Original article

Labeling practices of water bottling firms and its public health perspective in Ethiopia

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Abstract

Background: Bottled water labels enable the consumers to choose brands that can best fit to their needs and preferences. Anything inaccurate, however, may pose serious public health risks, especially to vulnerable individuals. In Ethiopia, regular monitoring of bottled water quality and labelling practices is still lacking.

Objectives: This study assessed the labeling practices of water bottling firms in Ethiopia and compared the values of physicochemical water quality parameters measured in the laboratory with figures inscribed on the labels.

Methods: Samples of 11 domestic bottled water brands (N = 165) were randomly purchased from retail stores and supermarkets in Addis Ababa at three different occasions (between July 2013 and May 2014) and analyzed for their physicochemical constituents. The written and graphic information on labels of bottled water products were examined and compared with the values measured in the laboratory. Besides, values of parameters determined in the laboratory were compared and contrasted against national standards and international guidelines to assess suitability for health and to evaluate their legal compliance.

Results: A number of deficiencies were identified with regard to labeling practices. The incompleteness of the constituents displayed on the labels was a clear weakness. Only the concentrations of Na^+, K^+, Ca^{2+}, and Mg^{2+} were appeared on the labels of all brands. On the other hand, ten, eight, and seven firms out of eleven manufacturers inscribed no information on their labels regarding the levels of total alkalinity, F^- and NO_3^- respectively. The paired *t*-tests performed to compare the values measured in the laboratory and the manufacturer's labeling revealed that significant differences ($P < 0.05$) observed for the values of Ca^{2+}. In addition, there were discrepancies between the labeled figures and the values measured in the laboratory for Cl^-, NO_3^-, Na^+, and Mg^{2+}. Moreover, there were inconsistencies when firms classify their bottled water products as 'Mineral water', 'Spring water', 'Purified Water', and 'Natural water' and a few of them were wrongly characterized.

Conclusions: From this study, it can be claimed that some parameters were mislabeled or unlabeled and a few brands were inaccurately characterized. Despite the presence of basic legal instruments, it can be said that consumers' right are yet to be respected. To tackle the problem, regular monitoring by responsible authorities would be helpful. Besides, third-party labeling services could be used to boost the credibility of the labeling process. [*Ethiop. J. Health Dev.* 2016;30(2):78-85]

Keywords: Ethiopia, labelling, misbranding, public health, water quality

Introduction

Food labels are expected to specify the composition, net weight (volume), nutrition facts, and a variety of other information about a product (1). It can essentially comprise of any written or graphic descriptions appear on a product, its container, and packaging. It may include information that can promote safe handling and eventual disposal (2). As aptly described by the International Bottled Water Association (IBWA), labels can be used as a 'gateway' for consumers to obtain information about the quality and safety of products (3). Besides, bottled drinking water labels provide information on the public health aspect of constituents.

Incidentally, IBWA, the Commission of the European Communities, the United States Environmental Protection Agency (US EPA), and the World Health Organization (WHO) have issued various guidelines and standards regarding the concentration limits of different bottled drinking water quality parameters and labeling requirements (3-6). Similarly, the Public Health Proclamation of the Federal Government of Ethiopia (200/2000) clearly stated that the process of importing, producing or distributing bottled mineral water, or plain water is prohibited unless its quality is verified (7). And more recently, the Standard Agency of Ethiopia proclaimed that constituents of bottled waters should clearly be stated and listed in the following order: calcium, magnesium, sodium, potassium, chloride, sulphate, total alkalinity, nitrate, fluoride, iron, bicarbonate, Total Dissolved Solids (TDS) and pH. Besides, it specifies that the bottlers are obliged to include whether the product is natural and still or carbonated and sparkling, its suitability for infants, net content, date of production and expiry dates, physical address of the manufacturer, and so on (8).

