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# Assessment of Bacterial Population and Some Physicochemical Properties of Compost in Wukari LGA, Taraba State, Nigeria

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**Abstract**

Field studies were conducted at the Teaching and Research Farm, Federal University Wukari, to evaluate the bacterial population and selected physicochemical properties of compost in Wukari, Taraba State, Nigeria. Eight compost treatments were tested: GCP (Gmelina leaf + cow dung + poultry droppings), SGCP (Sawdust + Gmelina leaf + cow dung + poultry droppings), RGCP (Rice husk + Gmelina leaf + cow dung + poultry droppings), MGCP (Maize stalks + Gmelina leaf + cow dung + poultry droppings), GCPU (Gmelina leaf + cow dung + poultry droppings + urea), SGCPU (Sawdust + Gmelina leaf + cow dung + poultry droppings + urea), RGCPU (Rice husk + Gmelina leaf + cow dung + poultry droppings + urea), and MGCPU (Maize stalks + Gmelina leaf + cow dung + poultry droppings + urea). Wood ash, water, and topsoil were added to all treatments. Compost pits (1 $m^3$) were prepared for each treatment, replicated three times in a Randomized Complete Block Design (RCBD). Turning, bacterial enumeration, and temperature recordings were conducted monthly. Results revealed significant variation in bacterial populations, with MGCPU recording the highest counts. Compost temperatures remained below 40°C across all stages, indicating decomposition occurred predominantly within the mesophilic range. Total nitrogen (TN) content varied significantly, with RGCPU yielding the highest TN value. Available phosphorus was moderate across treatments, while potassium levels showed no significant difference. Overall, RGCPU and MGCPU outperformed other treatments in terms of microbial activity and nutrient content. Thus, RGCPU is recommended as the most suitable composting treatment for the study area.

**Keywords**: Assessment; Nitrogen; Compost; Bacteria; Mesophilic Stage

## INTRODUCTION

Using compost made from organic waste is one of the most promising ways to increase soil fertility in intensified cropping systems (Summer, 2000; Adediran et al., 2003). In addition to producing high-quality soil amendment, composting is the most practical and cost-effective method of preventing the waste of valuable natural resources. The unwanted characteristics of waste materials (pathogens, odor) could be effectively controlled through composting. Generally speaking, finished compost has a lower bulk density and is highly valued for its capacity to increase plant development and soil fertility (Adediran et al., 2006). Because compost releases nutrients gradually, its effects endure longer than those of inorganic fertilizers (Shaik and Patil, 2013).art from their ability to release nutrients, composts are known to improve physical properties such as soil bulk density, water retention capacity, infiltration and aeration (Deksissa *et al*., 2008; Adeyemo and Agela, 2010).

One organic fertilizer that can be applied to soil is compost. Utilizing the positive qualities of organic matter, compost fertilization also improves soil health and plant growth by increasing the soil's capacity to hold onto moisture, aeration, and beneficial microbial activity. This means that water stays in the soil for plants longer during dry spells (FAO, 2010). Understanding the microbial population working at various phases of the composting process and their various roles is essential because bacteria play a significant role in the composting process. The microbial breakdown of biodegradable materials, known as composting, is controlled by physiological, microbiological, and physico-chemical variables (FAO, 2010). It is commonly known that microbial communities—which include bacteria, actinomycetes, and fungi—are crucial to the composting process. Consequently, research on the microbe population during the composting of various agricultural wastes is required (Chandna et al., 2013). Knowing the microbiology of composting is essential for comprehending the process and for developing new techniques to enhance it and provide a better end result (Partanen et al., 2010). Microbial community structure is the composition of the microbial community and the abundance of the members in a microbial community (Friedrich *et al.*, 2011).

Both bacteria and fungus, which reflect the composition of the microbial population in the composting environment, are present and actively participate in the composting process. The entire composting process might be impacted either favorably or unfavorably by the presence of various bacteria or fungi. Their variety also points to the mechanisms involved in composting. The microbial populations and the composting output can also be altered by changing the kind and quantity of input organic matter (Franke-Whittle et al., 2014). Physical factors including oxygen, temperature, moisture content, and nutrient availability affect the diversity and growth of the microbial community during composting (Leow et al., 2018). The physical parameters are crucial in understanding the activity of different groups of microorganisms that will indicate the quality of the final product of the composting process (Partanen, *et al.*, 2010).

