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THE IDENTIFICATION OF PHYTOCHEMICALS OF MEDICINAL IMPORTANT IN *SENNA OCCIDENTALIS* (L.) LINK

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Abstract

Plants or plant based traditional medicines are used to take care of issues related to human health using since long time. The present study was aimed to investigate the phytochemicals of aqueous, ethanol and hexane extracts of whole plant, leaves and seeds of *Senna occidentalis*. Phytochemicals like alkaloids, flavonoids, betaxanthin, coumarins, resin, steroids, terpenoids and tannins *etc*. have been reported in these extracts. GC-MS chromatogram of ethanol and hexane extracts of seeds has publicised eighteen and six compounds respectively. Some of the major compounds include eicosane 7-hexyl-, tricaproin, benzene, (ethoxymethyl)-, dasycarpidan-1-methanol, acetate (ester), astaxanthin. FTIR spectroscopic analysis revealed the presence alcohols, alkynes, alkenes, aldehydes amines and esters in different parts. The reported compounds have curative potential for different human health problems. Significance of utilizing *Senna occidentalis* in traditional medicines gets supported through these findings.

Key words : *Senna occidentalis*, Whole plant, Leaves, Seeds, Phytochemicals, GC-MS analysis, FTIR analysis.

Introduction

Plants are important for sustainable life on the earth including humans. Since large number of plants is used as a source of therapeutics, plants and their products have attracted the researchers in the field of ethno-medicine. Various studies have mentioned the use of plant materials in medicines because of their curative potential and minimum side effects. Medicinal plants are believed to be important source of new chemical substances with potential therapeutic effects (Sofowora, 1993). The medicinal value of plants pertains to presence of various metabolites (alkaloids, flavonoids, terpenoids, phenolics *etc*). It is pertinent to record that the chemical constituents of the plants depends upon the species, variety, growth conditions, geographical area, time of collection, climatic conditions and part of the plant used. The above mentioned phytochemicals, elements and some time their derivatives are utilized in the preparation of medicines (Ebomoyi *et al.,* 2004, Kabila *et al.,* 2017).

Different species of genus *Senna* L. are being used in various health care practices. This genus is a member of family fabaceae (subfamily caesalpinoideae). It grows in wild as weed and is distributed throughout the world. Most commonly found growing in unused lands along the roadside. Its high density has been reported in India, particularly in Western U. P, Uttarakhand, Punjab and Haryana, where it grows on the wasteland (Singh *et al.,* 2013, Choudhary and Nagori, 2014, Rekha *et al.,* 2016). There is an infinite literature on the medicinal importance of *S. occidentalis* but search for more, better and an effective compound is still to be found. Different plant parts such as roots, leaves, flowers and pods of the species contain useful phytoconstituents. *Senna occidentalis* is a major ingredient of a drug Liv-52 for the treatment of liver disorders (Wagh and Vidhale, 2010; Kaur *et al.,* 2014; Firdous *et al.,* 2015). It is useful in curing skin ailments and diseases such as ringworm, eczema, scabies, asthma, antibacterial, antidiabetic, antioxidant, antimalarial and possesses significant hepatoprotective and anti-inflammatory activities (Chukwujekwu *et al.,* 2006, Yadav *et al.,* 2009).

Senna occidentalis is an erect, branched herb and usually 2 to 3 m tall. The members of this species are annual and perennial. Leaves of the plant are alternate, paripinnately compound and petiole possesses the dark purple brown ovoid gland near the stem junction. Leaflets

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are 3-5 (usually 5) in pairs, larger ones are lanceolate or oblong- ovate and smaller leaflets are ovate with short stalk. Leaflets are acuminate at apex and possess foetid smell. Flowers are yellow coloured, short axillary racemes or terminal leaf axils. Pods are flat, thin, straight and slightly curved. Each pod contains around 30-40 seeds. Seeds are pale brown with dull surface (Vashishtha, *et al.,* 2009; Nassar, *et al.,* 2011).

In this study metabolomic analysis has been undertaken to characterize the useful metabolites of *Senna occidentalis*.

Materials and Methods

Collection of Plant Material

Plant material is collected from the natural habitat in district Mohali and Rupnagar, Punjab. The collected specimens were identified using the available literature, floras, manuals and by consulting the Department of Botany, Herbarium, Panjab University, Chandigarh.

Processing of Material

Plant material was washed first with tap water and then distilled water. The plant material was allowed to dry at room temperature. The completely dried material was powdered using an electric grinder. The powdered material was stored in air tight container for further analysis.

Preparation of Extracts

Aqueous extract- 20 g of powdered was soaked in 100 ml of distilled water taken in a conical flask. Kept it on a rotary shaker for about 24 hrs. Filtered the mixture through muslin cloth and then through Whattman filter paper No. 1. The filtrate (aqueous extract) was collected in vials and stored in the refrigerator till further use.

Ethanol and Hexane Extracts - 10 gm plant powder was extracted in 130 ml of solvent (Ethanol and Hexane). The extraction was carried out in a Soxhlet apparatus at a temperature ranging between 50°C to 60°C in Ethanol and 40°C to 50°C in Hexane. After complete extraction, the extract was allowed to evaporate at room temperature till the volume reduced to 1/3rd of the original and stored at 4°C.

