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Research Article

GAS CHROMATOGRAPHY-MASS SPECTROMETRIC ANALYSIS AND IDENTIFICATION OF BIOACTIVE CONSTITUENTS OF CATHARANTHUS ROSEUS AND ITS ANTIOXIDANT ACTIVITY

JYOTI RANI, MANISH KAPOOR*

Department of Botany, Punjabi University, Patiala, Punjab, India. Email: jdmanishkapoor@yahoo.com

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ABSTRACT

Objective: The main objectives of this study were analysis of the phytochemicals produced by two different *Catharanthus roseus* morphotypes, i.e., pink and white flowered and evaluate it morphologically and phytochemically in terms of total phenolic content (TPC), total flavonoid content (TFC), antioxidant properties, and gas chromatography-mass spectrometry (GC-MS) analysis.

Methods: Methanolic extracts of both morphotypes were prepared by Soxhlet apparatus. After extraction, the extracts were filtered and solvent removed by rotatory evaporator. TPC was determined by Folin–Ciocalteu reagent method and TFC was estimated by aluminum chloride colorimetric method. Antioxidant and free radical scavenging activities were estimated by superoxide dismutase and 1,1-diphenyl-2-picrylhydrazyl assay. GC-MS analysis was performed at Central Instrumentation Laboratory/ SAIF, Panjab University, Chandigarh.

Results: Pink-flowered *C. roseus* showed highest activities in terms of TPC, TFC, and antioxidant activity as compared to white-flowered *C. roseus*. 42 different bioactive compounds were detected in the methanolic extract of pink, while only 7 compounds were identified in white-flowered *C. roseus*. The identification was performed by GS-MS analysis mainly based on retention time, peak area, molecular formula, and molecular weight.

Conclusion: The finding indicated that the pink-flowered *C. roseus* was phytochemically superior then the white one.

Keywords: Catharanthus roseus, Total phenolic content, Total flavonoid content, Antioxidant properties, Gas chromatography-mass spectrometry.

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INTRODUCTION

Plants play a potential role, especially in the production of herbal medicine and pharmaceutical medications. A significant proportion of the world population relies on herbal and customary medicine due to the high costs and lack of orthodox medicine [1]. The modern medicine productions also rely on medicinal plant-derived therapeutic components. Many medicinal plants contain an assortment of pharmaceutical components which have an extremely fundamental role in the fields of veterinary and human prescription. Plant-based items play a dominant role in the development of novel drug leading to the treatment and prevention of diseases [2-4].

History reveals that plants are important sources of drugs and will continuously be essential for the discovery of new lead compounds [5]. The most essential bioactive constituents of the plants are phenols, alkaloids, cardiac glycoside, tannins, and flavonoid compounds. In India, medicinal plants are of great interest to the field of plant biotechnology, as most of the pharmaceutical industries depend on plants for the production of therapeutic compounds [6].

Catharanthus roseus (family: Apocynaceae) popularly known as Madagascar periwinkle or Vinca, grown as evergreen ornamental herbaceous plant in gardens throughout the world [7], flower having five petals and various colors including pink, red, white and purple. However, nowadays, this plant is mainly cultivated for its alkaloids, having antileukemic activities [8]. It is a subshrub plant growing up to 1 m tall. The plant has been used to treat a vast range of the assortment of diseases [9]. In India, leaf juice is used to treat wasp stings. In China, this plant is used as a diuretic, astringent, menstrual regulation, and cough remedy. In South America, it is used as a folk remedy for inflammation and cold. In Caribbean region, flower extract is mainly used to treat infection and irritation. In England and Brazil, entire dried plant extract is taken orally along with hot water to treat diabetes mellitus. In Australia, hot water extract of leaves is used to treat diabetes and menorrhagia [10]. A detailed literature survey about the medicinal properties of *C. roseus* leaves revealed it to possess antileukemic, antioxidant, antimicrobial, and anti-inflammatory activities [11]. The medicinal properties are attributed to the presence of alkaloids and phenolic compounds in its leaf extract. Therefore, it was essential to screen the methanolic extract of *C. roseus* leaves for the detection of phytochemicals, to identify and characterize phytoconstituents in its crude extracts for chemical profiling using gas chromatography-mass spectrometry (GC-MS) analytic technique, to evaluate its antioxidant potential using *in vitro* methods, and to correlate with the phenolic and flavonoid content.

METHODS

The current study involved two different morphotypes of *C. roseus*, differing in petal color, shape, arrangement of petal and color of eye, grown naturally in the Botanical Garden and Department of Botany, Punjabi University, Patiala (Table 1 and Fig. 1). Flower petal was separated as pink and white. The voucher specimen of *C. roseus* was identified and deposited in Herbarium (PUN) at the Department of Botany, Punjabi University Patiala.

Plant material

C. roseus leaves were collected in June 2015. The collected leaf material was washed thoroughly with tap water to remove dust particles and dried under the shade at room temperature for 6–7 days. The dried leaves were ground to obtain the fine powder and kept in airtight glass bottles, until further use.

Extraction of plant material

Extraction of plant material was done with methanol: water (1:1) using Soxhlet apparatus. After the completion of extraction, the extract was filtered and solvent was removed by rotary evaporator.

Phytochemical screening of leaf extract

The freshly prepared methanolic crude leaf extract was subjected to qualitative analysis to identify various bioactive constituents present

Table 1: Morphological characteristics of two morphotypes of *C. roseus*

Morphotypes	Petal color	Petal arrangement	Eye color
Catharanthus roseus	Pink	Overlap	Red
Catharanthus roseus	White	Free	Yellow



Fig. 1: Morphological features of two *Catharanthus roseus* morphotypes (a) pink and (b) white

in the leaves using standard procedures. The crude extract was also subjected for GC-MS analysis to identify the various phytochemical constituents present in the plant extracts.

Total phenolic content (TPC)

TPC was estimated by Folin–Ciocalteu reagent method. Phenols which react with phosphomolybdic acid in Folin–Ciocalteu reagent in the alkaline medium will produce a blue-colored complex (molybdenum blue) which can be estimated spectrophotometrically at 650 nm. A stock solution of plant extracts was prepared to 1 mg/mL. 5 mL of Folin– Ciocalteu and 2 mL of Na₂CO₃ were added to the 1 mL of plant sample. The solution was vortexed and incubated in the dark for 15 min. The absorbance was measured at 650 nm. Blank consisted of 5 mL Folin–Ciocalteu, 1 mL solvent, and 2 mL of Na₂CO₃ solution. Gallic acid was used as a standard of 10–100 µg/mL range from a stock solution of 1 mg/mL. The TPC was calculated from the calibration curve, and the result was expressed in terms of mg of gallic acid equivalent per gram dry weight. All tests were performed in triplicates [12].

Total flavonoid content (TFC)

TFC was estimated by aluminum chloride colorimetric method with some modifications to determine flavonoid content. 1 mL of plant sample was added to 3 mL of methanol, 0.2mL of 10% aluminium chloride, 0.2mL of 1M potassium acetate and 5.6 mL of distilled water and kept at room temperature for 30 min. The absorbance was measured at 420 nm. Quercetin was used as standard of 10–100 μ g/mL range from 1 mg/mL stock solution. All the tests were performed in triplicates. Flavonoid contents were determined from the calibration curve, and a result was expressed as mg of quercetin equivalent (per g of extracted compound) [13].

