

"Exploring the Quantitative Analysis of Water Quality in Various Brands of Mineral Water Bottles from Shahada District, Nandurbar."

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Abstract: Water is essential for human survival. According to the World Health Organization (WHO), approximately 36% of urban populations and 65% of rural populations in India lack access to safe drinking water. Water is primarily used for domestic purposes, especially for drinking. The present study shows that Bottled Water has become a necessity in people's lives due to the poor quality of the municipal water supply. However, based on the results obtained from the study, we can conclude that in all three mineral water brands, the amount of dissolved oxygen and alkalinity increased over time. The amount of dissolved carbon dioxide decreases as the storage time increases.

Key Words: Dissolved oxygen, Dissolved Carbon dioxide, Alkalinity, Brisleri, Bailey (17, Kinley).

I. Introduction

Water is essential for human survival. According to the World Health Organization (WHO), approximately 36% of urban populations and 65% of rural populations in India lack access to safe drinking water. Water is primarily used for domestic purposes, especially for drinking.

Additionally, water can be a pathway for various diseases. Some common waterborne diseases include typhoid fever, cholera, and bacillary dysentery. These infections occur when pathogens contaminate water through untreated or poorly treated sewage.

Water is rarely completely pure. Rainwater can become contaminated as it falls to the Earth, and the combustion of fossil fuels releases sulfur compounds into the atmosphere, contributing to the formation of acid rain. However, water that flows underground typically undergoes filtration, removing most microorganisms. For this reason, water from springs and deep wells is generally of good quality.

Previous studies on water quality have primarily focused on large, regional areas. This study aims to provide residents with essential information about their drinking water. It is important to note that packaged and bottled water may still contain contaminants such as chlorine and iodine. Major corporations like Coca-Cola® and Pepsico® do not disclose detailed data regarding the minerals or substances present in their water. Consequently, this study also seeks to improve the public's understanding of the physical composition of bottled water.

In light of consumer interest and public health concerns, the Union Ministry of Health and Family Welfare notified on September 29, 2000, mandating that all packaged water manufacturers and traders obtain ISI certification from the Bureau of Indian Standards (BIS). As a result, approximately 517 packaged water companies have received BIS certification for packaged drinking water (excluding packaged natural mineral water). Additionally, six companies in the natural mineral water category have obtained the mandatory ISI certification for packaged natural mineral water. The BIS has provided standards for various physical and chemical parameters in drinking water. (Tony Zheng et al., 2000; Prof. H.B. Mathur, Dr. Sapna Johnson et al., January 2003)

Water quality is a top priority on the policy agenda in many regions worldwide. In contemporary society, water used for household purposes is commonly referred to as domestic water. This water undergoes processing to ensure it is safe for consumption as drinking water and other uses.

The quality and suitability of water are determined by its taste, odor, and color. Contaminants can impact water quality and, as a result, human health. Therefore, water quality standards are established to guarantee the effective use of water for specific purposes. Water quality analysis involves measuring the necessary parameters according to standard methods to verify compliance with these standards.

The Indian Scenario: The Bottled Water Market. The bottled water industry, valued at Rs 1000 crore, is experiencing rapid growth at an annual rate of 40 percent (Business Today, 2001). Under the Bureau of Indian Standards (BIS) certification scheme, approximately 517 licenses for packaged drinking water have been issued in the country according to IS: 14543:98. Additionally, BIS has granted six licenses for packaged natural mineral water, complying with IS: 13428:98, including one license for a foreign manufacturer in France (Malik PP, 2002).

Leading brands in this market include Brisleri, Bailey, Yes, Kinley, and Aquafina. A variety of regional and local brands also cater to local demands. Many multinationals have entered the market and increased their marketing efforts to capitalize on untapped potential. However, most brands compete within a very narrow market segment, primarily targeting travel, tourism, catering,

restaurant, and hospital sectors. There is a lack of focus on the significant opportunities that exist in affluent and upper-affluent households.

Market share for major brands is dominated by Brisleri (51 percent), followed by Bailey (17 percent), Yes (11 percent), Kinley (10 percent), and Aqua (percentage not specified), according to BT Estimates from June 2001.

Why is Water Analysis Required?

