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# EXPLORING THE EFFECTS OF GOAT DROPPINGS ON SOIL MICROBIAL DISTRIBUTION AT AWKA SOUTH LOCAL GOVERNMENT AREA, ANAMBRA STATE, NIGERIA

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## ABSTRACT

Reduction in microbial distribution in soil has been described as one of the factors that limit optimum production of crops for consumption. This study was carried out to explore the effects of goat droppings on soil microbial distribution at Awka South Local Government, Anambra State, Nigeria. Forty goat (40) droppings were collected from four different communities (Umuawulu, Nibo, Mbaukwu, Nise) at Awka South LGA, The microbial distribution in the various communities and the effects of goat droppings on microbial distribution in the sampled communities were evaluated using standard microbiological techniques. The result revealed that Umuawulu community recorded 13 (54.17%) bacterial isolates, followed by Nibo and Nise, which recorded 4 bacterial isolates each (16.67%) while the lowest was Mbaukwu, which recorded 3 bacterial isolates (12.5%). Moreover, there was a significant ($P<0.05$) reduction in the microbial distribution in the impacted soil, especially in the total lipolytic bacterial count (LBC), which recorded $1.70\pm0.10X10^4$ CFU|g in the non-impacted soil and $0.50\pm0.01X10^4$ CFU|g in the impacted soil while the lowest reduction was recorded in the total heterotrophic aerobic bacterial count (THABC), which had $19.80\pm0.21X10^4$ CFU\g in the non-impacted soil and $5.20\pm0.10$ $X10^4$ CFU|g in the impacted soil. This study has revealed that excessive goat droppings exert a substantial negative impact on soil microbial distribution.

Key Words: Soil, Microorganisms, Goat droppings, Goat barn

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## 1.0: INTRODUCTION

The ubiquitous nature of microorganisms has been known globally as revealed in the isolation of bacteria, fungi, and viruses in air, soil, and water samples (Lennon et al., 2020). Microorganisms in the soil have been studied extensively in order to explore their potentials and negative impacts in the environment (Lennon et al., 2020; Garba et al., 2021). The role of soil in sustaining lives in the universe has been elucidated globally because every living thing is associated with soil (Lennon *et al*., 2020). For instance, plants are grown on soil, and all the foods that man needs for survival are produced in the soil. This depicts that ensuring the optimal state of the soil is paramount as far as existence of lives is concerned (Garba et al., 2021). The ability of soil to be productive depends on the availability of several nutrients such as nitrogen, phosphorus, carbohydrates, lipids, etc. (Lennon et al., 2020).

It is worthy to note that manure generated from domestic animals is capable of enriching the soil (Baryakabona et al., 2024). The use of organic manure has been described by some researchers as an alternative to synthetic fertilizers, which introduce poisonous chemicals to crops, aquatic lives, and wellbeing of man is also endangered (Lennon *et al*., 2020; Bello and Kolawole, 2024). Farm yard manure comprising of remains of plants and animals has been utilized at local areas in soil fertility enhancement, and positive results have been documented (Garba et al., 2021; Bello and Kolawole, 2024).

Research has shown that soil microbial distribution could be affected by certain wastes from domestic animals (Demissie et al., 2024). Excessive application of dung from domestic animals could introduce excess nitrogen and phosphorus into the soil. High concentration of nitrogen and phosphorus is capable of affecting the growth of some beneficial microbes that cannot adapt to it, which invariably reduces their activities (Lennon et al., 2020). When there is an impairment in the

microbial activities, soil fertility is altered, which reduces the uptake of nutrients by crops in the soil (Marzouk *et al.*, 2024).

Several researchers have worked on the roles of animal dung in soil fertility enhancement such as Song et al. (2015), Baryakabona et al. (2024) and Demissie et al. (2024) but few studies are available on exploring the effects of goat droppings on soil microbial distribution, especially at Awka South LGA, Anambra State**.** Hence, the aim of this study is to explore the effects of goat droppings on soil microbial distribution at Awka South LGA, Anambra State.

## 2.0 Materials and Methods

### Study Area

The study was carried out at four different communities (Umuawulu, Nise, Nibo, and Mbaukwu), Awka South L.G.A. in Anambra State.

