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Phytochemical Screening of Ethanolic Extracts of Nine Medicinal Plants Extracts Using Gas Chromatography-Flame Ionization Detection (GC-FID).

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Abstract

Bioactive organic chemical compounds also known as phytochemicals are found in grains, vegetables, fruits, and other plant products and are considered to be medicinal plants. Plants remains the most abundant natural primary source of active drugs and are invaluable in the ethnomedical treatment of diverse ailments. Medicinal plants are general sources of various phytochemicals, some of which are usually responsible for their biological activities. This study aimed at determining the phytochemical compounds of ethanolic extracts of nine medicinal plants using Gas Chromatography-Flame Ionization Detection. Using a BUCK M910 Gas chromatography equipped with a flame ionization detector. A RESTEK 15-meter MXT-1 column (15m x 250um x 0.15um) was used. The injector temperature was 280^{o}C with spitless injection of 2ul of sample and a linear velocity of 30cms^{-1}, Helium 5. 0pa.s was the carrier gas with a flow rate of 40 mlmin^{-1}. The oven operated initially at 200^{0}C it was heated to 330^{0}c at a rate of 3^{0}c min^{-1} and was kept at this temperature for 5min. the detector operated at a temperature of 320^{0}c. shows the various phytochemicals present in the ethanolic extracts of *M indica, Z. officinale, C. Zeylanicum, C. longa*, *S. aromaticum, M. oleifera, C. citratus, A. sativum,* and *C. odorata*. The results shows that the ethanolic extracts of these medicinal plants contains phytochemicals. The most prominent type of phytochemicals found belong to the broad class flavonoids (a class of phenolics compound). They include kaempferol, flavone, naringenin, rutin, flavanones, flavan-3 ol and proanthocyanin. Other polyphenols (not flavonoids) present include tannin, resveratrol, catechin and

epicatechin. The alkaloids found include lunamarin and spartein, while saponins found include sapogernin and sapogenin. Other class of phytochemicals found include cardiac glycosides, cyanogenic glycoside and steroids. GC-FID analysis of the phytochemical compounds shows that the extracts of these plants have potential bioactive compounds that can be used in the development of novel products that can be used in the treatment of various diseases.

Keywords: Phytochemicals, Gas Chromatography, Medicinal plants, screening

1.0 Introduction

Plants have been invaluable to humans throughout history, providing resources for food, medicine, and other purposes (Awah *et al.,* 2016; Umeoduagu *et al.,* 2023; Anazodo *et al.,* 2024; Ogbonna *et al.,* 2024; Awari *et al.,* 2024). Various plant parts, including leaves, flowers, seeds, pods, bark, and roots, have been used in traditional medicine to treat a wide range of ailments (Umeoduagu *et al.,* 2023; Obianom *et al.,* 2023; Ogbonna *et al.,* 2024). Medicinal plants are natural sources of compounds with pharmacological and nutritional properties that can help prevent and treat diseases (Awah *et al.,* 2017, Ubaoji *et al.,* 2020; Ogbonna *et al.,* 2024; Anazodo *et al.,* 2024). Plants remains the most abundant natural primary source of active drugs and are invaluable in the ethnomedical treatment of diverse ailments (Agu *et al.,* 2013; Adindu *et al.,* 2016; Harriet *et al.,* 2020; Ogbonna *et al.,* 2024). Medicinal plants are general sources of various phytochemicals, some of which are usually responsible for their biological activities. Application of ethnomedicinal knowledge in the fields of biosciences for investigation of novel bioactive compounds as well as the polypharmacological formulation of plant extracts for use in primary healthcare has been the central interest in research (Adeeyo *et al.,* 2018).

Bioactive organic chemical compounds also known as phytochemicals are found in grains, vegetables, fruits, and other plant products and are considered to be medicinal plants. They are known to play a protective role against major chronic diseases that are caused by both infectious and host-metabolic or genetic dysfunction (Esposito *et al.,* 2016) A limited variety of plants have secondary metabolites, which serve specific purposes, whereas phytochemicals carry out intermediate metabolic processes. Primary metabolites, including carbohydrates and lipids, are present in all plants. Though they are not necessary for the plants' immediate existence, secondary metabolites are biomolecules that help plants adapt to their surroundings and remain sustainable. Examples of these adaptations include pollination, drought resistance, and predation. Quinine (cinchona plant), digoxin (foxglove plant), morphine and codeine (poppy plant), and secondary metabolites and pigments are processed into pharmaceuticals due to their therapeutic effects on humans (Agunu *et al.,* 2011). Alkaloids, tannins, and saponins are only a few of the several bioactive substances that have been found in medicinal plants by screening of their chemical composition (Ezike *et al.,* 2016). Antioxidants, anticancer agents, immune-stimulating agents, detoxifying agents, and neuropharmacological agents are the primary functional groups of phytochemicals with therapeutic potential (Kennedy and Wightman, 2011) A variety of substances with varied potencies and occasionally multiple activities make up each of the phytochemicals' functional classes (Esposito *et al.,* 2016). A diverse range of phytochemicals, sometimes included in pre-existing biochemical themes, are produced by plants (Singh, *et al.,* 2015) Astringent, anti-inflammatory, and antibacterial activities are possessed by tannins, whereas triterpenoids are among the bioactive chemicals that exhibit anti-inflammatory action (Akinpelu *et al.,* 2015). As expectorants, blood cleaners and antibiotics, saponins are frequently used medicinally. Alkaloids and glycosides both have the capacity to raise the forces of systolic concentration, and both have a notable impact on the central nervous system (CNS) (Ukamaka *et al.,* 2015) The roots,