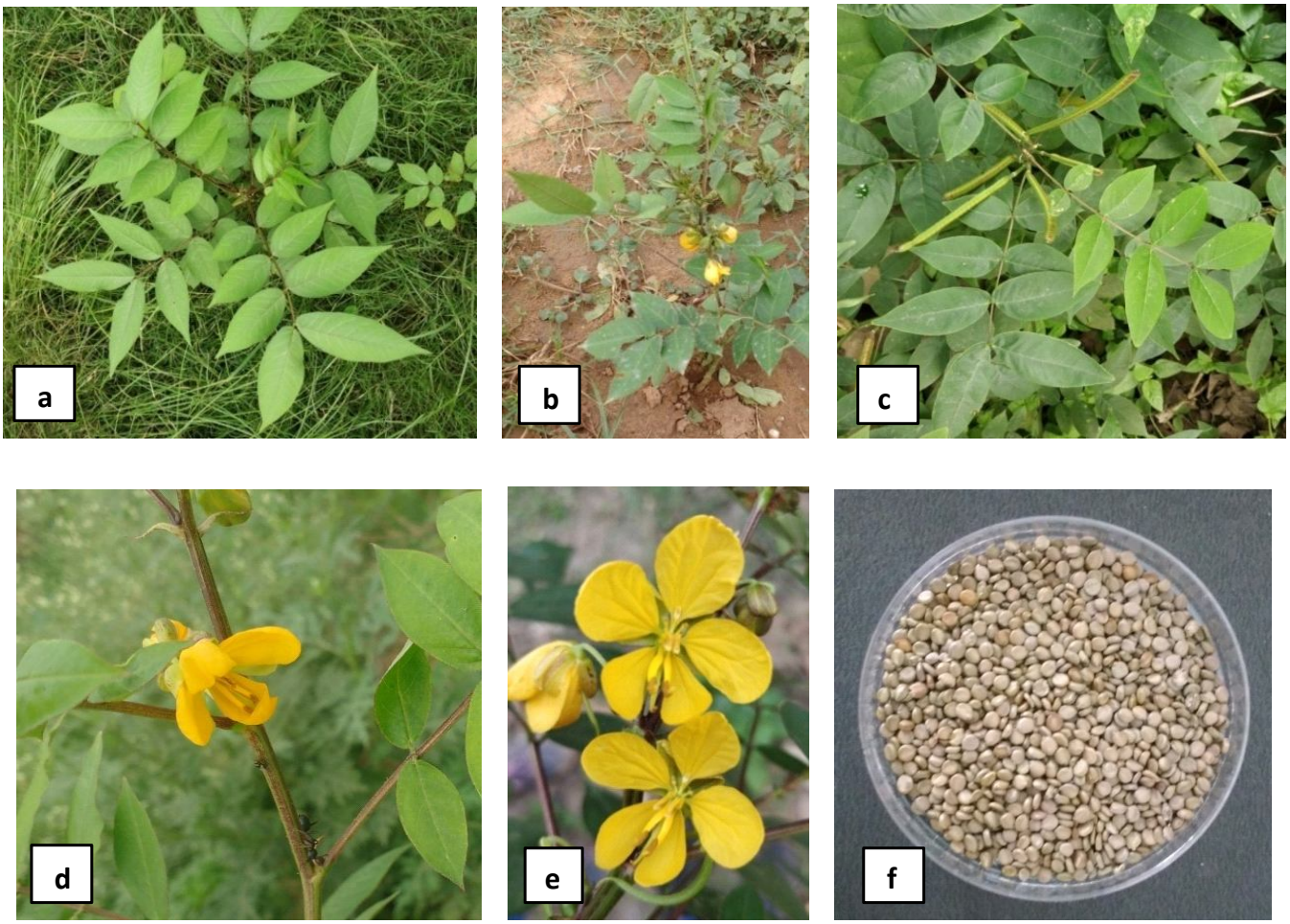

Fig. 1: (a-f): *Senna occidentalis* (a, b) Whole plant, (c) Plant with pods, (d, e) Flower, (f) Seeds.

Phytochemical Analysis

The whole plant and selected plant parts of *Senna occidentalis* have been screened for phytochemicals such as alkaloids, flavonoids, saponins, coumarins, anthraquinones, terpenoids, steroids *etc.* The analysis was carried out using standard procedures (Trease and Evans, 1989; Sofowora, 1993; Kokate, 1994; Harborne, 1998; Kokate *et al.,* 2005; Roopshree *et al.,* 2008; Evans, 2009; Njoku *et al.,* 2009; Basumatary, 2016; Sidhu and Thakur, 2016; Sidhu and Sharma, 2016).

GC-MS Analysis

The analysis is carried out by using thermo trace 1300GC coupled with Thermo TSQ 8000 triple quadrupole MS (for GC–Thermo Trace 1300 GC; for MS-Thermo TSQ 8000) at Central Instrumentation Laborartory, Panjab University, Chandigarh. Column TG 5MS composed of 5% Diphenyl; 95% dimethyl polysiloxane operating in electron impact mode and helium used as carrier gas at a constant flow of 1.5 ml/min and an injection volume of 1µl was employed (Split ratio 33.3) injected temperature 250°C. The oven temperature is programmed for 60°C with hold time of 1 min and increased of 10°C/min at 220°C with hold time of 4 min. Mass spectra transfer line temperature is 250°C, Ion source temperature is 230°C and Mass range from 50-700. The compound identification was done by comparison of retention time and mass spectra of GC-MS.

In Gas chromatography, heat separates the compound mixture into different individual substances and the compound was identifed using the databse of National Institute of Standards and Technology (NIST) Library 2.0. The unknown component mass spectrum has been compared with spectrum of known component of NIST library. This analysis has provided the name, molecular weight, molecular formula and area under the peak of the components.

FT-IR Spectroscopy Analysis

Fourier Transform Infrared (FTIR) Spectroscopy is helpful in the identification and classification of chemical bonds/functional groups pertaining to phytochemicals. The chemical bonds present in the spectrum has absorbed a light of particular wavelength. Thus, the chemical bonds present in the reported compounds can be resolved by interpreting the IR absorption spectrum (Visveshwari *et al.,* 2017). The test has been performed using Perkin Elmer Spectrum 400 FT-IR/ FT-FIR spectrometer with scan range from 400 to 4000 cm^{-1}. Plant samples powder was used for analysis and different functional groups were reported.

