International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 4, Issue 7, July – 2020, Pages: 32-38

Evaluation the Physicochemical and Microbial Parameters of Water Used in Soft Drinks (According to SSMO and WHO)

[1]Hassan Khojali Awad Elseed Abush, [1]Romissa Ahmed Al- Imam, [*2]Ammar M.S. Abdalla
[1]Department of Food Science and Technology Faculty of Agriculture.
Al- Zaeim Al- Azhari University P.O. Box1432, Khartoum North 13311, Sudan
[2] Department of Crop Protection, Faculty of Agricultural Sciences (FAS), University of Dongola, P. O.Box 47, Dongola, Sudan, ammarsorag@gmail.com, dr.ammar@uofd.edu.sd
**Corresponding Author: Ammar M. S. Abdalla, ammarsorag@gmail.com, dr.ammar@uofd.edu.sd*

Abstract: *The physico-chemical and microbial parameters of the water add in soft drinks products in Khartoum state were evaluated and compared with the Sudanese Septic Laboratories (SSMO) and the World Health Organization. The results of physical analysis treated water samples showed the mean pH value (7.79) and EC conductivity (50.8 µS/cm). Furthermore the results also of chemical analysis shows the alkalinity in was recorded (185.5mg/L), turbidity (0.17 mg/L), hardness (79.88mg/L) and chlorine (20.7 mg/L) in treated water samples (P≤0.05). Moreover the results showed absence of heavy metals (aluminums and lead) in all water samples before and after treatment. Also the results showed raw water samples were found from total bacterial count 7X10-6, mold 2X10-2 and total coli form 1. It is clear from, all samples treatment water showed the presence of total colony count, mold and yeast, E. coli and coliform. The study concluded that the physico-chemical properties of the water samples used in the soda industry for one of the companies in the state of Khartoum, as permitted by the High Health Organization and the Sudanese specification.*

Keywords: Evaluation, Physicochemical, Microbial Parameters

Introduction

Water, as the main component of a soft drink, usually accounts for between 85 and 95% of the product and acts as a carrier for the other ingredients. Therefore, it is important to determine all the water quality parameters of soft drinks (Jahagirdar, 2015). "Soft drinks" is a term used for beverages that doesn't contain alcohol ("hard" liquor). If you really know what the contents of soft drinks are, you would not think it is "soft". It is r eally "hard" on our healt h. Soft drinks have become so much a part of modern living, especially in major cities around the world. It particularly appeals to the younger generation who drinks soft drinks in place of water. Soft drinks advertisements target young people who are oblivious to the harm these drinks can do to their bodies. No wonder the people love drinking soft drinks too–they give the refreshing feeling and seem to quench thirsts on a blistering hot day (Jahagirdar, 2015).

Water is vital for drinking, sanitation, agriculture, industry (soft drink) and countless other purposes (WMO, 1997). However, the proportion of people with access to adequate water and sanitation has not increased due to population growth. In sufficient continued investment and inefficient system working order (Cheesbrough, 2000). The success of the water and sanitation decadence is largely depending on people becoming aware of the relationship that exists between health, water, hygiene and sanitation. The acceptable quality of water is defined by the WHO guidelines as that which is suitable for all usual domestic purpose, including personal hygiene (WHO, 1993).

Water is essential for life on earth. Because of the importance of water, the pattern of human settlement throughout history has often been determined by its availability. The fertile river valleys abundant water represents the beginning of civilizations. With growth, demand for water has increased dramatically, and its uses have become much more varied as used in agriculture, industry, recreation, and non-ingested personal consumption. Frequently, each of these uses required a different level of quality in order for the water to be considered adequate (Abdalrahim, 2007).

The WHO reported that thousands of organic and inorganic chemicals have been identified in drinking water supplies around the world, many are in extremely low concentration, the chemicals selected include those considered potentially hazard to human health (WHO, 1993). It has been estimated that over 90% of deaths from developing world today occur in children under 5 years old is caused by inadequate supplies of safe water and inadequate sanitation facilities and lack of hygiene behavior by the mother (WHO, 2006).

Problem of study

Water, as the main component of a soft drink, usually accounts for between 85 and 95% of the product and acts as a carrier for the other ingredients (Jahagirdar et al., 2015) Therefore, it is important to determine all the water quality parameters of soft drinks.

