



Sheer Stress Marker Protein Responses in Co-ordinated Air Particulate Matter Prevalence in Soil Samples within the Frontlines of an Abattoir Site within Awka Metropolis.

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ABSTRACT

An abattoir is a designated facility where animals are slaughtered and processed for meat under regulated conditions. This study employed lifecycle assessment tools and established environmental indices to evaluate the impacts of abattoir activities on wastewater and ambient air quality. The wastewater showed high acidity and conductivity, with elevated levels of toxic metals, particularly Pb, compared with the control. Total solids, suspended solids, and total dissolved solids were 1022, 363.55, and 658.45 mg/ml, respectively, while BOD5 and temperature were 5.12 mg/ml and 37.67°C. The concentrations of dissolved minerals Cl⁻, K, Ca, and Mg were 1203.42, 15.24, 39.76, and 23.71 mg/ml, respectively.

Heavy metals Pb, Fe, and Cu were detected at 5.61, 14.16, and 16.22, respectively, whereas Cd and As were below detectable limits. Ambient air-quality parameters remained below statutory limits, indicating limited pollution from the facility.

CO concentrations were 1–3 ppm across sampling points, while PM2.5 was 8 µg/m³ compared with the statutory limit of 250 µg/m³. CO₂, TVOC, and HCHO were detected at 543 ppm, 0.066 mg/dm³, and 0.002 µg/m³, respectively. Lipase, urease, peroxidase, and catalase activities showed varying OD values, with notable increases in lipase and peroxidase at Point I and reduced catalase activity at Points III and IV. Overall, the findings provide empirical evidence of the environmental effects of abattoir activities and their potential implications for ecosystem quality.

Keywords: Stress marker proteins, abattoir, air parameters, environmental pollution.

INTRODUCTION

Abattoirs in urban Nigeria, including those located within the Awka metropolis, contribute significantly to airborne pollution, particularly through the release of fine particulate matter (PM_{2.5}) and coarse particulate matter (PM_{≥10}), which often exceed both World Health Organization and national air quality standards (Abulude *et al.*, 2022; Arca-Lafuente *et al.*, 2025). These emissions are largely associated with common abattoir activities such as the singeing of animal hides using scrap tyres or kerosene, evaporation of untreated wastewater, and poorly managed waste disposal. These processes emit high concentrations of particulate matter, volatile organic compounds, heavy metals, and other reactive pollutants into the surrounding air. Studies have shown that burning tyres, in particular, releases carcinogenic polycyclic aromatic hydrocarbons, inspirable metals such as zinc and nickel, and particulate matter that induces oxidative stress through the excessive generation of reactive oxygen species and the inhibition of protective enzyme functions (Okonkwo *et al.*, 2018; Faisal and Rasol, 2022). Abattoirs in Awka release a lot of smoke and dust (particulate matter) into the air from burning animal skins, waste, and poor sanitation (Schraufnagel, 2020). Breathing in this polluted air can cause serious health problems like asthma, heart disease, and even cell damage (Kolawole *et al.*, 2023). Even though some studies have measured air pollution in abattoirs, very few have looked at how this pollution affects the body especially the enzymes that fight against stress in our cells, called stress marker enzymes we do not fully understand the health risks people face when exposed to pollution for abattoirs centres especially in Awka. Particulate matter, which includes harmful compounds like nitrates, sulfates, and polycyclic aromatic hydrocarbons, has been shown to cause cytotoxic effects that may damage or destroy exposed cells (Novo-Quiza *et al.*, 2024). Particulate matter affects the body by impairing critical stress marker enzymes such as superoxide dismutase, catalase, glutathione peroxidase, and glutathione reductase (Ighodaro *et al.*, 2018). These enzymes play essential roles in protecting cells from oxidative damage. When particulate matter exposure reduces their activity, reactive oxygen species accumulate, leading to oxidative stress that harms cellular lipids, proteins, and deoxyribonucleic acid (Cho and Roh, 2023; Hur *et al.*, 2022; Nigussie *et al.*, 2025).

