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Identification and Elucidation of Bioactives in Datura Stramonium Leaves: An Insight into Drugs Discovery

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Abstract

Medicines from plants help in treating ailments, but to utilize them effectively in the management of diseases requires the identification of potent phytochemicals relative to conventional drugs. These phytochemicals are compared with synthetics drugs in line with their treatment regimen. An investigation was designed to identify, and characterized the different phytochemicals in Datura stramonium (Jimson weed) leaves and compared with conventional or standard drugs. The identified phytochemicals were blasted on drugs bank website to find their correlation and relativity. Two solvent systems - Dichloromethane and 1- chloro-octadecanesurrogate were used to getting the extracts. GC/MS techniques was used to analyze the phytochemicals. The results showed 80 different phytochemicals belonging to several categories of phytochemicals - alkaloids, flavonoids, terpenoids, saponins, amine, and steroids. They also showed different percentage concentration and retention time. The flavonoid class had - 1.24% of 5H-Dibenzo[c, f][1, 2] diazepine, 3, 8 dichloro-6,11-dihydro, at 3.702 RT, Alkaloid class has – 2.98% 2,6-Dibromobenzoquinone was detected at 4.403 RT, steroid – 2.98% Acetanilide, 2-chloro-4'-nitro- at 4.403 RT was obtained and Terpene – 2.05% of Methyl .beta.-[N-methylanilino]acrylate was detected at 4.719 RT, respectively. Most of the identified phytochemicals matched with synthetic drugs and confirmed the purpose of their applicability in traditional medicine. This investigation established the reason a single extract may have a wide spectrum of effects on disease etiology. It validates the utilization of compounds in the extract for better therapeutic application, and drug delivery.

Keywords: Drugs-discovery, Datura stramonium, Bioactive, characterization secondary-metabolites

Introduction

There are several reports about the health benefits of herbal medicines. A lot has been tested on animal models as randomized trials in managing and controlling different ailments such as diabetes mellitus, arthritis, ulcer, cancers, and cases of flu, dysentery, and diarrhea. At most, the researcher may implicate the curative effect of the plant extract to the existence of several bioactive including alkaloids, flavonoids, terpenes, steroids, saponins, amines, and alcohols. Considering that each of the listed phytochemicals has sub-compound or classes of compounds, one may wonder which particular type or classes of these phytochemicals could ameliorate the effects of a disease on the test organism. To bridge the gap of generalizing the implication of the plant's extract, this work investigated the phytochemicals in Datura stramonium (Linn) leaves. The phytochemicals were identified, quantified, and characterized. The identified phytochemicals were blasted on the conventional or synthetic drug bank website to match their correlations and relativity. Meanwhile, synthetic drugs have the descriptions of formulation, synthesis, and indication for application. The choice of this plant was due to its applications in diverse areas. Curiously, it's been as an esoteric cannabinoid in some parts of Nigeria.

The learning of natural products in the expansion of curative interaction, include aspects of stereochemistry, Biochemistry, biosynthesis, bioinformatics and biological accomplishment to providing pathologically useful compounds. Primary metabolites are plant compounds that are expressed continuously (Jamal et al., 2016 cited in Babiker et al., 2017). Datura stramonium is known as Jimson weed (Lee, 2007). Its family is Solanaceae, which is rich in primary metabolites. Datura stramonium is a weed belonging to the Apiaceae family. Datura stramonium plant has been described by the World Health Organization (WHO) as one whose many of its parts contain substances that can be used for the synthesis of useful drugs. The demand for the medicinal plant is aggregating because of the rising recognition of regular products (Tatini and Raja, 2017). Plants chemicals are non-nutrient bioactive mixtures in plant's parts. Phytochemicals are a defensive and blocking mediator against many deteriorating infections including ageing, and Inflammation (Debasis et al., 2015). People have been exploring plants products in pursuit of novel medicines. This has led to use of a wide quantity of curative plants to treat various ailments. The leaves of D. stramonium are used in asthma treatment (Pretorius and Marx, 2006; Savithramma et al., 2007). The vital naturally active constituents in Datura stramonium comprised of alkaloids, atropine and scopolamine. Atropine has been utilized in treating Parkinson's disease, peptic ulcers, diarrhea, and bronchial asthma (Ivancheva et al., 2006). Its vegetation mucilages and PolyVinyl Pyrrolidone mixture has been used as

matrix-forming substances for continual production of matrix remedies (Ahad et al., 2012). D. stramonium is a normal source of antioxidants and phytochemicals with antimicrobial activities (Akharaiyi, 2011). Its juice usually express considerable antimicrobial activity against several microorganism including Staphylococcus aureus, Proteus Vulgaris, Pseudomonas aeruginosa, Escherichia coli, Aspergillus niger and Fusarium species (Reddy, 2009). The secondary metabolites of D. stramonium are vastly active against dissimilar ailments such as antidiabetic, antiviral, etc. (Nain et al., 2013). Water extract also shows insecticidal activities (Fan and Kriton, 2005). Datura stramonium is applied in Ayurvedic drug (Gaire and Subedi, 2013). The ethanol juice, show potent antimicrobial activities than water extracts. The leaves extracts suggest better efficacy than stem and root extract (Gachande and Khillare, 2013).

In India, about 75 % of the prescriptions are plants based (Solomon, 2015). The investigation on plant's natural products continues for the realizing a number of original energetic secondary metabolites (Ramendra and Vishnu, 2014), which has antifungal, antibacterial and anticancer activities. The basic extracts and uncontaminated compounds isolated from plant species are applied in herbal and traditional medications. Currently, it is necessary to isolate, identify and characterize novel secondary metabolites for the treatment of diverse maladies (Jalal 2016). The unidentified organic compounds in a complex mixture can be determined through the interpretation and matching their spectra with reference spectra (Rahim et al., 2018). The present work was carried out to identify some of the bioactive components in the leaves extract of Datura stramonium and matched with the reference spectra for the purpose of nascent drug discovery, production of drugs proper therapeutic regiment.

