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Determination of organic pollutants in hospital wastewater and food samples within Ahmadu Bello University Teaching Hospital (Abuth), Shika, Zaria-Nigeria

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ABSTRACT

Hospital wastewater and food samples (potatoes, cassava and tomatoes) were collected from Ahmadu Bello University Teaching Hospital wastewater Treatment plant, and from farm land respectively, within the vicinity of the research area. Samples were collected within the month of July, 2010. The following organic pollutants were determined, xylene, Methylene chloride, Butylated hydroxyltoluene, Octadecanioc acid and Tetradecene, with the aid of a GC-MS after proper samples treatment and isolation using solvent extraction. Diethyl ether and chloroform were used as organic solvents. All the organic parameters determined were lower than limits set by World Health Organization (WHO), United States Environmental Protection Agency (USEPA) and the maximum contaminant levels.

Keywords: Organic pollutants, carcinogenic, food samples, wastewater, solvent extraction, and maximum contaminant levels.

INTRODUCTION

Wastewater referred to any water, whose quality has been adversely abused by anthropogenic influence. This includes liquid waste discharge from Domestic home, Industries, Agriculture and Hospital[1].

TYPES OF HOSPITAL WASTEWATER

Wastewater produced by hospitals and by hospital – related industries originates from many sources. The classifications based on [1] are as follows:

a. Wastewater from clinical Laboratories
b. Wastewater from research Laboratories
c. Wastewater from medical waste incinerators equipped with fume scrubbers.
d. Wastewater from hospital Laundries

The types of process performed in a clinical laboratory can include transfusion, medicine, drug monitoring, toxicology and urinalysis. Wastewater from clinical Laboratories could contain mercury, organic chemicals, formaldehyde, dilute mineral acids and phosphates.

In research Laboratories, waste can originates from either automated instrumentation or from manual processes and may contain the following pollutants; oxidizers (disinfecting media such as bleach, iodine, peroxides, etc.) proteins (tissues and immunodiagnostics), oil and grease), organic solvents, phosphates, formaldehyde and detergents from medical waste incinerators and laundries, the following pollutants are there; detergents, mercury, bleach or other disinfectants that are used [1].

The use of disinfectants and drugs which are discarded through sinks normally led to pollution of water bodies [2]. Hospital wastewater reveals the presence of chlorinated molecule in high concentrations. [3] reported that the absorbable organic halogens concentration in effluents in a French academic hospital centre for infections and tropical disease is in a range of 0.38 – 1.24mg/l.

The chemicals used for the staining and preservation of slides and for the sterilization and cleaning of equipment and surroundings are potentially harmful to the Laboratory Technician and the environment [4].

The following are the organic solvents and other products that were determined, Xylene, Methylene chloride, Butylated hydroxytoluene(BHT), Octadecanoic acid and Tetradecene.

MATERIALS AND METHODS

The study area is the University Teaching Hospital Wastewater Treatment Plant and the immediate area down where vegetables were grown.

Wastewater samples. The wastewater samples were collected from four (4) different compartments within the wastewater Treatment plant designated as A_1, A_2, A_3 and A_4. About $50cm^3$ of the wastewater sample (each) were treated with $50cm^3$ diethyl ether, and further more the aqueous layer was treated with $50cm^3$ chloroform in order to separate the organic compounds from aqueous layer, before taking the samples for GC-MS analysis [5].

Food Samples

The food samples (Cassava, Potatoes and Tomatoes) were washed with distilled de-ionised water. A portion (50g) of each food samples were slashed and pounded in a Mortar to make a paste of its solution by adding $50cm^3$ of distilled de-ionised water. It was soaked for two to three hours before the mixture was filtered using whatman 0.45µm filter paper. The filtrate were treated with $20cm^3$ of chloroform first, and then $20cm^3$ of diethyl ether as organic solvents to extract the organic compounds in each sample for GC-MS analysis [5].

RESULTS AND DISCUSSION

Methylene chloride is a solvent used in hospital and is volatile. With reference to Table 1 above, methylene chloride was only detected in sample point A_1 without any trace detection in other sampling points. From Table 1, Methylene chloride is present in minute quantity (0.725ppm) which is far below its toxicity level of 200ppm when exposed continuously for 2 -3 hours, or 986ppm for 1 hour according to [6]. Methylene chloride causes mild central nervous system effects (headaches and dizziness). Other signs include inability to concentrate. No adequate report on its carcinogenicity to humans but it is linked to formation of carboxyhaemoglobin that prevent smooth transport of oxygenated blood in the body.

