SCIREA Journal of Chemistry

http://www.scirea.org/journal/Chemistry

January 12, 2017

Volume 1, Issue 2, December 2016

LEVELS AND AIR QUALITY INDEX OF SO_2 AND H_2S IN AMBIENT AIR OF JEMITA/ YOLA METROPOLIS, ADAMAWA STATE, NIGERIA

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Abstract

The Air quality of hydrogen Sulphide and Sulphur dioxide in Jimeta/Yola Metropolis were determined at ten different locations, using a portable hand held gas monitor (crown instrument Ltd Oxon CE-89/336/EEC). The result showed that concentration of SO_2 and H_2S ranged between 0.03 to 0.135 and 0.030 to 0.057 ppm for both seasons. There high levels may be due to high traffic density, anthropogenic activity and seasonal variation. The difference in mean concentration between dry and rainy season were significant for both SO_2 and H_2S. The Concentration of SO_2 and H_2S exceeded the permissible limit of 0.1 and 0.01 ppm respectively. However, poses serious threat to the human, animals and plant. Therefore relevant agency should embark on enlightenment and sensitization campaign in order to reduce the air pollution of those locations.

Keywords: Air quality, Gas monitor, Yola metropolis, Environment

INTRODUCTION

Jimeta/Yola, the capital and major city of Adamawa state, has developed in recent years, there by experiencing high emission of gaseous pollutant. Which have result to high traffic emission, anthropogenic activities and industrial emission. This has led to the hazy atmosphere within the metropolis. According to the World Health Organization, more than two million premature deaths may be attributed to gaseous pollutant (Farrah, 2011). Gaseous pollutants are gases when release into the air can have adverse effect on humans and the ecosystem. The gaseous pollutant may include Oxide of sulphur: which are produced when sulphur containing fossil fuel is burnt. The most common, sulphur dioxide is a gas that is poisonous to both animal and plant. At a low concentration, it can cause respiratory disease such as asthma, bronchitis, emphysema in human being. However at high concentration it leads to stiffness of flower bud which eventually falls off from plants. Hydrogen sulphide emissions result in damage to human health. It also causes irritation of the respiratory tract and damage to the central nervous system. At high concentrations it destroys immature plant tissue (Peirce, 1998). The major source of hydrogen sulphide is the microbial decay of organic matter and the reduction of sulphate ion (Sanchez, 2008).

Understanding the extent to which humans are exposed to toxic air pollutants requires a sound knowledge of their concentrations in the environment, and the health risks they pose but lack of monitoring data makes it difficult to develop a reliable control strategy (Kuko and Osuntogun, 2007). This is a broader study that investigated the levels of outdoor air pollution with the goal of examining the health effects associated with exposure to air pollutants. However, the study was seen as the first step to assess the environment in Jimeta/Yola. Even though there are number of reports on the adverse effects of air pollution on human health and the environment, no known available studies have been carried out around Jimeta/Yola metropolis to assess its air quality. This work is therefore aimed at assessing the air quality around the metropolis to determine the levels of sulphur dioxide (SO_2) and hydrogen sulphide (H_2S).

MATERIALS AND METHODS

Materials and Equipment

A portable gas monitor manufactured by crown instrument Ltd Oxon CE-89/336/EEC for each gas and sound level thermometers was used.

Study Area

Yola city is located between 9.2 ^{0}N and 12.48 ^{0}E, it has a population of 3,737,233. However Yola has an annual low temperature of 21.7^{0}C and a high temperature of 34.1^{0}C, which gives the total average of 28.1^{0}C and an annual precipitation of 917 mm.

Meanwhile Yola is split in two parts. The old town of Yola where the Lamido resides is the traditional city, but the new city of Jimeta (about 5 km NW) is the administrative and commercial center. Generally the term Yola means both.

Ten locations were selected for the study along the major roads in Jimata/Yola metropolis, as shown in Figure 1. It shows the major roads and sampling areas in Yola metropolis. These locations includes; Yola town market (location 1), Jippu-Jam round about (location 2), AA Lawan (location 3), Police roundabout (location 4), Jimeta shopping complex (location 5), Mubi roundabout (location 6), Hayin gada (location 7), Jimeta-ultra market (location 8), Airport roundabout (location 9) and Janbutu market (location 10), farm center (location C). A location in a farm far beside FGGC Yola was used as control site, which was neither close to houses nor any main road.

Figure 1: Map of Jimeta Showing the Study Areas.

Figure 2: Map of Yola Town Showing the Study Areas (Google Map, 2015).

RESULTS AND DISCUSSION

Results

Figure 3: shows the result of hydrogen sulphide, Seasonal average of H_2S ranged from; 0.034 – 0.038 ppm, 0.03 -0.0306 ppm, 0.031 – 0.032 ppm, 0.0313 – 0.326 ppm, 0.0373 – 0.036 ppm, 0.0306 – 0.0326 ppm, 0.0533 – 0.057 ppm, 0.036 – 0.038 ppm, 0.32 – 0.034 ppm, and 0.032 – 0.032 ppm for locations 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 respectively. No H_2S was detected at the control location. Highest concentrations of H_2S were obtained at location 7.

