International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.
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http://ijpsat.ijsht-journals.org
Vol. 22 No. 1 August 2020, pp. 282-294

Impacts of Quarry Activities on Corchorus Olitorius Grown within the Vicinity of the Quarry

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Abstract – Phytochemicals, Proximate compositions and heavy metal levels in leaves of *Corchorus oiltorius* (wild okra) grown in farm lands within Ugwuele quarry site were determined using standard analytical methods. This was done to check the impacts of quarry activities on the plant. Plant samples were harvested from the epicentre and different cardinal points of the quarry site, and control samples were harvested at a distance of 6.8km from the quarry site. Results show sixty two and thirty eight phytochemicals in leaves of *Corchorus olitorius* harvested within and outside the quarry vicinity respectively. The phytochemicals found in the leaves of the plant include oleic acid, linoleic acid ester, hexadecanoic acid, dodecanamide, N-(2- hydroxyethyl), tetradecanoic acid, dibuthyl phthalate, 9,12-octadecadienoic acid (Z,Z)-, methyl ester and pentadecane. The concentrations of heavy metals (Co, Zn, Cr, Cd, As and Pb) in the leaves of the plant grown within the vicinity of the quarry site were above the World Health Organisation (WHO) permissible limits and increased significantly ($p<0.05$) compared to the control. Protein, lipids and carbohydrate in the samples from the quarry decreased significantly ($p<0.05$) compared to those from control. Therefore *Corchorus olitorius* grown in the farms within the vicinity of Ugwuele quarry will likely have adverse health effects on its consumers. Although the leaves of wild okra are highly medicinal and may be helpful in the treatment of Corona virus disease-2019 (COVID-19), those from the quarry should be avoided because of the risk of heavy metal toxicity.

Keywords – Phytochemicals, *Corchorus Olitorius*, COVID-19, Quarry, Heavy Metals.

I. Introduction

Quarrying is the process of extraction of rock, sand, gravel or other minerals from the ground which are useful for construction or other purposes. It involves excavation of top soil necessary for agricultural activities causing a depletion of macronutrients and increases the concentration of heavy metals and other pollutants [1]. Plants can accumulate heavy metals from the soil which may alter their chemical and nutritional components. The maximum values of some heavy metals in vegetables are 0.3mg/kg for lead (Pb), 0.2mg/kg for cadmium (Cd) and arsenic (As) [2]. The world Health Organisation (WHO) permissible values of heavy metals in plants are 0.60mg/kg for zinc (Zn) and 1.30mg/kg for chromium (Cr) [3]. Excessive amounts of heavy metals in vegetables make them unsuitable for human consumption [4].

The act of using medicinal plants in treating diseases seems to be as old as man himself [5]. Medicinal plants are those plants that contain bioactive compounds in any of their organs which are used directly in treating diseases or used in the production of useful drugs [6]. These bioactive chemical substances found in plants are also called phytochemicals. They can be broadly classified into terpenes, phenolics and nitrogen containing compounds like glucosinolates and alkaloids [7].

Corchorus olitorius (jute mallow or wild okra) is a vegetable and a medicinal plant. It is a species of shrub in the family malvaceae [8]. Many of its parts like the leaves, roots, seeds and flowers are used as phytomedicines [9]. It is used in treating thyphoid fever, diarrhea, heart failure, child malnutrition and cholic [10]. *Corchorus olitorius* has anti-inflammatory, anticancer, and cardiovascular system modulatory agent activities [11]. It is also used in the treatment of malaria [12, 13]. Hasan and Kadhim [14] demonstrated that *Corchorus olitorius* leaves have antiviral activity due to their composition of phenolics and flavonoids. Wild okra is a prominent leafy vegetable in Nigeria and other parts of Africa [11]. In Nigeria, it is called ahihara or ulogburu (in Igbo), ewedu (in Yoruba) and rama (in Hausa). It is rich in carbohydrate, vitamins and minerals such as iron and therefore good for pregnant women and nursing mothers [15]. The plant is harvested 3 to 4 months after planting.

Recently, Madu *et al.* [16] reported high levels of heavy metals in soils of farm lands within the vicinity of Ugwuele quarry site and suggested that plants grown in the farms may have accumulated heavy metals into their edible parts. The present study is therefore aimed at assaying the level of heavy metal accumulation by *Corchorus olitorius* grown in the quarry and the concomitant effect on the proximate and chemical compositions of the plant.

II. Materials And Methods

2.1 Area of Study

The study area is Ugwuele in Uturu, Abia State Nigeria. It lies within latitude $05^{O}50^{'}18''$ N of the equator and longitude $07^{O}25^{'}$ 17” E of the Greenwich Meridian. The area is surrounded by farm lands.

2.2 Corchorus olitorius sampling

Corchorus olitorius (jute mallow or wild okra) samples were harvested from the epicenter and different cardinal points of the quarry site. Control samples were harvested at a distance of 6.8km from the quarry site. This was done in August, 2019. Plant samples identification was done by a Botanist at Gregory University, Uturu. The plant samples were washed with deionised water and taken to the laboratory for pre-treatment and analysis. Only the leaves of the plant were used for analyses.

2.3 Extraction of the *Corchorus olitorius* Samples

The method described by Hasan and Kadhim [14] was used for extraction of samples used for GC-MS determination of phytochemicals while another extraction for heavy metal determination was done on the same sample using the method described by James [17]

2.4 Method of Analysis

Phytochemicals were determined using GC-MS-QP 2010 SHIMADZU instrument as described by Skoog *et al.* [18]. The method described by James [17] was used in the Atomic Absorption spectrometry determination of heavy metals. Proximate compositions of the *Corchorus olitorius* were determined by the method described by AOAC [19].

2.5 Statistical Analysis

The results of heavy metals and proximate compositions were analysed with the use of Analysis of variance (ANOVA) and standard T-distribution test. Means of triplicate values were compared for significance at $p<0.05$ and 95% level of confidence. This was done with statistical package for social sciences (SPSS), version 20.

