

ANALYSIS OF SOME AIR POLLUTANTS IN YOLA NORTH LOCAL GOVERNMENT AREA, ADAMAWA STATE, NIGERIA

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ABSTRACT

The environmental burden of air pollution has been known to be the largest environmental health risk to mankind today. Ambient daily concentration levels of carbon monoxide (CO), Nitrogen dioxide(NO₂) and Sulphur dioxide (SO₂) status of eleven wards in Yola North local government areas were studied in the morning, afternoon and in the evening for a period of six weeks in months of February to March in 2018 using Crowcon Tetra 3 mobile gas sensor with model number IECEX BAS 05.0059. The mean concentration values of 34.0ppm, 28.0ppm, 22.4ppm, 32.0ppm and 26.0ppm of (CO) was recorded in Rumde, Demsawo, Yelwa, Luggere and Doubeli and (NO₂) concentration levels of 0.056ppm, 0.071ppm, 0.070ppm, and 0.073ppm was recorded for Rumde, Karewa, Luggere and Doubeli respectively. While the concentration levels of (SO₂) at the eleven wards were all found to be above the standard of 0.03ppm set limits. The higher concentrations of CO, NO₂ and SO₂ observed in this study is alarmingly higher than the safe limits of 20ppm, 0.053ppm and 0.03ppm set by NESREA standard and the air pollutants were mostly found to be higher in the morning and evening hours. The observed high concentration levels CO, NO₂ and SO₂ means that air quality in Yola North is strongly impaired and capable of triggering public health especially now that the whole world is battling with Covid 19 which is also airborne. Wearing face masks and constant monitoring air quality is recommended.

Keywords: Pollution, Carbon monoxide, Nitrogen dioxide, Sulphur dioxide, air quality

1 INTRODUCTION

Air pollution is defined as the contamination of air by discharge of harmful substances, which can cause health problems including burning eyes and nose, itchy irritated throat and breathing problem [1]. World health organization defines air pollution as the disequilibrium of air caused due to the introduction of foreign elements to humans natural and manmade sources to the air so that it becomes injurious to biological communities. In general air pollution involved an introduction of pollutants into the earth's atmosphere such as chemicals, particulate matters, or biological materials that cause discomfort, diseases, including burning eyes and nose, itchy irritated throat and breathing problems, or death to humans, damage other living organisms such as food crops, or damage the natural environment or built environment. Air pollution can be classified into natural air pollution which includes windblown dust, volcanic ash, and gases, smoke and trace gases from forest fires, and anthropogenic air pollution which includes products of combustion such as nitrogen oxide (NO₂), carbon oxides (CO₂), Sulphur oxide (SO₂), volatile organic compounds VOCs (primary hydro – carbons). Thus, air pollution is simply an anthropogenic condition in which substances are present at a concentration high enough above their normal ambient levels to produce measurable effects on man, animals, vegetation, materials etc. The nature of air is dependent on the source profile of the city, presence of sunlight to promote production of secondary pollutants, such as ozone, through photochemical reactions the altitude, which affects combustion processes and global air circulation patterns. Clean air is the basis for healthy life but any deficit to that may cause discomfort or harm to people and other living organisms. Therefore, air pollution must be controlled if air quality is going to

be maintained at an acceptable and safe limit. In recent years the public concern is being aroused due to the wide publicity on the damage to human health from the inhalation of gaseous pollutants and fine particulate. It has also been suggested that high incidence of respiratory health in urban areas may be associated with inhaling noxious gases and particulates in the air [2]. Air quality monitoring in most developing countries including Nigeria is not routinely conducted and in some urban areas like Yola Metropolis only a few of such information exist though signs of deteriorating air quality and health problems related to air pollution are visible. Most studies were conducted in major cities such as Lagos, Port Harcourt, Abuja, Kaduna and Kano [3, 4, 5]. According to [6] the human health problems due to air pollution that arise from vehicular emission in Abeokuta city was discovered to be approximately 56.4% of the total number of people suffered cough, while about 23.6% suffers breathing impairments among others; None of such study was conducted in Adamawa State. In order to archive environmental sustainability with regards to the atmosphere, air quality monitoring should be a routine exercise especially in Yola and its environs.