Antioxidant activity

Superoxide dismutase (SOD)

SOD levels in the cell-free supernatant were measured by the method of Kono [14]. Briefly, 1.9 mL of sodium carbonate buffer (50 mM, pH 10.0), 750 μ L of nitrobluetetrazolium dye (NBT), and 240 mM and 150 μ L of 0.3% Triton X-100 were added to the test cuvette. The reaction was initiated by the addition of 150 μ L of hydroxylamine hydrochloride (10 mM, pH 6.0). After 2 min, 70 μ L enzyme samples from the plant tissue were added. The percentage inhibition in the rate of NBT reduction was recorded as an increase in absorbance at 560 nm. The percentage inhibition of NBT reduction was calculated as follows:

Change in absorbance/minute (Control)-

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X = Change in absorbance/minute (Test)
Chnage in absorbance/minute (Control) ×100
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X% of inhibition is produced by 70 μL of sample.

Hence, 50% inhibition is produced by

$$Y\mu Lof sample = \frac{50 \times 70}{X} \times 100$$

Free radical scavenging activity

The free radical scavenging activity of leaves was measured using 1,1-diphenyl-2-picrylhydrazyl (DPPH) [15]. This method depends on the reduction of purple color of DPPH to yellow color diphenyl-picrylhydrazine. A stock solution of leaf extracts was prepared to 1 mg/mL in methanol. Each stock solution diluted from 10 μ /mL to 100 μ g/mL. 1 mL of 0.3 mM DPPH solution was added to 2.5 mL of sample solution. Ascorbic acid was used as standard with the same 1 mg/mL stock solution of different concentrations from 10 μ g/mL to 100 μ g/mL. The sample was incubated in the dark for 30 min. The absorbance was measured at 517 nm. The absorbance was converted into percentage antioxidant activity using the following equation:

	Absorbance (control)-			
Freeradical	Absorbance(sample) x100			
scavengingactivity(%)=	Absorbance (control)			

Statistical analysis

A statistical analysis of data was performed in accordance with the procedure given by Gomez and Gomez [16] and was analyzed as per completely randomized design [17] to test the significance of differences between the treatments. A coefficient of variation was calculated using the method given by Burton and Devane [18].

GC-MS analysis

GC analysis was carried out at Central Instrumentation Laboratory/SAIF, Panjab University, Chandigarh.` This technique is very important for the identification of various phytochemicals of plant. The equipment used for GC-MS was QP-2010 Ultra. For GC-MS detection, an electron ionization system with ionizing energy of 70 eV was used. Helium gas (99.999%) was used as the carrier gas at a constant flow rate of 1 mL/min and and 1 μ L of plant sample was employed (split ratio of 10:1), at injector temperature 250°C, ion-source temperature of 280°C, and total running time for a sample of about 76 min.

Identification of the components

Interpretation of GC-MS was conducted using the database of National Institute Standard and Technology (NIST) having >6200 patterns. The spectrum of the unknown component was compared with the spectrum of the known component in the repository of NIST library. The retention time, molecular weight, molecular formula, and composition percentage of the sample material were recorded.

RESULTS

TPC and TFC of leaf extracts are expressed in terms of gallic acid and quercetin, respectively, and presented in Table 2. *C. roseus* pink morphotype extract showed highest phenolic and flavonoid content as compared to the white morphotype leaf extract. The antioxidant activities were investigated by commonly used free radical scavenging methods such as DPPH and SOD. The scavenging effect of leaf extracts on the DPPH free radicals was expressed as percentage inhibition, and they were compared with standard antioxidant, ascorbic acid. Lower IC_{so} value indicates the higher antioxidant activity. The pink morphotype showed highest while the white one showed minimum antioxidant activity. Similar trend was observed for SOD activity.

GC-MS analyzed the results which include the active principles with their molecular formula, molecular weight, retention time, peak area %, and composition of the bioactive components of *C. roseus* which are presented in Tables 3 and 4. The GC-MS chromatogram of the detected compounds is as shown in Fig. 2.

Many significant physiological active components were identified from both the samples by GC-MS. Chlorozotocin (0.17 %), 2-Pyrrolidinone, 1-butyl- (0.13%), Ethyl N-(o-anisyl) formimidate (0.36%), 2-Pentyne-1,4-diol, 4- methyl-1-(2-thienyl)- (0.33%), Cis-Inositol (0.09%), Muco-Inositol (2.38), 3-Phenylbicyclo (3.2.2) nona-3,6-dien-2-one (0.06%), 9,12,15-Octadecatrienoic acid, methyl ester (2.70 %), 9-Octadecynoic acid (3.24%), Methyl 8,11,14-heptadecatrienoate (30.04%), [1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester (0.20%), Condyfolan, 14,19-didehydro-12-methoxy-,(14E)- (0.29%) and 2,20-Cycloaspidospermidine-3-carboxylic acid (1.05).

C. roseus white morphotype contained seven different components such as 1-4H-Pyran-4-one (4.73%), 5-Hydroxymethylfurfural (30.86%), n-Hexadecanoicacid(6.58%),phytol(17.17%),9,12,15-Octadecatrienoic acid, (Z,Z,Z)- (23.64%), 2,20-Cycloaspidospermidine-3-carboxylic acid (4.95%), and Aspidospermidine-3-carboxylic acid (12.09%).

Antioxidant and antimicrobial activities are shown by various identified compounds such as 4H-Pyran-4-one, Benzofuran, 2,3-dihydro, 1,2,3-Propanetriol, 1-acetate/acetin, l-Gala-l-ido-octonic lactone, desulfosinigrin, 3',5'-Dimethoxyacetophenone, α -D-Glucopyranoside, O- α -D-glucopyranosyl-(1.fwdarw.3)-ß-d-fru, 1,2,3,5-Cyclohexanetetrol, 2-Methyl-9-a-d-ribofuranosylhypoxanthine, Myo-Inositol, 4-C-methyl-, Hexadecanoic acid, methyl ester, pentadecanoic acid, dasycarpidan-1-methanol, acetate (ester, Phytol, Methyl 8,11,14-heptadecatrienoate, [1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester, and Phthalic acid, di(oct-3-yl) ester.

DISCUSSION

In the present study, a total of 42 compounds were identified in pink morphotypes and seven in white morphotype of *Catharanthus*. In terms of percentage amount, methyl 8,11,14-heptadecatrienoate, 9-octadecynoic acid, 9,12,15-octadecatrienoic acid, methyl ester, pentadecanoic acid, 1,2,3,5-Cyclohexanetetrol, muco-inositol, and sucrose were prominent in pink morphotype, whereas 5-Hydroxymethylfurfural, 9,12,15-octadecatrienoic acid, and phytol were prominent in white morphotypes. Identified compounds having

anti-inflammatory, antimicrobial, antioxidants, and antiproliferative activity have been identified. The plant is mainly used due to its antineoplastic properties.