Water analysis is primarily necessary for monitoring purposes. Key aspects of these assessments include the following:

1. To determine whether the water quality meets established standards and is suitable for its intended use.
2. To evaluate the effectiveness of systems in place for maintaining water quality.
3. To assess whether modifications to an existing system are needed and to identify what changes should be implemented.
4. To ensure that water quality complies with relevant rules and regulations.

The current study is titled "Exploring the Quantitative Analysis of Water Quality in Various Brands of Mineral Water Bottles from Shahada District, Nandurbar," conducted during the academic year 2019-2020..

II. Review of Literature;

- ❖ Tony Zheng** et al. (November 2014) "A Quantitative Analysis of the Water Quality of Major Water Bottling Brands, Tap Water, and Surface Water in Ocean County."
- ❖ Sohani Smruti and Iqbal Sanjeeda (2012). Microbiological Analysis of Surface Water in Indore, India. Department of Botany, Holkar Science College, Indore, India. Research Journal of Recent Sciences.
- ❖ Malik. P.P. (2002) Packaged drinking water standards. Everything about Water, pg 70-72

III. Material and Method:

Study Area: PSGVPM ASC College, Shahada. The laboratory for analyzing mineral water samples is located in the G. Mendel Lab of the Zoology Department.

Selection of Samples: Drinking water samples were collected from bottled mineral water purchased at the local supermarket in Lonkheda. Three bottles of mineral water were obtained from the following brands.

Kinley :(Manufactured by HINDUSTAN Coca-Cola Beverages PVL.LTD.1105/7/8/33, Pirangut, Tal-Mulshi.Dist-U Ne-412111, MAHARASHTRA.

Brisleri;(Manufactured by Shivam Beverages Plot No.13 3, Shiv City Industri Es -1, Village-Makana, NR, Kakarapar Can Al, Tal-Kamrej, Surat, GUJARAT Customer Care No.9033350333

Bailey (MFD.By ADITYA AGRO Industries D-75Atlanta, U. S, M.I.D.C. AVADHAN.Dhule-424006, MAHARASHTRA.

Laboratory Analysis: -

Parameters: -

1. Dissolve Oxygen
2. Dissolved Carbon dioxide
3. Alkalinity

1) Dissolved Oxygen

Method: Winkler Azide Modification Titrimetric

2) Free Carbon Dioxide:

Method: Winkler Azide Modification Titrimetric

3) Alkalinity, Phenolphthalein (PH 8.3)

Method: Titrimetric to Ph=8.3 (Phenolphthalein)

2 Approval: 01 April 1999 Laboratory Manual ID: 1.1 Version: 2 Page: 1/2

Note: • For turbid/colored samples, titration can be performed using a pH meter to end at a pH value of 8.3.

- ❖ Standard Analytical Procedures for Water Analysis (May 1999). Laboratory Manual ID: 1.23 Version: 1 Page No. Government of India & Government of The Netherlands.

- ❖ APHA –AWWA WEF (1998); “Standard methods for the examination of water and wastewater, 25th ed.” American Public Health Association, Washington, DC, pages 2000- 2605.
- ❖ ATSDIR (Agency for Toxic Substances and Disease Registries, 2004); “Toxicological profile for chromium, Dept. of Health and Human Services “Public Health Services **Observations And Results;**

Given this, the study titled "Exploring the Quantitative Analysis of Water Quality in Various Brands of Mineral Water Bottles from Shahada District, Nandurbar" examines the quality of different mineral water brands.

Table No.1 Dissolved Oxygen mg/ml at Three Types of Mineral Water Bottles; The amount of mineral content was found to increase over time for all three brands of mineral water. For Kinley, the values at 8-day intervals were 6.86 mg/ml, 7.52 mg/ml, and 8.78 mg/ml. For Brisleri, the values were 6.32 mg/ml, 7.49 mg/ml, and 8.89 mg/ml at the same intervals. Lastly, for Bailey, the measurements were 5.89 mg/ml, 6.89 mg/ml, and 7.49 mg/ml, also taken at 8-day intervals.