### Sample Collection

A total of 40 goat droppings were used for the study. The study was conducted at four (4) different communities at Awka South LGA namely; Umuawulu, Nise, Nibo, and Mbaukwu.

### Goat dropping (Soil) samples

The goat droppings were aseptically collected at 5 cm apart from each dropping using soil auger (15 cm depth). Then, the collected samples were carefully and aseptically mixed together as a representative sample for analysis using quadrant method. This was repeated at different sampling locations (Baryakabona et al., 2024).

### Transportation of the samples

The representative samples were placed or packed into a cooler containing ice block wrapped in a sterile polythene bag and were used for sample transportation. The temperature of the cooler was checked and adjusted to 28$^{o}$C – 30$^{o}$C by reducing the quantity of the ice inside the cooler in order to reduce or prevent microbial shock. The sample was carefully and aseptically arranged inside the cooler and the cover of the cooler was firmly closed to avoid accidental opening of the cooler. Then, the cooler was safely carried to the laboratory for microbial analysis within 2 h of sample collection. The same was repeated for other collection times (Baryakabona et al., 2024). .

### Sample preparation

The representative samples were prepared using the laboratory technique. The goat droppings were grounded using sterile blender (LXB 242), then, 10 g of each of the grounded goat dropping was weighed and transferred into a conical flask (pyrex) and 100 mL of normal saline was dispensed into the different conical flasks containing the goat droppings, and it was allowed to stand for some time before it was stirred evenly using stirring glass rod. Ten millimeters of normal saline was dispensed into the test tube (pyrex) and 0.01 mL of the sample (grounded goat dropping samples) was transferred into the test tubes containing the 9.99 mL of normal saline making it up to 10 mL ($10^{-3}$).

**Isolation of Test Organisms from the Samples**

The prepared and diluted samples (goat droppings) were aseptically grown on Nutrient agar (NA), MacConkey agar (MA), Centrimide Agar (CA), Sabouraud Dextrose agar (SDA), and Mannitol Salt Agar (MSA) (BIOTECH) which were prepared following the instruction of the manufacturer and procedures described in Cheesbrough (2010) and Frank and Robert (2015). The cultured plates were carefully placed inside the bacteriological incubator (ST X B128) in an inverted position, and incubated at 35±2ºC for 24 h.

**Purification of the Isolates**

The plates that showed discrete colonies were selected after 24 h and aseptically streaked on sterile plates (90 mm X 15 mm) containing Nutrient Agar (BIOTECH) prepared according to manufacturer's description. The streaked plates were placed in a bacteriological incubator in an inverted position and incubated at 37ºC for 24 h as described in Cheesbrough (2010) and Goldman and Green (2009).

**Determination of total heterotrophic aerobic bacterial counts**

One milliliter (1.0 ml) of water sample was aseptically transferred into a sterile test tube (Pyrex) containing 9.0 ml of the diluent (sterile normal saline) and from this; ten-fold serial dilutions were made up to $10^{-3}$. One milliliter of the diluted sample ($10^{-3}$) was plated on Petri dishes (60 mm OD × 55 mm ID × 13mm high) containing Nutrient agar medium (NA/Biotech) using pour plate method. All the plates in triplicates were incubated in an inverted position at 37±2˚C for 24 h. The total heterotrophic aerobic bacterial counts was determined after incubation using an electric colony

counter and colonies counted were expressed at CFU/ml as described by APHA (2012). The procedure was repeated for other samples.

**Estimation of Lipolytic Bacterial Counts (LBC)**

The prepared samples were aseptically cultured on sterile poured plates (90 mm x 15 mm) containing Tributyrin agar (TA) as described by Ibe et al. (2014). The plates were incubated in an inverted position using an electric incubator (STXB128) at 35±2°C for 24 – 48 h. LBC was enumerated by counting the number of colonies surrounded by the clear zones.