Prolonged inhalation of particulate matter is linked to a broad range of health problems, including respiratory diseases such as asthma, chronic obstructive pulmonary disease, and lung cancer; cardiovascular conditions like hypertension and coronary artery disease; metabolic disorders such as diabetes; and damage to various organs including the brain, pancreas, uterus, and skin (Ahn *et al.*, 2024). Stress marker enzymes provide measurable evidence of this imbalance. Focusing on oxidative stress offers a precise way to evaluate the biological impact of abattoir air pollution (Oni *et al.*, 2022). This approach supports better monitoring of health risks for workers and nearby residents

MATERIALS AND METHODS

Materials including equipments, apparatus and reagents utilized during the course of the present study were of products of designated companies like BDh, Bristol, May and Bakers. The equipments were calibrated at each use and in good working condition. The reagents were analytical graded and properly stored.

Sampling Sites

Effluent from abattoir sites were collected within a commercial animal slaughter house located in Awka, Anambra State. The effluents were collected while maintaining proper safety measures using EDTA bottles as described by APHA (1992). The collected effluents were homogenized properly and further utilized for profiling assessment.

Air quality assessment

Calibrated gas meter was used in the determination of air parameters such as: total volatile compounds (TVOC), methanal compounds (HCHO), particulate matter 2.5 (PM), relative humidity, carbon monoxide, carbondioxide, and temperature.

The air meter was raised above the height of 10m at four different location patches of each round about post assessed as described by ATSDR (2013). The raised points were designated in an assessed duration of fifty (50min) before taking a record of the readings.

Waste water analysis

Waste water sample from the surge site of the abbatoir were subjected to various physicochemical analysis as described in Journal of America Toxicology Substances and Disease Registry (ATSDR) (2010).

Stress maker enzyme assessment

Soil quality marker enzymes were determined from the contaminated soil with the petrochemical effluent using standard assay protocols, enzyme such as: lipase, catalase and peroxidase were assayed.

Lipase

Lipase activity in the effleunt was determined as described by Okwaye *et al.* (2010).

Absorbance was taken at wavelength of 410 nm with p-NPP as the experimental standard substrate.

Catalase

Catalase activity in the effluent was determined as described by Barata *et al.*, (2005).

Absorbance was taken at wavelength of 400 nm for 60 min.

Peroxidase

Peroxidase activity in the effluent was determined as described by Barata *et al.*, (2005).

Absorbance was taken at wavelength of 410 nm for 120 min.

Statistical analysis

Data obtained was expressed as mean $\pm$ SD and tests of statistical significance will be carried out using two-way Analysis of variance (ANOVA). Mean values with $p < 0.05$ that is 95% confidence interval was considered as significant.

RESULT AND DISCUSSION

Effluent physicochemical profiling

Table one below shows the physicochemical properties of effluent from the sampled abbatoir site as regards to the control experiment. From the table, acidity and high conductivity of the waste water were seen highly recorded. Toxic metals such as Pb were seen evidential in the waste water when compared with the control experiment as shown in (Table 1).

Table (1): The physicochemical properties of the effluent samples understudy:

Physiochemical parameters	Control experiment	Waste water
pH	7.20	6.00
Water Conductivity ($\Omega^{-1}\text{cm}^{-1}$)	782	1113
Total dissolved solid (mg/ml)	134.67	658.55
Total suspended solid (mg/ml)	577.66	383.55
Total solid (mg/ml)	712.33	1022
Chloride ion (Mg/ml)	723	1203.41
Dissolved oxygen (Mg/ml)	7.02	6.14
Magnesium (Mg/ml)	16.24	23.71
Potassium (Mg/ml)	1.02	15.24
Calcium (Mg/ml)	32.33	39.76
BOD ₅ (mg/ml)	0.88	5.12
Iron (Mg/ml)	1.25	14.16
Cadmium (Mg/ml)	BDL	BDL
Arsenic (Mg/ml)	BDL	BDL
Lead (Mg/ml)	BDL	7.01
Copper (Mg/ml)	1.14	24.22
Total Organic Carbon (TOC) (mg/ml)	38.40	190.41
Total Organic Matter (mg/ml)	46.74	234.20

From the table, acidity and high conductivity of the waste water were seen highly recorded. Toxic metals such as Pb were seen evidential in the waste water when compared with the control experiment. Total solids, suspended solid and total dissolved solids of the waste water were: 1022, 363.55 and 658.45 mg/ml, respectively. BOD₅ quotient and the temperature of the waste water were observed at 5.12mg/ml and 37.67°C, respectively. Dissolved mineral Cl-, K, Ca, Mg were: 1203.42, 15.24, 39.76 and 23.71 mg/ml respectively; heavy metals of Pb, Fe, Cu were: 5.61, 14.16 and 16.22, respectively while Cd and As were below detectable limit.

