



THE EFFECT OF AIR POLLUTION EMITTED FROM AL-DORA REFINERY ON (8-OHdG) FOR WORKERS AND RESIDENTS

Zainab M. khaleef^{1*}, Ahmed S. Abdul wahab²

¹Department of Biology, College of Science, University of Baghdad, Baghdad, Iraq, zenabmosea@gmail.com.

²Assist.Prof. Department of Biology, College of Science, University of Baghdad, Baghdad, Iraq, ahmed.aldhamin@sc.uobaghdad.edu.iq.

Received 10/ 9/ 2023, Accepted 4/ 3/ 2024, Published 30/ 6/ 2025

This work is licensed under a CCBY 4.0 <https://creativecommons.org/licenses/by/4.0>



ABSTRACT

The study aims to determine the risk of exposure to air pollution as a result of gases emitted by AL-Dora Refinery. The levels of gases emitted from the refinery in the city of Baghdad and their impact on air quality were evaluated. The gases were measured in four locations inside and near the Dora refinery, all sites urban areas except the control site was measured in AL-Yusufiyah district. The gases measured included CO, SO₂, NO₂, in addition to particulate matter with size 2.5 (PM_{2.5}). The results showed gases (0.05-2.46 ppm) for carbon dioxide, (0.05-1.30 ppm) for nitrogen dioxide, (0.04-1.62 ppm) for sulfur dioxide and (0.038-5.43 ppm) for particulate matter of size 2.5, where the most polluted sites the first and second sites with direction of the wind inside Al-Dora refinery. The study also included collecting blood samples during month of December 2022 from 40 workers and 40 residents whose ages ranged between (20-60) years and represent the exposed group, and all participants were given a questionnaire included participant's age, gender, diseases they suffered from, and hours of exposure, while the control group (the non-exposed group) was collected from 25 individuals living in AL-Yusufiyah, the results showed people who exposed to these gases had a biological change, and the results of DNA damage showed a significant increase ($P \leq 0.01$) in workers ($3.35 \pm 0.17 \mu\text{mol/ml}$) and residents ($4.69 \pm 0.21 \mu\text{mol/ml}$) compared to the control group ($0.905 \pm 0.10 \mu\text{mol/ml}$). An Enzyme-linked immunosorbent Assay (ELISA) device was used for diagnosis.

Keywords: Air quality, ELISA, DNA damage, Particulate matter 2.5.

*The article is taken from the master's thesis of the first researcher.



تأثير تلوث الهواء المنبعث من مصفى الدورة على عامل الأكسدة للعاملين والسكانين

زينب موسى خليف¹, احمد سعد عبد الوهاب²¹ قسم علوم الحياة، كلية العلوم، جامعة بغداد، بغداد، العراق. zenabmosea@gmail.com² استاذ مساعد، قسم علوم الحياة، كلية العلوم، جامعة بغداد، بغداد، العراق. ahmed.alldhamin@sc.uobaghdad.edu.iq

