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Harmattan Dust Characteristics using Fourier Transform-Infrared and Gas Chromatography-Mass Spectrometry Method of Selected Sub-Saharan Region in African Stations

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A B S T R A C T

Harmattan dust has been identified as a discrete mass of solid earth crust hanging in the air for an extended period of time. It has been noted that less studies have been conducted in Nigeria to determine the functional groups contained in harmattan dust. The goal of this study was to figure out what functional groups and chemicals that were present in the dust. Usmanu Danfodiyo University, Sokoto (12°N, 13.8°E), Kebbi State University of Science and Technology, Aliero (12.3070°N, 4.4955°E), Federal University of Agriculture, Zuru (11.4058°N, 5.2400°E), and Waziri Umaru Federal Polytechnic, Birnin Kebbi (12.4601°N, 4.4955°E), were the selected stations used in this study. The suspended Harmattan dust samples were obtained in glass petri plates using a direct deposition approach. Fourier Transform Infrared Spectroscopy (FTIR) and Gas Chromatograph-Mass Spectrometry (GC-MS) were used to examine the samples collected. The results show that eleven functional groups were present in the samples, including =CH-H, -CH_3, N-H, C=C, =C-H, C-H, O-H, C-N, C=O, C-O-C, and -CH_3. According to GC-MS, the component (2-methoxy ethyl) had the greatest quality value (Q-Value) of 83, area percentage corresponding to time rating (RT) of 13.647, and CAS 018173-63-2 in the dust samples. It is therefore recommended that the Federal Republic of Nigeria's government increase funding for the research centers so that researchers can study all cities in the country and better observe the functional group metals present in the harmattan dust.

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INTRODUCTION

The word Harmattan comes from Twi language, which means "Haramata", which is a banned term [1]. According to many scholars, harmattan originated in Sahara, the world's greatest dust plume [2]. Harmattan dust begins in November and lasts until roughly March of each year [1-4]. Harmattan season in northern Nigeria has been seen to blow from the Bodele depression, depositing samples into and throughout the region [5, 6]. Annually, the harmattan dust phenomenon is recorded, and samples are transported across Nigeria by wind from the Sahara Desert to the Guinea Gulf [7-9]. According to literature [10, 11], the harmattan takes an average of twenty-four hours to reach the Nigerian zone. According to literature [9, 12, 13], the chemical composition of harmattan dust has an impact on human health through various nasal disorders. However, according to literature [1, 9, 14-16], harmattan dust can easily infiltrate the human respiratory system through the wind medium, allowing hazardous elements to enter the body. Uncertainly, the chemical makeup of harmattan dust has a deleterious impact on human health, according to literature [9, 17, 18]. According to Ezeh et al. [6, 10, 19, 20] Adedokun [6, 10, 19, 20], Adedokun et al. [19] and Adedayo[20], harmattan dust spells are usually accompanied by nighttime and

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morning drops, which affect the temperature. According to various studies, dust spells can last up to three to five days in the air before dissolving [1, 10, 19, 21-23]. As a result, the purpose of this study was to determine the functional groups present in harmattan dust using Fourier Transform Infrared (FT-IR) and Gas Chromatography-Mass Spectrometry (GC-MS) equipment, as well as to investigate the level at which the groups are detected in the samples throughout the various stations.

MATERIAL AND METHODS

Suspended harmattan samples were obtained in four separate locations using 90 mm diameter cylindrical petri dishes with a height of 15.7 mm. Each of these glass petri dishes was kept safe from reptiles and external dust by being enclosed in a wire gauge (100x100x100) cm cage fixed to the tops of residential and some commercial buildings. The glass petri dish was chosen because of its heavy weight, which prevents it from being blown away by the wind and permits dust to accumulate in it when used in a direct open technique [1, 3, 24]. Several preventative precautions were implemented to prevent contamination by reptiles and roadway dust. The experimental setup for this investigation, on the other hand, is shown in Figure 1. Figure 2 depicts a map of the stations that were used. Table 1, on the other hand, illustrates the locations of the several sampling points at each station.

Sample preparation and characterization

The Agilent Technologies CARY 630FTIR Fourier Transform Infrared Machine was used to evaluate the samples collected at each location. The dry harmattan dust samples was digested before they could be examined using GC-MS. After that, the samples were run through FTIR and GC-MS equipment to determine their composition. Moreover, the quantitative and qualitative analyses of the sample were determined using this method.

