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Full Length Research Article

IMPACTS OF BAKERY EFFLUENTS ON THE PERFORMANCE OF MAIZE (*Zea mays* L.) AND SOIL PHYSICOCHEMICAL PARAMETERS IN ABRAKA, DELTA STATE, NIGERIA

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ABSTRACT
The study was carried out to evaluate the effect of bakery effluent on the growth of maize and soil physicochemical parameters. The study took place at botanical garden at site III Delta State University, Abraka, Delta State, Nigeria. The maize grains were purchased from Abraka main market and the bakery effluents were obtained from Menaces Bakery Abraka. The treatments used were 0, 25, 50, 75 and 100 per 2kg of soil. The results showed that bakery effluents have significant effects of reducing the germination percentage, delayed germination and reduced growth characteristics such as plant height, stem girth, leave area as well as the physicochemical properties of the soil. It is recommended that bakery waste water should be carefully disposed in areas where it would not affect the performance of plants. More research should be encouraged to examine the effects of this effluents on humans since bakery is widely used by people around the world. The study has great implications on soil degradation and environmental management.

Keywords: Bakery effluents, growth indices, maize, soil properties.

INTRODUCTION
During the 20th century the main emphasis of agricultural development all over the world was on the increasing productivity per unit area of land used for crop production to feed the ever increasing population of man. This was as a result of over exploitation of natural resources such as water and plant resources and excessive use of pesticides and fertilizers. Even though the use of pesticides, herbicides and fertilizer by farmers resulted in a considerable increase in crop yields in short term, it was no longer sustainable after sometimes (Ekebafe *et al*., 2011) the productive capacity of the arable land was impaired permanently, the natural water resources was depleted and also polluted with hazardous pesticides and chemical from fertilizers which threatened the survival and well-being of all life. Therefore the emphasis of agriculture development in the present century have shifted to the sustainable maximisation of land and maize has multiple was including being used as human food, feeds for animals, production of pharmaceutical and many industrial products.it is a stable crop for people over 166 countries of the world. "Akamu" (pap) and "Agidi" are common products from maize that we have in delta state. Maize can be cultivated using seed as well as providing adequate water, optimum sunlight and a nutrient rich soil (Badu-Apraku *et al*., 2022). Although maize is heavily reliant on human for its survival, it can be self-pollinated or cross pollinated. It disperses it pollen grain from the male tassels to the female stalk. Effluents are liquid waste products discharged from domestic commercial or industrial process, typically containing a complex mixture of organic and inorganic substances. These substances may include biodegradable and non- biodegradable materials such as sugars, proteins, fats, oils, detergent, heavy metals and microbial contaminants (kaur *et al*., 2021). The release of untreated or poorly treated effluents into the environment, especially into agricultural land and water bodies, has become a growing concerning due to its potential to cause ecological imbalances and pose risks to human health and food security. Industrial effluents vary in composition based on the nature of the production process bakery effluent in particular is originate from the cleaning of utensils, fermentation vessels, dough mixers and bakery equipment. These effluents are typically rich in organic matter mainly carbohydrates, starches, as well as food additives and preservatives. While some components of these effluents can act as fertilizers in small amount, high concentrations can lead to detrimental environmental effects for examples excessive organic loading from effluents may disrupt soil microbial activity, reduce oxygen availability and alter the chemical properties of soils (Ugbaja and Udeigwe 2020). When discharged into agricultural soils, effluents may initially seem beneficial due to their nutrient content. Continuous or excessive application can lead to negative consequences, such as increased soil acidity or salinity, waterlogged and the accumulation of toxic compounds. Studies have shown that the long term use of industrial effluents can degrade soil structure, reduce porosity and hinder the absorption of essential minerals by plants roots (Ezeogo *et al*., 2021). These alterations can significantly affect crop performances, including seed germination, vegetative growth and yield parameters. The biological components in effluents such as coliforms, bacteria and fungi can contribute to plant diseases and may pose serious health risks if transferred to crops if consumed by humans (Ezeogo *et al*., 2021). For this reason, untreated effluents are generally not recommended for direct use in agriculture, unless subjected to rigorous treatment protocols such as filtration, sedimentation and biological remediation (Ezeogo *et al*., 2021).

