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Trace elements levels in drinking water from gokana, ogoniland, river state, nigeria

Abstract

This study investigated the levels of trace metals in drinking water in crude oil contaminated communities in Gokana, Rivers State, Nigeria. The trace metals levels were measured with atomic absorption spectrophotometer. The levels of Co, Zn, Mg, Cu and Fe in the drinking water ranged between 0.65–0.93, 0.12−0.52, 0.21–57, 0.11−0.42, 0.67–2.20, respectively. The levels of Co, Cu and Fe in drinking water in the study sites analyzed were significant ($p<0.05$) higher when compared with their corresponding permissible limits by WHO except magnesium and zinc that were below the permissible limit. Co, Cu and Fe were ranged between 2−8 times larger than the permissible limits. The high level of Co, Cu and Fe render this water from these communities in Gokana unsuitable for human consumption due to their potentials adverse health effect at high levels.

Keywords: Trace metals, Gokana, Drinking water, WHO, Health risks

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Introduction

Trace element is one of the common and persistent contaminations aquatic ecosystems due to their resistance to decomposition in natural environment.[1] Common source of trace element in the aquatic environment are from agriculture water drainage, bedrocks, discharge of urban and industrial waste water and runoff from riverbank.[2,3] Moreover, increase of trace element above permissible limit may also be as a result of natural process or unethical human practices such as crude oil pipeline sabotage as in the case of Gokana, Ogoniland, Rivers State. The health risk of metals in the water body especially drinking water depend mainly on the dose, route of exposure, chemical form, body distribution, storage, bio-availability and excretion parameters.[4] Recently, more research work has focused more on investigating the metals in drinking water, seafood and food crops due to the fact that large population size contribute immensely to metals levels, whether the level is low or in excess including chronic poisoning.[5,6] It is also important to note that ingestion of water containing significant amounts of heavy metals may cause serious health effects. Trace element levels in ground water (Borehole water) are causing serious health concern because of their adverse effect on human physiological and biochemical functions. Some adverse effect of metals include cancer, renal failure, loss of breath, neuronal damage, skin lesion, hepatocellular toxicity, intravascular hemolysis, hypertension, melanosis, peripheral gastrointestinal bleeding, vascular disease etc.[7–10] among those who are exposed to high dose of trace metals. Trace element levels above the permissible limit of drinking water standards cause great health concern. Release of trace element into the water body may percolate via sub-surface water bodies and get absorbed in the cause of it transportation as a result of various geochemical processes. The presence and mobility of trace element in groundwater body is sustained by absorption processes. Gokana, Rivers State has experience so many incidence of crude oil spill due to pipeline failure, artisanal refining and illegal bunkering,[11–13] data on trace metals in water bodies of crude contaminated communities are scares. The people in these communities use water from these boreholes for drinking, bathing and cooking on a daily basis without further treatment. Therefore, this study aimed to assess the levels of trace metals in borehole water in some crude oil contaminated communities in Gokana, River State, Nigeria.

Materials and methods

Gokana, Ogoniland, Rivers State heavily polluted by crude oil spill. It is a region in Niger Delta covering some 1000 km^2 in the southeast of the Niger Delta basin. It is located at the following geographical coordinate: latitude 4° 40′ 5″ N and 4° 43′ 19.5″ N and longitude 7° 22′ 53.7″ E and 7° 27′ 9.8″ E.[11–13] The map of the study area is presented in Figure 1.

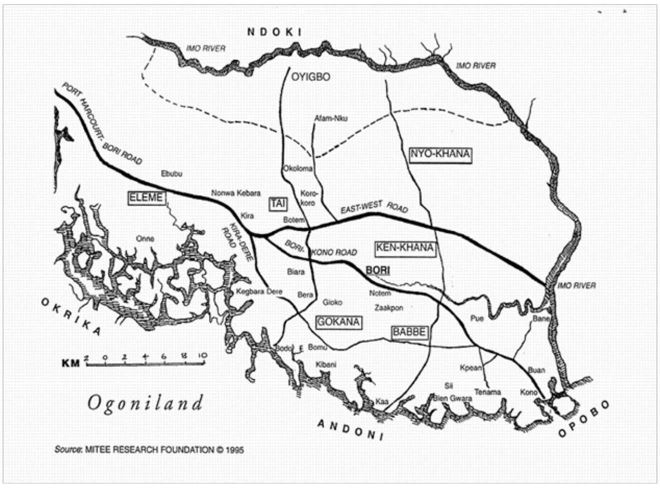

Figure 1 Map of the study area.