Among the identified compounds, 5-hydroxymethylfurfural is a sugar component and showed antioxidant and antiproliferative activity previously reported by Hussein [19]. 9,12,15-Octadecatrienoic acid (Z, Z, Z)- and 9,12,15-Octadecatrienoic, methyl ester (Z, Z, Z)- which is a linoleic acid and reported to have an anticancer, anti-arthritic, antiinflammatory, anti-acne, hypocholesterolemic, hepatoprotective, antihistaminic, nematicide and insectifuge properties. Similarly, the presence of 9-octadecenoic acid was observed in the ethanolic root extract of Plumbago zeylanica by Ajayi et al. [20]. Hexadecanoic acid methyl ester is also known as palmitic acid ester and effectively used as an antioxidant, pesticide, anti-androgenic, nematicide, flavoring agent, hypocholesterolemic, and lubricant [21,22]. Carbohydrates such as mannitol and sucrose are present in a considered amount in methanolic extracts of Catharanthus. The GC-MS analysis revealed that the methanolic extract of C. roseus pink morphotype is composed of more oxygenated hydrocarbons and predominantly phenolic hydrocarbons as compared to the white morphotype. These phytochemicals are responsible for various pharmacological actions such as antimicrobial, antioxidant, and antiproliferative activity. Results showed that components from both of the two morphotypes are a complex mixture of numerous compounds, many of which are found in trace amount. It is worth monitoring that there is a great variation in the chemical composition of these two morphotypes of *C. roseus*. This confirms that the reported variation in phytoconstituents is due to morphological variation between the two accessions.

The results of GC-MS testing indicated that *C. roseus* leaves contained numerous bioactive phytoconstituents belonging to various classes such as tannins, glycosides, alkaloids, flavonoids, and steroids. The leaf extract quantification, by colorimetric methods, was found to be rich in phenolic compounds (flavonoids) and therefore exhibited very good scavenging activity against DPPH and SOD free radicals. Based on the results, it can be concluded that *C. roseus* leaves could be used as a natural source of antioxidants and its regular consumption in diet could provide health benefits to humans by protecting against oxidative stress. Further detailed *in vitro* and *in vivo* correlation studies along with isolation of active constituents are needed to unravel novel treatment strategies for free radical-induced diseases.

CONCLUSION

The study reveals the presence of bioactive compounds of the methanolic extract of *C. roseus* leaves. The present study can provide

Morphotypes	DPPH assay (IC ₅₀) µg/ml	SOD	TPC (mg gallic acid equivalent per g of leaves)	TFC (mg quercetin equivalent per g of leaves)
Catharanthus roseus (Pink)	10.62±2.42	123±0.42	40.8±0.52	12.4±0.77
Catharanthus roseus (White)	25.95±1.32	88±1.05	15.3±1.12	9.82±0.67

Values are the average of triplicate experiments and values expressed as mean±SEM, SEM: Standard error of mean, SOD: Superoxide dismutase, TPC: Total phenolic content, TFC: Total flavonoid content, DPPH: 1,1-diphenyl-2-picrylhydrazyl



Fig. 2: Chromatogram of the leaf methanolic extract of Catharanthus roseus (a) pink and (b) white

Table 3: Results of the GC-MS anal	vsis from the leaves of <i>Catharanthus roseus</i> (pink	1
nubre bi nebunto bi tine de lite dina	, 515 11 0111 0110 104 105 01 040141 41101145 1 05045 (p1111	,