Results and Discussion

Phytochemical Analysis

The bioactivity of a plant species is likely due to the presence of different chemical compounds and elements. Various types of phytochemicals (alkaloids, phenolics, tannins, terpenoids, saponin *etc.*) have been reported during the present study. They are produced by the plant as per their need and some of them possess antimicrobial activity. Most of the studied phytochemicals get extracted in aqueous and ethanol extracts. Phytochemical like betaxanthin, cardiac active glycosides, glycosides and terpenoids are present in all the extracts except aqueous extract of leaves, whole plant and seeds and ethanol extract of seeds. Saponins are only present in aqueous extract of whole plant and seeds. Similarly, gum and mucilage are abundant in all the aqueous extracts of samples. Steroids have been recorded in all the extracts of whole plant but in case of leaves and seeds it is present only in aqueous and ethanol respectively. Amino acids, reducing sugar and anthocyanin are absent in all the extracts except traces in aqueous extract of whole plant and seeds. Similarly, anthraquinones, diterpenoids, lignins, phenolics, phlobataninns, quinones, and saponins are absent in all hexane extracts. This might be due to the less polarity of solvent to extract the metabolites. The presence and absence of the particular phytochemical is also dependent on the particular qualitatative test e.g. KOH test of tannins and NaOH test of flavonoids gives promising result as compared to $FeCl_3$ and H_2SO_4 tests respectively. The aqueous extract of leaves contains maximum number of phytochemicals followed by ethanol and aqueous whole plant extract and the least in hexane extracts of leaves and seeds.

The qualitative phytochemical characterization of different extracts prepared from the whole plant, leaves and seeds have revealed the presence of many metabolites such as alkaloids, anthraquinones, carbohydrates, coumarins, flavonoids, phenolics, steroid, terpenoids *etc* that have supported the pharmacological importance of this plant species. It has also been reported that the extraction of phytochemicals of the plant through polar solvent is the most efficient. The hexane extract has also shown some important phytochemicals. Odega *et al*., (2014) studied the phytochemicals of *Senna occidentalis* leaves in hexane, ethanol and methanol extracts. Alkaloids were present in all the extracts whereas reducing sugar and glycosides were recorded only in hexane extract. Flavonoids, phlobatannins, steroids and cardiac glycosides were absent in all the extracts. Phytochemical profiling of leaves of *C. occidentalis* had

Table 1: Phytochemical analysis of *Senna occidentalis* whole plant, leaves and seeds.

S.N.	Phytochemicals	Whole plant			Leaves			Seeds		
		Aqs	Eth	Hex	Aqs	Eth	Hex	Aqs	Eth	Hex
1.	Alkaloids	+	++	-	+++	+	-	+++	+	±
2.	Amino acids	±	-	-	-	-	-	-	-	-
3.	Anthocyanin	-	-	-	-	-	-	±	-	-
4.	Anthraquinones	±	++	-	±	-	-	±	+++	-
5.	Betaxanthin	±	++	±	+++	++	±	+++	-	++
6.	Carbohydrates	+++	++	+	++	+	±	++	+++	+
7.	Cardiac active glycosides	+	+	±	-	++	+	++	+++	±
8.	Coumarins	±	++	+	+	+	+	++	-	-
9.	Diterpenoids	++	+	-	+	+++	-	±	-	-
10.	Flavonoids a) NaOH Test	+	++	+	±	+	-	++	-	-
	b) H_2SO_4 Test	+	+	-	+	-	-	+	-	±
11.	Glycosides	-	+++	++	++	++	+	+	++	+
12.	Gum and mucilage	+++	-	-	+++	-	±	+++	-	-
13.	Lignins	-	+	-	±	++	-	-	-	-
14.	Oxalate	-	++	-	±	+	±	-	-	±
15.	Phenolics	++	+	-	+++	++	-	++	+++	-
16.	Phlobatannins	-	+	-	++	+	-	-	++	-
17.	Proteins	-	+	-	+	+	-	-	-	-
18.	Quinones	-	+	-	+++	++	-	-	++	-
19.	Reducing sugars	±	-	-	-	-	-	-	-	-
20.	Resin	+	+++	±	±	-	-	±	+++	-
21.	Saponins	+++	-	-	-	-	-	+++	-	-
22.	Starch	++	-	-	++	++	-	+	+	-
23.	Steroids	++	±	+	++	-	-	-	+	-
24.	Tannins a) $FeCl_3$ Test	+++	++	-	-	++	-	±	+++	-

+++ = Abundant, ++ = Moderate, + = Less and ± = Traces.

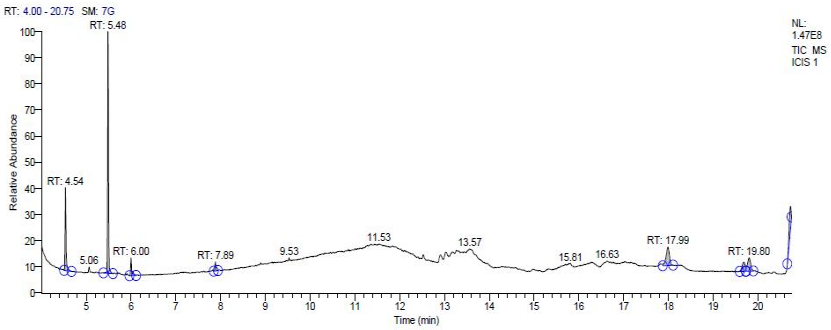

Fig. 2: GC-MS chromatogram of ethanol extract of *Senna occidentalis* seeds.