Materials and Methods

Collection and Identification of Plant Sample

Fresh and mature Datura stramonium leave, were obtained from Boki Local Government Area (LGA) of Cross River State, Nigeria. The leaves were washed with running water, and rinsed with distilled water. It was chopped into pieces, and air-dried. The dried samples were coarse using a blender. The coarse samples were stored at room temperature before extraction.

Identification and Authentification

The plant was identified by Dr. Ekpeike Solomon. He is in Biological Sciences Department, Faculty of Sciences, Cross River University of Technology, Calabar – Nigeria.

Preparation of Plant Extract

Twenty-five grams (25g) of the coarse leaves were weighed and transferred into the thimbles of the soxhlet extractor, One hundred and fifty (150 ml) normal-hexane) was measured and transferred into the round bottom flask of the soxhlet extractor. The solvent was heated to reflux through the heating mantle. After the extraction, the extracts were concentrated using a rotor for five days.

Screening of the Extract with GC/MS

A Gas Chromatography (Agilent 6890) was armed with a straight a deactivated 2 mm injector and 15 m All-tech EC-5 column (250 µ I.D., 0.25 µ film thickness). A split injection was used to inject the sample. The split ratio was set - 10:1. The oven temperature start at 35 °C, holds for 2 to 5 minutes, and ramped at 20 °C to 30 °C. The helium gas carrier was at 2 ml/minute flow rate. A GC mate II bench-top double-focusing magnetic sector was operated in electron ionization (EI) mode. TSS-20001 software was used for the analyses. Low-resolution mass spectra were attained at a determining power of 1000 (20 % height definition), while scanning starts from m/z 25 to m/z 700 at 0.3 seconds per scan with a 0.2-second inter-scan delay. High-resolution mass spectra were achieved at a resolving power of 5000 (20 % height definition) with a scanning of the magnet from m/z 65 to m/z 750 at 1 second per scan. The identification of the bioactive components of the pure compounds were matching their logged spectra with the data bank mass spectra of NIST library V 11 provided by the software of the instrument. During the analysis, the following conditions apply to the use of GC/MS techniques: GC/MS-QP2010 Agilent 6890 Plus; Ion source temperature: 200.00°C; Interface temperature: 250.00°C; Solvent cut time: 2.50 min; Detector gain mode: MS; Detector gain: 0.00 kV; Threshold: 2000; Column oven initial temperature: 70.0°C; Injection final temperature: 250.00°C; Injection Mode: Split; Flow control mode: linear velocity; Pressure: 116.9 kPa, total Flow: 40.8 ml min−1; Column flow: 1.80 ml min−1; Linear velocity: 49.2 cm sec−1; Trap and purge flow: 3.0 ml min−1; Split Ratio: 20.0; High pressure injection: OFF; Carrier Gas: Helium; Splitter hold: OFF.; While oven rating was as follows: Oven Temp. Program Rate Temperature (°C) Hold Time (min) Initial: 0.00 70.0 0.00 Final: 10.0 280 5.00.

Results

Bioactive Components Detected in D. Stramonium Leaves Extract

Results of bioactive analysis of Datura Stramonium leaves are presented in Tables designated as Table 1a, b, c, d, e, f, g, and h, separately. The Tables are indicated with peaks numbers (peak height), retention time (chromatogram peak number), area percentage (analyte concentration), library identified analytes (detected chemicals), bioactive class (secondary metabolites), reference number, CAS numbers, and minimum quality. About 80 variable bioactive were qualitatively and quantitatively detected in D. stramonium leaves with different concentrations. In most instances, three bioactive of the same or different metabolites will have the same peak height and area concentration, but different retention time, reference number and CAS number. For example, Table 1a have 5H-Dibenz ,f] [1,2]diazepine, 3, 8, dichloro-6, 11-dihydro whose metabolite is flavonoid had 1.24% area concentration at 3.702 retention time (minutes) on peak 1. A similar arrangement follows with other bioactive presented in Table 1b to 1h.

Peak H.	RT	Area %	Library/ID	Metabolites	Ref no	CAS	Min. Q
1	3.702	1.24	5H-Dibenzo[c,f][1,2]diazepine, 3,8 dichloro-6,11-dihydro- Acetylchloride, (2,4-dichlorophenoxy)- [5-(5-Bromopyridin-3-yl)-2H-1,2,4-triazol-3-yl]acetic acid	Flavonoid - Flavonoid	124275 100763 142388	00955-66-8 00774-74-3 1000387-64-2	74 64 48
2	3.834	1.29	1,5-Hexadiene, 1,1,2,5,6,6-hexachloro- 5-Bromo-2,3-dimethoxy-6-nitrobenzaldehyde 2,2',4',5'-Tetrachloroacetanilide	Terpenoid Flavonoid Flavonoid	146542 149053 131828	09841-62-9 1000253-65-8 02395-42-8	62 43 35
3	4.236	0.96	2-Oxo-3-[4-bromophenyl]propanoic acid s-Triazole-3-carboxaldehyde, 5-(p-chlorophenyl)	Flavonoid - Flavonoid	104693 71809 144540	03871 2-59-3 02689 9-27-4 1000305-64-9	40 35 35
			3-Bromo-4-chloro-5-methylbenzenesulfonic acid				
4	4.329	1.50	1H-Tetrazole, 1-ethyl-5-phenyl- Acetamide, 2-[4-(4-bromophenyl-thiazolyl]- 1,3,5-triazine-2-amine, 4-chloro-N-(4-ethenylphenyl)-6-methoxy-	Flavonoid Alkaloid Alkaloid	43503 154793 122371	02443 3-71-4 01796 9-16-3 1000401-58-8	53 51 51
5	4.403	2.98	2,6-Dibromobenzoquinone Ethyl 5-[2-pyridyl]-4-bromopyrazolcarboxylate Acetanilide, 2-chloro-4'-nitro-	Alkaloid Pyrazole alkaloids Steroid	125049 154049 78571	01964 3-45-9 1000211-49-9 01732 9-87-2	47 38 35
6	4.719	2.05	Methyl .beta.-[N-methylanilino]acrylate Methyl 2,4-tridecadiynoate Tetryl	Terpene Flavonoid Alkaloid	56745 83274 147304	08459 1-20-8 1000336-39-6 00047 9-45-8	25 18 15

7	4.818	1.38	Benzenesulfinic acid, 4-chloro-Oxazolidine, 2-isopropyl-4-[2-allyli]phenoxy]methyl]-Boron, difluoro(1,3-diphenyl-1,3-propanediolto)-	Alkaloid-Alkaloid	44721 135472 132302	000100-03-8 070687-97-7 014947-61-6	35 30 25

Table 1a: Bioactive Profile of Datura stramonium leaves Screened with GC-MS.