III. Results And Discussion

The Gas Chromatography-Mass Spectrophotometry (GC-MS) phytochemical results of the leaves of *Corchorus olitorius* (harvested within quarry vicinity and off quarry vicinity) are presented in tables 1 and 2 while the chromatograms of the results are given in figures 1 and 2 below. The GC-MS analysis of the *Corchorus olitorius* shows the presence of sixty two (62) phytochemicals in the sample from quarry vicinity and thirty eight (38) phytochemicals in the control sample. The result therefore shows that leaves of the *Corchorus olitorius* from the quarry contained more phytochemicals than those of the control. The *Corchorus olitorius* cultivated in the quarry may have synthesized more phytochemicals in response to the absorbed toxic heavy metals from the quarry. Osuocha *et a*l. [20] reported that vegetables cultivated in quarry vicinity absorb higher quantities of toxic substances such as heavy metals.

Table 1. GC – MS Phytochemical Components of *Corchorus olitorius* Samples grown at a farm not affected by the quarry at Uturu

SN	RT	COMPONENT	FORMULA	MW	%
1	3.808	4,9-Decadienoic acid, 2-nitro-ethylester	$C_{12}H_{19}NO_4$	241	1.16
2	4.359	Ethanol, 2’2-oxybis-, diacetate	$C_8H_{12}O_5$	190	1.03

3	5.889	Ethanol,2,2’-[1,2-ethanedylbis(oxy)]bis-, diacetate	$C_{10}H_{18}O_6$	234	0.55
4	7.613	Hexadecanoic acid, methyl ester	$C17H_{34}O_2$	270	1.41
5	7.793	Hexadecanoic acid	$C_{16}H_{32}O_2$	256	19.69
6	7.905	Hexadecanoic acid, ethyl ester	$C_{18}H_{36}O_2$	284	2.08
7	8.344	9,12-Octadecadienoic acid (Z,Z)-, methylester	$C_{19}H_{34}O_2$	294	3.78
8	8.456	Hexadecanoic acid	$C_{16}H_{32}O_2$	256	1.03
9	8.543	Dodecanamide, N-(2-hydroyethyl)-	$C_{14}H_{29}NO_2$	243	17.23
10	8.625	Linoleic acid ethyl ester	$C_{20}H_{36}O_2$	308	9.64
11	8.737	Ethyl 9-hexadecanoate	$C_{18}H_{34}O_2$	282	6.66
12	8.876	Oleic acid	$C_{18}H_{34}O_2$	282	2.16
13	8.985	Cyclopropaneoctanal, 2-octyl-	$C_{19}H_{36}O$	280	2.00
14	9.127	9-Oxabicyclo [6.1.0]nonane	$C_8H_{14}O$	126	0.44
15	9.18	9,12-Octadecadienoic acid (ZZ)-	$C_{21}H_{40}O_2Si$	353	0.83
16	9.281	1H-Imidazole-2-methanol	$C_5H_8N_2O$	112	0.84
17	9.459	9,17-Octadecadienal, (Z)-	$C_{18}H_{32}O$	264	0.43
18	9.738	9,12-Octadecadienoic acid (Z,Z)	$C_{18}H_{32}O_2$	280	0.20
19	9.873	2-Undecanone, 6,10-dimethyl-	$C_{13}H_{26}O$	198	1.20
20	9.952	9,12-Octadecadienoic acid (Z,Z)-	$C_{18}H_{32}O_2$	280	1.22
21	10.023	Octadecane	$C_{18}H_{38}$	254	0.64
22	10.106	Oleic Acid	$C_{19}H_{34}O_2$	282	0.56
23	10.162	Oxiraneundecanoic acid, 3-pentyl-, methylester, trans-	$C_{19}H_{36}O3$	312	0.55
24	10.874	(R)-(-)-14-Methyl-8-hexadecyn-1-ol	$C_{17}H_{32}O$	252	0.59
25	11.017	9,12-Octadecadienoic acid (Z,Z)-	$C_{18}H_{32}O_2$	280	1.94
26	11.197	11-Octadecanoic acid, methyl ester	$C_{19}H_{36}O_2$	296	0.44
27	11.433	Octadecane	$C_{18}H_{38}$	254	0.40
28	11.586	Hexadecane,-(ethenenyloxy)-	$C_{18}H_{36}O$	268	0.71
29	11.841	2,6,10-Dodecatrien-1-ol,3,7,11-timethyl-	$C_{15}H_{26}O$	222	3.53
30	12.242	Octadecane	$C_{18}H_{38}$	254	0.70
31	12.471	Octadecane	$C_{18}H_{38}$	254	0.72
32	12.700	Benzenecarbothioamide	C_7H_7NS	137	2.17
33	13.539	9-Borabicyclo[3.3.1]nonan-9-amine, N-methyl-	$C_9H_{18}BN$	151	1.00
34	15.185	Anthranilic acid, N-methyl-, buthyl ester	$C_{12}H_{17}NO_2$	207	1.01
35	15.489	Chola-5,22-dien-3-ol (3β,22Z)-	$C_{24}H_{38}O$	342	2.64
36	16.04	Chola-5,22-dien-3-ol (3β,22E)-	$C_{24}H_{38}O$	342	1.57
37	16.216	Propanoic acid,2-[4-1,1-dimethy lethyl)phenoxy]	$C_{16}H_{24}O_3$	264	0.81
38	16.846	1,1,1,3,5,7,7,7-octamethyltetrasiloxane	$C_8H_{26}O_3SI_4$	283	0.46

Table 2. GC – MS Phytochemical Components of Corchorus olitorius Samples grown at a farm within the Vicinity of Ugwuele quarry site Uturu