shown the presence of tannins, cardiac glycosides and anthraquinones in ethanol, methanol and aqueous extracts whereas alkaloids and flavonoids were absent (Sadiq *et al.,* 2012). Similarly, Shittu *et al*. (2014) reported tannins and flavonoids in aqueous and ethanol extracts but anthraquinones, saponins and phenols were present only in aqueous extract of *S. occidentalis*. Mohammed *et al*. (2012) carried out phytochemical screening of *C. occidentalis* leaves in six different solvents. Carbohydrates, glycosides, saponins, cardiac glycosides, phenolic compounds and tannins were reported in the ethanol and aqueous extracts. Alkaloids were absent in all the six extracts. Phytochemical analysis of the whole plant (*C. occidentalis*) had revealed the presence of fourteen metabolites including carbohydrates, saponins, terpenes, cardiac glycosides, anthraquinones etc. in the extracts whereas tannins, phenols, volatile oil and phlobatannins were absent in methanol extract (Egharevba *et al.,* 2010).

Tannins, phenols, flavonoids, alkaloids, glycosides, steroids and saponins were reported in leaves of *Senna occidentalis* (Aja *et al.,* 2017). Similarly, Sani (2016) reported alkaloids, tannins, saponins and phenols in aqueous and ethanol extracts of the plant leaves. The roasted seeds of *S. occidentalis* contain saponins,

glycosides, oxalate, alkaloids, phenolics etc (Olapade and Ajayia, 2016). Similarly, Veerchari *et al*., (2012) studied the leaf phytochemicals of *C. occidentalis* using ethanol, methanol and ethyl acetate as solvents. It had carbohydrates, steroids, terpenoids, cardiac glycosides, phlobatannins and alkaloids in all the extracts whereas anthraquinones and anthocyanosides were present in methanol, flavonoids in methanol and ethanol extracts. Some of the phytochemicals observed in the present study, were not reported from the earlier work such as flavonoids, phlobatannins, cardiac active glycosides and betaxanthinin leaves ethanol extract. Coumarins are present in all extracts except ethanol and hexane seeds extracts, diterpenoids in aqueous and ethanol extracts of whole plant and leaves whereas, lignins and quinones are present in ethanol whole plant and leaves (traces in aqueous leaves) and all ethanol or aqueous extract of leaves respectively.

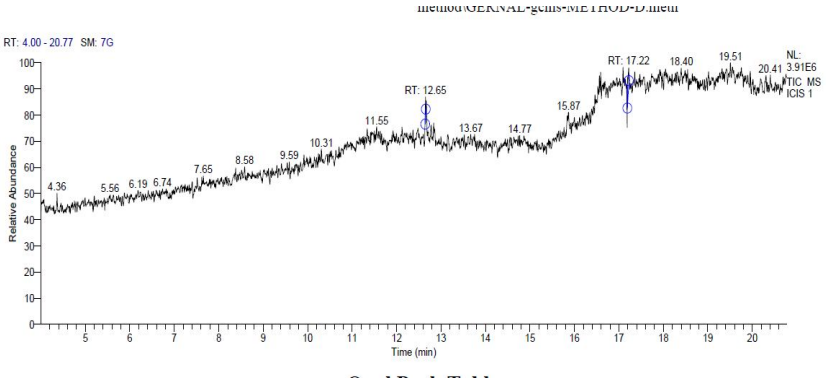

Fig. 3: GC-MS chromatogram of hexane extract of *Senna occidentalis* seeds.

Table 2: GC-MS analysis of *Senna occidentalis* hexane extracts of seeds.

S.N.	RT Value	Compound Name	Molecular Formula	Molecular Weight
1.	12.65	Astaxanthin	$C_{40}H_{52}O_4$	596.852 g/mol
2.	12.65	Pregnan-20-one, 3,17,21-tris[(trimethylsilyl)oxy]-, O-(phenylmethyl)oxime, (3á,5á)-	$C_{37}H_{56}NO_4Si_3$	672.185 g/mol
3.	12.65	Di-tungsten, tris(cyclooctatetraene)	$C_{24}H_{24}W_2$	680.136 g/mol
4.	17.22	(5á)Pregnane-3,20á-diol, 14à,18à-[4-methyl-3-oxo-(1-oxa-4-azabutane-1,4-d iyl)]-, diacetate	$C_{28}H_{43}NO_6$	489.644 g/mol
5.	17.22	.psi.,.psi.-Carotene, 3,3',4,4'-tetradehydro-1',2'-dihydro-1-hydroxy-1'methoxy (Hydroxyspirilloxanthin)	$C_{41}H_{58}O_2$	582.913 g/mol

Table 3: GC-MS analysis of ethanol extracts of *Senna occidentalis* seeds.