Many nations are now compelled to utilize chemical fertilizers to boost agricultural production in order to meet their ever-increasing food needs due to the pressures of an expanding population. However, excessive chemical use and polyvagal have led to environmental contamination as well as health risks for people and soil (Pandiselvi et al., 2017). Increased soil acidity, nutrient leaching, the loss of soil organic matter, and deterioration of the physical characteristics of the soil can all result from the excessive and inappropriate use of inorganic fertilizer (Plaster, 2013). Additionally, the majority of farmers cannot afford chemical fertilizer, and in some regions of Nigeria, it has become costly. As a result, making and using compost may be able to help with these issues. To really improve soil fertility in the long term, it is necessary to improve the soil structure and to increase the organic matter content of the soil.

One of the most crucial elements that supports sustainable agriculture and higher production is the usage of compost. Farmers no longer have to worry about their soil's declining fertility thanks to this. According to Paulin and Peters (2008), compost is made up of the comparatively decomposed organic components that come from the rapid biological breakdown of organic materials under controlled conditions. On the other hand, substituting inorganic inputs for organic ones lowers soil quality and may pollute the ecosystem (Albiach et al., 2000; Komiyams et al., 2013). Composting and the use of organic solid waste fertilizers can prevent this. In addition to increasing soil cation exchange capacity, which promotes mineralization and nutrient recycling, this procedure boosts microbial activity (Elbl et al., 2019) (Nath and Sing, 2012). For that, this research aimed at assessing the physio-chemical properties and bacteria population of compost mixtures in Wukari Local Government Area of Taraba State.

## MATERIALS AND METHODS

### Description of experimental sites

The experiments were conducted in Teaching and Research Farm Federal University Wukari, Taraba State. The Teaching and Research Farm lies within latitude $7.8^0$ to $8.2^0$N and longitude $9.3^0$ to $10.5^0$E with the elevation ranges from 159 to 166 meters above sea level. Wukari is situated within the Southern Guinea Savanna Zone of Nigeria.

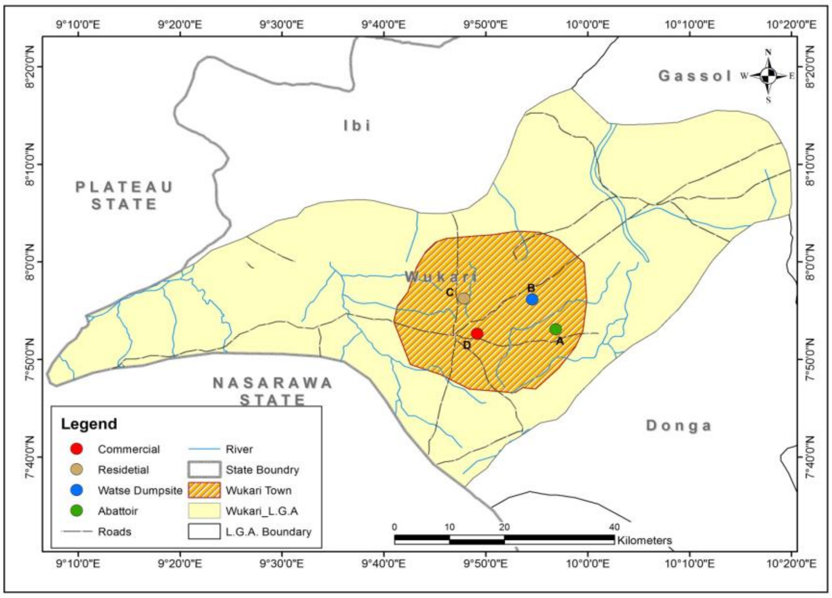


**Figure 1:** Map Showing the Study Area (Wukari LGA)

***Source***: Ministry of Land and Survey, Jalingo Taraba State

### Sources of raw materials for composting

Poultry droppings and cow dung were collected from the Federal University Wukari Animal and Poultry Farm, rice husk was collected from Wukari rice mill, urea from the open market, gmelina leaf from bush, sawdust from timber shade in Wukari, maize stalk from farm, wood ash from houses and all other materials were collected within Wukari town.