Xylene is also a solvent used in Hospital which is also a contaminant when present in concentration that can cause adverse effects. From the results shown in Table 1, Xylene was detected in sampling points A_1, A_3, cassava, potatoes and tomatoes, but it was not detected in sampling point A_2 and A_4. The research carried out by the International Agency for Research on Cancer (IARC) and the USEPA (2009), found out that high level of xylene (200ppm) causes increase number of death of unborn babies in womb of pregnant mothers, decrease in weight of foetus, delayed in skeletal development of young children. In animals, xylene causes changes in liver and harmful effects on the kidneys, lungs, heart and nervous system. The levels of xylene determined from the sampling points were very low to cause any serious effect. The level in which it can cause effect in animals is 200ppm as stated by [6].

Butylated hydroxytoluene (BHT) or 2, 6 – bis (1, 1-Dimethyl) – 4 – phenol is an organic compound that is primarily used as an antioxidant food additive as well as an antioxidant additives in pharmaceuticals. When such drugs are used and discarded, some flow into the wastewater treatment plant. The concentration of butylated hydroxytoluene

determined were 0.204ppm, 0.059ppm, 0.632ppm, 0.051ppm and 0.592ppm in A_2, A_3, A_4, cassava and tomatoes respectively. [7] stated that BHT could produce hyperactivity in small children at concentration above 100ppm.

Table 1: Types and concentration of organic pollutants obtained from GC-MS Spectral. (See Appendices 1-7).

Sampling Points	Organic Pollutants Detected	Concentration (Ppm)
A_1	Methylene chloride	0.725
	P - Xylene	0.001
	Octadecanoic acid	0.085
A_2	Butylated hydroxyltoluene	0.204
	1 - Tetradecene	0.122
A_3	P - Xylene	0.045
	Tetradecene	0.097
	Octadecanoic acid	0.032
	Butylated hydroxyltoluene	0.059
A_4	1 - Tetradecene	0.097
	Butylated hydroxyltoluene	0.632
Cassava	O - Xylene	0.047
	Butylated hydroxyltoluene	0.051
	1 - Tetradecene	0.087
Potatoes	Octadecanoic acid	0.081
	P - Xylene	0.065
Tomatoes	O - Xylene	0.047
	Butylated hydroxyltoluene	0.592

Octadecanic acid arises in the wastewater treatment plant due to some reactions that involves decomposition of some complex organic compounds (drugs used) and solvent involves. Its concentration were determined using GC-MS and was found to be 0.085ppm in sample A_1 and 0.081ppm in potatoes. According to [8], inhalation of 1 – octadecanoic acid may cause irritation to the respiratory tract with the following symptoms such as coughing, sore throat, difficulty in breathing and chest pain in concentration greater than 100ppm. From the results obtained, it cannot cause such effects mentioned above because it is within permissible level.

From table 1 above, tetradecene was detected only in sampling points, A_2, A_3 A_4 and cassava which contains 0.122ppm, 0.097ppm and 0.097ppm and 0.087ppm respectively. Its presence can cause irritation of the upper respiratory tract and mucous membrane at higher concentration which is in accordance with [9].

CONCLUSION

From the results obtained, it was observed that all the organic pollutants were lower than limits set by World Health Organization (WHO), United States Environmental Protection Agency (USEPA) and the maximum contaminant levels. It is also good for the general public to be aware of their effects (Organic pollutants) to human and take caution against future exposure, since the Hospital is still new.