2 THE STUDY AREA

Yola north local government area is located in the northeastern part of Nigeria and the Capital of Adamawa State. It has an estimated population of 307,714 people with an approximate land area of 1104.30 km² with a radius of 3.55km [6]. It can also be located between the latitude of 9° 14' 31.8" (9. 24 22°) North and Longitude 12° 31' 29.5" (12.5249°) East of Greenwich meridian with an average elevation of 166 meters (545 feet) [10]. Yola north local government has eleven (11) wards areas, namely: Ajiya, Alkalawa, Doubeli, Gwadabawa, Jambutu, Karewa, Limawa, Luggere, Nasarawo, Rumde and Yelwa wards (Fig 1). The area experiences a recorded relative humidity ranging from 20 - 30% and lies between the guinea savanna with climate zone and annual rainfall of 700mm with an average temperature range of 24 - 30°C around December to February and high temperature of 38 - 48°C in March to May annually.

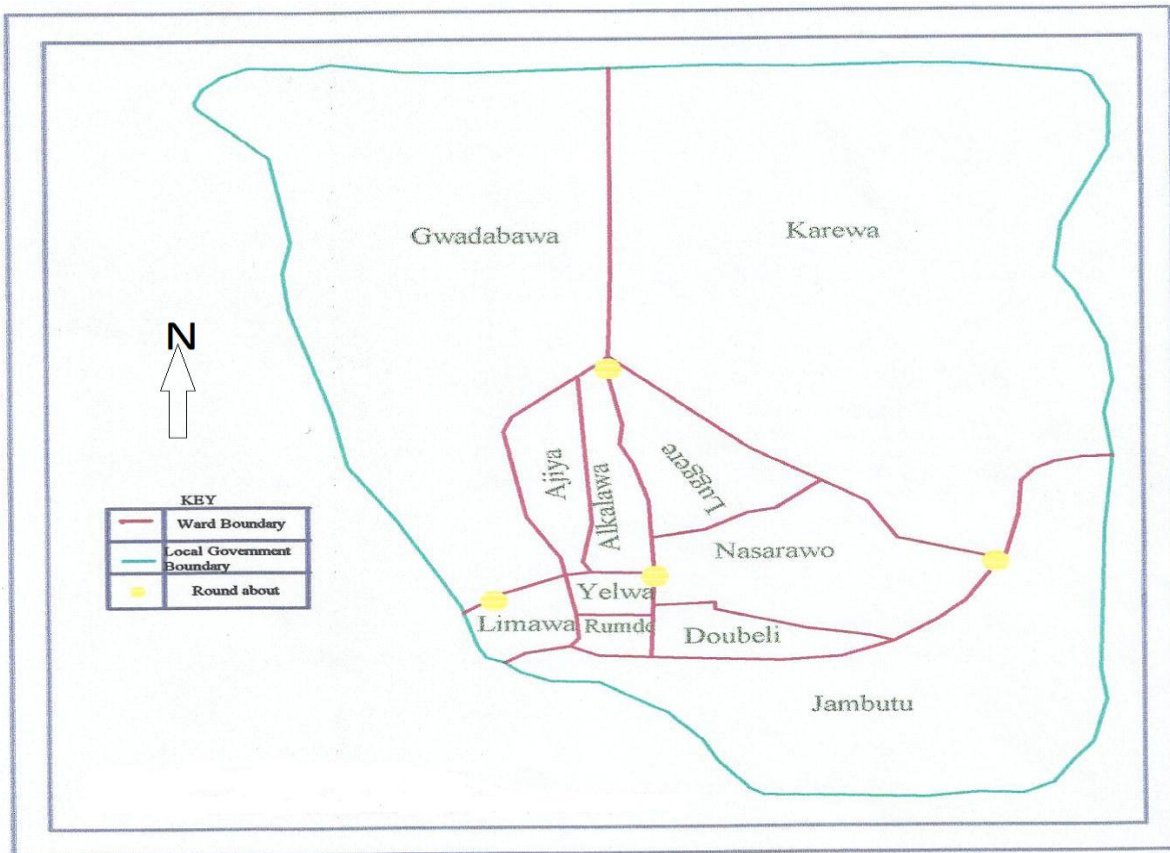


Figure 1. Map of Yola North Local Government area showing eleven wards of the study areas