Table 1: Composition of the treatments

| Treatment | Quantity of composting material used |
|---|---|
| GCP | 10 kg of gmelina leaf + 5 kg of cow dung + 5 kg of poultry droppings + thin layer of ash + a thin layer of soil from the surface and 2 litres of water; |
| SGCP | 10 kg of sawdust + 10 kg of gmelina leaf + 5 kg of cow dung + 5 kg of poultry droppings + thin layer of ash + a thin layer of soil from the surface and 2 litres of water; |
| RGCP | 10 kg of rice husk + 10 kg of gmeina leaf + 5 kg of cow dung + 5 kg of poultry droppings + thin layer of ash + a thin layer of soil from the surface and 2 litres of water; |
| MGCP | 10 kg of maize stalk + 10 kg of gmelina leaf + 5 kg of cow dung + 5 kg of poultry droppings + thin layer of ash + a thin layer of soil from the surface and 2 litres of water; |
| GCPU | 10 kg of gmelina leaf + 5 kg of cow dung + 5 kg of poultry dropping + 150kg/ha of urea + a thin layer of ash + a thin layer of soil from the surface and 2 litres of water; |
| SGCPU | 10kg of saw dust + 10kg of gmelina leaf+5 kg of cow dung +5 kg of poultry droppings + 150kg/ha of urea+ a thin layer of ash + a thin layer of soil from the surface and 2 litres of water; |
| RGCPU | 10 kg of rice husk + 10 kg of gmelina leaf + 5 kg of cow dung + 5 kg of poultry droppings + 150kg/ha of urea+ a thin layer of ash + a thin layer of soil from the surface and 2 litres of water; |
| MGCPU | 10 kg of maize stalk + 10 kg of gmelina leaf + 5 kg of cow dung + 5 kg of poultry droppings + 150kg/ha of urea+ a thin layer of ash + a thin layer of soil from the surface and 2 litres of water; |

**Key:** G = Gmelina leaf, C = Cow dung, P = Poultry dropping, S = Sawdust, R = Rice husk, M = Maize stalk, U = Urea fertilizer

The compost materials were laid as weighted. Each pit has three layers of the compost materials and the pit reaches 1.0 m high (3 layers). Each pit comprises 30 kg of bulky and hard plant materials, 30 kg of gmelina leaf, 15 kg of both poultry dropping and cow dung, 6 litres of water, 600 g of wood ash and top soil except for treatments GCP and GCPU which does not contain bulk and hard plant materials. Wood ash (600g) was added to the pit in order to neutralize the compost pit, and little amount of top soil was also added, water (6 litres, i.e 2 litres for each layer) are been sprinkled to provide adequate moisture for initiation of microbial activities. There was also addition of urea fertilizer to treatments GCPU, SGCPU, RGCPU and SGCPU. After all these processes, the pits were covered with sacs to prevent water loss.

Turning of pit content, two empty pits were dug for each treatment totaling 48 pits. After a month, all the contents of the pits were turned over into the second pit. At 2 months later, they were turned into the third pits. Turning of materials from one pit to another was at 1 month interval, and it was done 3 times for the duration of 3 months.

**Experimental design**

The experiment was laid out in a Randomised Complete Block Design (RCBD) with three replications. Eight compost pits of 1 m length, 1 m width and 1 m depth was dug for the eight treatments and was replicated 3 times.

**Temperature Test**

The temperature test was done by digital soil thermometer, in which the thermometer was placed little deep at the center of each compost pits and allowed to stayed for 3 minutes before it will be removed and the temperature value was recorded for every treatment.

**Collection of samples and determination of bacteria population**

After turning of each compost pit, hand trowel was used to collect the compost samples from the pit to the containers. The samples were taken to the lab for determination of Bacteria.

One milliliter of the diluted sample (homogenate) was aseptically transferred into 9 ml of distilled water where the samples were serially diluted using the pour plate method (Obidah *at al*., 2018). Each sample of compost had undergone ten-fold serial dilution. In order to determine the overall bacterial count, 0.2 ml from the $10^{-5}$ dilution factor was transferred to the media, Nutrient Agar and Sabroud Dextrose Agar respectively, using the spread plate technique as described by Agwaranze *et al.* (2017). The plates of bacteria were incubated for 28 hours at 37$^{o}$C and three days at 35$^{o}$C respectively. Bacterial colony forming unit per gram (cfu/g) were calculated by counting discrete colonies using colony counter and recorded as colony forming unit (cfu) per gram of compost and fungal pore forming unit per gram (sfu/g) were calculated by counting discrete spore and recorded as sfu /g of compost (Rebollido *et al*., 2008). The enumeration was done after every turning in each month for 3 months. After the last turning, when the compost was matured, a sample of the compost was taken for chemical analysis.

