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Bottled Water Quality in Lubumbashi, Assessment of Producer Label Information

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ABSTRACT

The preference for the consumption of drinking water in bottles in the city of Lubumbashi is a reality almost present in developing countries, where tap water is not drinkable. This study examined the quality of the information carried by the labels of drinking water bottles sold in the city of Lubumbashi, in the Democratic Republic of Congo. The purpose of this assessment was to compare the information of the physico-chemical parameters as stated by the producer of the water brand with the composition as recommended by the 2001 WHO guidelines for bottled water. And we collected information on 30 brands of bottled water produced and marketed in the city of Lubumbashi.

It emerges from this research that 7 brands presented no useful information to consumers and of the remaining 23 brands we observed a difference in the labeling of the bottles and discrepancies in the chemical composition. None of the bottles met all the parameters required by the WHO. The article highlighted the need for strict regulations on labeling standards and related information to adjust water bottle labels according to water characteristics.

Keywords
Water, Labels, Quality, Physico-chemical.

Introduction

Access to safe drinking water is a prerequisite for health, an essential human right and a key component of effective health protection policies. The supply of clean and safe water is undeniably paramount to human health, hence priority number 6 of the United Nations (UN) Sustainable Development Goal (SDG). This goal, among others, aims to achieve universal and equitable access to and affordable drinking water for all by 2030 [1]. A growing number of countries are facing water stress that affects more than two billion people worldwide. Achieving SDG 6 therefore requires the concerted efforts of all stakeholders [2].

The production and distribution of drinking water are governed by strict regulations, which impose standards defining the required quality of water intended for human consumption. The primary desire is to provide the user with water of sanitary quality, guaranteed against all risks, immediate or long term, real, potential, or even simply assumed. It is then a question of offering water of organoleptic quality, pleasant to drink, clear, odorless, and balanced in mineral salts. Water potability limits are imperative because they can have an impact on health and concern microbiological and chemical parameters.

In recent years, bottled drinking water has become an easy way to provide drinking water to consumers, especially in cities and urban areas [3]. In many developing countries, including Malawi, the market for bottled drinking water, mineral and natural spring waters is growing. The dramatic increase in bottled water consumption around the world is attributed to its affordability, convenience, connotations of higher social status drinking, and the widespread perception that it contains fewer contaminants [4]. Also, there is a common belief and perception that mineral waters have valuable medicinal and curative effects. Drinking bottled water provides an essential mineral supplement for proper growth and has also found widespread use in the preparation of infant formula, the reconstitution of other foods [5].

The labeling of bottles of chemical composition is of concern and, for example, cases of understatement and exaggeration have been reported elsewhere [6-8] and reports of independent studies on their chemical composition, safety and their conformance to standards are not readily available in the literature [9]. To our knowledge, there are few or no reports published in the literature on the chemical composition of bottled drinking water sold in the city of Lubumbashi.

Thus, we proposed to approach the question by an evaluation of the quality of the information provided by the producers of water marketed in the city of Lubumbashi and this in relation to the standards provided by the WHO [10].

Methodology

This is a cross-sectional descriptive study conducted in the city of Lubumbashi, a copper city in the Democratic Republic of Congo and capital of the province of Haut-Katanga. Our sampling was exhaustive, consisting of 30 brands of bottled water sold and consumed in the city of Lubumbashi.

For each bottle, we collected the following data: the brand of water, the information available on the bottles (Physico-chemical parameters related to the covers of the bottles: Ph, Dry residue), including:

- The fundamental elements: Calcium, magnesium, sodium, potassium, chloride, sulphate, Bicarbonates.
- Indicator elements of pollution (nitrate, nitrite).
- And all these parameters have been compared to the standards of the physico-chemical parameters of water potability set by the WHO. The data collected was analyzed using SPSS 22 software.

Results

the results obtained are compared with the standard set by the WHO (WHO guide values, 2017) and this for each physico-chemical parameter as indicated on the label of the water bottle. Each parameter is presented in the form of a table or a frequency histogram, which indicates the number of marks, compared to WHO standards.

The label of a bottle of mineral water contains various information, which it is necessary to decipher in order to find the water adapted to its needs. You can find there: The nature of the water, the origin, the mineral content [11]. Thus, in accordance with the recommendations, it should be noted that seven water producers do not provide any information on the bottles they market; which is a huge strain on the quality of water production.

From the information available on the labeled bottles, we found that there is no uniformity in the presentation of the composition of the waters. Indeed, certain important information is not available to the consumer as required by the standard which requires that the following parameter be presented: pH, total dissolved solids (TDS), electrical conductivity (EC), turbidity, calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), iron (Fe), nitrate (NO_3^-), chloride (Cl^-), fluoride (F^-), sulphate (SO_4^{2-}), hardness, alkalinity, are displayed on the label available to consumers.

Dry résidu content	Numbers	Percentage
Lower than 500	5	16,67
500 to 1000	1	3,33
Greater than 1000	2	6,67
No specified	22	73,33
TOTAL	30	100

Table 1: Distribution of water bottles according to the content of dry residue.