SN	RT	Component	Formula	MW	%
1	3.81	Naphthalene	$C_{10}H_8$	128	1.34
2	4.32	Pentadecane	$C_{15}H_{32}$	212	0.25
3	4.36	Ethanol, 2,2'-[1,2-ethanediylbis(oxy)]bis-, diacetate	$C_{10}H_{18}O_6$	234	1.30
4	4.4	1H-Inden-1-one, 2,3-dihydro-	C_9H_8O	132	0.39
5	5.01	Ethanol, 2-[2-(2-methoxyethoxy)ethoxy]-, acetate	$C_9H_{18}O_5$	206	0.29
6	5.37	Benzene, cyclohexyl-	$C_{12}H_{16}$	160	0.28
7	5.56	Docosane	$C_{22}H_{46}$	310	0.30
8	5.89	Pentanamide, N-ethyl-	$C_7H_{15}NO$	129	0.81
9	6.86	Tetradecanoic acid	$C_{14}H_{28}O_2$	228	0.65
10	7.24	Tetradecanal	$C_{14}H_{28}O$	212	0.30
11	7.32	Pentadecanoic acid	$C_{15}H_{30}O_2$	242	0.38
12	7.41	Dibutyl phthalate	$C_{16}H_{22}O_4$	278	0.49
13	7.62	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	270	2.03
14	7.78	Hexadecanoic acid	$C_{16}H_{32}O_2$	256	11.88
15	7.83	Dibutyl phthalate	$C_{16}H_{22}O_4$	278	1.40
16	7.91	Tetradecanoic acid, ethyl ester	$C_{16}H_{32}O_2$	256	1.80
17	8.12	3,8-Nonadien-2-one, (E)-	$C_9H_{14}O$	138	0.27
18	8.34	9,12-Octadecadienoic acid (Z,Z)-,methyl ester	$C_{19}H_{34}O_2$	294	3.35
19	####	Octadecanoic acid, methyl ester	$C_{19}H_{34}O_2$	294	0.80
20	8.54	2-Pyrrolidinone	C_4H_7NO	85	8.50
21	8.62	Linoleic acid ethyl ester	$C_{20}H_{36}O_2$	308	3.88

22	8.74	Octadecanoic acid, ethyl ester	$C_{20}H_{40}O_2$	312	1.53
23	8.85	Oleic Acid	$C_{19}H_{36}O_2$	296	0.70
24	8.99	Oleic Acid	$C_{19}H_{36}O_2$	296	0.50
25	9.13	2-Decanone	$C_{10}H_{20}O$	156	0.56
26	9.18	Tricosane	$C_{23}H_{48}$	325	1.21
27	9.28	Pipoxolan	$C_{22}H_{25}NO_3$	351	7.06
28	9.4	Hexanamide, N-(2-hydroxyethyl)-	$C_8H_{17}NO_2$	159	0.44
29	9.52	1-Phenanthrenecarboxylic acid, 1,2,3,4,4a,9,10,10a-octahydro-1,4a-dimethyl-7-(1-methylethyl)-, methylester, [1R-(1α,4aβ.,10aα)]-	$C_{21}H_{30}O_2$	314	0.70
30	####	Tetracosane	$C_{24}H_{50}$	337	1.85
31	9.74	9,12-Octadecadienoyl chloride, (Z,Z)-	$C_{18}H_{31}ClO$	299	1.40
32	9.87	2-Propenoic acid, 2-(dimethylamino)ethyl ester	$C_7H_{13}NO_2$	143	1.85
33	9.96	9,12-Octadecadienoic acid (Z,Z)-	$C_{18}H_{32}O_2$	280	0.98
34	####	Heptadecane	$C_{17}H_{36}$	240	2.71
35	10.1	Acetamide, N-methyl-N-[4-[4-methoxy-1-hexahydropyridyl]-2-butynyl]-	$C_{12}H_{19}BrN_2O_2$	303	0.82
36	10.2	Oxiraneundecanoic acid, 3-pentyl-, methyl ester, trans-	$C_{19}H_{36}O_3$	312	0.75
37	10.2	2,4-Bis(dimethylbenzyl)phenol	$C_{24}H_{26}O$	330	0.39
38	10.3	Hexadecane, 2,6,10,14-tetramethyl-	$C_{20}H_{42}$	283	0.55
39	10.5	Eicosane	$C_{20}H_{42}$	282	2.27
40	10.6	9-Hexadecenoic acid	$C_{16}H_{30}O_2$	254	0.29

41	10.6	1H-Indene, 5-butyl-6-hexyloctahydro-	$C_{19}H_{36}$	264	0.26
42	10.8	Decane 3-cyclohexyl-, 3-cyclohexyl	$C_{16}H_{32}$	224	0.36
43	10.9	9,12-Octadecadienoic acid (Z,Z)-	$C_{18}H_{32}O_2$	280	0.50
44	11	Octadecane	$C_{18}H_{38}$	254	3.55
45	11.2	Octadecane	$C_{18}H_{38}$	254	0.51
46	11.4	Octadecane	$C_{18}H_{38}$	254	0.48
47	####	Octadecane	$C_{18}H_{38}$	254	0.94
48	11.8	2,6,10-Dodecatrien-1-ol, 3,7,1trimethyl(E,E)-	$C_{15}H_{26}O$	222	6.71
49	12	Hexadecane, 1-(ethenyloxy)-	$C_{18}H_{36}O$	268	0.31
50	12.2	Eicosane	$C_{20}H_{42}$	282	1.42
51	12.5	Octadecane	$C_{18}H_{38}$	254	1.02
52	12.7	9-Borabicyclo[3.3.1]nonan-9-amine ,N-methyl-	$C_9H_{18}BN$	151	2.85
53	13.5	9-Borabicyclo[3.3.1]nonan-9-amine, N-methyl-	$C_9H_{18}BN$	151	1.26
54	14	4-Cyclohexene-1,2-dicarboximide, N -butyl-, cis-	$C_{10}H_9C_{l4}NO_2S$	349	0.34
55	15.2	Chola-5,22-dien-3-ol, (3β,22Z)-	$C_{24}H_{38}O$	342	1.8
56	15.5	Chola-5,22-dien-3-ol, (3β,22Z)-	$C_{24}H_{38}O$	342	4.24
57	15.9	2-Methyl-7-phenylindole	$C_{15}H_{13}N$	207	0.55
58	16.1	Chola-5,22-dien-3-ol, (3β,22E)-	$C_{24}H_{38}O$	342	2.31
59	####	Progesterone	$C_{21}H_{30}O_2$	314	1.62
60	16.4	Cyclotrisiloxane, hexamethyl-	$C_6H_{18}O_3Si_3$	222	0.69
61	####	Silane, trimethyl[5-methyl-2-(1-methylethyl)phenoxy]-	$C_{13}H_{22}OSi$	222	0.42

62	16.8	4-Dehydroxy-N-(4,5-methylenedioxy-2-nitrobenzylidene)tyramine	$C_{16}H_{14}N_2O_4$	298	0.63