1 5.75 4H-Pyran-4-one C ₄ H ₀ 0, 144 0.63 Anti-inflammatory and Antioxidant Antimicrobial Antioxidant Antimicrobial Real modulatory and Antioxidant Antioxidant C ₄ H ₁ 0, 2 6.39 CatecholyResorcinol C ₄ H ₁ 0, 10.1 0.60 Antioxidant Antimicrobial Real modulatory and Antioxidant C ₄ H ₁ 0, 134.1 0.44 Antioxidant Antimicrobial Antioxidant Antioxidant C ₄ H ₁ 0, 5 7.97 12.3-Propagnetriol 1-acetate/acetin C ₄ H ₁ 0, 134.4 0.42 Antimicrobial Antioxidant Antioxidant Conception C ₄ H ₁ 0, 7 7.44 Ascardole epoxide C ₄ H ₁ 0, 134.4 0.42 Antimicrobial Antioxidant Antioxidant Conception C ₄ H ₁ 0, 7 7.44 Ascardole epoxide C ₄ H ₁ 0, 134.6 0.14 Antioxidant Antioxidant Conception C ₄ H ₁ 0, 10 8.48 Limoner-6-0, pivalate C ₄ H ₁ 0, 134.2 0.16 Antioxidant Conception C ₄ H ₁ 0, 12 9.07 Desufosingin C ₄ H ₁ 0, 142.2 0.16 Native Conception C ₄ H ₁ 0, 14 9.38 Si5-Dintentropagne	S. No	RT	Name of the compound	Molecular formula	MW	Peak area %	Pharmacological actions
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	1	5.75	4H-Pyran-4-one	C ₆ H ₈ O ₄	144	0.63	Antioxidant, Antimicrobial,
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	0	6.00		<u></u>	1101	0.07	Anti-inflammatory, and Antioxidant
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	2	6.39 6.53	Latechol/Resorcinol Bonzofuran 2.3-dibudro		110.1	0.06	Dermatological treatment/Acne
$ \begin{array}{ccccccccccccccccccccccccccccccccccc$	3	0.55	Belizolulali, 2,3-ulliyulo	C ₈ n ₈ 0	120.1	0.01	Analogsic Antimutagenic
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	4	6.77	1.2.3-Propanetriol. 1-acetate/acetin	C_H_0	134.1	0.84	Antimicrobial
	5	7.09	Chlorozotocin	$C_0H_1C_1N_2O_7$	313.6	0.01	Antineoplastic
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	6	7.24	1,3-Diazacyclooctane-2-th	$C_{6}^{9}H_{12}^{10}N_{2}S^{3}$	144.2	0.82	Antimicrobial, Antioxidant
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	7	7.44	Ascaridole epoxide	$C_{10}H_{16}O_{3}$	184	0.14	Anticarcinogenic
9 8.21 Fullat-ido-octonic iactoine $C_{u}H_{u}O_{u}$ 0.05 Antibacterial activity against predomonsa security of a thick of the security of a security of a security of a security of a second security of a security of a security of a security of a security of a second security of a secu	8	7.71	Chlorozotocin	$C_9H_{16}C_1N_3O_7$	313.6	0.17	Antineoplastic
	9	8.21	I-Gala-I-Ido-octonic lactone	$U_8 H_{14} U_8$		0.05	Antibacterial activity against
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	10	8 4 8	Limonen-6-ol nivalate	СНО	2363	0.06	Anti-stress
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	10	8.73	Sucrose	$C_{15}H_{24}O_{2}$ $C_{12}H_{22}O_{14}$	342.2	3.14	Antioxidant
	12	9.07	Desulfosinigrin	$C_{10}^{12}H_{17}^{22}NO_{6}S$	279.3	0.06	Antioxidant
	13	9.16	2-Pyrrolidinone, 1-butyl-	C ₈ H ₁₅ NO	141.2	0.13	Unknown
15 9.61 2H-1-Henzopyranside, or-D-Gucopyransoide, Or-D-glucopyransoide, Or-D-glucopyransoide, Or-D-glucopyransoide, Or-D-glucopyransoide, Or-D-glucopyransoide, D-d-d-D-d-d-d-glucopyransoide,	14	9.38	3',5'-Dimethoxyacetophenone	$C_{10}H_{12}O_{3}$	180.2	0.17	Antioxidant
109.330.90Antitulatette activity and antitumini 0-cx-D-glucopyranosyl-(1.fwdarw.3)-6-d-fru C R_{12} 5.440.00Antitulatette activity and antitumini 0-cx-D-glucopyranosyl-(1.fwdarw.3)-6-d-fru R_{12} 179.20.36Unknown179.89Ethyl N-(o-anisyl) formimidate (2.3,5-Cyclohexanetetrol $C_{u}H_{12}O_{4}$ 148.15.12Polyhydroxy compound, Analgesic, Antibacterial, Antiviral cancer preventive1810.051,2,3,5-Cyclohexanetetrol $C_{u}H_{12}O_{4}$ 148.15.12Polyhydroxy compound, Analgesic, Antibacterial, Antiviral cancer preventive1910.282-Methyl-9-4-d- ribofuranosylhypoxanthine $C_{11}H_{14}N_4O_5$ 2820.03Antimicrobial2010.42Tetraacetyl-d-xylonic nitrile $C_{14}H_{12}N_0O_5$ 194.130.45Antioxidant and Antimicrobial2110.94Myo-Inositol, 4-C-methyl- $C_{14}H_{12}O_6$ 194.130.45Antioxidant and Antimicrobial2311.54Psicofuranine $C_{14}H_{12}O_6$ 180.60.90Chemopreventive2411.61Cis-Inositol $C_{14}H_{20}O_6$ 180.12.38Chemopreventive2511.90Muco-Inositol $C_{14}H_{20}O_2$ 3700.97Antioxidant, Antiencrobial, Antiandrogenic flavor, Hemolytic, S-Alpha-reductase inhibitor2712.64Pentadecanoic acid $C_{12}H_{20}O_2$ 292.20.06No activity reported3014.229.12.15-Octadecatienoic acid, methyl ester $C_{12}H_{20}O_2$ 294.40.67 <td>15</td> <td>9.61</td> <td>2H-1-Benzopyran-3,4-diol</td> <td>$C_{18}H_{20}O_5$</td> <td>316.3</td> <td>0.35</td> <td>Antihypertensives</td>	15	9.61	2H-1-Benzopyran-3,4-diol	$C_{18}H_{20}O_5$	316.3	0.35	Antihypertensives
179.89Ethyl N-Q-anisyl formindate cumindateC10 C41204179.20.36Unknown1810.051,2,3,5-CyclohexanetetrolC4141204148.15.12Polyhydroxy compound, Analgesic, Antibacterial, Antiseptic, Antibacterial, Antiseptic, Antiboxidant and Antimicrobial2010.42Tetraacetyl-d-sylonic nitrile C41404 SectorianineC41406 C41406 C41406194.130.45 30.45Antiboxidant and Antimicrobial2110.94Myo-Inositol, 4-C-methyl- C541404 C41405C41406 C41405292.2 C011 C0140250.35 C000 Chemopreventive2311.54Psicofuranine C41406C414206 C414206196.1 C90.22.36 C000Chemopreventive2612.29Hexadecanoic acid nona-36-dien-2-oneC41400 C41400210.2 C90-120.06No activity reported2712.64Pentadecanoic acid (Z,Z), methyl solutalC41400 C41400210.2 C90-120.06No activity reported2913.55Dasycarpidan-1-methanol,	10	9.03	$\Omega_{-}\alpha_{-}D_{-}\alpha_{-}\alpha_{-}\alpha_{-}\alpha_{-}\alpha_{-}\alpha_{-}\alpha_{-}\alpha$	$C_{18} T_{32} O_{16}$	304	0.00	Antiulabetic activity and antitumor
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	17	9.89	Ethyl N-(o-anisyl) formimidate	C H NO	179.2	0.36	Unknown
1910.282-Methyl-9-á-d- ribofuranosylhypoxanthine $C_{11}H_{14}N_4O_5$ 2820.03Antesthetic, Antioxidant, Antiseptic, Antibacterial, Antiviral cancer preventive1910.42Tetraacetyl-d-xylonic nitrile $C_{11}H_{14}N_4O_5$ 2820.03Antimicrobial2010.42Tetraacetyl-d-xylonic nitrile $C_{11}H_{12}O_5$ 196.20.03Antioxidant, Antiseptic, Antioxidant and Antipyretic2110.94Myo-Inositol, 4-C-methyl- 2- Chita $C_{11}H_{12}O_5$ 196.20.33Unknown2311.54Psicofuranine $C_{11}H_{12}O_5$ 196.20.33Unknown2411.61Cis-Inositol $C_{11}H_{12}O_5$ 180.12.38Chemopreventive2511.90Muco-Inositol $C_{11}H_{12}O_5$ 180.12.38Chemopreventive2612.29Hexadecanoic acid, methyl ester $C_{13}H_{12}O_5$ 10.41Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Antiandrogenic flavor, Hemolytic, 5-Alpha-reductase inhibitor2712.64Pentadecanoic acid $C_{15}H_{10}O_2$ 210.20.06No activity reported2813.053-Phenylbicyclo (3.2.2) nona-3.6-dien-2-one $C_{10}H_{20}O_2$ 226.40.11Antimicrobial3014.229.12.15-Octadecatinenic acid, methyl ester $C_{10}H_{20}O_2$ 222.22.70Anticancerous, Nematicides, Anti-inflammatory, Hypocholesterolemic, Nematicides, $C_{20}H_{20}O_2$ 226.40.11Anticioxidant, Antiseptic, Anti-inflammatory, Antioxidant, Cancer <br< td=""><td>18</td><td>10.05</td><td>1,2,3,5-Cyclohexanetetrol</td><td>$C_{H_{12}O_{4}}^{10}$</td><td>148.1</td><td>5.12</td><td>Polyhydroxy compound, Analgesic,</td></br<>	18	10.05	1,2,3,5-Cyclohexanetetrol	$C_{H_{12}O_{4}}^{10}$	148.1	5.12	Polyhydroxy compound, Analgesic,
