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Phytochemical Profile and Antimicrobial Evaluation of *Pterocarpus marsupium* and *Cryptolepis buchanani*: A Step Towards Natural Alternatives to Antibiotic Resistance

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Abstract

Pterocarpus marsupium Roxb. and *Cryptolepis buchanani* Reider are medicinal plants widely used in *Ayurvedic, Unani*, and tribal healthcare systems for the management of metabolic, inflammatory, and infectious diseases. This study aimed to evaluate the phytochemical composition and antimicrobial activity of leaf and bark extracts of these plants. Qualitative phytochemical screening was conducted, and bioactive compounds were identified using gas chromatography–mass spectrometry (GC–MS). Antimicrobial activity was assessed against *Pseudomonas aeruginosa*, *Salmonella typhi*, and *Staphylococcus aureus* using the agar well diffusion method. The bark extract of *P. marsupium* demonstrated broad-spectrum antimicrobial activity against all tested pathogens, whereas its leaf extract showed consistent inhibitory activity. The leaf extract of *C. buchanani* showed selective antimicrobial activity, whereas the bark extract exhibited minimal inhibition. GC–MS analysis revealed several phytochemicals that may contribute to the antibacterial properties of these plants. The findings validate the traditional medicinal use of *P. marsupium* and *C. buchanani* and suggest their potential as natural sources of antimicrobial agents for developing plant-based therapeutics to address bacterial infections and antibiotic resistance.

Major Findings: *Pterocarpus marsupium* bark and leaves showed strong broad-spectrum antibacterial activity. *Cryptolepis buchanani* leaves showed selective activity, whereas the bark showed minimal effect. GC–MS identified bioactive compounds supporting antimicrobial activity and traditional use.

Keywords: Antimicrobial Activity, *Cryptolepis buchanani,* Phytochemicals, Plant-based Antibiotics, *Pterocarpus marsupium*, GC–MS

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1. Introduction

The development of pharmaceuticals relies heavily on bioactive chemicals derived from medicinal plants. The endogenous phytochemicals found in these plants have several pharmacological uses, including antibacterial, antioxidant, anti-inflammatory, and antidiabetic activities[1–4]. Phytochemical compounds have emerged

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as potential alternatives for treating illnesses resistant to multiple drugs, a growing concern worldwide[5,6]. *P. marsupium* Roxb., a member of the Fabaceae family, is famous for its therapeutic qualities; it is also known as Indian Kino and *Bijasal*[7,8]. Traditional uses of the bark, leaves, and heartwood include alleviating diabetes, skin conditions, and gastrointestinal problems[3,5,9,10]. Research into phytochemistry has uncovered bioactive substances with antibacterial, antioxidant, and antidiabetic properties, such as phenolic acids, pterostilbene, and epicatechin[10–12].

The agar well diffusion studies demonstrate that *P. marsupium* extracts are very efficient antibacterials. The considerable effects observed in methanolic extracts of bark and leaves were attributed to tannins, flavonoids, and phenolic acids, all of which are known to weaken bacterial cell walls and inhibit protein synthesis[13]. New antibacterial agents may be derived from the plant's extracts, effective against both Gram-positive and Gram-negative bacteria[14]. The plant's antibacterial activity was enhanced by its synergistic antimicrobial interactions with medicines like gentamicin[15].

Traditional *Ayurvedic* medicine utilises *C. buchanani* Reider, *Jambu patra sariva*, and *Karanta*, a member of the Asclepiadaceae family, to treat skin conditions, ulcers, and wounds[16,17]. The antibacterial, anti-cancerous, and antioxidant properties are linked to a rich phytochemical composition that includes alkaloids, tannins, flavonoids, and saponins[18]. The medicinal potential of plants can be better understood through phytochemical profiling, which reveals the bioactive compounds present in plants[13]. To detect and quantify volatile and semi-volatile chemical components in plant extracts, scientists rely on gas chromatography-mass spectrometry, a modern analytical tool, to identify potential antibacterial compounds. This technique gives molecular weights, retention times, and structural details[19]. The phytochemical profile of *P. marsupium* bark and leaves extracts shows notable compounds, including 9-Octadecenamide, 1-monolinoleoylglycerol trimethylsilyl, and Ethyl iso-allocholate, which have antibacterial, antioxidant, and anticancer effects. Studies have linked these compounds to powerful antimicrobial activity against bacteria and fungi, including *S. typhi*, *S. aureus*, *E. coli*, *A. niger* and *C. albicans*[13,14,20–22]. The bark and leaves of *C. Buchanani* contain many bioactive compounds, including alkaloids and saponins. Flavonoids, which are derivatives of quercetin, have strong anti-inflammatory, antibacterial and antioxidant properties[23–25]. The antibacterial and astringent properties of tannins are due to their ability to precipitate proteins from microorganisms.

Methanolic extracts that contain a wide range of secondary metabolites show superior antibacterial activity against antibiotic-resistant *S. aureus*, *K. pneumoniae*, and *P. vulgaris*, which can resist several antibiotics[26,27]. The antibacterial capabilities of *P. marsupium* and *C. buchanani* are related to several bioactive components, such as phenolic acids, flavonoids, and alkaloids in both species, indicating their potential to have a significant impact on germs[15,23]. In contrast to *C. buchanani's* abundance of alkaloids and tannins, *P. marsupium* has unique terpenoids and long-chain fatty acids.

The main components of the antibacterial mechanism are the vulnerability of bacterial membranes to lipophilic compounds such as saponins and oleic acid. Phenolic acids and tannins interact with microbial proteins, leading to protein denaturation and inhibition of enzyme activity. Antioxidant activity, achieved through the scavenging of free radicals, boosts the immune system and reduces the likelihood of infection by flavonoids and phenolic compounds. *P. marsupium* and *C. buchanani* have the potential to be developed into plant-based antibiotics due to their antibacterial and pharmacological properties. Through phytopharmaceutical development, these plants may help combat microbial diseases and contribute to the global fight against antibiotic resistance. Keeping the above in view, the present study aims to analyse the phytochemicals present in the leaves and bark of *P. marsupium* and *C. buchanani*, and to assess their potential as antibacterial agents.

2. Materials and Methods

2.1 Plant Material Collection

Fresh bark and leaves of *P. marsupium* and *C. buchanani* were collected from Deendayal Research Institute (DRI), Chitrakoot, in mid-November 2023. The plants were authenticated by Dr. Ravindra Singh, Associate Professor in Botany and head of the Department of Biological Sciences at Mahatma Gandhi Chitrakoot Gramoday Vishwavidyalaya, Satna (MGCGV).

2.2 Bacterial Strains

Bacterial cultures, viz., *P. aeruginosa* (MTCC424), *S. typhi* (MTCC734), and *S. aureus* (MTCC1144) used in

the present study were procured from MTCC, IMTECH, Chandigarh, and maintained in the Department of Microbiology, Dr. Rammanohar Lohia Avadh University, Ayodhya, India.

2.3 Preparation of Plant Extract

The methanolic extract of shade-dried leaves and bark was prepared as described previously[28]. Briefly, the finely powdered material was soaked in methanol for 48 hours, then filtered through Whatman No. 1 filter paper, followed by drying in a rotary evaporator. Methanolic extraction of the shade-dried bark (SVS) (1195 g) and leaves (SVL) (410 g) of *P. marsupium* yielded 10.618 g and 91.404 g of dried extract, respectively. While the bark (SAS) (347 g) and leaves (SAL) (700 g) of *C. buchanani* yielded 30.32 g and 116.631 g of dried extract, respectively. The dried extracts were stored in a refrigerator at 4°C for future use.

2.4 Preliminary Phytochemical Screening

Phytochemical screening of *P. marsupium* and *C. buchanani* was carried out for leaf and bark extracts as per the standard method described earlier for the qualitative detection of Alkaloids, Flavonoids, Terpenoids, Tannins, Phenolic Acids, Saponins, Phytosterols, Amino Acids, Carbohydrates, Lipids, Glycerides, and Resin test[29,30].

2.5 GC-MS Profiling of Plant Extract

2.5.1 Instrument and Running Conditions

The sample was dissolved in methanol and injected into a GC-MS QP2010 model (Shimadzu®). The column used was an SH-I-5Sil MS capillary, measuring 30 m x 0.25 mm x 0.25 µm, with a splitless injection mode. The operating conditions for the GC–MS analysis were established as follows: The oven temperature was set to 45 °C for 2 minutes, followed by a ramp to 140 °C at a rate of 5 °C per minute, and finally increased to 280 °C, which was maintained isothermally for 10 minutes. The sample injection volume was 2 µL, and the carrier gas used was helium at a flow rate of 1 mL/min. The ionisation of the sample components was conducted at 70 eV. The GC runtime ranged from 9.10 to 52.0 minutes.