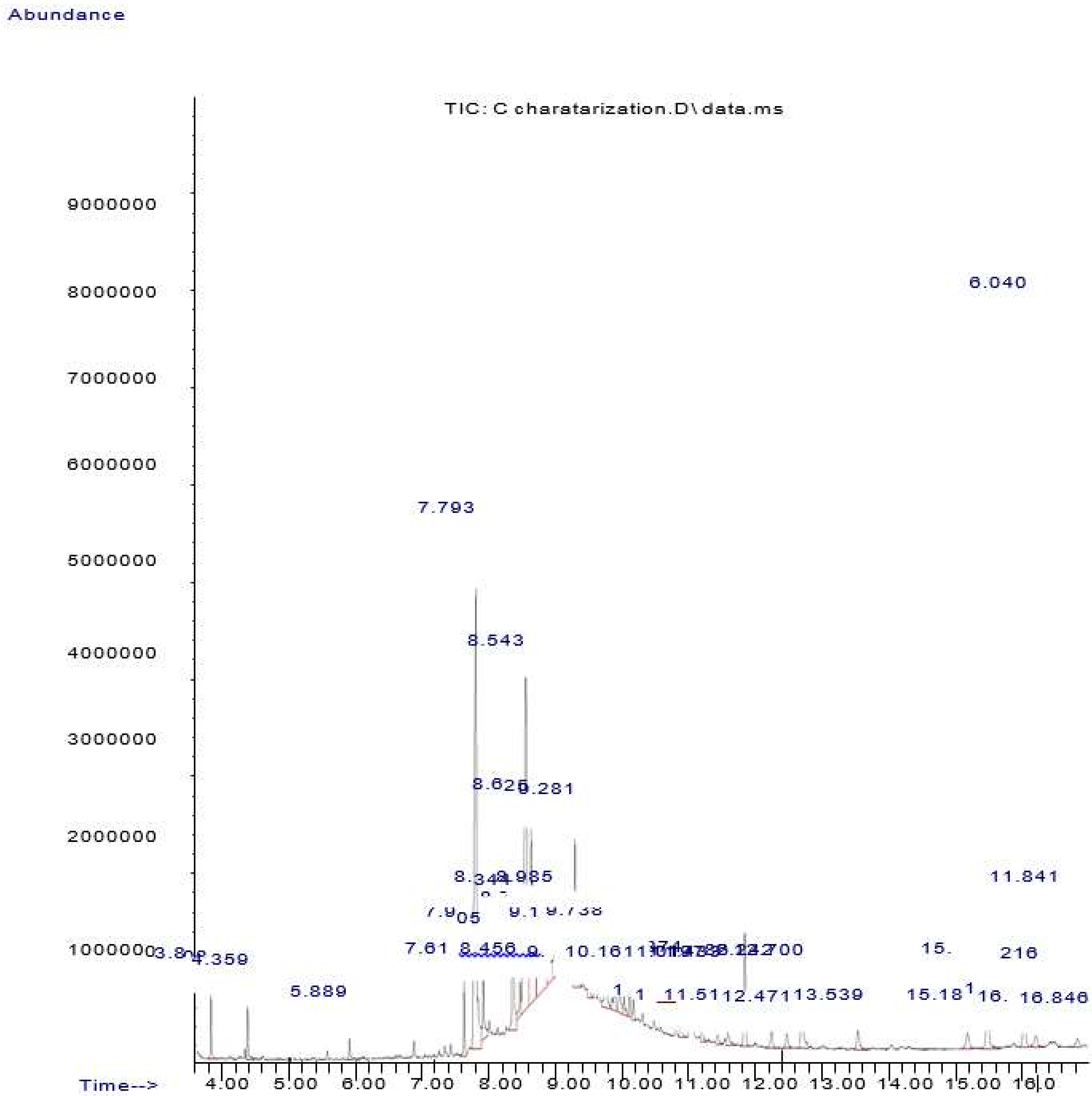


Figure 1: GC – MS Chromatogram of Corchorus olitorius Samples grown at a farm not affected by the quarry at Uturu