Figure 1. Schematic diagram of the experimental setup for sample collection

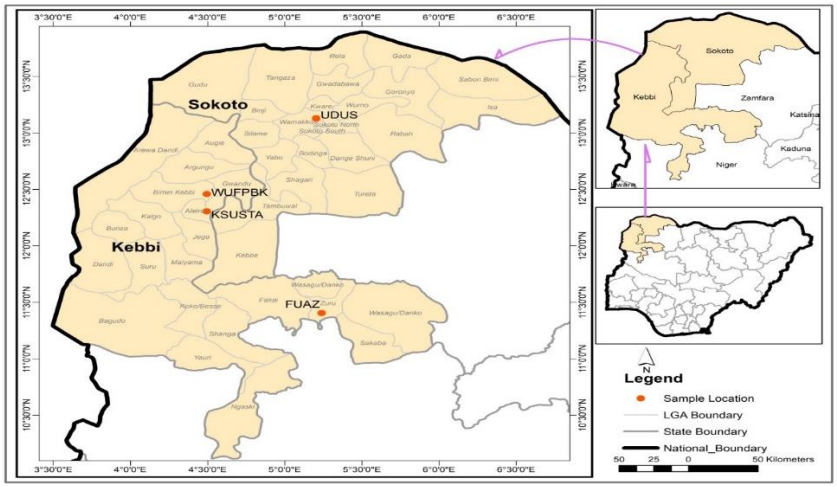

Figure 2. Map of the sampling locations

Table 1. Coordinates of different sampling locations across each station

Station	Longitude	Latitude	Local Area
Kebbi State University of Science and Technology, Aliero (full Meaning)	12.3070°N	4.4955°E	Aliero
Federal University of Agriculture	11.4058°N	5.2400°E	Zuru
Waziri Umaru Federal Polytechnic	12.4601°N	4.4955°E	Birni Kebbi
Usmanu Danfodiyo University	4°8'E and 6°54'E	12°N and 13.8°E	Wammakka

RESULTS AND DISCUSSION

The functional groups detected in the samples collected at Waziri Umaru Federal Polytechnic, Birni Kebbi, are listed in Table 2. The FTIR spectrum of the collected sample is shown in Figure 3. The absorption zones of 3302 cm^{-1} are found in this finding. 2914.4 cm^{-1}, 2851.8 cm^{-1}, 1727.4 cm^{-1}, 1612.6 cm^{-1}, 1004.1 cm^{-1}, 915 cm^{-1}, 775.1 cm^{-1} which is consistent with the findings reported in literature [1, 22, 23, 25, 26]. The absorption band at 3302.4 cm^{-1} corresponds to N-H bending, the band observed at 2914.8 cm^{-1} corresponds to C-H, the absorption band 2851.4 cm^{-1} corresponds to =-CH_3, the band observed at 1727.6 cm^{-1} corresponds to C=O, the absorption band at 1612.1 cm^{-1} corresponds to C=C, the absorption band at 1004.5 cm^{-1} corresponds to C-O B and, the absorption band at 915.1 cm^{-1} corresponds to =CH-H, and the absorption band at 775.3 cm^{-1} corresponds to -C-H, in line with literature [22, 23, 27, 28].

The FTIR Spectrum for Federal University of Agriculture, Zuru and KSUSTA are shown in Figures 4 and 5, respectively.

As observed from Table 3, the compound groups present in the samples collected at Federal University of Agriculture, Zuru. It shows the absorption regions of 3026.6 cm^{-1} in the sample is aromatic C-H stretch, while

Table 2. FTIR analysis for Waziri Umaru Federal Polytechnic, Birni Kebbi

S/N	Transmittance	Wave number (cm^{-1})	Functional group
1	14.80	3302.4	N-H
2	16.55	2914.8	C-H
3	17. 63	2851.4	= -CH_3
4	13.39	1727.6	C=O
5	-	1612.1	C=C
6	-	1004.5	-
7	16.16	915.1	-
8	16.16	775.3	-C-H