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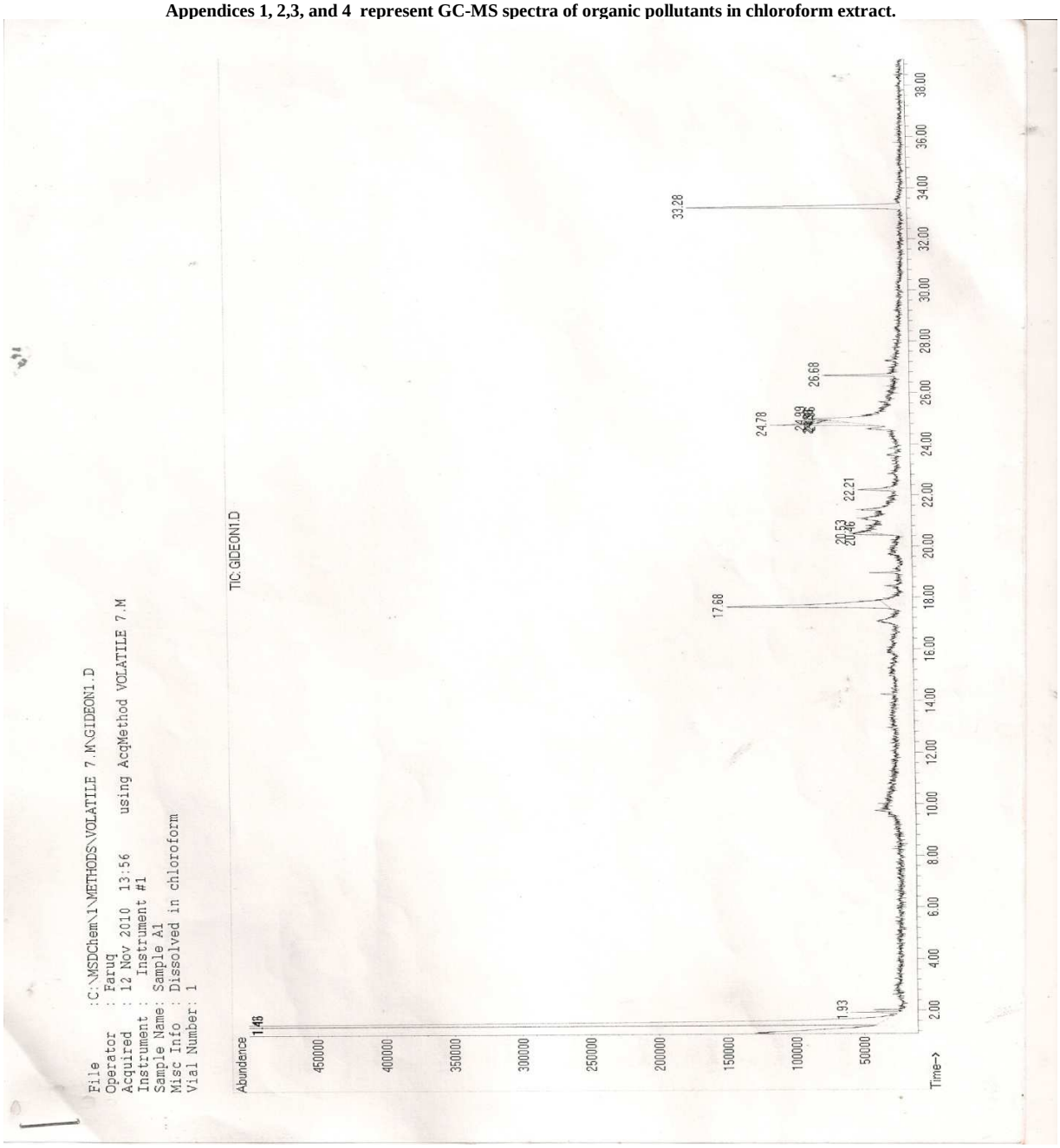