1910.282-Methyl-9-á-d- ribofuranosylhypoxanthine $C_{11}H_{14}N_4O_5$ 2820.03Antimicrobial2010.42Tetraacetyl-d-xylonic nitrile $C_{14}H_{17}NO_9$ 343.30.19Antimicrobial2110.94Myo-Inositol, 4-C-methyl- $C_1H_1O_4$ 194.130.45Antioxidant and Antimyretic2111.182-Pentyne-1,4-diol, 4- methyl-1-(2-thienyl)- $C_{14}H_1O_5$ 196.20.33Unknown2311.54Psicofuranine $C_{14}H_1O_5$ 180.12.38Chemopreventive2411.61Cis-Inositol $C_{14}H_2O_5$ 180.12.38Chemopreventive2511.90Muco-Inositol $C_{14}H_2O_5$ 180.12.38Chemopreventive2612.29Hexadecanoic acid $C_{15}H_{30}O_2$ 10.41AntimicrobialAntiaicrogenic flavor, Hemolytic, 5-Alpha-reductase inhibitor2712.64Pentadecanoic acid $C_{15}H_{30}O_2$ 210.20.06No activity reported3014.229.12-Octadecatienoic acid (Z, Z)-, methyl $C_{19}H_{20}O_2$ 210.20.06No activity reported3114.309.12,15-Octadecatienoic acid (Z, Z)-, methyl ester $C_{19}H_{20}O_2$ 292.22.70Anticacnecros, Nematicide, Sematicide, Cancer preventive, Hepatoprotective seter3314.869-Octadecynoic acid $C_{19}H_{20}O_2$ 294.40.67Anticacnecros, Nematicide, Sematicide, Antivicrobial, Antivicrobial, Antivicrobial, Antivicrobial, Antivicrobial, Antivicrobial, Antivicrobial, Antivicrobial, Antivicrobial,			· · · · •	0 12 4			Anesthetic, Antioxidant, Antiseptic,
19 10.28 2-Methyl-9-4-d-ribofuranosylhypoxanthine C11H14N_05 282 0.03 Antimicrobial 20 10.42 Tetraacetyl-d-xylonic nitrile C14H17N09 343.3 0.19 Antiasthmatic, Anti-inflammatory and Antipyretic 21 10.94 Myo-Inositol, 4-C-methyl- C, H1006 194.1 30.45 Antiasthmatic, Anti-inflammatory and Antipyretic 21 11.84 Psicofuranine C, H1006 194.1 30.45 Antioxidant and Antimicrobial 22 11.81 Psicofuranine C, H1006 194.1 30.45 Antioxidant and Antimicrobial 23 11.54 CiscInositol C, H1006 180.6 0.09 Chemopreventive 25 11.90 Muco-Inositol C, H1006 180.1 2.38 Chemopreventive 26 12.29 Hexadecanoic acid C11H3402 180.0 2.07 Antiaindrogenic flavor, Hemolytic, S-Alpha-reductase inhibitor 27 12.64 Pentadecanoic acid C11H400 210.2 0.06 No activity reported 30 14.25							Antibacterial, Antiviral cancer
1910.282.Methyl-9.4-d- ribofuranosylhypoxanthine $C_{11}H_{14}N_{0.5}$ 2820.03Antimicrobial2010.42Tetraacetyl-d-xylonic nitrile $C_{14}H_{17}N_{0_9}$ 343.30.19Antiasthmatic, Anti-inflammatory and Antipyretic2110.94Myo-Inositol, 4-C-methyl- $C_{1}H_{10}S_5$ 196.20.33Unknown2311.54Psicofuranine $C_{11}H_{15}N_{50}$ 297.20.11Antibiotic and Antiiuror2411.61Cis-Inositol $C_{6}H_{10}O_{6}$ 180.60.09Chemopreventive2511.90Muco-Inositol $C_{11}H_{20}N_{50}$ 3700.97Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Antiandrogenic flavor, Hemolytic, 5-Alpha-reductase inhibitor2612.29Hexadecanoic acid $C_{12}H_{20}O_2$ 3700.97Antiinicrobial, Antioxidant, Antiinicrobial, Antioxidant, Matioxidant, Matioxidant, Matioxidant, Matioxidant, Matioxidant, Matioxidant, Matioxidant, Matioxidant, Antiinicrobial, Antioxidant, Matioxidant, 							preventive
Torus or information in the information of the information o	19	10.28	2-Methyl-9-á-d-	$C_{11}H_{14}N_4O_5$	282	0.03	Antimicrobial
2010.42letraacetyl-a-sylonic nitrile $C_{14}H_{17}NO_9$ 343.30.19Antiastimatic, Anti-inflammatory and Antipyretic2110.94Myo-Inositol, 4-C-methyl- 21 $C_{7}H_{1}O_6$ 194.130.45Antioxidant and Antipyretic2311.54Psicofuranine $C_{14}H_{12}N_0^5$ 297.20.11Antioxidant and Antipyretic2311.54Psicofuranine $C_{6}H_{12}O_6$ 180.60.09Chemopreventive2511.90Muco-Inositol $C_{6}H_{12}O_6$ 180.12.38Chemopreventive2612.29Hexadecanoic acid, methyl ester $C_{12}H_{34}O_2$ 3700.97Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Antiandrogenic flavor, Hemolytic, 5-Alpha-reductase inhibitor2712.64Pentadecanoic acid $C_{15}H_{30}O_2$ 10.41Antimicrobial3014.229,12-Octadecadienoic acid (Z, Z)-, methyl $C_{19}H_{26}O_2$ 326.40.11Antimicrobial3014.329,12,15-Octadecatrienoic acid, methyl ester $C_{19}H_{32}O_2$ 294.40.67Antioxidant, Antimicrobial3114.329,12,15-Octadecatrienoic acid, methyl ester $C_{19}H_{32}O_2$ 292.22.70Antioxidant, Antimicrobial, Antioxidant, Antimicrobial, An	20	10.40	ribofuranosylhypoxanthine		040.0	0.10	
2110.94Myo-Inositol, 4-C-methyl- $C_{1}H_{12}O_{c}$ 194.130.45Antioxidant and Antimicrobial2211.182-Pentyne-1,4-diol, 4- methyl-1-(2-thienyl)- $C_{10}H_{12}O_{c}S$ 196.20.33Unknown2311.54Psicofuranine $C_{11}H_{12}N_{5}O_{5}$ 297.20.11Antibiotic and Antitumor2411.61Cis-Inositol $C_{6}H_{12}O_{6}$ 180.60.09Chemopreventive2511.0Muco-Inositol $C_{6}H_{12}O_{6}$ 180.62.38Chemopreventive2612.29Hexadecanoic acid, methyl ester $C_{11}H_{34}O_{2}$ 3700.97Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Antiandrogenic flavor, Hemolytic, 5-Alpha-reductase inhibitor2712.64Pentadecanoic acid $C_{15}H_{30}O_{2}$ 10.41Antimicrobial, Antioxidant, Anticancer2813.053-Phenylbicyclo (3.2.2) nona-3,6-dien-2-one $C_{19}H_{20}O_{2}$ 326.40.11Antimicrobial3014.229,12-Octadecadienoic acid (Z, Z)-, methyl ester $C_{19}H_{20}O_{2}$ 292.22.70Anticancerous, Nematicides, Anti-inflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective3114.329,12,15-Octadecatrienoic acid, methyl ester $C_{19}H_{20}O_{2}$ 292.22.70Anticancerous, Nematicides, Anti-inflammatory, Anticancer3314.869-Octadecynoic acid $C_{19}H_{30}O_{2}$ 280.43.24Inhibit fibrosis3414.99Methyl 8,11,14-heptadecatrienoate $C_{19}H_{30}O$	20	10.42	Tetraacetyl-d-xylonic nitrile	$C_{14}H_{17}NO_{9}$	343.3	0.19	Antiasthmatic, Anti-inflammatory
2116.74Myo instant and minimized and	21	10.94	Myo-Inositol 4-C-methyl-	СНО	194.1	30.45	Antiovidant and Antimicrobial