Figure 4: Revealed the results of SO_2 whose seasonal average ranges between; 0.052 – 0.058 ppm, 0.048 – 0.056 ppm, 0.032 – 0.072 ppm, 0.048 – 0.084 ppm, 0.102 – 0.109 ppm, 0.099 – 0.108 ppm, 0.135 – 0.138 ppm, 0.115 – 0.126 ppm, 0.123 – 0.126 ppm and 0.11 – 0.135 ppm for locations 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 respectively, Similar to H_2S, SO_2 was not detected at the control location. Highest concentration of SO_2 was observed in dry season at location 7.

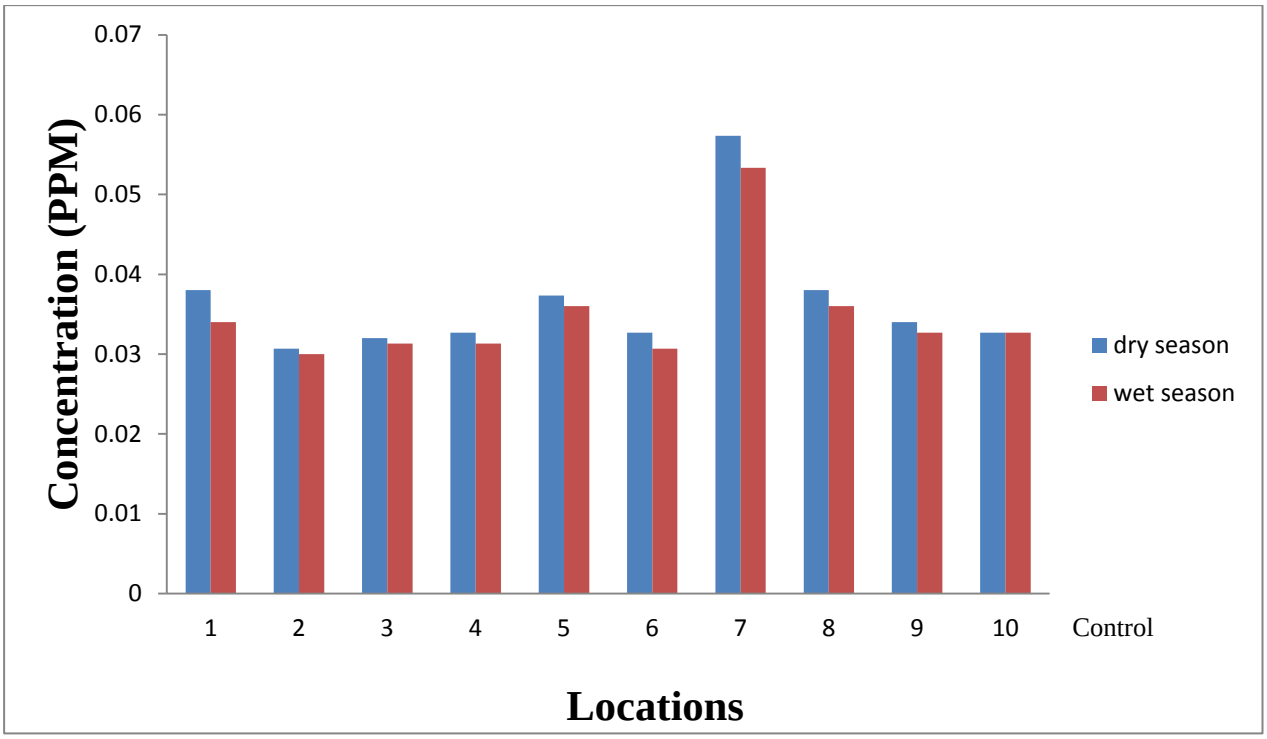

Figure 3: Mean Seasonal Variation of H2S across the sampling locations

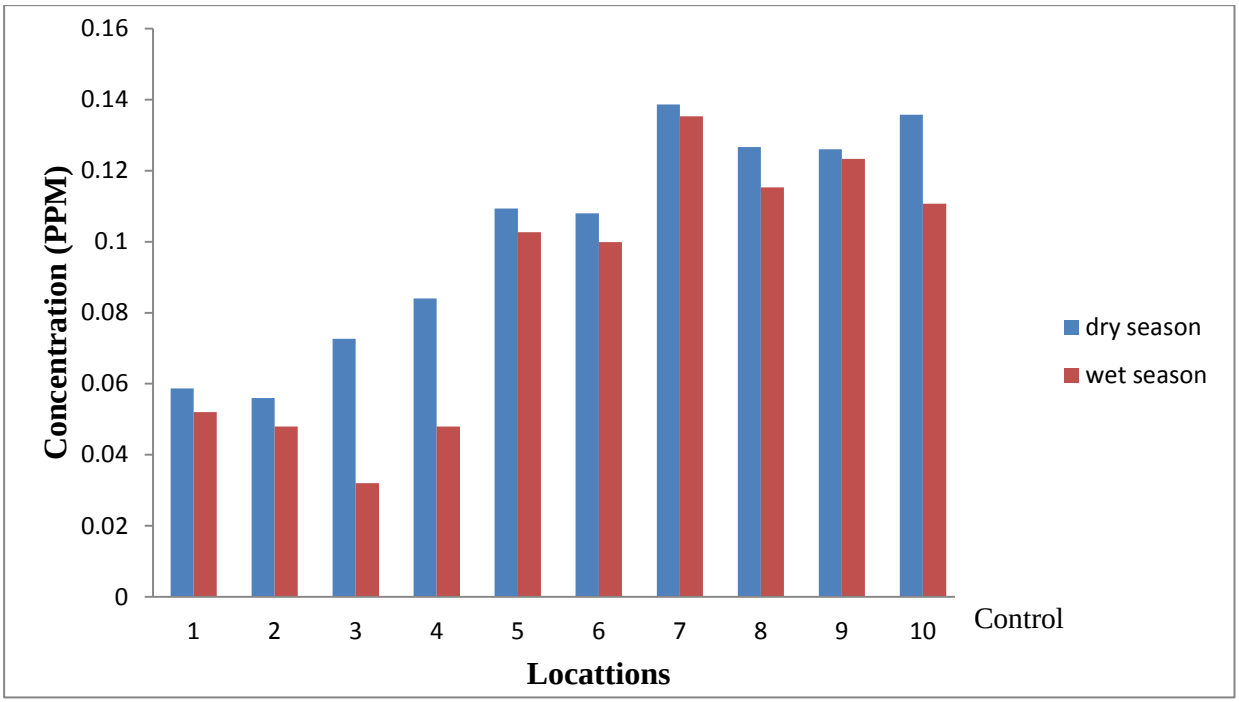

Figure 4: Mean Variation of SO2 across the sampling locations

Mean seasonal variation for H_2S, shows higher concentration in dry season, with no statistical difference of P <0.05. The high value may be due to microbial process which, including the decay of sulfur compound and bacterial reduction of sulphate. Consequently H_2S at a level well above ambient concentration destroy the immature plant tissue.

Similarly, for hydrogen sulphide, the highest concentration of 0.057 ±0.0059 ppm was recorded at location 7 in the dry season and the lowest was recorded at location 3, the variation within these locations could be due to breaking down of bacteria, organic matter, human and animal waste, this could be the source of bad odour at this location as observed during sampling. Also decay of food stuff, waste and refuse generated within this location, left for long period of time could be responsible for the high emission of H_2S.

However the value of H_2S obtained in this study, when compare with the reported value of Kano,(Okunola *et al.*,2012) was lower, but higher than a report from Abeokuta Metropolis (Oguntoke and Yusuf, 2008). The lower value may be due low emission and activities within the state of compared.

For, hydrogen sulphide, Air Quality index shows, that locations 5,6,7 and 9 are unhealthy (Above 100<150),while location 1,2,3,4, and 10 shows a moderate condition (Above 50 < 100). The high value may be due to high braking down of bacteria, Organic matter ,burning of decay food, waste and refuse within these location.