Yet, mislabeled products or products having inaccurate or misleading labels are common in the water bottling industry. A number of studies conducted at different times and places reported that descriptions of parameters appeared on labels might not be accurately specifying the real values contained in bottled water products. In this regard, Weinberger (1991) confirmed that the concentrations of F^- determined in the laboratory and the values reported on the labels showed great variations (9). In a similar account, an assessment done in Saudi Arabia, reported that the average measured content of F^-, Ca^{2+}, and pH were found higher than the values reported on the labels for 21

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brands that were being consumed in Riyadh (10). On the other hand, the same source discovered that the measured TDS contents were lower than the figures put on the labels. In the same way, a study conducted in Iran reported that the labeled F^- values were different from the measured concentrations in all sampled brands (11). Yet again, another investigation conducted by Moazeni *et al*. (2013) found that the measured levels of K^+ and SO_4^{2-} were about 43% and 52% higher than the amounts displayed on the labels respectively. The same authors also revealed that the real contents of Ca^{2+}, Cl^-, and pH were about 71%, 48%, and 67% less than labeled values respectively (12). According to Momani (2006), significant variations between the labeled and measured values for Ca^{2+}, Mg^{2+}, F^-, NO_3^-, and SO_4^{2-} were observed (13).

As can be inferred from the aforementioned reports, inaccurate labeling practices are more pronounced in the industry and may pose serious public health problems, especially to high risk and immune-compromised individuals (6). Despite the health risks and the emergence of various reports from different corners of the globe regarding unethical activities in the business, the labeling practices of water bottling companies have not been studied in Africa including Ethiopia. Thus, the intention of this assessment was to determine the concentration of important water quality parameters contained in the most widely marketed bottled water brands in Addis Ababa and to evaluate their labeling practices.

Methods

***Study Design*:** A cross-sectional study was conducted within the time frame of about 11 months (between July 2013 and May 2014). The study period was extended to 11 months to have representative physicochemical results for each brand within that time as changes (if any) in water treatment methods affect the quality of the products.

Study Area: Bottled waters are normally available everywhere in the city from big supermarkets to small shops. But, samples of the 11 bottled water brands were purchased from supermarkets and shops in Addis Ababa which were supplied by the manufacturers. Besides, the handling or storage of the products was considered to decide sampling palaces.

Study subjects: During the study period (2013/2014), there were about 32 functional drinking water bottlers all over the country (14). Nevertheless, purposive sampling technique was employed and only 11 bottled water brands (namely: Abyssinia, Ambo, Aquaddis, Aquasafe, Cheers, Classy, Kool, Oasis, Origin, Real, and Yes) which were widely available in the market were included for further analysis. To avoid undesirable effects from this study, letters A, B, C, D, E, F, G, H, I, J, K, L, and M were assigned hereafter to represent the brands (letters represent brands without alphabetic order).

Sample Size Determination and Sample Collection: From the 32 bottled water brands functional in Ethiopia during the time of the investigation, this study included 11 brands which were widely available in Addis Ababa. Five bottles of water from 11 commonly available and sold bottled water brands were collected randomly from retail stores and supermarkets at three different occasions. As a result, 15 samples from each 11 brand and a total of 165 bottles were collected.

Laboratory Analysis: Each time five bottles of water (of the same batch of production) from each brand were collected and thoroughly mixed to have an even distribution of chemicals, and then equal volume of water from each of the five bottles of water was taken and combined together in a clean bottle to have composite samples. Such composite samples were then run as single samples. Thus, triplicate runs of composite samples were conducted for each brand and the averages of the triplicate runs were taken for each parameter and every brand for further analysis and comparison.

Each composite sample was analyzed for aggregate parameters (pH, TDS, total hardness, bicarbonate alkalinity, and conductivity), anions (chloride, nitrate, nitrite, ammonia, fluoride, bicarbonate, phosphate, and sulphate), cations (sodium, potassium, calcium, and magnesium), trace elements (cadmium, chromium, copper, lead, manganese, nickel, and iron) and organoleptic characteristics (taste, odour, turbidity, and colour) in accordance with the procedures delineated in the standard methods (15).

To confirm the accuracy of laboratory outputs, the Public Health Chemistry Laboratory at the Ethiopian Public Health Institute followed multiple quality assurance steps and procedures in-line with ISO/IEC 17025 (16). Thus, analytical grade reagents were used for sample preparation and analysis; replicate tests were done to minimize bias; and blank samples, laboratory-fortified samples, and reagent blanks were analyzed simultaneously with water samples (to find out the contribution of the reagents to error). Internal standards were used and calibrations were done to equipments depending on the type of analysis. To check interpersonal reproducibility of the result, 10% of the samples were analyzed separately by different technicians (17).