Air quality assessment within the sample area

Fig. (1, 2, 3 and 4) show the air particulate assessment of the in-situ air quality within the abbatoir site. Recorded values of the air particulates were seen in the depicted figures as the quotients of carbon monoxide is seen at a disturbing threshold.

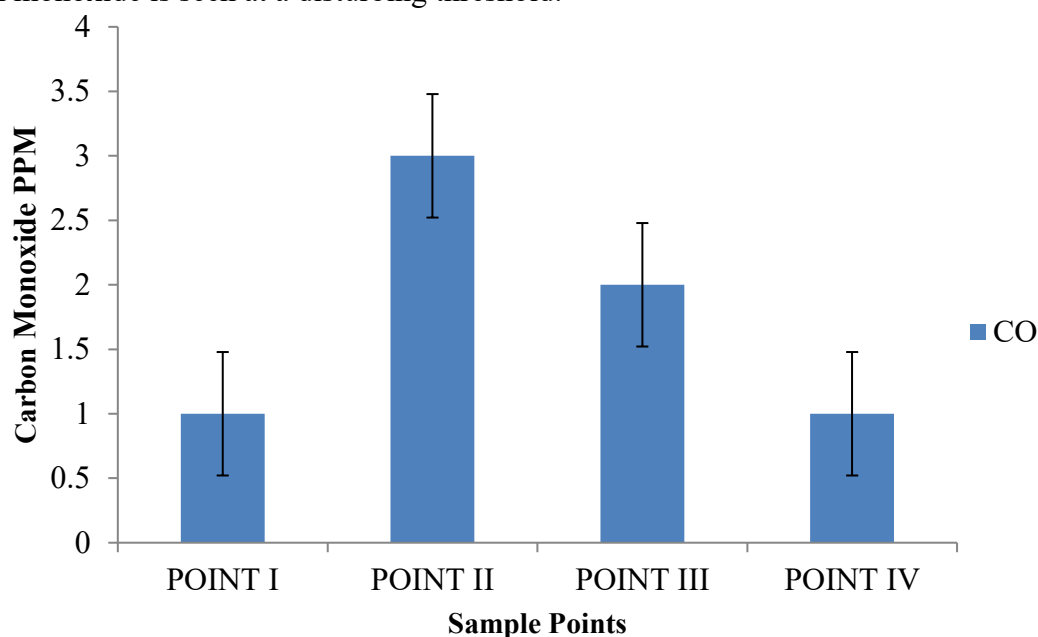


Fig. 1: CO quotients in the respective samples points of the abbatoirs.