3 MATERIALS AND METHODS

3.1 Air Sampling Equipment:

The equipment that was used to measure the concentration of Carbon monoxide (CO), Nitrogen dioxide (NO₂) and Sulphur dioxide (SO₂) in the eleven wards in Yola North is the digital Crowcon Tetra 3 portable multi – gas monitor detection device as shown below:

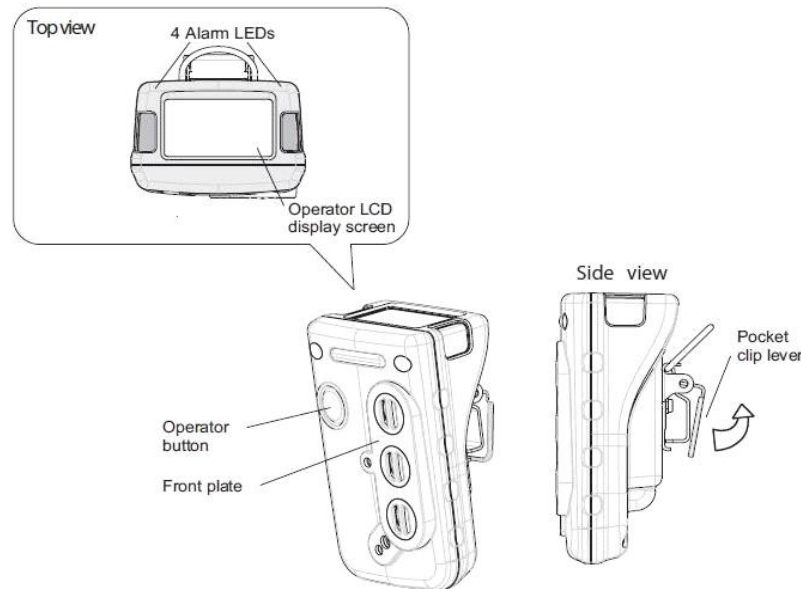


Figure 2. Crowcon Tetra 3, IECEx BAS 05.0059

3.2 Air Sampling Procedure

In the field the Crowcon Tetra 3 unit was first of all calibrated by setting to zero for 15 minutes before commencing the gas test, for this was the recommended time set by the manufacturer's instructions, until a confirmation message beeps up on the display reading 'calibration successful' which means that all channels were calibrated successfully within the allowed time. The air pollutants were measured using the calibrated Crowcon (Tetra 3) with a model number IECEx BAS 05.0059, a unique and portable multi-gas monitor for detection of Carbon monoxide (CO), Nitrogen dioxides (NO₂), and Sulphur dioxides (SO₂), and flammable gases. It offers flexibility, assurance, and robustness. Intrinsically safe, it is a portable gas detector with embedded software designed that met the requirements of International Electro Technical Commission (IEC 61508-3) which is the international standard for electrical, electronic and programmable electronic safety related systems, guaranteeing reliable and dependable operation and certified by Lloyds Register.

3.3 Air Sampling Time

The time frame for air quality monitoring using the calibrated Crowcon Tetra 3 at the selected study areas were carried out concurrently for a period of one month one week per each sampling point, and three (3) time in a day for duration of seven (7) days of the week from Monday to Sunday at the selected sampling points. These times are categorized as follows: 7:30 am – 9 – 30am morning peak hours, 12:30pm – 2:30pm off peak hours and 4:30pm – 6:30pm evening peak hours was selected as morning peak hours. The mean concentration of carbon monoxide (CO), Nitrogen dioxide (NO₂) and Sulphur dioxide (SO₂) were measured at the eleven wards of Yola North local Government and the results tabulated.