الخلاصة

تهدف الدراسة إلى تحديد خطر التعرض لتلوث الهواء نتيجة الغازات المنبعثة من مصفى الدورة. حيث تم تقييم مستويات الغازات المنبعثة من مصفى الدورة في مدينة بغداد وتأثيرها على جودة الهواء. وتم قياس الغازات في أربعة مواقع داخل وبالقرب من مصفى الدورة، وجميعها مناطق حضرية باستثناء موقع السيطرة تم قياسه في منطقة اليوسفية. شملت الغازات التي تم قياسها كل من CO , SO_2 , NO_2 بالإضافة إلى المادة الدقائقية بحجم 2.5. وظهرت نتائج الغازات ($0.05-2.46 \text{ ppm}$) لأول أكسيد الكربون، ($0.05-1.30 \text{ ppm}$) لثاني أكسيد النيتروجين، ($0.04-1.62 \text{ ppm}$) لثاني أكسيد الكبريت و ($0.038-5.43 \text{ ppm}$) للمادة الدقائقية لحجم 2.5، حيث ان المواقع الأكثر تلوث هو الموقع الاول والثاني مع اتجاه الرياح داخل مصفى الدورة. شملت الدراسة جمع عينات الدم خلال شهر ديسمبر لعام 2022 من 40 عاملاً و 40 مقيماً تراوحت أعمارهم بين (20-60) عاماً ويمثلون الفئة المعرضة، وتم إعطاء جميع المشاركين في الدراسة استبيان اشتمل عمر المشارك، جنسه، الامراض التي يعاني منها وساعات التعرض، في حين تم جمع مجموعة السيطرة (الفئة الغير معرضة) من 25 فردا يسكنون في اليوسفية، وظهرت النتائج أن الأشخاص الذين تعرضوا لهذه الغازات لديهم تغير بيولوجي وكانت لنتائج تلف الدنا زيادة معنوية ($P \leq 0.01$) في العمال ($3.35 \pm 0.17 \mu\text{mol/ml}$) والمقيمين ($4.69 \pm 0.21 \mu\text{mol/ml}$) مقارنة بمجموعة السيطرة ($0.905 \pm 0.10 \mu\text{mol/ml}$) وقد تم استخدام جهاز الاليزا للتشخيص.

الكلمات المفتاحية: جودة الهواء، الاليزا، عطب الدنا، المادة الدقائقية لحجم 2.5.

INTRODUCTION

Pollution is one of the most important causes of depletion of natural resources, pollution in its general sense is an unwanted change in physical, chemical and biological characteristics of air, water and soil that may cause harm to humans, other living organisms and elements of the environment (Haider *et al.*, 2013). Environmental pollutants also defined as any solid, liquid, or gaseous substances, noise, vibrations, radiation, heat, and the like, or biological factors that lead, directly or indirectly, to a disturbance in the ecosystem Ministry of Environment (2013). Air pollution is not the only source of negative health impacts. Stress and quality of life associated with being near a refinery has also been assessed by several studies (Downey, 2005). Humans experience oxidative stress due to both internal and environmental influences, such as parasite infections that upset the antioxidant balance. Nutrition and antioxidants both help to prevent this stress (Hamdia & Ahamed, 2023). Number of air pollutants are released from industrial facilities and other activities can cause adverse effects on human health and the environment (Chowdhary., *et al* 2020). Air pollutants maybe be a primary or secondary pollutants Primary such as nitrogen oxides (NO_x) those directly emitted into the atmosphere from an emission source, Secondary air pollutants such as smog are formed in the atmosphere as a product from the reaction between primary pollutants with atmospheric gases and water, The gas concentrations begin to decrease as you move away from industrial factories (Al-Khateeb & Mahmoud, 2020). Wind speed and direction patterns plays an important role in dispersion and mitigation of the high concentration of gas pollutants. However, they distribute the pollutions to cover more remote regions (Filonchyk & Hurynovich, 2020). 8-Hydroxy-deoxyguanosine (8-OHdG) is particularly a ROS-induced DNA base modification followed the attack of hydroxyl radicals (OH) to guanine which causes



damage to the DNA, If the DNA damage not fixed, it will also be involved in cancer promotion and tumorigenicity (**Halliwell et al., 2021**). 8-OHdG is also considered as one of the most common product of DNA damage that has genotoxicological effects (**Ernawati et al., 2021**). To reduce the negative impacts of air pollution from oil refineries, a variety of pollution control technologies are used such as scrubbers, filters, and catalytic converters. Government regulations and emissions standards can also play a role in reducing emissions from refineries. Additionally, efforts to shift towards cleaner energy sources, such as renewable energy, can reduce the demand for fossil fuels and help to mitigate the impacts of oil refinery air pollution, This study aims to determine the effect of air pollution levels emitted from Al-Dora refinery and to know which is more effected worker or resident.

