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BOTTLED MINERAL DRINKING WATER PRODUCED IN BURKINA FASO: CORRELATION BETWEEN PH, TURBIDITY, TEMPERATURE AND THE ORGANOLEPTIC QUALITY

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Abstract: In this study, we investigated the correlation between different drinking water parameters: pH, Turbidity, Temperature and the Organoleptic Quality of bottled mineral drinking water produced in Burkina Faso, along with the Tap water. The brands utilized are "Y", "B", "L" and "I". The study showed that only "Y" mineral water had a neutral pH of about 7; the others showed low pH of about 5. The investigated bottled mineral waters presented neglectable turbidity of less than 0.5 NTU, however, the tap water had a turbidity of 4 NTU, however, it fits the turbidity drinking water standards. The different temperatures were less than 30 degrees Celsius. Bottled mineral drinking waters produced in Burkina Faso are for the majority acidic. The water acidity is due to the water tables quality in Burkina Faso that are Ca-Mg-HCO₃ type. When calcium carbonates are not precipitated to reach the calcium carbonate equilibrium that leads the pH to remain low. The organoleptic quality of the mineral drinking water produced in Burkina Faso is preferred when acidic by the majority of its population, despite the fact that low pH drinking water may be unhealthy. Companies producing bottled mineral drinking water do not demineralize the water before supplying it since the water consumers easily accept the acidic taste. In fact, the water supplying pipelines can be corroded by low water pH. This study showed that brand "Y" bottled mineral drinking water has a better taste, and it is healthier for its neutral acidity than the other investigated brands.

Keywords: Mineral drinking water, pH, Turbidity, Temperature, Organoleptic Quality, Burkina Faso

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INTRODUCTION

Drinking water has always been a big issue in developing countries, mainly in sub-Saharan Africa. Burkina Faso is a landlocked country of 21,510,181 inhabitants (INSD 2020), with the majority of the population living in the capital city, Ouagadougou. The public drinking water supplying company called Office National de l'Eau et de l'Assainissement (ONEA), cannot satisfy the needs of a population that is rapidly increasing. Thus many Small and Medium Enterprises (SMEs) offer their services, by packaging (bottled and/or sachet) drinking mineral water (Kansole & Beidari 2020).

However, these SMEs are not well regulated, and the quality of the drinking water they produce is generally unknown. It was revealed in 2015, that out of 110 SMEs, only 11 complied with the drinking water producing standards (L'économiste du Faso 2017). Our previous study (Kansole & Beidari 2020) showed that the sachet waters were affordable by the Burkina Faso population in overall, regardless the water quality. Nevertheless, the bottled mineral drinking water, that are mainly produced by most serious enterprises have better quality, despite the higher price on the market compared to the water in sachets. Generally speaking, the

mineral drinking water comes from the underground, and follows many treatment processes such as Filtration, Reverse Osmosis, Deionization, Ozonation, Chlorination, UV light, each treatment method depending on the water producing company. The majority of these companies use almost similar groundwater table quality, because the hydrogeology of Burkina Faso, especially in places exploited for the water production have similar characteristics, and they are located mostly in Orodara (Western), Bobo-Dioulasso (Western), Ouagadougou (Central), Fada N'Gourma (Eastern), and Koubri (Central) regions of Burkina Faso. A simplified geological map of Burkina Faso showed that the country is mostly composed of 25.86% of Granitoid, 29.16% of Tonalite and 22.04% of Volcano-sedimentary belt (Courtois et al., 2009). The water producing enterprises are located on the Granitoid and Tonalite formations were the water tables. The groundwater of Burkina Faso in general is fresh and calcium-magnesium-carbonates dominant, with arsenic and nitrates pollutions that are found in some water tables (British Geological Survey 2002, Ouandaogo-Yameogo et al 2013). The water producing companies, generally, do not readjust the groundwater's own quality. In the contrary, they keep the water raw properties, and this leads to a similarity in terms of organoleptic quality among the mineral water produced in Burkina Faso. Differences are more related to the packaging and the microbiological removal treatment methods for the water safety.

The aim of the current study is to make a correlation between pH, turbidity, temperature and the organoleptic quality of four (04) bottled mineral drinking water produced in Burkina Faso, along with the tap water. The water producing companies are regularly requested to have their water analyzed by the Laboratoire National de Santé Publique (LNSP) before they supply it (Kabore 2019). However, the majority of the companies do not comply with the regulation, and the population does not always know much about the quality of the water they drink. Nevertheless, the water organoleptic preference of the population is usually the key point that leads the majority of the consumers to prefer one brand of the bottled mineral drinking water

to another brand, and the current research paper is a guide to it.

EXPERIMENTAL

The bottled mineral drinking water samples:

The bottled mineral drinking water samples come from four different mineral drinking water companies. One from Koubri that we named "Y"; one from Orodara that we named "B"; two samples from Bobo-Dioulasso that we named "L" and "I". The samples were bought from a unique supermarket in Ouagadougou. They are analyzed without prior conditioning.