4 RESULTS AND DISSCUSSIONS

4.1 Air Pollution Levels in Yola

4.2 Carbon Monoxide Concentration Level

The recorded mean daily concentration of air pollutants namely Carbon monoxide, Nitrogen Dioxide and Sulphur Dioxide in the eleven wards as observed in the morning, afternoon and in the evening using Crowcon Tetra 3 mobile gas sensor in Yola is presented in Tables 1, 2, 3 and Figures 1, 2, 3, 4, 5 below: Table 1 Shows the mean daily concentration of CO across periods of morning, afternoon and evening at the different sampling points. The results reveals that air pollution is usually at its peak in the evening periods between 4:30 pm to 5:30 pm, followed by Morning hours (7:30 to 9:30 am) and finally the afternoon (Fig.3). This in part could be as a result of the fact that most domestic activities such as cooking, driving takes place more during morning and evening hours than in the afternoon hours. The results for CO levels per day ranged from 32.0-37.0, 23.0 – 31.0, 2.42 – 4.00, 22.4 – 25.4, 11.6 – 13.4, 7.70 – 9.86, 5.24 – 7.05, 29.3 – 35.4, 12.5 – 19.7, 3.68 – 5.91 and 21.2 - 31.3 ppm for Rumde, Demsawo, Karewa, Yelwa, Ajiya, Gwadabawa, Alkalawa, Luggere, Nassarawo, Limawa and Doubeli respectively. The concentration level of CO are observed to be higher than the limit of 20ppm set by NESREA in Rumde, Demsawo, Yelwa, Luggere and Doubeli areas. This could be attributed to the fact that these areas are subjected to indiscriminately open dumping and burning of refuse which releases smoke, gases into the atmosphere and hence high CO concentration is evident in these wards.

Table 1. Mean daily Concentration of Carbon monoxide (CO) of the day in sampling sites

| Sampling points Wards | Concentration in (ppm) | | | |
|--------------------------|------------------------|-----------|---------|-------|
| | Morning | Afternoon | Evening | Mean |
| Rumde | 33.0 | 32.0 | 37.0 | 34.0 |
| Demsawo | 29.1 | 23.0 | 31.0 | 28.0 |
| Karewa | 3.84 | 2.42 | 4.00 | 3.42 |
| Yelwa | 19.3 | 22.4 | 25.4 | 22.40 |
| Ajiya | 14.6 | 13.4 | 11.6 | 13.2 |
| Gwadabawa | 7.70 | 8.92 | 9.86 | 8.83 |
| Alkalawa | 5.24 | 5.68 | 7.05 | 6.00 |
| Luggere | 29.3 | 31.4 | 35.4 | 32.03 |
| Nasarawo | 15.6 | 12.5 | 19.7 | 15.93 |
| Limawa | 4.18 | 3.68 | 5.91 | 4.59 |
| Doubeli | 21.2 | 24.6 | 31.3 | 25.70 |

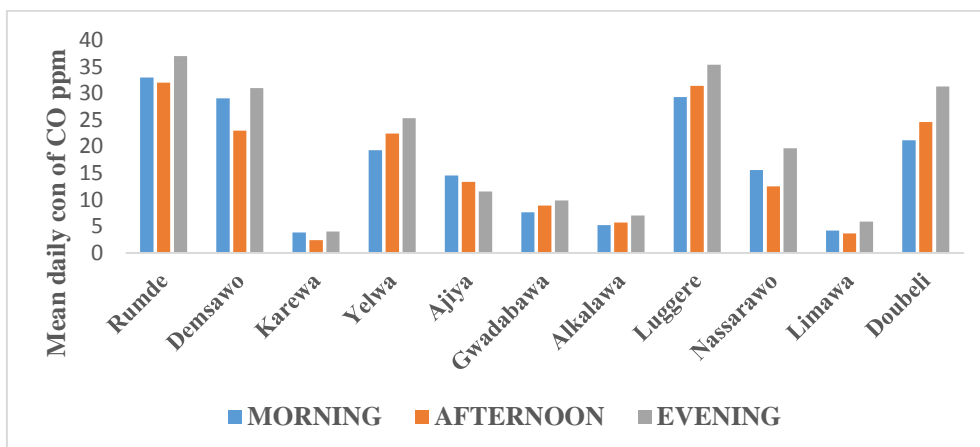


Figure 3. Mean daily concentration of CO in eleven wards in Yola.