**Determination of compost maturation**

For this research, it was terminated for the duration of 3 months, and maturity was detected by the colour of the compost when it turned into a dark brown.

### Collection of soil samples and chemical analysis of the compost

Soil of samples were collected, ground and passed through 2 mm sieve, organic waste materials were air-dried to remove excessive moisture and sorted to remove unwanted materials. The sorted organic materials were oven-dried at $65^0$C for 24 h and ground into fine particles, the samples were analyzed for chemical characteristics according to the methods described by Isirimah *et al*., (2003). The glass electrode method was being used to determine the soil pH (George *et al*., 2013).

The total N content of the sample was determined using the procedures described by Anderson and Ingram (1996). The Bray-1 method as described by George *et al*., (2013) and Zhang *et al*, (2018) were used in the determination of available P content in the samples. The method that has been used for determining the exchangeable cations involved the displacement of cations from soil colloids and their measurement in the displaced solution. Ammonium acetate ($NH_4OAc$) was used as the displacing solution as described by Thomas (1982). The concentration of K was determined by flame photometer. The organic carbon was determined using Walkley-Black method, which involves the oxidation of dichromate and tetraoxosulphate (VI) ($H_2SO_4$), (Black, 1963).

### Statistical Analysis

Data collected were subjected to Analysis of Variance (ANOVA) and significant means were compared using Duncan New Multiple Range Test (DMRT) at 5% probability level.

## RESULTS AND DISCUSSION

### Effects of Treatments on Monthly Bacteria Population

Table 2 displays the results for the population of bacteria. The findings demonstrate how composting materials affect bacteria over the course of three consecutive months of composting. According to the data, during the first month of composting, treatment GCP had the largest value on the bacterial population (276 cfu/ml), which is statistically the same for all treatments. Treatments RGCP and MGCPU had the lowest bacterial populations (134 cfu/ml), whereas the other treatments were statistically identical. The second-month results show that, although the other treatments were statistically equal, treatment GCP (277 cfu/ml) had the greatest value of the bacterial population. The lowest value was recorded in treatment

GCPU (128 cfu/ml). The results for the third month indicates that treatment GCP (276 cfu/ml) had the highest value of bacteria count which was statistically the same with all other treatments. The lowest value was obtained with MGCPU and was statistically the same with the other treatments.

**Table 2: Bacteria population (cfu/ml) in compost**

| Treatments | 1st Month | 2nd Month | 3rd Month | Total Bacteria |
|---|---|---|---|---|
| GCP | 276a | 277a | 276a | 829a |
| SGCP | 230a | 249a | 240a | 719ab |
| RGCP | 134a | 162a | 148a | 444b |
| MGCP | 272a | 278a | 275a | 825a |
| GCPU | 258a | 128a | 143a | 529b |
| SGCPU | 167a | 183a | 175a | 525b |
| RGCPU | 138a | 152a | 153a | 443b |
| MGCPU | 134a | 149a | 141a | 424b |
| SE | 70.1 | 62.2 | 58.9 | - |

Values with different letters in columns are significantly ($P$ = 0.05) different.

The experiment's findings indicate that, with the exception of treatment MGCPU, which had greater values than the others, practically all of the composting materials had an impact on the bacteria's quick development and multiplication during the course of the three months of composting. This could be because all of the materials had lower C:N ratios, which accelerated the decomposition process. According to Piyush et al. (2013), the highest recorded bacterial population during a mesophilic phase was between 105 and 109 cfu/g of compost. According to Gray et al. (1971), several microbial communities—each tailored to a specific environment—predominated during the various composting processes. This are in line with the results of Davis *et al.,* (1992) who reported that primary decomposers create a physio-chemical environment suitable for secondary organisms, which cannot attack the initial substrates, while metabolites produced by the one group can be utilized by the other. The bacteria population were found to be decreased during the thermophilic phase and declined further in the cooling and maturation phase.