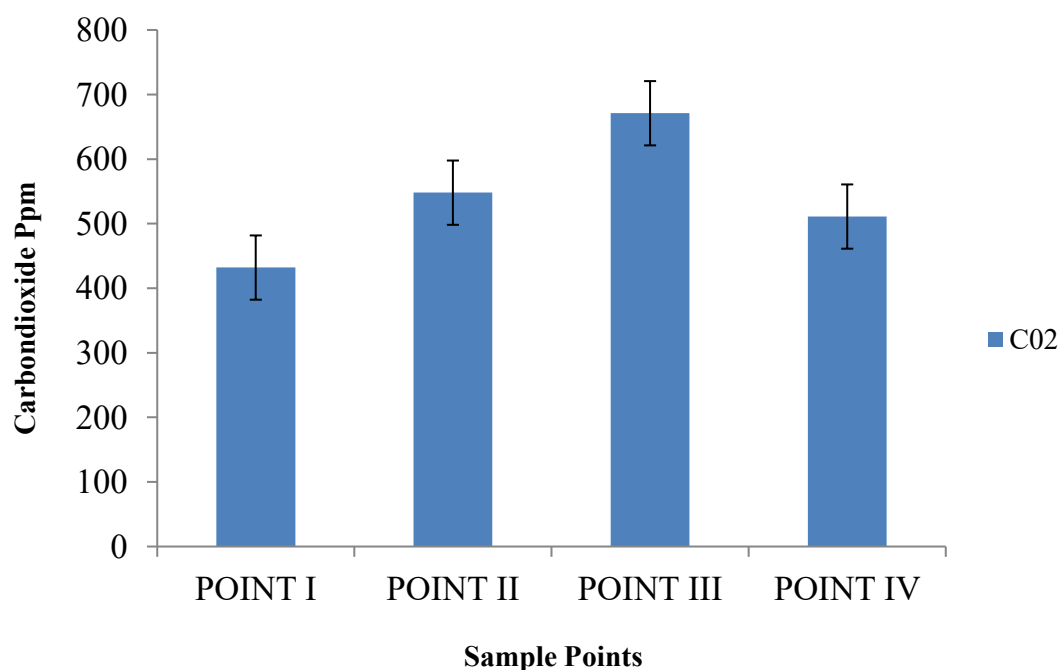


Fig. 2: CO₂ quotients in the respective samples points of the abbatoirs.

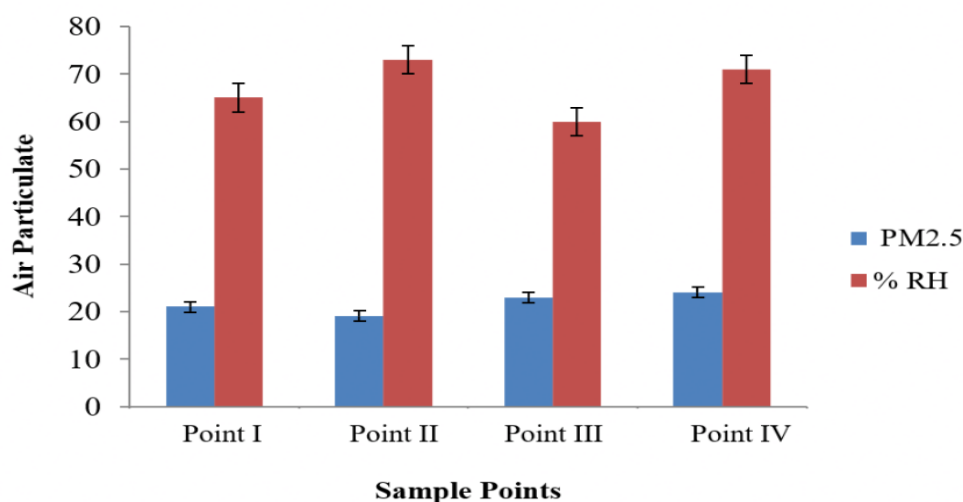


Fig. 3: PM 2.5 and % RH quotients in the respective samples points of the abbatoirs.

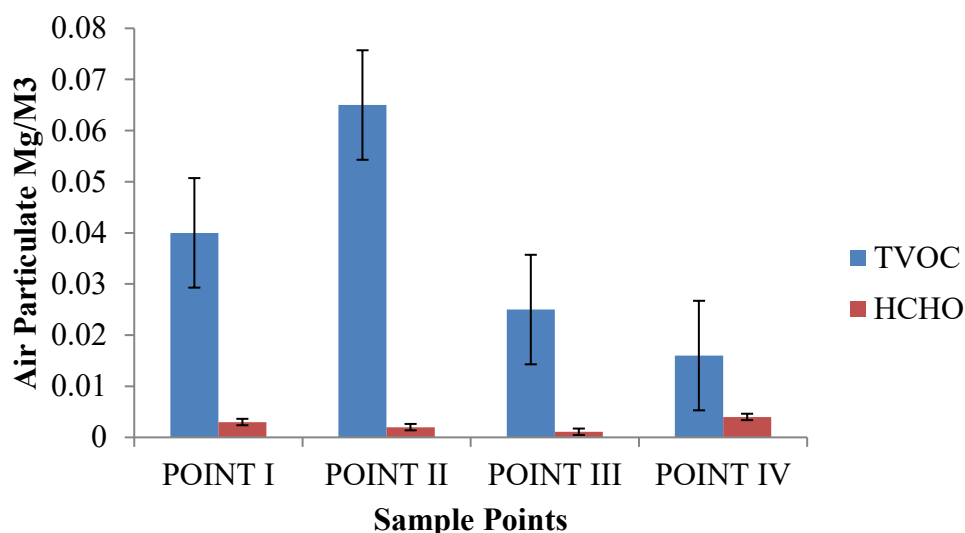


Fig. 4: TVOC and % HCHO quotients in the respective samples points of the abbatoirs.