**Estimation of Cellulolytic Bacterial Counts (CEBC)**

The prepared samples were aseptically cultured on sterile poured plates (90 mm X 15 mm) containing cellulose agar (carboxy methyl cellulose) as described by Ibe et al. (2014). The plates were incubated in an inverted position using an electric incubator (STXB128) at 35±2°C for 24 – 48 h. CEBC was enumerated by counting the number colonies with hydrolyzed zones.

**Estimation of Phosphate Solubilizing Bacterial Count (PSBC)**

The prepared samples were aseptically cultured on sterile Petri plates (90 mm X 15 mm) containing National Botanical Research Institute's Phosphate Growth Medium (NBRIP) which comprises 10 g glucose, 5 g $Ca(PO_4)$, 2.5 g $MgCl_2$.6H2O, 0.25 g $MgSO_4$.7$H_2$0, 0.2 g KCl and 0.1 g $(NH_4)_2SO_4$ in 1000 mL of distilled water as described by Wafula and Murunga (2020). These were placed in an electric incubator (STXB128) in a vertical positions at 35±2°C for 24 – 48 h. PSBC was enumerated by counting the number of colonies in each plate after 24 – 48 h, and the mean counts were calculated and presented in form of mean ± standard deviation (Wafula and Murunga, 2020).

**Estimation of Nitrifying Bacteria Counts (NBC)**

The prepared samples were aseptically cultured on sterile Petri plates (90 mm X 15 mm) containing Glucose Nitrogen Free Mineral Medium (GNFMM) which comprises 1.0 g $K_2HPO_4$, 1.0 g $CaCl_2$, 0.5 g NaCl. 0.25 g $MgSO_4$.7H2O, 0.01 g $FeSO_4$.7H2O, 0.1 g $Na_2MoO4.2H_2O$, 0.01 g $MnSO_4.5H_2O$ and 7.0 g glucose in 1000 mL distilled water as described by Wafula and Murunga. (2020). These were incubated in a vertical positions at room temperature (30±2°C). The NBC was enumerated after 48 h.

**Statistical Analysis**

The data obtained in this study were presented in Tables. One way Analysis of variance was used to determine the significance of the sample sources and distribution of the isolates in the sampled communities at 95% confidence level. Pairwise comparison was used to carry out student "t" test (Iheukwumere et al., 2018).

## 3.0 Results

The overall evaluation and distribution of the bacterial isolates in the sampled communities revealed that Umuawulu community recorded 13 (54.17%) bacterial isolates, followed by Nibo and Nise, which recorded 4 bacterial isolates each (16.67%) while the lowest was Mbaukwu, which recorded 3 bacterial isolates (12.5%) (Table 1).

**Effects of Goat droppings (dung) on Soil Microbial Distribution**

The effects of goat droppings on soil microbial distribution are presented in Table 7. The result revealed that the highest THBC was recorded at Nise community ($5.90X10^4$ CFU/g), followed by Mbaukwu ($5.20X10^4$ CFU/g) while the lowest was recorded at Nibo community ($4.10X10^4$ CFU/g). There was a high reduction in the microbial distribution in the impacted soil compared to non-impacted soil, which recorded $19.80X10^4$ CFU/g. Similar observation was recorded in NBC, LBC, and CEBC, where impacted soil recorded 1.30, 0.50, 1.50 ($X10^4$ CFU/g) and non-impacted recorded 3.70, 1.70, 3.40 ($X10^4$ CFU/g), respectively. Meanwhile, different observation was recorded at Nibo and Umuawulu, where PSBC in the impacted soil ($4.30X10^4$ CFU/g) exceeded the count in the non-impacted soil ($2.40X10^4$ CFU/g).

Table 1: Distribution of the bacterial isolates in the sampled communities

| Community | Number of isolate | % occurrence |
|---|---|---|
| Umuawulu | 13 | 54.17 |
| Nibo | 4 | 16.67 |
| Mbaukwu | 3 | 12.50 |
| Nise | 4 | 16.67 |
| Total | 24 | 100 |

