Natural Mineral Water and Bottled Drinking Water

P. Madarasinghe

Every cell in the body needs water, and that is why it is so important to drink a sufficient quantity of water daily. The brain consist 90% of water and when the body is under supplied the brain cannot function well and signs of dehydration manifest.

Although 70% of the earth is covered with water, most of it is not available for human consumption without being processed first. Of the planet's water, the oceans make up for 97%, while glacial shields hold another 2%. Only about 1% is soft water from lakes, rivers, and underground sources, but even out of that tiny amount an increasingly large volume is unsafe for human consumption. Finding quality water for consumption has become a problem for humans.

Due to the vast expansion of industries, agriculture, population growth, and increasing use of harmful chemicals, as well as geographical factors, contamination of drinking water occurs through a range of chemical, microbial, and physical hazards which cause health risks when present at high levels. Examples of chemical hazards include lead, arsenic, and benzene. Microbial hazards include bacteria, viruses and parasites such as *Vibrio cholerae*, and hepatitis A virus, and due to these reasons providing safe and accessible drinking-water has become a major challenge world over.

This situation, linked with the prevalence of market trends, has caused the business of bottled water to flourish. Consumption of bottled water has been increasing consistently over the last decade, even in countries where pipe-borne water quality is considered good.

Bottled water industry has grown dramatically in the last few decades, and today millions of people around the world in developed and developing countries consume bottled water regularly. Most people believe that bottled water is safe, and hence it has become an increasingly popular beverage all over the world.

Food (Bottled or Packaged Water) Regulations

In Sri Lanka, bottled water is regulated by the Ministry of Health through the Food

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(Bottled or Packaged Water) Regulations 2005 framed under the Food Act No. 26 of 1980, which regulates bottled water as a 'food', and manufacturers are obliged for producing safe wholesome and honestly-presented products.

Regulations include a standard of identity that define two different types of bottled water, namely 'Natural Mineral Water' and 'Bottled Drinking Water'. The regulations mandate the obtaining of a certificate of registration from the Chief Food Authority (CFA) prior to bottling or packaging or importing Natural Mineral Water or Bottled Drinking Water.

Provision 4 specifies that; No person shall sell, offer for sale, keep for sale, transport or advertise for sale any Bottled or Packaged Natural Mineral Water or Bottled or Packaged Drinking Water unless such product has been duly registered by the Chief Food Authority and a registration number in terms of the foregoing provisions of this regulation has been assigned thereto.

Applications received from prospective manufacturers for registration are processed by an institution that has the expertise in the required field, and presently the Sri Lanka Standards Institution functions as the recognized body under a Memorandum of Understanding with the Ministry of Health. At present there are about 130 brands of bottled drinking water, 9 brands of Natural Mineral Water, and 09 brands of imported products from countries such as France and Italy, registered by the Ministry.

The regulations define 'Natural Mineral Water' as "water that originates from an underground water bearing strata and is extracted for human consumption from natural or drilled sources such as springs, wells or boreholes" and 'Bottled or Packaged Drinking Water' as "water that is sealed in bottles (containers) ready for human consumption; but shall not include Natural Mineral Water".

Special provisions related to Natural Mineral Water to guarantee the original purity of the products, are also specified, and accordingly "Natural Mineral Water be collected under conditions, which guarantee the original purity, not be subjected to any treatment other than separation of unsuitable constituents by decantation or filtration, and if necessary, accelerated by pre-aeration, be bottled or packaged close to the point of emergence of the source under hygienic precautions, not be transported in bulk containers for packaging, pipeline transport is allowed if all precautions have been taken to maintain the purity of water".

The Food Act requires that bottled water should be safe and processed, bottled, stored, and transported under sanitary conditions. Processing practices addressed in the regulations include protection of the water source from contamination, sanitation at the bottling facility, quality control to ensure bacteriological and chemical safety of water.

Bottled water labels should meet the appropriate standard of identity, or it will be considered as violatory under the Act. For example, a bottle labelled as containing "mineral water" must meet the criteria set out for "Mineral Water" and it must come from a geologically and physically protected underground water source and it must contain no added minerals.

Standard of Quality Regulations

There are microbiological standards that set

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Table 1: Physical Chemical and Microbial requirements

Characteristic	Mineral Water Requirements	Drinking Water Requirements
Colour Hazen Units (Max)	5.0	15.0
Odour	Unobjectionable	Unobjectionable
Taste	Unobjectionable	Unobjectionable
Turbidity, NTU (max)	5.0	5.0
pH	--	6.5 to 8.5
Total dissolved solids, (values are presented hereunder as mg/l (max)	1500.0	1000.0
Arsenic as As	0.01	0.01
Aluminum as Al	0.2	0.2
Cadmium as Cd	0.003	0.003
Cyanide as CN	0.07	0.07
Chromium as Cr	0.05	0.05
Mercury as Hg	0.001	0.001
Nickel as Ni	0.02	0.02
Selenium as Se	0.01	0.01
Lead as Pb	0.01	0.01
Copper as Cu	1.0	1.0
Antimony as Sb	0.005	--
Barium as Ba	0.7	--
Manganese as Mn	0.5	0.5
Zinc as Zn	--	3.0
Total iron as Fe	--	0.3
Total hardness as CaCO3	--	250
Free residual Chlorine as Cl2	--	0.2
Alkalinity total as CaCO3	--	200
Free ammonia as NH3	--	0.06
Chloride as Cl	250.0	250.0
Fluoride as F	1.5	1.5
Nitrate as NO3	50.0	50.0
Nitrite as NO2	3.0	3.0
Sulphide as H2S	0.05	--
Sulphates as SO4	--	250.0
Chemical Oxygen Demand (COD)	--	10.0
Phenolic compounds and mineral oil	Absent	Absent
Grease and oil	Absent	Absent
E. coli and coliforms	Absent	Absent
Pathogenic organisms	Absent	Absent

