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Microbial Assessment of the Shallow Wells of Miango, Central Nigeria

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Abstract:
Waterborne pathogenic agents affect the health of people either by direct consumption of contaminated water or by its indirect use in food production and/or processing. Studies on the microbiological quality of water in rural areas of Miango and environs are still limited, especially at the household level. The aim of the present study was to assess the microbial quality of water from different hand dug wells and boreholes. In total, 19 water samples were analyzed for E. coli *contamination. In most of the analyzed samples, a higher prevalence of* E. coli *was recorded in areas where pit latrines and pigsties are on a higher elevation and close to the water sources of the people. The E.coli count range, form 2-50 per 100ml. Taking* E. coli *as a proxy for water quality, the microbiological quality of water consumed in the study area was found to be very poor, posing a potential food safety and health risk to the entire community.*

Keywords: *E.coli, miango, microbial assessment, shallow well*

1. Introduction

In many developing countries, microbial contamination of water is causing various diseases. Children, women, immunocompromised individuals, and rural residents are considered to be at the highest risk of contracting waterborne pathogenic microorganisms. People can become infected by waterborne pathogenic agents, if they either consume contaminated water directly or indirectly through its use in food production, processing, or preparation Studies on the microbiological quality of water are limited and mainly focused on urban settings . The present study aimed to assess the microbial quality of water used by rural households for domestic purposes (primarily for drinking), based on E. coli as a quality indicator. It was assumed that the quality of water consumed in rural communities of the study area is poor, posing a potential health risk to people. Water quality investigation carried out involved microbial test. This was done to determine the coliform count in the water samples collected from fifteen (15)Hand dug wells and four(4) boreholes within the study area . Bacteria species, particularly Escherichia coli and related organism (streptococci and clostridium perfringens) designated as coliforms, are particularly present in human intestines in large numbers. They gain entrance into water bodies via intestinal discharges of humans or other animals. These organisms live longer in water than other intestinal organism, and cause disease like typhoid, cholera, dysentery, etc. (Pelczar et al., 1993). These water-borne diseases have high incidence of occurrence, particularly in rural and other communities where hygiene is not taken seriously. In practice, therefore, the bacterial examination of water intended for human consumption is usually limited to a search for coliform bacteria (Price, 1985).

1.1. Location, Accessibility and Areal Extent

The study area is located in Bassa Local Government Area, which is situated in the northern fringe of Jos, the Plateau State capital (Fig. 1). It lies between latitudes 9^0 49’ 02’’N and 9^0 52’ 36’’N and longitudes 8^0 39’ 06’’E and 8^0 43’ 18’’E(Naraguta 1:50,000 sheet 168 NW).

The main access route to the area is the Jos-Miango major road(Fig 1). The minor accessory roads and foot path as well as cattle tracts, which aided access to the interior parts of the area are linked to the major road. The minor roads and foot paths link different settlements and villages within the study area and this acted as major links to outcrops during field work mapping.

1.2. Relief and Drainage (Geomorphology)

The study area has a distinct and rugged topography with hills of different heights (Fig 1). The drainage pattern is mainly dendritic. It has various tributaries, rivers and streams most of which take their source from surrounding hills. This drainage pattern is typical of crystalline basement environment and depicts the homogeneity of the rock.

The area is drained by River Nge'll and other smaller rivers and streams. The river at the eastern part flow westwards though an aqueduct. The streams and rivers in the area are seasonal with the water having their highest flow in the rainy season around August and lowest flow during the dry season around March.
The relief of the study area is relatively high with highlands situated at the western, northwestern, southern and the north eastern parts. The low lands are mainly on the central parts of the area with undulating landscapes. Both the plains and some of the hills have been extensively affected by weathering and erosion.