S.N.	RT Value	Compound Name	Molecular Formula	Molecular Weight
1.	4.54	Benzene, (ethoxymethyl)-	$C_9H_{12}O$	136.194 g/mol
2.	4.54	2-Butanol, 3-benzyloxy-	$C_{11}H_{16}O_2$	180.247 g/mol
3.	4.54	Benzene, 1,1'-[oxybis(methylene)]bis- (Dibenzyl Ether)	$C_{14}H_{14}O$	198.265 g/mol
4.	5.48	Camphor	$C_{10}H_{16}O$	152.237 g/mol
5.	6.00, 7.89	Heptadecane, 9-hexyl-	$C_{23}H_{48}$	324.637 g/mol
6.	6.00, 7.89	Dodecane, 5,8-diethyl-	$C_{16}H_{34}$	226.448 g/mol
7.	6.00	Dodecane	$C_{12}H_{26}$	170.34 g/mol
8.	7.89	Heptacosane, 1-chloro-	$C_{27}H_{55}Cl$	415.187 g/mol
9.	17.99	Tricaproin	$C_{21}H_{38}O_6$	386.529 g/mol
10.	17.99	Spiro(1,3-dioxolane)-2,3'-[5'-androsten-16'-trimethylsilyloxy)-	$C_{24}H_{40}O_3Si$	404.666 g/mol
11.	17.99	Hexanethioic acid, S-decyl ester	$C_{16}H_{32}OS$	272.491 g/mol
12.	19.69	Octadecane, 3-ethyl-5-(2-ethylbutyl)-	$C_{26}H_{54}$	366.718 g/mol
13.	19.69	Heptadecane, 9-hexyl-	$C_{23}H_{48}$	324.637 g/mol
14.	19.69	Eicosane, 7-hexyl-	$C_{26}H_{54}$	366.718 g/mol
15.	19.80	Dasycarpidan-1-methanol, acetate (ester)	$C_{20}H_{26}N_2O_2$	326.44 g/mol
16.	19.80	9,12,15-Octadecatrienoic acid, 2-[(trimethylsilyl)oxy]-1-[[(trimethylsilyl)oxy]methyl]ethyl ester, (Z,Z,Z) (2-Monolinolenin, 2TMS derivative)	$C_{27}H_{52}O_4Si_2$	496.879 g/mol
17.	19.80	9-Hexadecenoic acid, 9-octadecenyl ester, (Z,Z)- (Oleyl palmitoleate)	$C_{34}H_{64}O_2$	504.884 g/mol
18.	20.72	Diisooctyl phthalate	$C_{24}H_{38}O_4$	390.564 g/mol

Table 4: FTIR peak values and functional groups of *Senna occidentalis.*

IR Frequencies (Wave number cm^{-1})			IR frequencies range for the respective functionality (Wave number cm^{-1})	Groups (Coates, 2000; Pavi *et al*., 2006)
Whole plant	Leaves	Seeds		
———	3627.87	———	3650-3300	O-H Stretch
———	3550.74	———		
———	3523.95	———		
———	3469.59	———		
———	3269.59	3275.06	3400-3200	Normal ''polymeric'' OH stretch , O-H stretching in alcohols, phenols and carboxylic acids, Sp, C- H Stretch
3186.83	——-	——-	3300-3030	Ammonium Ion
2915.64	2921.69	2966.17	3000-2800	O-CH_3, C-H Stretch, Methyl Ester, Alkanes, Sp^3 C- H Stretch
2851.76	2844.70	2923.52		
———	———-	2843.59		
———	2187.88	———	2200-2100	Alkyne
———	2163.59	———		
———	2130.52	———		
———	2039.69	———	2100-1800	Transition metal Carbonyls
———	1962.83	———		
1728.04	———	———	1740-1705	C=O stretch in aldehydes, ketones
———	———	1752.55	1760-1740	Alkyl Carbonate
		1635.44	1650-1550	N-H Bend, Secondary amine
1593.72	1597.04	1535.98	1650-1550	N-H Bend, Secondary amine
		1	600-1500	C=C Stretch
1421.57	1412.89	1462.43	1475-1350	CH_2/CH_3 Bending Vibration
———	———	1405.22		
1372.53	———	———	1440-1200	C-O-H Bending Vibrations
1319.41	———	1237.68		
1229.51	———	———		
1053.69	1053.12	1056.11	1350-1000	C-O Alcohols, Ethers, Esters, Carboxylic acid, Anydrides
1005.71	1032.97	1000.68		
———	1011.52	———		
882.18	———	———	900-670	C-H, Aromatic compounds
514.59	———	518.50	600-500	C-I Stretch, Aliphatic Iodine Compounds
———	499.16	———	500-470	S-S Stretch, Polysulphide
———	445.08	444.95	500-430	S-S Stretch, Aryl Sulphide

These metabolites are the less studied phytohemicals in *S. occidentalis* as per the available literature.

GC-MS Analysis

GC-MS has provided the detailed account of phytoconstituents present in ethanol and hexane extracts of seeds of *Senna occidentalis*. The mass spectrophotometery identifies the different compound in the samples. The GC-MS disclose various compounds with relative concentration getting eluted as per the retention time. The chromatogram of ethanol and hexane extracts of *S. occidentalis* seeds showed eight and two peaks respectively, corresponding to the presence of major chemical compounds at different peaks (Tables 2 and 3).

In previous GC-MS studies revealed the presence of 31 and 6 compounds in methanol leaf extracts (Ibrahim *et al.,* 2015, Javaid *et al.,* 2017). According to Panigrahi *et al*. (2015) GC MS analysis of *S. occidentalis* seeds

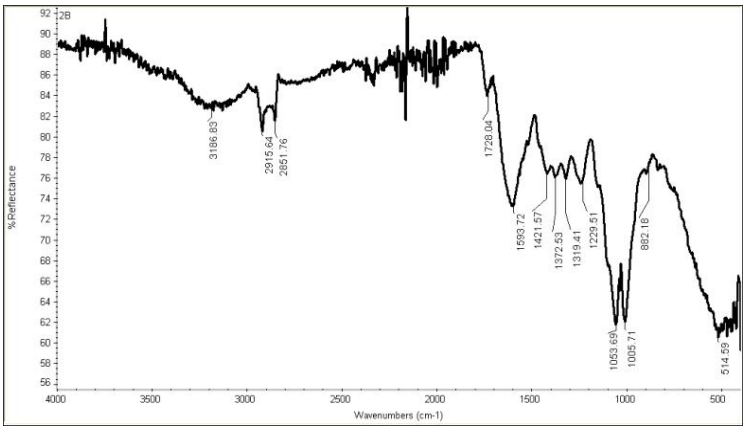

Fig. 4: FTIR Spectrum of *Senna occidentalis* whole plant.

