, bottled water consumption more than doubled from 16.7 gallons a person to 36.4 gallons, chiefly owing to its increasing demand. It is also stated that over 89 billion litres of bottle water are annually used worldwide. The global bottled water industry has become a multibillion dollar industry.

In India, bottled water industry saw virtually no activity till 1993, when Bisleri was launched by parley. But now India is among the top ten countries in terms of bottled water consumption. Today, bottled water is one of the India's fastest growing industrial sectors. Further, for the low income population, packed water is also available in the form of relatively cheaper hand sealed sachets (Indian Bottled Water Market, 2012).

Bottled water is one of the fastest growing drink choice and its consumption in the world increased by average 10% because of its accessibility, relatively low cost, better taste and lower level of impurities (EPA) (EPA, 2003). In recent years, the popularity of bottled water can be gauged by the number of brands (over, 5000) produced worldwide (Guler, 2007).

Drinking water plays a major role in the intake of some of valuable and toxic trace elements in human's body (Nkono and Asubiojo, 1997; Turk and Alp, 2010). Because of the high risk and health hazards associated with intake of contaminated tap water, the consumption of bottled water is becoming a popular worldwide.

Bottled water not only serves the drinking purposes, it has also found wide usage in infant formula preparations, reconstitution of various food products, skincare formulations and for filling humidifiers (Warburton, 1993). The rise in the demand and availability of large number of commercial brands of bottled water in the market have led to the prescription and enforcement of water standards which are prescribed for maximum permissible levels of different constituents, which vary from country to country. More than 450 million people in 29 countries suffer from water shortage (Salih.N., 2015). Many countries with scarce water resources rely

on alternative or non-conventional water resources (Guler.C., 2007).

Water of poor quality can cause different types of disease which have major impact on both individuals and communities health. So, it is necessary to have a safe drinking water and the bottled water have made the choice of it.

Therefore the current study aims ay comprehensively investigating the physico-chemical parameters and quality of most available bottled water brands consumed in Kalyan and Bhiwandi city, the result of selected parameters are compared with Bureau of Indian Standards (BIS) and World Health Organization (WHO).

MATERIALS AND METHODS

Six (6) different brands of bottled water were purchased during rainy season in 2015, from randomly selected grocery shops from Kalyan and Bhiwandi city. The volume of the bottle is 1 litre. All these samples were stored at ambient conditions prior to complete the concerned analysis.

The physico-chemical parameters were analyzed by standard methods. The conducted analysis included parameters like pH, Electrical conductivity (EC) were measured using the portable meter for pH and EC. The other parameters include O₂, CO₂, NO₃, PO₄, SO₄, Pb and Zn, were determined by using the laboratory standard method.

The different physical parameters were also determined in the laboratory. It is noteworthy to mention that all the analytical tests were performed in accordance to the standard method for the examination of water and waste water (APHA, 2005).

RESULTS AND DISCUSSION

The physico-chemical parameters of the analyzed Indian drinking waters are summarized in table for six different brands, together with corresponding guidelines by Indian Standards IS:10500 (BIS) and World Health organization for drinking water.

Table: Physical and Aggregate Properties of different Brands of Bottled Waters from Bhiwandi and Kalyan City.

Brands Name	pH	EC	CO2 mg/l	O2 mg/l	NO3-N µg atom/l	PO4-P µg atom/l	Pb mg/l	Zn mg/l	SO4-S mg/l
Brand A	6.85	0.10	3	7.47	42	3.44	0.12	3.57	5.32
Brand B	6.77	0.11	3	10.30	40	4.82	0.13	4.64	3.62
Brand C	6.74	0.14	15	10.10	41	5.86	0.16	4.28	4.28
Brand D	6.77	0.14	9	8.08	41	4.48	0.10	5.0	2.22
Brand E	6.79	0.15	7	7.87	40	5.51	0.15	3.92	9.08
Brand F	6.80	0.17	10	11.31	42	4.13	0.09	5.35	3.14
Minimum	6.74	0.10	3	7.47	40	3.44	0.09	3.57	2.22
Maximum	6.80	0.17	15	11.31	42	5.86	0.16	5.35	9.08
Mean	6.78	0.13	7.83	9.18	41.5	4.7	0.125	4.46	4.61
BIS	6.5-8.5	-	-	-	45	5.0	0.1	5.0	150
WHO	6.5-8.0	-	-	-	50	-	0.01	3-5	250

❖ The Brand names were kept hidden for the safety of firms.

The physical and aggregate properties of the tested waters ranges between 6.74 and 6.80 (mean= 6.78) for pH, 0.10 and 0.17 (mean=0.13) for electrical conductivity, 3 and 15 (mean= 7.83) for CO₂, 7.47 and 11.31 (mean= 9.18) for O₂, 40 and 42 (mean= 41.5) for NO₃-N, 3.44 and 5.86 (mean= 4.7) for PO₄-P, 0.09 and 0.16 (mean= 0.125) for Pb, 3.57 and 5.35 (mean= 4.46) for Zn, 2.22 and 9.08 (mean= 4.61) for SO₄-S.