Peak H	RT	Area %	Library/ID	Metabolites	Ref no	CAS	Min. Qual.
8	4.892	7.68	4-benzoxazole, 2-(trifluoromethyl)-Pyridine, 2-(1-methyl ethyl)-Pyrazine, ethenyl-	Alcohol Amide Alkaloid Pyrazine	67709 9818 5132	100039 6-05-4 000644-98-4 004177-16-6	47 41 35
9	5.008	1.08	Ethyl 5-[4-pyridyl]-4-bromopyrazol-carboxylate Pyrrole-3-carboxaldehyde, 1-(4-bromo-3-methyl phenyl)-2,5-dimethyl-	Alkaloid Alkaloid Alkaloid	154050 150489 49053	100021 1-51-2 347331-84-4 001521-39-7	25 25 25
			Veratramide				
10	5.178	0.95	8-(2,3-Dimethylanilino)naphtho-1,2-quinone Acetamide, 2-chloro-N-(2,3-dihydro -1-methyl-pyrrolo[2,3-b]quinolin-4-yl)- Dimethyl trans, trans-3-(4-cyano-buta-1,3-dienyl)isoxazole-4,5-dicarboxylate	Alkaloid Alkaloid Alkaloid	137361 135285 122365	100005 8-06-7 351073-49-9 100014 7-02-5	50 48 30
11	5.210	0.94	Terephthalonitrile N, N'-dioxide 5-Bromo-6-methoxy-2-methyl-8-nitroquinoline 4,5,6-Trichloro-2-benzoxazolinone	Alkaloid Alkaloid Alkaloid	32504 154789 99549	003729-34-8 100021 4-70-0 050995-94-3	92 38 35
12	5.320	2.66	Benzene, 1-azido-4-nitro-Methyl .beta.-[N-methylanilino]acrylate	Alkaloid Alkaloid Alkaloid	35302 56745 147304	001516-60-5 084591-20-8 000479-45-8	30 25 12

			Tetryl				
13	5.609	1.09	1,3,4-Oxadiazol-2-amine, 5-(4-bromophenyl)- Terephthalonitrile N, N'-dioxide 3(2H)-Isoquinolinone, 1-amino-, oxime	Amine Flavonoid Flavonoid	101482 32504 44125	033621-62-4 003729-34-8 041536-79-2	55 53 53
14	5.641	1.41	s-Triazole-3-carboxaldehyde, 5-chlorophenyl)- 2-Methyl-2,3-epoxy-2,3-dihydro-naphthoquinone 4-Phenyl-2-(pyrrolidine-2-yl)-1H-imidazole	Flavonoid Alkaloid Alkaloid	71809 54382 77220	026899-27-4 015448-59-6 944030-47-1	50 46 44

Table 1b: Bioactive Profile of Datura stramonium leaves Screened with GC-MS.

Peak H.	RT	Area %	Library/ID	Metabolites	Ref no	CAS	Min. Qual.
15	5.670	0.94	Ethane, 1-[(2-chloroethyl)thio]-2-(ethylthio)- s-Triazole-3-carboxalde	Alkane Flavonoid Alkaloid	51593 71809 69825	092569-22-7 5026899-27-4 056055-54-0	90 47 45
			hyde, chlorophenyl)- Methyl 5,6-dichloropyridine-3-carb				
16	5.696	0.92	s-Triazole-3-carboxaldehyde, 5-chlorophenyl)- Furazan, nitrophenyl-, 5-oxide 5-Bromo-6-methoxy-2-methyl-8-nitroquinoline	Flavonoid Steroid isoquinoline alkaloid	71809 71753 154789	026899-27-4 049558-03-4 1000214-70-0	92 56 53
17	5.837	1.67	Benzenesulfinic acid, 4-chloro-1H-Tetrazole, 1-ethyl-5-phenyl- 5-Methyl-4-[4-(1,2,4-triazole-1-ylm ethyl)phenyl]-1,2,4-triazole-3-thiol	Flavonoid Alkaloid Alkaloid	44721 43503 131973	000100-03-8 024433-71-4 1000410-40-8	53 53 49
18	6.027	1.73	9,10-Di[chloromethyl]-S-octahydroanthracene	Terpenoid Quinoline alkaloid Terpene	141786 154789 29487	018256-06-9 1000214-70-0 058679-08-6	53 38 35

			5-Bromo-6-methoxy-2-methyl-8-nitroquinoline 1,2-Butadiene, 1,1,4-trichloro-				
19	6.052	1.09	N-(2-Phenylethyl)undeca-(2Z, 4E)-diene-8,10-diynamide 5-Chloro-N-methylisatoic anhydrazide 1,2-Butadiene, 1,1,4-trichloro-	Amide Amide Terpene	137413 75605 29487	099615-80-2 040707-01-5 058679-08-6	38 35 35
20	6.558	1.12	s-Triazole-3-carboxaldehyde, chlorophenyl)- 2-Methyl-2,3-epoxy-2,3-dihydro-1,4-naphthoquinone 1,2-Digermacyclopentane, 1,1,2,2-tetramethyl-	Flavonoid Quinoline alkaloid Cyclic Alkane	71809 54382 111878	5-026899-27-4 015448-59-6 035839-71-5	68 55 53
21	6.587	1.22	5-Bromo-6-methoxy-2	Quinoline alkaloid Alkane	154789 113828	1000214-70-0	62 59 38
			-methyl-8-nitroquinoline Mercury, chloromethyl- N-(2-Phenylethyl)undeca-(2Z, 4E)-diene-8,10-diynamide	Amide	137413	000115-09-3 099615-80-2	

Table 1c: Bioactive Profile of Datura stramonium leaves Screened with GC-MS.

