Physico-Chemical and Microbiological Assessment of Human Urine Impacted Top Soil

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ABSTRACT
This study was carried out to investigate the impact of human urine as an organic contaminant on soil samples collected within University of Benin, Benin City. Using standard analytical methods, the physicochemical and microbiological qualities of the urine-contaminated soils were evaluated to assess soil quality and biota. Heavy metal concentrations were determined using Atomic Absorption Spectrophotometer. Measured pH, electrical conductivity, total nitrogen, sodium, potassium, total hydrocarbon, available phosphorus, ammonium nitrogen, nitrate and sulphate were 5.51±0.34, 700.4±44.95, 2.3±0.14, 1.77±0.15, 4.07±0.16, 1.33±0.14, 35.1±4.91, 10.09±0.85, 6.49±0.46, 10.76±0.76 and 6.11±0.69 respectively. Particle size showed that the soil samples were basically sandy (90.69±0.57%). Statistical analysis showed significant difference (P<0.001) for electrical conductivity, chloride and total hydrocarbon content. Iron content had the highest mean concentration (736.88±70.58 mg/kg) followed by manganese (79.24±17.06 mg/kg). Bacteria isolated included; species of Bacillus, Staphylococcus, Enterobacter, Micrococcus and Citrobacter. Fungal isolates were; Aspergillus spp., Penicillium sp., and Candida sp. Findings from this study is therefore a clarion call for an urgent public awareness by the relevant authorities, so as to discourage this low esteemed human behaviour, which is unleashed on the environment by both literates and illiterates in the society.

Key Words: Human urine, acidity, soil, microorganisms, heavy metal

INTRODUCTION
Soil is a naturally occurring unconsolidated or loose material on the surface of the earth, capable of supporting life. It is a small ecosystem consisting of both living and no-living matter (Akpoture, 2009). The top soil is where most of the organic matter and microorganisms activities take place, and also where most of the earth’s biological soil activity occurs. The soil environment includes viable plants (roots), animals and microorganisms that reside in the pore spaces and are attached to the geological materials. Dada and Aruwa, (2014) opined that soil organic and inorganic matter is determinants of soil fertility and they also aid the proliferation of various soil micro flora which in-turn play vital roles in the maintenance of the nutritional balance and geochemical cycles of the soil. Some species of bacteria thrive on different food sources and in different micro-environments in the soil (Dada and Aruwa, 2014, Imarhiagbe et al., 2016). The continual improper deposition of human urine at open places result in a net acidification of the receiving soil due to the conversion of ammonium to nitrate that involves release of protons, thereby promoting acidity and pungent smell Dedeke et al., 2011). Contamination of topsoil by heavy metals has remained a serious concern considering their bioaccumulation potential, toxicity, and non-degradability, persistence in the receiving environment (Anyakora et al, 2011; Olayinka et al., 2017). They accumulate overtime in soils, which act as a sink from which these toxicants are released to the groundwater and plants and end up through the food chain thereby causing various toxicological effects. Soils have been known to act as a major sink for heavy metals, from
which they end up as toxicants into the food chain, passing through groundwater and plants thereby eliciting toxicological effects. Approximately, 75 – 90 % nitrogen of urine is excreted as Urea. In the presence of urease, urea is degraded to ammonium and carbon dioxide with an increase pH of 9-9.3. The continual deposition of urine at a spot results to net acidification of the soil due to the conversion of ammonium to nitrate, thereby promoting acidity.

There seems to be a dearth in literature regarding the impact of urine on soil environment especially of human origin (Dedeke, 2011). Earlier report had described human urine are non-toxic except when mixed with faeces and other organic components in septic tanks (Dedeke, 2011). Therefore the need to establish the impact of human urine deposition on soil and soil biota cannot be over emphasis. This study was aim at evaluating the environmental impact of human urine on soil samples collected from University of Benin, Benin City.

MATERIALS AND METHODS

Collection of soil sample:
Top soil samples (0-15cm) were collected from regular urine contaminated site; while control soil (an uncontaminated site) was collected from approximately 100 meters away from the urine discharge location at the Faculty of Social Sciences. GPS coordinates for the sites are 06.40296°N and 005.62369°E respectively, all within in University of Benin Campus, Nigeria. Samples were collected between March and July 2015, with the aid of a soil augar and were sealed in polythene sachets and transferred to the laboratory immediately for physiochemical and microbiological evaluation.