4.3 Nitrogen Dioxide (NO₂) Concentration Level

Table 2 below gives the mean daily concentration levels of nitrogen dioxide (NO₂) level across periods at sampling points. It was observed that NO₂ during the evening hours between 4:30 pm to 5:30 pm for Doubeli, Nassarawo, Gwadabawa, Luggere, Karewa, and Rumde were relatively high while during the morning hours between 7:30 pm to 9:30 pm for Rumde, Demsawo, Yelwa, Luggere and Limawa were also relatively high. This result is a strong indication of consistent domestic activities (burning firewood for cooking in residential homes and refuse dump wastes sites) and gaseous emissions from vehicles plying roads during these hours which leads to NO₂ emission in these areas. The results for NO₂ levels per day as presented in Table 2 ranged from 0.013-0.093 ppm with a recorded mean value of 0.056 ppm for Rumde sampling point; 0.015 - 0.066 ppm for Demsawo sampling point; 0.0380 - 0.092 ppm for Karewa sampling point: and 0.018-0.099 ppm for Yelwa sampling point, 0.009- 0.047 ppm for Ajiya sampling point, 0.006 - 0.048 ppm for Gwadabawa sampling point, 0.010 - 0.063 ppm for Alkalawa, 0.048 to 0.097 ppm for Luggere, 0.063 to 0.069 ppm for Nassarawo, 0.008 to 0.066 ppm for Limawa and finally 0.046 to 0.099 ppm with an average of 0.073ppm for Doubeli respectively. The mean NO₂, concentration recorded was relatively moderate at all sampling points with exemption of Rumde, Karewa, Luggere, and Doubeli. However, the highest levels of NO₂ recorded was still during the evening hours at most of sampling points. When the levels of NO₂ were compared with values reported in literature, periodic mean of NO₂ was found to be lower than 35 - 108ppm reported in [7], but similar with the report of [8] where concentration of NO₂ in Calabar metropolis, Nigeria which was found to be in the range of 0.20 - 0.521ppm. It also agrees with the lower range of report by [9] for Kano metropolis, Nigeria. But relatively lower than the upper limit which range between 0.14 - 1.09ppm. However, NO₂ concentration is still within the safe limits set by [10] for NO₂ which is 0.04 - 0.06ppm.

Table 2. Mean concentration of Nitrogen dioxide (NO₂) of the day at sampling sites

| Sampling points Wards | Concentration in (ppm) | | | |
|--------------------------|------------------------|-----------|---------|-------|
| | Morning | Afternoon | Evening | Mean |
| Rumde | 0.093 | 0.013 | 0.062 | 0.056 |
| Demsawo | 0.055 | 0.066 | 0.015 | 0.045 |
| Karewa | 0.038 | 0.092 | 0.083 | 0.071 |
| Yelwa | 0.089 | 0.018 | 0.040 | 0.049 |
| Ajiya | 0.047 | 0.011 | 0.009 | 0.022 |
| Gwadabawa | 0.006 | 0.026 | 0.048 | 0.027 |
| Alkalawa | 0.010 | 0.063 | 0.035 | 0.036 |
| Luggere | 0.064 | 0.048 | 0.097 | 0.070 |
| Nasarawo | 0.017 | 0.069 | 0.063 | 0.050 |
| Limawa | 0.066 | 0.008 | 0.037 | 0.037 |
| Doubeli | 0.046 | 0.073 | 0.099 | 0.073 |