Sample collection and analysis

Twenty-five water samples were collected from Kpor, Mogho, B-Dere, K-Dere and Bodo City in Gokana, Rivers State, five water samples from each community. People in these communities fetch water from borehole for drinking, washing or cooking without further treatment. The water samples were collected in plastic containers acidified in situ with 10% solution of Nitric acid (HNO_3), sealed, labeled and then transported to the laboratory. The water samples were thereafter filtered through 0.45-µm filter membranes. All samples were then stored in sealed polyethylene sample bottles and refrigerated at 4°C until analyzed. Trace metals evaluated in the water samples were: Cobalt (Co), zinc (Zn), magnesium (Mg), copper (Cu) and iron (Fe). The concentrations of elements in the water sample were measured using atomic absorption spectrophotometer (AAS) equipped with graphite furnace (AAnalyst 700 Perkin-Elmer).

Statistical analysis

The data were statistically analyzed by SPSS software version 26. T-Test was applied for evaluating the significant difference between hazardous metals concentration in drinking water from the study sites and established permissible limits.

Results and discussion

The standard permissible limits of trace metals as recommended by the World Health Organization are presented on Table 1**.** The levels of trace evaluated in this were compared with the permissible to ascertain the health risks via consumption of drinking water from crude contaminated communities in Gokana, Rivers State, Nigeria. The level of Co, Zn, Mg, Cu and Fe in drinking water from the study sites are presented in Table 2. The trace metals analyzed in this study were detected in the water samples in varying concentrations. The levels of Co, Zn, Mg, Cu and Fe in the drinking water ranged between 0.65–0.93, 0.12−0.52, 0.21–57, 0.11−0.42, 0.67–2.20, respectively. The trace metals (Co, Cu and Fe) in drinking water in the study sites analyzed were significant ($p<0.05$) difference when compared with their corresponding permissible limits by WHO[14] except magnesium and zinc that were below the permissible limit. Co, Cu and Fe were even a 2-8 times larger than the permissible limits. In this study, Co, Cu and Fe exceeded the permissible limit recommended by WHO for drinking water and may not be safe for human consumption. It is evidenced from this study that the quality of water is below standard. The levels of Co, Cu and Fe in drinking water from the study area are higher than the permissible limit established by WHO[14] These higher levels of trace metals may lead to detrimental effect on the inhabitant of the study area and as such may not be safe for human consumption. Regulatory bodies may need to step up the monitoring of water body especially drinking water assessment. Penalties also need to be implemented on individuals or companies contributing to environmental degradation. This will drastically reduce the exposure rate of the people in study area to trace metals contamination. There is urgent need to investigate the levels of trace metals in seafood, food crops and borehole on a monthly basis and evaluation of seasonal variations of these trace metals.

Table 1 Permissible limits of trace elements in drinking water by World Health Organization

Trace metals	Symbols	Permissible limit14
Cobalt	Co	0.05
Zinc	Zn	5
Magnesium	Mg	3
Copper	Cu	0.05

Table 2 Trace metals level (mg/L) in drinking water from Gbe, Kpor, Mogho, B-Dere, K-Dere, and Bodo City, Gokana Local Government Area, Ogoniland, Rivers State, Nigeria

Heavy metals					
Sites	Co	Zn	Mg	Cu	Fe
Gbe	0.77±0.02	0.43±0.01	0.57±0.02	0.34±0.01	0.67±0.03
Kpor	0.65±0.03	0.12±0.01	0.33±0.03	0.42±0.01	1.34±0.04
Mogho	0.75±0.02	0.34±0.02	0.64±0.02	0.11±0.01	1.28±0.02
B-Dere	0.93±0.01	0.22±0.02	0.21±0.02	0.31±0.02	1.43±0.03
K-Dere	0.88±0.03	0.32±0.03	0.43±0.01	0.27±0.01	2.20±0.02
Bodo City	0.90±0.02	0.52±0.02	0.22±0.03	0.21±0.01	1.28±0.02

Acknowledgment

None.

Conflict of interest

None.

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