Treatment GCP (829 cfu/ml) had the most bacteria, according to the results of Effects of Treatments on Total Number of Bacteria Population. This number was statistically equal to that of treatments MGCP and SGCP, while that of treatments RGCP, GCPU, SGCPU, RGCPU, and MGCPU was statistically different. This could be because GCP is treated to remove any large, hard plant materials that could raise the temperature of the compost and cause a high C/N ratio, which could impact the microorganism population.

**Effect of temperature on total bacteria population**

According to the findings of effects of treatments on total number of bacteria population, treatment GCP (829 cfu/ml) included the greatest number of bacteria. While this figure was statistically different for treatments RGCP, GCPU, SGCPU, RGCPU, and MGCPU, it was statistically identical to that of treatments MGCP and SGCP. This might be as a result of GCP being treated to get rid of any big, tough plant materials that could cause the compost to get hotter and have a higher C/N ratio, which could affect the number of microorganisms. In contradictions to these results, Zhang *et al,* (2020) investigated the effects of temperature on microbial community dynamics during composting. The results show that higher temperature of 55 $^0$C and 60 $^0$C supported greater microbial diversity and abundance compared to lower temperature. Thermophilic microorganisms which thrive at high temperatures played a crucial role in composting systems increased with temperature with optimal growth occurring between 50 $^0$C and 60 $^0$C. The contradictions may be due to some factors like climatic factors, type of composting materials, method of composting and soil type.

The graphs also show that during the first month of composting, the temperature range was higher than that of the second month and the temperature range of the second month was higher than that of the third month. This indicated that at initial stage of composting, the temperature tends to be much higher due to the activities and presence of microorganisms, and the temperature tends to drop slightly towards maturation stage of composting because decomposition have already occurred.