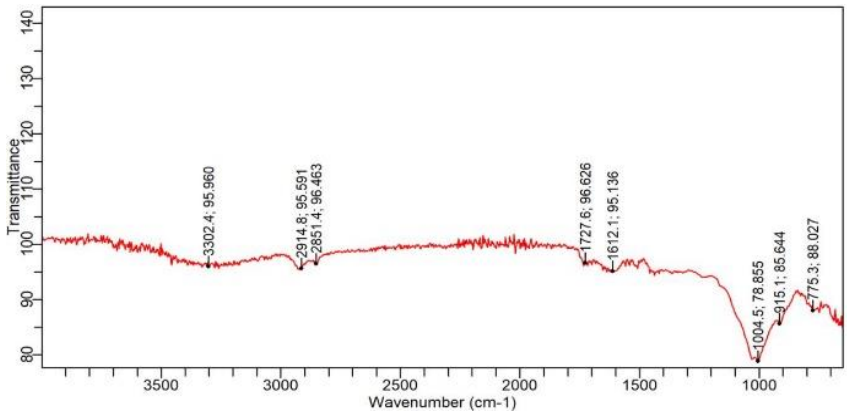

Figure 3. FTIR spectrum for Waziri Umaru Federal Polytechnic, Birni Kebbi

2926.0 cm^{-1}, 2847.7 cm^{-1} were observed to be in the methly C-H asyml./sym. stretch, 1487.2 cm^{-1}, 1444.3 cm^{-1}, 1026.9 cm^{-1}, 903.9 cm^{-1}, 833.1 cm^{-1}, 743.6 cm^{-1}, 697.0 cm^{-1}. The absorption band at 3026.6 cm^{-1} corresponds to =C-H, the absorption band at 2926.0 cm^{-1} corresponds to =-CH_3, The absorption band at 2847.7 cm^{-1} corresponds to -CH_3, the band observed at 1487.2 cm^{-1} corresponds to C=C, the band observed at 1444.3 cm^{-1} corresponds to C-H, the band observed at 1026.9 cm^{-1} corresponds to C-O-C, the band observed at 903.9 cm^{-1} corresponds to O-H, the band observed at 833.1 cm^{-1} corresponds to =CH-H, the band observed at 743.6 cm^{-1} corresponds to N-H, and the band observed at 697.0 cm^{-1} corresponds to double bound = CH-H and is in agreement with Reddy et al. [25]. Observation from Table 4 shows the FTIR spectrum with the highest absorption peaks in

Table 3. FTIR analysis for Federal University of Agriculture, Zuru

S/N	Transmittance	Wave number (cm^{-1})	Functional group
1	14. 63	3026.6	=C-H
2	16. 55	2926.0	= -CH_3
3	17. 63	2847.7	-CH_3
4	13.39	1487.2	C=C
5	13.39	1444.3	C-H
6	14.85	1026.9	C- O- C
7	16.16	903.9	O- H
8	17.63	833.1	=CH-H
9	16.16	697.0	N- H, = CH-H

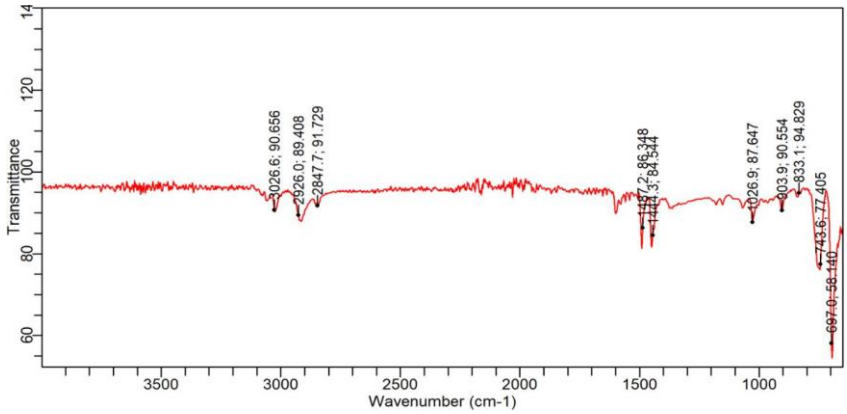

Figure 4. FTIR Spectrum for Federal University of Agriculture, Zuru

the samples collected at in the samples collected at Kebbi State University of Science and Technology, Aliero. It shows the absorption regions of 3030.3 cm^{-1}, 2911.1 cm^{-1}, 2840.2 cm^{-1}, 1494.7 cm^{-1}, 1455.5 cm^{-1} ,1023.2 cm^{-1}, 907.6 cm^{-1}, 844.2 cm^{-1}, 739.9 cm^{-1}, 697.0 cm^{-1}. The absorption band at 3030.3 cm^{-1} corresponds to =C-H, the absorption band at 2911.1 cm^{-1} corresponds to C-H, the band observed at 2840.2 cm^{-1} corresponds to = $-CH_3$, the band observed at 1494.7 cm^{-1} corresponds to C=C, the band observed at 1455.5 cm^{-1} corresponds to $-CH_3$, the band observed at 1023.2 cm^{-1} corresponds to C-O band, the band observed at 907.6 cm^{-1} corresponds to =CH-H, the band observed at 844.2 cm^{-1} corresponds to =CH-H, the absorption band at 739.9 cm^{-1} corresponds to N-H, the absorption band at 697.0.3 cm^{-1} corresponds to N-H, =CH-H all of which are in agreement with [22, 23, 26, 29].

Table 4. FTIR analysis for Kebbi State University of Science and Technology, Aliero

S/N	Transmittance	Wave number (cm^{-1})	Functional group
1	17. 63	3030.3	= C-H
2	17. 63	2911.1	C-H
3	17. 63	2840.2	= $-CH_3$
4	13.39	1494.7	C=C
5	13.39	1455.5	= $-CH_3$
6	14.85	1023.2	C. O bond
7	-	907.6	= CH-H
8	16.16	844.2	=CH-H
9	16.16	739.9	N- H
10	16.16	697.0	N-H, =CH-H

