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QUANTIFICATION OF PHYTOCHEMICAL AND METABOLOMICS PROFILING OF THE NIGERIAN'S BOTANICAL APHRODISIAC Microdesmis keayana (MICRODESMIS) J. LEONARD (PANDACEAE) ROOT

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ABSTRACT

Microdesmis keayana is commonly known as microdesmis and is used in South-Western Nigeria as an aphrodisiac. Despite its extensive traditional usage, the bioactive constituents of this plant's roots are yet to be explored thoroughly. The present study was carried out to actuate the chemical components of Microdesmis keayana root by quantitative phytochemical screening and gas chromatography-mass spectrometry (GC-MS). Sixty grams of the powdered roots was sequentially extracted by ethanol and later tested for preliminary quantitative phytochemical screening and further subject to GC-MS analysis. The results showed the presence of alkaloids (17.85±0.48), flavonoids (6.17±0.27), tannins (6.17±0.27), steroids (5.53±0.1), saponins (9.25±0.02), phenols (3.01±0.11) and cardiac glycoside (3.41±0.13) in the extract. The GC-MS analysis revealed the presence of 14 major compounds of different chemical class relevant to the National Institute of Standards and Technology (NIST) library. The findings indicated that the studied plant possesses therapeutic compounds that could improve a person's health, and therefore justifies its traditional usage in the management of male sexual dysfunction and other reproductive disorders.

Keywords: Aphrodisiac activity, disorders, gas chromatography-mass spectrometry, Microdesmis keayana, phytochemical screening.

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1. INTRODUCTION

The use of plants for curative measures dates back to the birth of mankind on earth. Medicinal plants are frequently used in variance inevitable aspect of mankind, be it medical, industrial, agricultural, nutritional, environment and a great many of the other sustainable fields. The relevancy of the medicinal species in health sustainability is of a global interest in making use of the medicinal herbs. These species and their pharmaceutical values are introduces in pharmacopoeia (Fatemaeh *et al*., 2017); having been subjected to scientific research and investigation. Scientific research and investigation on medicinal herbs, remains distinct position in the precise identification of active ingredients, which usually contributes to the proposition of predictions regarding the medicinal value of specific species (AzadBakht, 2000). The botanical aphrodisiac, *Microdesmis keayana* (J. Leonard) (synonymous *Microdesmis puberula*), belongs to the family, Pandaceae. It is known as 'Apata' (Yoruba (Ikale/Ilaje) –Western Nigeria); and has being in use extensively, among the local population, as an aphrodisiac to relieve sexual dysfunction, boost libido and enhances fertility in male. The common name of *Microdesmis keayana* is Microdesmis, it is a dioecious shrub growing up to 3-6 m high, and is widely distributed in the western part of Africa from Senegal east to south-western Nigeria (Burkill, 1997). According to oral communication and the information collected from the village physicians, herbalist, herb sellers and those engaged in self-medication in Ilaje local government area of ondo state, Nigeria, the root of *M. keayana* is widely used to curtail male sexual dysfunction and other related ailments. The leaves, which are practically alternate, distichous, ovate, stipules linear and simple are commonly taken orally or applied, sometimes together with twigs sap as enema to treat diarrhea. The infusion of the leaf is taken to induce menstruation and as an abortifacient in Liberia, Nigeria and Sierra Leone (Neuwinger, 2000). A decoction made from the leaves, or leafy twigs or ground young leaves is used as a steam bath or wash to treat rheumatism or migraine in Cote d' Ivoire and Ghana (Cunningham, 1993).

The use of plant products or materials in ethnomedicine is increasing globally. The World Health Organization has also pointed out that about 80% of the world's population rely heavily on herbal medicinal products for the treatment of various health challenges (WHO, 2004). These products are being prepared as decoction, infusions, extracts, or pastes with easily accessible liquids such as alcohol, water, and milk. In olden days itself the importance of medicinal plants have been discovered. At that time there was no synthetic medicines, they have been using only the herbal medicines to treat all ailments. From this one can understand that plants are rich in medicinal properties and they are very useful in human health and wellbeing. Nowadays, much attention is focused on the vast botanical resources of Africa and their use as alternatives and complementary sources of medicine. This is likely to be as a result of the putative salutary effect of most Africa plants that is attributed to the