Table No.1 Dissolved Oxygen mg/ml

Sr.no.	Brand Name of Bottles	Time Interval	Dissolved Oxygen mg/ml Reading	
			Control (Tap Water)	Branded Bottles
1	Kinley	8 Days	4.08 mg/ml	6.86 mg/ml
		8 Days	3.06 mg/ml	7.52 mg/ml
		8 Days	2.72 mg/ml	8.78 mg/ml
2	Brisleri	8 Days	4.08 mg/ml	6.32 mg/ml
		8 Days	3.06 mg/ml	7.49 mg/ml
		8 Days	2.72 mg/ml	8.89 mg/ml
3	Bailey	8 Days	4.08 mg/ml	5.89 mg/ml
		8 Days	3.06 mg/ml	6.89 mg/ml
		8 Days	2.72 mg/ml	7.49 mg/ml

Calculate the **standard deviation** of the **branded bottle readings** and analyze their variation compared to the control (tap water) **Dissolved Oxygen mg/ml.**

- Brisleri has the highest standard deviation, indicating the most variation in its oxygen content after 8 days.
- Bailey is the most consistent with the lowest standard deviation.
- All brands have higher DO levels than tap water, but variation differs

Brand	Mean (mg/ml)	Standard Deviation (mg/ml)
Kinley	7.72	0.98
Brisleri	7.57	1.29
Bailey	6.76	0.81

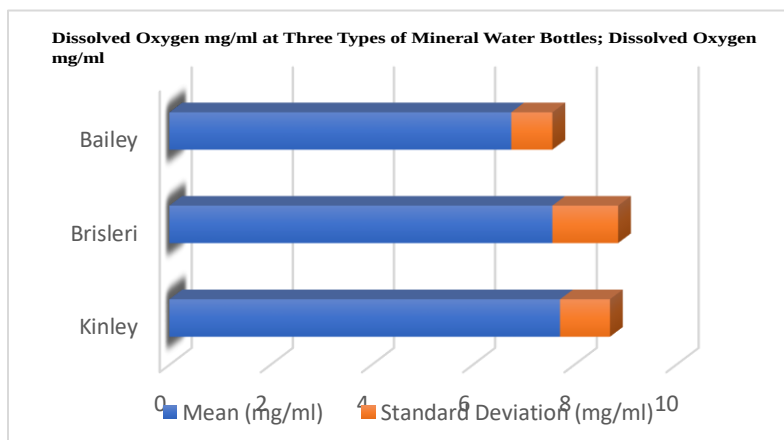


Table No.2 Dissolved Carbon Dioxide mg/ml at Three Types of Mineral Water Bottles; The concentration of minerals was found to decrease over time for all three brands of mineral water. In Kinley, the levels measured were 15.46 mg/ml, 13.89 mg/ml, and 12.91 mg/ml at 8-day intervals, respectively. For Brisleri, the concentrations were 15.69 mg/ml, 13.86 mg/ml, and 11.88 mg/ml at the same intervals. Lastly, Bailey showed levels of 15.56 mg/ml, 12.89 mg/ml, and 11.12 mg/ml at 8-day intervals, respectively.

Table No.2 Dissolved Carbon Dioxide mg/ml.

Sr.no.	Brand Name of Bottles	Time Interval	Dissolved carbon dioxide mg/ml Reading	
			Control (Tap Water)	Branded Bottles
1	Kinley	8 Days	15.10 mg/ml	15.46 mg/ml
		8 Days	13.78 mg/ml	13.89 mg/ml
		8 Days	12.67 mg/ml	12.91 mg/ml
2	Brisleri	8 Days	15.10 mg/ml	15.69 mg/ml
		8 Days	13.78 mg/ml	13.86 mg/ml
		8 Days	12.67 mg/ml	11.88 mg/ml
3	Bailey	8 Days	15.10 mg/ml	15.56 mg/ml
		8 Days	13.78 mg/ml	12.89 mg/ml
		8 Days	12.67 mg/ml	11.12 mg/ml

Calculate the standard deviation of the branded bottle readings and analyze their variation compared to the control (tap water), Dissolved Carbon Dioxide mg/ml.

- **Bailey** shows the **highest variation** in CO₂ levels (least consistent).
- **Kinley** has the **most consistent** carbon dioxide content.
- All brands show a change compared to the **control values**, which are decreasing over time (natural degassing).