Peak H.	RT	Area %	Library/ID	Metabolites	Ref no	CAS	Minimum Quality
22	6.648	1.20	9,10-Di[chloromethyl]-S-octahydroanthracene 4,6-Dibromo-2-benzoxazolinone 3,5,6,7,7,8-Hexachloro-5,6,7,8-tetrahydro-S-triazolo[4,3-a]pyridine	Alkaloid Alkaloid Alkaloid	141786 150985 185439	018256-06-9 1000260-92-6 022841-85-6	43 38 38
23	6.947	1.14	Terephthalonitrile N, N'-dioxide Androstan-4,16-dien-3-one, 17-formyl- Acetanilide,	Steroidal Alkaloid Steroid Steroidal Alkaloid	32504 157994 78571	003729-34-8 114724-34-4 017329-87-2	50 38 35

			2-chloro-4'-nitro-				
24	6.989	0.95	1,4-Dioxaspiro[4.5]deca-6,9-diene-2,8-dione 6-Bromo-4,7-dimethoxy-2H-1,3-benzodioxole-5-carbaldehyde 2-Thiophenecarbonitrile, 4-Bromo-	Terpene Aldehyde Steroidal Alkaloid	37021 147355 53820	00438 5-47-1 10954 8-10-9 10003 62-65-0	50 38 35
25	7.053	1.30	Methyl 2-bromo-3-cyano-6-methylpyridine-4-carboxylate 7,8-Methylenedioxy-5-oxo-1-fluorenecarboxylic acid, methyl ester 2,3-Diazabicyclo[3.3.0]octa-3,7-diene-4-carboxylic acid, 2-(4-methoxyphenyl)-, ethyl ester	Alkaloid Alkaloid Alkaloid	115716 141694 145855	10004 10-58-8 10001 11-66-8 10002 60-14-0	55 47 45
26	7.069	1.72	Acetanilide, 2-chloro-4'-nitro- 7-[2-Chloroethyl]guanine 5-Bromo-6-methoxy-2-methyl-8-nitroquinoline	Alkaloid Steroid Nucleotide Isoquinoline	78571 77363 154789	01732 9-87-2 02224 7-87-6 10002 14-70-0	35 35 35
27	7.120	1.70	(3-Nitrobenzyl)-O-tolylamine 4-Amino-6-morpholino-5-nitropyrimidine Phenol, 2-cyclohexyl-4,6-dinitro-	Amine Alkaloid Saponin Saponin	103988 88749 125969	10002 96-75-0 02495 7-88-8 00013 1-89-5	56 45 44
28	7.644	1.06	(3-Nitrobenzyl)-O-tolylamine [(2-Oxochromen-4-yl)sulfanyl]acetic acid 5-Chloro-3-[(2-chloro-acetylamino)-methyl]-2-hydroxy-benzo	Amine Flavonoid Amine alkaloid	103988 97970 136837	10002 96-75-0 10004 10-90-7 10002 94-79-5	90 40 40

			ic acid				

Table 1d: Bioactive Profile of Datura stramonium leaves Screened with GC-MS.

Peak H.	RT	Area %	Library/ID	Metabolites	Ref no	CAS	Min. Quality
29	7.773	0.98	5-Bromo-6-methoxy-2-methyl-8-nitro quinoline Ethyl 4-([(E)-(2-nitrophenyl)methy lidene]amino)benzoate 1H-1,2,3-benzotriazole, 5,6-dibromo-	Quinoline Alkaloid Alkaloid Alkaloid	154789 157260 135658	1000214-70-0 057707-09-2 1000401-84-4	83 45 42
30	7.924	0.93	5-Bromo-6-methoxy-2-methyl-8-nitro quinoline N-(2-Cyclopropylphenyl)-N'-(2,5-di methylphenyl)thiourea 2H-3,5a-Epoxynaphth[2,1-b]oxepin, dodecahydro-3,8,8,11a-tetramethyl-[3R-(3.alpha., 5a.alpha., 7a.beta., 11a.alpha., 11b.beta.)]-	Quinoline Alkaloid Flavonoid Flavonoid	154789 155625 138442	1000214-70-0 1000305-33-1 038419-74-8	55 45 44
31	8.191	0.95	4-Bromo-.alpha.-toluenesulfonic acid Lycoramine 2,5-Cyclohexadiene-1,4-dione, 2,5-dichloro-3,6-dimethoxy-	Alkaloid Alkaloid Terpene	111885 148854 98877	110874-72-1 021133-52-8 007210-71-1	43 40 35
32	8.287	0.99	1,4-Dioxaspiro[4.5]deca-6,9-diene-2,8-dione Hydrazine, 1-(bromo)nitromethylide ne-2-(4-nitrophenyl)-7-Nitro-2,1,3,4,5-[1,2,5]oxadiazol o[4,3-c]cinnoline-1, 5-dione	Terpene Alkaloid Indole *alkaloid*	37021 148348 110737	004385-47-1 064817-09-0 1000387-20-7	90 55 45
33	8.525	1.59	Terephthalonitrile N, N'-dioxide N-[4-Chloro-2-chloroacetamidopheny l]piperidine o-Veratramide	Alkaloid Alkaloid *Amide*	32504 145469 49053	003729-34-8 1000254-96-6 001521-39-7	43 38 35
34	8.564	0.94	Benzene, pentachloronitro- Terephthalonitrile N, N'-dioxide 5-Chloro-N-methylisatoic anhydrazide	Alkaloid Alkaloid Alkaloid	152888 32504 75605	000082-68-8 003729-34-8 040707-01-5	42 35 35
35	8.590	1.78	5H-Dibenzo[c,f][1,2]diazepine ,3,8 -dichloro-6,11-dihydro- 1,2,5,6-Tetrahydropyridine, 1-methyl-6-[2-pyridyl]-Benzofurazan , 4-Bromo-	Flavonoid Alkaloid Alkaloid	124275 42951 63746	000955-66-8 1000132-27-6 035036-93-2	70 56 48

Table 1e: Bioactive Profile of Datura stramonium leaves Screened with GC-MS.