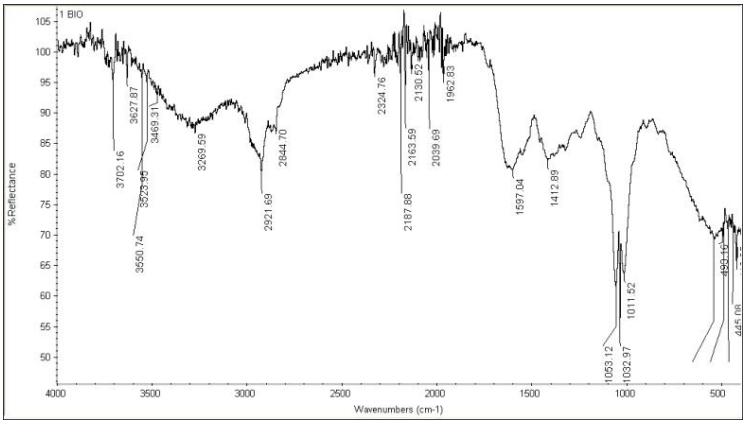

Fig. 5: FTIR Spectrum of *Senna occidentalis* Leaf.

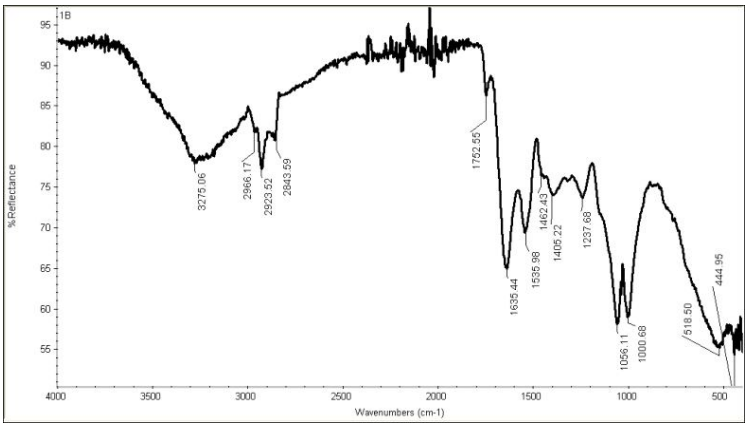

Fig. 6: FTIR Spectrum of *Senna occidentalis* Seeds.

has resulted into sixty one compounds at different peaks. The hexane and chloroform extracts of aerial parts of this species showed seven and ten phytocompounds respectively. Some of the reported compounds included dodecanoic acid, n-hexadecanoic acid, phytol and tetradecanoic acid etc at different retention time (Manikandaselvi *et al.,* 2016). Recently, Essien *et al*., (2019) reported forty one and thirty eight compounds in volatile oil of fresh fruits of *S. occidentalis* and *Senna hirsuta* respectively. The phytoconstituents that are not reported in earlier available literature included benzene, (ethoxymethyl)-, Tricaproin, 9-Hexadecenoic acid, 9-octadecenyl ester, (Z,Z)- (Oleyl palmitoleate), Dasycarpidan-1-methanol, acetate (ester), Astaxanthin and Hydroxyspirilloxanthin. Some of the reported compounds from this study have importance like Camphor (antidote, tooth ache, antihelminthic, antiseptic, stimulant *etc.*), 9-Hexadecenoic acid, 9-octadecenyl ester, (Z,Z)- (Oleyl palmitoleate) (cholesterol metabolism, improves secretory function, helps in insulin activity), Astaxanthin (antioxidant, anti-inflammatory, anticancer and immuno modulating properties), and Tricaproin (anticancer activity) (Jose *et al.,* 2018; Kim, *et al.,* 2019; Dr. Duke and Ethnobotanical Databses). Presence of these chemical constituents in the plant extracts provides the evidence of medicinal properties of the plant and its part.

FT-IR Analysis

The results pertaining to FTIR spectrum of *Senna occidentalis* whole plant, leaves and seeds are presented in (Figs. 4 to 6) and (Table 4). The peak values of the spectrum are important for identification of probable functional groups of different compounds in the plant samples.

Khyade *et al*. (2015) studied the FTIR spectrum of leaf extract of *Cassia occidentalis, Cassia tora* and *Cassia uniflora* and reported aldehydes, alcohols, carboxylic acid, alkenes, aromatic compounds, ester and nitro compounds. Different functional groups such as alkyl groups, methyl groups, alcohols, ethers were reported in the root, stem, flower and leaf tissues of *Cassia occidentalis* by FTIR analysis (Arora, 2015). Alcohol, aliphatic compounds, aldehydes, alkynes, alkenes, amines, alkyl carbonate and esters have been reported in the whole plant, leaf and seeds of *S. occidentalis* during the present study. The observations of the present study are compliance with the earlier findings except aryl sulphide, anhydrides, transition metal carbonyls and polysulphide. The variations in FTIR data is likely be due to use of different plant part or geographical variations.

Conclusion

Senna occidentalis is of immense medicinal importance and used in the treatment of various diseases. Several phytoconstituents in the whole plant, leaves and seeds of aqueous, ethanol and hexane extracts of this plant have been reported during the present study. The aqueous and ethanol extracts of leaves and whole plant have yielded more promising results. The GC-MS analysis has shown eighteen and five phytocompounds in ethanol and hexane extracts of seeds respectively including Benzene, (ethoxymethyl)-, Camphor, Tricaproin, Spiro (1, 3-dioxolane) - 2,3'-[5'-androsten-16'-trimethylsilyloxy)- *etc*. The FTIR analysis of plant samples has shown major functional groups such as aldehydes, alcohols, aliphatic compounds, alkynes, alkenes and amine *etc*. Therefore, it is clear that the plant contains phytochemicals of medicinal interest and further studies are required to isolate and investigate the bioactivity of these compounds individually or in combination. Depending upon the activity, specific plant or plant part can be recommended to the pharmaceutical sector for the preparation of new or alternate medicine.