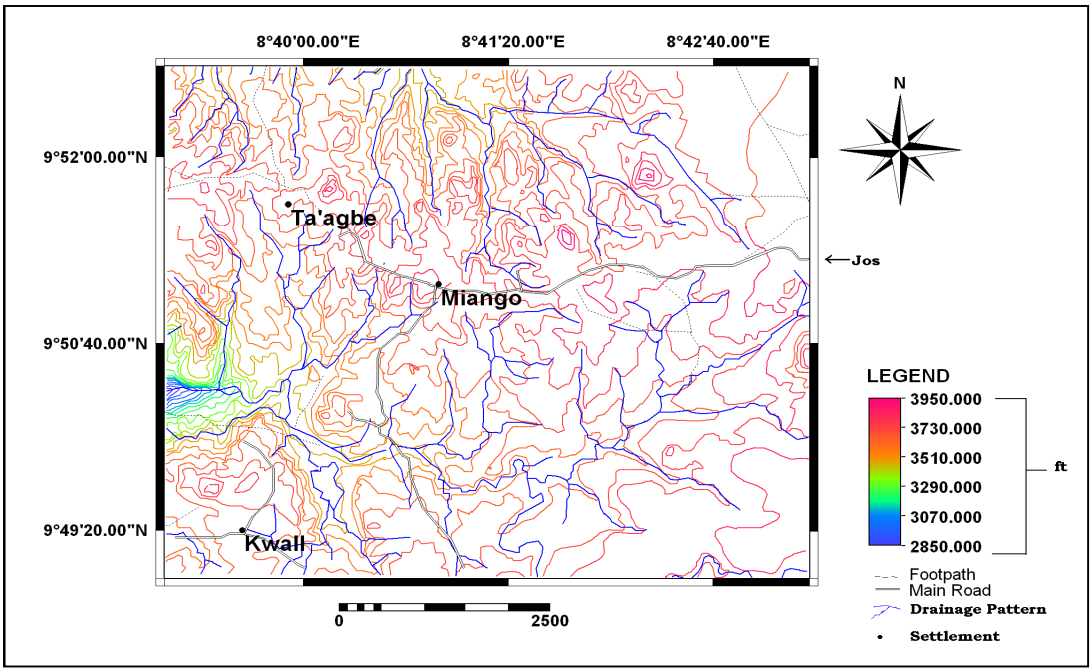

Figure 1: Location map of the study area showing relief and drainage

2. Materials and Methods

The water samples were collected in transparent sterile bottle and then physically examined for turbidity and presence of colloids and other suspended particles. The samples were subsequently transported to the laboratory for further analysis to determine the coliform population. The population was estimated by the Most Probable Number (MPN) technique, adopted from the Water, Sanitation and Health Electronic Library.

2.1. Presumptive Test

Nine (9) tubes of 10 ml lactose broth were engaged for each sample. Three (3) tubes of 10 ml, 1 ml and 0.1 ml of each samples were inoculated into 10 ml of the lactose broth, i.e. 10 ml of sample into three tubes of 10 ml lactose broth, 1 ml of samples into another three tubes of 10 ml lactose broth and then 0.1 ml of the same sample into three tubes of 10 ml lactose broth containing inverted Durham tubes inside the tubes. This was done for each sample, and the inoculated samples then incubated at 37^0C for 24 hours for acid and gas formation. The control experiment was distilled water with zero coliform count per 100 ml. The results of the experiment are displayed in Table 1.

2.2. Confirmation Test

A loop full of the lactose broth with acid and gas production was streaked on Essinmethylene blue (EMB) agar and was incubated at 37^0C for 24hours for characteristic determination of colonies and plate count. Presence of typical colonies constitutes a confirmed test.

3. Results and Discussion

Escherichia Coli produces small colonies, dark, almost black centre with green metallic sheen.
Presence of typical colonies constitutes a confirmed test, i.e coliforms present.
The interpretation of the results of groundwater quality studies contained in Table 1 must take into account the fact that the presence of a few pathogenic microorganisms (disease causing organism) in water is more significant than that of many saprophytic bacteria (microbes that obtain food by absorbing dissolved organic matter). This is of course because of the human health implication. In fact, the World Health Organization (WHO) guidelines (2006) stipulated that all water intended for drinking must have zero coliform (Escherichia coli, Salmonella species, Shigella species etc.) count in any 100ml samples of water. Therefore, the groundwater quality results disclose a poor groundwater quality within the study area with the coliform count, ranging from 2 to 50 per 100ml.This is as a result of the proximity and high elevations of pit latrines and pigsties to water sources.

Latitude(^{0})	Longitude(^{0})	Sample No	A + G	Characteristic colour of EMB	Coliform count /100ml
8.70483	9.85500	B 1	+ +	Pink	20
8.68667	9.85100	B 2	+ +	Pink	03
8.66883	9.85983	B 3	+ +	Pink	18
8.68433	9.84500	B 4	+ +	Pink	26
8.70400	9.85400	W 1	+(a)	Pink	20
8.70163	9.85400	W 3	+ +	Pink, Dark - Green	27
8.69533	9.85103	W 4	+ +	Pink	32
8.69133	9.85200	W 5	+ +	Pink	15
8.68717	9.85167	W 6	+ +	Pink, Dark - Green	13
8.68567	9.85178	W 7	+ +	Pink	27
8.68150	9.85087	W 8	+ +	Pink	05
8.66867	9.85983	W 9	+ +	Pink	28
8.66900	9.86117	W 10	+ +	Pink	02
8.67067	9.86200	W 11	+ +	Pink	05
8.69767	9.84917	W 12	+ +	Pink, Dark - Green	32
8.69617	9.85072	W 13	+ +	Pink	20
8.69433	9.85058	W 14	+ +	Pink	50
8.68283	9.85153	W 15	+ +	Pink	25
8.68 117	9.84717	W 16	+ +	Pink, Dark - Green	45

Table 1: Result For Microbial Analysis of study area
+ + = Acid and Gas production
+ (a) = Acid production only
B = Borehole, W = Hand dug well

Deep groundwater sources normally record little or no presence of pathogenic organism because the population of these organisms tends to attenuate with depth partly because of the relatively high temperature and pressure conditions characteristic of such depths and partly because of the filtering effects the earth medium has on groundwater that infiltrates through it. On the contrary, temperature and pressure conditions of shallow groundwater sources and lack of sufficient filtering of infiltrating water are conducive to the thriving of such organism. Aquifers in the study area by and large occur at shallow depths, since the depth to the bedrock average 39m(Bala, 2010). This factor coupled with the poor hygiene practices of the residents in the study area make for high frequency of high coliform count in the area. Thus the Miango central axis form the focal points of high pathogenic concentrations in the study area. These areas are known for high population densities and have coliform counts in excess of 20 count/100ml. This perhaps explains the prevalence of water-borne diseases in the study area.