Using the quality control procedures delineated above, the concentration of all the metals such as cadmium, chromium, copper, lead, manganese, nickel, and iron were evaluated using graphite furnace atomic absorption spectrometry with the exception of potassium and sodium which were measured by a flame photometer. Similarly, the content of ammonia, fluoride, nitrate, nitrite, phosphates, and silica were determined by using UV/VIS spectrophotometer. Besides, other physical parameters such as conductivity, pH, and turbidity were assessed by means of conductivity meter, pH meter, and turbidity meter respectively. Besides, argentometric and H_2SO_4(0.02N) titration methods were used to determine the levels of chloride and alkalinity respectively. The amounts of calcium and hardness were determined by the EDTA titrimetric method. However, the values of magnesium were estimated from the difference between hardness and calcium as $CaCO_3$. On the other hand, sulphates and TDS contents were quantified by gravimetric analysis (15, 17).

Evaluation of Labels: The written and graphic information on labels of bottled water products of all brands were examined and compared with the values measured in the laboratory, and also evaluated against national standards and international guidelines to assess their suitability for health and also to judge their legal compliance. The TDS values of all brands were estimated from other parameters inscribed on the labels using equation 1 and 2 and compared with the labeled TDS values (18).

TDS = Sum of cations + Sum of anions + Silica ….. (1)
Or
TDS = 0.6 (alkalinity) + Na^+ + K^+ + Ca^{2+} + Mg^{2+} + Cl^- + SO_4^{2-} + HCO_3^- + SiO_3 ……………….……... (2)

***Statistical Analysis*:** The physicochemical data generated from laboratory procedures and the facts and figures collected from the labels of each brand of bottled water were fed into the spreadsheet of MINITAB®17 (Minitab Inc., State College, Pennsylvania, USA) and appropriate statistical tests were done (19). Paired *t*-tests were conducted to investigate the significance of the differences between the average of the values of each parameter measured in the laboratory and their respective values written on the labels of bottled water products. The one-sample *t*-tests were also done to evaluate the significance of the differences between the values measured in the laboratory with values set by national standards. Prior to statistical tests, however, normality of the data was evaluated by performing the Kolmogorov-Smirnov tests and visual examination of bar graphs (20). Besides, Dixon's tests for outliers were done to scrutinize whether differences between a suspected extreme value and other values in each parameter were significant (21). In this assessment, a *P*-value of < 0.05 was considered statistically significant.

Ethical Consideration: Ethical clearance was obtained from the Ethical Review Office of the Ethiopian Public Health Institute.

Results

Most of the constituents tested during the assessment were within the acceptable level. Thus, only the parameters that went beyond the standard limits set by the Ethiopian Standard Agency are reported.

Misbranded products: As can be seen from Table 1, most of the bottled water brands inscribed exaggerated figures on their labels. Specially, brands A, B, F, and G inclined to put elevated values of a few parameters on their labels. On the other hand, the labeled values of most parameters in Brand D, I, and K were found lower than mean values measured in the laboratory.

The normality tests run for different parameters showed that all the values measured in the laboratory and the figures inscribed on the labels were normally distributed for all constituents except the pH values (as the pH in drinking water has a very narrow range, i.e. between 6 and 8). Similarly, the outlier tests showed that the values of Ca^{2+}, Na^+, K^+, Mg^{2+}, and TDS were contained single outlier values each (p < 0.05). The outlier values were excluded in the paired *t*-test analyses. And yet, the paired *t*-test analyses performed to compare between the data obtained from laboratory procedures and the manufacturer's labels revealed that only Ca^{2+} showed significant differences (p < 0.05).