Justification of study

Soft drink production starts with a pure source of water. Regular soft drinks contain 90 percent water, while diet soft drinks may contain up to 99 percent water. Drinking water often includes trace amounts of various ions that alter its taste.

Objective of study

- The aim objective of this study was to assessment of some physical drinking water.
- To determine the physico-chemical properties and some toxic metals in raw and treated water used in soft drinks.
- To assessment the physico-chemical properties of the water used in soft drinks were evaluated and compared with the (SSMO) and the World Health Organization.

Materials and Methods Material

Two samples of raw and treatment water were collected from factory of soft drink in Khartoum state – Sudan in ultra-clean sampling bottles (250 ml).

Methods Physicals analysis

Measurement of pH and Conductivity

The pH and conductivity parameters were determined by electrochemical methods; with the adoption of the WTW-pH/Cond 340i instrument, following the instructions recorded in the Instruction Manual (WTW, 2007; Radiometer Analytical SAS, 2004) provided by the manufacturer. Measurements in triplicate runs for both parameters were taken at 20°C.

Chemicals analysis Alkalinity

Water alkalinity was determined immediately after sample collection using phenolphthalein and methyl orange as indicators. The methods of analyses are discussed in the American Public Health Association (APHA, 1998). Based on ISO standard 9963-1:1994 pH-metric Titration 0.4 to 20 mmol/L of Total Alkalinity

Hardness

Determination of hardness was performed by the method described in (Vogel, 1989). The titration involved water sample against EDTA (Ethylene Di amine Tetra Acetate) using Eriochrome black T as indicator. An average value for triplicate determinations was recorded.

Chlorine

Chloride was measured using Mohr's method and sulfate by turbid metric methods. The methods of analyses are discussed in the American Public Health Association (APHA, 1998).

Determination of Turbidity

Turbidity was determined by adoption of Palintest Photometer 7500 instrument. The measurement runs were performed according to the instructions described in the Instruction Booklet of the manufacturer. Values were in Formazin Turbidity Units (FTU) based on the fact that FTU is equivalent to Nephlometric Turbidity Units (NTU) as recommended by the manufacturer.

Determination of the concentration levels of heavy metals

The analytical instrument used for the determination of heavy metals in the water samples were performed using Savant AA 5th generation AAS from GBC. The air- acetylene flame was adjusted according to the manufacturer's recommendation. For each of the heavy metals, the standard solutions were prepared by serial dilution from known standard stock solutions of 1000 mg/L. A calibration curve was prepared and then the analysis of the samples for the heavy metals was performed. All measurements were made in triplicate, the elements AL and Pb and were analyzed using Atomic Absorption Spectrophotometer according to (Greenberg et al., 1992; Hauser, 2002).

Microbial examinations

Bacterial and fungal analysis (coliform, fecal coliform and total plate counts (TPC) and salmonella were depends in order to evaluation the bacterial quality of these samples (WHO, 2006).

Statistical Analysis

Data were analyzed by statistical software SPSS ver. 16. The M-STAT software was used for statistical analysis. Analysis of variance (ANOVA) was performed according to the method described by Means were separated by the Least Significant Difference (LSD) and Duncan Multiple Range Test.

Results and discussion

Physical parameters in the water samples pH value

Table (1) shows the pH value in water samples. The highest pH value recorded (8.33) in raw water sample, while the treatment water was showed (7.49). The results showed having different among the pH value in water samples ($P \leq 0.05$).

Tamungang et al., (2016) who studied the physicochemical and bacteriological quality assessment of the Bambui community drinking water in the North West Region of Cameroon then were showed the pH value of all the samples ranged from 6.0 to 7.5.

WHO pH limit range is 6.5 to 8.5. thus, the pH of the samples fell within the limit in April 2014 and out of it in December 2013.

The water samples shows remarkable variation from the WHO and SSMO recommended value of pH.

The standard pH value according to WHO, (1982), Geneva and Sudanese Standardization Metrology Organization S.S.M.O is ranging from (6.5 to 8.5).

Conductivity EC

Table (1) shows the conductivity in water samples. The highest conductivity of raw water samples collected revealed that (60.33µS/cm), followed (50.8 µS/cm) by treated water sample. The results showed having different among the water conductivity in water samples ($P \leq 0.05$).