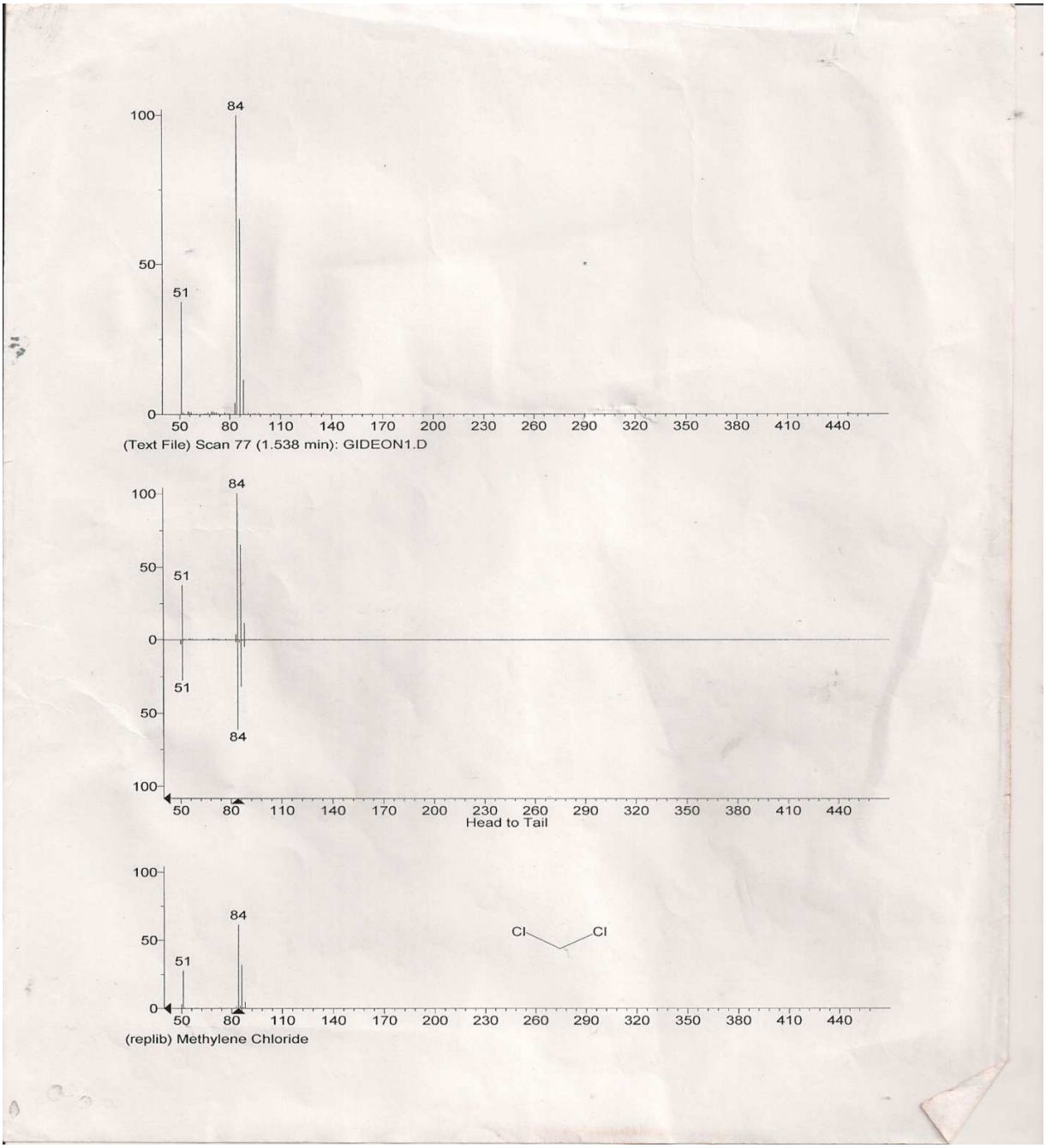
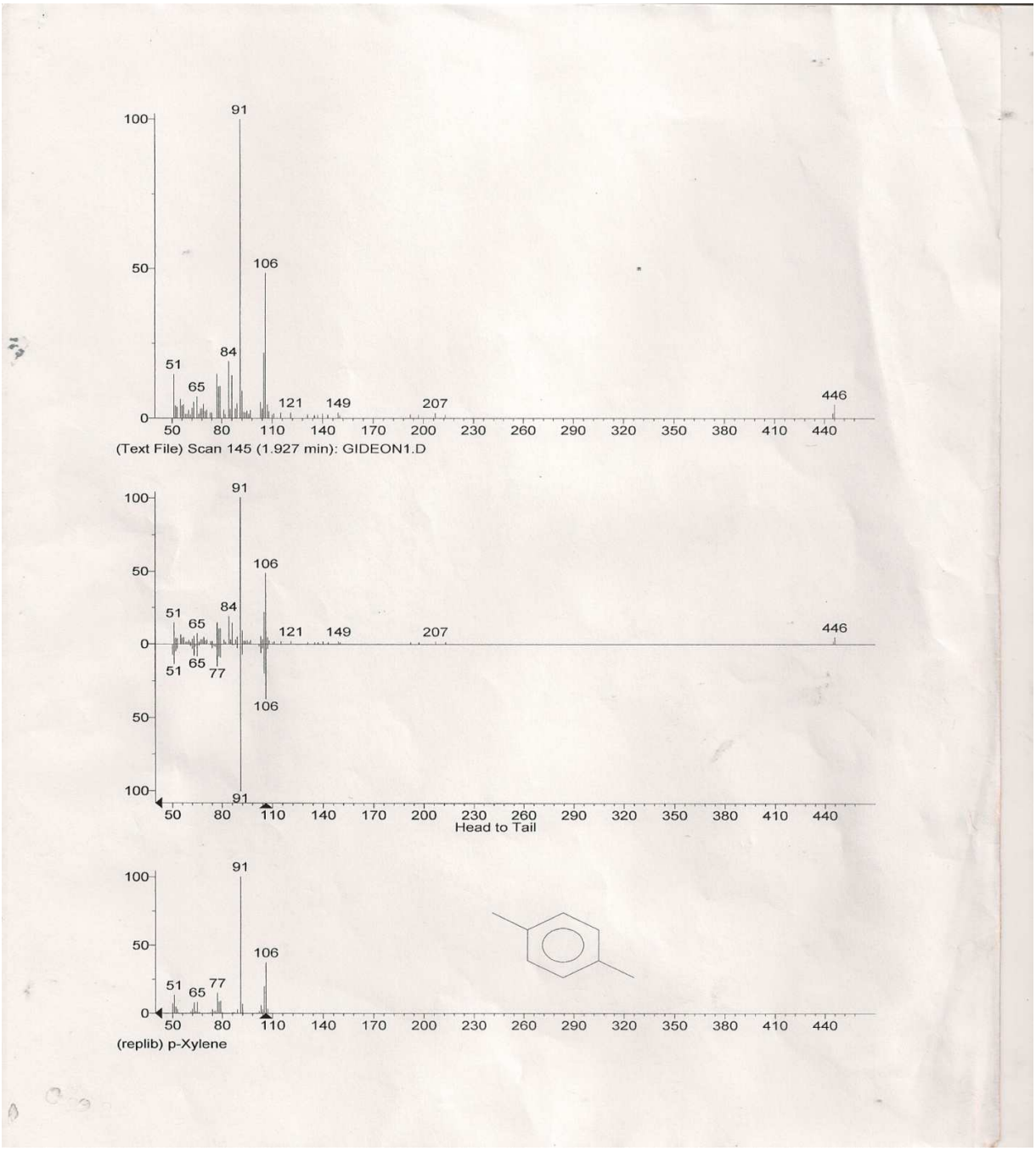
APPENDICES