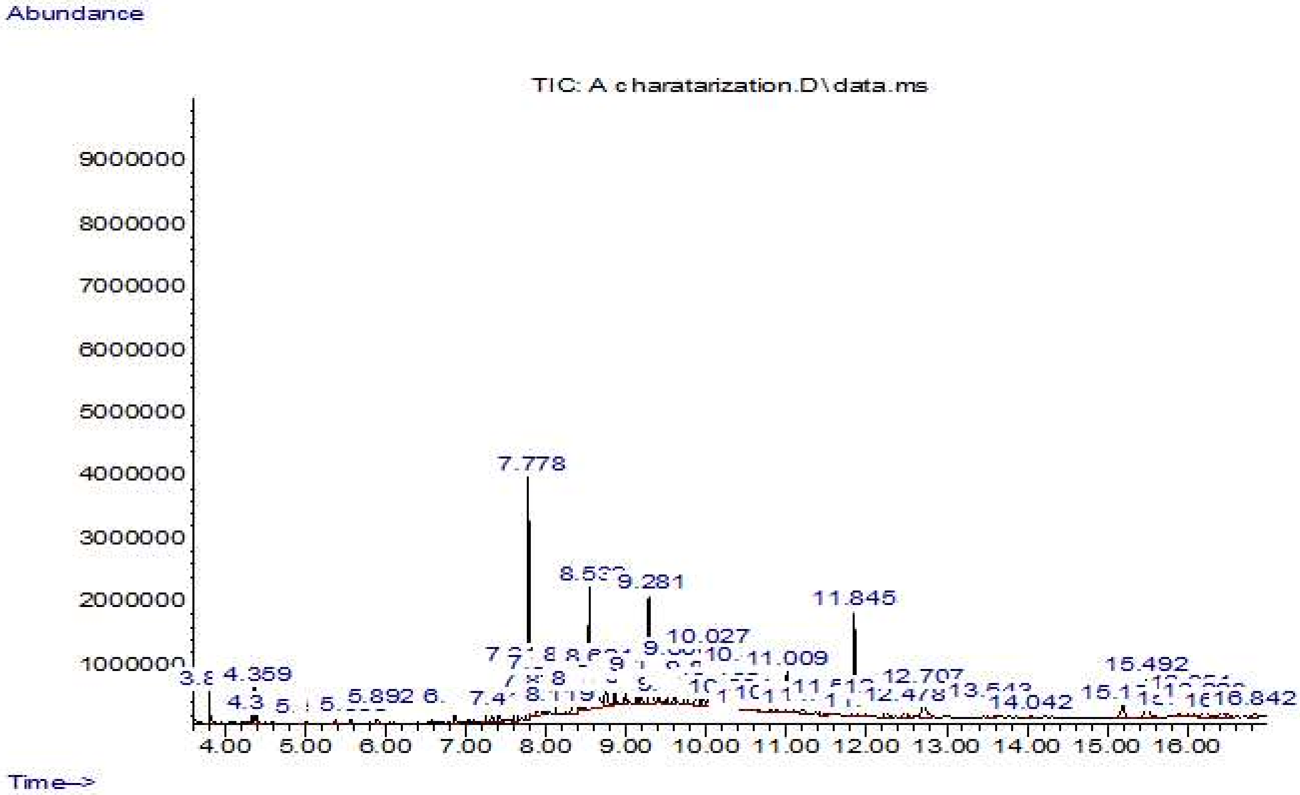
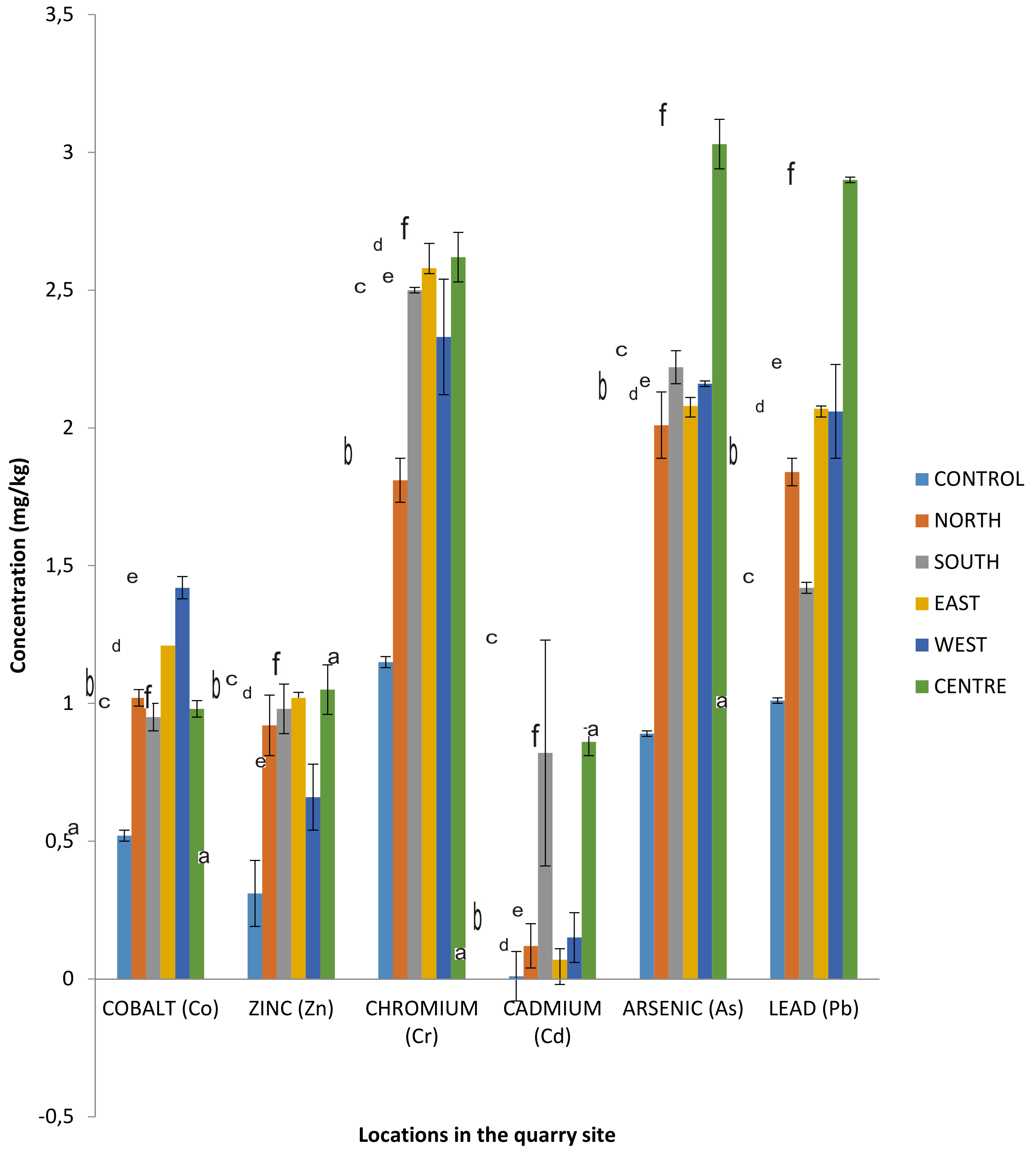
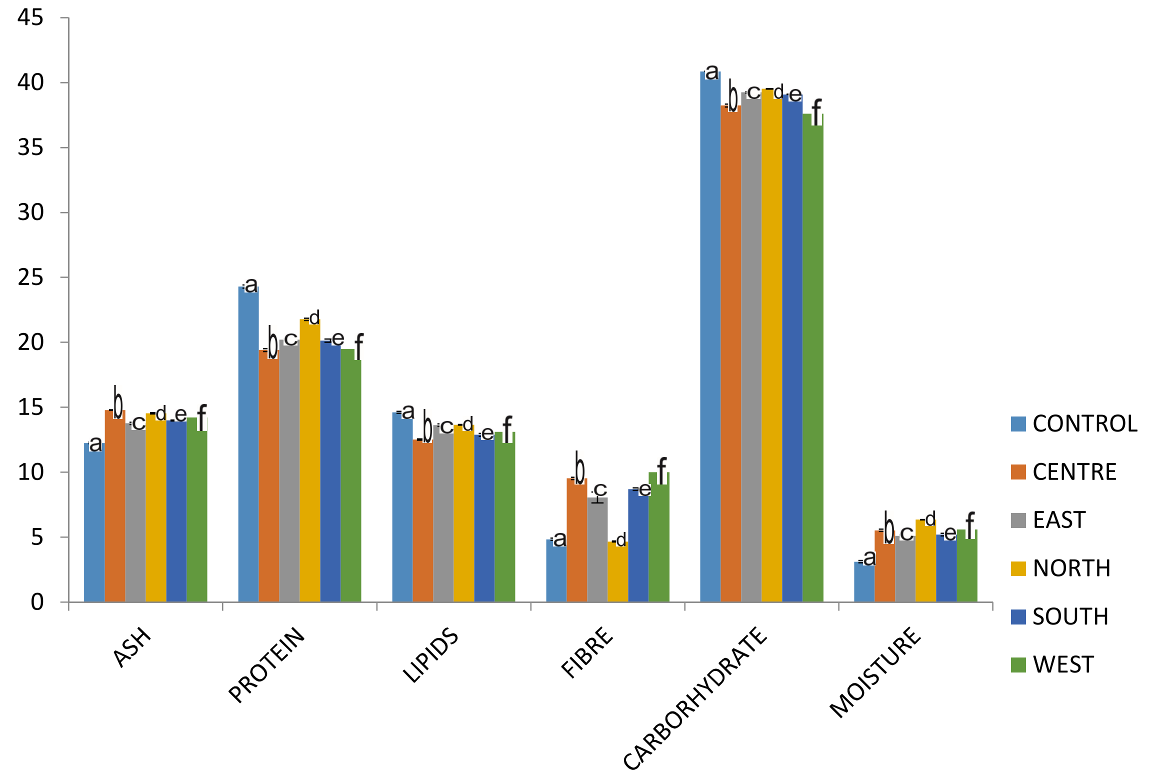