The results of the ambient air qualities showed that the air quality parameters of the site were far below the statutory limits and therefore were not yet inundated by pollution from institutional, commercial and light industrial activities that characterized most cities in Nigeria.

CO was detected at 1, 2, 3 ppm at the respective sampling points. Proper formation of combusted gas expeller will further derive the CO more out of the facility. Particulate matter (PM 2.5) was $8 \mu\text{g}/\text{M}^3$ as against Statutory limit of $250 \mu\text{g}/\text{M}^3$. Carbondioxide, TVOC and HCHO were found at 543 ppm and $0.066 \text{ mg}/\text{dm}^3$ and $0.002 \mu\text{g}/\text{m}^3$. These factorials are inturn an indication of the natural existence of the surroundings, however the presence of CO is probably from the exhaust fumes of vehicles across the trunk A road standing alibi of the site.

Effluent stress marker enzyme assessment

Fig. (5) below shows the activity of quality marker enzyme activity in the effluent from the abbatoir site within awka metropolis, anambra state. stress maker enzymes lipase, peroxidase and catalase were differential in activity at the different sample points assayed.

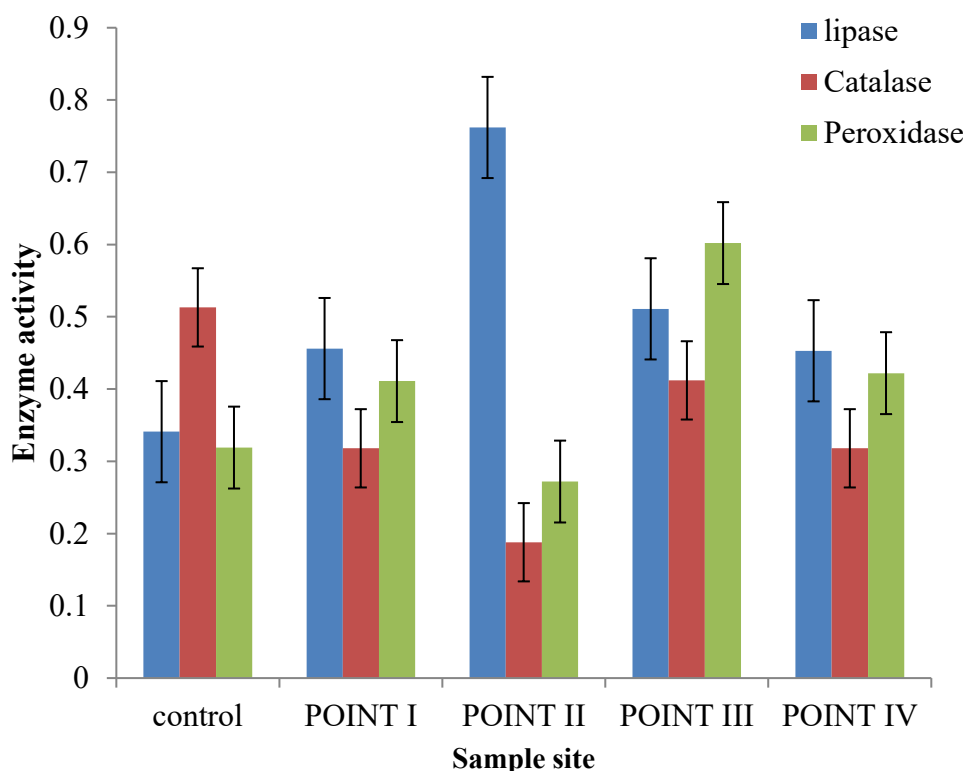


Fig. 5: Stress marker enzyme responses in the respective samples points of the abbatoirs.