Table 1: **Parameters elevated or reduced on bottled water labels**

Brand	Parameters labeled higher than the values measured in the laboratory (%)	Parameters labeled lower than the values measured in the laboratory (%)
Brand A	TDS (65), K^+ (500), HCO_3^- (235)	Na^+ (93), Ca^{2+} (30)
Brand B	Mg^{2+} (456)	Ca^{2+} (54), Fe^{2+} (68)
Brand C	Cl^- (65)	Na^+ (57), Ca^{2+} (54)
Brand D	….	Mg^{2+} (47), Cl^- (73)
Brand E	Mg^{2+} (80), F^- (183)	….
Brand F	Mg^{2+} (500)	Ca^{2+} (36)
Brand G	TDS (247), Na^+ (667), K^+(341), Ca^{2+}(216), HCO_3^- (400)	….
Brand H	Mg^{2+} (25)	Ca^{2+} (87)
Brand I	….	TDS (66), HCO_3^- (83), Na^+ (44), Ca^{2+} (88), Mg^{2+} (57), Cl^- (68), NO_3^- (very high difference), F^- (84)
Brand J	HCO_3^- (75)	TDS (48)
Brand K	….	TDS (92), Na^+ (97), K^+ (76), Ca^{2+} (44), HCO_3^- (97)

Apart from laboratory measurement of water quality parameters, this assessment estimated values of TDS from the other inscribed constituents using equation1 and 2, and compared with the labeled TDS values. From visual inspection of labeled values and estimations (using equation 1 and 2), inconsistencies were obtained between estimated and labeled TDS values (Table 2). Based on this calculation, about 7 brands reported lower values of TDS than calculated levels (reduced up to 64 mg/L of TDS). Normally, the calculated values must be lower than measured (inscribed) values as some cations and anions left unlabeled and consequently left out of the calculation. The rest four brands were failed to report either TDS or major parameters like HCO_3^- and SiO_3. As a result, these four brands were not included in this visual examination and estimation.

Table 2: **TDS values reported on labels and estimated values based on equation (1&2)**

Brand Name	TDS values (mg/L) Reported on the label	Estimated TDS values (mg/L) from cations and anions reported on the label	Differences (Labeled value - estimated value) in mg/L	Note
Brand A	149	166	-17	
Brand B	-	1565		No TDS value on the Label
Brand C	82	98	-16	
Brand D	158	176	-18	
Brand E	200	264	-64	
Brand F	74	90	-16	
Brand G	111	136	-25	
Brand H	169	32	+137	No HCO_3^- and SiO_3 values on the label
Brand I	124	43	+81	No HCO_3^- and SiO_3 values on the label
Brand J	85	121	-36	
Brand K	10	6	+4	No SiO_3 value on the label

Vague inscriptions: Ambiguous labeling descriptions were observed in all brands (Table 3). In this regard, the most ambiguous labeling description was the classification of brands. Some of the bottled water brands incorporated in this assessment labeled their product as 'Mineral Water', 'Natural Water', 'Purified Water' and so on despite the results showed otherwise. One of the brands also got it wrong while writing the scientific expression of ionic forms of chemicals as it labeled Na^{2+} for sodium, K^{2+} for potassium, HCO_3^{2-} for bicarbonate.

Table 3: **Vague inscriptions observed on the labels**

Brand	Inappropriate features	Important descriptions
Brand A	Natural spring water, Rich in minerals, safe for infants, no additive, no preservative, bacteriologically potable	Keep in cool and dry place, store out of direct sun light
Brand B	Naturally sparkling mineral water, Product of Ethiopia	
Brand C	Natural spring water	
Brand D	Pure natural spring water	
Brand E	Healthy living, no unit of measurement, uses modern treatment technology	
Brand F	Bottled at source, Export standard, natural purified, purified by ultra filtration and ozone, safe for infants	
Brand G	Natural mineral water	
Brand H	Pure natural water	
Brand I	Purified natural mineral water, source of life, no additive, no preservative, safe for infants	
Brand J	Purified natural spring water	
Brand K	Natural mineral water, purified, boost energy	Address included (bottling site, telephone, fax, P. O. Box, website)

Unspecified parameters: Ten out of eleven manufacturers included in this study inscribed no information regarding the values of 'total alkalinity', in their labelling. Similarly, about eight brands failed to show the content of F^- and Fe^{2+} in their bottled water products, and seven firms also seemed to be reluctant to show the values of NO_3^- on their labels (Table 4 & 5). On the other hand, the concentrations of Na^+, K^+, Ca^{2+}, and Mg^{2+} were appeared on the labels of all brands. Besides, the level of pH, TDS, and Cl^- were also inscribed in 10 brands of the bottled water (Table 4). Surprisingly, one of the brands also missed 'unit of measurement' of the values of the constituents from its description.