presence of secondary metabolites. Medicinal plants have constituted the source of health care all over the world since time immemorial and thus remain the mainstay of drug discovery (Beyene and Deribe, 2016); this is believed to be as a result of the presence of certain plant chemicals (phytochemicals). Phytochemicals which may also be referred to as phytonutrients/phytoconstituents are present in diverse kinds of plants which are consumed as essential components of both human and animal diet where they have marked physiological effects (Awotedu *et al*., 2019). The bioactive principles of note in plants are alkaloid, flavonoid, tannins, saponins and phenolic compounds; this active principles, alongside the vitamins and minerals have been implicated to contribute to their various physiologic, metabolic and protective effects (Awotedu *et al*., 2019).

The metabolic state of an organism depends on its genome, proteome and exposome (environment). Thus, metabolomics is the study of metabolites profiles. It utilizes mass spectrometry methods to analyze many different metabolites in a biological sample. Hence, secondary metabolites or products are heterogeneous group of natural metabolic products that are not essential for vegetative growth of the producing organisms, but they are considered differentiation compounds conferring adaptive roles, for examples, by functioning as defense compounds or signaling molecules in ecological interactions, symbiosis, and so on (Markley *et al*., 2017). The multitude of secondary metabolites secretions is harvested by human kind to improve their health (antibiotics, enzymes inhibitors, and antitumor), and widen the pyramid of healthy nutrition. They are sources of antioxidant and antimicrobial agents (Markley *et al*., 2017).

Wild vegetation are potential sources of these phytochemicals and antioxidants that play a vital role in health promotion, especially in the rural populations, which have better access to these plants. These phytochemicals are responsible for many biological effects, including antioxidant, anti-inflammatory, antimicrobial, and anticancer activities (Tabuti *et al*., 2003), and therefore, they may find therapeutic applications in formulation of various pharmaceutical drugs. Medicinal plants appears to be rich in secondary metabolites, widely used in traditional medicine to combat and cure various ailments, thus, the increasing demands. Traditional medicine occupies a central place among rural communities of developing countries for the provision of health care in the absence of an efficient primary health care system. The existence of traditional medicine depends on plant species diversity and related knowledge of their use as herbal medicines (Tabuti *et al*., 2003).

The bioactive components responsible for medicinal activities of any plants can be identified by various analytical biological techniques such as gas chromatography-mass spectrometry. Gas chromatography- mass spectrometry (GC-MS) is used as a technique that serves a broad range of applications aimed at sample identification, quantitative determination or both. The sample identification (qualitative analysis) needs a high degree of selectivity whereas quantitative analysis requires high accuracy (the precision and trueness) (Fialkov *et al*., 2006). GC-MS is one of the valuable tool for the identification of phytochemical compounds. It combines two

analytical techniques to a single method of analyzing mixtures of chemical compounds. Gas chromatography separates the components of the mixture and mass spectroscopy analyses each of the components separately. It is the best technique to identify the bioactive compounds/constituents of long chain hydrocarbon, such as alcohols, acids, esters, alkaloids, steroids, amino and nitro compounds (Azhagumurugan and Rajan, 2014; Baskaran *et al*., 2016). The first step in investigating the presence of metabolites in any medicinal plants is by phytochemical screening that gives a broad idea on the nature of chemical constituents (Konig and Hochmuth, 2004). To identify the compound, processing data from GC-MS must fulfil two criteria which includes; correct determination of mass spectrum of individual compounds; and accurate calculation of the abundance of chromatographic peaks corresponding to those compounds in each sample. Moreover, for sample introduction into GC-MS, there are three considerations. Firstly, the constituent of the sample must be volatile and secondly the analytes must be present at concentration which is appropriate to it. Thirdly, while injecting the sample, it must not degrade the separation (Fialkov et al., 2006). The source material, *Microdesmis keayana*, was reported indigenously, to be a plant of strong aphrodisiac potentials (Erhabor *et al*., 2015), but so far there is no enough research performed on determination of the quantitative chemical composition of its root in literature.

Hence, in continuation to the on-going project on the survey of medicinal plants used as aphrodisiacs in South-Western Nigeria, this study therefore, aimed to investigate the bioactive constituents of the studied plant with the view to justify its ethnomedicinal usage.

