

# Bottled Drinking Water: Evaluation of Consumption Tendencies and Quality

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**Abstract**—Use of bottled drinking water shows a growing trend worldwide. Recently, highest growing rates were observed in developing countries in Asia and South America. Many studies have been carried out in developed countries in the world on consumer perception and water quality of bottled drinking water. However, the studies are limited in developing countries. This study approaches to understand consumer perception, issues and concerns in using bottled drinking water in Sri Lanka. A questionnaire and a water quality analysis were carried out in the study. The study was carried out in Southern Sri Lanka. The results of the study reveal that respondents tend to use bottled drinking water while they are travelling and when they are staying somewhere outside of their residence. Water quality analysis results revealed that all samples are complying with the standards for tested parameters. However, significant differences among different brands were found.

**Keywords**— Bottled drinking water, consumer perception, water quality.

## I. INTRODUCTION

CONSUMPTION of bottled drinking water is growing ten percent every year and fastest growth rates are observed in developing countries in Asia and South America [1]. As a result bottled water has become fastest growing non-alcoholic beverages [2]. There is a common belief that bottled drinking water is safer than tap water. Unavailability or very low chlorine level etc. and presence of minerals may contribute to this opinion [3]. However, scientific studies have proven that it is not necessarily true [4], [5]. Moreover, a large portion of bottled water is processed tap water (40%-60% globally) [2]. Incidents and reports on unsafe drinking water is also show a growth in parallel to the growth of bottled water industry worldwide [6]. In Sri Lanka also, several cases were reported on contaminations of bottled drinking water. One of the recent cases were reported on end of April 2014 in which 37000 water bottles were seized due to a mixing of chemical to the drinking water. It was reported that a chemical released from the bottle caused the unpleasant odor encountered by the

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consumers.

To the knowledge of the authors, there are no studies on bottled drinking water consumption in Sri Lanka. Worldwide researches have focused the attention on the production, regulation, sales and consumption, criticisms and concerns on bottled drinking water [1]. In this background, this study focused on evaluating the relationship between bottled water use, the education and income of the consumers, concerns of consumers and the quality of bottled drinking water. The study was conducted among 150 consumers and 44 bottled water samples available for sale in the area were tested for some common water quality parameters.

## II. METHODOLOGY

### A. Questionnaire

Evaluation of bottled water consumption tendencies was done by the participation of randomly selected bottled water consumers in Southern province of Sri Lanka. The survey was carried out from August to October in year 2014. Potential candidates were approached in the city, by personnel from the study team. Consumers greater than or equal to 18 years of age was asked to participate. Once he is consented to join the study, an interview was conducted. The survey was conducted among 150 bottled water consumers (n= 150) in Southern, Sri Lanka, in which the occasions people go for bottled water, and what are the details they concern about bottled water and their perception on safety has been evaluated.

### B. Water Quality Testing

Bottled water samples (n=44) were tested in order to find the pH, conductivity, total nitrate concentration, total coliforms and total hardness in bottled drinking water according to standard methods [7]. The samples were selected randomly from a wide variety of shops selling bottled drinking water.

## III. RESULTS

More than 50% of the respondents reported that they are using bottled drinking water while they are travelling. 35% of respondents have reported that they are using bottled water when they are temporarily staying somewhere, for example while they are on a holiday in outside of their residential area. Only 9% of respondents use bottled water as their primary drinking water source while 6% of them reported that they are usually using bottled drinking water.

In analyzing the facts, which takes their attention in

consuming bottled drinking water, 63% of the consumers responded that they concern about the details provided in the label, while 16% reported that they concern on the brand name. Moreover, 82% out of all respondents concern about the storage conditions of the water bottles.

Meanwhile, it was reported that 79.6% of people aware of the issues recently reported about the contaminated bottled water, however, 62.2% of consumers assume that the bottled drinking water is safe to drink, while 25.5% has a neutral idea about the safety and the rest (17.3%) believes that bottled drinking water is not safe to drink.

The results of the water quality analysis are shown in table 1. The variation in the water quality parameters was very high. However, samples with same brand name showed less variation among different samples. The variation of conductivity, hardness and total nitrate concentration among different brands were significant (ANOVA,  $p < 0.05$ ).

TABLE I  
SUMMARY OF MEASURED WATER QUALITY PARAMETERS IN SELECTED  
BOTTLED WATER SAMPLES

Sample details	pH	Hardness (mg/l)	Conductivity ( $\mu$ S)	Total coliforms (cfu/ml)	Total nitrate (mg/l)
Mean $\pm$ SD	6.3 $\pm$ 0.36	12.13 $\pm$ 14.78	87.4 $\pm$ 66.0	2.95 $\pm$ 3.12	4.76 $\pm$ 3.73
Median	6.31	4	112.1	2	3.11
Range	5.71-7.07	0-46	7.23-177.2	0-12	0.55-9.13
% below detection	0	41%	0	34%	0

#### IV. DISCUSSION

The results reveal that respondents tend to use bottled drinking water mostly, while they are travelling and when they stay temporarily in an unknown area. It may be because they are unknown about the drinking water quality and safe drinking water sources in that particular area and it is easy to use bottled drinking water in such situations. The adoption of such preventive action like drinking bottled water is suggested to be influenced by perception of risk associated with drinking water [8]. However, study reveals that irrespective of the recent issues raised on bottled drinking water people believe that bottled drinking water is a safe drinking water source. In the mean time chemical analysis of bottled drinking water samples also support above opinion since it is complying with standards [9]. However, identification significant differences in measured water quality parameters show that different brands have differences may be due to the differences in primary water source they use. Nevertheless, until they are complying with the standards, the bottled drinking water is acceptable for consumption.

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#### REFERENCES

- [1] Z. Hu, L. W. Morton and R. L. Mahle, Bottled Water: United States Consumers and Their Perceptions of Water Quality, *Int. J. Environ. Res. Public Health*, vol. 8, 2011, pp. 565-578. <http://dx.doi.org/10.3390/ijerph8020565>
- [2] M. F. Doria. Bottled water versus tap water: understanding consumers' preferences, *Journal of water and health*, Vol. 4, 2006, pp. 271-276.
- [3] J.A. Lalumandier and L.W. Ayers, Fluoride and bacterial content of bottled water vs. tap water, *Arch.FAm.Med.* vol 9, 2000, pp. 246-250. <http://dx.doi.org/10.1001/archfami.9.3.246>
- [4] S.D. Raj, Bottled water: How safe is it? *Water Environ. Res.* vol. 77, 2005, pp. 3013-3018. <http://dx.doi.org/10.2175/106143005X73893>
- [5] A. Azoulay, P. Garzon, and M. J. Eisenberg, Comparison of the Mineral Content of Tap Water and Bottled Waters, *J Gen. Intern. Medicine* Vol.16, 2001, pp. 168-175. <http://dx.doi.org/10.1111/j.1525-1497.2001.04189.x>
- [6] Pacific Institute, Bottled water recalls summary table, Available online, <http://www.pacinst.org/> (accessed on January 2014).
- [7] American Public Health Association/American Water Works Association/Water Environment Federation, Standard methods for the examination of water and wastewater. (20th ed.). *Washington DC: APHA/AWWA/WEF*, 1998.
- [8] P.D. Cleary, Why people take health precautions? In *Taking care: Understanding and encouraging Self-protective behavior*, Weinstein, N.D., Ed. Cambridge University Press: Cambridge: USA, 1987, pp. 119-149. <http://dx.doi.org/10.1017/CBO9780511527760.009>
- [9] Sri Lanka Standards for potable water – SLS 614, 1983.