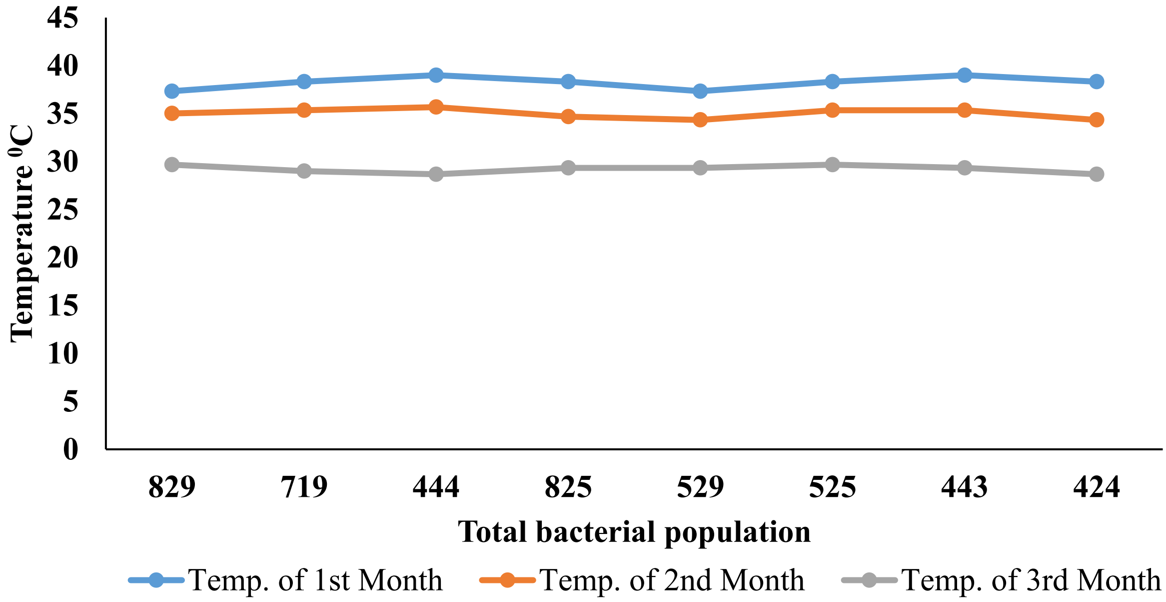


**Fig. 1**: A graph of temperature plotted against total bacterial population.

**Physicochemical Property of the compost**

***Temperature***

Temperature of various compost pits were measured during the period of composting. Table 3 shows the temperatures recorded with different treatments in composting pits. Throughout the first month, temperature ranged between 37°C – 39°C. The results show that during the first month of composting, treatments RGCP and RGCPU recorded the highest temperature (39.00 °C), but statistically the same with treatments SGCP, MGCP, SGCPU and MGCPU and significantly differed from treatments GCP and GCPU. Treatments GCP and GCPU had the lowest temperature of 37.33 °C but statistically the same with SGCP, MGCP, SGCPU and MGCPU. During the second month, the highest temperature was obtained with treatment RGCP (35.67 °C) while treatments MGCPU and GCPU had the lowest temperature with the value of 34.33 °C. At this month, there was no significant difference among the treatments at 5% level of probability. Temperature recorded during the third month shows that treatments GCP and SGCPU had the highest temperature of 29.67 °C, while treatments

RGCP and MGCPU obtained the lowest temperature of 28.67 °C. All treatments at the third month were statistically the same at 5% level of probability.

The results show that temperature of the compost materials in the first month of composting, falls within the optimum range of a mesophilic stage. At this stage, mesophilic fungi such as yeasts and molds as well as acid-producing bacteria such as *Lactobacillus* spp. and *Acetobacter* spp. are the dominant species to decompose organic waste materials (Partanen, 2010). At the mesophilic stage, microbial activities during the degradation process will result in an increase in temperature owing to energy of the organic combinations (Palaniveloo *et al.*, 2020). Fungi such as molds and yeasts are responsible for breaking down tough debris, which enables bacteria to continue the decomposition process which explains the degradation of several compounds such as amino acids, sugars and other simple components (in the waste product) in this phase. During the process, the temperature is known to increase rapidly, indicating the occurrence of degradation where organic matter was being transformed. Thereby, the compost will undergo the second phase process known as the thermophilic stage (Rastogi *et al.*, 2020).

**Table 3: Temperature of compost pits**

| Treatment | 1st Month | 2nd Month | 3rd Month |
|---|---|---|---|
| GCP | 37.33b | 35.00a | 29.67a |
| SGCP | 38.33ab | 35.33a | 29.00a |
| RGCP | 39.00a | 35.67a | 28.67a |
| MGCP | 38.33ab | 34.67a | 29.33a |
| GCPU | 37.33b | 34.33a | 29.33a |
| SGCPU | 38.33ab | 35.33a | 29.67a |
| RGCPU | 39.00a | 35.33a | 29.33a |
| MGCPU | 38.33ab | 34.33a | 28.67a |
| SE | 0.523 | 0.553 | 0.508 |

Values with different letters in columns are significantly ($P$ = 0.05) different.

According to Leow *et al*, (2018), diversity and development of microbial population during composting are dependent on physical parameters such as temperature. This entire process of decomposition triggers the rise and decrease in temperature during composting which determines the type of microorganisms that can exist at each stage of composting. As increasing temperature accelerates the breakdown of substances, hence exhaustion of nutrients. This causes the temperature to decrease gradually and enter the mesophilic phase again before the compost matures (Yu *et al.*, 2019). During the cooling phase, the mesophiles once again migrate back to the compost and work on digesting the remaining organic matter. The mesophilic temperature and availability of carbon-rich substrates at the early stages of composting process favor the growth of mesophiles with mixtures of bacteria, actinomycetes and fungi. Thus they grow at temperatures between 15 °C to 45 °C and achieve optimum growth at the range of 30 °C to 39 °C (Schiraldi De-Rosa, 2014).