stems, bark, leaves, or flowers of aromatic and medicinal plants contain the active chemicals found in plant extracts (Harriet *et al.,* 2020) The majority of the time, these active components' effects on the central nervous system of humans may be linked to their ecological functions or biochemical identities in other plants and higher animals (Ukamaka *et al.,* 2015) Utilizing these physiologically active chemicals from plant resources requires a number of important stages, including pharmacological and toxicological assessments along with extraction, initial screening, isolation, purification, and characterization (Harriet *et al.,* 2020).

In the pharmaceutical industry, extraction entails separating the components of plant and microbe tissues using solvents or a selective buffer solution in accordance with established procedures (Udochukwu *et al.,* 2020) The nature of the plant material, its source, the degree of processing, moisture content, and particle size all affect the chemical constituents obtained from the extract. Critical factors that can affect the quality of an extract from a plant include parts used as a sample (leaf, bark, or root), solvent and its concentration used for extraction, and extraction method. The kind and timing of the extraction process, the kind and concentration of the solvent, the processing temperature, and the polarity of the analytes are some of the variables that might affect the composition and number of secondary metabolites in an extract (Oramadike and Ogunbanwo, 2017)

The purification, identification, and structural characterization of different groups of phytochemical compounds in plant extracts are frequently accomplished step-by-step using a variety of techniques, such as nuclear magnetic resonance (NMR), Fourier-transform infrared spectroscopy (FTIR), ultraviolet (UV) spectrophotometry, and different types of column chromatography ((Harriet *et al.,* 2020). Phytochemicals can exhibit antimicrobial activities through various mechanisms, such as: (i) blocking enzyme and toxin activity, (ii) damaging the bacterial membrane, (iii) suppressing virulence factors, (iv) biofilm formation, (v) blocking protein synthesis, and (vi) quorum quenching (Harriet *et al.,* 2020) Tannins primarily function by binding to proteins, which prevents the creation of new proteins in cells (Maitera *et al.,* 2018). Quorum sensing occurs at three different levels: signal development, signal preservation, and signal reception (Ajayi *et al.,* 2016).

ESBL-producing bacteria have emerged as a major public health threat in recent decades. Among the Enterobacteriaceae family, *Klebsiella pneumoniae* and *Escherichia coli* are particularly concerning due to their ability to acquire and develop ESBL-type resistance (Ekpunobi *et al.,* 2024).

2. 0 Materials and Methods

2.1 Collection and Preparation of medicinal plants

Plant materials used in this study were collected during the month of June 2023. These plants were packed separately in different polybags and transported to Botany Department Nnamdi Azikiwe University Awka Anambra State, where Taxonomic identification of the plants were identified and authenticated by a plant Taxonomist. The voucher specimens from each plant were deposited at the Department of Botany. The following plants were identified with identification numbers leaves of *Cymbopogon citratus (*lemon grass), leaves of *Chromolaena odorata* (Awolowo), *Mangifera indica(Mango), Moringa, oleifera* were collected *f*rom the Neighborhood of Federal housing estate, new Owerri and its environs while the dried seeds of *Syzygium aromaticum* (cloves), bark of *Cinnamomum Zeylanicum* (cinnamon), Bulb of *Allium sativum* (Galic), roots of *Curcuma longa* (turmeric) roots of *Zingiber officinale* (ginger) were sourced from the local markets in Owerri.

2.2 Processing of medicinal plants;

The leaves, stem and roots of the medicinal plants collected were thoroughly washed with clean water and wiped with a clean cloth

accordingly. Old leaves and some dried parts were discarded. The leaves were then cut in 2-3 parts using sterile stainless- steel knife for drying convenience. They were then spread in clean trays and allowed to air dried at room temperature. The dried parts of the different medicinal plants were grounded into powder using a blender

❖ Medicinal plants used

Dried seed of *Syzgium aromaticum* (cloves). dried stem of *Cinnamomum zeylanicum* (cinnamon), dried Bulb of *Allium sativum* (Galic), dried roots of *curcuma longa* (turmeric), leaves of *Cymbopogon citratus* (lemon grass), *Chromolaena odorata* (Obiara Ohuru) Mangifera *indica* (Mango leave), *Zingiber officinale* (ginger), *Moringa oleifera* (moringa leaves).

2.3 Preparation of medicinal Plants

2.3.1 Soxhlet Extraction method

Extraction procedure

All the equipment's were assembled and sterilized, 300ml of ethanol was added to a round bottom flask, which was attached to a Soxhlet extractor and condenser on an isomantle. 10g of the grounded medicinal plant sample was loaded correspondingly into the Soxhlet thimble, which was placed inside the Soxhlet extractor. The side arm was lagged with cotton wool. The solvent was heated and allowed to reflux for about 4 hours at a temperature of 60^0C, then the thimble was removed with care and pour the extract into a volumetric flask and allow to cool. Then transfer the content in the volumetric flask into a rotatory evaporator to separate the solvent (ethanol) from the extract.