Appendices 1, 2,3, and 4 represent GC-MS spectra of organic pollutants in chloroform extract.

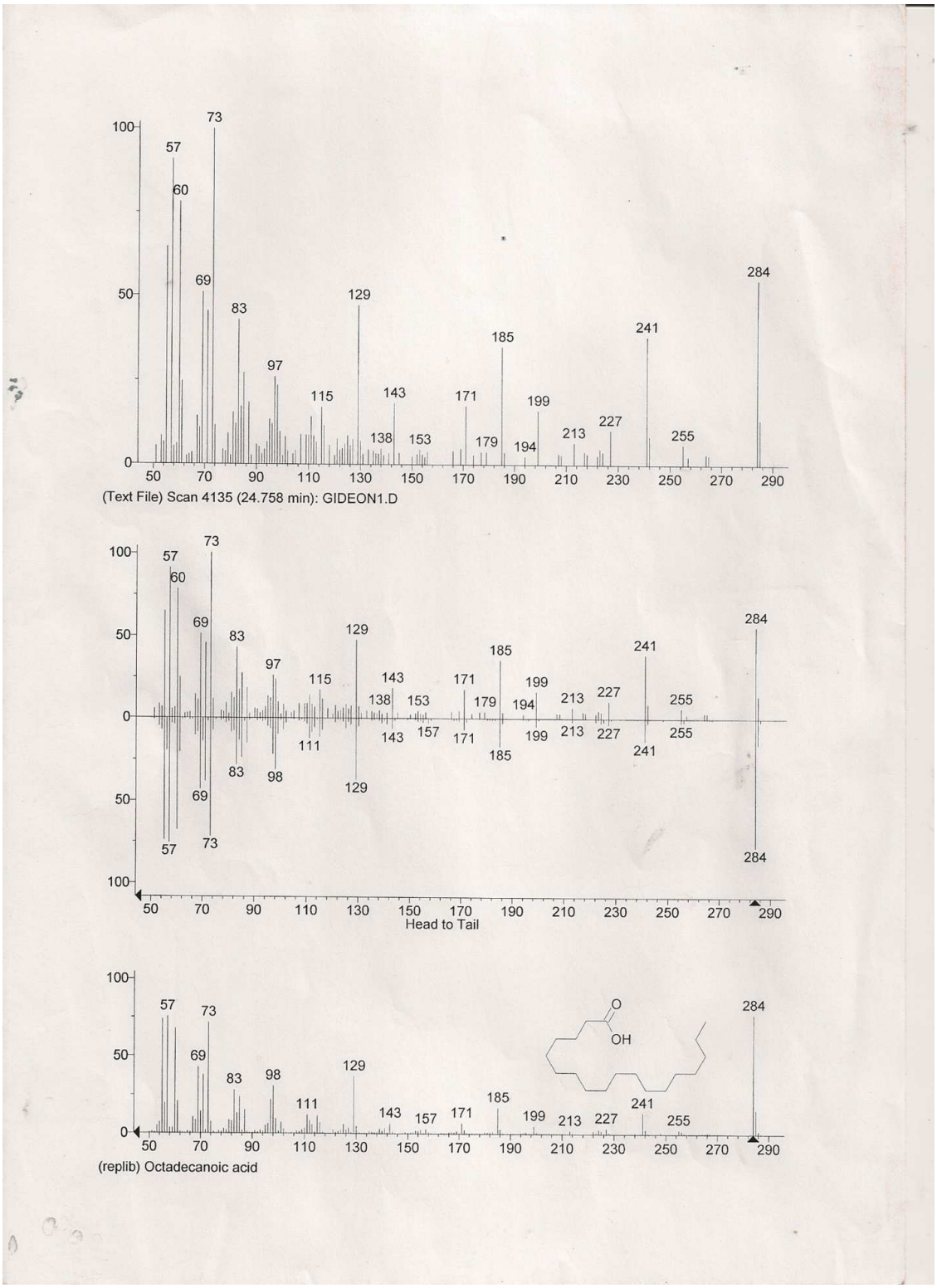