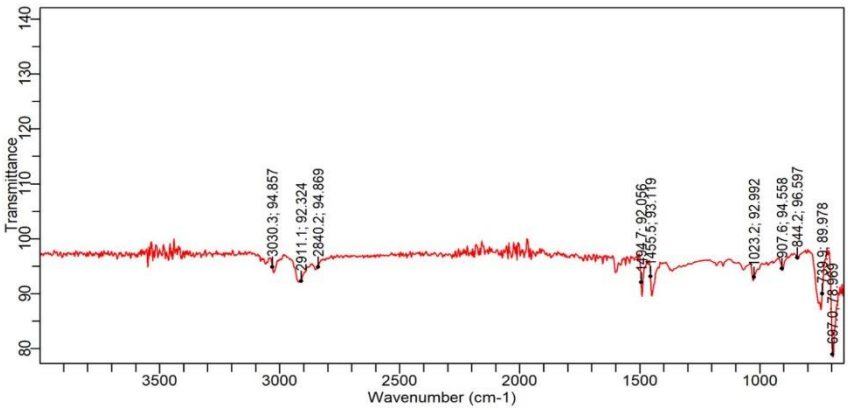

Figure 5. FTIR Spectrum for KSUSTA

Table 5 shows the FTIR spectrum with the highest absorption peaks in the samples collected at USmanu Danfodio University, Sokoto. It shows the absorption regions of 3022.9 cm^{-1}, 2914.8 cm^{-1}, 2844.0 cm^{-1}, 1595.3 cm^{-1}, 1490.9 cm^{-1}, 1448.1 cm^{-1}, 1369.8 cm^{-1}, 1069.7 cm^{-1}, 1023.2 cm^{-1}, 903.9 cm^{-1}, 836.8 cm^{-1}, 743.6 cm^{-1}, 693.3 cm^{-1}. The absorption band at 3022.9 cm^{-1} corresponds to =C-H, the absorption band at 2914.8 cm^{-1} corresponds to $-CH_3$, the absorption band at 2844.0 cm^{-1} corresponds to = $-CH_3$, the absorption band at

Table 5. FTIR analysis for Usmanu Danfodio University, Sokoto

S/N	Transmittance	Wave number (cm^{-1})	Functional group
1	17. 63	3022.9	=C-H
2	17. 63	2914.8	$-CH_3$
3	17. 63	2844.0	$= -CH_3$
4	13.39	1595.8	C=C
5	13.39	1490.9	C=C
6	14.85	1448.1	C-H
7	-	1369.8	Iso propyl group
8	16.16	1069.7	C-O Band
9	16.16	1023.2	C-O Band
10	-	903.9	N-H
11	16.16	836.8	Aromatic compound
12	16.16	743.6	-C-H
13	-	693.3	N-H

1595.3 cm^{-1} corresponds to C=C, the band observed at 1490.9 cm^{-1} corresponds to C=C, the band observed at 1448.1 cm^{-1} corresponds to C-H, the band observed at 1369.8 cm^{-1} corresponds to Iso propyl group, the band observed at 1069.7 cm^{-1} corresponds to C-O Bond, the band observed at 1023.2 cm^{-1} corresponds to C-O Bond, the absorption band at 903.9 cm^{-1} corresponds to N-H, the absorption band at 836.8 cm^{-1} corresponds to aromatic compound, the absorption band at 743.6 cm^{-1} corresponds to -C-H, and the absorption band at 693.3 cm^{-1} corresponds to N-H, which is confirmed by [22, 23, 30].

The FTIR spectrum for Usmanu Danfodio University, Sokoto is shown in Figure 6.

FTIR spectra for the four locations compared with the FTIR Functional Group Chart Reference are listed in Table 6.

The GC- MS spectrum for Waziri Umaru Federal Polytechnic, Birni Kebbi and Kebbi State University of Science and Technology, Aliero are shown in Figure 7 and 8, respectively.

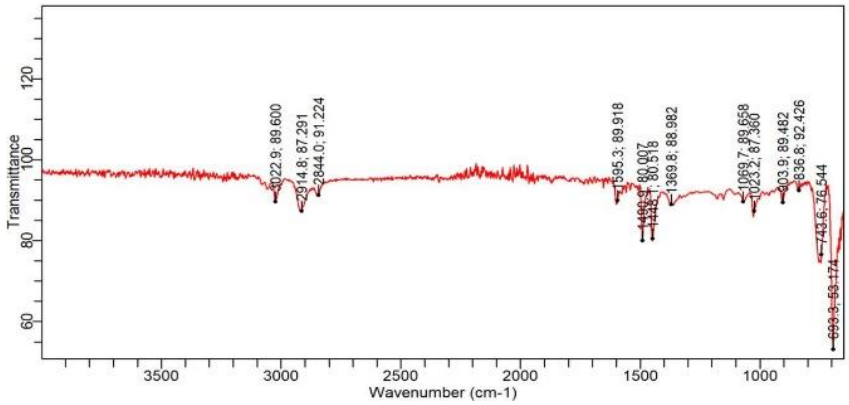

Figure 6. FTIR spectrum for Usmanu Danfodio University, Sokoto

Table 6. FTIR spectra for the four locations compared with the FTIR Functional Group Chart Reference