2.4 Extraction of phytochemicals

Each extract was weighed 0.2g and transferred into a test tube and 15ml ethanol and 10ml of 50%m/v potassium hydroxide was added. The test tube was allowed to react in a water bath at 60^0c for 3hrs. After the reaction time, the reaction product contained in the test tube was transferred to a separating funnel. The tube was washed successfully with 20ml of ethanol, 10ml of cold water, 10ml of hot water and 3ml of hexane, which transferred to the funnel. The extracts were combined and washed three times with 10ml of 10%v/v ethanol aqueous solution. The ethanol solvent was evaporated. The sample was solubilized in 1000ul of pyridine of which 200ul was transferred to a vial for analysis.

2.5 Quantification by GC-FID.

The analysis of phytochemical was performed on a BUCK M910 Gas chromatography equipped with a flame ionization detector. A RESTEK 15-meter MXT-1 column (15m x 250um x 0.15um) was used. The injector temperature was 280^oC with spitless injection of 2ul of sample and a linear velocity of $30cms^{-1}$, Helium 5. 0pa.s was the carrier gas with a flow r ate of 40 $mlmin^{-1}$. The oven operated initially at 200^0C it was heated to 330^0c at a rat e of 3^0c min^{-1} and was kept at this temperature for 5min. the detector operated at a temperature of 320^0c. Phytochemicals were determined by the ratio between the area and mass of internal standard and the area of the identified phytochemicals. The concentration of the different phytochemicals expresses in ug/g.

3.0 Results

Table 1: Compounds present in the leaves Ethanolic extracts of *Mangifera indica* using GC-FID

S/N	Name of compound	R. time	Area	Height	External	Unit
1	Catechin	0.760	5935.269	102.835	10.1806	ug/ml
2	Steroid	3.0933	125.8246	54.650	4.7505	ug/ml
3	Aphyllidine	5.480	2783.9799	48.146	0.3018	ug/ml
4	Anthocyanin	7.873	4889.9091	82.157	8.3875	ug/ml
5	Naringenin	9.346	2885.5740	50.415	5.2811	ug/ml
6	Aphyllidine	10.83	5999.6554	99.712	10.7521	ug/ml
7	Dihydrocytisin	14.036	3243.6990	52.307	6.0829	ug/ml
8	Ammondendin	20.156	8367.8872	104.085	3.7377	ug/ml
9	Cyanogenic glycoside	23.366	6747.6011	113.857	6.8527	ug/ml
10	Flavonones	25.956	7175.4352	121.081	15.3847	ug/ml
11	Flavone	29.330	5017.0988	85.992	6.2266	ug/ml
12	Ribalinidine	31.650	6538.4368	111.906	14.0189	ug/ml
13	Spartein	34.150	2967.3613	50.671	6.6473	ug/ml
14	Phylate	36.770	4312.3473	73.305	7.8923	ug/ml
15	Oxalate	38.643	7938.7844	132.798	4.1920	ug/ml
16	Sapogenin	43.536	5050.1959	84.201	3.2011	ug/ml

Table 2: Compounds present in the leaves Ethanolic extracts of *Zingiber officinale* using GC-FID

S/N	Name of	R. time	Area	Height	External	Unit	compound
1	Kaempferol	0.386	2631.0434	206.270	4.5129	ug/ml	
2	Catechin	0.873	4824.9767	377.473	10.3451	ug/ml	
3	Aphyllidine	5.483	2954.8422	265.800	6.0740	ug/ml	
4	Anthocyanin	7.873	4968.2281	231.937	0.3162	ug/ml	
5	Naringenin	9.350	3057.1151	389.420	8.5218	ug/ml	
6	Aphyllidine	10.830	6003.0656	240.132	6.5547	ug/ml	
7	Dihydrocytisine	14.036	3250.6604	470.455	10.7582	ug/ml	
8	Ammondendine	19.973	4928.684	255.555	6.0959	ug/ml	
9	Tannin	20.616	3419.6849	387.165	2.2015	ug/ml	
10	Cyanogenic glycoside	23.363	6954.4788	268.983	3.5038	ug/ml	
11	Flavonones	25.960	7289.2832	536.637	7.3102	ug/ml	
12	Flavone	29.326	5273.2844	410.247	6.5446	ug/ml	
13	Ribalinidine	31.653	6802.6676	532.675	14.5855	ug/ml	
14	Spartein	34.150	3084.5871	241.227	6.9099	ug/ml	
15	Phylate	36.773	4449.9298	348.939	9.5410	ug/ml	
16	Oxalate	38.640	8024.0488	624.601	4.2370	ug/ml	
17	Sapogenin	43.536	5031.2166	394.788	3.4834	ug/ml	
18	Epihedrine	45.066	10.1155	0.225	0.0181	ug/ml	

Table 3: Compounds present in the leaves Ethanolic extracts of *Cinnamomum zeylanicum* using GC-FID