2.5.2 Identification of Components

The mass spectrum obtained was analysed for interpretation as follows: The National Institute of Standards and Technology (NIST14.L) database (2020), containing more than 62000 patterns, was subsequently searched to compare the structures of the compounds. Compounds were identified by comparing their retention times and mass spectra with those of known compounds in the NIST library (C:\Database\NIST14.L). A comparison was made between the spectra of the unknown component and the spectra of known components previously stored in the NIST Library. To predict the compound's bioactivity, Dr. Duke's Phytochemical and Ethnobotanical Databases are used. By comparing the average peak area of each phyto-component to the total area, the relative percentage of each phyto-component was determined. During testing, the components of the materials were recorded along with their names, molecular weights, molecular formulas, and structures.

2.6 Antibacterial Potential of Plant Extracts

The antibacterial potential of plant extracts was studied as follows:

2.6.1 Preparation of Extract Solutions

The plant extracts were dissolved in dimethyl sulfoxide (DMSO) to prepare a stock solution of appropriate concentration. DMSO served as the solvent due to its ability to dissolve both polar and nonpolar compounds, as well as its minimal interference with microbial growth.

2.6.2 Sensitivity Assay

Mueller-Hinton (Himedia, India) agar plates were prepared according to the manufacturer's prescription. The test bacterial cultures were grown overnight in LB medium. The OD of overnight-grown bacterial cultures was adjusted to 0.5×10^8 cells mL^{-1} spectrophotometrically. A sterile cotton swab was dipped into the bacterial suspension, which was adjusted to a specific cell count. Excess liquid was removed by gently pressing the swab against the inner wall of the culture tube. The swab was used to evenly spread the bacterial inoculum across the agar surface in a Petri dish, ensuring a uniform lawn of growth. The Petri dishes were allowed to dry for 5–10 minutes, followed by the well creation using a cork borer (8 mm diameter). The agar plugs were removed using sterile forceps. Twenty-five microlitres of 10% (w/v) plant extract in DMSO, equivalent to 2.5 mg of plant extract, was dispensed into the well using a sterile micropipette. Control wells contained only 25 mL of DMSO solution.

3. Results and Discussion

The phytochemical screening of methanolic extracts of *P. marsupium* Roxb. SVL (Leaves) and SVS (Bark), and *C. Buchanani* Reider SAL (Leaves) and SAS (Bark) revealed the presence of several bioactive compounds. Alkaloids were confirmed in all extracts through Mayer's, Wagner's, and Hager's tests. Flavonoids were detected in all samples using the Shinoda test, the Alkaline Reagent test, and the Beta-Smith and Metcalf test. Terpenoids were also present, as indicated by the positive results in the Salkowski test. The presence of tannins was confirmed in all extracts by the Gelatin test. Similarly, phenolic compounds were detected using the Ferric Chloride and Lead Acetate tests. Saponins were also present in all extracts, as evidenced by the Foam test.

Further analysis revealed the presence of phytosterols through the Libermann-Burchard test, while amino acids were confirmed using the Ninhydrin and Millon's tests. Carbohydrates were detected in all samples via the Molisch test. However, the absence of lipids was noted, as indicated by the negative results in the saponification test. Additionally, glycerides were absent, as confirmed by the Acrolein test. Similarly, resins were not detected in any of the samples, as demonstrated by the Alcohol Precipitation, Acetone, and Turbidity tests. Overall, the study highlights the rich presence of alkaloids, flavonoids, terpenoids, tannins, phenolic compounds, saponins, phytosterols, amino acids, and carbohydrates in all tested extracts, whereas lipids, glycerides, and resins were absent. The results are presented in Table 1.

Table 1. Qualitative analysis of *Pterocarpus marsupium* Roxb., *Cryptolepis buchanani* Reider leaves, and bark methanolic extracts [leaves of *P. marsupium* (SVL); bark of *P. marsupium* (SVS); leaves of *C. buchanani* (SAL); bark of *C. buchanani* (SAS)] to detect the presence of phytochemicals, where (+) is present and (-) is not present. Results are shown in triplicate form

Sr. No.	Test Name	Results			
		SVL (Leaves)	SVS (Bark)	SAL (Leaves)	SAS (Bark)
1. Alkaloids	Mayer's Test	+++	+++	+++	+++
	Wagner's Test	+++	+++	+++	+++
	Hager's Test	+++	+++	+++	+++
2. Flavonoids	Shinoda Test	+++	+++	+++	+++
	Alkaline Reagent Test	+++	+++	+++	+++
	Beta-Smith and Metcalf Test	+++	+++	+++	+++
3. Terpenoids	Salkowski Test	+++	+++	+++	+++
4. Tannins	Gelatin Test	+++	+++	+++	+++
5. Phenolic Compounds	Ferric Chloride Test	+++	+++	+++	+++
	Lead Acetate Test	+++	+++	+++	+++
6. Saponins	Foam Test	+++	+++	+++	+++
7. Phytosterols	Libermann-Burchard's Test	+++	+++	+++	+++
8. Amino Acids	Ninhydrin Test	+++	+++	+++	+++
	Millon's Test	+++	+++	+++	+++
9. Carbohydrates	Molisch Test	+++	+++	+++	+++
10. Lipids	saponification test	---	---	---	---
11. Glycerides	Acrolein Test	---	---	---	---
12. Resin	Alcohol Precipitation Test	---	---	---	---
	Acetone Test	---	---	---	---
	Turbidity Test	---	---	---	---

Research carried out by other researchers for qualitative analysis of plant extracts has shown similar findings[31–35].

3.1 GC-MS Analysis of *Pterocarpus marsupium* Leaves

There are 111 peaks with different total ion strengths listed in the SVL extract's GC-MS analysis report. The GC-MS chromatogram is shown in Figure 1, displaying the total ion intensities of the identified chemicals. The data is shown in Supplementary Table 1.

These consist of bioactive, antimicrobial, antioxidant, and functional compounds. Out of these 37 compounds, including oleamide, erucamide, linoleyl acetate, and ethyl linolenate, some have antibacterial activity. In contrast, 52 peaks were identified as bioactive antioxidant compounds, including vitamin E, gamma-tocopherol, and ethyl linolenate, which are used in preservation and health applications to fight oxidative stress. Remining 25 compounds were identified as precursors of lipids and fatty acids, with bioactive functions and anticancer properties. These substances serve multiple purposes, including industrial, cosmetic, and medicinal applications[36]. Because of its antibacterial properties, oleamide is used to prevent bacterial and fungal growth. Erucamide has been used as an antimicrobial[37]. The antibacterial and antioxidant properties of linoleyl acetate have been reported[38]. The antioxidant ethyl linolenate is known to help preserve biological materials[39].

3.2 GC-MS Analysis of *Pterocarpus marsupium* Bark

Sixty-five distinct peaks with varying bioactivities were identified by chromatographic analysis and classified into antimicrobial, antioxidant, terpenoids, fatty acids, phenolic, and miscellaneous bioactive groups. These results highlight the potential of the sample (SVS) as a source of bioactive compounds for therapeutic use and suggest a broad range of applications in biomedicine, pharmaceuticals, and nutraceuticals. The results are presented in Figure 2, showing the Total Ion Chromatogram (TIC). The data is presented in Supplementary Table 2.

Eighteen of these compounds, including phenol, lupeol, and n-hexadecanoic acid, are known to have

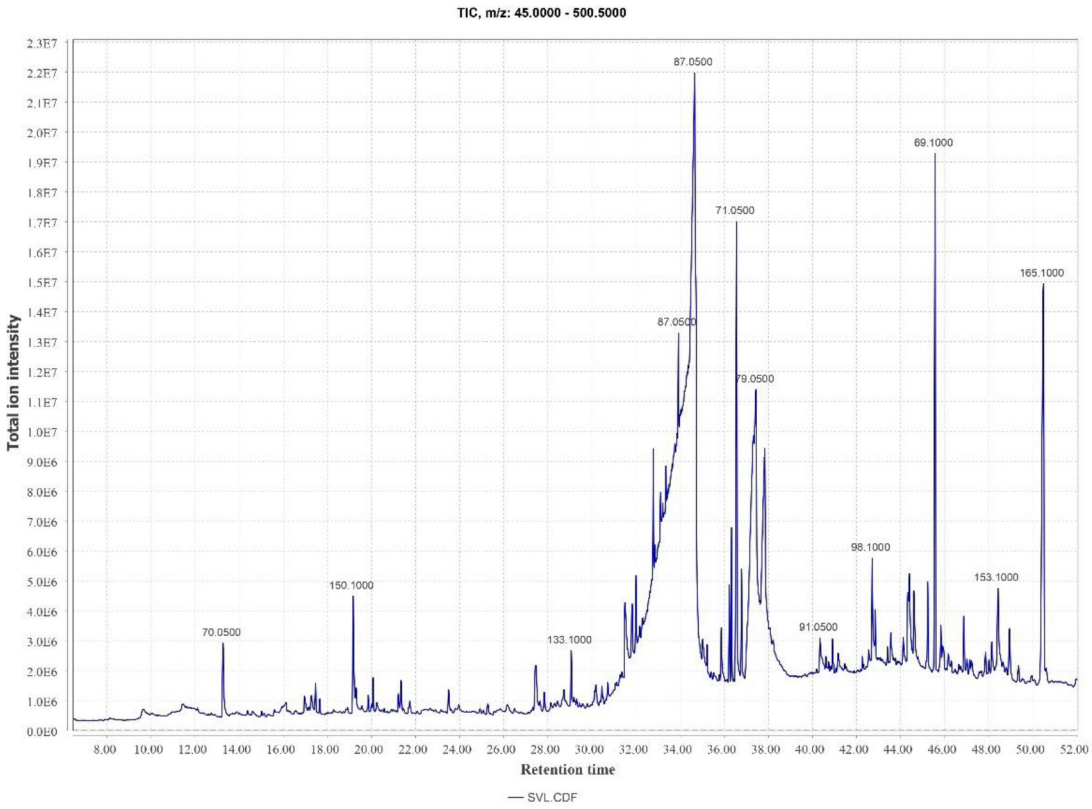


Figure 1. GC-MS Chromatogram of the methanolic extract of *Pterocarpus marsupium* leaves.