Source: Food (Bottled or Packaged Water) Regulations 2005

permissible coliform levels, and physical standards specifying levels for turbidity, color, and odour as shown in the table.

Treatment during processing of bottled drinking water

The regulations provide for chemical and physical treatment methods during processing to reduce, remove or prevent growth of micro-organisms such as chlorination,

ozonation, carbonation, high heat, ultraviolet radiation, and filtration. Treatment process includes the use of sand or compressed fiber filers, cartridge filters, pleated membrane filters, activated carbon filters, aeration, demineralization, de-ionization and/or water softening.

Inspection of Bottled Water Plants

The Authorized Officers appointed under the Food Act monitors and inspects bottled water products and processing plants. In addition, follows up on consumer and trade complaints and other leads, as appropriate, on use of potentially violative products, and also collect samples for analysis and submit these to Food Laboratories gazetted under the Food Act to test for microbiological or chemical contamination. It is the responsibility of all consumers to report observed faults such as presence of foreign particles, unusual or unpleasant odours, suspicious label information etc. to Health Authorities.

Shelf Life of Bottled Water

Bottled Water Regulations neither set nor suggest limitation to the shelf life of bottled water. Most bottled water containers retailed bear a two-year expiry period. General position of the International Bottled Water Association (IBWA) is that as long as bottled water is packaged in accordance with regulatory processing in compliance with Good Manufacturing Practices(GMP), and meeting the quality standards, the product's shelf life should remain intact for a considerable period of time provided that product storage and other post-packaging and handling practices do not adulterate or deleteriously affect the finished product.

Misleading Bottled Water Labelling and Marketing

The Labelling Regulations define essential labelling and advertising rules, specify mandatory information which should be on product labels, and impose restrictions in relation to the declaration of false claims, or misleading descriptions in such a manner as to mislead the purchaser or consumer, or presented in a manner that is likely to create an erroneous impression regarding its character in any respect. In addition to the above, special provisions have been introduced to control false or misleading descriptions under the Bottled or Packaged Water Regulations, such as:

Nothing shall be printed or published on the label or on the bottle in respect of medical or other benefits that can be gained by a consumer using Drinking Water ;

Shall not print or publish on the label or on the bottle any statement or any pictorial device, which may create confusion in the minds of the public, or in any way mislead the public about the nature, origin, composition and properties of Drinking Water.

Some labels may carry descriptions such as "Spring water" with graphics of mountains and a lake on the label, whereas the actual source is located in an entirely different locality, thereby misleading the public about the product's origin.

Moreover the use of descriptive terminology suggesting bottled water is extraordinarily pure and uncontaminated are observed. For instance, descriptions such as 'Pure', 'Naturally Purified', 'Premium', 'Mountain Water', 'For Health Conscious' are being used to boost sales.

Enforcement officers should be vigilant to identify such exaggerated descriptions and take appropriate action, and consumers also should pay more attention to the labelling information and be sharp enough to make a correct choice without being misled by exaggerated claims.

Reported illnesses due to bottled water

As far as Sri Lankan experiences are concerned no water-borne illness have been traced to bottled water since the introduction of bottled drinking water. This is evident from the

Weekly Epidemiological Reports published by the Ministry of Health, and to date bottled water has not been responsible for an outbreak of any such diseases. Nevertheless there have been waterborne-disease outbreaks elsewhere traced to bottled water. For example, in 1996 a bottled water-related cholera outbreak was reported in the Morbidity and Mortality Weekly Report of the United States. In Portugal, during the cholera epidemic of 1974, bottled mineral water was identified as one of the vehicles of transmission of *Vibrio cholera*.

Imported bottled water:
Regulatory provisions make it mandatory to obtain a Certificate of Registration from the Chief Food Authority to import Bottled Water. For registration it is necessary to submit samples of the product along with a Certificate of Analysis from an accredited laboratory relating to the content of such sample. The Food Authority with the concurrence of the SLSI makes decisions regarding awarding the certifications based on the above reports. Evidently the Food Authority has no access for inspection of Good Manufacturing Practices, sources, and bottling facilities which are outside Sri Lanka to evaluate compliances.