S/N	Name of compound	R. time	Area	Height	External	Unit
1	Kaempferol	0.123	3359.9492	350.197	5.7632	ug/ml
2	Steroid	2.700	2436.2185	191.759	4.3660	ug/ml
3	Catechin	5.793	5819.4134	456.746	12.4773	ug/ml
4	Anthocyanin	8.436	4721.4984	371.183	8.0986	ug/ml
5	Naringenin	10.793	4775.5038	375.479	10.2391	ug/ml
6	Aphyllidine	12.450	4741.5096	372.761	8.4973	ug/ml
7	Dihydrocytisine	14.040	4578.3976	359.987	8.5858	ug/ml
8	Cyanogenic glycoside	15.076	1038.4018	81.524	1.0915	ug/ml
9	Ammondendine	19.756	3930.5748	308.144	1.7557	ug/ml
10	Tannin	21.553	5025.1523	394.848	5.1488	ug/ml
11	Flavonones	24.580	4953.9757	389.494	10.6217	ug/ml
12	Ribalinidine	31.363	4199.9884	329.743	9.0051	ug/ml
13	Spartein	34.120	2174.5382	171.250	4.8713	ug/ml
14	Phylate	36.010	663.9956	52.301	1.4237	ug/ml
15	Oxalate	39.900	2206.4580	173.478	1.1651	ug/ml
16	Epihedrine	41.836	3159.5580	248.559	5.6623	ug/ml

Table 4: Compounds present in the leaves Ethanolic extracts of *Curcuma longa* using GC-FID

S/N	Name of compound	R. time	Area	Height	External	Unit
1	Proanthocyanin	0.096	1016.3139	387.135	1.4294	ug/ml
2	Proanthocyanin	0.150	4113.8927	220.677	5.7861	ug/ml
3	Naringin	2.220	6658.7606	133.911	9.7493	ug/ml
4	Cardiac glycoside	3.950	8088.9220	161.863	7.5292	ug/ml
5	Anthocyanin	6.893	4491.2881	89.269	5.7778	ug/ml
6	Ribalinidine	10.590	4322.8817	85.952	9.2686	ug/ml
7	Naringenin	13.300	4890.0248	97.723	2.0664	ug/ml
8	Spartein	15.783	12778.7672	253.455	22.9010	ug/ml
9	Cyanogenic Glycoside	19.573	12553.4443	240.821	22.4972	ug/ml
10	Flavonones	22.290	4738.2288	94.581	8.1273	ug/ml
11	Steroids	26.003	6756.8345	134. 687	11.5898	ug/ml
12	Kaempferol	28.583	5968.4874	116.805	4.1333	ug/ml
13	Epicatechin	29.456	4238.8672	91.392	5.4508	ug/ml
14	Flavone	34.093	9101.5490	148.201	11.2957	ug/ml
15	Oxalate	37.273	6444.3546	132.783	12.5876	ug/ml
16	Catechin	38.320	9775.0765	189.383	2.1460	ug/ml
17	Resveratrol	39.586	4252.4572	86.944	4.8470	ug/ml
18	Tannin	40.933	3321.8780	68.664	1.9291	ug/ml
19	Sapogernin	42.136	5941.6411	125.317	9.7644	ug/ml

Table 5: Compounds present in the leaves Ethanolic extracts of *Syzgium aromaticum* using GC-FID

S/N	Name of compound	R. time	Area	Height	External	Unit
1	Proanthocyanin	0.116	3681.8254	411.025	6.9045	ppm
2	Naringin	2.223	6793.2211	528.999	12.4327	ug/ml
3	Cardiac glycoside	3.950	8180.0436	637.037	10.1521	ug/ml
4	Anthocyanin	6.893	4491.1913	350.845	7.7036	ug/ml
5	Ribalinidine	10.593	4339.0384	337.681	9.3033	ug/ml
6	Naringenin	13.300	4918.6080	385.135	3.1176	ug/ml
7	Spartein	15.783	12794.3857	919.800	28.6613	ug/ml
8	Rutin	19.516	12631.1433	566.996	15.6763	ug/ml
9	Flavonones	22.293	4749.7578	372.508	10.1839	ppm
10	Steroids	26.000	6633.3794	529.584	11.7211	ppm
11	Kaempferol	28.566	5744.9478	450.313	3.9785	ug/ml
12	Epicatechin	29.493	4459.3978	349.793	5.7343	ug/ml
13	Phylate	33.753	3207.2732	252.912	5.7478	ug/ml
14	Flavone	34.206	5932.5289	458.609	7.3827	ug/ml
15	Oxalate	37.260	6525.2532	508.857	12.7456	ug/ml
16	Catechin	38.326	9393.7324	732.257	2.0623	ug/ml
17	Resveratrol	39.586	4412.4024	345.673	6.7056	ppm
18	Tannin	40.930	3451.5680	270.978	2.0044	ug/ml
19	Sapogernin	42.086	6000.1311	470.143	7.3954	ug/ml
20	Epihedrine	42.9465	24.26 34	510.969	11.1905	ug/ml

Table 6: Compounds present in the leaves Ethanolic extracts of *Moringa oleifera* using GC-FID