2. MATERIALS AND METHODS

2.1. Sampling of *Microdesmis keayana*

The samples of the plant material (root) was collected from Digbolu Camp-area of Ikoya Land, Okitipupa local government area of Ondo State, Nigeria during the month of January, 2020, at 10:00 AM. The collected plant was authenticated by a Botanist at the OSUSTECH Herbarium of the Department of Biological Sciences, Faculty of Science, Ondo State University of Science and Technology, Okitipupa, Nigeria, where voucher specimen are kept. The roots of *Microdesmis keayana*, were detached from the rest of the plant after which they were washed with clean tap water thrice to eradicate debris, and later oven-dried to a constant weight at 30˚C for 1 week. Thereafter, the dried roots were then milled to a homogenous powder using an electric blender (Polymix PX-MFC 90D, KINEMATICA AG, Luzern, Switzerland).

2.2. Plant extraction

About 60 g of the powdered roots was extracted in 1000 ml of ethanol (99.99%) and placed on an orbital shaker (Labcon laboratory service [Pty], South Africa) for 24 h. The extract was later filtered using a Buchner funnel and Whatman No. 1 filter paper. The resulting filtrate was concentrated to dryness using a rotary evaporator (Heidolph Laborata 4000, Heidolph instruments, GmbH and Co, Germany). The final extract

was weighed to determine the yield (4.54%) and then stored at 4˚C in a refrigerator for further studies.

2.3. Determination of preliminary quantitative phytochemical of *M. keayana* root

Phytochemical constituents such as alkaloids, flavonoids, saponins, tannins, steroids, phenol, and cardiac glycosides were screened quantitatively. The method described by Trease and Evans (1989) was adopted to assay for the quantitative phytochemical in the roots of *M. keayana*.

2.3.1. Estimation of Saponin

The sample was ground and 20 gm of the sample put into a conical flask followed by the addition of 100 ml of 20% methanol. It was then heated over a hot water bath for 4 hours with continuous stirring at about 55˚C. The mixture was filtered and the residue re-extracted with 200 ml of 20% methanol. The extract was reduced to 40 ml over water bath at about 90˚C. The concentrate of the extract was washed twice with 10 ml of 5% aqueous sodium chloride. The remaining solution was heated in a water bath. After evaporation, the sample was dried in the oven to a constant weight. Saponin content was calculated as percentage.

2.3.2. Estimation of Alkaloids

5 gm of the sample was weighed into a 250 ml beaker and 200 ml of 10% acetic acid in methanol was added and covered and allowed to stand for 4 hrs. The solution was then filtered and the extract was concentrated on a water-bath to one-quarter of the original volume. Concentrated ammonium hydroxide was added drop-wise to the extract until the precipitation was complete. The whole solution was allowed to settle and the precipitate was collected and washed with dilute ammonium hydroxide and then filtered. The residue if present is the alkaloid which is dried and weighed. **2.3.3. Estimation of Phenols by Spectrophotometric Method**

The fat free sample was boiled with 50 ml of methanol of the phenolic component for 15 minutes. 5 ml of the extract was pipetted into a 50 ml flask, followed by the addition of 10 ml of distilled water. 2 ml of ammonium hydroxide solution and 5 ml of concentrated amylalcohol were also added. The sample was made up to mark and colour developed was measured after 30 minutes at 505 nm under room temperature.

2.3.4. Estimation of Flavonoids

10 mg of the plant sample was extracted repeatedly with 100 ml of 80% aqueous methanol at room temperature. The whole solution was filtered through whatman filter paper No. 42 (125 mm). The filtrate was later transferred into a crucible and evaporated into dryness over water bath and weighed to a constant weight.

2.3.5. Estimation of Tannins

200 mg of the sample was weighed into a 50 ml plastic bottled. 50 ml volumetric flask and made up to the mark. Then 5 ml of the filtrate was pipette out into a test tube and mixed with 2 ml of 0.1M FeCl3 in 0.1N HCl and 0.008M potassium ferrocyanide. The absorbance was measured at 120 nm within 10 minutes.