MATERIALS AND METHODS

Air Sampling

The gases samples collected inside Al-Dora refinery. The device is portable to use for PM_{2.5} called Smiledrive, for other gases called four in one detector NO (201904014348). Data collection of the meteorological parameters (wind speed, air temperature and humidity) were taken from the Ministry of Health and Environment in AL-Wazireya station in Baghdad. Four sites were selected located inside and near Al-Dora refinery one of them control site located out of baghdad in AL-yusofiya district, all them with air direction at different distances with three season, and taking three replicates for each sub-station. The highest temperature recorded during summer was 35C° in september, whereas lowest temperature recorded was 12 C° during winter in January month. Wind is one of the climatic factors that effect on the spread of pollutants at different distances from the source of their emission, when the prevailing trend in the study area was northwest of the country.

Blood Samples

Workers (40), residents (40) and controls (25) blood samples were collected by venipuncture, 5ml of blood was drawn using disposable syringes. The blood was placed in gel disposable tubes. Sera were separated by centrifugation for 5 min at 3000 round per minute (rpm). The separated serum was transferred to Eppendorf tube and kept at -20C° until assayed, and then tube frozen at -20C° until measured.

Statistical Analysis

The Statistical Analysis System- (**SAS 2018**) program was used to detect the effect of difference groups (workers, residents and control) in study parameters. T-test was used to significant compare between means. Estimate of correlation coefficient between variables in this study.

RESULT AND DISCUSSION

1. Meteorological Parameters

the result show CO gas recorded the highest mean value in S1 station during winter (2.46 ppm). However, the lowest mean value was recorded during autumn in control site (0.05 ppm). In the present study the results indicated that CO concentrations were accepted in all sites and seasons during the study period, when comparing with (**WHO, 2020**) of global determinants which are (9-35 ppm). The gas concentrations started to decline when moved further from refinery, this agreed with previous studies which observed that CO gas



concentrations begin to decrease in area away from industrial factories (**Al-Khateeb & Mahmoud, 2020**).

NO₂ gas the results revealed that the S1 station is more affected by this gas in most of study period, the highest mean values in winter and utumn at S1 (1.30 ppm and 1.15 ppm), and the lowest mean value recorded in the control station for Autumn was (0.05 ppm). all stations during all sites except control site the mean values were higher than the determinants of (**WHO, 2020**), the high concentration of this gas was recorded In winter cause of high combustion in this month.

SO₂ gas the highest mean values were recorded during winter and autumn at S1 (1.62 ppm,1.20ppm), and the lowest mean value was (0.04 ppm and 0.04 ppm) at the control station during summer and winter .When compared to the limits by the (**WHO, 2020**) value (0.01ppm), this study revealed that all sites exceeded this limits, but the mean values within the limitations only for control site during all months of the study, this high value can be explained by the fact that the gas leaving the chimney is hotter than the surrounding air, which lowers its density relative to that of the air around it. Due to the force of buoyancy and turbulence the gas raises higher, improving the dispersion of contaminants and lowering their concentrations, Sulfur dioxid concentration in the air reach high levels in the seasons when the need for fuel usege is greater and because of the consumption of low-quality fossil fuels (**Tayanc, 2000**).

PM_{2.5} the highest mean values were recorded during winter at S1(5.34 ppm), respectively, and the lowest mean value was (0.038ppm) at the control station during summer, The particulate matter level in the ambient air is affected by the variation in source strength and meteorological conditions such as relative humidity and wind speed and its direction in Morogoro, Tanzania (**Mkoma & Mjemah, 2011**).

2- Biochemical Parameters

❖ Serum Levels of 8-OHdG

Present results revealed serum level of 8-OHdG was highly significant ($P \leq 0.01$) increased in resident ($4.69 \pm 0.21 \mu\text{mol /ml}$) and worker was ($3.35 \pm 0.17 \mu\text{mol /ml}$) compared to control group ($0.905 \pm 0.10 \mu\text{mol /ml}$) And show a significant ($p \leq 0.01$) between workers ($3.35 \pm 0.17 \mu\text{mol /ml}$) and resident ($4.69 \pm 0.21 \mu\text{mol /ml}$), in figure (1).