Peak H.	RT	Area %	Library/ID	Metabolites	Ref no	CAS	Minimum Quality
36	9.352	1.61	2-Phenyl-6-nitrochromen-3-one, oxime 1(2H)-naphthalene, 3,4-dihydro-5-methoxy-2-methyl-, oxime Ethane, 1-[(2-chloroethyl)thio]-2-	Flavonoid Steroid -	143624 69606 51593	111421-24-0 1000396-08-3 092569-22-7	56 46 46

			(ethylthio)-				
37	9.435	2.20	5-Bromo-2-aminobenzophenone hydrazones 5-Bromo-2,3-dimethoxy-6-nitrobenzaldehyde 1H-Indolizino[8,7-b]indole-2-propanol, .beta.-ethyl-2,3,5,6,11,11b-hexahydro-	Flavone Flavone Flavone	148494 149053 157868	039573-18-7 1000253-65-8 014058-65-2	64 50 44
38	9.546	0.96	s-Triazole-3-carboxaldehyde, 5 chlorophenyl)- 2-Phenyl-6-nitrochroman-3-one, oxime 6-(2-Imino-3-oxazolidinyl)-N,N,N',N'-tetramethyl-1,3,5-triazine-2,4-diamine	Flavonoid Flavonoid Flavonoid	71809 143624 111988	026899-27-4 111421-24-0 087166-33-4	62 56 55
39	9.644	1.34	6-(2-Imino-3-oxazolidinyl)-	Alkaloid Amine Flavonoid	111988 123000 134384	087166-33-4 088701-57-9	72 48 48
			N,N,N',N'-tetramethyl-1,3,5-triazine-2,4-diamine Ethanone, 1-[4-(3-indolylmethylen)amino]phenyl- 2-[2-Methyl-4-chlorobenzoyl]benzoic acid			1000251-54-3	
40	9.738	1.05	Ethane, 1-[(2-chloroethyl)thio]-2-(ethylthio)- 1,2-Cyclopentanedicarboxylic acid, 4-[(trimethylsilyl)methylene]-, dimethyl ester, trans- 2-Methyl-2,3-epoxy-2,3-dihydro-1,4-naphthoquinone	Terpene Terpene Quinone Alkaloid	51593 130059 54382	092569-22-7 109613-12-9 015448-59-6	48 45 44
41	9.760	1.77	6,8,9-Trimethoxy-2-methyl-2,3-dihydronaphtho[1,2-b]furan-2-ol	Alkaloid Alkaloid Steroid	149757 148183 147975	1000195-16-7 000481-30-1 1000251-43-8	44 44 44

			Androst-4-en-3-one, 17-hydroxy-, (17.alpha.)- 5,10-Methano-2,7-dichloro-5-methyldibenzo[a,d]cycloheptane				
42	9.931	0.99	5-Bromo-6-methoxy-2-methyl-8-nitroquinoline 11H-Dibenzo[c,f][1,2]diazepin-11-ol, 3,8-dichloro-,5-xidediethylselanadiselenide	Isoquinoline Flavonoid Alkaloid	154789 153126 158086	100021470-0 023469-59-2 1000374-05-3	74 60 55

Table 1f: Bioactive Profile of Datura stramonium leaves Screened with GC-MS.

Peak H.	RT	Area %	Library/ID	Metabolites	Ref no	CAS	Minimum Quality
43	9.988	1.21	4-(1-Benzofuran-2-yl)-7-methoxychromen-2-one 6-Bromo-4,7-dimethoxy-2H-1,3-benzodioxole-5-carbaldehyde Pyrrolo[2,3-b]indole, 1-benzoyl-1,2,3,3a,8,8a-hexahydro-3a,8-dimethy l-, (3aS-cis)-	Flavon Flavonoid Alkaloid	151822 147355 151993	108154-51-4 109548-10-9 054833-65-7	44 25 25
44	10.001	1.25	2,3,5-Trichlorophenol, O-trifluoroacetyl- 2,4,6-Trichlorophenol, trifluoroacetate 2-Chloro-5-methyl-4,6-bis(2-thienyl)pyrimidine	Alkaloid Flavonol Amide	152147 152146 151235	1000374-26-9 1000365-26-5 131022-82-7	30 30 25
45	10.310	1.38	Ethyl 4-([(E)-(2-nitrophenyl)methylidene]amino)benzoate 1H-Indolizino[8,7-b]indole-1-propanol, .beta.-ethyl-2,3,5,6,11,11b-hexahydro-Chromone, 5-hydroxy-6,7,8-trimet	Flavonoid Flavonoid Flavonoid	157260 157867 139558	057707-09-2 055670-04-7 1000124-95-9	25 25 15

			hoxy-2,3-dimethyl-				
46	11.039	1.43	1H-Benzotriazole, 4,5,6,7-tetrachloro-3-(3,4-Methylenedioxy)phenyl-4-nitrocyclohexanone 4-Methyl-6-phenyl-3-thioxo-3,4-dihydro-1,2,4-triazine-5(2H)-one	Flavonoid Flavone Alkaloid	116404 123534 82127	002338-10-5 1000111-64-4 022936-87-4	47 46 45
47	11.037	2.06	Carbazol-1-ol, 1,2,3,4-tetrahydro-6-Bromo-9-ethyl- Ethyl 4-Bromo-alpha-cyano-beta-methyl-cis-cinnamate Benzene, pentachloronitro-	Flavonoid Terpenoid Terpenoid	152409 152287 152889	1000263-26-5 020992-89-6 000082-68-8	90 58 56
48	11.069	1.06	Pyrazole, 1-methyl-3-(4-nitrophenyl)- 1,3,4-Oxadiazol-2-amine, 5-(4-bromophenyl)- 1H-Tetrazole, 1-ethyl-5-phenyl-	Alkaloid Alkaloid Alkaloid	67254 101482 43503	073387-59-4 033621-62-4 024433-71-4	58 55 53
49	11.339	1.45	4-(4-Chlorophenyl)-3-morpholinopyrrol-2-carbaldehyde Dibenzo[b,f][1,4]diazocine, 5,6,11,12-tetrahydro-2-(trifluoromethyl) Ethanone, 1-(3,5-bromophenol)-	Flavonoid Flavonoid Flavonoid	149595 137963 136769	142405-54-7 027188-36-9 014401-73-1	46 46 45

Table 1g: Bioactive Profile of Datura stramonium leaves Screened with GC-MS.