Functional Groups	Absorption Frequency (cm^{-1})	Wave number (cm^{-1})	Functional group			
			Waziri Umaru	FUAZ	KSUSTA	UDUS
N-H	3500-3300, 1650-1590, 900-680	-	N-H (3302.4)	N-H (697.0)	N-H (697.0)	N-H (693.3)
=CH-H	3100-3070, 1420-1410, 900-880	-	-	=CH-H (833.1)	= CH-H (907.6, 844.2)	=CH-H (836.8)
=C-H	3100-3000, 2000-1600	-	-	=C-H C=C (3026.6)	=C-H (3030.3)	=C-H (3022.9)
C-H	2900-2700, 1440-1320	1490.9	C-H (2914.8)	C-H (2926.0)	C-H (2911.1,)	C-H (2914.8, 1448.1)
$-CH_3$	2880-2060, 2970-2950, 1380-1370, 1470- 1430	-	$= -CH_3$ (2851.4)	$-CH_3$ (2847.7), $-CH_3$ (1444.3)	$-CH_3$ (2840.2), (1455.5)	CH_3 (2844.0)
O-H	2700-2500, 1320-1210, 950-900	-	O-H (915.1)	O- H (903.9)	-	O-H (903.9)

C=C	2140- 2100	-	-	-	-	-
C=O	1750- 1700	-	C=O (1727.6)	-	-	-
C=C	1600- 1500		C=C (1612.1)	C=C (1487.2)	C=C (1494.7)	C=C (1595.8)
C-N	1340- 1250	-	-	-	-	Aromatic compound (1369.8)
C-O-C	1200- 1180	-	C-O-C (1004.5)	C- O- C (1026.9)	C-O-C (1023.2)	C-O-C (1069.7, 1023.2)
-C-H	770- 730	-	-C-H (775.3)	-	-C-H (739.9)	-C-H (743.6)

Note: FTIR- Fourier Transform-Infrared; UDUS- Usman Danfodio University Sokoto; KSUSTA- Kebi State University of Science and Technology Aleiro; FUAZ -Federal University of Agriculture, Zuru

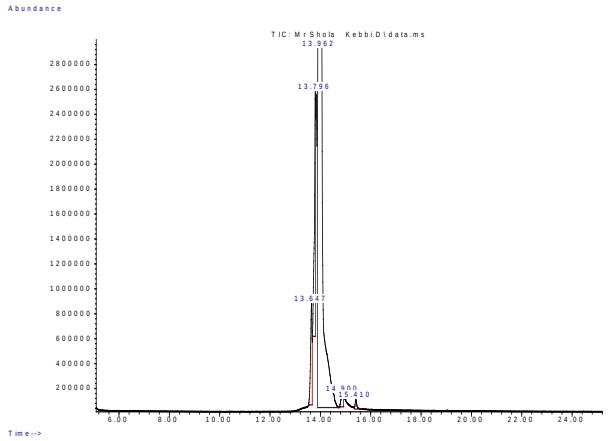

Figure 7. GC- MS spectrum for Waziri Umaru Federal Polytechnic, Birni Kebbi

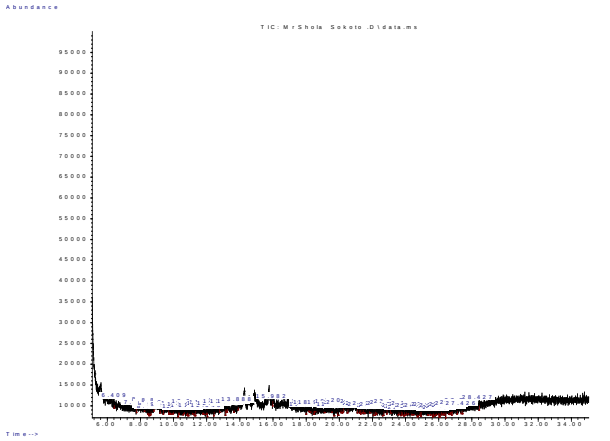

Figure 9. GC- MS spectra for Usmanu Danfodio University, Sokoto (UDUS)

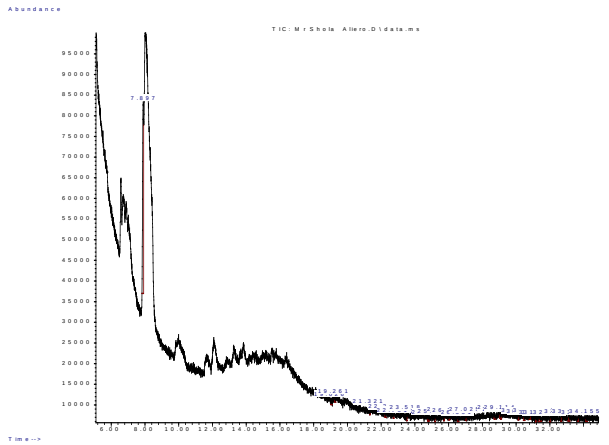

Figure 8. GC- MS spectrum for Kebbi State University of Science and Technology, Aliero