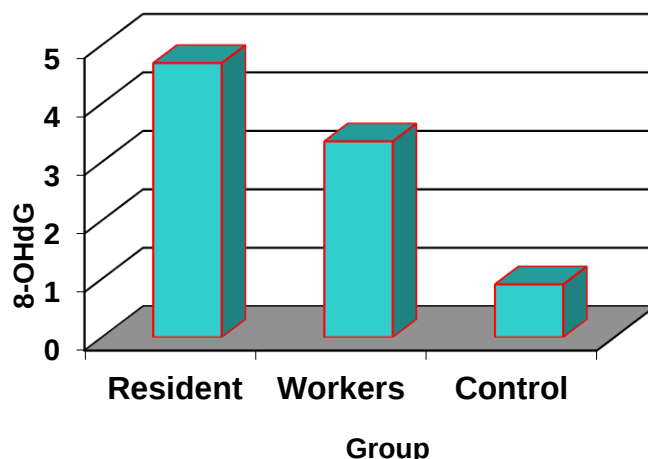


Figure (1): comparison between groups in 8-OHdG.

**Table (1):** mean $\pm$ standard deviation of biochemical analysis between groups.

Group	Mean $\pm$ SE
8-OHdG	
Workers	3.35 $\pm$ 0.17 $\mu\text{mol /ml}$
Residents	4.69 $\pm$ 0.21 $\mu\text{mol /ml}$
Control	0.905 $\pm$ 0.10 $\mu\text{mol /ml}$
LSD	0.532**
p-value	0.0001
Mean having with the different letters in same column differed significantly, **($p \leq 0.01$)	

8-OHdG is a major spontaneous oxidized derivative of 2'-deoxyguanosine and a biomarker of oxidative DNA damage. 8-OHdG is formed through the reaction of guanine with reactive oxygen species. Although normally repaired and removed by the base excision repair mechanism, 8-OHdG can potentially mispair with deoxyadenine leading to G-to-T transversion mutations, which cause frequent recombination and single nucleotide polymorphisms (SNPs) in the human genome. The concentration of 8-OHdG within a cell is a measurement of oxidative stress and may thus be used to assess the extent of physiological and environmental damage to DNA (Sayers *et al.*, 2023).

Studies showed that urinary 8-OHdG is a good biomarker for risk assessment of various cancers and degenerative diseases. The biomarker 8-OHdG has been a pivotal marker for measuring the effect of endogenous oxidative damage to DNA and as a factor of initiation and promotion of carcinogenesis. the biomarker has been used to estimate the DNA damage in humans after exposure to cancer-causing agents, such as asbestos fibers, heavy metals, and polycyclic aromatic hydrocarbons. In recent years, 8-OHdG has been used widely in many studies not only as a biomarker for the measurement of endogenous oxidative DNA damage but also as a risk factor for many diseases including cancer (Valavanidis *et al.*, 2009). 8-OHdG is a sensitive and critical biomarker to reflect oxidative DNA damage, The association between 8-OHdG and the ambient PM has been reported for nearly 20 years, but the effect size varies depending on different research methods adopted by the investigators and the types of pollutants that the existing research focused on (Chuang *et al.*, 2007).

DNA damage such DNA lesions can change sequences of nucleotides and lead to expression of disrupt in functional proteins that alter normal cellular function (Kim *et al.*, 2019). In solid tumours, studies have shown increased levels of oxidative damage products, such as oxidized DNA base 8-OHdG, which is the most frequently investigated product, because of its mutagenic character and the high sensitivity of its immunological detection (Chow *et al.*, 2004). The increase in 8-OHdG has been demonstrated in thyroid neoplasia (Kim *et al.*, 2004). in squamous cell carcinoma, in nonsmall-cell lung cancer (Tsao *et al.*, 2007) and in prostate cancer cells (Kumar *et al.*, 2008). Other studies have indicated a positive association between particulate and oxidative DNA damage (Merzenich *et al.*, 2001).