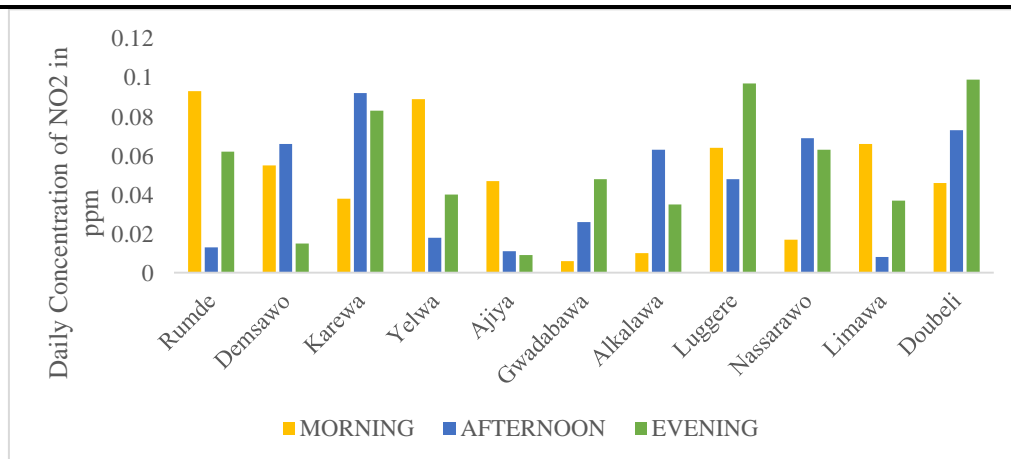


Figure 4. Mean daily concentration of SO₂ in eleven wards in Yola

4.4 Sulphur Dioxide Concentration Level

The concentration levels of SO₂ as presented in Table 3 below were also found to be exhibiting the same trend of concentration values as observed for carbon monoxide and nitrogen dioxide. High concentrations values were more observed in the evening hours in Rumde, Demsawo, Karewa, Yelwa, Ajiya, Luggere, Nassarawo, Limawa, Doubeli, while in the morning hours high concentration values of SO₂ was recorded in Rumde, Demsawo, Ajiya, Limawa and Doubeli respectively. It was also observed that Gwadabawa had its peak concentration during the afternoon hours which be attributed to the release of SO₂ automobile exhaust systems and decaying garbage's from refuse dumping sites. The concentration levels of SO₂ range from 0.060 - 0.71 ppm with a mean value of 0.067ppm for Rumde sampling point; 0.037 - 0.083 ppm for Demsawo sampling point; 0.016 - 0.090 ppm for Karewa sampling point: and 0.015 - 0.065 ppm for Yelwa sampling point, 0.008 - 0.061 ppm for Ajiya sampling point, 0.026 - 0.083 ppm for Gwadabawa sampling point, 0.017 - 0.096 ppm for Alkalawa, 0.041 to 0.053 ppm for Luggere, 0.016 to 0.065 ppm for Nassarawo, 0.022 to 0.075 ppm for Limawa and finally 0.041 to 0.096 ppm for Doubeli respectively. However, the concentration of SO₂ is lower than ranges of 3.21 - 5.18ppm, 7.4 – 15.5ppm, and 16 - 64ppm as reported in similar studies conducted by [10, 11, 12, 13] in Lagos, Port-Harcourt and Greece respectively, but was within the range of 0.03 - 0.09 ppm reported in Kano metropolis, Nigeria [9].

Table 3. Mean Concentration of Sulphur Dioxide (SO₂) of the day at sampling sites

| Sampling points Wards | Concentration in (ppm) | | | |
|--------------------------|------------------------|-----------|---------|-------|
| | Morning | Afternoon | Evening | Mean |
| Rumde | 0.060 | 0.071 | 0.070 | 0.067 |
| Demsawo | 0.072 | 0.037 | 0.083 | 0.064 |
| Karewa | 0.016 | 0.062 | 0.090 | 0.056 |
| Yelwa | 0.015 | 0.035 | 0.065 | 0.038 |
| Ajiya | 0.061 | 0.008 | 0.049 | 0.039 |
| Gwadabawa | 0.026 | 0.083 | 0.038 | 0.064 |
| Alkalawa | 0.096 | 0.017 | 0.025 | 0.046 |
| Luggere | 0.041 | 0.053 | 0.050 | 0.048 |
| Nasarawo | 0.040 | 0.016 | 0.065 | 0.040 |
| Limawa | 0.072 | 0.022 | 0.075 | 0.056 |
| Doubeli | 0.096 | 0.041 | 0.093 | 0.077 |