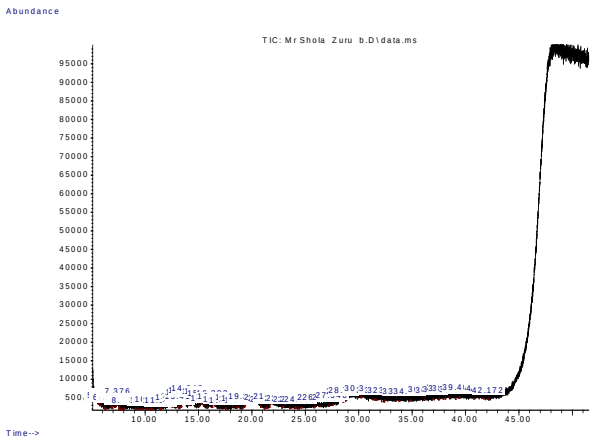

Figure 10. GC- MS spectrum for Federal University of Agriculture, Zuru, Kebbi State

The GC- MS spectra for Usmanu Danfodio University, Sokoto (UDUS) and Federal University of Agriculture, Zuru, Kebbi State are shown in Figures 9 and 10, respectively.

Table 7 shows that Salene (2-mehoxy ethyl) is the component with the highest quality value (Q-Value) of 83, corresponding to a time rating (RT) of 13.647, and CAS 018173-63-2 in dust samples taken from Waziri

Umaru Federal Polytechnic, Birni Kebbi. Table 8 reveals that the compound with the greatest Q- value of 50, area percent of 1.23 corresponding to the RT of 34.155, and CAS 000748-30-1 is Benzene, 1, 1'-oxybis [3-phenoxy- in dust samples obtained from Kebbi State University of Technology, Aliero. Table 9 shows that Benzene, 1,1'-oxybis [3-phenoxy- is the compound with the highest Quality value of 83, area percent of 0.84, corresponding to the RT of 6.409, and CAS 000748-30-1 in dust samples obtained from Federal University of Agriculture, Zuru. Table 10 reveals that the top chemical in the dust samples obtained from Usmanu Danfodiyo University, Sokoto is Benzene, 1, 1'-oxybis [3-phenoxy-, with a Quality value of 83, an area of 6.409, a rating time of 0.84, and a CAS 000748-30-1. According to the findings, the elemental composition of the dust samples studied revealed that the percentage compositions of some elements are higher than the permissible WHO standard values, posing a health risk. As a result, it is suggested that suitable preventative measures and regulations be implemented to help minimize the effects of the observed elevated elements concentrations. Significant quantities of trace elements in the samples obtained throughout the four locations studied are thought to be harmful to human health. Inhalation is, of course, one of the principal causes of direct dust particle exposure in every section of the country.

Table 7. GC-MS Analysis of Waziri Umaru Federal Polytechnic, Birni Kebbi, Kebbi State

S/N	RT	Compound Name	CAS	Q Value
1	13.647	Salene (2- mehoxy ethyl)	018173-63-2	83
2	13.796	-	052686-72-6	72
3	13.962	Disiloxane, hexamethyl	000107-460	80
4	14.900	Acetamide,2,2,2-tril	000354-38-1	78
5	15.410	1,3,5- Trisiloxane, 1	1000458-50-5	59

Table 8. GC- MS analysis for Kebbi State University of Science and Technology, Aliero, Kebbi State

S/N	RT	1.02	Compound Name	Ref	CAS	Q Value
1	21.321	1.69	Benzene, 1, 1'- oxybis Methylene chloride			
2	19.026		Methylene chloride	1694	000075-09-2	40
3	19.261	1.02	Oxazolidine, 2-ethyl-2-methyl-	8703	017026-89-0	38
4	21.321	0.89	Acetic acid, dichloro-	13332	000079-43-6	25
5	22.242	0.94	2,4-Diamino-5-[3,4-[p-chlorobenzyl	231709	071525-16-1	22
6	22.751	0.79	Acetic acid, dichloro-	13332	000079-43-6	35
7	23.518	1.17	6-Methoxy-4-methyl-8-nitro-5-	231792	1000212-33-8	38
8	25.177	0.85	2-Ethyl-5-(4-nitro-1,8-naphthalimi do)-1,3,4-thiadiazole	231569	302955-08-4	37
9	26.041	0.96	1-Azetidinecarboxaldehyde, 2,2,4,4 -tetramethyl-	21292	050455-46-4	30
10	29.114	0.97	2-Ethyl-5-(4-nitro-1,8-naphthalimido)-1,3,4-thiadiazole	231569	302955-08-4	37
11	31.180	1.22	1,8,8-Trimethyl-3-(4-p-tolyl-thiazol-2-yl)-3-aza-bicyclo[3.2.1]octane-2,4-dione	231956	1000274-34-1	38
12	34.155	1.23	Acetic acid, (4-chlorophenoxy)-, odecyl ester	232003	1000415-10-5	32
13	34.155	1.23	Benzene, 1,1'-oxybis[3-phenoxy-	232550	000748-30-1	50