antibacterial properties that inhibit microorganism growth. Eighteen substances, including olean-12-en-3-ol and 3,5-dimethoxybenzyl alcohol, possess antioxidant qualities that can reduce oxidative stress. Ten terpenoids and steroids were found in the investigation, including β-amyrone and γ-sitostenone, which are often linked to anti-inflammatory and anti-cancer properties[40]. Seven substances were fatty acids and their derivatives, including ethyl oleate and 9,12-octadecadienoic acid, which have potential bioactivity and metabolic control functions. A noteworthy set of ten compounds, including aromatic and phenolic compounds, such as 6-hydroxy-3- (3,5-dimethoxyphenyl) benzo (b)furan and 2-methoxy-4-vinylphenol, are often associated with antioxidant and antibacterial properties[41]. The remaining 18 substances are classified as miscellaneous bioactives and exhibit a range of pharmacological characteristics, including complex aromatic structures and benzaldehyde derivatives, which may have special therapeutic uses. The distribution of these chemicals demonstrates the sample's bioactive diversity, with a significant proportion of molecules exhibiting antioxidant and antibacterial properties[37,39].

3.3 GC-MS Analysis of *Cryptolepis buchanani* Leaves

A total of 171 chromatographic peaks were detected by GC-MS analysis of the SAL sample. The complete identification of the analytes in the sample is shown by the extensive information provided for each compound, including its name, area, height, and retention time (Supplementary Table 3). The results are shown in Figure 3.

Out of 171 substances, 63 were shown to be bioactive antimicrobial agents capable of inhibiting the growth of microorganisms. Forty antioxidant compounds that may neutralise free radicals and provide therapeutic or protective advantages were also found. Additionally, 35 anti-inflammatory substances have been identified that show promise for therapeutic use in lowering inflammation[42]. In addition, 33 compounds with cytotoxic or other pharmacological characteristics were divided

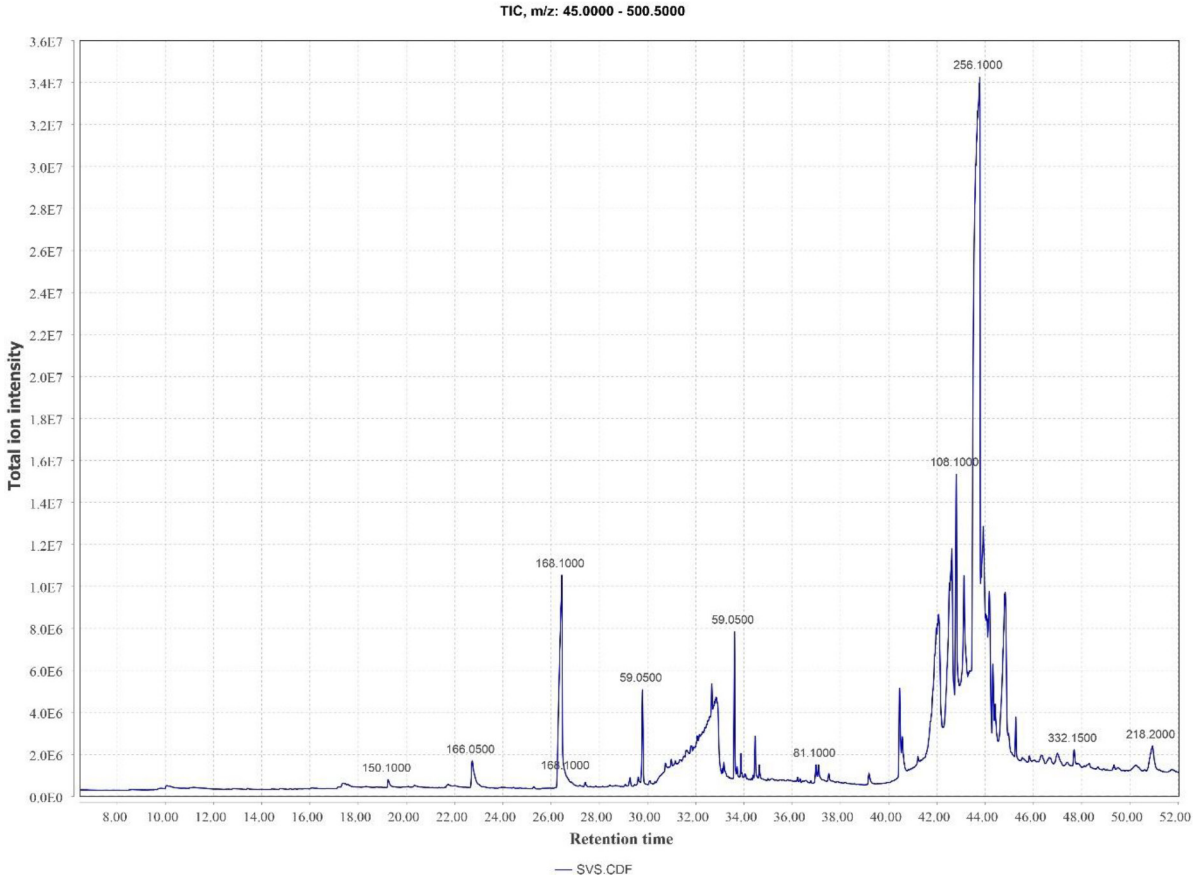


Figure 2. GC-MS Chromatogram of the methanolic extract of *Pterocarpus marsupium* bark.

into the following groups: pro-apoptotic molecules (1), immunomodulators (1), cytotoxic agents (10), enzyme inhibitors (5), antiviral compounds (4), antifungal compounds (3), neuroprotective agents (3), anti-diabetic compounds (2), cardioprotective agents (2), and anti-proliferative agents (1)[23,43]. This thorough investigation opens the door for further research into pharmaceutical and biotechnological applications by highlighting the compounds' diverse pharmacological potential.

3.4 GC-MS Analysis of *Cryptolepis buchanani* Bark

The GC-MS analysis of the SAS extract revealed 142 compound peaks. Out of which, 35 compounds exhibited antibacterial properties, with notable examples including hexanoic acid, 4-vinylphenol, and lanosterol. The total Ion chromatogram showing peaks is presented in Figure 4. The data is shown in Supplementary Table 4.

These compounds are effective against a variety of microbial strains and have potential applications in medicinal and preservation fields. Furthermore, 45 substances exhibited antioxidant activity, with essential contributions including oleic acid, β-sitosterol, and 9,12-octadecadienoic acid, recognised for their capacity to scavenge free radicals and their uses in food preservation, cosmetics, and medical care[23,43,44]. Furthermore, 20 substances, including epilupeol and β-sitosterol acetate, were classified as bioactive with characteristics including anti-inflammatory, cytotoxic, or anticancer activities, highlighting their potential for therapeutic use[45-47]. Additionally, 15 compounds—including dotriacontane and cyclooctasiloxane—were categorised as inert or non-bioactive, meaning they possess structural or functional properties but exhibit no discernible biological effects[10,15]. Twelve additional chemicals, including silane derivatives, were identified as useful solvents or additives that enhance the stability and functionality of chemical formulations[48,49]. Lastly, 15 chemicals are yet unknown or unique, indicating untapped research potential. The need for further research into the lesser-known properties of these compounds is underscored by