Plate 1a and b: Photograph of the sampling site

Physicochemical Analysis

Soil preparation:
At the laboratory, 2mm and 0.5mm mesh-size sieves were used to sieve the soil samples. The sieved soil samples were preserved and analysed for the different parameters.

Determination of soil pH
Filtrates of soil sample (100 ml) were prepared using Whatmann No. 4 filter paper. The pH of the soil sample filtrate was determined using the Hanna microprocessor pH meter. It was standardized with buffer solutions of pH range between 4 to 7. Small amount of the various water samples were poured into sterile 100ml beakers. Buffer solutions of pH 4 and 7 were prepared to properly adjust pH meter before usage. The electrodes of the pH meter were then immersed in the buffer of pH 7 and the needle set to pH 7 after checking the zero point. The buffer is removed, the electrode washed and buffer of pH 4 substituted. This should read 4.00 without the need for adjustment. The electrode of the pH meter was then dipped into each of the water samples, one at a time, and was washed with distilled water at each point in time before dipping into another sample. The reading was taken about 1 minute after inserting the electrodes (Onyeonwu, 2000).
**Determination of electrical conductivity**

Conductivity meter was used in the determination of Electrical conductivity level of the soil samples. Filtrate from the soil sample were prepared and then tested for EC level, and the calibrated meter was powered and allows stabilising for 10 minutes. It was then calibrated by pressing CND and the probe was immersed in KCl solution (0.1M KCl: dissolved in exactly 7.4553g of water and made to 1liter). The probe was rinsed and immersed in the soil sample filtrate. The meter was then read after pressing the CND button.

**Determination of organic carbon**

50g of air-dried fine soil sample was passed through 2mm sieve and was ground to a fine consistency for carbon and nitrogen determinations. The ground sample was passed through 0.5mm sieve. Before grinding it was checked for roots and organic debris.

Soil sample (0.05g) was then weighed into a 250ml conical flask. From an automatic pipette or a burette, 10ml of N k2Cr2O7 was added and then 10ml of Conc. H2SO4. It was rocked for 1min and allowed to cool on an asbestos sheet.

To the cold solution, 60ml of distilled water was added to make the volume up to 150ml. It was then rocked (shake) and allowed to cool.

After adding 5ml of Phosphoric acid and 8-10 drops of 1% Diphenylamine solution the solution assumed a dark violet colour.

It was then titrated with 0.4Nferron Ammonium Sulphur solution until the colour changed to green.

0.2g of Glucose was weighed in triplicate and then treated as above. The blank was determined using 10ml of N K2Cr2O7 solution. The entire reagents as before was added and titrated to a green colour with 0.

**Calculation**

\[
\%C = \frac{\text{Titre}}{0.24} \\
\%C = \frac{\text{Bk} - \text{Titre}}{0.24} \\
\text{Total Organic Carbon} = (\text{Bk} - \text{Titre}) \times 1.72 \text{ (Organic Matter)}
\]

**Determination of ammonium nitrate**

Five millilitres (5ml) of filtrate was prepared using Sodium Acetate extract. Then 2.5 ml of alkaline phenol, 1ml Sodium Potassium Tartrate and 2.5ml of Sodium Hypochlorite were added. The resultant solution was properly mixed together in between each addition. The standard was treated similarly. It was then read colorimetrically at 636nm against the ppm as blank.

**Calculation**

\[
\text{NH}_4^+ \text{N (ppm as } \alpha/\text{g for soil)} = \frac{\text{IR} \times \text{SR} \times \text{Colour Vol.} \times \text{Extra. Vol.}}{\text{Wt. of sample} \times \text{Aliquot taken}}
\]

**Determination of total hydrocarbon content (THC):**

Soil sample (5g) was weighed into a 100ml plastic bottle. This was followed with the addition of 25ml of n-Hexane. It was then rocked for 10minutes and let to stand covered. Then solution was filtered and read spectrophotometrically at 460nm.

**Calculation**

\[
\text{THC (ppm)} = \frac{\text{Instr. Reading} \times \text{Slope Reciprocal} \times 25}{5g}
\]
Determination of nitrate
10ml of the filtrate was pipetted into a 50ml flask. Then 2ml of Brucine was added and then rapidly 10ml of conc. H$_2$SO$_4$ was added. It was then mixed well and let to stand for 10minutes. The standards were then treated similarly and thereafter the samples and standards to mark. It was then read spectrophotometrically at 470nm.