Table 4: **Number of bottled water brands labeled/unlabeled the parameter (Total No. of brands = 11)**

Constituent most appeared	Number of brands labeled the constituent
Na^{+}	11
K^{+}	11
Ca^{2+}	11
Mg^{2+}	11
pH	10
TDS	10
Cl^{-}	10
HCO_3^{-}	9
SO_4^{2-}	7
NO_3^{-}	4
Constituent most unlabeled	**Number of brands unlabeled the constituent**
Total alkalinity	10
Fe^{2+}	8
F^{-}	8
NO_3^{-}	7

Table 5: **Parameters missed (not included) on the labels of each bottled water brand (from 13 constituents)**

Brand	Missed constituents that should appear on the label	Number of unlabeled constituents
Brand A	SO_4^{2-}, Total alkalinity, Fe^{2+}	3
Brand B	Total alkalinity, NO_3^{-}, F^{-}, TDS, pH	5
Brand C	SO_4^{2-}, Total alkalinity, NO_3^{-}, F^{-}, Fe^{2+}	5
Brand D	Total alkalinity, NO_3^{-}, F^{-}, Fe^{2+}	4
Brand E	Cl^{-}, SO_4^{2-}, Total alkalinity, Fe^{2+}	4
Brand F	SO_4^{2-}, Total alkalinity, NO_3^{-}, F^{-}, Fe^{2+}	5
Brand G	Total alkalinity, F^{-}	2
Brand H	Total alkalinity, NO_3^{-}, F^{-}, Fe^{2+}, HCO_3^{-}	5
Brand I	–	0
Brand J	Total alkalinity, NO_3^{-}, F^{-}, Fe^{2+}	4
Brand K	Total alkalinity, NO_3^{-}, F^{-}, Fe^{2+}	4

Discussion

Misbranded products: The labeled concentrations of Cl^{-}, NO_3^{-}, and Na^{+} of a few brands (Table 1) were found an order of magnitude lower than the values measured in the laboratory (17). Such variations in the values of these specific ions seem intentional as they are normally unwanted in drinking water (6). Conversely, some brands tend to elevate the concentration of Ca^{2+} and Mg^{2+} up to five times more than the real values. This distortion might also be deliberate as high quantities of Ca^{2+} and Mg^{2+} is associated with health benefits and good flavour of water (22-23).

With respect to mislabeling of bottled waters, a number of studies were published thus far. An assessment conducted by Al Nouri *et al*. (2014) revealed that the concentration of major cations (Ca^{2+}, Mg^{2+}, and K^{+}) reported on the labels of most bottled water brands were higher than values observed in the laboratory (22). Another study from Saudi Arabia, undertaken by Khan and Chohan (2010) reported that the mean contents of F^{-}, Ca^{2+}, and pH measured in their studies were higher than the values reported on the labels. The same authors revealed that the TDS contents were reported higher on the labels than the products really contained (10). A similar report from Iran also found that the values of F^{-} determined in all analyzed brands were different from what were seen on the labels (11). Again additional investigation from Iran showed that Ca^{2+}, Cl^{-}, and pH were found about 71%, 48%, and 67% less than values on labels respectively (12). Yet, another account on labeling practices reported that significant variation of figures between measured and labeled values of Ca^{2+}, Mg^{2+}, F^{-}, NO_3^{-}, and SO_4^{2-} (13).

In this assessment, it seemed that some of the bottling firms tend to alter the values of the constituents without real purposes. The practice of one of the brands evaluated in this study could be an important case in point. This particular brand (Brand I) mislabeled (reduced) the concentrations of almost all the parameters (Table 1) including the most important and essential constituents like calcium, magnesium, fluoride, and TDS. However, the values of all the parameters measured in the laboratory were within an acceptable range or at ideal levels for most consumers.

Vague inscriptions: The Ethiopian standard demands the labels or the name of the product to be the true description of the product concerned. Besides, the Standard declared that the use of any phrase or of any pictorial device that might create confusion in the mind of the public or in any way mislead the public about the nature, origin, composition and properties of the product being sold is prohibited (8). Similarly, according to European Economic Council Directive, when brands containing TDS lower than 500 mg/L, they may need to be labeled as 'low mineral content'. If a brand of water contained TDS lower than 50 mg/L, the phrase 'very low mineral content' should appear on the labels (23). Again, in the United States, 'mineral waters' required to contain a minimum of 250mg/L of TDS, and they are normally classified by their TDS contents (24). Thus, the phrase 'Mineral water', 'Natural Water' and the like might not be the right nomenclature for some of the brands included in this assessment (17). In this evaluation, it was found that only two brands out of eleven showed TDS content higher than 250mg/L.