Brand	Mean (mg/ml)	Standard Deviation (mg/ml)
Kinley	14.09	1.29
Brisleri	13.81	1.91
Bailey	13.19	2.24

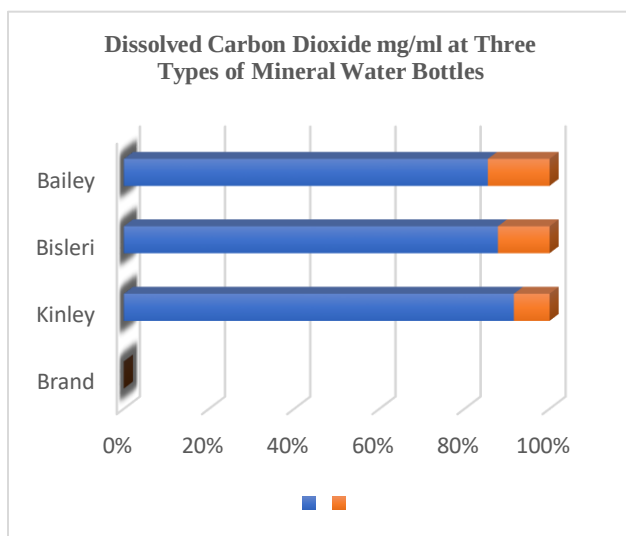


Table No.3: Alkalinity mg/ml at Three Types of Mineral Water Bottles The concentration of minerals was observed to decrease as the period increased for all three brands of mineral water tested: Kinleys showed values of 20.37 mg/ml, 22.78 mg/ml, and 24.84 mg/ml at 8-day intervals; Brisleri had values of 20.62 mg/ml, 22.78 mg/ml, and 24.84 mg/ml at 8-day intervals; and Bailey recorded values of 20.62 mg/ml, 22.78 mg/ml, and 22.86 mg/ml at 8-day intervals.

Table No.3 The Alkalinity mg/ml

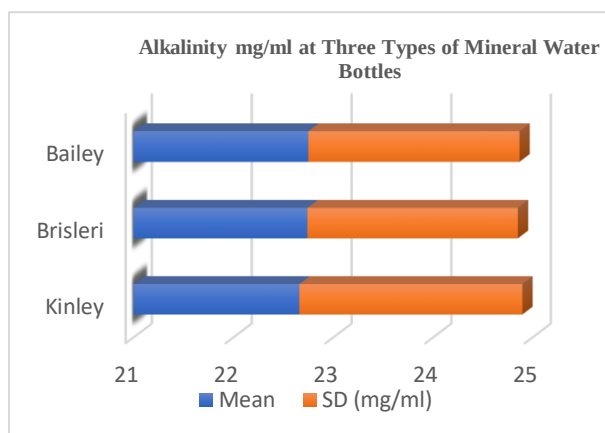
Calculate the standard deviation of the branded bottle readings and analyze their variation compared to the control (tap water), Alkalinity.

Sr.no.	Brand Name of Bottles	Time Interval	Alkalinity mg/ml Reading	
			Control (Tap Water)	Branded bottle
	Kinley	8 Days	19.54 mg/ml	20.37 mg/ml
		8 Days	20.65 mg/ml	22.78 mg/ml
		8 Days	19.42 mg/ml	24.84 mg/ml
2	Brisleri	8 Days	21.95 mg/ml	20.62 mg/ml
		8 Days	20.79 mg/ml	22.78 mg/ml
		8 Days	19.51 mg/ml	24.84 mg/ml
3	Bailey	8 Days	21.93 mg/ml	20.62 mg/ml
		8 Days	20.81 mg/ml	22.78 mg/ml
		8 Days	19.21 mg/ml	24.86 mg/ml

mg/ml.

- Kinley had the most variation in alkalinity across the 3 samples, suggesting inconsistent mineral content.
- **Brisleri** and Bailey had very similar and slightly lower SDs, indicating more stable alkalinity levels

Brand	Mean	SD (mg/ml)
Kinley	22.66	2.236
Brisleri	22.74	2.111
Bailey	22.75	2.117



IV. Discussion;

People depend on the quality of bottled drinking water, expecting it to be free from microbial contamination and health hazards. Most bottled water brands fall under the category of packaged drinking water. According to the Bureau of Indian Standards (BIS), this type of water is filled in hermetically sealed containers made of various materials, forms, and capacities, making it suitable for direct consumption without the need for further treatment.