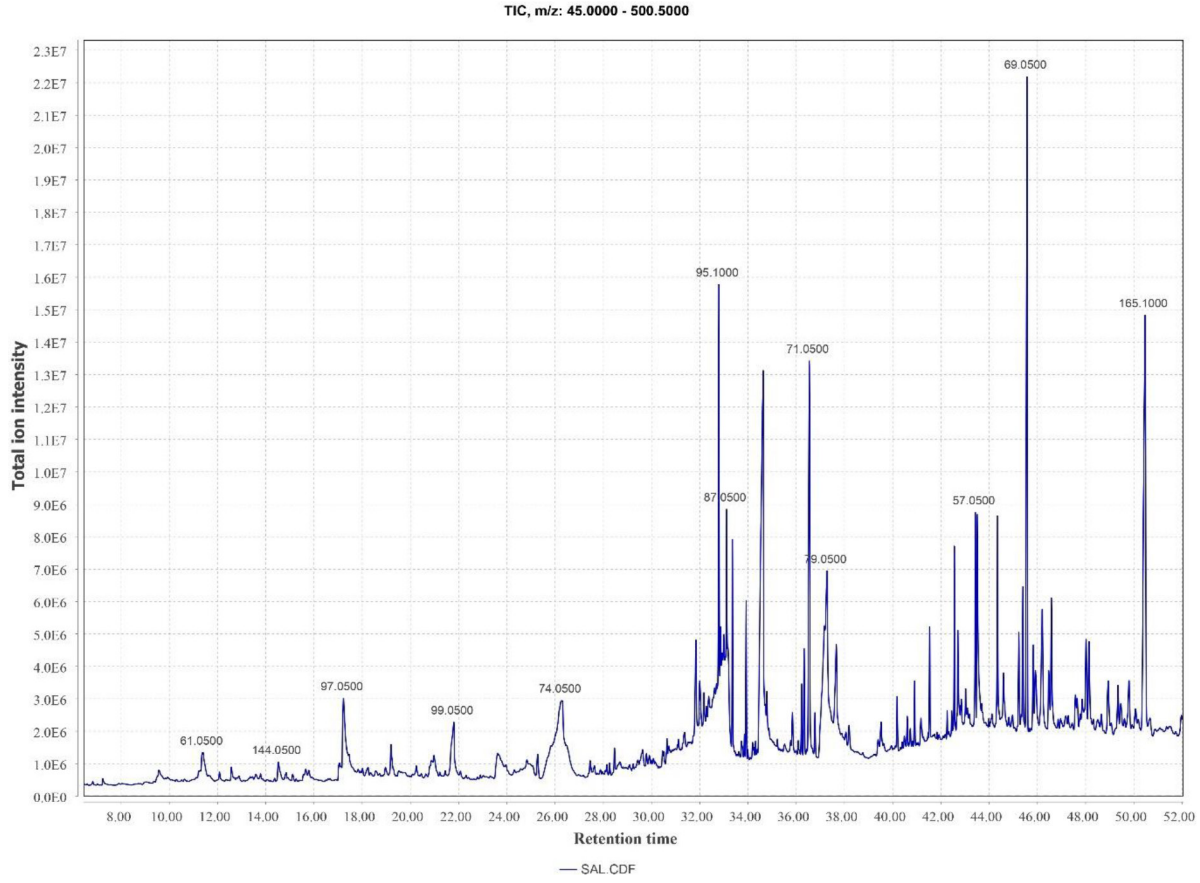


Figure 3. GC-MS Chromatogram of the methanolic extract of *Cryptolepis buchanani* leaves.

this accurate classification, which also highlights their multifunctionality and significance in the antibacterial, antioxidant, and therapeutic domains.

3.5 Antibacterial Activity of Plant Extracts Against Bacterial Strains

Observation of the assay plates revealed the formation of zones of inhibition around the extract, indicating its antimicrobial activity. The diameters of the zones were measured using the zone scale. The antibacterial activity of the plant extract was assessed against three bacterial strains: *Staphylococcus, Pseudomonas*, and *Salmonella*. The zone of inhibition, measured in millimetres, was recorded for each sample at a concentration of 25 µL (100 mg/mL). The results revealed varying degrees of antibacterial activity among the tested samples.

The leaf extract of *C. buchanani* (SAL) demonstrated moderate antibacterial activity against all three bacterial strains, with inhibition zones of 10 mm for *Staphylococcus*, 12 mm for *Pseudomonas*, and 10 mm for *Salmonella*. In comparison, the leaf extract of the *P. marsupium* (SVL) sample showed slightly higher antibacterial activity, with zones of inhibition of 11 mm for *Staphylococcus*, 14 mm for *Pseudomonas*, and 13 mm for *Salmonella*. Similarly, the bark extract of *C. buchanani* (SAS) exhibited antibacterial activity comparable to SAL, with inhibition zones of 11 mm for *Staphylococcus*, 12 mm for *Pseudomonas*, and 11 mm for *Salmonella*. However, the bark extract of *P. marsupium* (SVS) exhibited the highest antibacterial activity among all tested samples. It produced significantly larger zones of inhibition, measuring 20 mm for *Staphylococcus*, 18 mm for *Pseudomonas*, and 25 mm for *Salmonella*[50–52]. The results are shown in Figure 5.

The results suggest that the SVS sample is the most effective against the tested bacterial strains, indicating its strong potential for further exploration in antimicrobial applications. These findings highlight the efficacy of SVS and its possible use as a natural antibacterial agent.

The well diffusion method provides a qualitative measure of antimicrobial activity based on the size of the inhibition zones produced by the tested plant

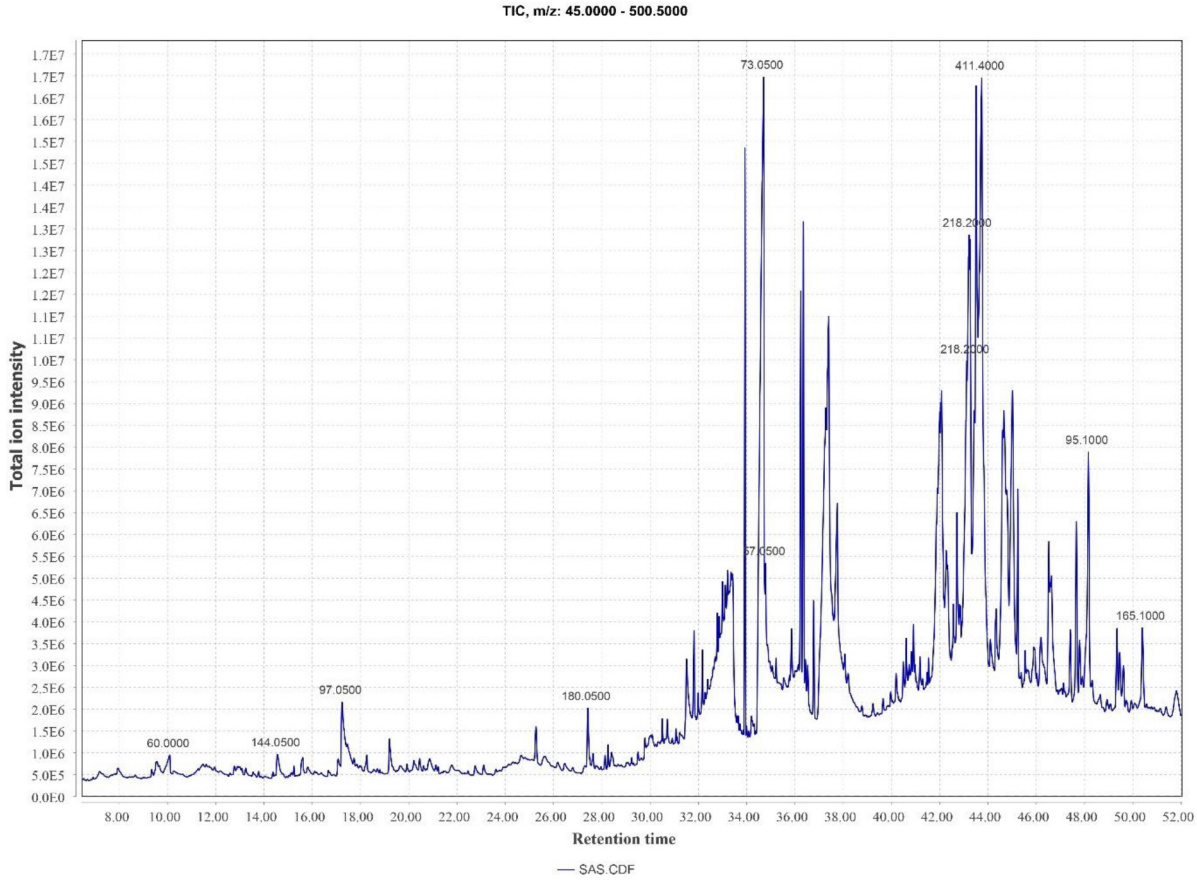


Figure 4. GC-MS Chromatogram of the methanolic extract of *Cryptolepis buchanani* bark.