The electrical conductivity levels of all the samples ranged from 56 to 90 µS/cm compared to the WHO limit of 2000 µS/cm. These values were quite low and within limits indicating that there were very little dissolved solids.

The result showed lower value of EC than Adam and Hassan, (2017) showed that some drinking water in Sudan and found that, the mean EC value was 892.33µs/cm, also the minimum measured EC value was 541.00µs/cm and the maximum value was 1045.00µs/cm in samples.

The use of such sources may be safe for human drinking according to WHO drinking water standards, (1993) which considered the highest maximum EC values less than 1400 µs/cm with the exception of samples, the analyzed drinking water samples may be classified as safe for drinking from TDS and EC values as basic drinking water quality parameters. The Drinking water of the area contains higher amounts of TDS than the desirable limits (Jain et al., 2009).

Table (1) Physical parameters in water samples

Samples	**Raw water**	Treated water	SSMO (2002)	WHO (1993) and U.S. EPA (1991)
pH value	8.33±0.11a	7.49±0.02b	6.5 – 8.5	6.5 – 8.5
Conductivity	60.33±0.08 a	50.8±0.3 b	1600 micromohs/cm	1600romohs/cm

*Mean values ± SD within the raw having different superscripts letters are significantly different ($P \leq 0.05$).

Chemical parameters in water samples

Alkalinity

Table 2 shows the total alkalinity is referred to as amount of buffering material in water. The highest alkalinity were found in raw samples (246mg/L), followed by treatment water (185.5mg/L). The results showed having different among water samples (P≤0.05).

Also the alkalinity was less than physical and chemical standards of drinking water by Sudanese Standards and Metrology Organization SSMO, (2002) and WHO, (1993).

Rodenburg, (1985) reported that, water alkalinity is ppm assayed as calcium carbonate and water of less than 500 ppm alkalinity and pH 6.8 to 8 its nature of alkalinity is the presence of bicarbonate is not harmful.

Total hardness

Total hardness is defined as the sum of the calcium and magnesium concentration, both expressed as CaCO3, in mg/L. the highest total hardness was found in raw water samples (164 mg/L), followed in sample after treatment (79.88mg/L). Were lower than the WHO, (2008) and SSMO (Table 2) maximum admissible limit (200 mg/L).

Whilst the hardness levels in dry season is less than limit. The total hardness in wet season is moderately higher than hardness in dry season by 78.04 mg/L.

Chlorine

The highest water CL c found (30.1 mg/L) in raw water sample, while the lowest obtained (30.1 mg/L) in treated water sample (Table 2). The results showed having different among water samples (P≤0.05). Chloride in water samples were lower than the WHO (2008) and SSMO (Table 1) maximum admissible limit (250 mg/L).

The concentration of chloride was well within the desirable limit (Jain et al., 2009).

Turbidity

Table 2 showed the highest water turbidity found (0.22 mg/L) in raw water sample, while the treatment water obtained by (0.17 mg/L). The results showed having different among water samples (P≤0.05).

The result showed less than El Hassan et al., (1986) reported that, the Hco3 ions for the three Niles ranged from 114.7 to 128.1 mg/L. These author also that neither Co3 ions nor No3 where found in the Niles and tap water.

Table (2) chemical parameters in water samples

Samples	Raw water	Treated water	SSMO (2002)	WHO (1993) and U.S. EPA (1991)
Alkaline	246±0.31a	185.5±0.16 b	500–1000 g/L	500 mg/L
Chlorine*	30.1±0.3 a	20.7±0.34 b	250 mg/L	250 mg/L
Total Hardness*	164±0.7 a	79.88±0.6 b	-	500 mg/1
Turbidity**	0.22±0.02 a	0.17±0.005ab	-	1 mg/1

*Mean values ± SD within the raw having different superscripts letters are significantly different (P≤0.05).

Toxic elements (aluminum and lead) in the water

The result was showed nil of both aluminum and lead concentration in all sample were investigated (Table 3). The maximum level of lead in drinking water was (0.05mg|l) according to WHO and (0.007mg|l) according to SSMO. The maximum admissible concentrations of aluminum in drinking water (ill mg/I) were (0.200 mg| l) according to WHO and SSMO.