MATERIALS AND METHODS
Description of the Study Area
The experiment was conducted at botanical garden site III, Delta state university, Abraka. The study location is located between latitude 5 ° 45' and 5° 5 0'N and longitude 6° and 6°15' E. This area is defined by total annual rainfall of about 3.098mm with mean monthly rainfall ranging from 28.8mm. The soil temperature in this area was about 28°c and soil pH ranging from 4.5-8 (Ozabor and Obaro 2016). The fresh soil was collected into a polythene bag at site III, Delta State University, Abaca. This soil that was collected is fresh and not polluted.

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Sources of seeds
A local variety of maize was gotten from Abraka main market.

Collection and storage of bakery effluents
Bakery effluent used in this experiment was obtained from menac bakery, is located within campus 3 of Delta State University, Abraka. The effluents primarily composed of water used in cleaning bakery equipment contain organic matter, flour, residues, oil traces and food additives. Effluent samples were collected in 25-litres plastic sterile containers were immediately taken to the laboratory for analysis to avoid degrading of the samples (Ozabor and Obaro 2016).

Physiochemical characterisation of the effluents
pH (Hydrogen ion concentration), Electrical conductivity EC to estimate salt content, Hydraulic conductivity, Water holding capacity, BOD, DO , COD, Total porosity, Bulk density, Moisture content ,Nitrogen, Phosphorus and Magnesium.

Treatment structure
The treatments consisted of different concentrations of the effluents as follows.

Treatment code	effluent concentration
To	O% effluent (control distilled water only)
T1	25% effluent +75% distilled water
T2	50% effluent +50% distilled water
T3	75% effluent + 25% distilled water
T4	100% effluent (undiluted)

Effluent and water were mixed in the stated ratio and applied uniformly to the soil

Sourcing and sowing of maize seeds
Maize seeds local white variety, where sourced from Abraka main market. Four seeds were planted per plot at a depth of 2-3cm. Effluent treatment began before planting. Watering with distilled water was done to maintain equal moisture levels across all treatments. No fertilizers or additional amendment were added to avoid interference

Field Work
The field work was conducted at the botanical garden, site III, Delta state university, Abraka fresh soil with no history of pollution was collected in 25 polythene bags. Out of the 25 polythene bags 5 were the control plant (1 control and 4 replicates, the other 20 were samples with different concentration (100 75 50 25) the soil of the samples were polluted before planting. The results were recorded for 5 weeks.

Statistical analysis
The data which collected were analysed using a one way analysis of variance (Anova). Determination of percentage of germination and germination rate. Percentage germination for each concentration was determined using the method of Agbogidi (2010) this was done using the formula below.

No of seedling/ no of seeds planted × 100%

Maize sprouting began on the fourth day after which other parameters were measured and documented.

RESULTS AND DISCUSSION
The results obtained from the study were analysed and is presented in Tables 1 - 6

Table 1 shows germination indices of maize plants as influenced by different concentrations of the bakery effluents. Germination percent was highest in maize grown in the uncontaminated plots (100) when compared with maize subjected to battery contaminants (25: 75: 50; 50; 75; 25 and 100; 25). Similarly, maize seeds planted in the control plots germinated 4 days after planting while it took 6 days for their counterparts sown in plots containing 50, 75 and 100 percent bakery effluents. In the same vein, all the maize seeds planted in the control soils germinated while the number of seeds that germinated decreases with increasing level of pollutants in soils. All these indicate that the performance of the maize seeds subjected to the bakery effluents is contaminant dependent.