2.3.6. Estimation of Steroids

The extract (1 g) was marcarated with 20 ml ethanol and filtered. To the filterate (2 ml). 2 ml of chromagen solution was added and the solution left to stand for 30 minutes. The absorbance was read at 550 nm.

2.3.7. Estimation of Cardiac Glycosides

The extract (1 g) was marcarated with 50 ml of distilled water and filtered. To the filtrate (1 ml). 4 ml of alkaline pirate solution was added. The mixture was boiled for 5 minutes and allowed to cool. The absorbance was read at 490 nm.

2.4. Gas chromatography-mass spectrometry analysis

The GC-MS analysis of the ethanol extract of *Microdesmis keayana* root was carried out using an Agilent 7890 GC system equipped with an Agilent 5977A Mass selective detector system (Chemetrix [Pty] Ltd., Agilent Technologies, DE, Germany) with a Zebron-5MS (cross-linked 5% - phenyl methyl polysiloxane) column (HP-5 fused silica 30 m x 0.320 mm x 0.250 µm film thickness). The instrument was operated at injection temperature (250˚C), ion source temperature (280˚C), and pressure (48.745 kpa). The carrier gas used was GC-grade helium (99.999% purity) at a flow rate of 36.262 cm/s, and about 1 µL sample injections was used. The oven temperature was initially started from 40˚C (held for 1 minute) and then ramped to 240˚C at 3˚C/minute.

2.4.1. Identification of Components

Identification of components was conducted using the National Institute of Standard and Technology library source. The mass spectrum of individual unknown compound was achieved by comparing their retention times with those of the known compound in the software database library.

2.5. Data analysis

The data obtained in chemical contents were analysed by one way ANOVA and values were regarded significant at $p < 0.05$. Results expressed as means and standard error of mean.

3. RESULTS

3.1. Phytochemical assay

In the present study; phytochemical components detected were analyzed quantitatively in the laboratory by the common methods using chemicals, and the result shown in Table 1. Alkaloids ($17.85^{a}\pm0.48$), flavonoids ($6.17^{c}\pm0.27$), saponins ($9.25^{b}\pm0.02$), tannins ($6.17^{c}\pm0.27$), steroids ($5.53^{c}\pm0.1$), phenols ($3.01^{d}\pm0.11$), and cardiac glycoside ($3.41^{d}\pm0.13$) were found in valuable quantity in the root extract of this plant (Table 1).

2.2. Gas chromatography-mass spectrometry analysis

From the GC-MS analysis of *Microdesmis keayana* roots, the spectral chromatogram (Figure 1), showed 14 peaks, revealing the presence of fourteen (14) compouds (phytochemical constituents) in the medicinal quality of the plant. Peak area,

retention time and molecular formula were used for the confirmation of phytochemical compounds. The active principles with their retention time (RT), molecular formula (MF), molecular weight (MW), chemical structure and peak area in percentage are presented. GC-MS analysis of ethanol extract of *Microdesmis keayana* roots revealed the existence of 1,2,3-Propanetriol, Octodecanoic acid, Tridecanoic acid, Hexadecanoic acid, 9,12-Octodecanoic -1-ol, 10-Octadecenoic acid, Docosanoic acid, 1,3-Propanediol, n-Decanoic acid, 1-Fluorodecane, Trans-Dodec-5-enal, 9-Tetradecenal, Pentadecanoic acid, and 13-Tetradecenal (Table 2). The peak report TIC (total ion chromatogram) of the fourteen (14) identified compounds by GC-MS analysis of *M. keayana* root is shown in Table 3.

Table 1.Preliminary quantitative phytochemical analysis of *M. keayana* root

Phytochemicals	**Composition (%)**
Saponins	9.25^{b}±0.02
Phenols	3.01^{d}±0.11
Alkaloids	17.85^{a}±0.48
Tannins	7.65^{c}±0.04
Flavonoids	6.17^{c}±0.27
Cardiac glycosides	3.41^{d}±0.13
Steroids	5.53^{c}±0.1

*Data expressed as mean ± SEM; means with different superscripts differs significantly
at $p < 0.05$.