Based on the temperature recorded in this experiment, the decomposition of the composting materials can be said to take place at mesophilic stage (within the first month). Lower bound of thermophilic temperature range and an upper bound of cooling/maturing stages of composting, as no any temperature above 40°C was recorded with any of the compost material. The thermophilic phase is the stage whereby most of the decomposition takes place. This stage sees the process of the organic matter degradation (fats, cellulose, hemicelluloses and some lignin) by thermophilic microorganisms represented namely by fungi and bacteria. During this stage of composting, mesophiles are replaced by thermophiles which grow optimally at the temperature between 40 °C and 80 °C, favoring actinomycetes and thermophilic bacteria such as *Bacillus* spp (Santos *et al.*, 2006). The final maturation phase is characterized by an even lower temperature below 25 °C. Due to the depletion of substrates, the microbial activity of thermophiles ceases and mesophiles are now getting back to recolonize the organic matters from the spores which survive under high temperature and germinate when the temperature drops or through external inoculation from the environment or the edge of the compost pile. At the final cooling phase, the amount of readily available substrates becomes a limiting factor, resulting in a decline in microbial activity which implies reduced oxygen uptake and heat output (Diaz and Savage, 2007).

***Soil reaction (pH)***

The result of pH of compost is presented in Table 4. The pH of the compost shows significant differences ($p<0.05$) in values among the treatments which ranged from 6.35 to 7.05. The highest value (7.05) was obtained at treatment GCPU but statistically the same with treatments GCP, RGCP and SGCPU and significantly differed from other treatments. Treatments MGCP, SGCPU and MGCPU are statistically the same with pH values of 6.55, 6.78 and 6.53 respectively. The lowest pH was obtained with treatment SGCP (6.35) which was statistically the same with treatments MGCP, RGCPU and MGCPU but differed significantly from other treatments. The pH values of the compost were slightly acidic and neutral varied from 6.35 to 7.05. The highest pH value was recorded when maize stalk was combined with urea, this value obtained was within the value of 5.5 to 7.0 for optimum plant growth (Perry, 2003), and 6.0 – 8.5 for compatibility with most plants (Lasaridi *et al*., 2006). The value was also in agreement with the compost quality standards for compost used in agriculture in Switzerland (pH < 8.20) and Roman *et al*.(2015) who stated that the ideal pH range for most compost is from 5.80 to

7.20 while the value is in contrary to the value obtain by Great Britain (7.50 – 8.50) and Dessie *et al*., 2022 (7.62 to 7.72). The variation in pH can be explained by the fact that the atmospheric $CO_2$ or $CO_2$ produced by microbial activities dissolved in compost extract forming carbonic acid, which is a weak acid, thus resulting in decline of pH over time (Zumdahl, 1993). Also, the variation could be attributed to increased nitrification process by nitrifying bacteria in the extract (Cacerese *et al*., 2006).

**Table 4: Chemical properties of compost**

| Treatment | pH in $H_20$ | OC (%) | Total N (% ) | Avail. P (%) | K (%) |
|---|---|---|---|---|---|
| GCP | 7.00$^{a}$ | 0.89$^{a}$ | 0.91$^{a}$ | 0.25$^{b}$ | 0.15$^{ab}$ |
| SGCP | 6.35$^{c}$ | 0.78$^{ab}$ | 0.66$^{a}$ | 0.29$^{a}$ | 0.15$^{ab}$ |
| RGCP | 6.93$^{a}$ | 0.77$^{ab}$ | 0.98$^{a}$ | 0.36$^{a}$ | 0.13$^{b}$ |
| MGCP | 6.55$^{bc}$ | 0.81$^{ab}$ | 0.43$^{b}$ | 0.25$^{b}$ | 0.14$^{ab}$ |
| GCPU | 7.05$^{a}$ | 0.54$^{ab}$ | 0.42$^{b}$ | 0.27$^{ab}$ | 0.17$^{a}$ |
| SGCPU | 6.78$^{ab}$ | 0.93$^{a}$ | 0.49$^{a}$ | 0.28$^{b}$ | 0.16$^{a}$ |
| RGCPU | 6.40$^{c}$ | 0.45$^{b}$ | 1.08$^{a}$ | 0.29$^{ab}$ | 0.14$^{ab}$ |
| MGCPU | 6.53$^{bc}$ | 1.43$^{a}$ | 0.83$^{a}$ | 0.26$^{b}$ | 0.15$^{ab}$ |
| SE | 0.149 | 0.169 | 0.289 | 0.3077 | 0.0135 |

Values with different letters in columns are significantly ($P$ = 0.05) different.