Table 1: Germination indices of maize as affected by bakery effluents in soil

	Level of oil (%)				
Percentage of germination %	**0**	**25**	**50**	**75**	**100**
	100	75	50	25	25
Days to germination	4	4	6	6	6
Number of germination	4	3	2	1	1

Germination index= N1/D1 + N2/D2 + N3/D3 + N4/D4 + N5/D5
= 4/4 + 3/4 + 2/6 + 1/6 + 1/6=2.40

Table 2 shows a slow increase in the stem girth of the samples (50, 75 and 100%) when compared to 0.00% and 25% which showed a rapid appreciation. Significant reductions were observed in all the values of the stem girth grown in bakery contaminated soil and they are concentration based. Stem girth of maize reflects the robustness and structural strength of plant. Stem girth was highest in the 0% control (2.60cm) and lowest in the 100% effluent treatment (1.35cm) 0% 2.1±0.41 cm to 100% 1.22±0.14cm there is a progressive decline in stem girth with increasing in effluent levels was noted.

Table 2: Stem girth (cm) of maize plant as affected by bakery effluents (%) in soil /WAP

	Level of oil (%)				
Weeks	**0.00**	**25**	**50**	**75**	**100**
1	1.60	1.16	1.00	1.10	1.13
2	1.80	1.50	1.40	1.20	1.10
3	2.20	1.70	1.50	1.35	1.20
4	2.40	2.00	1.55	1.40	1.30
5	2.60	2.20	1.60	1.50	1.35
Mean±S.D	2.12±0.41	1.71±0.41	1.41±0.24	1.31±0.16	1.22±0.11

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The number of leaves also increased with number of weeks after planting generally but the increase was more rapid with the control with no addition of the effluents and the plots that received 25% of the contaminant (Table 3). The number of leaves increased weekly with the control plants (maize) producing the highest number (13 leaves at week 5) whiles the 100% effluent group had only 5 leaves. Mean leaf no between 0% and 100% is 8.2±3.50 to 3.2±1.30.

Table 3: Number of leaves of maize as affected by bakery effluents (%) in soil.

	Level of oil (%)				
Weeks	**0.00**	**25**	**50**	**75**	**100**
1	4	4	3	3	2
2	6	5	4	3	2
3	8	7	5	4	3
4	10	9	6	5	4
5	13	12	8	6	5
Mean±S.D	8.2±3.50	7.4±1.76	5.2±1.92	4.2±1.30	3.2±1.30

Leaf area increase was also observed more in the control plants with a range value of 12 to 33.37cm^2 from week one to 5 followed by 25 percent treatment. The least was observed in the 100 % treatment with the effluents (Table 4)

Table 4: Leaf area (cm^2) of maize plant as affected by bakery effluents (%) in soil

	Level of oil (%)				
Weeks	**0.00**	**25**	**50**	**75**	**100**
1	12	11.25	9.0	6.0	4.5
2	15.75	13.5	10.5	7.5	6.0
3	21	18	13.5	10.5	9.0
4	26.25	22.5	18	13.5	11.25
5	33.75	27	20.25	18.0	15.0
Mean±S.D	21.8±8.5	18.45±6.44	14.3±4.8	11.1±4.81	9.15±4.07

Increases in plant height was also observed more with the control than all treatments (Table 5).

Table 5: Plant height (cm) of maize as affected by bakery effluents (%) in soil

	Level of oil (%)				
Weeks	**0.00**	**25**	**50**	**75**	**100**
1	3.8	3.1	2.2	2.1	2.0
2	8.5	7.0	4.0	4.0	3.5
3	9.0	8.0	5.1	5.0	4.2
4	12	9.0	5.5	5.2	4.3
5	14	11	5.6	5.3	4.4
Mean±S.D	9.46±3.88	7.62±2.97	4.48±1.42	4.32±1.34	3.68±1.00

Soil physiochemical parameters as affected by bakery effluents are presented in Table 6.

It is evident that bakery effluents soil physical and chemical parameters. F or example, the pH was reduced, the temperature, organic matter, biological oxygen demand, chemical oxygen demand, bulk density, nutrients like nitrogen, phosphorus and magnesium increased.