Peak H.	RT	Area %	Library/ID	Metabolites	Ref no	CAS	Minimum Quality
50	11.664	1.33	Mercury, chloromethyl- 5-Bromo-6-methoxy-2-methyl-8-nitroquinoline 4,5,6-Trichloro-2-benzoxazolinone	Alkaloid Isoquinoline Isoquinoline	113828 154789 99549	000115-09-3 1000214-70-0 050995-94-3	80 62 62

51	11.850	1.03	3-Bromo-2,5-dichlorothiophene 5-Bromo-6-methoxy-2-methyl-8-nitroquinoline 3,5-Dichloro-2-hydrazinopyridine	Flavonoid Quinoline Alkaloid	93483 154789 45439	060404-18-4 1000214-70-0 104408-23-3	40 38 30
52	13.229	1.01	Pyrazole, 1-methyl-3-(4-nitrophenyl)- 1H-Tetrazole, 1-ethyl-5-phenyl- 1,3,4-Oxadiazol-2-amine, 5-(4-bromophenyl)-	Alkaloid Alkaloid	67254 43503 101482	073387-59-4 024433-71-4 033621-62-4	59 53 46
53	13.911	1.25	1,3,4-Oxadiazol-2-amine,5-(4-bromophenyl)- 1H-Tetrazole, 1-ethyl-5-phenyl- s-Triazole-3-carboxaldehyde, 5 chlorophenyls)-	Flavonoid Alkaloid Alkaloid	101482 43503 71809	033621-62-4 024433-71-4 026899-27-4	55 53 50
54	14.126	21.66	Phytol, 4-Chloro-6,7-dimethyl-3-N-(oxolan- 2-ylmethyl)-2H-pyrrolo[3,4-c]pyridine-1,3-diimine 2,2,6-Trimethyl-1-(3-methyl beta-1, 3-dienyl)-7-oxabicyclo[4.1.0]heptan-3-ol	Alkaloid Alkaloid Flavonol	155850 151308 85557	000150-86-7 1000388-01-6 1000191-85-4	53 41 41

Table 1h: Bioactive Profile of Datura stramonium leaves Screened with GC-MS.

Key: Peak height = peak H; RT = Retention time.

Discussion

An investigation to identify, quantifies, and characterized the different bioactive compounds in Datura stramonium (Jimson weed) leaves was carried out. The results showed 80 different bioactive constituents belonging to different metabolites including alkaloids, flavonoids, terpenoids, saponins, amine and steroids. A number of phytochemicals were detected and quantified - flavonoid had - 5H-Dibenzo[c,f][1,2]diazepine – 1.24% concentration at 3.702 retention time see Table 1a. This compound is also called 3-amino-5,12,12a-trihydro-4-oxo-1Hpyrazolo[4,3-e] thiochromeno [4,3-c] [1,2] diazepines (Ramendra and Vishnu, 2014). 5H-Dibenzodiazepines are used in treating a array of health problems. They act by activating a sedative substance in the brain and central nervous system (CNS). Negative outcome may include dizziness, poor co-ordination, and depression (Salzman, 1990). 5H-Dibenzodiazepines are usually used for a temporary management of severe insomnia. 5H-Dibenzodiazepines remain a potent anticonvulsants and vastly effective at averting protracted epileptic seizures. The dangerous part of this leave extract is when used in combination with alcohol or opioids. (American Psychiatric Association, 1998). 5H-Dibenzodiazepines binds stereo-specifically to an exclusive portion of GABA receptors with large protein complexes, located at some neurons in the CNS. GABA is the main inhibitory neurotransmitter in the brain (Stahl, 2002). 5H-Dibenzodiazepines potentiate GABA-

mediated transmission and are indirect GABA agonists (Buffett-Jerrott and Stewart, 2002; Fick et al., 2003). A chemical class of terpenoid - 1,5-Hexadiene, 1,1,2,5,6,6-hexachloro was detected and shown in Table 1a. It has 1.29% concentration and 3.834 retention time (RT). Also, an alkaloid - 2,6-Dibromobenzoquinone commonly called Quinone, 2,6-dibromo- had 2.98% at 4.403 RT. 2,6-Dibromoquinone-4-chloroimide is a reagent for the determination of phenols (Wagner et al., 2007). Katherine (2016) study the effect of halobenzoquinone on human neural stem cells (hNSCs), a flow cytometric analysis revealed that hNSCs exposed to 0.5 µM of 2,6-dichlorobenzoquinone (2, 6- DCBQ), for 96 hours which occasioned a greater quantities of cells in S-phase. This proposes the arrest of cell cycle in the S-phase where deoxyribonucleic (DNA) replication ensues.