Calculation
Nitrate (ppm as $\alpha$/g for soil) = IR x SR x Colour Vol. x Extra. Vol.  
Wt. of sample x Aliquot taken

Determination of chloride:
Ten (10) ml of the filtrate was pipetted into a 250ml conical flask. The 1ml or 3 drops of K$_2$CrO$_4$ was added. Then 0.05M standard was then titrated until a slight red precipitate occurs. The blank was then treated with 9ml of the K$_2$CrO$_4$ indicator and 10ml of 20ppm Cl$^-$. as in steps above.

Calculation
Cl$^-$ ($\alpha$/g for soil) = Molarity x Titre x Extra. Vol. x 1000 x mol. wt  
Wt of sample x Aliquot taken

Determination of available phosphorus:
Soil sample (5g) was weighed into the plastic bottle. Then 40ml of the extracting solution was added and stoppered. It was then rocked manually for 1 minute. The solution was then filtered with Whatman filter paper No. 42. When filtrate was seen not to be clear, the filtration process was repeated. If after filtering again the solution is not clear, then 3-5 drops of conc. H$_2$SO$_4$ was added and let to stand for about 2 hours. The clear supernatant was then easily decanted. The filtrate or supernatant was then kept for determination.

Determination of particle size:
One hundred grams (100g) of the soil sample was accurately weighed into a 1 litre-shaking bottle, and then added 50ml Calgon solution, 3ml of 1N Sodium Hydroxide and 200ml of distilled water and shake on the mechanical shaker for 3 hours and the resultant solution was transferred to a measuring cylinder and made up to mark (the volume of 1000ml) with distilled water. The solution was further mixed by inverting it a few times, and then placed on the bench and read with time. After 4 minutes, with the hydrometer and again read after 5 minutes later (Bouyoucos, 1962).

Calculation:
Temperature coefficient = (Temp - 19.4) x 0.3  
%Clay = H$_2$ + its Temperature Coefficient  
% Silt = H$_1$ + its Temperature Coefficient – (H$_2$ + its Temp Coefficient)  
%Sand = 100 – (%Clay + %Silt)

Determination of exchangeable sodium:
The Ammonium Acetate extract was employ for the determinations and were analysed using Flame Photometer.
Calculations:
Instr. Reading x Slope Recip. x 100ml x Dilution Factor x $10^{-3}$  
Weight of Sample x Eq. Wt
Determination of exchangeable magnesium by EDTA:
Twenty millilitre (20ml) of the filtrate was measured into a conical flask, then 5ml of ammonia buffer 10 solution, 2 drops of KCN, 5 drops of hydroxylamine hydrochloride and drops of Erichrome Black T indicator were added. Leave for 5 min for the reaction to take place and Titrate against the EDTA to a permanent blue colour end point.

Determination of calcium:
Twenty millilitre (20ml) of the filtrate was measured into a conical flask, 5 drops KCN, 5 ml of 8M KOH, 5 drops hydroxylamine hydrochloride and 5 drops of Cal Red indicator were added and Leaved for 5 min for reaction to take place and Titrate against the EDTA until the colour of the solution turns from red to blue end point.

Determination of heavy metals:
One (1) gram of the respective air-dried samples was dissolved into 30ml Kjeldahl digestion flasks containing 10 ml of nitric acid (HNO₃). The solutions were digested with the aid of a Digester (Gerhardt digester, UK.). The levels of heavy metals of the digested clear supernatants were determined using an Atomic Absorbance Spectrophotometer (AAS) (Model-Solar 969 Unicam series, UK).

Enumeration and isolation of heterotrophic bacteria and fungi:
Ten (10) grams of respective soil samples were suspended in ninety (90 ml) millilitre of sterilized nutrient broth in a conical flask. The soil suspension was thoroughly mixed and serially diluted tenfold. Appropriate dilutions were plated in duplicates on sterile nutrient agar and potato dextrose agar for total heterotrophic bacterial counts and total heterotrophic fungal counts respectively. The potato dextrose agar plates were made selective for fungal growth by the addition of 1 ml of chloramphenicol (antibiotic) solution prior to addition of the molten medium. The agar plates were incubated aerobically at 35 °C for 48 hrs and 5 days at room temperature (28°C ± 5°C) for 5 days for bacteria and fungi respectively. After incubation, counts obtained from culture plates were recorded and expressed as the colony forming unit per gram (cfu/g) of the original sample. The various isolates were further identified and characterized (Barnett and Hunter, 1975, Cullimore, 2000, Collins et al., 2004, Cheesbrough, 2006).