Figure 2: GC-MS Chromatogram of Corchorus olitorius Samples Grown at a Farm within the Vicinity of Ugwuele Quarry Site Uturu



Results are mean ± standard deviation of triplicate results obtained. Bars of the same colour and parameter having different letters of alphabet are statistically different ($p < 0.05$) using Least Significant Difference (LSD).

Figure 3: Concentrations (mg/kg) of heavy metals in Corchorus olitorius grown at Ugwuele quarry site Uturu.



Results are mean ± standard deviation of triplicate results obtained. Bars of the same colour and parameter having different letters of alphabet are statistically different ($p < 0.05$) using Least Significant Difference (LSD).

Figure 4: Proximate composition (%) of *Corchorus olitorius* grown at Ugwuele quarry site Uturu.

Hexadecanoic acid was of the highest percentage in both the *Corchorus olitorius* harvested within the quarry and the other harvested outside the quarry vicinity. However, other bioactive chemical compounds were present in the studied *Corchorus olitorius* leaves and they have different medicinal importance. Hexadecanoic acid has antioxidant, hypocholestrolemic and antibacterial activities [21]. Dodecanamide, N-(2-hydroxyethyl) is an antivirus and contraceptive compound [22]. Tetradecanoic acid has antibacterial and antifungal activity [23]. Dibutyl phthalate also has antibacterial activity [24]. Hexadecanoic acid, methyl ester has both antibacterial and antiallergic activity [25]. The 9,12-octadecadienoic acid (Z,Z)-, methyl ester is anti-inflammatory and cancer preventive [26]. Also, octadecanoic acid, methyl ester has anti-inflammatory, antiandrogenic, cancer protective and dermertigenic activity [26]. Pentadecane is an antibacterial agent [23].

The results of the present study also show that leaves of *Corchorus olitorius* contain oleic acid and linoleic acid ethyl ester which may have anti severe acute respiratory syndrome-corona virus-2 (SARS-CoV-2) activity. Elshahawy [27] proposed oleic acid vaccine for the treatment of COVID-19. Current studies have shown that increased levels of interleukin-6 (IL-6), which is an inflammatory marker, correlate with severity of illness in COVID-19 patients [28, 29, 30]. Oleic acid and linoleic acid which decrease IL-6 [31] therefore has anti SARS-CoV-2 activity. Liu *et al.* [30] reported that decreased levels of IL-6 are closely related to effectiveness of treatment and recovery in COVID-19 patients. Again, oleic acid and linoleic acid are biosurfactants [18] and biosurfactants have the potential to rupture the membrane of SARS-CoV-2 [17].

The results from the present study also show that *Corchorus olitorius* accumulated all the determined heavy metals into its leaves. However, the concentrations of heavy metals in the vegetable differed from one studied location to the other within the vicinity of the quarry site. This may be due to the difference in the level of heavy metals in the soil at different locations of the area under study. The results obtained from this study also show that the plant harvested from the vicinity of the quarry showed greater content of heavy metals than those from the control. This is in agreement with the works of Akubugwo *et al*., [32] and, Chinyere and Madu, [4] on different vegetables.

The concentrations of cobalt in the test samples ranged from 0.95±0.02mg/kg (in the North) to 1.42±0.01mg/kg (in the West). The level in the control sample was 0.52±0.02mg/kg. The concentrations of zinc in the test samples ranged from 0.66±0.12mg/kg (in the West) to 1.05±0.05mg/kg (in the centre) and were above the WHO permissible value of 0.60mg/kg. The least recorded value (0.31±0.03mg/kg) was from the control sample. The levels of chromium from the test sample ranged from 1.81±0.09mg/kg (in the North) to 2.58±0.41mg/kg (in the East) and were above the WHO permissible value of 1.30mg/kg. The least recorded value (1.15±0.05mg/kg) was from the control. The concentrations of cadmium in the test sample ranged from 0.07±0.03mg/kg (in the East) to 0.86±0.02mg/kg (in the centre) which were also above the FAO/WHO maximum value of 0.2mg/kg. The least recorded value (0.01±0.02mg/kg) was from the control sample. The level of arsenic in the test vegetable sample ranged from 2.01±0.12mg/kg (in the North) to 3.03±0.17mg/kg (in the centre). The least recorded value of 0.89±0.04mg/kg was from the control sample. These values for arsenic were above the FAO/WHO maximum permissible value of 0.2mg/kg. The concentrations of lead in the test samples ranged from 1.42±0.09mg/kg (in the South) to 2.90±0.01mg/kg (in the centre). The least recorded value of 1.01±0.01mg/kg was from the control sample. These values were also above the FAO/WHO permissible value of 0.3mg/kg. In all, the concentrations of the heavy metals determined from the *Corchorius olitorius* grown in the quarry site increased significantly ($p<0.05$) compared to the control.

