

EVALUATION OF MICROBIOLOGICAL AND CHEMICAL QUALITY OF COMMERCIALY AVAILABLE BOTTLED DRINKING WATER IN SRI LANKA

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Use of bottled water in Sri Lanka has increased over the last decade, while new brands of bottled water are often introduced to the market. However, the manufacturers' adherence to bottled water regulations is questionable, raising concerns over the quality of bottled water. The objective of the current study was to investigate microbiological and chemical quality of bottled drinking water in Sri Lanka and determine if these parameters are within permitted levels, and thereby create an awareness of the quality of bottled drinking water in Sri Lanka.

Numerous bottled water brands were subjected to several experiments to determine the microbiology and chemical quality of bottled water. Most of the brands tested exhibited high numbers of Heterotrophic Plate Count bacteria. The study also revealed that most bottled water brands exceeded the permitted level of total coliform (0-10 cfu/100 ml) and fecal coliform (0 cfu/100 ml) counts determined by the membrane filtration method which is used by the National Water Supply and Drainage Board and many private laboratories. Variance analysis revealed a significant reduction in microbial numbers between the numbers of microorganisms initially (1 -3 months) present in the water and those present after one year of storage.

Results of the confirmation tests showed that, among presumptive total and fecal coliforms colonies detected, only typical red colonies with a metallic sheen on M-Endo medium were confirmed as total coliforms and not the pink/red colonies without a metallic sheen. Considering fecal coliforms, even typical blue colonies on M-FC medium

and blue colonies on m-ColiBlue24 media were most often not confirmed as fecal coliforms.

Biochemical tests, API 20E and API 20NE revealed that bottled water samples were contaminated with coliforms and non-coliform species. Among the coliforms species *Klebsiella pneumoniae* ssp. *pneumonia* and *Enterobacter cloacae* were identified. *Escherichia coli* was not detected in any of the samples tested. The presence of thermotolerant coliforms (*Klebsiella* sp. and *Enterobacter* sp.) provides a possibility of fecal contamination in some brands of bottled water sold in Sri Lanka.

Pseudomonas aeruginosa, an opportunistic pathogen, and *Pasteurella haemolytica* were non-coliform isolates detected in this study. Detection of *P. aeruginosa* in 18 (50%) brands out of 36 brands is of considerable interest. Out of 186 isolates, 108 isolates were identified as *P. aeruginosa* according to the results of ISO 16266:2006 standardized procedure and API 20NE identification system. The presence of *P. aeruginosa* was confirmed by molecular identification with bidirectional direct DNA Sequencing using the primer pair rD1 and fD1 (forward: 3'AGAGTTTGATCCTGGCTCAG5'; reverse: 3'AAGGAGGTGATCCAGCC5'). Experiments revealed that an UV dose of approximately 17,300 $\mu\text{W}/\text{cm}^2$ was effective against *P. aeruginosa*, eliminating all bacteria within 5 seconds of exposure time.

Considering the chemical parameters of bottled water, electric conductivity, alkalinity, hardness, ammonium, nitrite, nitrate, sulphate, phosphate, sulphide, chloride, fluoride, manganese, iron, calcium and zinc were at a satisfactory level. Ninety three percent of brands investigated were below the minimum recommended pH value (6.5) imposed by the Health Ministry of Sri Lanka. When considering the relationship between microorganisms and chemical parameters, bacterial counts showed a positive correlation with Ca and a negative correlation with Cl.

In conclusion, the results of the current study raises concerns over the bottled water industry in Sri Lanka and a need for the bottling industry to be monitored closely by relevant authorities, in order to provide safe bottled drinking water to consumers in Sri Lanka.