In addition, the European Economic Community Directive (EEC 1980) instructs that the phrase 'contains sodium' needs to appear when the content of sodium is greater than 200mg/L, 'Rich in mineral salts' when TDS content is higher than 1500mg/L, 'very low mineral content' when the TDS value is less than 50mg/L, 'contains bicarbonate' when its value goes beyond 600mg/L, 'contain chloride' in cases it goes above 200mg/L, and 'contain fluoride' if it contains above 1mg/L (23). And yet, such descriptions were missing in the Ethiopian bottled water labels.

In the European Union, bottled waters can be grouped into three major types: 'natural mineral waters' (could be natural underground, still or aerated water, but with a constant level of mineral and trace element content), 'spring water' (groundwater and it is not supposed to be treated with any mechanism but it does not expected to have a constant mineral composition either), 'purified water' (which can be surface or underground water that has to be treated in order to be suitable for human consumption, which can chemically be similar to tap water except the way of delivery to consumers) (25). According to European Economic Council Directives (23) and the Commission Directive (25), the bottling companies need to state whether their product is natural, still, carbonated, or slightly carbonated on their labels. Besides, it clearly states that the term 'natural mineral water' represents microbiologically unaltered or untreated water. However, some bottling companies evaluated in this study used the phrase 'natural water' for 'ozone treated', or 'reverse osmosis' treated waters. In the same way, the IBWA has also its own categories of bottled waters as: artesian water/artesian well water; drinking water; sparkling water; and well water (4). Thus, the bottling companies in Ethiopia may need to adopt such classifications.

The other important observation from this assessment was that most of the brands were using eye-catching labels and graphics and a bottle designed to be attractive for consumers. Although visual attractiveness of bottles and their labeling affects market success positively (26-28), those attractive pictures of blue sky and green hills with sparkling streams might not have any association to the actual origin of the product. Descriptions of the product also contain terms that imply purity, such as 'natural', 'crystal', 'premium', or 'purified' (29).

One thing that can be considered vague from the part of the law making bodies was that the standards were set only as 'maximum allowable limits'. However, the concentration of some essential elements like magnesium, potassium, calcium and fluoride should not have only the maximum allowable limits, but also minimum requirements as they are essential minerals. Because, low concentrations of these elements may exhibit some undesirable effects when consumers are lacking balanced diets and when bottled waters consumed regularly as a sole source of water. For instance, the Ethiopian Standard stated that the maximum allowable limits of F^- in water supplies should not be higher than 1mg/L. However, according to the WHO (2011), drinking water containing F^- less than 0.5 mg/L needed additional sources of fluoride when it is the only source of water for drinking purposes (8). Fluoride supplementation may also be needed for children between 3 and 13 years of age if the level of fluoride in drinking water is below 0.3mg/L (30).

Generally, any mistaken information on labels may affect or mislead consumers and thereby affect their health. Besides, deceptions in labeling can reduce the efficiency of the markets in the long run as widespread deceitfulness and fraud makes consumers less receptive to new information, even for truthful messages. Such practices may damage the economy at large if no appropriate measure is taken. In addition to the responsibility of customers, manufacturers, and government offices, the role of private and international organizations can also be pivotal to boost the credibility of information on food labels in general through setting standards, certification, and enforcement. Consequently, third-party labeling services could be taken as an alternative (28-29, 31).