S/N	Name of compound	R. time	Area	Height	External	Unit
1	Lunamarin	0.116	3681.8254	411.026	4.7168	ug/ml
2	Naringenin	2.223	6793.2211	528.999	5.9206	ug/ml
3	Flavan 3 ol	3.950	8180.0436	637.037	5.7020	ppm
4	Rutin	6.893	4490.1913	350.840	2.7866	ug/ml
5	Tannin	10.593	4339.0384	337.681	2.8977	ug/ml
6	Spartein	13.300	4918.6080	385.129	2.4859	ug/ml
7	Sapogemin	15.783	12794.3857	919.800	16.0753	ug/ml
8	Catechin	19.516	7077.0506	566.914	2.4859	ug/ml
9	Flavonones	19.616	5530.7470	549.868	3.2729	ppm
10	Steroids	22.293	4749.7578	372.508	7.5972	ppm
11	Kaempferol	26.000	6830.6364	529.572	6.1495	ug/ml
12	Cyanogenic glycoside	28.566	5744.3978	450.313	7.9791	ug/ml
13	Phytate	29.493	4459.3978	349.793	5.8440	ppm
14	Flavone	33.753	3207.2732	252.910	1.9902	ug/ml
15	Epicatechin	34.206	5932.5289	458.604	7.6707	ug/ml
16	Oxalate	37.260	6525.2532	508.835	6.7065	ug/ml
17	Resveratrol	38.326	9393.7324	732.257	7.0310	ppm
18	Sapogenin	39.586	4412.0147	345.669	3.0835	ug/ml
19	Proanthocyanin	40.930	3451.2339	270.975	2.3623	ppm
20	Cardiac glycoside	42.086	6000.1311	470.143	2.3531	ug/ml
21	Epihedrine	42.943	6524.2634	510.968	4.7841	ug/ml

Table 7: Compounds present in the leaves Ethanolic extracts of *Cymbopogon citratus* using GC-FID

S/N	Name of compound	R. time	Area	Height	External	Unit
1	Resveratrol	0.080	232.8066	139.940	0.1743	ppm
2	Lunamarin	0.280	33400.398	117.455	4.3563	ug/ml
3	Naringenin	2.390	12252.8106	301.042	10.6788	ug/ml
4	Flavan 3 ol	4.120	6344.5478	157.568	.4.4226	ug/ml
5	Rutin	6.016	18154.0688	442.689	11.2653	ug/ml
6	Anthocyanin	7.470	8442.9838	206.428	11.6218	ug/ml
7	Tannin	10.366	19598.0668	476.646	13.0881	ug/ml
8	Spartein	12.970	6238.3258	152.341	2.6332	ug/ml
9	Sapogenin	15.460	4967.5639	121.273	6.2414	ug/ml
10	Naringin	17.966	11339.2568	276.424	10.5424	ug/ml
11	Flavonones	20.313	12756.4840	307.630	7.5489	ppm
12	Steroids	22.730	9573.1408	233.186	15.3121	ppm
13	Kaempferol	25.650	10008.8176	245.115	9.0107	ug/ml
14	Cyanogenic glycoside	27.536	11458.0104	280.295	15.9139	ppm
15	Phytate	29. 860	5478.4406	133.723	7.1794	ug/ml
16	Flavone	32.996	14337.0482	348.877	8.8967	ug/ml
17	Epicatechin	34.600	6059.7940	147.836	7.8364	ug/ml
18	Oxalate	36.876	6988.5601	170.310	7.1845	ug/ml
19	Sapogenin	39.200	10234.6024	249.263	7.1529	ug/ml
20	Cardiac glycoside	42.276	3473.1416	85.310	1.3621	ug/ml
21	Proanthocyanin	44.170	10509.6768	256.782	7.1937	ppm

Table 8: Compounds present in the leaves Ethanolic extracts of *Allium sativum* using GC-FID

S/N	Name of compound	R. time	Area	Height	External	Unit
1	Proanthocyanin	0.330	5743.6906	191.344	5.3856	ppm
2	Epihedrine	1.370	12308.3341	252.395	7.6378	ug/ml
3	Ribalinidine	3.196	7287.1844	181.144	3.1249	ug/ml
4	Ellagic acid	4.093	7507.2951	183.663	9.3429	ug/ml
5	Coumaric acid	5.486	12528.8822	245.191	10.7452	ug/ml
6	Spartein	7.026	17818.5769	432.684	10.3506	ppm
7	Ferullic acid	9.026	10027.9036	243.817	17.9712	ug/ml
8	Sapogenin	17.033	10810.2516	261.989	17.7654	ug/ml
9	Vanillic acid	19.113	15829.8099	383.021	21.2766	ppm
10	Anthocyanin	23.306	3631.7268	89.200	3.1147	ppm
11	Epicatechin	25.080	9936.8383	241.806	14.9074	ug/ml
12	Tyrosol	28.593	3561.4480	86.290	6.1088	ppm
13	Kaempferol	30.986	6168.6561	149.389	2.8479	ug/ml
14	Rutin	34.116	7294.7142	176567	9.0533	ug/ml
15	Hydroxytyrosol	39.026	4541.0092	109.798	7.1722	ug/ml
16	Resveratrol	43.983	9610.1972	141.130	7.3026	ppm

Table 9: Compounds present in the leaves Ethanolic extracts of *Chromolaena odorata* using GC-FID