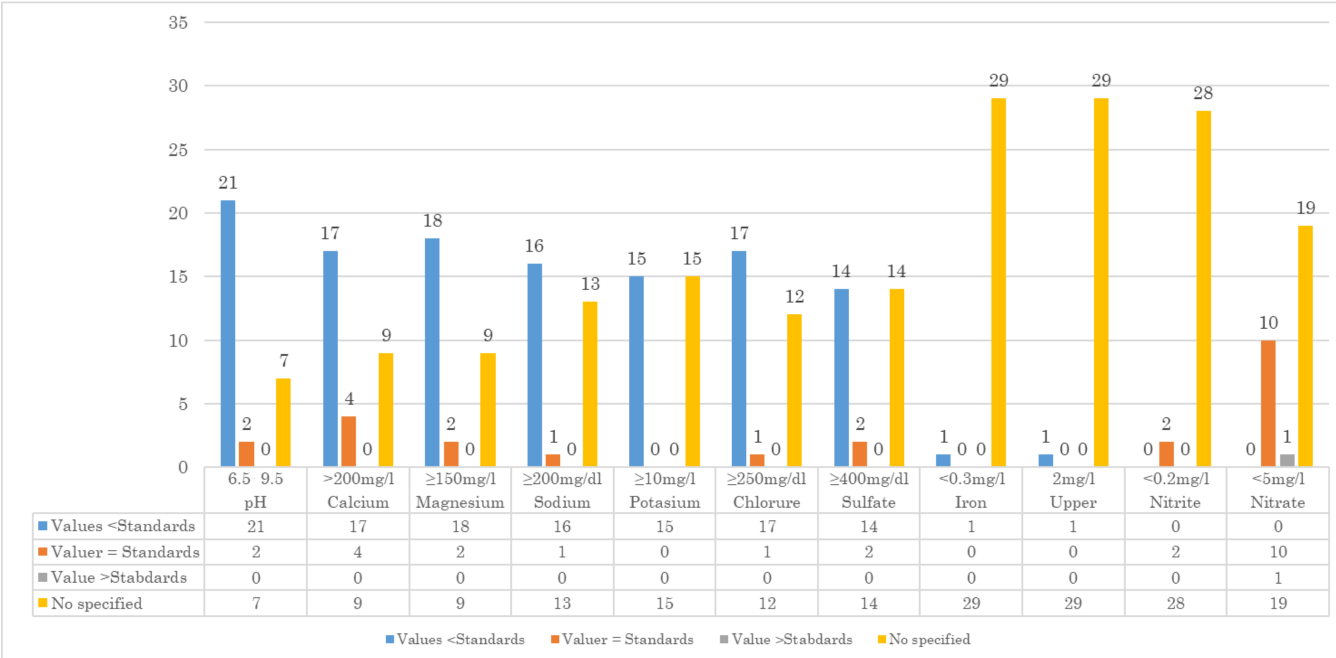
This table 1 shows us that out of the total of 30 bottles of water, the bottles without dry residue had a high frequency of 22 or 73.33%, the bottles with a dry residue content < 500 had a frequency of 5 or 16.67%, followed by those with a dry residue content > 1000 had a frequency of 2 or 6.67% and those with a content ranging from 500 to 1000 had a low frequency of 1 or 3.33%. The Dry Residual Content is an indicator that allows the load of mineral salts and trace elements in the water to be assessed; it has been found that many bottles bearing this information are weakly (content less than 500 mg/L) and moderately (content between 500 and 1,500 mg/L) mineralized [12].

In general, it should be noted, from Figure 1, that on the bottles of water marketed in the city of Lubumbashi, all the physic-chemical information is not systematically displayed and seven bottles of water provide no information on the physic-chemical composition of their water.

With regard to the fundamental elements: Calcium, magnesium, sodium, potassium, chloride, sulphate, Bicarbonates; the results collected show the total absence of the notification of bicarbonate on all the bottles, calcium is indicated only on 21 bottles out of 30, 17 bottles provide calcium values below the WHO threshold value; magnesium is given for 20 bottles, and only two bottles display values corresponding to those recommended by the WHO (≥ 150mg/l); sodium is displayed on 17 bottles and only one is within the WHO range (≥ 200mg/l); for potassium, fifteen bottles display it and none contain it at the recommended concentration; Seventeen bottles present the chlorides on their labels, but only one provides information on the values recommended by the WHO; sulfates are present on sixteen labels and two of which display the values desired by the WHO.

All living organisms depend on magnesium in all types of cells, body tissues and organs for various functions, while calcium is very important for the physiology of human cells and bones.