MS spectrometry peaks for methylene chloride

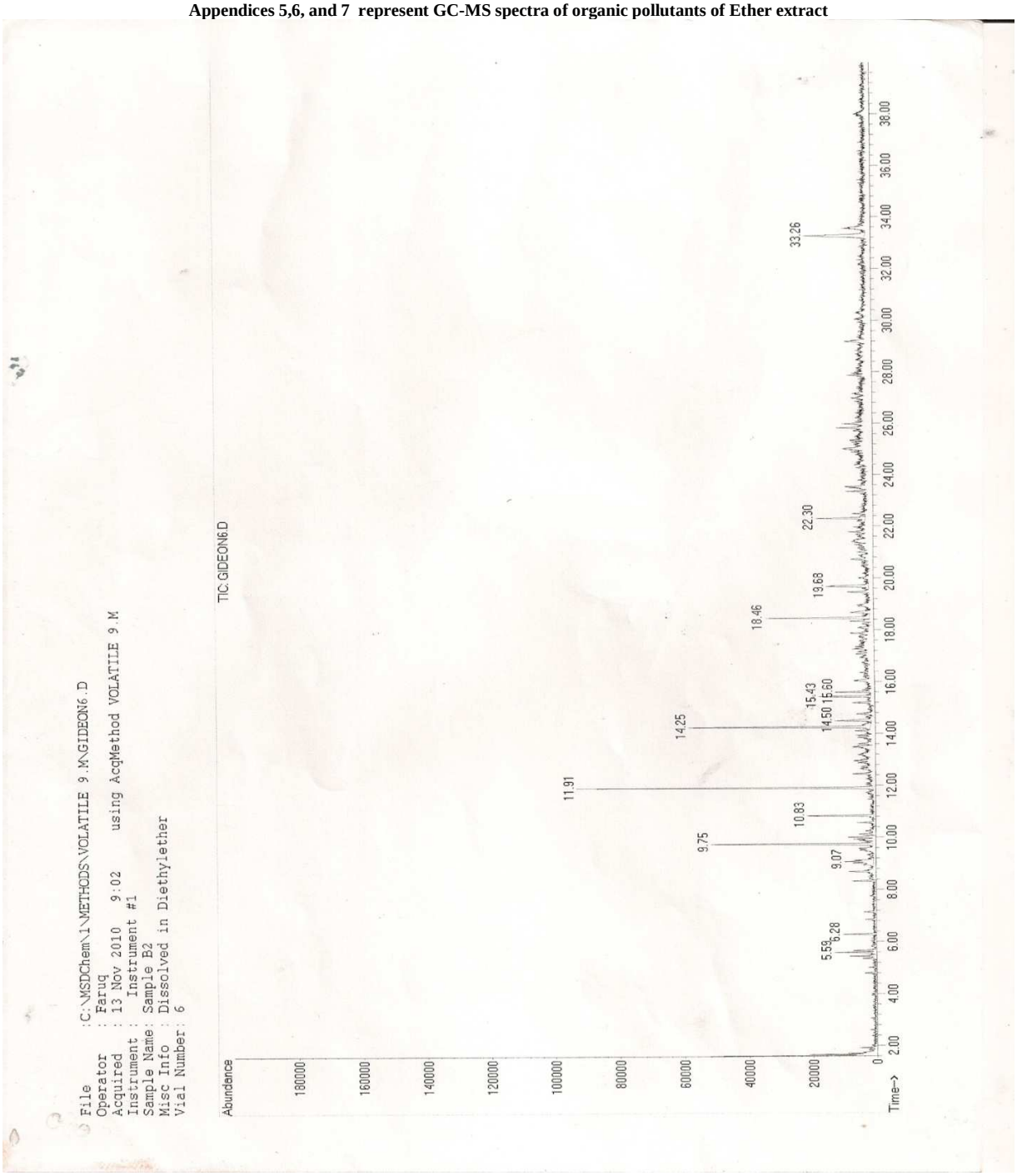


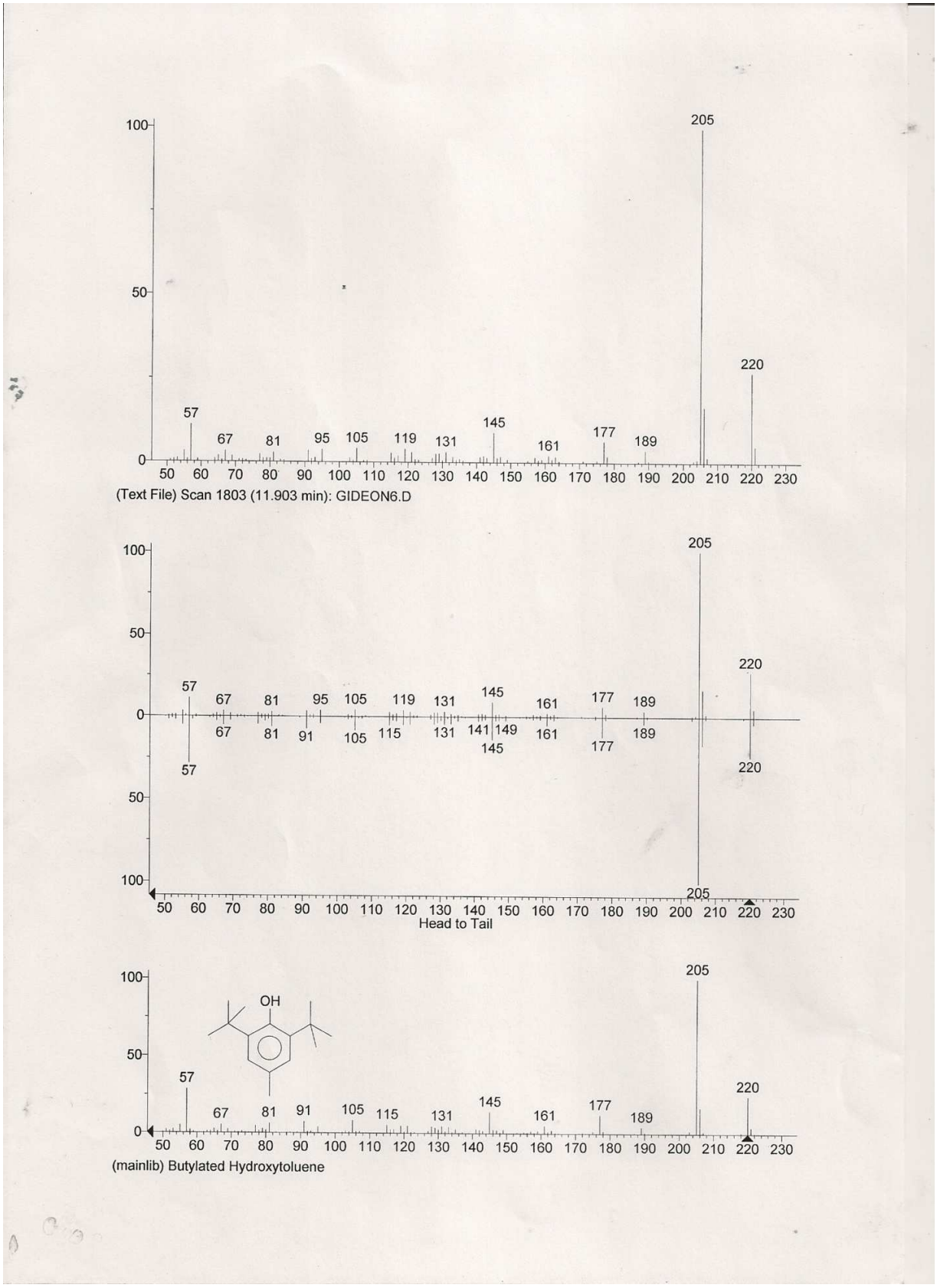
MS peaks of p-xylene



MS peaks of Octadecanoic acid

Appendices 5,6, and 7 represent GC-MS spectra of organic pollutants of Ether extract