RESULTS AND DISCUSSION
RESULTS
There were variations between the control soil and soils from studied location, which therefore indicated possible contamination and alteration of the soil physicochemical quality. The mean values of pH, electrical conductivity, total nitrogen, sodium, potassium, total hydrocarbon, available phosphorus, ammonium nitrogen, nitrate and sulphate were; 5.51±0.34, 700.4±44.95, 9(µS/cm), 2.3±0.14 (%), 1.77±0.15(meq/100g), 4.07±0.16 (meq/100g), 1.33±0.14 (meq/100g), 35.1±4.91(meq/100g), 10.09±0.85 (meq/100g), 6.49±0.46(meq/100g), 10.76±0.76 (meq/100g) and 6.11±0.69(meq/100g) respectively. Also, the results of the particle size showed that the contaminated soil samples were basically sandy soil (90.69±0.57%). The analysis of the studied soil samples also showed relative levels of heavy metals such as iron, manganese, zinc, copper and lead. On comparatively analysis of soil samples collected from studied location between March to July, iron content had the highest mean concentration (736.88±70.58 mg/kg) followed by manganese (79.24±17.06 mg/kg). Levels of zinc, copper and lead were 77.56±2.74 mg/kg, 17.78±1.60 mg/kg and 14.5±1.82 mg/kg.
Variations were observed between control and studied soil, with the control soil recording lower microbial counts in comparison with contaminated soils from the respective sampled locations.
The results of the microbiological enumeration are stated in Table 4. Heterotrophic bacterial counts enumeration ranged from $2.7 \times 10^4$ cfu/g to $22.5 \times 10^4$ cfu/g and fungal enumeration also ranged from $0.8 \times 10^4$ cfu/g to $7.8 \times 10^4$. The predominant microbial isolates were *Bacillus* sp., *Micrococcus* sp. and *Staphylococcus* spp.

### Table 1: Physiochemical analysis of soil samples

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control(a1)</th>
<th>Mean±SE(b)</th>
<th>P-Value</th>
<th>Significant level</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.12</td>
<td>5.51±0.34</td>
<td>0.966</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>EC (µS/cm)</td>
<td>250</td>
<td>700.4±44.95</td>
<td>0.000</td>
<td>P&lt;0.001**</td>
</tr>
<tr>
<td>Org. C (%)</td>
<td>1.58</td>
<td>2.3±0.14</td>
<td>0.985</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>Na(meq/100g)</td>
<td>0.70</td>
<td>1.77±0.15</td>
<td>0.945</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>Ca(meq/100g)</td>
<td>1.23</td>
<td>4.07±0.16</td>
<td>0.714</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>Mg(meq/100g)</td>
<td>0.54</td>
<td>1.33±0.14</td>
<td>0.955</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>Cl (mg/kg)</td>
<td>21.4</td>
<td>47.4±9.21</td>
<td>0.000</td>
<td>P&lt;0.001**</td>
</tr>
<tr>
<td>THC(mg/kg)</td>
<td>5.8</td>
<td>35.1±4.91</td>
<td>0.000</td>
<td>P&lt;0.001**</td>
</tr>
<tr>
<td>Av. P(mg/kg)</td>
<td>5.50</td>
<td>10.09±0.85</td>
<td>0.628</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>NH4N(mg/kg)</td>
<td>2.33</td>
<td>6.49±0.46</td>
<td>0.527</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>NO3(mg/kg)</td>
<td>3.56</td>
<td>10.76±0.76</td>
<td>0.264</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>SO4(mg/kg)</td>
<td>1.96</td>
<td>6.11±0.69</td>
<td>0.645</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>Clay (%)</td>
<td>5.30</td>
<td>6.65±0.25</td>
<td>0.978</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>Silt (%)</td>
<td>2.10</td>
<td>2.66±0.33</td>
<td>0.881</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>Sand (%)</td>
<td>92.60</td>
<td>90.69±0.57</td>
<td>0.999</td>
<td>P&gt;0.05</td>
</tr>
</tbody>
</table>