Table (3) Toxic elements (aluminum and lead) in the water

Samples	Raw water	Treated water	SSMO (2002)	WHO (1993) and U.S. EPA (1991)
Pb	-	-	0.007 mg/1	0.05 mg/1
AL	-	-	0.2 mg/L	0.2 mg/L

Microbial parameters raw and treatment water samples

As indicated in Table (4), raw water samples were found from total bacterial count 7X10-6, mold 2X10-2 and total coli form 1, therefore they were acceptable for the consumer and were suitable for drinking. It is clear from, all samples treatment water showed the presence of total colony count, mold and yeast, E. coli and coliform so it's remarkable according to the Sudanese standards for drinking water.

These standards stated that all water intended for drinking must be free from E. coli or total coliform bacteria in any 100 ml of water sample. When comparing these results with some studies carried before (Ahmed, 2005) samples which had been taken from different cisterns of selected food factories at industrial area North Khartoum and analyzed for total coliforms, feacal coliforms and feacal streptococci using two techniques (MPN and MF), found that 60% of the total samples showed the detection of total coliform by the MPN technique whereas the MF technique detected them in 52% of the total samples (Abdel Moneim et al., 2011).

As indicated with Khartoum groundwater samples were free from E. coli and the total coliform, therefore they were acceptable for the consumer and was suitable for drinking, because they matched all conditions of the Sudanese standards for drinking water and according to the international standards for drinking water (WHO, 1997).

Salehi et al., (2014) who evaluated the microbial and physico-chemical quality of bottled water produced in Hamadan province of Iran and found that all the samples meet standard regulations of national standards of Iran and the WHO guidelines. None of the samples, had coliforms or fecal coliforms. Similar findings were found by Miranzadeh et al. (2011) and Godini et al. (2011) in Ardabil, Ilam and Kashan, Iran. This situation indicates that the methods applied by the companies for disinfection, such as UV irradiation, are useful and practical. However, according to Venieri et al. (2006), Pseudomonas aeruginosa, a food-borne bacterium, were found among 1527 bottled water samples in Greece. The study by Franco and Cantusio (2002) in Brazil demonstrated the presence of Cryptosporidium spp. in three types of bottled water samples.

Table (4) Microbial load in water samples

Samples	Raw Water	Treatment Water	
Total Bacteria	7X10-6	Null	-
Mold	2X10-2	Null	-
Yeast	Null	Null	-
Total Coli form	1	Null	-

*Mean values ± SD within the raw having different superscripts letters are significantly different (P≤0.05).

Conclusion and recommendation

Conclusion

- In our results showed having different among the physicals, chemicals parameters between tow samples of water ($P \leq 0.05$).
- The obtained result shows standard Specification for water used in soft drinks have good quality.
- The results concluded that physicochemical properties of treated water samples collected from factory were remarkable variation from the WHO and SSMO.

Recommendations

- The study recommended that show other investigation of heavy metals.
- Further attention is needed to improve the hygienic, safety in water used in soft drinks.