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References

Aja, P.M., O.P.C. Ugwu, K. Keke, J.B. Ibere and E.U. Ekpono (2017). Phytochemical analysis of *Senna occidentalis* leaves. *Journal of Applied Sciences*, **2(1):** 75-91.

Arora, K. (2015). Comparative account of allelopathic potential of different parts of *Cassia occidentalis* and its correlation with bio-molecular profile through FTIR. *Journal of Chemical and Pharmaceutical Research*, **7(12):** 91-95.

Basumatary, A.R. (2016). Preliminary phytochemical screening of some compounds from plant stem bark extracts of *Tabernaemontana divaricata* Linn. used by Bodo community at Kokrajhar District, Assam, India. *Archives of Applied Science Research*, **8(8):** 47-52.

Choudhary, P.K. and B.P. Nagori (2014). Evaluation of *in vitro* antimalarial activity of *Cassia occidentalis*. *World Journal of Pharmacy and Pharmaceutical Sciences*. **3(2):** 2241-2248.

Chukwujekwu, J.C., P.H. Coombes, D.A. Mulholland and J.V. Staden (2006). Emodin, An antibacterial anthraquinone from the roots of *Cassia occidentalis*. *South African Journal of Botany*, **72:** 295-297.

Coates, J. (2000). *Interpretation of Infrared Spectra, A Practical Approach*. Encyclopedia of Analytical Chemistry R. A. Meyers (Ed.). John Wiley & Sons Ltd, 1-23.

Dr. Duke's Phytochemical and Ethnobotanical Databases. (1992-2016). U.S Department of Agriculture, Agricultural Research Services.

Ebomoyi, M.I., V.I. Iyawe and E.E. Egbagbe (2004). Effect of *Garcinia conravana* Ingestion in adult Nigerian asthmatics. *Nigerian Journal of Health and Biomedical Sciences*, **3(1):** 24-27.

Egharevba, H., A.C. Odigwe, M.S. Abdullahi, S.K. Okulute and J.I. Okogun (2010). Phytochemical analysis and broad spectrum antimicrobial activity of *Cassia occidentalis* L. whole plant. *New York Science Journal,* **3(10):** 74-81.

Essien, E.E., P.S. Thomas, R. Ascrizzi, W.N. Setzer and G. Flamin (2019). *Senna occidentalis* (L.) Link and *Senna hirsuta* (L.) H. S. Irwin & Barneby: constitutents of fruit essential oils and antimicrobial activity. *Natural Product Research*, **33(11):** 1637-1640.

Evans, W.C. (2009). *Trease and Evans Pharmacognosy* (16th edn), Saunders Ltd, 133-353.

Firdous, F., M. Mujeeb, R. Sharma, A. Hudsain, A.H. Khan and M. Akram (2015). A review on pharmacological and toxicological potentials of *Cassia occidentalis* Linn. *European Journal of Biomedical and Pharmaceutical Sciences*, **2(6):** 260-265.

Harborne, J.B. (1998). *Phytochemical methods-A guide to modern techniques of plant analysis*. (3rd Edn.), published by Springer (India) Pvt. Ltd, 49-129.

Ibrahim, A.M., B. Lawal1, N.A. Tsado, A.A. Yusuf and A.M. Jimoh (2015). Phytochemical screening and GC-MS determination of bioactive constituents from methanol leaf extract of *Senna occidentalis*. *Journal of Coastal Life Medicine,* **3(12):** 992-995.

Javaid, A., H. Qudsia and A. Shoaib (2017). Bioassays guided fractionation of *Senna occidentalis* for identification of natural antifungal constituents against *Macrophomina phaseolina*. *Planta Daninha*, **35:** 1-8

Jose, A., M.V.N.L. Chaitanya, E. Kannan and S.V. Madhunapantula (2018). Tricaproin isolated from *Simarouba glauca* inhibits the growth of human colorectal carcinoma cell lines by targeting class-1 histone deacetylases. *Frontiers in Pharmacology*, **9:** 127.

Kabila, B., M.C. Sidhu and A.S. Ahluwalia (2017). Phytochemical profiling of different *Cassia* species A: Review. *International Journal of Pharmaceutical and Biological Archives,* **8(2):** 12-20.

Kaur, I., S. Ahmad and S.L. Harikumar (2014). Pharmacognosy, Phytochemistry and Pharmacology *of Cassia occidentalis* Linn. *International Journal of Pharmacognosy and Phytochemical Research*, **6(2):** 151-155

Khyade, M.S., S.P. Kamble, A.R. Kurhe and D. Padwal (2015). Comparative fourier transform infrared spectroscopic analysis and free radical quenching properties of three *Cassia* species. *Asian Journal Of Pharmaceutical and Clinical* Research, **8(5):** 119-125.

Kim, S., J. Chen, T. Cheng, A. Gindulyte, J. He, S. He, Q. Li, B.A. Shoemaker, P.A. Thiessen, B. Yu, L. Zaslavsky, J. Zang and E.E. Bolton Pub Chem (2019). Improved access to Chemical Data. *Nucleic Acid Research,* **47(D1):** D1102-D1109

Kokate, C.K. (1994). *Practical Pharmacognosy* (4th Edn.). Vallabh Prakashan, New Delhi, 112-120.

Kokate, C.K., A.P. Purohit and S.B. Gokhale (2005). *Pharmacogonosy.* (31st Edn.), Nirali Prakashan, Pune India, 133-429.