S/N	Name of compound	R. time	Area	Height	External	Unit
1	Kaempferol	0.236	2291.4194	58.768	0.5288	ug/ml
2	Steroids	2.393	12523.1176	166.221	5.7817	ug/ml
3	Proanthocyanin	4.113	5981.6360	86.580	1.3808	ug/ml
4	Catechin	6.023	19029.4792	243.829	3.4961	ug/ml
5	Anthocyanin	7.416	7067.8738	114.108	1.6315	ug/ml
6	Narigenin	10.366	18424.4042	256.762	4.2531	ug/ml
7	Dihydrocytisine	12.970	5123.5761	76.479	1.1825	ug/ml
8	Cyanogenic glycoside	15.460	3955.3720	59.884	2.7718	ug/ml
9	Aphylldine	17.966	10273.9718	145.579	0.6704	ug/ml
10	Ammodendrine	20.313	11947.7422	165.529	5.8532	ug/ml
11	Tannin	22.730	8926.4888	124.680	4.8589	ug/ml
12	Flavonones	25.653	9622.6889	132.865	4.4426	ug/ml
13	Cardiac glycoside	27.533	11251.8161	152.781	3.2680	ug/ml
14	Flavone	29.860	5176.1126	71.889	1.1946	ug/ml
15	Ribalinidine	33.000	14536.9018	191.887	6.7114	ug/ml
16	Spartein	34.576	5504.7656	81.376	2.4170	ug/ml
17	Phytate	36.876	6824.3378	92.938	3.1507	ug/ml
18	Oxalate	39.200	10052.1708	136.587	3.7914	ug/ml
19	Epihedrine	42.280	3265.1114	46.499	1.0137	ug/ml
20	Sapogenin	44.170	10578.6726	141.652	4.8828	ug/

4.0 Discussion

Quantitative phytochemical analysis by GC-FID.

GC-FID is one of the modern methods used to detect and isolate the phytoconstituents in plants (Ogbuagu *et al*., 2019). Tables 1-9 shows the various phytochemicals present in the ethanolic extracts of *M indica, Z. officinale, C. Zeylanicum, C. longa*, *S. aromaticum, M. oleifera, C. citratus, A. sativum,* and *C. odorata*. The results shows that the ethanolic extracts of these medicinal plants contains phytochemicals. The compound detected in different species were *M. indica (16), Z. officinale* (18), *C. Zeylanicum (16), C. longa (19), S. aromaticum (*20), *M. oleifera (21), C. citratus (21), A. sativum (16),* and *C. odoranta* (20)**.** The most prominent type of phytochemicals found belong to the broad class flavonoids (a class of phenolics compound). They include kaempferol, flavone, naringenin, rutin, flavanones, flavan-3 ol and proanthocyanin. Other polyphenols (not flavonoids) present include tannin, resveratrol, catechin and epicatechin. The alkaloids found include lunamarin and spartein, while saponins found include sapogernin and sapogenin. Other class of phytochemicals found include cardiac glycosides, cyanogenic glycoside, anti-nutrient, and steroids. It has been asserted that at least 25% of medications are derived from plants, and the drug pharmacopoeia still has a significant number of synthetic counterparts. (Shashank and Egbuna, 2019). Epicatechin and Proanthocyanin were mentioned as antimalarials (Nwankwo *et al*., 2021) while Naringin and Resveratrol have been reported to possess antimicrobials. (Vestergaard and Ingmer, 2019) The World Health Organization estimates that 80 percent of people in developing nations get their main medical care from traditional medicines, the most of which are plant-based. (Shashank and Egbuna, 2019). Tannins have physiological effects that include lowering blood Pressure, lowering serum cholesterol levels, producing liver

necrosis, promoting quick blood clotting, and altering immunological response, in addition to their inherent defense mechanism against microbial infection. (Ogbuagu *et al*., 2019) El Omari *et al*. 2021 reviewed the research on the anticancer effects of quinones, isothiocyanates, terpenoids, and alkaloids and discussed how these compounds may be able to target epigenetic pathways in cancer treatment. In another

systematic review by Hwang *et al.* (2019), He conducted an online search in the Medline database using keywords pertaining to the apoptotic effects of natural products on particular leukemia cell lines (HL-60, U937, KG-1, Kasumi-1, and THP-1) for articles published between September 2013 and September 2018. Five classes of phytochemicals were identified from the 58 publications selected for the study: phenolics, alkaloids, carotenoids, nitrogen-containing compounds, and organosulfur compounds. They emphasized that although other groups have also demonstrated significant apoptotic effects, phenolics are the most common category to affect AML cells.

Conclusion

Phytochemical analysis of the nine Medicinal plants extracts used in this study have shown the abundant reservoir of flavonoids and other classes of phytochemicals. These phytochemicals have important metabolic roles which leads to the pharmacological and physiological activities of the plant. GC-FID analysis of the phytochemical compounds shows that the extracts of these plants have potential bioactive compounds that can be used in the development of novel products that can be used in the treatment of various diseases.