Vegetables are a very important source of nutrients and also a source of income to subsistence farmers in the villages. Most of these farmers cultivate these vegetables within the vicinity of quarries because of lack of land for agricultural use and/or lack of relevant education. Continuous consumption of these vegetables may cause ill health due to the presence of heavy metals. Heavy metals are relevant genotoxic agents due to their long term persistence in the environment [33]. High concentrations of heavy metals in vegetables may cause biochemical changes that may result to cancer, Alzhelmer's disease, cardiovascular disease and memory lost in anyone that consumes the vegetable [34].

Results from this study indicate that the proximate compositions of the vegetable from the quarry differed from vegetable from the control. Whereas, ash, moisture and fibre were higher in the samples from the quarry, protein, lipids and carbohydrate were significantly lower ($p<0.05$) in the samples from the quarry when compared to those from control. This clearly suggests that the quarry impacted negatively on protein, lipids and carbohydrate compositions of *Corchorus olitorius*. Osuocha *et al*. [20] reported similar result on other vegetables from a quarry. The decrease in the percentage composition of these nutrients (protein, lipids and carbohydrate) is likely to be a consequence of competition for binding sites between toxic heavy metals and nutrients in the cell wall, plasma membrane, etc. [35]. Cadmium, for example causes oxidative damage to proteins, lipids, carbohydrates and other biomolecules by promoting the formation of reactive oxygen species (ROS), which interfere with the redox status of the cell [36]. The results from the present study also show that the proximate composition of *Corchorius olitorius* differed in samples collected from different locations within the vicinity of the quarry site. This may be due to the difference in soil nutrients and heavy metals at different areas of the quarry.

IV. CONCLUSION

Quarry activities at Ugwuele decreased the protein, carbohydrate and lipid components of *Corchorus olitorius* grown within the vicinity of the quarry. The plant grown in the quarry contains excessive levels of heavy metals (Co, Zn, Cr, Cd, As and Pb) which were all above the WHO permissible limits for heavy metals in vegetables. Therefore *Corchorus olitorius* grown in the farms within the vicinity of Ugwuele quarry, will likely have adverse health effects on its consumers. Even though the results of this research indicate that the leaves of wild okra are highly medicinal and may be helpful in the treatment of COVID-19, those from the quarry should be avoided because of the risk of heavy metal toxicity.

REFERENCES

[1] Ogundele, L. T., Owoade, O. K., Hopke, P. K. and F.S. Olise, F. S. 2017. "Heavy metals in industrially emitted particulate matter in lle-Ife, Nigeria". *Environmental Research*. Vol. **156**, pp.230 – 325,

[2] FAO/WHO. 2015. General standard for contaminants and toxins in food and feed (CODEX STAN 193-1995), FAO/WHO Geneva, pp. 1-59

[3] WHO. 1996. Permissible limits of heavy metals in soil and plants (Geneva: World Health Organisation), Switzerland

[4] Chinyere, G. C. And Madu, F.U. 2015. "Physicochemical characteristics and heavy metal constituents of five dumpsite soils and edible vegetables grown in two major metropolis of Abia State Nigeria". *Journal of Biochemistry and Biotechnology* vol. **2,** issue 2, pp. 14-27,

[5] Petrovska, B. B. 2012. "Historical review of medicinal plants' usage", *Pharmacogn Rev*. Vol **6,** issue 11, pp. 1-5,

[6] Sofowora, A., Ogunbodede, F. and Onayade, A. 2013. "The role and place of medicinal plants in the strategies for disease prevention". *Afr.J. Tradit.Compliment Altern Med*. Vol.**10,** issue 5, pp. 210-229,

[7] Hanson, J. R. 2013 "Natural products the secondary metabolites. The Royal society of chemistry", Cambridge, UK. Pp**. 1-27,**

[8] Nyadanu, D., Amoah, R. A. Kwarteng, A. O., Akromah, R. Agboagye, L. M., Adu-dopaah, H., Dansi, A. Lotsu, F. and Tsama, A. 2017. "Domestication of Jute mallow (*Corchorus olitorius L.*): ethnobotany, production constraints and phenomics of local cultivars in Ghana". *Genetic Resources and crop Evolution* vol.**64,** issue 6, pp. 1313-1329,

[9] Adebo, O.A., Ahoton, L. E., Quenum, F. J. B., Adoukonou-Sagbadja, H. Bello, D. O. and Chrysostome, C. A. A. M. 2018. "Ethnobotanical knowledge of jute (Corchorus olitorius L.) in Benin", *European journal of medicinal plants*, vol.**26,** issue 1, pp. 1-11,

[10] Ta, B. N'Guessan, I. K., Bomisso, E. R., Assa, R. R. And Ake, S. 2016. "Etude ethnobotanique de queiques especes du genre Corchorus Rencontrees En Cote d' Ivoire". *European Scientific journal*. Vol. **12,** pp**.** 412-431,

[11] Orieke, D. Ohaeri, O. C., Ijeh, I. I. and Ijioma, S.N. 2018. "Identification of phytocomponents and Acute toxicity evaluation of *Corchorus olitorius* leaf extract". *European Journal of medicinal plants* vol. **23,** issue 1, pp. 1-16,

[12] Saotoing, P. T., Tchobsala, V., Tchuenguem, F. F. N., Njan-Nlol, A. M. and Messi, J. 2011."Medicinal plants used in traditional treatment of malaria in Cameroon". *Journal of Ecology and Natural Environment*. Vol. **3**, pp. 104-117,

[13] Asnake, S., Teklehaymanot, T., Hymete, A., Erko, B. and Giday, M. 2016. Antimalarial medicinal plants used by Gumuz people of Mandura Woreda, Benishangul-Gumuz Regional State, Ethiopia*. Indian Journal of Traditional Knowledge***.** Vol**. 15,** pp. 546-552,

[14] Hasan, T. H. And Kadhim, E. J. 2018."Phytochemical investigation of *Corchorus olitorius* L. Leaves cultivated in Iraq and its in vitro antiviral activity". Iraqi J. Pharm. Sci. Vol. **27,** issue 2, pp. 115-122,