In Table 1b, 4-benzoxazolol, 2-(trifluoromethyl) which belongs to Chlorzoxazone family of drugs was detected in the D. stramonium leave extract. Its concentration was 7.68% at 4.892 RT. This class of chemical is an alcohol derivative which acts as muscle relaxant bearing tranquilizing properties. It is claimed to prevent muscle twinge by causing an effect mostly at the spinal cord and subcortical areas (Martindale, https://www.drugbank.ca/drugs/DB00356). A series of ten different oxadiazole analogues were appraised for their *in vitro* activities against cancer in single-dose assay. The oxadiazole equivalents exhibited reasonable activity against cancer on several cell lines. The oxadiazole analogues increase their anticancer activities (Mohamed et al., 2013). Another alkaloid - 4-Phenyl-2-(pyrrolidin-2-yl)-1H-imidazole whose IUPAC name is 5-phenyl-1H-imidazole was detected and estimated as 1.41% at 5.641 RT. 5-phenyl-1H-imidazole 4.41% at 5.641 RT; 1,3,4-Oxadiazol-2-amine 1.09% at 5.609 RT and s-Triazole-3-carboxaldehyde, 5-chlorophenyl were detected. There are supplemented as azole antifungal agents. They work by obstructing the making of ergosterol, a vital constituent of cell membranes in fungal. It actions is by disrupting the cyctochrome p450 51 (Lanosterol 14-alpha demethylase) in fungal. This is crucial in the structure of the cell membranes of fungus. Its inhibition resulted into cell lysis (Tassaneeyakul et al., 1998). The inhibition in the production of ergosterol, causes holes to appear in cell membrane. This is because cell membranes are necessary for the survival of fungi. There general functions include Steroid hydroxylase action, which break down more than a few precarcinogens, tablets, and diluents to reactive metabolites (Tassaneeyakul et al., 1998; Monostory et al., 2004).

Furazan, nitrophenyl-, 5-oxide 0.92% at 5.696 RT. This compound is an organic compounds - nitrobenzenes. They contain a nitrobenzene moiety, this bioactive play a vital role on metalloaminopeptidase activity by removing the N-terminal of methionine from an emerging protein. The N-terminal of methionine is repeatedly sliced when the second residue in the primary sequence is lesser and uncharged (Met-Ala-, Cys, Gly, Pro) Berman et al. (2000). 5 -Bromo-6-methoxy-2-methyl-8-nitroquinoline (Quinoline *alkaloid*) 1.22% at 6.587 RT. This is an organic compound known as nitroquinolines. It contains a nitro group bonded to a quinoline (Pelletier et al., 1994) see Table 1c. This phytochemical had exhibits antitumor activity via inhibiting the type-2 methionine of aminopeptidase (MetAP2) protein involved in angiogenesis. Its antibacterial action originates from the metal ion complexion that is useful for bacterial growth (Pelletier et al., 1995; Shim et al., 2010).

In Table 1d, most important bioactive were detected and estimated. For example, androstan-4, 16-dien-3-one,17-formyl 1.14% at 6.947 RT is categorize as androstanes. This compound belongs to androgens and derivative, they are 3-hydroxylated C19 steroid hormones. Known to service the development of masculine characteristics, this accounted for its utilization as an esoteric cannabinoid by some youths (Chen et al., 2000). These same properties corroborate the use of this plant extract for the treatment of hair loss in humans, and function in Steroid hormone receptors - ligand-activated transcription factors that control the expression of eukaryotic gene and affect cellular proliferation and differentiation in target tissues (Takahashi et al., 2004). 2, 5-Cyclohexadiene-1,4-dione with 0.95% at 8.191 RT is also called RH-1. These are organic compounds known as p-benzoquinones. Benzoquinones have two C=O groups attached to carbon 1- and 4-positions, respectively. RH-1 has been used in trials studying the handling of Progressive Hard Cancers and Non-Hodgkin's Lymphoma (Tudor et al., 2005). At the superoxide dismutase activity, the enzyme help as a quinone reductase by linking with conjugation reactions of hydroquinons that is involved in detoxification corridors and biosynthetic routes including the vitamin (Overington et al., 2006; Imming et al., 2006). l]piperidine o-Veratramide 1.59% at 8.525 RT. This compound belongs to aminopiperidines. They contain piperidine that carries an amino group. At the triglyceride lipase activity pathway, l]piperidine is applied in the decontamination of xenobiotics and activation prodrugs containing ester and amide.

In Table 1e, tricyclic dibenzodiazepine, categorized as an uncommon antipsychotic agent (5H-Dibenzo[c,f][1,2]diazepine, 3,-dichloro-6,11-dihydro-) was detected and quantified – 1.78% at 8.590 RT. This compound binds to some receptors at the central nervous system and displays a distinctive pharmacological effect. 5H - Dibenzo[c,f][1,2]diazepine is a serotonin antagonist, with high binding to 5-HT 2A/2C receptor subtype (Berman et al., 2000; Weizman et al., 2003;). It also displays high affinity to numerous dopaminergic receptors, but expresses weak antagonism at the dopamine D2 receptor, a receptor that controls neuroleptic activity (Guarrera, 1999). The major adverse effect associated with the administration of this agent is agranulocytosis (an acute febrile condition noticeable by severe reduction in blood granulocytes and often linked with the use of certain drugs). Dibenzo[c,f][1,2]diazepine is a psychotropic agent belonging to benzisoxazole derivatives indicated for the treatment of schizophrenia (a mental disorder that is characterized by disturbances in thought in the case of hallucination). 5H - Dibenzo[c,f][1,2]diazepine is a discriminating monoaminergic antagonist with strong affinity for the serotonin Type-2 (5HT2), dopamine Type-2 (D2), 1 and 2 adrenergic, and H1 histaminergic receptors (Young et al., 2004). 5H-Dibenzo[c,f][1,2]diazepine serves as an antagonist to other receptors sites, but with lesser potency. Antagonism at receptors other than dopamine and 5HT2 with similar receptor affinities explain the side effect of 5H-Dibenzo[c,f][1,2]diazepine's (Stonehouse and Jones, 2005). 5H-Dibenzo[c,f][1,2]diazepine's antagonism of muscarinic M1-5 receptors explain its anticholinergic outcome

after administration or ingestion. 5H-Dibenzo[c,f] [1,2]diazepine's antagonism of histamine H1 receptors elucidate the somnolence experience with this drug. 5H-Dibenzo[c,f] [1,2]diazepine's antagonism of adrenergica-1 receptors could clarify the orthostatic hypotension observed with this bioactive (Takano et al., 2006). 5H-Dibenzo[c,f][1,2]diazepine's antipsychotic action is prospectively regulated via a combination of antagonistic effects at D2 receptors in the mesolimbic pathway and 5-HT2A receptors in the frontal cortex (Chen et al., 2002). The D-2 antagonism could relieve a helpful symptom while 5-HT2A antagonism alleviates harmful symptoms.