Table 2. Antibacterial activity of plant extracts

Plant extract (2.5 mg in 25 ml DMSO)	Zone of Inhibition (mm ± SD) Against Bacterial Strains		
	***S. aureus* MTCC1144**	***P. aeruginosa* MTCC424**	***S. typhi* MTCC734**
SAL (leaves of *C. buchanani*)	10.0 ± 0.5	12.0 ± 0.6	10.0 ± 0.4
SAS (bark of *C. buchanani)*	11.0 ± 0.5	12.0 ± 0.7	11.0 ± 0.5
SVL (leaves of *P. marsupium*)	11.0 ± 0.7	14.0 ± 0.8	13.0 ± 0.6
SVS (bark of *P. marsupium)*	20.0 ± 1.2	18.0 ± 1.0	25.0 ± 1.5

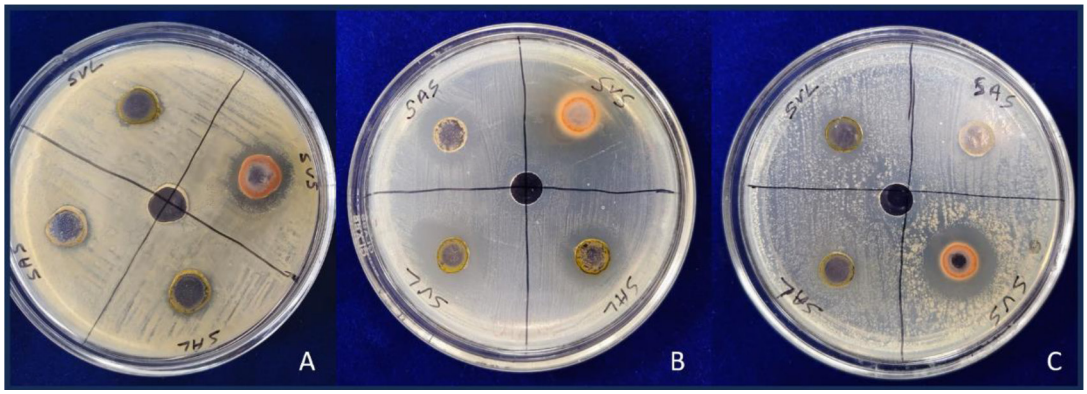


Figure 5. Antibacterial sensitivity assay of plant extracts [leaves of *C. buchanani* (SAL); bark of *C. buchanani* (SAS); leaves of *P. marsupium* (SVL); bark of *P. marsupium* (SVS)]: photographs showing zones of inhibition of bacterial pathogens. **A:** *P. aeruginosa* (MTCC424); **B:** *S. typhi* (MTCC734); **C:** *S. aureus* (MTCC1144). The DMSO loaded well in the centre of each Petri dish served as a negative control. The experiment was conducted in triplicate for reliable results.

extracts[50,52–54] The diameter of each zone of inhibition was measured in millimetres using a zone scale (Himedia, India). The measurements were recorded for each bacterial strain and test concentration. Each test was performed in triplicate to ensure reproducibility and accuracy. The result is shown in Table 2.

The antimicrobial activity of the SVS, SVL, SAS, and SAL extracts is predominantly driven by phenolic compounds (syringaldehyde, syringic acid, vanillin derivatives, 2,4-di-tert-butylphenol), aldehydes (benzaldehydes and methoxybenzaldehydes), guaiacol derivatives, and naphthalene-based molecules[55,56]. These classes of compounds collectively mediate antimicrobial effects through a multi-target mode of action, involving membrane disruption, enzyme inactivation, DNA intercalation, oxidative stress induction, and quorum-sensing inhibition[57–59]. The observed synergy among these phytochemicals underscores the extracts' broad-spectrum antimicrobial efficacy and highlights their potential as natural, eco-friendly alternatives to synthetic antimicrobials for pharmaceutical, nutraceutical, and agricultural applications.

4. Conclusions

The purpose of this study was to evaluate whether a methanol extract from *C. buchanani* (SAL and SAS) and from *P. marsupium* (SVL and SVS) would demonstrate any antibacterial effects against *S. aureus*, *P. aeruginosa*, and *S. typhi*. Both *Cryptolepis* and *Pterocarpus* extracts showed antibacterial activity against all tested bacteria. The most effective extract against *S. aureus*, *P. aeruginosa*, and *S. typhi* was SVS, which produced inhibition zones measuring 20, 18, and 25 mm, respectively. The extracts that exhibited moderate antibacterial activity against the listed bacteria were SAS and SVL, whereas SAL did not demonstrate significant antibacterial activity against any of the three bacteria tested.

The differences in antibacterial activity may have been caused by differences in the types and amounts of bioactive phytochemicals present in the plant extracts, which affect their interactions with bacterial cell structures. The use of methanol as an extraction solvent and DMSO as a carrier for the extraction solvent was effective for extracting and delivering the antibacterial agents without promoting microbial growth.

The study validates the traditional use of medicinal plants; however, SVS shows the best antibacterial activity among the four extracts and may therefore be a good candidate for further research aimed at developing new antibiotics to combat the growing problem of antibiotic resistance.

5. Availability of Data and Materials

The data used to support the findings of this study are available from the first author upon reasonable request.

6. Acknowledgments

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Author Contribution

Devendra Singh: Data curation, Formal Analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing; **Priyanka:** Data curation, Formal Analysis, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing; **Krishna N Mishra:** Data curation, Formal Analysis, Investigation, Writing – original draft, Writing – review & editing; **Indra Prasad Tripathi:** Project administration, Validation, Writing – review & editing; **Shailendra Kumar:** Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – review & editing

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Supplementary Table 1. Identification of compounds by the GC-MS analysis in the methanolic extract of the leaves of *Pterocarpus marsupium* and their biological activities

Peak#	R. Time	F. Time	Area	Area%	Height	Name	Biological Activity
1	9.649	9.83	2261064	0.27	218610	Silane, [3-(2,3-epoxypropoxy) propyl] ethoxydimethyl-	AM/AF
2	9.999	10.185	417360	0.05	43752	Phenol	AM, AO, AI, AA
3	11.464	11.57	1386818	0.17	161747	Unkown	No data available
4	13.267	13.475	10988325	1.34	2460258	4-(4-Methyl-piperazin-1-yl)-1,5, -dihydro-imidazol-2-one	AV,AC
5	14.376	14.445	494651	0.06	139656	Disiloxane, 1,1,3,3-tetramethyl-1,3-bis[3-(oxiranylmethoxy)propyl]-	AM
6	14.609	14.715	652818	0.08	113191	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	AO, AM, AI
7	15.009	15.07	439897	0.05	165997	2-Allyl-2-methylcyclohexanone	IR, FA, AM
8	15.598	15.675	611363	0.07	152930	Pentanedioic acid, 2-methyl-	AM; AI
9	16.125	16.165	1097767	0.13	251657	N-Methylpyrrole-2-carboxylic acid	AC, AM
10	16.546	16.665	654658	0.08	97310	Carbonic acid, monoamide, N-butyl-, 2-methoxyethyl ester	AM
11	16.958	17.1	2644289	0.32	547401	4-Vinylphenol	AM, AO, FA, IR
12	17.27	17.4	2472280	0.3	480086	2-(E)-Hexenoic acid, (4S)-amino-5-methyl-	AM
13	17.46	17.53	2430491	0.3	934166	Benzene, 2-(2-butenyl)-1,3,5-trimethyl-	IC
14	17.651	17.715	1277339	0.16	493856	(1,4-Dimethylpent-2-enyl) benzene	AM
15	19.169	19.27	13083072	1.59	3732571	2-Methoxy-4-vinylphenol	AM, AO, AI, IR
16	19.305	19.35	992511	0.12	450718	1H-Indene, 2,3-dihydro-1,1,5,6-tetramethyl-	AO
17	19.851	19.915	1495545	0.18	555937	1H-Indene, 2,3-dihydro-1,1,5,6-tetramethyl-	AO
18	20.073	20.13	2418852	0.29	1051703	1H-Indene, 2,3-dihydro-1,1,5,6-tetramethyl-	AO
19	20.244	20.41	1586193	0.19	299422	Naphthalene, 1,2-dihydro-1,1,6-trimethyl-	AO, AM, FE
20	21.224	21.28	1540510	0.19	552373	(E)-1-(2,3,6-trimethylphenyl) buta-1,3-diene (TPB, 1)	AO
21	21.34	21.405	3294993	0.4	970481	(E)-1-(2,3,6-trimethylphenyl) buta-1,3-diene (TPB, 1)	AO
22	21.74	21.815	755938	0.09	286563	4-(2,6,6-Trimethylcyclohexa-1,3-dienyl) but-3-en-2-one	AO, AC, AM
23	23.499	23.58	2663454	0.32	732649	(1R,2R,4S,6S,7S,8S)-8-Isopropyl-1-methyl-3-methylenetricyclo [4.4.0.02,7] decan-4-ol	AI
24	23.961	24.105	805808	0.1	182881	4-(2,6,6-Trimethylcyclohexa-1,3-dienyl) but-3-en-2-one	AO, AC, AM
25	24.921	25.01	631746	0.08	149053	4-butoxy-Benzenamine	AO
26	25.069	25.18	511033	0.06	117438	(1R,2R,4S,6S,7S,8S)-8-Isopropyl-1-methyl-3-methylenetricyclo [4.4.0.02,7] decan-4-ol	AI

Supplementary Table 1. Continued...