References

1. Abdalrahim, O. (2007). Effect of Khartoum City for Water Qualityof the River Nile. Changes of Water Quality along the River Nile Master's Thesis. Department of Water and Environmental Studies Linköpings Universitet, Linköping Sweden Linköping.
2. Abdel Moneim, E.; Sulieman, Batran E. El Hilali and Mohammed O. Babeki (2011) the suitability of water in khartoum state industrial area for food processing. Fifteenth International Water Technology Conference, IWTC-15, Alexandria, Egypt
3. Abdel-Magid, E.M. and Elhassan, B.M. (1986). Water supply in the Sudan.
4. Khartoum University Press. Khartoum. Sudan. (In Arabic).
5. Abdel-Magid, H.M.; Ibrahim, I.S. and Dirar, H.A. (1984). Chemical and microbiological examination of well and Nile water. Environmental international. 10:259-263.
6. Adam, A. F and Hassan, A. (2017) Analytical Study of Some Physicochemical Properties of Ground Water from El-Obeid (Bano Area) North Kordofan State, Sudan. J. Chem. Bio. Phy. Sci. Sec. D, February 2017 – April 2017, Vol. 7, No. 2; 251-256
7. Ahmed, I.F. (2005). Microbiological Quality of Water in Some Food Facilities Storage Cisterns in Khartoum North Industrial Area Ph.D. Thesis, Univ. of Khartoum, Sudan .p 54-60, 20-32.
8. APHA,(1998). Standard methods for the examination of water and, waste water. In: Clesceri, L.S., Greenberg, A.E., Eaton, A.D. (Eds.). America Public Health Association, Washington, DC.
9. Cheesbrough, M. (2000). District laboratory practice in tropical countries. Part
10. 2. Cambridge University Press.
11. El Hassan, B. M. and Abdel-Magid, I. M. (1986). Industrial Contamination of Water Sources in Sudan. Conference Paper. DOI: 10.13140/RG.2.1.1020.2084
12. Franco R.M., Cantusio Neto R. (2002). Occurrence of cryptosporidial oocysts and Giardia cysts in bottled mineral water commercialized in the city of
13. Campinas. Memórias do Instituto Oswaldo Cruz. 97: 205207
14. Gomez K, Gomez AA. 1984. Statistical Procedures for Agricultural Research.
15. John Wiley and Sons, New York USA.
16. Greenberg, A.E., Clesceri, L.S. & Eaton, A.D. (Ed.). (1992). Standard Methods for the Examination of Water and Waste Water (18th ed.). Washington, DC: American Public Health Association.
17. Hauser, B.A. (2002). Drinking Water Chemistry, a Laboratory Manual. USA: CRC Press
18. Jahagirdar, S. S..; Patki, V.K.; Thavare, R. M.; Patil, S. and Rangrej, S. (2015) Comparative Study of Water Quality Parameters of Different Brands of Soft Drinks IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE). e- ISSN : 2278-1684, p-ISSN : 2320-334X PP 142-148

19. Jain, C.K., Bandhopadhy, A. and Bhadra, A. (2009)Assessment of ground water quality for drinking purpose, District Nainital, Uttarakhand, India.
20. Miranzadeh M.B., Hassani A.H., Iranshahi L., Ehsanifar M., Heidari M. (2011b). Study of Microbial Quality and Heavy Metal Determination in 15 Brands of Iranian Bottled Drinking Water During 2009-2010. Journal of Health and Hygiene. 2: 40-48.
21. Rodenburg, J. (1985). Water quality can affect production and health. Ontario milk producer 62, pp. 12 – 14.
22. Salehi, I.; Ghiasi, M.; Rahmani, A.R.; Nouri Sepehr, M.; Kiamanesh, M.; Rafati,
23. L. (2014). Evaluation of microbial and physico-chemical quality of bottled water produced in Hamadan province of Iran. Journal of Food Quality and Hazards Control 1 (2014) 21-24
24. SSMO, (2002). Sudanese Standards and Metrology Organization Drinking water guidelines bulletin, Sudan.
25. Tamungang, N.E; Alakeh, M.N; Niba, M.L and Jude, S. (2016) Physicochemical and bacteriological quality assessment of the Bambui community drinking water in the North West Region of Cameroon. Vol. 10(6), pp. 181-191, June 2016
26. Venieri D., Vantarakis A., Komninou G., Papapetropoulou M. (2006). Microbiological evaluation of bottled non-carbonated (still) water from domestic brands in Greece. International Journal of Food Microbiology. 107: 68-72
27. Vogel, A.I. (1989). Vogel's Textbook of Quantitative Analysis, 5th Ed., Longman Scientific and Technical, Essex, England and John Wiley and Sons Inc. New York, USA, pp. 332 -333.
28. WHO (1982) Rapid Assessment of Sources of Air, Water and Land Pollution.
29. WHO, Geneva, Switzerland, Offset publication No. 62,
30. WHO (1993). Guidelines for drinking water quality. Second edition, vol. Vol. 2, World Health Organization Geneva.
31. WHO (1997), "Guidelines for Drinking Water Quality" 2nd Ed., Vol 3, Geneva, p. 4, 7, 84-128.
32. WHO (2008). Guidelines for drinking-water quality [electronic resource]: incorporating 1st and 2nd addenda, Vol.1, Recommendations. – 3rd ed. WHO Press, Geneva, Switzerland.
33. WMO (1997). World Meteorological Organization. The world's water is there enough? WMO, United Nations Educational, Scientific and Cultural Organization, UNESCO.