

Microbial Analysis of Bottled Drinking Water Merchandized in Sabratha and Surman Regions

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Abstract:

Consumer quality confidence of the bottled and canned water is almost taken for granted, such blind certainty belief eliminates any hesitation or applying a second thought on the possibilities of potential risks present. Such self-promoted trust makes people think that this type of water is always very clean with balanced quantities of salts, minerals and microbial free. As a result, most individuals are inspired to buy and consume any bottled water brand available in the markets and this type of water is permanently preferred to the other tap or well water. The aim of current study is to evaluate consumer quality confidence. random samples

of the retailed bottled drinking water Were collectel prom Sabratha and Surman supermarkets and grocery stores. Every sample was subjected to Physical, and Microbial contents analysis and then evaluation and results compared to the current Libyan Standard (LS) values. Approved methods, validated instruments and reagents were used to analyze the randomly 19 collected samples for Total Dissolved Solids (TDS), pH, total aerobic bacterial count, Escherichia coli, Coliform, Pseudomonas aeruginosa, Yeast and Mold count. Of the nineteen bottled samples tested, (TDS) content had ranged from: 15.40 to 97.35 mg/l, the pH values were between 5.76 to 7.19 and total aerobic bacterial counts fluctuated from 0 to uncountable quantities. Eight (42.11 %) of the 19 brand of bottled water were categorized to be unsafe for consumption. They were 36.8% total aerobic, 10.5% coliforms, 10.5% P. aeruginosa and 26.31 yeast. 100 % of the collected reusable 18 liters bottles samples found to be contaminated with various bacteria's. The study concluded that Some of the examined samples (both single use bottled water and reusable 18 liters bottles) TDS values were very low, others contain a very dangerous bacteria and this due to either the complete absence or poor disinfectants systems in those bottling plants and all of reusable 18 liters bottles samples found to be contaminated with various bacteria's and this due to the absence of bottles disinfects or sterilization prior their refilling.

Key words: *Bottled water, Total aerobic bacteria, Coliform, E. coli, P. aeruginosa and Libyan standards.*

1.Introduction:

Water's unique chemical and physical properties are essential to human survival. Without water, basic physical processes would be

impossible. Cells within the human body would die. None of the essential physical functions, such as breathing, digestion, or muscle movement could take place without water. About 70 percent of the human body is made up of water and coincidentally more than 70 percent of Earth is covered with water. Water creates an environment that sustains and nurtures plants, animals and humans, making Earth a perfect match for life in general ^[1]. Supposedly, water for human consumption should be organisms free. But in reality is not always the case ^[2]. Bacteria may be present in bottled water at low harmless and outbreaks of human illness associated with bottled water are infrequent compared to those linked to tap water ^[3]. However, the contamination problem has been existing for quite a while, As a matter of fact a bottled water microbiological contamination study was carried out in 2009 to survey the Libyan market retailed reusable 18 liters bottled water microbiological contaminates had indicated that 89% of the tested samples total aerobic bacterial count were beyond the acceptable bottled water microbial limits, 65 % of the tested samples, Coliform contents were over the normal limits and 7% of the samples *Escherichia coli* quantities were far above those listed limits in the Libyan bolted water microbiological standards, 30% of the tested samples *Pseudomonas aeruginosa* totality were over the normal limits ^[9].

Monitoring bottled water for specific pathogens is a very difficult task, because pathogens tend to be intermittently present and in very low numbers. Therefore, it is more effective to monitor water for index and indicator microorganisms which may be present in the water in higher numbers^[7]. However, if the index microorganism *E. coli* is detected, then, water is considered unsafe for human consumption. This is because such bacteria presence points to a potential presence of enteric pathogens. If

coliforms (indicator microorganisms) are detected, then it could be an indication of water source quality problem or possible contamination during the bottling process. Water that tests positive for coliforms (but negative for *E. coli*) is not considered to be unsafe for consumption because the presence of coliforms on its own is not a strong indication of the potential presence of enteric pathogens. Yet, the presence of *coliforms* do require careful investigation in the possible causes and requires an enhanced monitoring of finished product and source water for the presence of *E. coli* ^[3].