Peak#	R. Time	F. Time	Area	Area%	Height	Name	Biological Activity
27	25.277	25.37	1531901	0.19	357338	4-Di-tert-butylphenol	AO, AM, AI
28	26.156	26.405	2159299	0.26	252490	Unkown	No data available
29	26.487	26.605	659078	0.08	141230	1,4,4,7a-Tetramethyl-2,4,5,6,7,7a-hexahydro-1H-indene-1,7-diol	AM
30	27.45	27.585	9365339	1.14	1435113	Unkown	No data available
31	27.641	27.725	672985	0.08	208988	Dodecanoic acid	AC, AM, AI, CL
32	27.841	27.965	2447648	0.3	639613	Cycloocta-1,3,6-triene, 2,3,5,5,8,8-hexamethyl-	AO
33	28.134	28.225	955314	0.12	225020	Diethyl Phthalate	AM, AO, AI
34	28.312	28.36	557856	0.07	125619	Phenol, 2-(1,1-dimethyl-2-propenyl)-3,6-dimethyl-	AO
35	28.438	28.535	845063	0.1	176997	Emicymarin	AC
36	28.728	28.775	2065050	0.25	427894	Megastigmatrienone	AO, FA, AC
37	29.061	29.15	5011925	0.61	1803607	Megastigmatrienone	AO,AC
38	29.306	29.37	561534	0.07	214318	trans-Carveol	AM, AO, AI, AC
39	29.56	29.69	656008	0.08	126650	2-Cyclohexen-1-one, 4-(3-hydroxy-1-butenyl)-3,5,5-trimethyl-	AM
40	29.786	29.865	468247	0.06	131308	(1R,4aR,7R,8aR)-7-(2-Hydroxypropan-2-yl)-1,4a-dimethyldecahydronaphthalen-1-ol	AI
41	30.181	30.25	985303	0.12	369213	7-Oxabicyclo [4.1.0] heptan-3-ol, 6-(3-hydroxy-1-butenyl)-1,5,5-trimethyl-	AM
42	30.451	30.485	1085388	0.13	476852	1-(2-[3-(2-Acetyloxiran-2-yl)-1,1-dimethylpropyl] cycloprop-2-enyl) ethanone	epoxy ketone
43	30.713	30.805	1740334	0.21	534899	(E)-2,6-Dimethoxy-4-(prop-1-en-1-yl) phenol	AO, AM, AI
44	31.495	31.62	11005916	1.34	2286454	(E)-4-(3-Hydroxyprop-1-en-1-yl)-2-methoxyphenol	AO, AM, AI
45	31.828	31.88	5988022	0.73	1684835	Tetradecanoic acid	AC, AM, AI
46	31.999	32.06	6943645	0.84	2445741	Loliolide	AO, AI
47	32.165	32.21	794809	0.1	378261	13-Tetradecen-1-ol acetate	AM
48	32.301	32.325	1384018	0.17	327071	5,5,8a-Trimethyl-3,5,6,7,8,8a-hexahydro-2H-chromene	AO
49	32.783	32.83	7851150	0.95	4201808	Neophytadiene	AC, AI, AM, AO
50	32.861	32.89	1121067	0.14	685532	2-Pentadecanone, 6,10,14-trimethyl-	AC, AD, AM, AO
51	33.112	33.155	2619220	0.32	1343152	Phthalic acid, isobutyl trans-dec-3-enyl ester	AM
52	33.21	33.245	1018624	0.12	548092	Pentadecanoic acid	AC, AM, AI
53	33.35	33.38	2477644	0.3	1380439	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	AC, AM, AI
54	33.923	33.965	5961320	0.72	3328621	Hexadecanoic acid, methyl ester	AC, AM, AI
55	34.662	34.81	1.59E+08	19.31	15167236	n-Hexadecanoic acid	AC, AM, AI
56	35.02	35.145	2846656	0.35	707049	trans-Sinapyl alcohol	AO, AI,AC

Supplementary Table 1. Continued...

Peak#	R. Time	F. Time	Area	Area%	Height	Name	Biological Activity
57	35.222	35.27	1613743	0.2	833832	Cyclopropanebutanoic acid, 2-[[2-[[2-[(2-pentylcyclopropyl) methyl] cyclopropyl] methyl] cyclopropyl] methyl]-, methyl ester	AM
58	35.405	35.465	663173	0.08	218648	2H-1-Benzopyran-2-one, 6,7,8-trimethoxy-	AN, AM, AC
59	35.522	35.605	695922	0.08	195143	E, E, Z-1,3,12-Nonadecatriene-5,14-diol	AI
60	35.774	35.805	465383	0.06	215630	Cyclooctasiloxanehexadecamethyl-	AM, AC
61	35.87	35.975	5928646	0.72	1735811	l-(+)-Ascorbic acid 2,6-dihexadecanoate	AO, AM
62	36.23	36.275	7659336	0.93	3266144	9,12-Octadecadienoic acid (Z, Z)-, methyl ester	AO, AC,AM
63	36.333	36.4	12814969	1.56	5138874	11,14,17-Eicosatrienoic acid, methyl ester	AI
64	36.56	36.725	52508061	6.38	15311105	Phytol	AO, AM, AC
65	36.785	36.92	9763027	1.19	3603161	Methyl stearate	AM, AC, AI
66	37.321	37.36	83876919	10.19	6606377	Unkown	No data available
67	37.445	37.585	50845086	6.18	7649216	9,12,15-Octadecatrienoic acid, (Z, Z, Z)-	AC, AC, AI
68	37.842	38.03	45394508	5.52	5667711	Unkown	No data available
69	38.074	38.135	713426	0.09	232367	Eicosyl ethyl ether	AM
70	38.219	38.31	950101	0.12	278554	Cyclononasiloxaneoctadecamethyl-	AO, AM, AI
71	40.341	40.495	5076174	0.62	1070064	Benzyl. beta. -d-glucoside	AO,AC
72	40.614	40.675	1052410	0.13	409955	Cyclopropanebutanoic acid, 2-[[2-[[2-[(2-pentylcyclopropyl) methyl] cyclopropyl] methyl] cyclopropyl] methyl]-, methyl ester	AM
73	40.736	40.775	568190	0.07	269928	Cyclononasiloxaneoctadecamethyl-	AOAM, AI
74	40.911	40.99	3008969	0.37	1082199	4,8,12,16-Tetramethylheptadecan-4-olide	AO, AM, AC
75	41.164	41.2	1104602	0.13	408589	Benzyl. beta. -d-glucoside	AO, prebiotic, AC
76	41.468	41.505	530498	0.06	189526	Ethyl hexacosyl ether	potential long-chain ether with emollient properties
77	42.26	42.29	726126	0.09	443132	Tetracosamethyl-cyclododecasiloxane	AO, ACr, AM
78	42.556	42.63	1725951	0.21	479188	Oxirane hexadecyl-	AM
79	42.712	42.805	8840298	1.07	3241613	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	AO, AC, AM
80	42.854	42.885	2304395	0.28	1465930	Bis(2-ethylhexyl) phthalate	AO, AC
81	43.407	43.455	1263178	0.15	577027	Tetracosamethyl-cyclododecasiloxane	AO, AC, AM
82	43.558	43.67	3487320	0.42	977219	3-Hydroxy-4' 5-dimethoxystilbene	AO, AM, AC
83	44.12	44.245	3275385	0.4	870640	(E)-3,3'-Dimethoxy-4,4'-dihydroxystilbene	AO, AI,AC
84	44.326	44.365	8800461	1.07	2262568	6,9-Octadecadienoic acid, methyl ester	AI
85	44.399	44.555	12074128	1.47	2816252	Methyl 5,11,14,17-eicosatetraenoate	AI
86	44.604	44.76	8495348	1.03	2153120	Octadecanoic acid, 2,3-dihydroxypropyl ester	AO, AM, AI

Supplementary Table 2. Continued...