References

Adeeyo, A. O. Odiyo, J. and Odelade, K. (2018) "Chemical profiling and antimicrobial properties of phyto-active extracts from *Terminalia glaucescens* stem against water microbial contaminants," *The Open Biotechnology Journal*.**12**, 1,

Awah, N.S., Agu, K.C., Ikedinma, J.C., Uzoechi, A.N., Eneite, H.C., Victor-Aduloju A.T., Umeoduagu, N.D., Onwuatuegwu, J.T.C., Ilikannu S.O. (2017). Antibacterial Activities of the Aqueous and Ethanolic Extracts of the Male and Female *Carica papaya* Leaves on Some Pathogenic Bacteria. *Bioengineering and Bioscience,* **5**(2): 25-29. DOI: 10.13189/bb.2017.050201

Awah, N.S., Agu, K.C., Okorie, C.C., Okeke, C.B., Iloanusi, C.A., Irondi, C.R., Udemezue, O.I., Kyrian-Ogbonna, A.E., Anaukwu, C. G., Eneite, H. C., Ifediegwu M.C., Umeoduagu, N.D., Abah, N.H., Ekong, U.S. (2016). In-vitro Assessment of the Antibacterial Quality of Some Commonly Used Herbal and Non-herbal Toothpastes on *Streptococcus mutans*. *Open Journal of Dentistry and Oral Medicine,* **4**(2): 21-25. DOI: 10.13189/ojdom.2016.040201

Adindu, C.S., Odili, L.C., Nwagu, E.E., Agu, K.C., Awah, N.S., Okeke, B.C. and Orjionwe, R.N. (2016). Phytochemical and Antimicrobial Screening of Cola gigantea Leaves, Stem and Bark. *Universal Journal of Microbiology Research*, **4** (2): 49-54

Agu, K.C., Igweoha, C.A. and Umeh, C.N. (2013). Antimicrobial Activity of the Ethanolic and Petroleum Ether Extracts of Tangerine Seeds on Selected Bacteria. *International Journal of Agriculture and Bioscience.* **2** (1): 22- 24

Agunu, A., A. A. Ahmadu, S. O. Afolabi, A. U. Yaro, J. O. Ehinmidu, and Z. Mohammed, (2011) "Evaluation of the antibacterial and antidiarrhoeal activities of Heeria *insignis*," *Indian Journal of Pharmaceutical Sciences*, **73**, 3, 328–332.

Ajayi, O. S., Awala, A., Ogunleye, F. Okogbue, and Olaleye, B. F. (2016.) "Antimicrobial screening and phytochemical analysis of *Elaeis guineensis* (ewe igi ope) against salmonella strains," *British Journal of Pharmaceutical Research*, **10**, 3, 1–9,

Akinpelu, D. A., Abioye, O. A., Aiyegoro, O. F., Akinpelu, and A. I. Okoh, (2015)

"Evaluation of antibacterial and antifungal properties of *Alchornea laxiflora* (benth.) pax. & Hoffman," *Evidence-Based Complementary and Alternative Medicine*, **13**. Article ID 684839,

Anazodo C. A., Abana C. C., Agu K. C., Victor-Aduloju A. T., Okoli F. A., Ifediegwu M. C., Awari V. G., Chidozie C. P. (2024). In Vitro Antifungal Efficacy of *Allium Cepa* and *Allium sativum*: A Comparative Study with Commercial Drugs. *Research and Analysis Journals*, **7**(08): 33-39

Awari, V.G., Umeoduagu, N.D., **Agu, K.C.**, Obasi, C.J., Okonkwo, N.N. and Chidozie, C.P. (2024). Antibiogram of Pathogenic *Pseudomonas aeruginosa* Isolated from Hospital Environment. *International Refereed Journal of Engineering and Science,* **13** (2): 01-10

Ekpunobi, N. F., Mgbedo, U. G., Okoye, L. C. and Agu, K. C. (2024). Prevalence of ESBL genes in Klebsiella pneumoniae from individuals with community acquired urinary tract infections in Lagos state, Nigeria. *Journal of RNA and Genomics*, **20** (2):1-6.

Esposito, F. I., Carli, C., Del Vecchio (2016.) "Sennoside A, derived from the traditional Chinese medicine plant rheum L., is a new dual HIV-1 inhibitor effective on HIV-1 replication," *Phytomedicine*, **23**, 12, 1383–1391,

Ezike, A. C. C. H., Okonkwo, P. A., Akah, T. C. Okoye, C. S. Nworu (2016.) "*Landolphia owariensis* leaf extracts reduce parasitemia in *Plasmodium berghei*-infected mice," *Pharmaceutical Biology*, **54,** 10, 2017–2025,

El Omari, N., Bakrim, S., Bakha, M., Lorenzo, J. M., Rebezov, M., Shariati, M. A., Aboulaghras, S., Balahbib, A., Khayrullin, M., and Bouyahya, A. (2021). Natural Bioactive Compounds Targeting Epigenetic Pathways in Cancer: A Review on Alkaloids, Terpenoids, Quinones, and Isothiocyanates. Nutrients, **13**(11), 3714.

Harriet, U., Ugboko**,** Obinna, C. Nwinyi, Solomon U. Oranusi, Toluwase, H. Fatoki, Conrad A. and Oonhinmin (2020) Antimicrobial importance of medicinal plants in Nigeria, *scientific World Journal* **10**.1016.