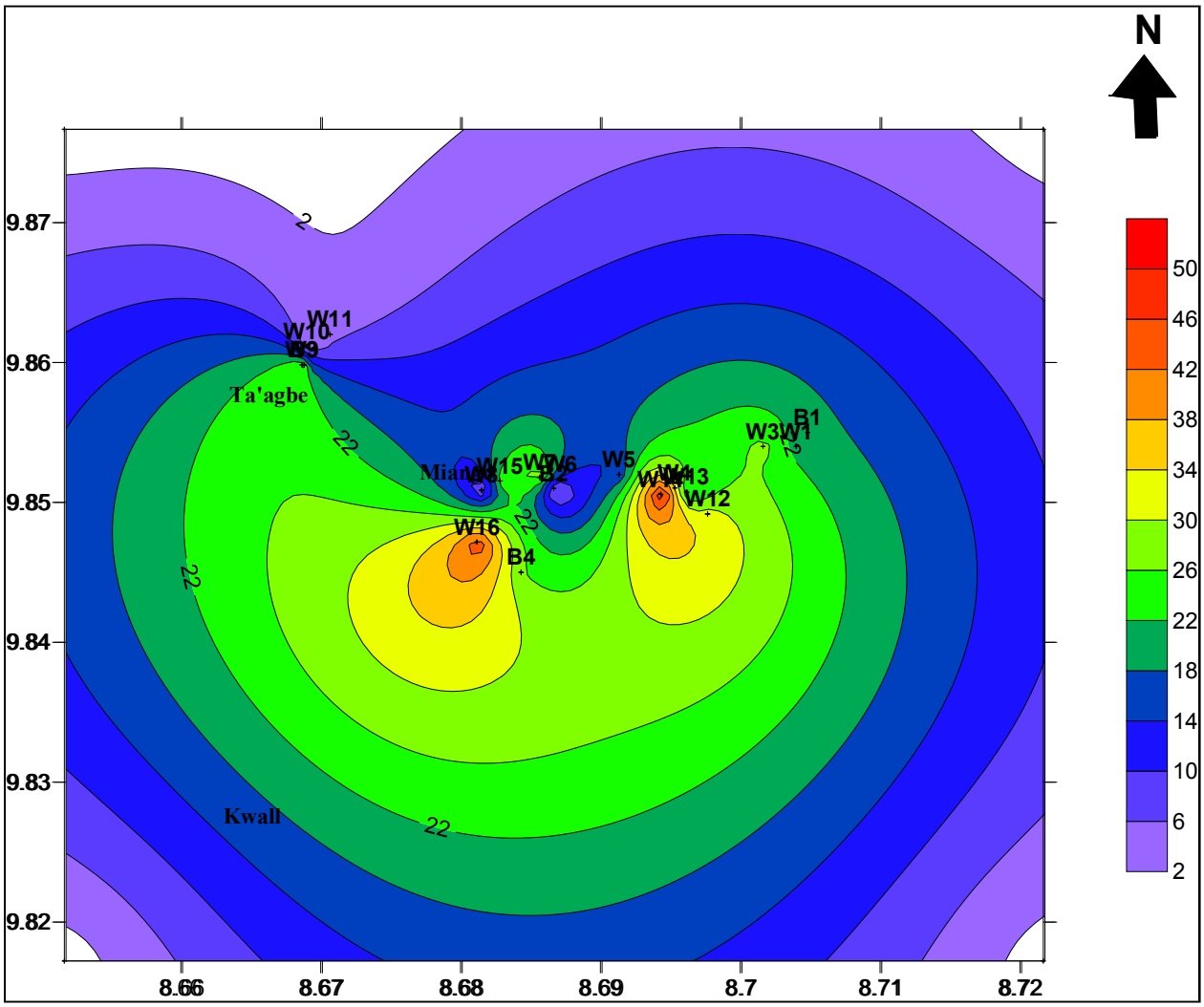

Figure 2: Contour map showing E. coli distribution in the study area.

4. Conclusion and Recommendation

The study reveals that the number E coli organisms in Miango area is above the recommended standard of zero(0) organisms per 100mls of water as set by WHO 2006. The occurrence and presence of these organisms in the water show microbiological contamination. The water therefore needs to be treated by chlorination and boiled if it should be taken for drinking by man to avoid the water borne diseases such as typhoid, diarrhea and cholera. Also, latrines and animal houses should be far from water sources to avoid contamination.

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