Higher concentrations above 0.25mg/m^3 have the ability of deadening the odour cells of the olfactory lobes, so that the victim may not be sensitive to the impending danger of death. Hydrogen sulphide can be oxidized by atmospheric molecular oxygen (O_2) and Ozone (O_3).

Furthermore the concentration of SO_2 obtained in this study, was lower than ranges of 3.21 – 5.18 ppm, 7.4 – 15.5 ppm, and 16 – 64 ppm reported by Ayodele and Abubakar (2010). At some location the emission values were within 0.1 ppm limit of Federal Environmental Protection Agency FEPA (1991) ambient air quality standards.

For sulphur dioxide, in dry season, the AQI show that location 1,2,3,4,5,and 6 are in a moderate condition while location 7,8,9,and 10 are unhealthy. However in wet season moderate conditions was observed in locations 1,2,3 and 4,while unhealthy location was seen at location 5,6,7,8,9 and 10. The unhealthy condition is as a result of high vehicular emission, burning of house hold and solid waste as observed during sampling

Sulphur dioxide is the most corrosive of the sulphur oxides. SO_2 is oxidized to SO_3 in the atmospheric air by photolytic and catalytic processes involving ozone, oxides of nitrogen. Under normal conditions of the atmosphere, SO_3 reacts with H_2O vapour to produce droplets of H_2SO_4 aerosol which give rise to ‘acid rain’ causing damage to vegetation and materials. The tetraoxosulphate (VI) acid and sulfate aerosols present in the air are smaller than 2 μm, hence can easily reach the pulmonary region of the lungs, causing respiratory problem.

$$2SO_2 + O_2 \longrightarrow 2SO_3\,(g)$$

$$SO_3 + H_2O \longrightarrow H_2SO_4\,(g)$$

CONCLUSION

The ambient air quality for H_2S and SO_2 was investigated for toxic air pollutants in Jimeta/Yola metropolis. Their concentration revealed that some locations were in serious threat of these pollutant, which may pose environmental and health risk problem. However there is need for sanitization and enlightenment programmed to reduce the level of these gaseous pollutant.

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