



BACTERIOLOGICAL ASSESSMENT OF PACKED BOTTLE DRINKING WATER SOLD IN GONDIA DISTRICT OF MAHARASHTRA

Microbiology

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ABSTRACT

Bottled water is generally considered good quality water for drinking but if not properly protected during bottling and transit, it could be a subject of contamination. Technically packaged drinking water should be free from microorganisms and any other harmful chemicals but literature review confirming that the packaged drinking water available in India and globally, having microbiological contamination even though there is regulatory compliance at the national level. The present study was carried out under three steps i.e., survey, sample collection, and analysis of bottled water, which was followed by statistical analysis and interpretation of results. The factors such as handling, unhygienic practices at the filling station or factory premises, maintenance of equipment, etc. responsible for microbial contamination which is directly associated with human health. Therefore, the Government and the monitoring agency must take serious note of it and act stringently to avoid such failure. It was recommended that the concerned authority should prioritize this issue and continuously monitor the quality of available bottled water manufacturers in the eastern region to provide safe drinking water to the population.

KEYWORDS

Bottled water, Microbial contamination, packaged drinking water

INTRODUCTION

Water is the utmost important requirement of life and plays vital role in social equity, environmental stability, and cultural diversity. Access to safe drinking water is important as a health and development issue at a national, regional, and local level (Chauhan *et al.*, 2017; Sharma and Kaur, 2015; Warburton DW, 2000). Consumption of bottled water is rapidly increasing in developing countries especially, middle- and high-income earners as it is generally perceived to be pure, clean, and of good quality (Addo *et al.*, 2009). Today, bottled water is primarily used for drinking but has also been considered for the preparation of baby formula, cleaning contact lens or used in humidifiers. Bottled water is generally perceived by consumers as being of better quality and taste than tap water. However, the good quality of bottled water is sometimes a misconception. Furthermore, the collection, packaging, transport, and disposal of plastic bottles hurt the environment. It is, therefore, necessary that everyone has access to a safe, affordable, and sufficient quantity of water for drinking, other personal use, and sanitation (Tambekar and Tambekar 2009). The main objective of the introduction of bottled water in society was its better safety, taste, and convenience over tap water (Singla *et al.*, 2014).

Traditionally, pipe water distributed by the municipalities has been the trusted water supply for drinking purposes. In the earlier days, water available from the wells and springs used to be considered safe and was stored in earthen pots or brass containers. Almost a decade ago, the introduction of bottled water or "packaged mineral water" has changed the tradition of serving and consuming drinking water. Almost all the major international and national brand's water bottles are available in the Indian market right from the malls to railway stations, bus stations, grocery stores, and even at panwala's shop. Growing the incidences of water-borne diseases and water pollution and scarcity of potable and wholesome water has also added to the growth in the consumption of bottled water (Shalini and Lavanya, 2016).

The major bottled water brands operating in India are Bisleri, Kinley, and Aquafina. In India, bottled water is sold in four main types of stock-keeping units (SKUs) - one-liter bottles, two-liter bottles, 500-milliliter bottles, 250-milliliter bottles, pouches, and barrels of 15-20 liters. Among the different SKUs, one-liter bottles have acquired the largest market share of ~42% in 2018, followed by 500-milliliter bottles and 250-milliliter bottles.

The Bureau of Indian Standards (BIS) had formulated Indian Standard (IS) for packaged drinking water (PDW) and packaged natural mineral water (PNMW) under mandatory BIS certification as per Food Safety and Standards Regulation (FSS). India is rated among the top ten countries in the world concerning bottled water consumption. The fastest-growing industrial sectors are the bottled water production companies, presently in India; more than 3400 bottling plants are in operation (Joseph *et al.*, 2018). Several studies have documented the detection of coliforms and heterotrophic bacteria in bottled/ sachet

drinking water counts which far exceeded the national and international standards set for potable water for human consumption (Okohet *et al.*, 2005; Hasan *et al.*, 2010; Obiri *et al.*, 2003). Worldwide, contaminated water and food caused more than 3 million deaths were recorded, of which more than 80 % were among children under age 5 (Daud *et al.*, 2017; Chauhan *et al.*, 2017). Therefore, the present study aims with the facts and awareness about bacteriological contamination present in the packaged drinking water, comparative analysis of the known and locally produced packaged drinking water brands, and assesses the bacteriological quality of packaged drinking water samples sold in Gondia district of Maharashtra.

MATERIALS AND METHODS

Isolation and Identification of bacterial contamination in bottled drinking water:

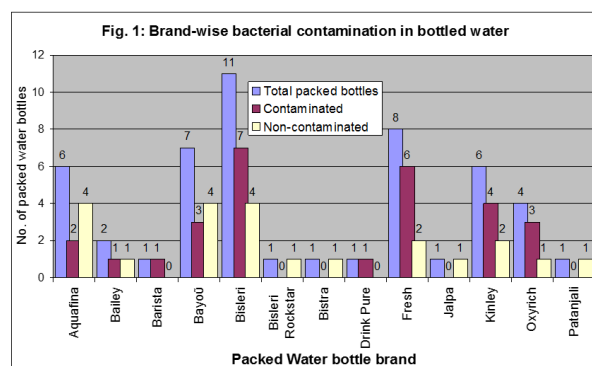
A total of 50 bottled water; Intact and sealed; (1-liter capacity of different brands) samples were collected from Gondia city (Maharashtra State). Bottles were washed externally with sterilized distilled water and thoroughly cleaned by swabbing with cotton soaked in 70% alcohol. Bottles were opened in the aseptic condition in laminar in front of the flame. 1 mL water was withdrawn from the bottle with a sterilized pipette and poured it aseptically in to test tube containing 5 mL MacConkey Broth (Purple) with inverted Durham's tube. The solution was kept for incubation at 37°C for 48-72 Hrs. After incubation, tubes were observed for the development of yellow color as acid and formation of gas in Durham's tube as well as turbidity. Loop full culture from positive tubes (A+G, A) was inoculated in plates containing CLED medium, whereas loop full culture from negative tubes showing turbidity was inoculated in Cetrimide Agar plate. Plates containing inoculated CLED medium and Cetrimide agar were incubated at 37°C for 24 to 48 Hr. after incubation, characteristic colonies were selected. Take out a portion of the isolated colony and inoculated it in a Nutrient broth tube for further tests. It was kept for incubation at 37° for 24 hr. After incubation, the broth culture was processed for morphological, cultural, and biochemical tests. Cultural characteristics of microorganisms were observed by colonies formed on C.L.E.D and Cetrimide Agar plates. Morphology of microorganisms was observed by performing Gram's staining and Motility test Biochemical characteristics of isolated microorganisms were observed by performing the IMViC test, Sugar fermentation test, Triple Sugar Iron Agar Test, Catalase Test, Urease Test, Oxidase Test, and Nitrate Reduction Test.

RESULTS AND DISCUSSION

Table 1: Bacteriological contamination in Bottled water

Samples	No. of Sample
Contaminated	28 (56%)
Free from Contamination	22(44%)
Total	50

Out of 50 bottled water samples collected from different shops in Gondia City, 28 (56%) found to be contaminated with 35 different pathogenic microorganisms whereas 22 samples (44.0%) did not show the presence of pathogenic organisms in it (Table 1). Fig. 1 shows information on 13 brand-wise bacterial quality bottled water contamination. It was concluded that even though the packaged water is considered a safe and potable drinking water source (in absence of alternative drinking water resources) but in actual many brands are not up to the mark and observed pathogenic bacteria when analyzed. The International and national brands such as Aquafina, Bailey, Barista, Bayo, Bisleri, Drink Pure, Fresh, Kinley, and Oxyrich found positive for the presence of pathogenic bacteria while the brands (including local brand) such as Bisleri Rockstar, Bistra, Jalpa, and Patanjali were found negative for the presence of pathogenic bacteria hence considered as safe for consumption. The brands which are found to be bacterial contaminated are reputed and well-known, their demand and very high in supply. The results observed in the present study are alarming and raise doubt on the quality check mechanism. It is their responsibility to sell safe packaged drinking water as it is directly associated with human health.



In the present study, 56 percent of the total (28 of 50 nos.) analyzed packaged drinking water found bacterial contaminated and four bacterial species such as *Pseudomonas* sp., *Streptococcus* sp., *E. coli*, and *Staphylococci* sp. The specific types of these species (except *Pseudomonas*) may cause different infections to the human body. *Pseudomonas* bacteria are generally harmless to healthy people while they may cause infection in people who have weak immunity. *Streptococcus* may cause some disorders, including strep throat, pneumonia, and wound, skin, heart valve, and bloodstream infections. *E. coli* are not harmful but some of the strains such as *E. coli* O157:H7, can cause intestinal infection including diarrhea, abdominal pain, fever, and sometimes vomiting and the species of *Staphylococcus* spp. such as *S. aureus* is the most pathogenic, it typically causes skin infections and sometimes pneumonia, endocarditis, and osteomyelitis which commonly leads to swelling. The Local brands of packaged drinking water were found unfit for human consumption and hence it was suggested that government should intensify the efforts in the monitoring of activities in this rapidly expanding industry to supply potable and wholesome water to the public.

In the present study, out of a total of 50 bottled water of different brands, *Pseudomonas* spp. was identified in 27 samples, *Streptococcus* spp was observed in 6 samples, *E. coli* was observed in 2 samples whereas *Staphylococci* spp was observed in 1 sample. So, excess bacterial count in packaged drinking water could pose serious threats to consumers. Therefore, Surveillance of bottled water manufacturing industries is needed to be done by regulatory agencies

CONCLUSION

The supply of safe drinking water to the community is always a major concern. It is a well-known fact that the microorganisms multiply in the pipe of the water distribution system but it is still the subject of research that why they grow in packaged drinking water. It was concluded that these bottled waters were not fit for human consumption and are hazardous to health and strict and routine monitoring of the packaged drinking water is required. Thus, a more stringent standardization of the bottled water market with special attention to quality, identity, and licensing by concerned authorities is recommended to safeguard the health of consumers. It was recommended that the products should be properly stored and bacteriological tests of the air quality and environment of the factory should also be carried out regularly. It's a common practice nowadays for many people to have packaged drinking water when they are out, considering it the safe and reliable source of drinking water in absence

of alternative drinking water sources. The markets also flourished with international, national, and local brands as the demand for the packaged drinking water is increasing day by day.

RECOMMENDATIONS: While in travelling carry bottle of water and do not entirely rely on the packaged drinking water available in the market. The local government authorities must check the quality of packaged drinking water available in the local market and also inspect manufacturer's activities regularly. Industries should assess the quality of bottled water at different stages (production and post-production) to ensure quality and safety and follow the SOP of water packaging to improve system in the processing and bottling to eliminate microbial contamination.

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