❖ Distribution According to Smoking

The paisesnts divided into two group according to smoking, so the first group smoking and the result show high significant increase ($p < 0.01$) between resident (52.50%), workers (55.00%) and control (0.00%). its show 21 from 40 resident was smokig and 22 from 40 worker smoking, the second group was not smoking its show 19 from 40 resident not smoking and the control not smoking as shown in table (2). Chronic smoking is an established risk



factor for the development of various types of malignancy as well as inflammatory diseases. ROS are oxygen-containing intermediates that can indiscriminately damage macromolecules, such as proteins, lipids, and nucleic acids (Yan *et al.*,2016). However, continued smoking can overwhelm the defense mechanisms, providing an opportunity for the produced ROS to exert their damaging effects (Klaunig ,2018).

Table 2: Distribution according to Smoking

Factor		Resident (No=40)	Workers (No= 40)	Control (No= 25)	P-value
Smoking: No (%)	Smoker	21 (52.50%)	22 (55.00%)	0 (0.00%)	0.0001 **
	Non-smoker	19 (47.50%)	18 (45.00%)	25 (100%)	0.049 *
	P-value	0.862 NS	0.611 NS	0.0001 **	---
* (P≤0.05), ** (P≤0.01).					

CONCLUSION

This principle conclusion of this research was a significant difference in the levels of 8-OHdG between three groups. Residents, worker and control, participants lived inside refinery, represented the resident more effected by air pollution indicated a potentially increased levels of DNA damage than workers and control. And the study demonstrated the levels of CO and PM 2.5 did not exceed in Iraqi and international standards at all measurement seasons because of the high burning efficiency and the levels of SO₂, NO₂ exceed in Iraqi and international standards at all measurement seasons except the control site, As a result of the continuous exposure of workers and residents to air pollution they were subjected to continuous oxidative stress so, 8-OHdG is a sensitive and critical biomarker to reflect oxidative DNA damage.

REFERENCES

- 1- Al-Khateeb, A.H.N., & Mahmoud, M.B. (2020). study of the ecological impacts of air pollutants emitted from brick manufacturing in al-sinaiya, qadisiyah governorate, Iraq. *Plant Archives*, 20(2), 176-181.
- 2- Chow, E., Thirlwell, C., Macrae, F., & Lipton, L. (2004). Colorectal cancer and inherited mutations in base-excision repair. *The Lancet Oncology*, 5(10), 600-606.
- 3- Chowdhary, P., Bharagava, R. N., Mishra, S., & Khan, N. (2020). Role of industries in water scarcity and its adverse effects on environment and human health. *Environmental Concerns and Sustainable Development: Air, Water and Energy Resources*, 243(1),235-256.
- 4- Chuang, K. J., Chan, C. C., Su, T. C., Lee, C. T., & Tang, C. S. (2007). The effect of urban air pollution on inflammation, oxidative stress, coagulation, and autonomic dysfunction in young adults. *American journal of respiratory and critical care medicine*, 176(4), 370-376.