Peak#	R. Time	F. Time	Area	Area%	Height	Name	Biological Activity
87	45.233	45.295	6623876	0.81	2773385	13-Docosenamide, (Z)-	AO, AC
88	45.564	45.65	48824481	5.93	17276458	Squalene	AO, AC
89	45.826	45.865	3264139	0.4	1220239	1,6,10,14-Hexadecatetraen-3-ol, 3,7,11,15-tetramethyl-, (E, E)-	AO
90	45.906	45.925	414752	0.05	198710	. alpha. -Tocospiro A	AO, AC
91	45.946	45.995	509276	0.06	223870	Tetracosamethyl-cyclododecasiloxane	AO, AC, AM
92	46.16	46.255	1994243	0.24	509613	alpha. -Tocospiro B	AO, AC
93	46.293	46.355	741831	0.09	271536	1-(2,2,3,5,6-Pentamethylcyclohex-4-enyl)-9-(3,3,4-trimethylcyclohex-1-enyl)-3,6-dimethyl-6-ethenyl-dec-4-ene	AO
94	46.637	46.68	632569	0.08	239125	Tricyclo[20.8.0.0(7,16)] triacontane, 1(22),7(16)-diepoxy-	AC
95	46.866	46.955	5397137	0.66	1864138	1,6,10,14,18,22-Tetracosahexaen-3-ol, 2,6,10,15,19,23-hexamethyl-, (all-E)-	AO,AC
96	47.01	47.07	1395371	0.17	448734	1,6,10,14,18,22-Tetracosahexaen-3-ol, 2,6,10,15,19,23-hexamethyl-, (all-E)-	AO,AC
97	47.14	47.18	1059372	0.13	388450	2,2,4-Trimethyl-3-(3,8,12,16-tetramethyl-heptadeca-3,7,11,15-tetraenyl)-cyclohexanol	AO, AC, AM
98	47.217	47.325	1225707	0.15	334394	1,3-bis([(2Z)-3,7-Dimethylocta-2,6-dien-1-yl] oxy)-1,1,3,3-tetramethyldisiloxane	AM
99	47.576	47.615	412337	0.05	110689	Unkown	No data available
100	47.85	47.92	3049394	0.37	782523	1,6,10,14,18,22-Tetracosahexaen-3-ol, 2,6,10,15,19,23-hexamethyl-, (all-E)-(.+/-.)-	AO,AC
101	48.012	48.07	1476697	0.18	465010	2,6,10,15,19,23-Pentamethyl-2,6,18,22-tetracosatetraen-10,15-diol	AO
102	48.137	48.265	4243954	0.52	1022477	1,6,10,14,18,22-Tetracosahexaen-3-ol, 2,6,10,15,19,23-hexamethyl-, (all-E)-(.+/-.)-	AO, AC
103	48.42	48.595	13409642	1.63	2613381	N-(2,4-Dimethoxy-phenyl)-2-(3H-imidazo[4,5-b] pyridin-2-ylsulfanyl)-acetamide	AM,AC
104	48.65	48.725	807970	0.1	218246	Undec-10-ynoic acid, hexadecyl ester	AO, AM, AC
105	48.794	48.855	683480	0.08	211376	Tetracontane-1 40-diol	AM
106	48.943	49.095	6988628	0.85	1623382	gamma. -Tocopherol	AO, AC, AM
107	49.346	49.425	2065484	0.25	545660	Cholesta-4,6-dien-3-ol, (3. beta.)-	AO, AC, AM
108	49.953	50.01	842592	0.1	199210	1-Hexacosanol	AO, AC, AM
109	50.068	50.16	423312	0.05	100925	3'-Hydroxy-4'-O-methylglabridin	AOt, AM, AI
110	50.478	50.565	81098269	9.86	13069044	Vitamin E	AO, AI
111	50.606	50.68	672181	0.08	212441	Lup-20(29)-en-3-ol, acetate, (3. beta.)-	AI, AC, AO, AM,

Note: AG: Analgesic; AI: Anti-inflammatory; AO: Antioxidant; AC: Anticancer; AD: Anti-diabetic; AM: Antimicrobial; AF: Antifungal; IM: Immunomodulatory; VEM: vitamin E metabolite; CYP: Cytoprotective CL: Cholesterol-lowering; AP: Antiproliferative: PP: Potential Plasticizer PA: Progestogenic Activity.

Supplementary Table 2. Identification of compounds by the GC-MS analysis of the methanolic extract of the bark of *Pterocarpus marsupium* and their biological activities

Peak#	R. Time	F. Time	Area	Area%	Height	Name	Biological Activity
1	10.071	10.25	1038274	0.11	114739	Phenol	AM, AO, AI, analgesic
3	19.245	19.415	1773238	0.18	366655	2-Methoxy-4-vinylphenol	AM, AO, AI, IR
4	21.736	21.835	793614	0.08	110309	Benzaldehyde, 4-hydroxy-	AO, AM, FA
5	22.727	23.165	11472101	1.19	1257209	3,5-Dimethoxybenzaldehyde	AOAM, potential AC
6	25.28	25.4	415145	0.04	95573	2,4-Di-tert-butylphenol	AO, AM, AI
7	26.446	26.795	86964298	8.99	10026198	3,5-Dimethoxybenzyl alcohol	AO, AM, AI
8	27.411	27.535	801335	0.08	200029	Phenol, 4-ethenyl-2,6-dimethoxy-	AM, AO, AI
9	29.275	29.36	1611554	0.17	405435	2-Naphthalenemethanol, 1,2,3,4,4a,5,6,7-octahydro-. alpha.,. alpha.,4a,8-tetramethyl-, (2R-cis)-	AM, AI
10	29.615	29.655	698127	0.07	288157	Benzene, 1,2,3-trimethoxy-5-(1-propenyl)-, (E)-	AM, AO
11	29.79	29.9	14026522	1.45	4472714	2-Naphthalenemethanol, decahydro-. alpha.,. alpha.,4a-trimethyl-8-methylene-, [2R-(2. alpha.,4a. alpha.,8a. beta.)]-	AM, AI, AC
12	30.092	30.215	759028	0.08	173253	Benzaldehyde, 4-hydroxy-3,5-dimethoxy-	AO, AI,
13	30.52	30.54	355805	0.04	37035	alpha. -Methyl mannofuranoside	AO, AI
14	30.739	30.85	1564263	0.16	382456	(E)-2,6-Dimethoxy-4-(prop-1-en-1-yl) phenol	AO, AM, AI
15	30.984	31.025	828538	0.09	338020	(3R,4aS,8aS)-8a-Methyl-5-methylene-3-(prop-1-en-2-yl)-1,2,3,4,4a,5,6,8a-octahydronaphthalene	AM, AI
16	31.15	31.21	576571	0.06	193112	Methyl 3-hydroxybenzoate, TMS derivative	AM,AO
17	31.599	31.615	300652	0.03	124285	(E)-4-(3-Hydroxyprop-1-en-1-yl)-2-methoxyphenol	AO, AI, AM
18	32.058	32.095	949512	0.1	350024	7-(2-Hydroxypropan-2-yl)-1,4a-dimethyldecahydronaphthalen-1-ol	AM, AI, AC
19	32.146	32.19	530784	0.05	193972	4-(4-Hydroxy-2,2,6-trimethyl-7-oxabicyclo [4.1.0] hept-1-yl) butan-2-one	AM, AI
20	32.661	32.705	3187971	0.33	1408005	7-(2-Hydroxypropan-2-yl)-1,4a-dimethyldecahydronaphthalen-1-ol	AM, AI, AC
22	33.11	33.13	359471	0.04	226245	2.beta. -HYDROXY-1. beta., (4A). beta. -DIMETHYL-7. beta. -(1-METHYL-1-HYDROXYETHYL) -(8A). beta.-DECAHYDRONAPHTHALENE	AI, AM
23	33.163	33.29	1768803	0.18	555618	6-(2-Hydroxypropan-2-yl)-4,8a-dimethyl-2,3,4,6,7,8-hexahydro-1H-naphthalen-1-ol	AM, AI
24	33.605	33.68	16191437	1.67	6911873	[7-(2-Hydroxypropan-2-yl)-4a-methyl-1-methylidene-2,3,4,5,6,7,8,8a-octahydronaphthalen-2-yl] acetate	AM, AI, AC

Supplementary Table 2. Continued...

Peak#	R. Time	F. Time	Area	Area%	Height	Name	Biological Activity
25	33.712	33.775	832441	0.09	394201	6-(2-Hydroxypropan-2-yl)-4,8a-dimethyl-2,3,4,6,7,8-hexahydro-1H-naphthalen-1-ol	AM, AI
26	33.87	33.905	2067769	0.21	1062015	[7-(2-Hydroxypropan-2-yl)-4a-methyl-1-methylidene-2,3,4,5,6,7,8,8a-octahydronaphthalen-2-yl] acetate	AM, AI, AC
27	34.38	34.405	328619	0.03	181500	(4aS,7R)-7-(2-Hydroxypropan-2-yl)-1,4a-dimethyl-4,4a,5,6,7,8-hexahydronaphthalen-2(3H)-one	AM, AI
28	34.464	34.585	5473939	0.57	2020340	n-Hexadecanoic acid	AC, AM, AI
29	34.631	34.745	1869755	0.19	657791	(4aS,7R)-7-(2-Hydroxypropan-2-yl)-1,4a-dimethyl-4,4a,5,6,7,8-hexahydronaphthalen-2(3H)-one	AM, AI
30	36.221	36.265	524890	0.05	216049	9,12-Octadecadienoic acid (Z, Z)-, methyl ester	AO, AC, AM
31	36.322	36.375	387603	0.04	158275	Ethyl Oleate	AO, AI
32	36.986	37.04	2321719	0.24	695310	9,12-Octadecadienoic acid (Z, Z)-	AC, AO, AI
33	37.093	37.215	1875612	0.19	609556	Ethyl Oleate	AO, AI
34	37.517	37.635	1300433	0.13	374166	Octadecanoic acid	AO, AC, AM
35	39.18	39.38	2767939	0.29	544481	1-Methoxy-3-[2-(3-methoxyphenyl) ethenyl] benzene	AO, AI
36	40.45	40.525	13156491	1.36	3755764	3-Hydroxy-4' 5-dimethoxystilbene	AO, AM, AC
37	40.564	40.67	3198989	0.33	980877	(4-(n-Propyloxycarbonyl)oxyphenyl) acetic acid	AI
38	41.21	41.25	707044	0.07	305474	(3-Methoxyphenyl) methanol, n-pentyl ether	AM
40	42.617	42.715	76952143	7.95	7019841	Olean-12-en-3-ol, acetate, (3. beta.)-	AC, AI, AV
41	42.804	42.94	38115468	3.94	10390347	Phenol, 4-(2-aminoethyl)-	AD
42	43.126	43.275	26748758	2.76	5056483	Benzamide, N-(4,5-dichloro-1,3-benzothiazol-2-yl)-3,5-dimethoxy-	AM, AC
45	43.921	43.97	6414575	0.66	2093555	Lup-20(29)-en-3-one	AC, AI, AM
46	44.057	44.105	1222687	0.13	401154	alpha. -Amyrin	AI, ACAM
47	44.172	44.275	17633566	1.82	3971289	1-Naphthalenepropanol, alpha. -ethenyldecahydro-. alpha.,5,5,8a-tetramethyl-2-methylene-, [1S- [1. alpha. (S*),4a. beta.,8a. alpha.]	AM, AI, IC
48	44.322	44.38	8444021	0.87	3064289	6-Hydroxy-3-(3,5-dimethoxyphenyl) benzo(b)furan	AO, AI
49	44.41	44.505	2926421	0.3	1009145	6-Hydroxy-3-(3,5-dimethoxyphenyl) benzo(b)furan	AO, AI
50	44.834	44.94	68208918	7.05	6928447	Lupeol	AI, AC,AO, AM
51	44.971	45.05	975081	0.1	343073	Lanosterol	AC, AI
52	45.269	45.37	4771256	0.49	1960852	13-Docosenamide, (Z)-	AO, AC
53	45.832	45.94	1169513	0.12	301363	Isomucronulatol diacetate	AO, AI

Supplementary Table 2. Continued...