Comparison of these parameters with various national i.e. Bureau of Indian Standard (BIS) and international i.e. World Health Organization (WHO) standards of quality of bottled waters recorded concentrations are within the acceptable ranges. This is shown in the table and as well as in the graphical line forms. The graphical representation clearly shows the variations in different physico-chemical parameters.

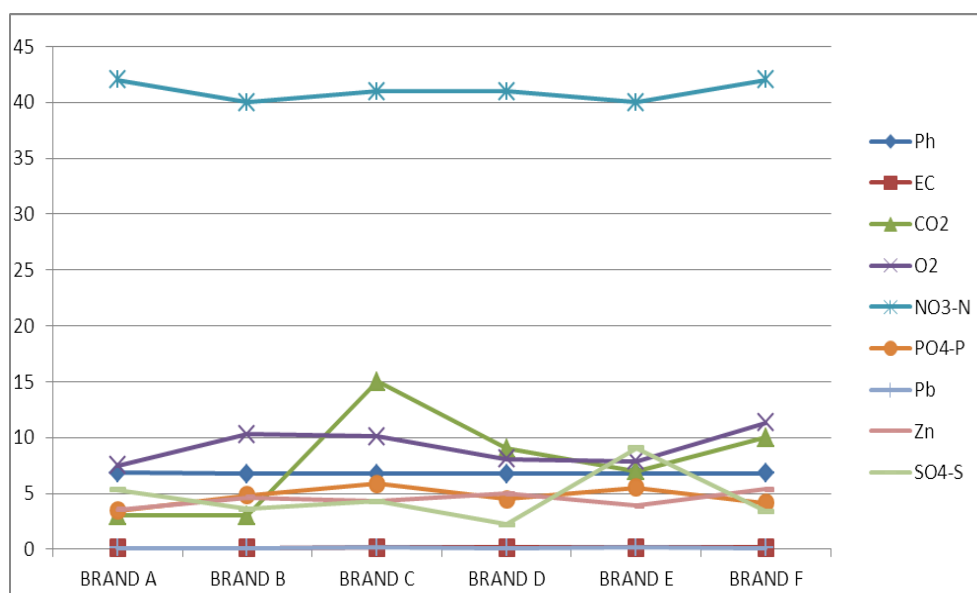


Fig: Relationship between Different Parameters of investigated Bottled Water Brands.

As the result comes within the acceptable range, the table shows different chemical parameters in the investigated bottled drinking water brands demonstrated variations in composition. The variations depends on various factors like – natural environment from which the water is taken, the source of water, the types of treatments and the purification techniques used during their production. Additional changes may also occur due to transportation and storage, or direct exposure to sunlight.

The result show slightly acidic pH but comes under the range of standard value. pH of water is influenced by different types like the buffering capacity of water.

The EC i.e. Electrical Conductivity in water is usually used as a measure of ionic concentration. The low EC is due to low ionic concentration and the high EC is for higher ionic concentration. Brand A shows low and Brand F shows higher level of ionic concentration. The different concentration of NO₃, SO₄, PO₄ are also within the range of (BIS) and (WHO) standard.

The sulphate (SO₄) and phosphate (PO₄) are generally not toxic to people, but slightly increase in concentration of sulphate ion effects the taste of water. The phosphate ion is not toxic unless they are present in very high level. Due to high level of phosphate and major digestive

problems can occur and dehydration and gastrointestinal irritation occur due to high level of sulphate.

The oxygen present in bottled water is to increase the water quality. The amount of O₂ and CO₂ are present in dissolved form and varies according to the temperature, climate and environmental condition.

As the metals are harmful to Human body, the presence of metal in water is not suitable for drinking. In present study 2 heavy metals lead and zinc were studied. It was found that the amount of lead and zinc present in the 6 brands of bottled water is normal and comes under the acceptable ranges. Hence, they are safe for drinking.

CONCLUSION AND RECOMMENDATION

The above study showed that a major quality constituents of 6 brands of bottled water. The physico-chemical parameters which were studied show a significant difference in the variables. These variations occur due to various factors. The results showed that the bottled water brands are safe for Human consumption. The parameter of these brands of bottled water comes within the range of standard limits which is set by BIS and WHO for drinking water quality.

It is recommended from the above studies that, the bottled water should be monitored by concerned

authority for its quality and safeguard's consumer's health. It is also recommended that, the brands name with the source and company name should be mention clearly on the bottled water. The analysis of different parameters with microbiological and heavy metals should be done in different brands of bottled water for the protection of public health.

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