Furthermore, detection of *P. aeruginosa* in bottled water is not a significant public health risk sign, rather than an opportunistic pathogen associated with hospital-acquired infections in individuals that are profoundly immunocompromised. These include patients with profound neutropenia, cystic fibrosis and severe burn ^[3, 4]. The most serious *P. aeruginosa* infections include bacteremia, pneumonia, urosepsis, and wound infections ^[4]. In order to contain the problem from spreading, a quick and appropriate safety measures are implemented within those hospitals, the simplest and easiest measure is to stop rationing suspected affected bottled water batch(s) for consumption to reduce the risk of patients infection ^[5, 3].

However, due to the exponential increasing demand caused by high consumption of bottled water in the Local market, a newly ever growing numbers of bottled water brands are entering the market every day .

As a result of the above mentioned, product quality concern is dramatically rising by the day as well, especially, when this quality of bottled water is not subjected to any tough quality control measures and as a consequence, this microbial contamination, physical properties and chemical contents bottled water analysis study is aimed to give some

glimmering of the existing problem. Hoping that this would alert the authorities to act quickly to contain such disaster before it is too late.

Materials and Methods:

Media Used for culture:

The used media were compact dry TC for Total bacterial Count, EC for both *E. coli* and *Coliform* and YM For Yeast and Mold from *HyServe*, Germany. M- Endo medium from *HACH*, Germany.

Collection of Samples:

A total of 19 different brands sealed samples of bottled water were randomly collected from different retailers and grocery stores in different parts of Sabratha and Surman regions.

Microbiological Analyses:

Determination of Total bacterial count, total *E. Coli* , Coliform, *P. aeruginosa* Yeast and Mold count in water samples were done in triplicates. Each bottle was adequately shaken then; three samples of 1 ml were taken from each bottle for microbiological analysis, TC, EC and YM Compact Dry Media plates were properly labelled and recorded. One ml of each bottled water was placed on TC, EC and YM Compact Dry Media plate , The TC and EC plates were incubated at 37°C for 24 hrs. The YM plates, were incubated at 37°C for 7 days, then, counted each plates colony.

Total bacterial count was also tested by Filtration Membrane FM method in triplicates. A 250 ml of water sample is passed through 0.45 mm membrane using filter funnel and vacuum system. The filters were placed on the absorbent pad saturated with M – Endo media, and Incubated at 37°C for 24 hrs. Then, counted each plates colony.

Physical analysis of water samples:

The EC, pH and Total Dissolved Solid (TDS) for each water sample were measured with a *WTW multiline parameter, Germany*.

Results and Discussion:

A total of 19 coded brands (W1, W2, W3, W4, W5, W6, W7, W8, W9, W10, W11, W12, W13, W14, W15, W16, W17, W18 and W19) were analyzed. All samples selected for this study were stored at room temperature (25-30°C) until analyzed (Table 1).

Total dissolved solid (TDS) content of the 19 samples varied between 15.40 to 97.35 mg/l with the mean of 43.84 mg/l (Table 1). Libyan Standard LS recommends that a bottled drinking water can have TDS up to 500 mg/l^[8]. Electrical Conductivity of the 19 samples ranged from 19 to 200 µS/cm (mean value was 80.36 µS/cm; Table 1). The pH values of the 19 samples varied from 5.76 to 7.19 with the mean of 6.83 (Table 1) and the recommendation is 6.5 to 8.5^[8].

Eight (42.11%) of the 19 brand of bottled water samples which collected for this study were categorised as unsatisfactory because one or more parameter was detected (Table 1). They were 36.8% total aerobic, 10.5% coliforms, 10.5% *P.aeruginosa* and 26.31% yeast.

According to the Libyan Standard^[8], acceptable aerobic count is from 50 - 100 cfu/mL. Table 1 shows the aerobic bacterial count present in different brands of bottled water samples. Total aerobic count varied from 0 to uncountable. The W1, W2, W3, W4 (18L), W7 (7L), W15 and W16 (0.500L) brands contained higher aerobic bacterial contamination than the recommended value of LS^[8].

Libyan standard for *E. coli* is 0/250ml^[8]. Hence, all brands of water samples were negative for *E. coli*. pointing to no presence of enteric pathogens.

A further, two brands (18L) of water sample W3 and W4 tested positive for *P. aeruginosa*, their count were 250/250ml and uncountable in respectively, they exceeded the limit according Libyan standard of bottled drinking water number 10 for 2008 ^[8], which is 0/250ml. *P. aeruginosa* is resistance to the antibiotics and exist in large number in human feces of the adult person, so it considered as index to inefficiency of the treatment process.