Packaged drinking water undergoes several treatment processes, including decantation, filtration, a combination of filtration methods, aeration, use of membrane filters, depth filters, cartridge filters, activated carbon filtration, and demineralization. Additionally, it is disinfected to ensure it remains free from harmful contaminants, ensuring safety for consumers. The current study indicates that the concentration of dissolved oxygen (DO) in milligrams per milliliter increases over time among the three brands of mineral water examined. It is generally acknowledged that healthy drinking water should possess dissolved oxygen

concentrations ranging from 6.5 to 8 mg/L and maintain values between approximately 80% and 120%. This level of dissolved oxygen is often referred to as "oxygenated" water. Certain bottled brands reportedly contain up to 40 times more oxygen than conventional water, a feature that is marketed as enhancing athletic performance.

The concentration of dissolved oxygen is influenced by three primary factors. Tap water, when stored in tanks, experiences less exposure to sunlight, which results in a slower warming process compared to natural water sources. Due to its generally lower temperature, tap water can maintain higher levels of dissolved oxygen. Dissolved oxygen refers to the oxygen that is dissolved in water and is introduced via diffusion from the surrounding atmosphere, through the aeration of water that cascades over falls and rapids, and as a by-product of photosynthesis.

The production of mineral water involves a combination of chemical treatments and filtration techniques. Companies such as Minscot, Volga, Bailley, Prime, and Aquaplus utilize both chemical and filtration methods, while Brisleri and Paras primarily focus on filtration.

Various purification techniques are employed by different companies. These techniques include adding chlorine to eliminate microorganisms, using ultrafiltration to remove suspended impurities, passing water through an ozonation process to kill bacteria, and employing both mechanical and organic filters to eliminate physical impurities.

(Source: Analysis of pesticide residues in bottled water, CSE/PML-6/2002. CSE Report on pesticide residues in bottled water (Delhi region). Therefore, the present study stated that Dissolved Oxygen mg/ml was found to increase as the period was intermodal of three brands of mineral water. Healthy water should generally have dissolved oxygen concentrations above 6.5-8 mg/L and between about 80-120 %. It's "oxygenated." Some bottled brands supposedly contain up to 40 times as much oxygen as conventional water; ads say the extra oxygen improves athletic performance.

Dissolved oxygen is dependent on three major factors. Since tap water is stored in a tank, it is less exposed to sunlight and hence gets heated up more slowly than natural water. Since it's at a lower temperature, it can hold up more DO. Dissolved oxygen (DO) is oxygen that is dissolved in water.

The oxygen dissolves by diffusion from the surrounding air, aeration of water that has tumbled over falls and rapids, and as a waste product of Photosynthesis. (What's In Your Bottled Water? How Different Purification Methods Affect Drinking Water ...<https://www.meco.com> ›)

Carbon Dioxide Levels in Three Types of Mineral Water: The concentration of dissolved carbon dioxide (mg/ml) was observed to decrease over time in three different brands of mineral water.

Carbon dioxide is a common gas present in groundwater, particularly in higher concentrations in mineral waters. Large reserves of this gas are generated in the Earth's crust due to the dynamo effects and thermos metamorphism of carbonate rocks, as well as through biochemical reactions in sedimentary rocks. The presence of carbon dioxide, in specific amounts, gives the water distinct characteristics. From a balneological perspective, these waters are considered medicinal.

In contrast, the alkalinity (mg/ml) increased over time across the three brands of mineral water. Alkaline water has a higher pH level compared to regular drinking water, which typically has a neutral pH of 7. Alkaline water generally has a pH of 8 or 9. However, pH alone does not provide sufficient alkalinity; alkaline water must also contain alkaline minerals and have a negative oxidation-reduction potential (ORP). ORP refers to the water's ability to act as either a pro-oxidant or an antioxidant.

V. Conclusion;

Mineral water is produced artificially by adding salts to distilled water or aerating it with carbon dioxide. The mineral content of both natural and artificial mineral water varies greatly, and in some cases, it may be less than that of ordinary tap water.

Bottled Water has become a necessity in people's lives due to the poor quality of the municipal water supply. However, from the results obtained from the study, we can conclude that in all three mineral water brands, the amount of dissolved oxygen and alkalinity increased with the time of storage. The amount of dissolved carbon dioxide decreases as the time of storage increases.

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