The recommended dietary allowance for calcium ranges between 700–1,200 mg/day throughout life, as listed both internationally by the United States Department of Agriculture (USDA) [13]; although dairy products are the most recognized dietary sources



	6.5 9.5 pH	>200mg/l Calcium	≥150mg/l Magnesium	≥200mg/dl Sodium	≥10mg/l Potasium	≥250mg/dl Chlorure	≥400mg/dl Sulfate	<0.3mg/l Iron	2mg/l Upper	<0.2mg/l Nitrite	<5mg/l Nitrate
Values <Standards	21	17	18	16	15	17	14	1	1	0	0
Valuer = Standards	2	4	2	1	0	1	2	0	0	2	10
Value >Stabdards	0	0	0	0	0	0	0	0	0	0	1
No specified	7	9	9	13	15	12	14	29	29	28	19

Figure 1: Results of the physico-chemical parameters distributed according to the presence of its information on the bottle according to the WHO hills (2006).

of calcium, natural mineral waters are also an important potential source [14]. Calcium-rich mineral waters could therefore be recommended to provide both a dietary source of calcium and adequate hydration, while being calorie-free. Calcium is equivalent to or possibly greater than that of the calcium contained in milk and milk products [16]. It flows as well as calcium mineral waters as an important source of dietary calcium, which must be considered in order to obtain the recommended daily calcium intake, especially in cases of lactose intolerance.

Regarding magnesium, several large prospective cohort studies have shown that low magnesium intake is associated with the incidence of type 2 diabetes (T2D) and cardiovascular disease (CVD) [17-20] because studies show that circulating Mg levels are inversely associated with the incidence of coronary artery disease, hypertension and T2D. magnesium in drinking water and coronary heart disease mortality (RR = 0.89, 95% CI = 0.79 to 0.99, I 2 = 70.6) [21].

Sodium is essential in humans for the regulation of body fluids and electrolytes, and for the proper functioning of nerves and muscles, however, excess sodium in the body can increase the risk of developing high blood pressure, diseases cardiovascular and renal damage [22,23]. Potassium is very important for protein synthesis and carbohydrate metabolism, so it is very important for normal growth and bodybuilding in humans, but an excessive amount of potassium in the body (hyperkalemia) is characterized by irritability, decreased urine production and cardiac arrest [24] as for the intake of sodium and potassium.

As for the elements indicating pollution, including nitrite and nitrate, the first are informed in only two bottles and at the values recommended by the WHO and the second are displayed on eleven labels and ten are at the desired threshold. Ingested nitrate is reduced to nitrite, which binds to hemoglobin to form methemoglobin (MetHb). Methemoglobinemia occurs when high levels of MetHb (greater than about 10%) interfere with the oxygen carrying capacity of the blood. Infants are particularly susceptible to developing methemoglobinemia for several reasons, including their increased ability to convert nitrate to nitrite and their lower levels of the enzyme cytochrome b5 reductase, which converts MetHb back to hemoglobin. Of course, the risk of methemoglobinemia in infants depends on many factors other than nitrate ingestion from drinking water. Several studies support a direct relationship between nitrate intake and endogenous NOC formation. High nitrate intake in drinking water (above MCL) is associated with increased endogenous ability to nitronate proline [25].

More recently, it has been observed in studies, an association between exposure to nitrates from drinking water and clinical methemoglobinemia and that cytochrome b5 reductase activities were higher in those who consumed water at high nitrate content, indicating a level of adaptation to drinking waters with high nitrate content [26].

Copper and iron are present on a single bottle and at a value lower than the WHO recommendation. Heavy metals such as Mn, Fe and Ni are necessary for enzymatic activity. Iron (Fe) is an essential element for human health, necessary for the production of protein hemoglobin, which carries oxygen from our lungs to other parts of the body. Too little or too much iron can have a negative effect on bodily functions [27]. A high concentration of Fe in water can give water a metallic taste, even if it remains drinkable [28]. Also, heavy metals will be toxic to humans if exposed or ingested in greater amounts [29]. Thus, the standards of the various countries provide that bottled mineral waters containing concentrations of heavy metals below the limit authorized by the drinking water quality standard, which indicates that the water could be consumed without danger as drinking water.

Sulfate is a mandatory nutrient for many metabolic and cellular processes, especially in fetal growth and development [30]; in adults and children, sulfate comes from the diet and intracellular metabolism of sulfur amino acids. Dietary sulfate intake can vary widely and depends on the type of food eaten and the source of drinking water. In drinking water, its content can vary widely, ranging from negligible levels in demineralized bottled water to >500 mg/L in water from spring-fed wells and dams. Sulfate levels above 500 mg/L in drinking water can cause an unpleasant taste, although some people are more sensitive to lower concentrations [31].

Conclusion

Access to safe drinking water is a prerequisite for health, an essential human right and many consumers believe that bottled water is a high-quality product. Access to safe drinking water also has a significant impact on health and development at national, regional, and local levels.

This study examined the chemical composition on the labels of bottled drinking water sold in the city of Lubumbashi, in the Democratic Republic of Congo. Compliance with WHO drinking water standards and potential health implications associated with the consumption of bottled drinking water brands were assessed. The results showed differences in chemical composition information between the thirty brands of bottles collected. Seven brands provide nothing on their labels other than advertising information. Most brands did not meet the WHO standard in terms of the list of required parameters and in terms of quantities per parameter assessed.

An effort is being made to study the regulation of the production and marketing of bottled water without which the population would be exposed to unknown risks.

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