Public concerns on bottled drinking water:
Major concern about the consumption of bottled water can be cited as the issues related the Bisphenol-A (BPA) in Bottled Water containers. Studies regarding BPA and how this chemical may adversely affect the health have been conducted and results released by independent researchers. BPA is used in the production of epoxy resins and polycarbonate plastics worldwide. It is used to make plastic bottles of all kinds. However, as these plastic bottles become aged, BPA has a tendency to leach into the contents. According to several studies, they adversely affect health in many different ways.

Results of studies conclude that BPA causes long-term effects on mammary tissue development, increasing risks to cancer in rats, chromosomal disorder in mice, and BPA alters development of the reproductive tract as well as increases prostate tumor proliferation.

Almost all the research papers highlight the formation of BPA and other toxic substances due to the aging of plastic bottles, and leaching of these compounds were found to depend on storage conditions, temperature, and exposure to direct sunlight.

Thus the consumers should be well aware in selecting bottled water which should be properly sealed with tamper-proof coverings, and appropriately stored in a cool and dry place, before causing an alarm when consuming bottled drinking water. In addition when considering the polluted water and the possible contaminants in water available in urban and rural food establishments, it can be argued that consumption of quality bottled drinking water is advantageous.

Other controversies on Bottled Water include concerns over the energy and material that are used for making bottles and transportation of water countrywide as well as the implications of climate change concerns regarding the bottles which are not recycled, the harmful toxins that are released to the environment during incineration, the accumulation in the decomposing process in landfills, and over-extraction of spring water resulting in harming natural water resources.

Food for thought:
Sri Lanka being a tropical country is fortunate to have a vast number of natural fruit drinks and especially several varieties of coconut such as “Thambily”, Kundhira” and “Kurumba”. All these products are totally free from chemical and bacteriological contamination and provide essential nutrients that the body requires.

It is worthwhile to know that 100g of coconut water provide

and Applied Human Science provide nutritional composition of plain water, fresh young coconut and carbohydrate - electrolyte beverages.

Potassium 250 mg, Calcium 24g, Copper 40 mcg, Magnesium 25 mg, and so forth, and coconut water can be marketed as a natural energy or sports drink due to its high potassium and mineral contents. Nutrition values obtained from the National Nutrition Data Base of the United States Department of Agriculture (USDA) is cited as reference in support.

Furthermore the following data published in the Journal of Physiological Anthropology

Above factors should be borne in mind when selecting a beverage to quench the thirst. The law mandates traders to abide by all the rules and regulations. In addition all the manufacturers and traders are bound to comply with ethical aspects of marketing, all of which cannot be taken as granted for continuous supply of quality, wholesome, and safe bottled drinking water. It all depends on the honesty, dedication and commitment of all persons involved in the chain from the source to consumption.

Coconut water (*Cocus nucifera*)
Fresh, Nutrition Value per 100 g
Source: USDA National Nutrient database

Principal	Nutrient Value	Percentage of RDA
Energy	19 Kcal	1%
Cabohydrates	3.71 g	3%
Protein	0.72 g	1.5%
Total Fat	0.20 g	1%
Cholesterol	0 mg	0%
Diatary Fiber	1.1 g	3%
Vitamins		
Folates	3 µg	0.75%
Niacin	0.080 mg	0.5%
Pantothenic acid	0.043 mg	‹1%
Pyridoxine	0.032 mg	2.5%
Riboflavin	0.057 mg	4%
Thiamin	0.030 mg	2.5%
Vitamin C	2.4 mg	4%
Vitamin A	0 IU	0%
Vitamin B	0 mg	0%
Vitamin K	0 mcg	0%
Electrolytes		
Sodium	105 mg	7%
Potassium	250 mg	5%
Minerals		
Calcium	24 mg	2.4%
Copper	40 mcg	4.5%
Iron	0.29 mg	3.5%
Magnesium	25 mg	6%
Manganese	0.142 mg	%
Zinc	0.10 mg	1%

Table 1 Nutrient composition and osmolality of plain water, fresh young coconut water and carbohydrate-electrolyte beverage. Data presented as Mean ± SEM

Variables	PW	CW	CEB
Glucose (mmol l^{-1})	0	139.63 ± 4.95	179.40 ± 2.40^{++}
NA^{+} (mmol l^{-1})	0	5.09 ± 0.40	19.01 ± 0.29^{++}
K^{+} (mmol l^{-1})	0	52.66 ± 0.59	3.75 ± 0.14^{++}
C^{1-} (mmol l^{-1})	0	1.11 ± 0.59	0
Osmolality (mOsm kg^{-1})	0	405 ± 10.89	404 ± 10.73

PW = Plain water
CW = Fresh young coconut water
CEB = Carbohydrate-electrolyte beverage
$^{++}$ = significantly different from CW at $p<0.01$

SEM- standard error of mean ; mmol l- millimoles per litre ; mOsm kg - milliOsmols per kilogram;
Osmolality is the measure of solute concentration, defined as the number of osmoles (Osm) of solute per litre (L)

P. Madarasinghe
Rtd. Assistant Director
Food Control Administration Unit
Ministry of Health
(Consultant, Food Products Evaluation n& Consultative Services)
0773 559758