Key: (a1): uncontaminated soil, (a) over all mean values, (b): mean values±standard error of urine contaminated soils samples from March to July
Table 2: Statistical analysis of physiochemical analysis of soil sample using chi-square test
Key: (a¹): uncontaminated soil, (b): mean values±standard error of urine contaminated soils samples from March to July. P>0.05 No significant difference, P<0.001 highly significant difference**

Table 3: Heavy metal composition (mg/kg) of soil samples

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control (a)</th>
<th>March (a)</th>
<th>April (a)</th>
<th>May (a)</th>
<th>June (a)</th>
<th>July (a)</th>
<th>Mean±SE (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe</td>
<td>195.1</td>
<td>825.0</td>
<td>809.0</td>
<td>899.6</td>
<td>512.6</td>
<td>637.8</td>
<td>736.88±70.58</td>
</tr>
<tr>
<td>Mn</td>
<td>14.5</td>
<td>119.7</td>
<td>1.05.7</td>
<td>92.3</td>
<td>31.6</td>
<td>46.9</td>
<td>79.24±17.06</td>
</tr>
<tr>
<td>Zn</td>
<td>25.2</td>
<td>74.0</td>
<td>85.0</td>
<td>69.5</td>
<td>77.5</td>
<td>81.8</td>
<td>77.56±2.74</td>
</tr>
<tr>
<td>Cu</td>
<td>5.83</td>
<td>20.3</td>
<td>18.7</td>
<td>21.4</td>
<td>12.5</td>
<td>16.0</td>
<td>17.78±1.60</td>
</tr>
<tr>
<td>Cr</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Cd</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Pb</td>
<td>0.48</td>
<td>19.1</td>
<td>17.5</td>
<td>10.6</td>
<td>15.3</td>
<td>10.0</td>
<td>14.5±1.82</td>
</tr>
<tr>
<td>Ni</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>V</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Key word: (a) over all mean values, (b): (a) mean values±standard error of monthly analysis from March to July, Fe- iron, Mn- manganese, Zn-zinc, Cu-copper, Cr-chromium, Cd- cadmium, Pb-lead, Ni- nickel, V-vanadium

Table 4: Microbiological analysis of soil samples

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Total Heterotrophic Bacterial count (cfu/g ×10⁴)</th>
<th>Total Fungal count (cfu/g × 10⁴)</th>
<th>Tentative Bacterial isolates</th>
<th>Tentative Fungal isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.7</td>
<td>0.8</td>
<td>Bacillus sp., Micrococcus sp.</td>
<td>Aspergillus sp., Penicillium sp.</td>
</tr>
<tr>
<td>March</td>
<td>12.5</td>
<td>6.1</td>
<td>Bacillus sp., Citrobacter sp., Micrococcus sp., Enterobacter aerogenes</td>
<td>Aspergillus sp., Penicillium sp.</td>
</tr>
<tr>
<td>April</td>
<td>17.7</td>
<td>7.8</td>
<td>Bacillus sp., Citrobacter sp., Micrococcus sp., Staphylococcus sp.</td>
<td>Aspergillus sp., Penicillium sp., Candida sp.</td>
</tr>
<tr>
<td>May</td>
<td>22.5</td>
<td>7.2</td>
<td>Bacillus sp., Enterobacter sp., Micrococcus sp., Staphylococcus sp.</td>
<td>Aspergillus sp., Penicillium sp.</td>
</tr>
<tr>
<td>June</td>
<td>14.3</td>
<td>5.9</td>
<td>Bacillus sp., Micrococcus sp., Staphylococcus sp.</td>
<td>Aspergillus sp., Penicillium sp.</td>
</tr>
<tr>
<td>July</td>
<td>11.8</td>
<td>4.6</td>
<td>Bacillus sp., Micrococcus sp., Staphylococcus sp.</td>
<td>Aspergillus sp., Penicillium sp.</td>
</tr>
</tbody>
</table>
DISCUSSION
This study has further revealed that the deposition of human urine has great negative impact on the soil quality and its microbial community. Physical examination of the soil showed that the colour of urine polluted soil is much darker than the unpolluted soil; which may be due to the presence of high level of chlorides and nitrates contained in the urine polluted soil. The urine polluted soil also revealed patchiness of soil and no plant growth as observed (Plate 1a and b) despite the significantly higher levels of nutrients in urine polluted soil (Table 1 and 2). The high level of chloride in this study could be ascribed to low volatility and high viscosity of urine; as well as high nitrate value observed therein for the soils (Akpozure, 2009, Dedeke et al., 2011). The major physical impact of urine deposition on soil was the significantly lower pH, which indicated high soil acidity (Table 1). The low pH in urine polluted soil may be due to microbial oxidative process of urea.