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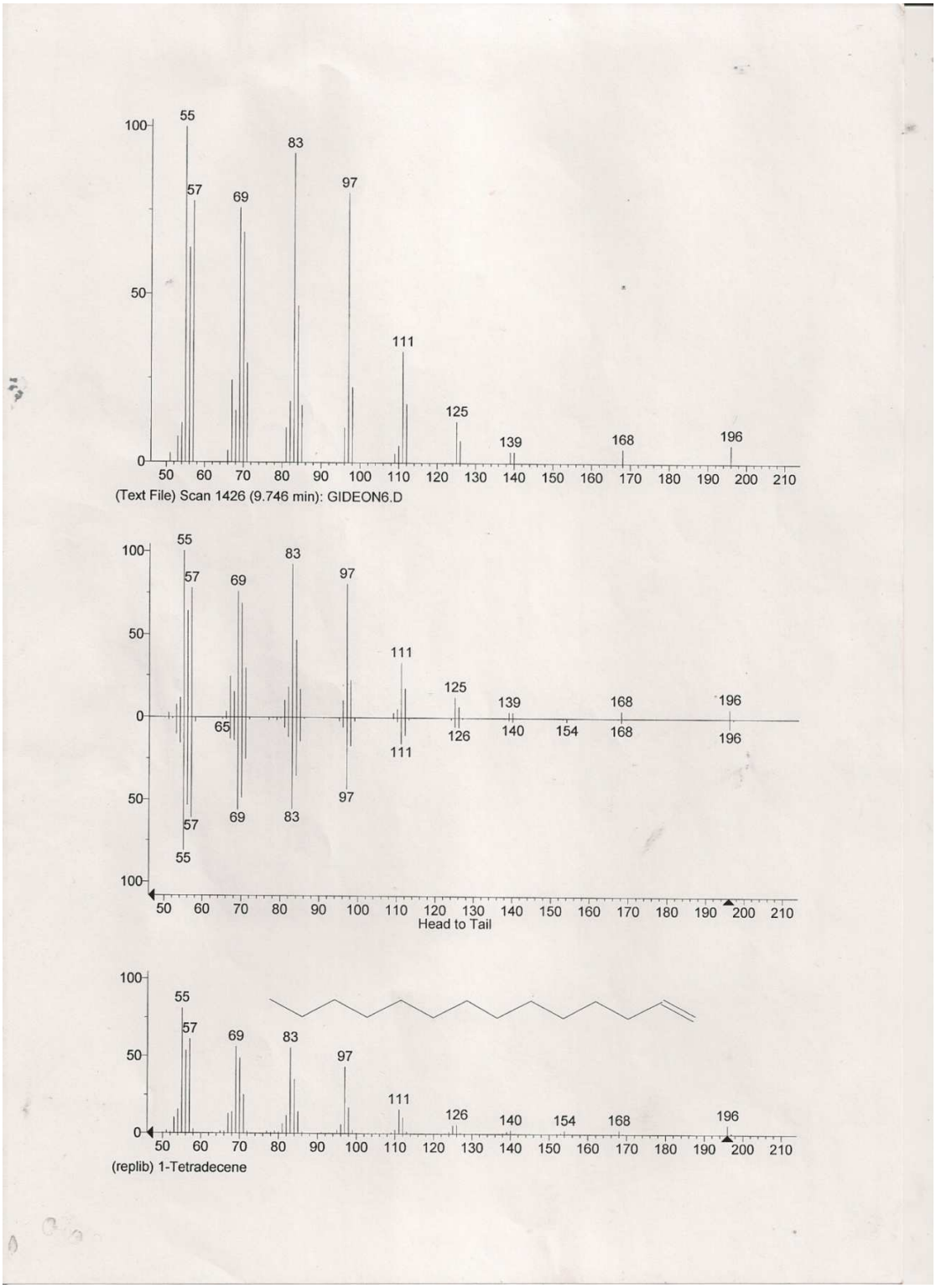

MS peaks of Tetradecene.