Table 9. GC- MS analysis for UDUS

S/N	Area%	RT	Compound Name	CAS	Q Value	
1	6.409	0.84	Benzene, 1,1'-oxybis(3-phenoxy-)	232550	000748-30-1	83
2	7.754	0.90	Cholest-5-en-19-ol, 3-methoxy-, (3. beta)-	273323	021072-63-9	64
3	8.440	0.83	Acetic acid, (4-chlorophenoxy)-, dodecyl ester	232003	1000415-10-5	36
4	8.486	1.85	Cholest-5-en-19-ol, 3-methoxy-, (3 .beta)-	273323	021072-63-9	64

5	10.346 0.59	0.59	D-Ethyl-2-[4-(4-[trifluoromethyl]phenoxy)phenoxy]propionate	231713	058594-73-3	42
6	10.792	0.79	2,4-Diamino-5-[3,4-[p-chlorobenzylidine]dioxybenzyl]pyrimidine	231709	071525-16-1	47
7	10.895	1.40	D-Ethyl-2-[4-(4-[trifluoromethyl]phenoxy)phenoxy]propionate	231713	058594-73-3	64
8	12.045	0.98	6-Methoxy-4-methyl-8-nitro-5-[[4'-ethoxy]phenoxy]quinoline	231792	1000212-33-8	9
9	13.888	0.75	2-butenedioic acid, 2,3-bis[(3-methylphenyl) amino]-, dimethyl ester	231972	1000398-40-1	50
10	18.236	0.67	2-Pyrazolin-5-one, 4-[[p-(methylamino) phenyl]imino]-1,3-diphenyl-	232304	013617-71-5	33
11	18.460	0.76	Phosphoric acid, bis(4-methylphenyl) phenyl ester	231943	034909-69-8	53
12	21.080	1.14	2,4-Diamino-5-[3,4-[p-chlorobenzyl idine]dioxybenzyl]pyrimidine	231709	071525-16-1	64
13	21.218	0.82	7-Hydroxy-4-methyl-3-(2-thiophenyl) coumarin, trifluoroacetate	231633	1000449-06-8	53
14	24.863	0.69	2-butenedioic acid, 2,3-bis[(3-met hylphenyl) amino]-, dimethyl ester	231972	1000398-40-1	9
15	28.427	1.44	6-Methoxy-4-methyl-8-nitro-5-[[4'-ethoxy]phenoxy]quinoline	231792	1000212-33-8	59

Table 10. GC- MS analysis for Federal University of Agriculture, Zuru, Kebbi State

S/N	RT	Area%	Compound Name	Ref	CAS	Q Value
1	6.409	0.84	Benzene, 1,1'-oxybis [3-phenoxy-	232550	000748-30-1	83
2	7.754	0.90	Cholest-5-en-19-ol, 3-methoxy-, (3. beta.)-	273323	021072-63-9	64
3	8.240	0.76	1,8,8-Trimethyl-3-(4-p-tolyl-thiazol-2-yl)-3-aza-bicyclo [3.2.1] octane-2,4-dione	231956	1000274-34-1	33
4	8.440	0.83	Acetic acid, (4-hlorophenoxy)-, dodecyl ester	232003	1000415-10-5	36
5	8.486	1.85	Cholest-5-en-19-ol, 3-methoxy-, (3. beta.)	273323	021072-63-9	64
6	8.543	1.06	2-butenedioic acid, 2,3-bis[(3 methylphenyl)amino]-, dimethyl ester	231972	1000398-40-1	9
7	8.601	1.52	2-p-Methoxyphenyl-8-methyl-4-quinolyl-2-pyridyl ketone	232472	018062-40-3	50
8	8.818	0.81	Silane, dimethyl(2-fluorophenyloxy)dodecyloxy-	232022	1000347-36-2	50
9	9.173	0.72	D-Ethyl-2-[4-(4-[trifluoromethyl]phenoxy)phenoxy]propionate	231713	058594-73-3	45
10	9.699	0.94	(4-Methoxy-phenyl)-(1-phenoxy-naphthalen-2-yl)-diazene	232473	1000189-65-4	9
11	9.842	1.07	2,4-Diamino-5-[3,4-[p-chlorobenzylidine]dioxybenzyl]pyrimidine	231709	071525-16-1	50
12	11.965	0.74	Acetic acid, (4-chlorophenoxy)-, dodecyl ester	232003	1000415-10-5	28
13	13.888	0.75	2-butenedioic acid, 2,3-bis[(3-methylphenyl)amino]-, dimethyl ester	231972	1000398-40-1	50
14	18.236	0.67	2-Pyrazolin-5-one, 4-[[p-(methylamino)phenyl]imino]-1,3-diphenyl-	232304	013617-71-5	33
15	18.460	0.76	Phosphoric acid, bis(4-methylphenyl) phenyl ester	231943	034909-69-8	53
16	25.841	0.66	2-butenedioic acid, 2,3-bis[(3-methylphenyl)amino]-, dimethyl ester	231972	1000398-40-1	53
17	27.375	2.54	2-Pyrazolin-5-one, 4-[[p-(methylamino)phenyl]imino]-1,3-diphenyl-	232304	013617-71-5	33