Analysis of soil enzymes showed the activity of the lipase, urease, peroxidase and catalase with corresponding OD reading of 0.403, 0.611, 0.652 and 0.817, respectively. There was an increase in the activity of lipase and peroxidase in the waste water at point I of the sampling while an activity of 0.610, 0.677 and 0.712 were assayed for lipase, catalase and peroxidase from the Point II of the sampling respectively while catalase activity was reduced in point III and Point IV, respectively.

Anikwe *et al.*, (2024) reported the activities of quality marker soil enzymes in the presence of recalcitrant; most constitutive enzymes are said to be mark qualities of soil otherwise House-keeping enzymes whose activities are activated in the presence/influx of recalcitrant to a particular ecological inch(es). Lipases are activated in the presence of triacyl glyceride while peroxidase and catalase activity is stimulated in the presence of peroxide and other superoxides; urease activity is activated in the presence of organic matter urea.

CONCLUSION

This experimental assessment has encouraging lines for the public health domains and the entire ecological health/toxicology expertise. Air quality indices from the assessment have shown deviant anomalies of the assessed air qualities from the standardized baselines. Also stress quality marker proteins as assayed in the stratified effluent abattoir sites showed from the catalytic cycles of the assayed enzymes that there are evident of disturbing recalcitrant in the effluent which also affect the compromise statue of the underground water.

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استجابات بروتينات مؤشر الإجهاد القوي في انتشار الجسيمات الهوائية المنسقة في عينات التربة ضمن الخطوط الأمامية لموقع مسلخ داخل مدينة أوكا

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الملخص

المسلخ هو منشأة مخصصة لذبح الحيوانات وتجهيزها لإنتاج اللحوم وفق ظروف وإجراءات منظمة. هدفت هذه الدراسة إلى استخدام أدوات تقييم دورة الحياة ومؤشرات بيئية معتمدة لتقييم تأثير أنشطة المسلخ في نوعية مياه الصرف الصحي وجودة الهواء المحيط. أظهرت مياه الصرف ارتفاعاً في الحموضة والتوصيلية الكهربائية، مع وجود مستويات مرتفعة من بعض المعادن السامة، ولا سيما الرصاص (Pb)، مقارنةً بعينة السيطرة. بلغت قيم المواد الصلبة الكلية، والمواد الصلبة العالقة، والمواد الصلبة الذائبة الكلية 1022 و 363.55 و 658.45 ملغم/مل، على التوالي، في حين بلغت قيمة الطلب الحيوي على الأكسجين (BOD5) ودرجة الحرارة 5.12 ملغم/مل و 37.67 °م، على التوالي. وكانت تراكيز المعادن الذائبة Cl^- و K و Ca و Mg هي 1203.42 و 15.24 و 39.76 و 23.71 ملغم/مل، على التوالي. كما سُجلت تراكيز Pb و Fe و Cu بمقدار 5.61 و 14.16 و 16.22، على التوالي، بينما كانت تراكيز Cd و As دون حدود الكشف.

أظهرت نتائج جودة الهواء المحيط أن جميع المعايير بقيت ضمن الحدود المسموح بها، مما يشير إلى محدودية التلوث الناتج عن أنشطة المنشأة. تراوحت تراكيز أول أكسيد الكربون (CO) بين 1-3 جزء بالمليون، بينما بلغت الجسيمات الدقيقة PM2.5 مقدار 8 ميكروغرام/م³ مقارنةً بالحد المسموح به البالغ 250 ميكروغرام/م³. كما بلغت تراكيز CO₂ و TVOC و HCHO مقدار 543 جزءاً بالمليون و 0.066 ملغم/دسم³ و 0.002 ميكروغرام/م³ على التوالي. وأظهرت أنشطة الإنزيمات اختلافاً بين نقاط أخذ العينات، مع زيادة ملحوظة في نشاط الليبية والبيروكسيد وانخفاض نشاط الكاتالاز في بعض النقاط. وتوفر هذه النتائج دليلاً تجريبياً على التأثيرات البيئية لأنشطة المسالخ وانعكاساتها المحتملة في جودة النظام البيئي.

الكلمات الدالة: بروتينات مؤشر الإجهاد، المسلخ، معايير الهواء، التلوث البيئي.