Hwang, D., Kim, M., Park, H., Jeong, M. I., Jung, W., & Kim, B. (2019). Natural Products and Acute Myeloid Leukemia: A Review Highlighting Mechanisms of Action. Nutrients, **11**(5), 1010.

Kennedy D. O. and E. L. Wightman, (2011) "Herbal extracts and phytochemicals: plant secondary metabolites and the enhancement of human brain function," *Advances in Nutrition*, **2,** 1, 32–50.

Maitera, O. N. H. Louis, O. O. Oyebanji, and Anumah, A. O. (2018) "Investigation of tannin content in *Diospyros mespiliformis* extract using various extraction solvents," *Journal of Analytical & Pharmaceutical Research*, **7**, 1.

Nwankwo O.L, Chukwuebuka O.C, Collins O.O, Samuel B.J, Obasi J.C, Iloh E.S, and Nwankwo E.O, (2021) Quantitative phytochemical analysis of the fungus endophytic extracts isolated from *Azadirachta indica* using gas chromatography- flame ionization detector*, Journal of Drug Delivery and Therapeutics.* **11**(5):80-83.

Obianom, O.A., Ogbonna, U.S.A., **Agu K.C.,** Ozuah, C.L., Okonkwo, N.N., Victor-Aduloju, A.T. and Umeoduagu, N.D. (2023). Microbiological and Phytochemical Evaluation of Jackfruit and Soursop. *International Journal of Science Academic Research* (4) 11: .6662-6674

Ogbonna U. S. A., Okoh F. N., Obianom, O. A., Agu K. C., Abana C. C., Anazodo C. A., Okoli F. A., Egurefa S. O., Chidubem-Nwachinemere N. O., Nwosu J. C. (2024). Nutritional Composition and Fungi Isolates Associated with *Moringa Oleifera* Leaves and Seeds. *Research and Analysis Journals*, **7**(08): 54-60

Ogbonna U. S. A., Okoh F. N., Obianom, O. A., Agu K.C., Anazodo C. A., ChidubemNwachinemere N. O., Abana C. C., Okoli F. A., Egurefa S. O., Nwosu J. C. (2024). Phytochemical Composition &

Bacterial Isolates Associated with Moringa Oleifera Leaves/Seeds. *Research and Analysis Journals*, **7**(08): 40-53

Ogbuagu, A.S., Eric, S.N. and Obumselu, F.O., (2019). Qualitative and Quantitative Phytochemical and Physicochemical Analyses on the Oil and Extracts from Ricinodendron Heudelotii. *Chemical & Pharmaceutical Research*, **1**(1): 1-7.

Oramadike, C. E. and Ogunbanwo, S. T. (2017) "Antagonistic activity of *Thymus vulgaris* extracts against vibrio species isolated from seafoods," *Journal of Food Science and Technology*, 54 (5) 1199–1205,

Singh, G. E. Tamboli, A. Acharya, C. Kumarasamy, K. Mala, and P. Raman, (2015) "Bioactive proteins from solanaceae as quorum sensing inhibitors against virulence in *Pseudomonas aeruginosa*," *Medical Hypotheses*, **84,** (6) 539–542.

Shashank, K. & Egbuna, C. (Eds.) (2019). Phytochemistry: In vitro and in silico updates. 1st edn. Springer Nature, Singapore, 589

Ubaoji, K.I, Nwosu, O.K, **Agu, K.C,** Nwozor, K.O, Ifedilichukwu N.H, Okaka, A.N.C. (2020). Gas Chromatographic Analysis of the Phyto-Constituents and the Assessment of the Anti-Microbial Properties of the Leave Extracts of Nigeria-Grown *Gingko biloba. Journal of Scientific Research in Medical and Biological Sciences*, **1**(2):45-56

Udochukwu, U. F. I. Omeje, I. S. Uloma, and F. D. Oseiwe, (2020) "Phytochemical analysis of vernonia amygdalina and *Ocimum gratissimum* extracts and their antibacterial activity onsome drug resistant bacteria," *American Journal of Respiratory and Critical Care Medicine*, **3**(5)225–235.

Ukamaka, O. Paul, N. and Ikechi, E. (2015) "Antiviral effects of *Nauclea latifolia* on ne O. wcastle disease virus (NDV)," *Sky Journal of Microbiology Research*, .**3** 1–5.

Umeoduagu, N.D., Chidozie, C.P., Ifemeje E.M., Anazodo, C.A., Okoli, F.A., Okonkwo, N.N., Uwanta L.I., **Agu, K.C.** and Azuka G.E. (2023). Halitosis: The Antimicrobial Susceptibility Pattern of some Commercially Sold Toothpaste on Selected Isolates. *International Journal of Scientific Research & Engineering Trends*, **9** (5): 1309-1315

Umeoduagu, N.D., Egurefa, S.O., Awari, V.G., Agu, K.C., Udenweze, E.C. and Uwanta, L.I. (2023). Bacteriological and Antibiotic Resistance Evaluation of Bacteria Isolated from Fresh Meat Sold at Afor Oba Market, Anambra State. *International Journal of Research Publication and Reviews,* 4 (8): 554-560

Vestergaard M, and Ingmer H. (2019) Antibacterial and antifungal properties of resveratrol. International *Journal of Antimicrobial Agents*.; 53(6):716-723

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