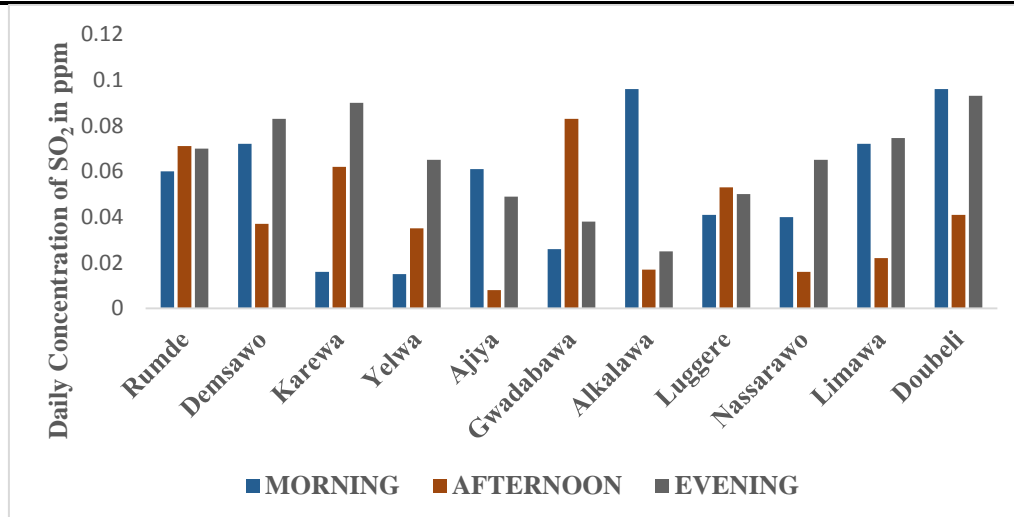


Figure 5. Mean daily concentration of SO₂ at Sampling Sites

Generally, the concentrations of pollutants (CO, NO₂ and SO₂) were higher in the evening periods and relatively lower during morning periods. This result also agrees with the findings of the research conducted by [9] who reported lower concentration of gaseous pollutants during morning

hours. The highest levels of CO recorded were around Rumde sampling point with levels value up to CO 37.0 ppm. This concentration value when compared with other concentration values reported in literature was found to be very high. For example, in Athens, Greece the average range of atmospheric concentration of urban air pollutants was 1.6 - 3.8ppm, as reported by [13]. This value is also higher than range of 0.7 - 1.9 ppm in Jahara, Kuwait [12] and higher than the range of 4.25 - 14.33ppm in Kano, Nigeria [9]. However, in this study the concentration values were lower than range of 233 - 317ppm reported in three cities of Nigeria: Lagos, Ibadan and Ado - Ekiti [13]. Comparing the concentration values of CO at the eleven (11) sampling points, the highest value was seen at the sampling point near Rumde roundabout due to dense population which triggers intense activities as well as high traffic congestion by cars, taxis intra-city commercial buses, trucks and commercial motorcycles congestions as well as burning of old tiers around this area. Generally, at all the sampling points the CO concentration across the periods revealed that air quality is poor higher than the value of 20ppm safe limit set by NESREA at all sampling points with exemption of the Karewa, Limawa, Gwadabawa, Alkalawa. Generally, condition of the air during afternoon - evening hours indicate poor air quality. This further indicates that the environment around these sampling points are exposed to CO contamination. The attendant potential effect of poor quality air or exposure to high concentration of CO is associated with potential health risk because it reduces the oxygen carrying capacity of blood, which in turn impairs oxygen release into tissue and adversely affects sensitive organs such as the brain and heart [11].

4 CONCLUSIONS

The concentration levels of CO, NO₂, and SO₂ in the ambient air in Yola North were determined. The results indicated that air quality is severely impaired which might have resulted into a potential human health effect in the long run. The results revealed that most domestic activities in Yola North especially the urban core give off air pollutants like CO, NO₂, and SO₂. The levels of the CO measured at all the sampling points with exemption of few areas were above the NESREA standard limit. Therefore, in this aspect air quality is poor and hazardous to health. As for SO₂ measured, at most of the sampling points were relatively above the NESREA lower limit but still does not exceeded the upper safe limit. This implies that air pollution within Yola North is not within the safe limits. The findings from this present study revealed that in Yola activities-related to environmental pollution in Yola North is significant with potentially hazardous health consequences. Finally, this study also revealed that gaseous pollutants in the air, such as CO, NO₂ and SO₂ directly or indirectly threaten the environment and life of inhabitants of Yola North and that motor vehicles emission and other related activities carried out along these roads remain the dominant sources of these pollutants.

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