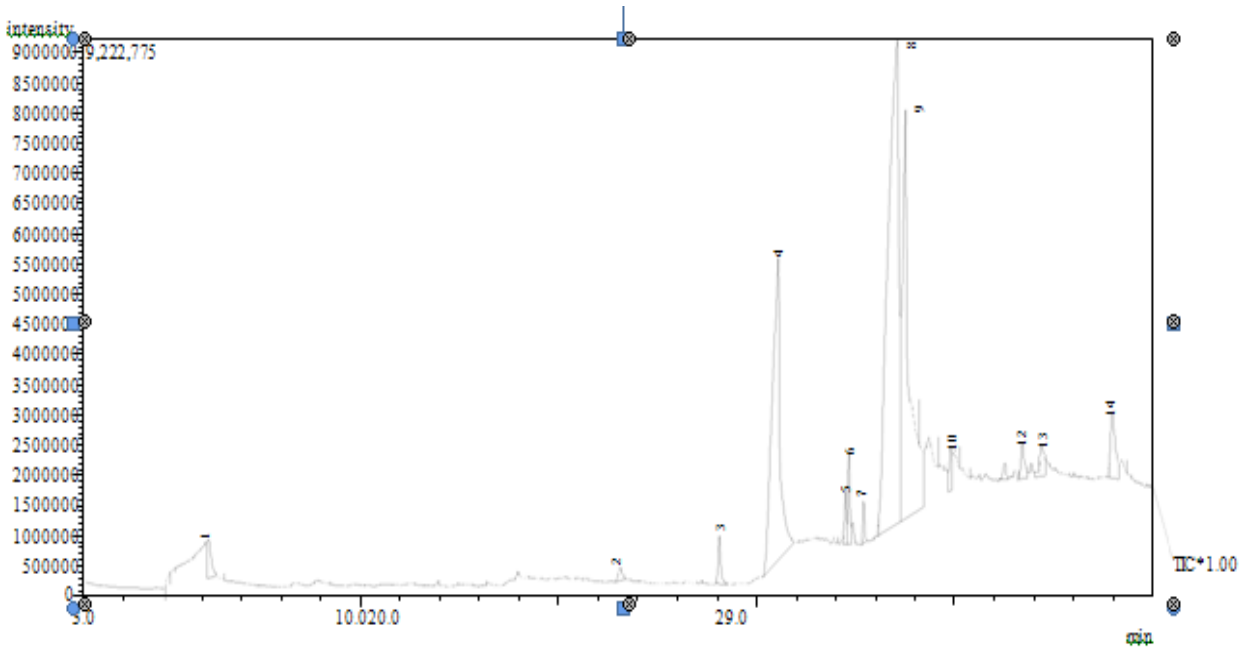
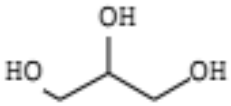
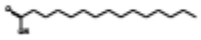
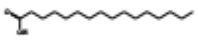
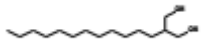
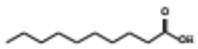
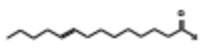


Figure 1. GC-MS spectral chromatogram of *Microdesmis keayana* root

Table 2.The major phytocompounds detected in the ethanol root extract of *Microdesmis keayana* by gas cromatography-mass spectrometry analysis

Sr. no.	Name of Compound	Molecular Formula	Molecular weight	Chemical structure	Bioactivity
1	1,2,3-Propanetriol	$C_3H_8O_3$	92		Antimicrobial (Alagammal *et al*., 2012)
2	Octadecanoic acid	$C_{18}H_{36}O_2$	284		Antioxidant (Baskaran *et al*., 2016)
3	Tridecanoic acid	$C_{14}H_{28}O2$	228		Antioxidant (Baskaran *et al*., 2016)
4	Hexadecanoic acid	$C_{16}H_{32}O_2$	256		Antimicrobial, and antioxidant (Rai *et al*., 2016)
5	9,12-Octodecanoic-1-ol	$C_{18}H_{34}O_2$	266		No activity reported
6	10-Octadecenoic acid	$C_{19}H_{36}O_2$	296		Antibacterial (Azhagumurugan and Rajan, 2014)
7	Docosanoic acid	$C_{23}H_{46}O_2$	354		No activity reported
8	1,3-Propanediol	$C_{15}H_{32}O_2$	244		Antibacterial (Baskaran *et al*., 2016)
9	n-Decanoic acid	$C_{10}H_{20}O_2$	174		No activity reported in literature
10	1-Fluorodecane	$C_{10}H_{21}F$	146		Antimicrobial (Baskaran *et al*., 2016)
11	Trans-Dodec-5-enal	$C_{12}H_{22}O$	182		Antipyretic, and Antioxidant (Rai *et al*., 2016)
12	9-Tetradecenal	$C_{14}H_{26}O$	210		No reported activity in literature