### *Organic carbon*

The organic carbon content of the compost obtained ranged from 0.45% to 1.43%. The Organic carbon content of the compost shows that treatment MGCPU (1.43%) had the highest value which was statistically the same with all treatments except for treatment

RGCPU. Treatment RGCPU had the lowest value of organic carbon (0.45%) which was statistically the same with all the treatments except for treatment GCP, SGCPU and MGCPU. The values obtained are in agreement with the findings of Baffour, (2009) who reported a similar pattern of reduction in organic carbon content, while the result is in contradiction with the findings of Rachel and Mulugeta (2013) who revealed that the value of organic carbon in matured compost is 16.6% based on research done in Bahir Dar. The results obtained from this study also contradict the results revealed by Huang *et al*, (2020) who stated that organic carbon content in compost typically ranges from 20% to 50%, high organic content indicates high levels of unified organic matter, which improves soil structure, fertility, and carbon sequestration (Liu *et al*., 2020). Factors like feedstock composition, aeration, moisture, and temperature during composting influence organic carbon content and compost quality.

***Total nitrogen***

The total nitrogen was highest at treatment RGCPU (1.08%), which was statistically the same with all the other treatments except for treatments MGCP (0.43%) and GCPU (0.42%). The nitrogen contents of the compost ranged from (0.42 % to 1.08 %). The lowest value was showed at treatment GCPU (0.42%), though statistically the same with MGCP and different with others. The highest value was obtained from RGCPU, this indicates that rice husk if combine with urea increases the amount of nitrogen in compost. The results are in agreement with the result obtained by Benito *et al*. (2005) who reported that the total nitrogen rate ranged between 0.99 to 2.01 %, the result was also in conformity with recommendation for total nitrogen in compost by the Ontario Ministry of the Environment (2004) which recommended the typical minimum concentration (% dry weight) of total N as 0.6%. However, the result was in contrary with the results obtained by Larney *et al*. (2002) who reported that plant available nitrogen in finished compost varied from 4.6 to 6.3% of total N for straw bedded materials and from 6.8 to 11.0% for wood bedded materials. The decline in total carbon might also be responsible for N upgrading as stated by Sangwan *et al*, (2008) and Karmegamand and Daniel (2009).

***Available phosphorus***

The results of the available P in the compost shows that treatment SGCP (0.36%) recorded the highest value which was statistically the same with RGCPU (0.29%) and SGCP (0.29%) but differed significantly with treatments MGCP GCPUGCP and MGCPU. The available phosphorus content for the compost ranged from 0.25% to 0.36%. The lowest value was recorded at treatment GCP (0.31). The results highest values were obtained is in line with the result of Dessie *et al.* (2022) who reported that the high amount of P concentration were observed to range from 0.19% to 1.41%. The increase in phosphorus level could be attributed to conservation of inorganic ions in the compost as reported by (Sartaj *et al.*, 1997).

***The potassium content***

The potassium content of compost shows that treatment GCPU had the highest value (0.17%) but was statistically the same with all the treatments except for treatment RGCP. Treatment RGCP (0.13) recorded the lowest value at 5% level of significance which was statistically the same with all other treatments except for treatment GCPU. The value of potassium in the compost ranges from 0.14 % to 0.17 %. The values obtained are in line with the result of Lochr *et al.* (2018) who reported that the value of potassium in compost ranges from 0.5 % to 1.5 %, and to Brady and Weil, (2002) who stated that potassium level was observed to drastically reduce in the $8^{th}$ week of composting in all the compost ratios, with percent reduction ranging from 5-87 %. This reduction may have resulted from temporary K fixation by organic matter. Tiquia and Tam, (2002) stated that an increase in total potassium is due to concentration effect as organic matter was being solubilized and mineralized. The agricultural quality of composts prepared by mixing various types of organic waste is evaluated by measuring a limited number of parameters such as the amounts of available nutrients mainly N, P K (Kopittke *et al.*,2017).

## CONCLUSION

The study's conclusions show that treatment GCP had the largest population of microorganisms. The predominant microorganisms linked to the composting materials utilized in this investigation were mesophilic bacteria, as shown by the temperature of the materials. According to the compost's chemical characteristics, treatment RGCPU had the highest N content. It was found that the maximum amount of organic matter was recorded by treatment MGCPU. Compost had pH levels that ranged from mildly acidic to neutral. According to the study's findings, it is advised that: RGCPU treatments be taken into account while creating compost in the study area since they comprise a larger percentage of the compost's nutrient contents.

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