CONCLUSION

According to the findings, some components are in lesser quantities while others are in higher quantities. In summary, the greatest absorbance measured in dust samples taken from Waziri Umaru Federal Polytechnic, Birni Kebbi, is 96 % at 3302.4 cm^{-1}, which corresponds to 20.4 percent of intensity. The greatest absorbance measured in dust samples taken from the Federal University of Agriculture, Zuru, is 92% at 3026.6 cm^{-1}, which corresponds to 19.5 percent intensity. The greatest absorbance measured in dust samples obtained from Kebbi State University of Science and Technology, Aliero, is 94% at 3030.3 cm^{-1}, which corresponds to 19.9% of intensity. The greatest absorbance found was 90 percent at 3022.9 cm^{-1}, which equated to 19 percent of intensity in dust samples obtained from Usmanu Danfodiyio University in Sokoto. In a same line, the presence of elements in the samples collected in the four locations suggests that the dusts in Nigeria may contain nearly all of the elements found in harmattan. Furthermore, the study discovered that the elemental composition of the dust samples studied has greater percentages than the WHO-recommended tolerable guideline levels for human health. As a result, it is suggested that suitable preventative measures and regulations be implemented to help minimize the effects of the observed elevated elements concentrations. For proper verification of Harmattan dust effect on human health, daily collection of the dust is recommended. In order to provide precautionary measures to every citizen of the nation, the researcher would like to inform the government of the federal agency in charge of monitoring the weather.

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Persian Abstract

چکیده

گرد و غبار هارمتان به عنوان یک توده مجزا از پوسته زمین جامد شناخته شده است که برای مدت زمان طولانی در هوا معلق است. اشاره شده است که مطالعات کمتری در نیجریه برای تعیین گروه‌های عاملی موجود در گرد و غبار هارماتان انجام شده است. هدف از این مطالعه این بود که بفهمیم چه گروه‌های عاملی و مواد شیمیایی در گرد و غبار وجود دارد. دانشگاه عثمانو دانفودیو، سوکوتو (۱۲ درجه شمالی، ۱۳.۸ درجه شرقی)، دانشگاه علوم و فناوری دولتی کبی، آلیرو (۱۲.۳۰۷۰ درجه شمالی، ۴.۴۹۵۵ درجه شرقی)، دانشگاه فدرال کشاورزی، زورو (۱۱.۴۰۵۸ درجه شمالی، ۵.۲۴۰۰ درجه شرقی)، و وزیری Umaru فدرال پلی تکنیک، Birnin Kebbi (۱۲.۴۶۰۱ درجه شمالی، ۴.۴۹۵۵ درجه شرقی)، ایستگاه‌های انتخابی مورد استفاده در این مطالعه بودند. نمونه‌های گرد و غبار معلق هارماتان در صفحات پتری شیشه‌ای با استفاده از روش رسوب مستقیم به دست آمد. برای بررسی نمونه‌های جمع‌آوری‌شده از طیف‌سنجی فروسرخ تبدیل فوریه (FTIR) و طیف‌سنجی جرمی کروماتوگرافی گازی (GC-MS) استفاده شد. نتایج نشان می‌دهد که یازده گروه عاملی شامل =CH-H، -CH3، N-H، C=C، =C-H، C-H، O-H، C-N، C=O، C-O-C و -CH3 در نمونه‌ها وجود داشتند. طبق GC-MS، جزء (۲-متوکسی اتیل) دارای بیشترین ارزش کیفی 83 (Q-Value)، درصد مساحت مربوط به رتبه زمانی 13.647 (RT) و CAS 018173-63-2 در نمونه‌های گرد و غبار بود. بنابراین توصیه می‌شود که دولت جمهوری فدرال نیجریه بودجه مراکز تحقیقاتی را افزایش دهد تا محققان بتوانند تمام شهرهای کشور را مطالعه کنند و فلزات گروه عاملی موجود در گرد و غبار هارمتان را بهتر مشاهده کنند.