Manikandaselvi, S., V. Vadivel and P. Brindha (2016). Studies on physicochemical and nutritional properties of aerial parts of *Cassia occidentalis*. *Journal of Food and Drug Analysis*, **24:** 508-515.

Mohammed, M., M.A. Aboki, H.M. Saidu, O. Victor, A. Tawakalitu and S.A. Maikano (2012). Phytochemical and some antimicrobial activity of *Cassia occidentalis* L. (Caesalpiniaceae). *International Journal of Science and Technology,* **2(4):** 200-209.

Nassar, M.A.A., H.R.H. Ramadan and H.M.S. Ibrahim (2011). Morphological characteristics of vegetative and reproductive growth of *Senna occidentalis* (L.) Link (Caesalpiniaceae). *Research Journal of Agriculture and Biological Sciences*, **7(2):** 260-270.

Njoku, O.V. and C. Obi (2009). Phytochemical constituents of some selected medicinal plants. *African Journal of Pure and Applied Chemistry*, **3(11):** 228-233.

Odeja, O.O., G. Obi, C.E. Ogwuche, E.E. Elemike and O.O. Oderinlo (2015). Phytochemical screening, antioxidant and antimicrobial activities of *Senna occidentalis* (L.) leaves Extract. *International Journal of Herbal Medicine,* **2(4):** 26-30.

Olapadea, A.A. and O.A. Ajayia (2016). Effect of roasting regime on phytochemical properties of *Senna occidentalis* seeds. *International Journal of Food Studies*, **5:** 203–211.

Panigrahi, G.K., C. Ratnasekhar, M.K.R. Mudiam, V.M. Vashishtha, S. Raisuddin and M. Das (2015). Activity-guided chemo toxic proûling of *Cassia occidentalis* (CO) seeds: Detection of toxic compounds in body fluids of CO-exposed patients and experimental rats. *Chemical Research Toxicology*, **28:** 1120-1132.

Pavia, D.L., G.M. Lampman and G.S. Kriz (2006). *Introduction to spectroscopy*, 3rd ed., printed by Thomson Business Information India private limited, India.

Rekha, U., J. Thomas, V. Thomas, J.M. Tiju, P. Prakash and M.S. Latha (2016). Therapeutic potential of the phytochemicals in *Cassia occidentalis*-a review. *European Journal of Pharmaceutical and Medical Research*, **3(9):** 180-188

Roopashree, T.S., D. Raman, R.H. Sobha Rani and C. Narendra (2008). Antibacterial activity of antipsoriatic herbs *Cassia tora, Momordica charantia* and *Calendula officinalis*. *International Journal of Applied Research in Natural Products*, **1(3):** 20-28.

Sadiq, I.S., M. Shuaibu, A.B. Bello, S.G. Tureta, A. Isah, T. Izuagie, S. Nasiru and M.B. Kamaru (2012). Phytochemistry and antimicrobial activities of *Cassia occidentalis* used for herbal remedies. *Journal of Chemical Engineering*, **1(1):** 38-41.

Sani, I. (2016). Preliminary phytochemical screening, antioxidant potentials and proximate composition of *Senna occidentalis* and *Leptadenia pyrotechnica* leaves extracts. *Applied Science Reports*, **14(3):** 273-277.

Shittu, O.B., O.O. Olabode, A.M. Omemu, S.A. Oluwalana, A. Samuel and I. Akpan (2014). Phytochemical and antimicrobial screening of *Spondias mombin, Senna occidentalis* and *Musa sapientum* against *Vibrio chloerae* 01. *International Journal of Current Microbiology and Applied Sciences,* **3(5):** 948-961.

Sidhu, M.C. and T. Sharma (2016). Meiotic and phytochemical studies of three morphotypes of S*olanum nigrum* L. from Punjab (India). *Indian Drugs*, **53(04):** 20-28.

Sidhu, M.C. and S. Thakur (2016). Phytochemical and Elemental Exploration of *Nothoscordum gracile* (Aiton) Stearn for Its Medicinal Potential. *Journal of Chemical and Pharmaceutical Science*, **9(4):** 2627-2631.

Singh, S., K.S. Singh and A. Yadav (2013). A review on *Cassia* species pharmacological, traditional and medicinal aspects in various countries. *American Journal of Phytomedicine and Clinical Therapeutics,* **1(3):** 291-312.

Sofowora, A. (1993). *Medicinal Plants and Traditional Medicines in Africa*. Spectrum Books Ltd., Ibadan, 191-289.

Trease, G.E. and W.C. Evans (1989). *Pharmacognosy* (12th edn). Balliere Tindall, Eastbourne, London, U.K., 45-50.

Vashishtha, V.M., T.J. John and A. Kumar (2009). Clinical and pathological features of acute toxicity due to *Cassia occidentalis* in vertebrates. *Indian Journal of Medical Research*, **130:** 23-30.

Veerchari, U. and A.K. Bopaiah (2012). Phytochemical investigation of the ethanol methanol and ethyl acetate leaf extracts of six *Cassia* species. *International Journal of Pharma and Biosciences,* **3(2):** p260-p270.

Visveshwari, M., B. Subbaiyan and V. Thangapandian (2017). Phytochemical analysis, antibacterial activity, FTIR and GCMS analysis of *Ceropegia juncea* Roxb. *International Journal of Pharmacogonsy and Phytochemical Research*, **9(7):** 914-920.

Wagh, S. and N.N. Vidhale (2010). Antimicrobial efficacy of *Cassia occidentalis* (Kasmard) against human pathogenic bacteria and fungi. *Pharmacologyonline*, **1:** 706-713.

Yadav, J.P., V. Arya, S. Yadav, M. Panghal, S. Kumar and S. Dhankar (2010). *Cassia occidentalis* L: A review on its ethnobotany phytochemical and pharmacological profile. *Fitoterpia*, **81:** 223-230.