2311.54Psicofuranine $C_{11}^{11}H_{15}^{11}N_{5}^{10}O_{5}$ 297.20.11Antibiotic and Antitumor2411.61Cis-Inositol $C_{11}H_{15}^{11}N_{5}^{10}O_{5}$ 180.60.09Chemopreventive2511.90Muco-Inositol $C_{0}^{11}H_{20}^{10}O_{6}$ 180.12.38Chemopreventive2612.29Hexadecanoic acid, methyl ester $C_{17}H_{34}O_{2}$ 3700.97Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Antiandrogenic flavor, Hemolytic, S-Alpha-reductase inhibitor2712.64Pentadecanoic acid $C_{15}H_{30}O_{2}$ 10.41Antimicrobial, Antioxidant, Anticancer2813.053-Phenylbicyclo (3.2.2) nona-3,6-dien-2-one $C_{15}H_{30}O_{2}$ 210.20.06No activity reported2913.56Dasycarpidan-1-methanol, acetate (ester ester $C_{19}H_{32}O_{2}$ 294.40.67Antii-inflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective3114.329,12,15-Octadecatrienoic acid, methyl ester $C_{19}H_{32}O_{2}$ 292.22.70Anticancerous, Nematicides, Anti-inflammatory, Anticancer3314.869-Octadecynoic acid $C_{19}H_{32}O_{2}$ 292.22.70Anticancerous, Nematicides, Anti-inflammatory, Anticancer3314.869-Octadecynoic acid $C_{19}H_{32}O_{2}$ 292.22.70Anticiancer3414.99Methyl 8,11,14-heptadecatrienoate $C_{19}H_{30}O_{2}$ 292.22.70Anticiancer3515.33[1,1'-Bicyclopropyl]-2-	22	11.18	2-Pentvne-1.4-diol. 4- methyl-1-(2-thienyl)-	$C_{14}O_{6}$	196.2	0.33	Unknown
2411.61Cis-InositolCis H120 h120 h120 h120 h120 h120 h120 h120 h	23	11.54	Psicofuranine	$C_{11}H_{12}N_{10}O_{10}$	297.2	0.11	Antibiotic and Antitumor
2511.90Muco-Inositol $C_6H_{12}O_6$ 180.12.38Chemopreventive2612.29Hexadecanoic acid, methyl ester $C_{17}H_{34}O_2$ 3700.97Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Antiandrogenic flavor, Hemolytic, S-Alpha-reductase inhibitor2712.64Pentadecanoic acid $C_{15}H_{30}O_2$ 10.41Antimicrobial, Antioxidant, Anticancer2813.053-Phenylbicyclo (3.2.2) $C_{15}H_{14}O$ 210.20.06No activity reported2913.56Dasycarpidan-1-methanol, acetate (ester ester $C_{20}H_{26}N_2O_2$ 326.40.11Antimicrobial3014.229,12-Octadecadienoic acid (Z, Z)-, methyl $C_{19}H_{34}O_2$ 294.40.67Anticancerous, Nematicides, Cancer preventive, Hepatoprotective3114.329,12,15-Octadecatrienoic acid, methyl ester $C_{19}H_{32}O_2$ 292.22.70Anticancerous, Nematicides,3314.869-Octadecynoic acid $C_{18}H_{20}O_2$ 280.43.24Inhibit fibrosis3414.99Methyl 8,11,14-heptadecatrienoate $C_{18}H_{30}O_2$ 278.430.04Antioxidant3515.33[1,1'-Bicyclopropyl]-2-octanoic acid, $C_{21}H_{38}O_2$ 228.40.04Antioxidant3616.739,12,15-Octadecatrienoic acid, $C_{27}H_{52}O_4Si_2$ 496.20.04Antiirinflammation	24	11.61	Cis-Inositol	$C_{6}^{11}H_{12}^{15}O_{6}^{5}$	180.6	0.09	Chemopreventive
26 12.29 Hexadecanoic acid, methyl ester $C_{17}H_{34}O_2$ 370 0.97 Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Antiandrogenic flavor, Hemolytic, 5-Alpha-reductase inhibitor 27 12.64 Pentadecanoic acid $C_{15}H_{30}O_2$ 10.41 Antioxidant, Hypocholesterolemic, Nematicide, Pesticide, Antiandrogenic flavor, Hemolytic, 5-Alpha-reductase inhibitor 28 13.05 3-Phenylbicyclo (3.2.2) $C_{15}H_{30}O_2$ 210.2 0.06 No activity reported 29 13.56 Dasycarpidan-1-methanol, acetate (ester case of the structure) $C_{19}H_{34}O_2$ 294.4 0.67 Antiinicrobial 30 14.22 9,12,15-Octadecatrienoic acid, methyl ester $C_{19}H_{32}O_2$ 292.2 2.70 Anticancerous, Nematicides, Anticancerous, Nematicides, Cancer 31 14.32 9,12,15-Octadecatrienoic acid, methyl ester $C_{19}H_{32}O_2$ 292.2 2.70 Anticancerous, Nematicides, Anticancerous, Nematicides, Cancer 33 14.86 9-Octadecynoic acid $C_{18}H_{32}O_2$ 292.2 2.70 Anticancerous, Nematicides, Antiinicrobial, Antiininflammatory, Anticancerous, Antiioxidant, Antiininflammatory, An	25	11.90	Muco-Inositol	$C_{6}H_{12}O_{6}$	180.1	2.38	Chemopreventive
 27 12.64 Pentadecanoic acid C₁₅H₃₀O₂ 13.05 3-Phenylbicyclo (3.2.2) C₁₅H₁₄O 210.2 0.06 No activity reported Antimicrobial Antioxidant, Antioancer 29 13.56 Dasycarpidan-1-methanol, acetate (ester C₂₀H₂₆N₂O₂ 32.64 0.11 Antimicrobial 30 14.22 9,12-Octadecadienoic acid (Z, Z)-, methyl C₁₉H₃₄O₂ 294.4 0.67 Anti-inflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective 31 14.32 9,12,15-Octadecatrienoic acid, methyl ester C₂₀H₃₀O₂ 32.14.50 Phytol 33 14.86 9-Octadecynoic acid C 34 14.99 Methyl 8,11,14-heptadecatrienoate C₁₈H₃₀O₂ 35 15.33 [1,1'-Bicyclopropyl]-2-octanoic acid, C₂₁H₃₀O₂ 36 16.73 9,12,15-Octadecatrienoic acid, C₂₇H₅₂O₄Si₂ 496.2 0.04 Anti-inflammation 	26	12.29	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	370	0.97	Antioxidant, Hypocholesterolemic,
 27 12.64 Pentadecanoic acid 27 12.64 Pentadecanoic acid 28 13.05 3-Phenylbicyclo (3.2.2) nona-3,6-dien-2-one 29 13.56 Dasycarpidan-1-methanol, acetate (ester seter 29 13.56 Dasycarpidan-1-methanol, acetate (ester ester 30 14.22 9,12-Octadecadienoic acid (Z, Z)-, methyl 31 14.32 9,12.15-Octadecatrienoic acid, methyl ester 31 14.32 9,12.15-Octadecatrienoic acid 31 14.86 9-Octadecynoic acid 33 14.86 9-Octadecynoic acid 34 14.99 Methyl 8,11,14-heptadecatrienoate 35 15.33 [1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester 36 16.73 9,12,15-Octadecatrienoic acid, 4.57 9,12,15-Octadecatrienoic acid, 4.58 0,20 2,27 H₅₂0,4Si₂ 496.2 0.04 Anti-inflammation 							Nematicide, Pesticide,
2712.64Pentadecanoic acid $C_{15}H_{30}O_2$ 10.41Antimicrobial, Antioxidant, Anticancer2813.053-Phenylbicyclo (3.2.2) nona-3,6-dien-2-one $C_{15}H_{14}O$ 210.20.06No activity reported2913.56Dasycarpidan-1-methanol, acetate (ester ester $C_{20}H_{26}N_2O_2$ 326.40.11Antimicrobial3014.229,12-Octadecadienoic acid (Z, Z)-, methyl ester $C_{19}H_{34}O_2$ 294.40.67Anti-inflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective3114.329,12,15-Octadecatrienoic acid, methyl ester 32 $C_{19}H_{40}O_2$ 292.22.70Anticancerous, Nematicides, Anti-inflammatory, Anticancerous, Nematicides, C $_{20}H_{40}O_2$ 296.51.38Antioxidant, Antimicrobial, Anti-inflammatory, Anticancer3314.869-Octadecynoic acid $C_{18}H_{32}O_2$ 280.43.24Inhibit fibrosis3414.99Methyl 8,11,14-heptadecatrienoate $C_{18}H_{30}O_2$ 278.430.04Antioxidant3515.33[1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester $C_{27}H_{52}O_4Si_2$ 496.20.04Anti-inflammation							Antiandrogenic flavor, Hemolytic,
11.0112.0112.0112.0110.0110.011 <td>27</td> <td>12 64</td> <td>Pentadecanoic acid</td> <td>СНО</td> <td></td> <td>10.41</td> <td>Antimicrobial Antioxidant</td>	27	12 64	Pentadecanoic acid	СНО		10.41	Antimicrobial Antioxidant
2813.053-Phenylbicyclo (3.2.2) nona-3,6-dien-2-one $C_{15}H_{14}O$ 210.20.06No activity reported2913.56Dasycarpidan-1-methanol, acetate (ester ester $C_{20}H_{26}N_2O_2$ ester326.40.11Antimicrobial3014.229,12-Octadecadienoic acid (Z, Z)-, methyl ester $C_{19}H_{34}O_2$ 294.40.67Anti-inflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective3114.329,12,15-Octadecatrienoic acid, methyl ester U $C_{19}H_{32}O_2$ $C_{20}H_{40}O$ 296.51.38Antioxidant, Antimicrobial, Anti-inflammatory, Anticancer3314.869-Octadecynoic acid 14.99 $C_{18}H_{32}O_2$ 14.99 280.43.24Inhibit fibrosis3414.99Methyl 8,11,14-heptadecatrienoate $2'-hexyl-$, methyl ester $C_{21}H_{38}O_2$ $2'-hexyl-, methyl ester3220.20Antioxidant3616.739,12,15-Octadecatrienoic acid,2'-hexyl-, methyl esterC_{27}H_{52}O_4Si_2496.20.04Anti-inflammation$	27	12.01		015113002		10.11	Anticancer