Unspecified parameters: In spite of intensive promotion about the flawless quality of their products through a range of communication channels, bottling companies have got numerous deficiencies to address with respect to labelling. One of the weaknesses that can be corrected easily was the incompleteness of constituents that should have been displayed on the labels. The Ethiopian Standard Agency required a complete list of constituents in the order of: calcium, magnesium, sodium, potassium, chloride, sulphate, total alkalinity, nitrate, fluoride, iron, bicarbonate, TDS, and pH. However, this assessment discovered that all the brands were not conforming to the command of the Agency (8). As can be seen from Table 4 and 5, some of the manufacturers were failed to inscribe the 'total alkalinity',F^-, Fe^{2+}, and NO_3^- content of their products. From missed parameters, F^- and NO_3^- need special attention, especially from public health perspectives and that made it a serious mistake (6). Such lack of uniformity in labeling is, however, not restricted to the Ethiopian bottling companies as witnessed by Versari *et al*. (2002) with their similar study conducted in Italy (24). Regardless of this practice, it is difficult to comprehend the reason why the bottling companies prefer not to include all the unspecified parameters. Almost all the parameters required to be mentioned on labels were within the acceptable range in all brands except one brand which contained excess of TDS, hardness, alkalinity, and Na^+ (17). When a labeling delineates the true level of constituents, it can be seen as a win-win strategy as it can be helpful to protect public health and to enhance market share of bottling firms simultaneously (32-34). From the public health point of view, labels on food and drink items can help consumers choose the products that can best fit their nutritional requirements. Moreover, it can help customers get the best value for their money (32).

Other helpful descriptions: On the labels of most products, the location of the source, the name of the source, name and physical address of the exploiter were declared. Besides, each bottle was marked with bar codes, date of manufacture, and best before dates. The type of treatment used and net content (volume) were declared. In this regard, all the brands included in this study were in conformity with the Ethiopian standards. Surprisingly, only one brand reported on its labeling that it is a member of the IBWA. Being a member of the IBWA is good for the motivation of the bottlers to meet strict standards and to promote their product and thereby to fulfil their market ambitions.

Drinking water bottling companies are supposed to report accurate values and descriptions on their labels. Nevertheless, accurate labeling of constituents may not be enough if consumers failed to understand the health implication of individual ions and aggregate parameters in bottled waters to select the brands that best suit their individual health needs or preferences. For instance, those susceptible to osteoporosis may need to refrain from waters with low TDS and need to select water with elevated calcium and magnesium concentrations. Conversely, those with problems related to kidney stones may benefit from avoiding hard or mineralized waters. Furthermore, those suffering from hypertension may need to monitor their sodium intake and avoid water products with high sodium content (35). Thus, apart from an accurate description of labels, water bottlers may have to specify the health concerns when some minerals found in excess or at very low concentrations. In this regard, the Ethiopian Standards (ES 2001) clearly stated that when a product contains Na^+ exceeding 100mg/L, a statement that described the product's unsuitability for the preparation of food for infants should be made (8). However, one of the brands included in this analysis found to contain Na^+ higher than 250mg/L and made no such attempts on its labelling.

This assessment tried to show how the bottling companies are working. Even though, the evaluation was a cross-sectional type and limited in its coverage in area and subject matter, it helps to understand the modus operandi in the business.

Conclusion and Recommendations:
This assessment observed a number of flaws with respect to labeling practices of water bottling firms and the accuracy of their inscriptions. One of the shortcomings that can be corrected easily was the incomplete list of parameters on labels of some brands, despite the Ethiopian Standard Agency required the constituents to be listed in full in a specific order. It was also found out that the concentrations of common water quality parameters measured in the laboratory and the values written on the labels of bottled water products exhibited considerable discrepancies. Ambiguities were also observed in matters related to classification of products. In this regard, classifications like 'Natural water', 'Mineral water', and 'Purified water' found to be inaccurate characterization of the products. The other important observation was that most of the brands were using eye-catching labels and graphics which were different from the situation on the ground.

Accurate labeling of constituents may not be enough if consumers failed to understand the health implication of individual ions and aggregate parameters in bottled waters to select the brands that best suit their individual health needs or preferences. The existing water bottling and labeling practice needs support and enrichment from decision-making bodies and researchers. Hence, broader and all inclusive studies (like sampling from the source and considering all firms in the country) will be helpful to inform the supervisory agencies such as, the Ethiopian Standard Agency, and Ministry of Health to have more effective monitoring and control and thereby to improve the quality of products and in turn to enhance public health.

Acknowledgments
I would like to thank the Ethiopian Public Health Institute for the financial support to this study.

Competing interests
The author declares that he has no competing interests.

Authors' contributions
This manuscript is prepared by a solo author from inception to submission.

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