[15] Okewole, S. A., Oyekunle, L. O., Akande, O. O., Adebisi, T. T. and Olubode, T. P. 2018. "Nutritional composition of leafy vegetables in Oyo state Nigeria". *Asian Journal of Applied chemistry research*. Vol. **1**, issue 1, pp. 1-7,

[16] Madu, F. U., Akubugwo, E. I., Uhegbu, F. O. and Uzoma, K. U. 2020. "Assessment of Soil Quality Characteristics and Pollution Status of Farm Lands within Ugwuele Quarry Site, Uturu Abia State Nigeria*." International Journal of Scientific research in Multidisciplinary studies*, **6** (7): 52-59

[17] James, C. S. 1995. "Analytical chemistry of foods. Blakie Academic and professional". London. Pp. **505-509,**

[18] Skoog, D. A., Holler, F. J. and Crouch, S. R. 2007. "Principles of instrumental analysis". (6th edn.). Brookes/Cole cengage Learning PP. **11-27,**

[19] AOAC. 2000. “Official methods of Analysis of the Association of the official Analytical chemists” AOAC. International (17th edn.). Washignton, D.C., USA.,

[20] [Osuocha, K. U., Chukwu, E. C., Ugbogu, E. A., Atasie, O. C. and Ogbonna, C. E. 2016.

[21] “Effect of quarry mining activities on the nutritional composition of edible vegetables in Ishiagu Ebonyi State, Nigeria”. *Journal of experimental Biology and Agricultural Sciences* vol. **4,** issue 5, pp. 467-474.

[22] Sermakkani, M. and Thangapandian, V. 2012. “GC-MS analysis of *Cassia italica* leaf methanol extract”, *Asian J. Pharm. clin. Res.* Vol. **5,** issue 2, pp. 90-94,

[23] Zang, Y., Li, D., Li, P. Y. and Zhang, S. 2015.“High electric conductivity of liquid crystals formed by ordered self-assembly of non- ionic surfactant, N,N-bis(2-hydroxyethyl dodecanamide in water”. *Soft matter* vol. **11,** issue 9, pp. 1-6,

[24] Konovalova, O., Gergel, E. and Herhel, V. 2013. “GC-MS analysis of Bioactive components of shepherdia argentea (Pursh.). Nutt. From Ukrainian flora”. *The pharma innovation Journal*. Vol. **2,** issue 6, pp 7 – 12

[25] Elija, K., Vaishali, B. A., Manik, K., Deshpande, N. R. and Kashalkar, R. V. 2012.“Antibacterial activity of dibutyle phthalate: a secondary metabolic isolated from *Ipomoea carnea* stem”. *Journal of pharmacy research* vol.**59,** isssue 1, pp. 150-152

[26] Rukshana, M. S., Doss, A. and Kumari, P. R. T. 2017. “Phytochemical sceening and GC-MS analysis of leaf extract of *Pergularia daemia* (Forssk)” *Chiov. Asian J. plant Sci. Res. Vol.* **7**, issue 1, pp. 9-15

[27] Karthika, K. and Paulsamy, S. 2014.“Phytochemical profiling of leaf, stem and tuber parts of *Solena amplexicaulis* (Lam.) Gandhi using GC-MS”. *Int.sch. Res. Notices*. Vol. **14,** pp 1-15

[28] Elshahawy, K. E. M. 2020. “Using Covid 19 oleic acids (COA19) compound and covid 19 Hyena vaccine (CHV 29) to stop covid 19: A systematic review’, *IOSR Journal of pharmacy*, vol. **10**, issue 7, pp. 11-22

[29] Chen, X. Zhao, B., Qu, Y., Chen, Y., Xiong, J., Men, D., Huang, Q., Liu, Y., B. Yang, Y., Ding, J. and Li, F. 2020. “Detectable serum SARS-CoV-2 viral load (RNAaemia) is closely associated with drastically elevated interleukin 6 (IL-6) level in critically ill COVID-19 patients”. medRxiv doi: 10.1101/2020.02.29.20029520

[30] Harold, T., Jurinovic, V., Arnreich, C., Hellmuth, C. J. C. Von Bergwelt-Baildon, M., Klein. M. And Weinberger, T. 2020.“Level of IL-6 predicts respiratory failure in hospitalized symptomatic COVID-19 patients” medRxiv doi: 10 1101/2020 04.01.20047381

[31] Liu, T., Zhang, J., Yang, Y., Ma, H., Li, Z., Zhang, J., Cheng, J., Zhang, X., Zhao, Y., Xia, Z., Zhang, L., Wu, G. and Yi, J. 2020. “The potential role of IL-6 in monitoring severe cases of coronavirus disease 2019”. medRxiv doi: 10.1101/2020.03.01.20209769

[32] Radzikowska, U., Rinaldi, A. O., Sozener, Z. C., Karaguzel, D., Wojcik, M., Cypryk, K., Akdis, M., Akdis, C. A. and Sokolowska, M. 2019.“The influence of dietary fatty acids on immune responses” *.Nutrients* vol. **11**, pp. 1-52

[33] Akubugwo, E. I., Osuocha, K.U., Nwaogu, L. A. and Chinyere, G. C. 2013.“Studies on bioaccumulation of heavy metals and selected minerals from mining effluent contaminated soil treated with fertilizers into *Cucurbita pepo* vegetable”. *Advances in applied Science Research*, vol.**4,** issue 4, pp. 190-195

[34] Ackova, D.G. 2018. “Heavy meatls and their general toxicity on plants”. *Plants science today* **5**(1): 14-18

[35] De, A. K. 2010.“Environmental chemistry (7th edn.)”. Newage international publishers. Pp **112-115**

[36] Jibril, S. A., Hassan, S., Ishak, C. F. and Wahab, P. E. M. 2017. “Cadmium toxicity affect phytochemicals and nutrient elements composition of Lettuce (*Lactuca sativa* L.)”. *Advances in Agriculture.* Vol. **17**, pp.1-7

[37] Schutzendubel, A., Schwanz, P. and Teichmann, T. 2001. “Cadmium induces changes in antioxidative systems, hydrogen peroxide content, and differentiation in Scots pine roots”, *plant physiology* vol. **127,** issue 3, pp. 887-898