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	28	13.05	3-Phenylbicyclo (3.2.2)	$C_{15}H_{14}O$	210.2	0.06	No activity reported
2913.56Dasycarpidan-1-methanol, acetate (ester $C_{20}H_{26}N_2O_2$ 326.40.11Antimicrobial3014.229,12-Octadecadienoic acid (Z, Z)-, methyl ester $C_{19}H_{34}O_2$ 294.40.67Anti-inflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective3114.329,12,15-Octadecatrienoic acid, methyl ester T $C_{19}H_{32}O_2$ 292.22.70Anticancerous, Nematicides, Anti-inflammatory, Anticancer3214.50Phytol $C_{20}H_{40}O$ 296.51.38Antioxidant, Antimicrobial, Anti-inflammatory, Anticancer3314.869-Octadecynoic acid $C_{18}H_{32}O_2$ 280.43.24Inhibit fibrosis3414.99Methyl 8,11,14-heptadecatrienoate $C_{18}H_{30}O_2$ 278.430.04Antioxidant3515.33[1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester $C_{27}H_{30}O_4$ 3220.04Anti-inflammation3616.739,12,15-Octadecatrienoic acid, $C_{27}H_{52}O_4$ Si496.20.04Anti-inflammation			nona-3,6-dien-2-one	15 14			
3014.229,12-Octadecadienoic acid (Z, Z)-, methyl ester $C_{19}H_{34}O_2$ 294.40.67Anti-inflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective3114.329,12,15-Octadecatrienoic acid, methyl ester $C_{19}H_{32}O_2$ $C_{20}H_{40}O$ 292.22.70Anticancerous, Nematicides, Antioxidant, Antimicrobial, Anti-inflammatory, Anticancer3314.869-Octadecynoic acid $C_{18}H_{32}O_2$ $E_{18}H_{30}O_2$ 280.43.24Inhibit fibrosis3414.99Methyl 8,11,14-heptadecatrienoate $C_{18}H_{30}O_2$ $E_{21}H_{38}O_2$ 278.430.04Antioxidant3515.33[1,1'-Bicyclopropyl]-2-octanoic acid, $E_{2'}H_{30}O_2$ 3220.20Antimicrobial3616.739,12,15-Octadecatrienoic acid, $E_{2'}H_{5'}O_{4}Si_2$ 496.20.04Anti-inflammation	29	13.56	Dasycarpidan-1-methanol, acetate (ester	$C_{20}H_{26}N_2O_2$	326.4	0.11	Antimicrobial
ester Hypocholesterolemic, Cancer preventive, Hepatoprotective 31 14.32 9,12,15-Octadecatrienoic acid, methyl ester $C_{19}H_{32}O_2$ 292.2 2.70 Anticancerous, Nematicides, 32 14.50 Phytol $C_{20}H_{40}O$ 296.5 1.38 Antioxidant, Antimicrobial, 33 14.86 9-Octadecynoic acid $C_{18}H_{32}O_2$ 280.4 3.24 Inhibit fibrosis 34 14.99 Methyl 8,11,14-heptadecatrienoate $C_{18}H_{30}O_2$ 278.4 30.04 Antioxidant 35 15.33 [1,1'-Bicyclopropyl]-2-octanoic acid, $C_{21}H_{36}O_2$ 322 0.20 Antimicrobial 2'-hexyl-, methyl ester 36 16.73 9,12,15-Octadecatrienoic acid, $C_{27}H_{52}O_4Si_2$ 496.2 0.04 Anti-inflammation	30	14.22	9,12-Octadecadienoic acid (Z, Z)-, methyl	$C_{19}H_{34}O_2$	294.4	0.67	Anti-inflammatory,
3114.329,12,15-Octadecatrienoic acid, methyl ester $C_{19}H_{32}O_2$ 292.22.70Anticancerous, Nematicides, Antioxidant, Antimicrobial, Anti-inflammatory, Anticancer3214.50Phytol $C_{20}H_{40}O$ 296.51.38Antioxidant, Antimicrobial, Anti-inflammatory, Anticancer3314.869-Octadecynoic acid $C_{18}H_{32}O_2$ 280.43.24Inhibit fibrosis3414.99Methyl 8,11,14-heptadecatrienoate $C_{18}H_{30}O_2$ 278.430.04Antioxidant3515.33[1,1'-Bicyclopropyl]-2-octanoic acid, $C_{21}H_{38}O_2$ 3220.20Antimicrobial3616.739,12,15-Octadecatrienoic acid, $C_{27}H_{52}O_4Si_2$ 496.20.04Anti-inflammation			ester				Hypocholesterolemic, Cancer
3114.529.12.139.12	21	14.32	9.12.15-Octadocatrianoic acid mothyl octor	СНО	202.2	2 70	Anticancorous Nomaticidos
3214.869-Octadecynoic acid $C_{18}H_{32}O_2$ 280.43.24Inhibit fibrosis3314.869-Octadecynoic acid $C_{18}H_{30}O_2$ 280.43.24Inhibit fibrosis3414.99Methyl 8,11,14-heptadecatrienoate $C_{18}H_{30}O_2$ 278.430.04Antioxidant3515.33[1,1'-Bicyclopropyl]-2-octanoic acid, $C_{21}H_{38}O_2$ 3220.20Antiicrobial2'-hexyl-, methyl ester3616.739,12,15-Octadecatrienoic acid, $C_{27}H_{52}O_4Si_2$ 496.20.04Anti-inflammation	32	14.52	Phytol	$C_{19} H_{32} O_2$	296.5	1 38	Antioxidant Antimicrobial
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	01	11.00	i ily toi	02011400	2,0.0	1.00	Anti-inflammatory. Anticancer
34 14.99 Methyl 8,11,14-heptadecatrienoate $C_{18}^{10}H_{30}^{20}O_{2}^{2}$ 278.4 30.04 Antioxidant 35 15.33 [1,1'-Bicyclopropyl]-2-octanoic acid, $C_{21}H_{30}O_{2}^{2}$ 322 0.20 Antimicrobial 36 16.73 9,12,15-Octadecatrienoic acid, $C_{27}H_{52}O_{4}Si_{2}$ 496.2 0.04 Anti-inflammation	33	14.86	9-Octadecynoic acid	$C_{10}H_{22}O_{2}$	280.4	3.24	Inhibit fibrosis
3515.33 $[1,1'-Bicyclopropyl]-2-octanoic acid,2'-hexyl-, methyl esterC_{21}H_{38}O_23220.20Antimicrobial3616.739,12,15-Octadecatrienoic acid,C_{27}H_{52}O_4Si_2496.20.04Anti-inflammation$	34	14.99	Methyl 8,11,14-heptadecatrienoate	$C_{18}^{10}H_{30}^{32}O_{2}^{2}$	278.4	30.04	Antioxidant
2'-hexyl-, methyl ester 36 16.73 9,12,15-Octadecatrienoic acid, $C_{27}H_{52}O_{4}Si_{2}$ 496.2 0.04 Anti-inflammation	35	15.33	[1,1'-Bicyclopropyl]-2-octanoic acid,	$C_{21}H_{38}O_2$	322	0.20	Antimicrobial
$36 16.73 9.12,15$ -Octadecatrienoic acid, $C_{27}H_{52}O_4S_1 496.2 0.04$ Anti-inflammation	26	4 (50	2'-hexyl-, methyl ester	0.11.0.0	406.0	0.04	
27 22 E6 N dogmothyltypemodol C U NO 240.2 0.17 Decymotoid orthyitig Dogtlogg logg	36	16.73	9,12,15-Octadecatrienoic acid,	$C_{27}H_{52}O_4SI_2$	496.2	0.04	Anti-inflammation
$C_{15}H_{23}NO_2$ 249.3 0.17 Kneumatoid artifuls, Results legs	37	22.56	N-desmethyltramadol	$C_{15}H_{23}NO_2$	249.3	0.17	sundromo and fibromyalgia
38 22.61 Prednisolone hemisuccinate CHO. 460.5 0.20 Anti-inflammatory	38	22.61	Prednisolone hemisuccinate	C., H., O.	460.5	0.20	Anti-inflammatory
$39 22.69 \text{Condyfolan, 14, 19-didehydro-12-methoxy-, (14E)-} C_{10}H_{10}N_{20} 322.4 0.29 \text{Antimicrobial}$	39	22.69	Condyfolan, 14,19-didehydro-12-methoxy-, (14E)-	$C_{10}H_{24}N_{20}O$	322.4	0.29	Antimicrobial
40 22.76 Aspidospermidine-3-carboxylic acid $C_{22}^{19}H_{28}^{24}N_8O_5$ 400.4 0.11 Anticancer	40	22.76	Aspidospermidine-3-carboxylic acid	$C_{22}^{19}H_{28}^{24}N_8^2O_5$	400.4	0.11	Anticancer
41 22.97 Phthalic acid, di (oct-3-yl) ester $C_{24}H_{38}O_4$ 390.5 0.54 Antimicrobial and antifouling	41	22.97	Phthalic acid, di (oct-3-yl) ester	C ₂₄ H ₃₈ O ₄	390.5	0.54	Antimicrobial and antifouling
42 23.76 2,20-Cycloaspidospermidine-3-carboxylic $C_{21}H_{42}N_2O_2$ 336 1.05 Anticancer	42	23.76	2,20-Cycloaspidospermidine-3-carboxylic	$C_{21}H_{42}N_2O_2$	336	1.05	Anticancer