Table 2: Frequency of occurrence of the bacterial isolates in the impacted goat barn sites and non-impacted sites

| Bacterial Group | Impacted Goat Barn Site | | | | Non-Impacted |
|---|---|---|---|---|---|
| | MBA | NSE | NBO | UMU | Control |
| THBC(X $10^4$CFU/g) | 5.20±0.10 | 5.90±0.20 | 4.10±0.10 | 4.30±0.07 | 19.80±0.21 |
| NBC(X$10^4$ CFU/g) | 1.30±0.10 | 0.90±0.10 | 0.70±0.01 | 0.50±0.01 | 2.70±0.08 |
| LBC(X10 | 0.50± | 0.40± | 0.30± | 0.20± | 1.70±0.1 |

| | | | | | |
|---|---|---|---|---|---|
| $^{4}$ CFU/g) | 0.01 | 0.10 | 0.01 | 0.01 | 0 |
| CEBC X10$^{4}$CFU /g) | 1.50±0.07 | 1.10±0.07 | 1.00±0.06 | 0.70±0.01 | 3.40±0.10 |
| PSBC(X10$^{4}$CFU/g) | 1.60±0.10 | 1.30±0.09 | 4.10±0.10 | 4.30±0.07 | 2.40±0.08 |

UMU= Umuawulu; NBO= Nibo; MBA= Mbaukwu; NSE= Nise ; THBC=Total Heterotrophic Bacterial Counts; NBC= Nitrifying Bacterial Counts; LBC=Lipolytic Bacterial Counts; PSBC=Phosphate Solubilizing Bacterial Counts; CEBC= Cellulolytic Bacterial Counts.

## 4.0 Discussion and Conclusion

Conservation of soil fertility is paramount in environmental microbiology because it enhances productivity and overall wellbeing of individuals in the community. This study investigated the effects of goat droppings on soil microbial distribution at four communities within Awka South LGA. The highest number of bacterial isolates which was observed at Umuawulu community could be attributed to high contamination of the goat barns. This finding corresponds to the observation of Mala et al. (2021), Lennon et al. (2020), and Basnet and Kilonzo-Nthenge (2024) who screened the environment of domestic animals and their body surfaces for the presence of pathogenic bacteria.

The result obtained in this study showed that there was a substantial reduction in the microbial distribution in the impacted soil. The microbial count of total heterotrophic bacteria, nitrifying bacteria, cellulolytic bacteria, lipolytic bacteria and phosphate solubilizing bacteria decreased due to effect of the goat droppings. The ability of the goat droppings to alter microbial activities in the soil could be attributed to their composition, which does not support the proliferation of soil microorganisms. For instance, Bello and Kolawole (2024) investigated phytotoxicity profile of dung from cow, goat, and poultry on Okra, Pepper, and Tomato, and reported that the animal dungs exhibited substantial phytotoxcity effect on the vegetables. The researchers attributed the growth inhibition to excessive nitrogen in the soil, which could also inhibit the growth of beneficial microorganisms in the soil such as nitrogen fixing bacteria and phosphate solubilizing bacteria, which are highly essential for providing nitrogen and phosphorus for proliferation of plants. In a similar study conducted by Balasubramani et al. (2017), phytotoxicity effect of chicken dung was evaluated on selected vegetables, and their result revealed that the dung reduced the germination index of the vegetables to less than 50%, which they attributed to heavy metals in the manure, though all the heavy metals evaluated were below the acceptable limit stipulated by the U.S. Environmental Protection Agency (USEPA). However, the result obtained in this study does not corroborate to the findings of several researchers (Cho et al., 2017; Saxena et al., 2020; Baryaakabona et al., 2024) who evaluated the effect of animal manures (organic) on soil nutrient and microbial distribution. They reported

that application of organic manure from domestic animals increased microbial distribution and crop yield. This was attributed to introduction of nitrogen and phosphorus (in a good proportion) into the soil, which are both utilized by soil microorganisms and plants.

## Conclusion

This study has shown that there are bacteria in goat droppings-contaminated soil, and the distribution of these bacteria can be reduced significantly. Lipolytic bacterial count had the highest reduction while total heterotrophic aerobic bacterial count recorded the lowest reduction. This invariably shows that excessive application of goat dropping as farm yard manure should be thoroughly checked in order to conserve soil microbial distribution.


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## Conflict of Interest

There was no conflict of interest among the authors.

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