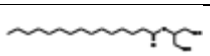
13	Pentadecanoic acid	$C_{18}H_{36}O_4$	316		Hypocholesterolemic (Baskaran *et al*., 2016)
14	13-Tetradecenal	$C_{14}H_{26}O$	210		No reported activity in literature

Table 3.Peak report TIC identified by GC-MS analysis of *M. keayana* root

Peaks	R.Time	I.Time	F.Time	Area	Area%	Height	Height%	A/H	Mark
1	6.076	6.050	6.258	4249356	1.20	655969	2.35	6.48	V
2	16.494	16.408	16.658	1499185	0.42	211585	0.76	7.09	
3	19.018	18.925	19.225	3813529	1.07	804415	2.88	4.74	S
4	20.519	20.133	20.908	71456333	20.11	5041697	18.03	14.17	
5	22.211	22.150	22.250	3030585	0.85	900460	3.22	3.37	V
6	22.302	22.250	22.358	5640404	1.59	1547529	5.53	3.65	V
7	22.673	22.600	22.767	2277975	0.64	712895	2.55	3.20	
8	23.523	22.967	23.608	155367724	43.72	8053710	28.80	19.29	
9	23.738	23.608	24.200	85746097	24.13	6808121	24.35	12.59	V
10	24.876	24.817	24.917	3442516	0.97	733749	2.62	4.69	V
11	26.254	26.108	26.333	1623654	0.46	283781	1.01	5.72	
12	26.696	26.583	26.833	3575456	1.01	592333	2.12	6.04	
13	27.178	27.008	27.275	3850536	1.08	507870	1.82	7.58	V
14	28.968	28.825	29.142	9796705	2.76	1106121	3.96	8.86	
				355370055	100.00	27960235	100.00		

4. DISCUSSION

The medicinal values of plants, *Microdesmis keayana* for instance, lies in the bioactive phytochemical constituents that are non-nutritive chemicals that produce definite physiological effects on human body and protect them from various diseases. Plants defend themselves from pathogens and other herbivorous enemies by elaborating a variety of bioactive secondary metabolites that may have multiple molecular sites of action. Accordingly, exploitation of these useful plants has spread rapidly to safeguard increasing population from various pathogens and ailments. Phytochemical screening can help to reveal the chemical constituents of the plant extract and the one that predominates over the others. It may also be used to search for bioactive agents for starting products used in the partial synthesis of some useful drugs (Evans, 2002). The quantitative phytochemical screening of the plant root ethanol extract showed the detection of major metabolites (saponins, alkaloids, phenols, flavonoids, tannins, steroids and cardiac glycosides) that were reported to be useful phyto-therapeutically. The phytochemical analysis conducted in this study, reveals quantifiable concentrations of alkaloids ($17.85^{a}\pm0.48$), flavonoids ($6.17^{c}\pm0.27$), saponins ($9.25^{b}\pm0.02$), tannins ($6.17^{c}\pm0.27$), steroids ($5.53^{c}\pm0.1$), phenols ($3.01^{d}\pm0.11$), and cardiac glycoside ($3.41^{d}\pm0.13$) (Table 1). Other phytoconstituents of biochemically active compounds in *M. keayana* roots have been reported, these include 1,2,3-Propanetriol, Octodecanoic acid, Tridecanoic acid, Hexadecanoic acid, 9,12-Octodecanoic -1-ol, 10-Octadecenoic acid, Docosanoic acid, 1,3-Propanediol, n-Decanoic acid, 1-Fluorodecane, Trans-Dodec-5-enal, 9-Tetradecenal, Pentadecanoic acid, and 13-Tetradecenal (Table 2). Several phytochemicals have been implicated in enhancing sexual functions in male rats, and so many bioactivities. For example, saponins in *Fadogia agrestis* and *Tribulus terrestris* as well as alkaloids in *Pausinystalia yohimbe* and *Microdesmis kearyana* have been shown to be responsible for aphrodisiac activity (Ernst and Pittler, 1998; Gauthaman *et al*., 2002; Yakubu *et al*., 2005 and Zamble *et al*., 2008).