The tap water: The tap water comes from the Office National de l'Eau et de l'Assainissement (ONEA), that is the public drinking water supplier in Burkina Faso. In the city Ouagadougou, ONEA utilizes the surface water of a large dam called Ziga (Newborne 2015) for the water treatment. Ziga Dam has a maximum depth of 15 meters, and contains 200 million cubic meters water. The dam occupies a surface of 900 hectares, and it was constructed in 1999, with the first potable water been produced in 2004 to supply the capital city Ouagadougou. Nowadays, Ziga Dam produces a capacity of 180,000 cubic meters water per day.

The water pH and Temperature: pH of the different water samples was measured using a pH Meter (P5310 PeakTech). Water temperature and pH are correlated (APHA 1989), and these parameters give an overview of the drinking water quality. The temperature was measured using a thermometer (HI98501 Checktemp CL Electronic Digital Thermometer), and it is expressed in Celsius. The drinking water pH is usually 6.5-8.5 (World Health Organization 2007)

The water turbidity: The water turbidity is known as the appearance of the water, and it talks about the water quality in general. The water turbidity was measured using a turbidimeter (2100Q Portable Turbidimeter, HACH), and it was expressed in Nephelometric Turbidity Units (NTU). The potable water turbidity should not exceed 5 NTU (World Health Organization 2017).

The organoleptic water quality: The organoleptic quality of the water is more related to its taste and odor. Water taste and odor are

one of the drinking water potability criteria, and these parameters are tightly related to the acceptance of the water. The organoleptic water quality is measured by tasting and smelling the water (Kansole & Beidari 2020), and a water with a low organoleptic quality is not usually accepted by the consumers.

RESULTS AND DISCUSSION

According to a simplified hydrogeological map of Burkina Faso (British Geological Survey 2002), all the surface of the country produces low to high quantity of groundwater, which is generally of Ca-Mg-HCO₃ type with Arsenic issues in gold mineralized areas (Smedley et al 2007). The bottled mineral water producing industries are located usually in Western, Central and Eastern regions of Burkina Faso where better water tables Arsenic free are found. In order to produce a potable mineral water which organoleptic quality and potability is acceptable, the same water tables are utilized by the industries, leading the commercialized mineral water to have similar taste as shown in Figure 1 for their pH. All the investigated bottled mineral drinking water, have an acid taste (Table 1) with a pH around 5, except "Y" which has a neutral pH of 7.2. The tap water produced by ONEA has a pH around 6.5, with the temperatures of the samples taken at 30 degrees Celsius. From the water tasters, the acidic taste was the most consumed taste in the market of Burkina Faso when it comes to bottled mineral drinking water taste. According to the World Health Organization, the drinking water should not be acidic, in the contrary, it should be ranged between 6.5-8.5 (World Health Organization 2007). Thus, only "Y" bottled water was respecting the WHO pH standards. In other words, the acidic producing bottled drinking water industries, do not readjust the water taste by doing a mineralization or a demineralization depending on the type of minerals they find in their water table. Nonetheless, the calcium carbonates, and magnesium carbonates are the most found minerals, it is obvious for the dominant cations (Ca²⁺ and Mg²⁺) that they will

acidify the water when the calcium-carbonic equilibrium is not reached for most of the cases. Thus, the bottled mineral drinking water producing industries should precipitate the calcium carbonates (CaCO₃), to bring the water from low pH to about to a neutralized pH in order to fit the WHO drinking water pH standards. In terms of taste/odor of the bottled mineral drinking water found in Burkina Faso market, due to its neutral pH, many consumers say that "Y" water has a metallic taste (Table 1), leading the majority of them to prefer the other brands that are acidic. At the other hand, the Tap water, except the fact that it has the higher turbidity of 4 NTU among the investigated bottled mineral drinking waters, still respects the standards of WHO in terms of drinking water turbidity being less than 5 NTU (World Health Organization 2017). The Tap water can be seen as the best quality drinking water one could easily afford and be sure of its potability despite the odors of the residual chlorine which is detected (Table 1), and which is unpleasant to the consumers.

In this Covid 19 (World Health Organization 2021), the best option is to use disposable cups as personal drinking water facilities in order to avoid being contaminated or to contaminate others. Thus, exceptionally, it is recommended to utilize the bottled mineral drinking waters when it is affordable. However, regarding the poverty of the majority of Burkina Faso population, and the expensiveness of the mineral drinking water been sold, people will always drink the tap water when they cannot afford the bottled mineral drinking waters. In other words, one will prefer the mineral water since it is shown to have more quality by the marketers, despite the fact that their thoughts are not evident. Our study is a plus to show that the tap water could be as easily accepted as the bottled mineral drinking waters if it is well conditioned and supplied to citizens. In addition, this study is explaining why the majority of the investigated bottled drinking waters have the same taste (acidic) which is due to the uniformity of the water tables where they are produced in Burkina Faso.