- 5- Downey, L. (2005). Single mother families and industrial pollution in metropolitan America. *Sociological Spectrum*, 25(6), 651-675.
- 6- Ernawati, K., Cantika, I. B., Isaputri, R. R., Andari, A. W., Ramadhan, M. F., Nathasia, S. K., ... & Ismail, Y. (2021). Community knowledge, attitudes and behaviors in prevention of covid-19 transmission: A systematic review. *International Journal of Public Health Science*, 10(1), 16-26.
- 7- Filonchyk, M., & Hurynovich, V. (2020). Spatial distribution and temporal variation of atmospheric pollution in the South Gobi Desert, China, during 2016–2019. *Environmental Science and Pollution Research*, 27(15), 26579-26593.
- 8- Haider, H. A., Jassim, R., & Habib, M. (2013). Physical assessment of the Tigris River within the city of Baghdad. *Iraqi Journal of Market Research and Consumer Protection*, 3(21), 1125-1116.
- 9- Hamdia, M. S., & Ahamed, S. H. (2023). Preparation of a Combination of Nano-Medicinal Plants as Antioxidants and Microorganisms. *Iraqi Journal of Market Research and Consumer Protection*, 15(1), 1-16.
- 10- Halliwell, B., Adhikary, A., Dingfelder, M., & Dizdaroglu, M. (2021). Hydroxyl radical is a significant player in oxidative DNA damage in vivo. *Chemical Society Reviews*, 50(15), 8355-8360.
- 11- Kim, S., Chen, J., Cheng, T., Gindulyte, A., He, J., He, S & Bolton, E. E. (2019). PubChem 2019 update: improved access to chemical data. *Nucleic acids research*, 47(1), 1102-1109.
- 12- Kim, J. Y., Mukherjee, S., Ngo, L. C., & Christiani, D. C. (2004). Urinary 8-hydroxy-2'-deoxyguanosine as a biomarker of oxidative DNA damage in workers exposed to fine particulates. *Environmental health perspectives*, 112(6), 666-671.
- 13- Klaunig, J. E. (2018). Oxidative stress and cancer. *Current pharmaceutical design*, 24(40), 4771-4778.
- 14- Kumar, B., Koul, S., Khandrika, L., Meacham, R. B., & Koul, H. K. (2008). Oxidative stress is inherent in prostate cancer cells and is required for aggressive phenotype. *Cancer research*, 68(6), 1777-1785.
- 15- Ministry of Environment, (2013). *Instructions for classifying projects, locational specifications, and environmental requirements for their establishment*.
- 16- Merzenich, H., Hartwig, A., Ahrens, W., Beyersmann, D., Schlepegrell, R., Scholze, M., ... & Jöckel, K. H. (2001). Biomonitoring on carcinogenic metals and oxidative DNA damage in a cross-sectional study. *Cancer Epidemiology Biomarkers & Prevention*, 10(5), 515-522.
- 17- Mkoma, S. L., & Mjemah, I. C. (2011). Influence of meteorology on ambient air quality in Morogoro, Tanzania. *International Journal of Environmental Sciences*, 1(6), 1107-1115.
- 18- Sayers, E. W., Bolton, E. E., Brister, J. R., Canese, K., Chan, J., Comeau, D. C., & Sherry, S. T. (2023). Database resources of the National Center for Biotechnology Information in 2023. *Nucleic acids research*, 51(1), 29-38.
- 19- SAS. (2018). *Statistical Analysis System, User's Guide*. Statistical. Version 9.6th ed. SAS. Inst. Inc. Cary. N.C. USA.
- 20- Tsao, S. M., Yin, M. C., & Liu, W. H. (2007). Oxidant stress and B vitamins status in patients with non-small cell lung cancer. *Nutrition and cancer*, 59(1), 8-13.
- 21- Tayanc, M. E. T. E. (2000). An assessment of spatial and temporal variation of sulfur dioxide levels over Istanbul, Turkey. *Environmental pollution*, 107(1), 61-69.



-
- 22- Valavanidis, A., Vlachogianni, T., & Fiotakis, C. (2009). 8-hydroxy-2'-deoxyguanosine (8-OHdG): a critical biomarker of oxidative stress and carcinogenesis. *Journal of environmental science and health Part C*, 27(2), 120-139.
 - 23- World Health Organization. (2020). *Methods for sampling and analysis of chemical pollutants in indoor air: supplementary publication to the screening tool for assessment of health risks from combined exposure to multiple chemicals in indoor air in public settings for children*.
 - 24- Yan, M., Lo, J. C., Edwards, J. T., & Baran, P. S. (2016). Radicals: reactive intermediates with translational potential. *Journal of the American Chemical Society*, 138(39), 12692-12714.