Coliforms were detected in two brand W1 and W3(18L) of water sample, their count were 8250/250ml respectively, while the maximum range of Libyan standard for total *coliform* is 0/250ml. The presence of *coliforms* indicates that may be a problem with the quality of the source water or possible contamination during the bottling process.

Of the 19 bottled drinking water brands tested, five brands W1, W2, W3, W4 (18L) and W9 (1.5L) contained yeast contamination, they varied from 250/250ml to 500/250ml.

According to the results, there are high level of microbial contamination of total 4 brands 18L bottled water W1, W2, W3 and W4 which produces locally. High microbial index was found, indicating the failure efficient water purification and cleaning especially in the process of re-packaged more and more.

Conclusion:

- Some of the examined samples TDS values were too low that the bottled water are almost considered distilled and for this reason its consumption may cause body dehydration (specially to infants and toddlers)

- A considerable percentage of the single use bottled water tested samples found to contain a very dangerous bacteria and this due to either the complete absence or poor disinfectants systems in those bottling plants.
- 100 % of the collected reusable 18 liters bottles samples found to be contaminated by various bacteria's and this due to the absence of bottles disinfectants or sterilization prior their refilling.

However, as per the discovered results and facts, It would be concluded that not all bottled water brands are safe to drink and therefore every one ought to think twice before buying a bottle of water from supermarkets. Yet, the team advice the related authorities in both Sabratha and Surman reigions to implement a strict rules to force the retailers to not to accept any bottled water without a quality certificate supplied by the water producers and those authorities should carry out their own regularity comparison tests to compare the actual bottled water quality with the provided certificates values and to eliminate any none complied products Also. To produce a media programs and posters to highlight the contamination risks of the reusable bottles in order to convince people to terminate their use.

Less than half of the bottled drinking water brands sold in Sabratha and Sorman were contaminated with aerobic bacteria and/or yeast. Lack of knowledge about water quality, long storage period from manufactured date and higher environmental temperatures could be the reason for this high bacterial contamination of bottled drinking water.

Table 1 physical constituents, aerobic bacterial count, E. coli, coliform, P. aeruginosa and yeast results of compact dry test of different brands of bottled drinking water.

Brands	Physical constituents			Count/250ml				
	EC μS/cm	TDS mg/l	PH	Total aerobic bacterial	<i>E. coli</i>	<i>Coliform</i>	<i>P. aeruginosa</i>	yeast
W1	63	34.65	5.76	Unaccountable-	non	8250	Non	500
W2	52	28.8	6.15	250	non	non	Non	250
W3	19	32.45	6.92	Unaccountable-	non	750	Unco-	250
W4	200	110	6.70	Unaccountable-	non	non	Unaccountabl e-	750
W5	117	97.35	7	non	non	non	non	non
W6	131	72.02	6.72	non	non	non	non	non
W7	40	22	7.25	1000	non	non	non	non
W8	106	58.30	7.03	non	non	non	non	non
W9	90	49.5	6.40	non	non	non	non	500
W10	28	15.4	6.70	non	non	non	non	non
W11	89	48.95	6.85	non	non	non	non	non
W12	108	59.40	7.19	non	non	non	non	non
W13	28	15.40	7.04	non	non	non	non	non
W14	69	537.95	7.50	non	non	non	non	non
W15	68	37.4	6.38	Unaccountable-	non	non	non	non
W16	59	32.45	6.76	500	non	non	non	non
W17	89	46.20	7.9	non	non	non	non	non
W18	83	45.65	6.61	non	non	non	non	Non
W19	88	48.4	6.87	non	non	non	non	Non

EC: Electrical Conductivity, TDS: Total dissolved solid.

Finally this study recommended the manufacturers of locally drinking bottled water to: follow food safety management systems to meet the microbiological criteria laid down in L.S. No. 10 of 2008 and comply with the specific labeling requirements for bottled water laid down in L.S. No10 of 2008 , also It is also recommended that the importers ensure that the bottled water they place on the market in Libya complies with the microbiological criteria and specific labeling requirements of L.S. No. 10 of 2008 ^[8].

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