GC-MS: Gas chromatography-mass spectrometry

a good concrete base for further research to isolate the lead bioactive compounds in the leaves to develop new antioxidant and antimicrobial agent.

AUTHORS' CONTRIBUTIONS

Manish Kapoor conceptualized the research and framework and supervised it. Jyoti Rani performed all the experimental work. Both the

S. No	RT	Name of the compound	Molecular formula	MW	Peak Area %	Pharmacological actions
1	5.78	4H-Pyran-4-one	C ₆ H ₈ O ₄	144	4.73	Antioxidant, Antimicrobial,
			0 0 4			Anti-inflammatory, and Antioxidant
2	6.67	5-Hydroxymethylfurfural	C ₃ H ₆ O ₃	126	30.86	Antioxidant, Antiproliferative activity
3	12.43	n-Hexadecanoic acid	$C_{16}H_{32}O_{2}$	256	6.58	Antioxidant, Hypocholesterolemic,
						Nematicide, Pesticide, Lubricant,
						Antiandrogenic, Flavor
4	13.38	Phytol	$C_{20}H_{40}O$	296	17.17	Hypocholesterolemic, Antimicrobial,
			20 40			Anticancer, Diuretic, Anti-inflammatory
5	13.57	9,12,15-Octadecatrienoic acid	$C_{18}H_{30}O_{2}$	278	23.64	Anti-inflammatory, Hypocholesterolemic,
			10 50 2			Cancer preventive, Hepatoprotective,
						Nematicide, Insectifuge
6	16.08	2,20-Cycloaspidospermidine	$C_{21}H_{24}N_{2}O_{2}$	336	4.95	Anticancer
		-3-carboxylic acid vindolinine	21 24 2 2			
7	20.57	Aspidospermidine-3-carboxylic acid	$C_{22}H_{20}N_2O_E$	400	12.09	Anticancer
		vindoline	22 20 2 3			

Table 4: Results of the GC-MS analysis from the leaves of Catharanthus roseus (white)

GC-MS: Gas chromatography-mass spectrometry

authors analyzed the data and interpreted the results. Jyoti Rani and Manish Kapoor wrote and finalized the manuscript.

CONFLICTS OF INTEREST

Both the authors declare that there are no conflicts of interest regarding the publication of this research.

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