Table 6: Soil physiochemical parameters as affected by bakery effluents

Parameters	Control	Treated
Ph	6.45	5.88
Temp(°c)	28.4	30.6
Electrical Conductivity	0.28	0.21
Organic carbon	0.54	0.76
DO	6.70	2.42
BOD	3.21	6.74
COD	3.24	7.61
Moisture content	13.5	11.6
Total porosity	43.56	40.10
Potassium	5.2	2.01
Bulk density	1.48	1.86
Water holding Capacity	3.78	2.61
Texture	69.0	68.0
Pollutants	None	Many
Calcium	5.40	6.00
Nitrogen	0.03	0.08
Magnesium	3.96	4.67
Phosphorus	57.2	60.2

In addition, the following components were also observed suspended solids, yeast, protein, oil, grease, carbohydrate, cleaning agent, flour, sugar, dairy products.

DISCUSSION

The results showed that the performance of maize in terms of germination indices (germination percentage, days to germination and rate of germination) and maize seedlings (plant height, plant girth, number of leaves, leaf area) were significantly affected by bakery effluents). Maize height was reduced by higher concentrations of bakery effluents and the reduction is concentration based. This observation aligns with earlier findings of Sigha *et al*. (2006). This might result from restricted activity due to toxic accumulation or poor water absorption. Number of leaves orientate the plant's ability to photosynthesize and grow efficiently. Effluent concentration had a clear suppressive effect on leaf production this trend can linked to poor nutrient assimilation and possible toxicity. According to Okonokwhua *et al*. (2007), industrial effluents may disrupt metabolic activities needed for leaf development. Reduced plant parameters following exposures to various contaminants and pollutants have been reported by various authors and their effects are drastic on plant growth, development, productivity and yields and hence food security.

The results obtained from the chemical analyses of two soil samples control soil (untreated) and treated soil with bakery effluents reflect the effects of biodegradation on various soil physical, chemical biological parameters. This analyses is

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important in understanding the extent to which microbial or natural remediation process can previously exposed to contamination such as organic waste deposition biodegradation is a natural process by which microorganisms breakdown hard organic contaminants into simpler, non- toxic or less harmful compounds (Brady and Weil, 2016). While this process has environmental benefits, it may also cause changes in essential soil parameters that could impact soil fertility, microbial activity, plant growth and environmental sustainability and comparative analyses of soil properties. Soil pH is a fundamental indicator of soil health and fertility. It influence nutrient availability, microbial activity and chemical behavior of pollutants the control soil pH 6.45 is near neutral, which is ideal for most plant growth and microbial process (Brawl and Weil,2016). After biodegradation, the pH dropped to 5.88 indicating increased acidity. An increase in soil temperature after biodegradation is a common phenomenon due to the heated generated during microbial respiration and enzymatic degradation of organic matter (Nowak and Mang, 2018). Higher temperature in treated soil (30.6) are indicative of active microbial metabolism. A **s**lightly increase in the nitrogen, potassium, phosphorus levels in the treated soil indicates mineralisation. A process where organic phosphorus compound are converted into inorganic, plant available forms through microbial enzymatic action (Zhou *et al*., 2020). Potassium content dropped significantly in the biodegraded soil, possibly due to microbial uptake, leaching or immobilization uptake. Potassium is essential for plant enzyme activation. Bulk density increased substantially in the biodegraded soil higher bulk density indicate soil compaction, which may reduce porosity, root penetration and water infiltration this may result from microbial residue binding soil particles more tightly or loss of aggregate structure due to heavy microbial activity (Brady and Weil, 2016). Water holding capacity reflects soil ability to retain water for plant use. The observed reduction may result from a decline in organic matter and structural degradation, leading to rapid water drainage and reduced retention (Onwuka and Mang, 2018). The observed heightened BOD and COD also places stress on soil and this could have effects on soil degradation and plant yields as they indicate the presence of moderate organic matter (Agbogidi *et al*., 2025).

Conclusion

This study examined the effect of bakery effluent on the growth and development of maize. It was established that bakery effluent has significant effect on the performance of maize and soil physicochemical properties. The study has great implications on soil degradation and environmental management.

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