Plants have been used for therapeutic, religious, cosmetic, nutritional, and beautification purposes since ancient times and humanity of all civilization are familiar with their usage. Herbs have been used prevalently as home remedies to treat diseases like diabetes, cough, cold, arthritis, stomachache etc., in several countries of Asia, Africa, Europe, and beyond. They contain phytochemicals that possess beneficial effects in health maintenance, management of diseases, and alleviating the harmful effects of toxic substances.

This study was designed to investigate and document the bioactive compounds present in the root of *Microdesmis keayana* for scientific validation of its phytotherapeutic agent as claimed in the folkloric medicine. Plants are the richest sources of secondary metabolites with varying biological activities. These secondary metabolites are the important source with variety of structural arrangements and properties (Kumari *et al*., 2016). Metabolite profiling in plant species was done by gas chromatography-mass spectrometry method for last few years. But only a limited number of plant research laboratories have gas chromatography-mass spectrometry. The identified compounds exhibits many biological properties (Table 2). GC-MS

analysis of phytoconstituents in plants gives a clear picture of the pharmaceutical value of that plant. Thus, this type of GC-MS analysis is the first step towards understanding the nature of medicinal properties in this medicinal plant, and type of study will be helpful for further detailed study. Further investigation is needed to identify the pharmacological importance and phytochemistry of *Microdesmis keayana*.

The available literature supports that the identified compounds (secondary metabolites) of *Microdesmis keayana* root possess several biological activities like antimicrobial (Alagammal *et al*., 2012), antioxidant (Baskaran *et al*., 2016; Rai *et al*., 2016), antibacterial (Azhagumurugan and Rajan, 2014), antipyretic (Rai *et al*., 2016), and hypocholesterolemic activities (Baskaran *et al*., 2016). Owing to the biological activities of the plant-derived metabolites, as observed in the ethanol extract of *Microdesmis keayana* root, many source material of plant origin have becomes field of great scientific interest, and further study of these phytoconstituents may prove the medicinal importance in future.

GC-MS is the best techniques to identify the constituents of volatile matter, long chain, branched chain hydrocarbons, alcohols acids, esters, etc. Mass spectrometry becomes a vital tool in the hands of the organic chemists and biochemists because of its potential to supply the definitive, qualitative and quantitative information on molecules based on their structural compositions. Gas chromatography attached to a Mass Spectrometer (GC-MS) enables mixture of small molecules mainly organic compounds of low molecular weight (<600) which can be analysed (Thomas *et al*., 2013; Salido *et al*., 2016). Recently GC-MS analysis is increasingly applied for the analysis of medicinal plants and this technique prove to be a valuable method for the analysis of non-polar components and volatile essential oil, fatty acids, lipids and alkaloids (Xie et al., 2013). Plants produce diverse phytochemicals known as secondary metabolites. It is well known that plants produce these metabolites to protect themselves from pathogenic attacks. The structures of the various phytochemicals which contribute to the medicinal activity of the ethanol extract of *Microdesmis keayana* root are shown in Table 2. The findings from the study were found to be rich and confirm the therapeutic application of this botanical.

5. CONCLUSION AND RECOMMENDATION

The present study reveals useful information about phytochemicals and phytocompounds contained in the root extract of *M. keayana*. From the results, it was found that the detected phytochemicals possessed valuable concentrations, and it can be deduced that medicinal plants are natural reservoirs of several phytonutrients and compounds which are inevitable and essential to life in general. The phytochemical constituents of ethanol extract of *Microdesmis keayana* root revealed by quantitative screening and gas chromatography-mass spectrometry analyses depicts their importance in folklore and phytopharmaceutical. Therefore, further studies should be

carried out on the extensive and detailed bioactivity of the identified phytocompounds coupled with safety in effecting healing.

6. REFERENCES

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