Table 1: Organoleptic quality of the investigated bottled mineral drinking waters investigated

Water sample Taste/odor	Y	B	I	L	Tap Water
Alkaline	-	-	-	-	-
Acid	-	+	+	+	-
Metallic	+	-	-	-	-
None	-	-	-	-	+
Chlorine's	-	-	-	-	+

+ : Positive - : Negative

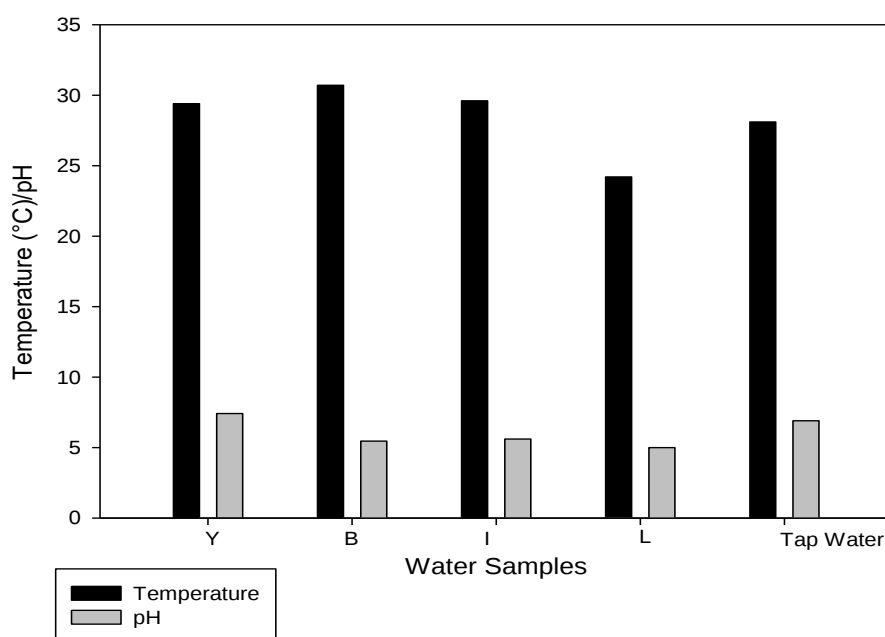


Figure 1: Temperatures and pH of the bottled mineral drinking water been investigated

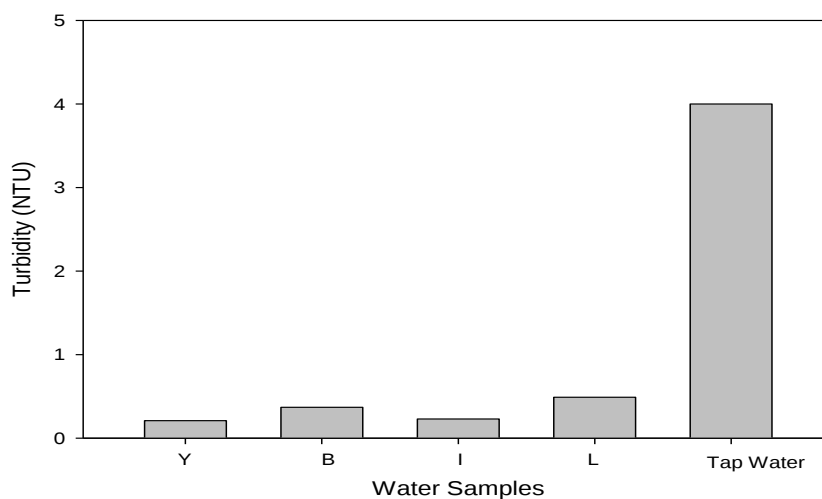


Figure 2 : Turbidity of the bottled mineral drinking water been investigated

CONCLUSION

Burkina Faso is a landlocked country, which is underdevelopment. The country's hydrogeology is an advantage that occurs on its entire surface, allowing the water tables to be uniformly distributed. The underground water of Burkina Faso is mostly used for agricultural purposes. Nevertheless, SMEs produce bottled mineral drinking water from the country's water tables, without bringing too much treatment methodologies. The groundwater quality is calcium-magnesium-carbonates dominant leading the water to have an acidic taste in general. The majority of the commercialized mineral drinking waters in Burkina Faso have a low pH, except few of them that have a neutral pH. The habit to acidic taste for drinking waters facilitate the SMEs in their water treatment protocol without remineralizing the water original acidic taste. Despite the acidic habit of the population, the bottled mineral drinking water companies should avoid supplying low pH in order to have a concern for the population's health as a priority. Calcium carbonates have to be precipitated and the calcium-carbonates equilibrium should be always balanced before the water supply.

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