A 1.61% at 9.352 RT of 1(2H)-naphthalenone, 3,4-dihydro-5 was detected. It is called 2-[4-(4-Chlorophenyl) Cyclohexylidene]-3,4-Dihydroxy-1(2h)-Naphthalenone. Its mechanism of action deals ubiquinone binding to catalyzes the transformation of dihydroorotate to orotate, while quinone will remain electron acceptor (Berman et al., 2000). Phenyl-2H-chromene derivatives are derivative to synthesize triazole and biotin-containing chromene derivatives, to facilitate purification of protein targets (Bhaskar et al., 2010). These organic compounds are phenol ethers. They are aromatic compounds having ether group substituted with a benzene ring. It derivatives is 6-(2-phenoxyethoxy)-1, 3, 5-triazine-2, 4-diamine. It function deals with acetylation of coenzyme-A carboxylase complex. Where at first, biotin carboxylase will catalyze the carboxylation of the carrier protein and then the transcarboxylase transfers the Ca+ (Berman et al., 2000), find Table 1f.

A flavonoid named 4-(1-Benzofuran-2-yl)-7-methoxychromen-2-one had 1.21% at 9.988 RT was detected in D. stramonium leaves. This compound is a flavone whose backbone is 2-phenylchromen-4-one (2-phenyl-1-benzopyran-4-one) (Shimada et al., 2009). It has antibiotic activity (for Gram-positive bacteria) and antitumor activity (for some mouse tumors). It binds non-covalently to a chromophore which is the cytotoxic and mutagenic component of the antibiotic. The chromophore inturn binds to DNA as a weak intercalator and reasons a single - and double - strand breakdown (Shimada et al., 2010).

2-Chloro-5-methyl-4, 6-bis (2-thienyl) pyrimidine 1.25% at 10.001 RT was obtained from D. stramonium leaves and presented in Table 1g. This organic compound is known as aminobenzenesulfonamides (Derewlany et al., 1994). They contain benzenesulfonamide moiety with an amine group bonded to the benzene ring. This amide is directed for the treatment of bacterial infections which causes bronchitis, prostatitis and urinary tract infections. The role of 2-Chloro-5-methyl-4,6-bis(2-thienyl) pyrimidine is to inhibit the enzymatic conversion of pteridine and p-aminobenzoic acid (PABA) to dihydropteroic acid by opposing PABA from binding to dihydrofolate synthetase, an intermediate of tetrahydrofolic acid (THF) synthesis. THF is usually needed to synthesze purines and dTMP. Any disruption of its synthesis will inhibit the growth of bacterial. Pyrimethamine and trimethoprim inhibit dihydrofolate reductase, additional pace in THF synthesis, and act in synergy with 2-Chloro-5-methyl-4,6-bis(2-thienyl) pyrimidine. 2-Chloro-5-methyl-4,6-bis(2-thienyl) pyrimidine has a side effect which may be nausea, vomiting, diarrhea and hypersensitivity reactions (Friaza et al., 2010). Hematologic effects such as anemia, agranulocytosis, thrombocytopenia and hemolytic anemia in patients with glucose-6-phosphate dehydrogenase insufficiency may arise (Bratlid and Bergan, 1976). 2-Chloro-5-methyl-4,6-bis(2-thienyl) pyrimidine might dislodge bilirubin from albumin binding sites triggering jaundice or kernicterus in newborns (Angelakou et al., 1993).

In Table 1h, 5-Bromo-6-methoxy-2-methyl-8-nitroquinoline 1.33% at 11.664 RT was obtained. This compound is nitroquinolines and it derivatives. They contain a nitro group bonded to a quinoline. It is indicated for dealing with Schistosomiasis affected by Schistosoma mansoni (Filho et al., 2006). 5-Bromo-6-methoxy-2-methyl-8-nitroquinoline is an anthelmintic with schistosomicidal activity against Schistosoma mansoni, but not against other Schistosoma spp. 5-Bromo-6-methoxy-2-methyl-8-nitroquinoline causes worms to move from the mesenteric veins to the liver where the male worms are retained; the female worms return to the mesentery, but can no longer release egg (Overington et al., 2006). 5-Bromo-6-methoxy-2-methyl-8-nitroquinoline may link with an irreversible inhibitor of the nucleic acid metabolism. A premise has been put forth that the drug is activated by a single step, in which a schistosome sulfotransferase enzyme converts 5-Bromo-6-methoxy-2-methyl-8-nitroquinoline into an ester (probably acetate, phosphate, or sulfate group). Successively, the ester suddenly dissociates, the resultant electrophilic reactant is capable of alkylating the schistosome DNA (Imming et al., 2006; Pica-Mattoccia et al., 2006). The phytochemistry and therapeutic elucidation of Datura stramonium leaves extract has been well recognized in this investigation. In view of its multiple uses, more bioactive screening and structural elucidation studies are yet to be explored. The information presented in this work would be helpful in promoting research aiming at the development of methods for isolation and application of new agents for medical application and agro industries based on natural products derived from plants.

Conclusion

The information about jimson weed (leaves) covers many aspects including botanical, chemical, pharmaceutical and medical. The objectives of this study were to (a) develop an improved GC-MS procedure for the analysis of bioactive drug components in jimson weed leaves to shown the known and unknown alkaloids, Flavonoids, Terpenoids, saponins, amide, amines and alcohols using GC-MS technique. These bioactives were identified, classified, characterized and estimated. They were blasted against the synthetic drug bank to ascertain their therapeutic relevance, correlation and relativity. Much of their pharmacological relevance was describe together with their mechanism of actions. This is with the believe that drugs producers, researchers and herbal technicians will find better understanding in redirecting their treatment.

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