The high acidity observed for the urine contaminated soils could interfere with nutrient cycling between soil, air and water. The presence of soil microorganisms isolated from soil samples in this study has revealed that soils from polluted site consist of opportunistic microbial species of importance to human and public health. Bacillus species are known versatile aerobic spore formers, capable of respiration using a variety of simple organic compounds (sugars, amino acids, organic acids). Bacillus species such as B. cereus is a pathogen of humans (and other animals), causing food borne illness (diarrhoeal-type and emetic-type syndromes) and opportunistic infections (Logan, 2005). Citrobacter species are commonly found in water, soil, food and intestinal tracts of animals and humans. Micrococcus is generally thought to be a saprotrophic or commensal organism, though it can be an opportunistic pathogen, particularly in hosts with compromised immune systems, such as HIV patients (Smith et al., 1999), Entrobacteriaceae, several strains of these are pathogenic and cause opportunistic infections. Staphylococci are commonly found in air and water and on the skin and upper part of the human pharynx. These bacteria are known to cause pneumonia and septicemia as well as boils and kidney and wound infections. The presence of high organic matter, alongside the practice of indiscriminate urination, may have accounted for the high counts of bacteria obtained from soils. The genera Aspergillus and Penicillium were the most prominent among the fungal species isolated. Higher fungal counts were observed from the urine contaminated soils compared to count from control soil. The pH of urine is known to fall more within the acidic range. Drangert (2000) stated that the presence of urine may have affected the pH of the polluted soil, lowering it to an acidic state which favored fungal growth more than bacterial growth. Public urinal soils may become a major factor in the spread of infection especially...
when adequate sanitary facilities are not available. Anthropogenic activities in urban areas have been observed to largely contribute to the contamination of urban soils and this is a major health concern (Olayinka et al., 2017). The contaminated soil samples were composed of appreciable high contents of toxic heavy metals.

The continuous entry of these metals into the surrounding environment can result in serious contamination. Iwegbu et al. (2013); Dauda and Odoh, (2012) had earlier reported high concentrations of heavy metals from soil samples. Heavy metals such as lead, zinc, copper etc have been incriminated with the potentials to accumulate in plants. According to (USDA, 2000), excess heavy metal accumulation in soils and water bodies are toxic to humans and other animals; exposure to heavy metals is normally chronic (exposure over a longer period of time), due to food chain transfer.

Microorganisms from public urine polluted soils have potential to cause disease either as primary or opportunistic pathogens. The stench from these urine polluted soils is also nauseating. Regular visits to the public urinal site may contribute to increasing microbial load above threshold levels within the body systems (Hoglund et al., 2002). Hence, persons visiting these urinals site stand the risk of contracting opportunistic infections and diseases.

In conclusion, it is generally observed that the available toilet facilities within most universities in Nigeria are far below the required to cater for the ever growing population of students admitted, and the provision of more and adequate toilet facilities within the institutions cannot be overemphasized. This is therefore a clarion call for an urgent public awareness by the relevant authorities so as to discourage this low esteemed human behaviour, which is unleashed on the environment by both literates and illiterates in the society.

REFERENCES


Olayinka, O. O; Akande, O. O; Bamgbose, K; Adetunji, M. T (2017) Physicochemical characteristics and heavy metal levels in soil samples obtained from selected anthropogenic sites in Abeokuta, Nigeria. Journal of Applied Sciences and Environmental Management, 21 (5): 883-891


United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS): Heavy Metal Soil Contamination. Soil Quality Institute 411 S. Donahue Dr. Auburn, AL. 36832 334-844-4741 X-177 Soil quality urban technical note No.3. 2000