Peak#	R. Time	F. Time	Area	Area%	Height	Name	Biological Activity
54	46.022	46.115	432466	0.04	69552	Betulin	AO, AI, AV
55	46.361	46.48	2991399	0.31	358654	gamma. -Sitostenone	AO, AI
56	46.659	46.805	2630670	0.27	278306	Lup-20(29)-en-3-ol, acetate, (3. beta.)-	AC, AI, AM
57	47.001	47.115	2865760	0.3	396253	(3S,6aR,6bR,8aS,12S,14bR)-4,4,6a,6b,8a,11,12,14b-octamethyl-1,2,3,4,4a,5,6,6a,6b,7,8,8a,9,12,12a,12b,13,14,14a,14b-icosahydrop	AC, AI
58	47.399	47.54	1170031	0.12	167931	Betulin, diacetate	AC, AI, AV
59	47.693	47.785	2851085	0.29	741593	4H-1-Benzopyran-4-one, 2,3-dihydro-5,7-dihydroxy-3-(4-hydroxy-2-methoxyphenyl)-3-methoxy-	AO, AI, AC
61	48.677	48.77	487529	0.05	118271	24-Noroleana-3 12-diene	AC, AI
62	49.341	49.41	984503	0.1	241906	Cholesta-4,6-dien-3-ol, (3. beta.)	AM, AF
63	49.509	49.66	809111	0.08	99602	Lup-20(29)-ene-3,21-dione, 28-hydroxy-	AC, AI
64	50.231	50.52	4407907	0.46	268987	Cyclopropa[5,6] stigmast-22-en-3-ol, 3',6-dihydro-, (3. beta.,5. beta.,6. alpha.,22E)-	AO, AI
65	50.942	51.135	13088994	1.35	1151368	beta. -Amyrone	AC,AI, AM

Note: AG: Analgesic; AI: Anti-inflammatory; AO: Antioxidant; AC: Anticancer; AD: Anti-diabetic; AM: Antimicrobial; AF: Antifungal; IM: Immunomodulatory; VEM: vitamin E metabolite; CYP: cytoprotective CL: Cholesterol-lowering; AP: Antiproliferative: PP: Potential Plasticizer PA: Progestogenic Activity.

Supplementary Table 3. Identification of compounds by the GC-MS analysis of the methanolic extract of the leaves of *Cryptolepis buchanani* and their biological activities

Peak#	R.Time	F.Time	Area	Area%	Height	Name	Reported Biological Properties
1	6.825	6.875	310409	0.04	105871	2,5-Hexanediol, 2,5-dimethyl-	AM
2	7.237	7.365	732306	0.1	197295	1-Hexanol	AM, AF, IR
3	9.571	9.68	1768385	0.23	267114	beta. -Citronellol, triethylsilyl ether	AO,AM, IR
4	9.938	10.06	308622	0.04	59840	Phenyl. alpha. -d-sedoheptuloside	AO
5	11.358	11.375	521742	0.07	204352	3,3-Diacetyl-2,3,4,5-tetrahydro-2-oxofuran	AO, AM
6	11.399	11.53	525397	0.07	150258	Valeric acid, thio-, S-sec-butyl ester	AM
7	11.626	11.835	412945	0.05	43139	Unknown	No biological data
8	12.082	12.205	677692	0.09	236707	2-Furanmethanol, 5-ethenyltetrahydro-. alpha.,.	AO, AM, FA
9	12.571	12.665	1371392	0.18	391706	Hydrouracil, 1-methyl-	AV, AC
10	12.884	12.975	312986	0.04	87286	Cyclohexanecarboxylic acid, 3-tridecyl ester	AM, AI
11	13.585	13.695	787377	0.1	151180	Unknown	No biological data
12	13.788	13.845	474227	0.06	158785	3,5-Dimethylhexanoic acid	AM
13	14.521	14.73	3663387	0.48	574220	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6	AO, AM, AI

Supplementary Table 3. Continued...

Peak#	R.Time	F.Time	Area	Area%	Height	Name	Reported Biological Properties
14	14.844	14.88	745849	0.1	187394	1-Oxetan-2-one, 4,4-diethyl-3-methylene-	AM, AF
15	15.117	15.205	763746	0.1	204308	2,4,5,6,7-Pentamethoxyheptanoic acid, methyl	AO,AM
16	15.658	15.725	668973	0.09	185017	Heptanal	AM, AF
17	15.786	15.87	627032	0.08	180081	Methyl salicylate	AI, AM
18	17.053	17.105	1438923	0.19	305093	Unknown	No biological data
19	17.223	17.415	13927266	1.81	2053770	5-Hydroxymethylfurfural	AO, AC, AM
20	17.449	17.515	304018	0.04	135844	cis-4-Decenal	AM
21	17.833	17.89	330325	0.04	99113	Unknown	No biological data
22	18.011	18.08	479732	0.06	174015	Hexane, 3,3-dimethyl-	AM, FA
23	18.241	18.3	1464933	0.19	248925	Nonanoic acid	AM, AF, IC, AI
24	18.345	18.45	379121	0.05	85390	2-Amino-4-chloro-6-hydroxypyrimidine	AO, AM
25	18.565	18.665	827841	0.11	153110	1,2-Cyclohexanediol, 1-(1-methylethyl)-, cis-	AM, IC
26	18.962	19.075	1214415	0.16	248133	1-Pyrrolidinamine, N-ethylidene-	AM,AO
27	19.194	19.39	4871369	0.63	950925	2-Methoxy-4-vinylphenol	AM, IR
28	19.732	19.865	357463	0.05	40493	ICN 3847	AO, AM, AC
29	20.244	20.34	1171687	0.15	288409	Naphthalene, 1,2-dihydro-1,1,6-trimethyl-	AC, AM
30	20.639	20.725	431156	0.06	99645	2,7-Octadiene-1,6-diol, 2,6-dimethyl-	AC, AI
31	20.971	21.08	1258127	0.16	285742	2-Butenamide, N,2,3-trimethyl-	AM, IC
32	21.44	21.5	438081	0.06	151131	Hexadecane	AO, AM, AC
33	21.8	22.01	14701565	1.91	1644802	1,4-Dioxaspiro [4.4] nonane-7-methanol	AM, IC
34	22.072	22.18	606116	0.08	156233	Andrographolide	AO,AM, FA
35	22.897	22.945	315985	0.04	114034	5,9-Undecadien-2-one, 6,10-dimethyl-, (E)-	AM, IC
36	23.612	23.645	1391531	0.18	220070	3-Pentanol, 2-methyl-	AM, IR
37	23.958	24.02	357194	0.05	110689	4-(2,6,6-Trimethylcyclohexa-1,3-dienyl) but-3-	AO, AC,AM, AI
38	24.309	24.37	513879	0.07	122931	Eicosane	AM, IC
39	24.833	24.89	704431	0.09	175331	Pentadecane	AO, AM
40	25.274	25.375	2755869	0.36	709697	2,4-Di-tert-butylphenol	AM, IC
41	25.833	25.845	390008	0.05	55000	Unknown	No biological data
42	26.303	26.35	840694	0.11	354896	Urea, N-ethyl-N-nitroso-	AM, IC
43	26.46	26.63	803760	0.1	76115	1,6-Anhydro-. beta. -d-talopyranose	AO, AM, AC, AI
44	27.452	27.53	1292791	0.17	380282	Phenol, 4-ethenyl-2,6-dimethoxy-	AM, IR,
45	27.626	27.705	965676	0.13	237141	Dodecanoic acid	AC, AM, AI
46	27.881	27.93	416060	0.05	138350	Fumaric acid, ethyl 2-methylallyl ester	AM, IC

Supplementary Table 3. Continued...

Peak#	R.Time	F.Time	Area	Area%	Height	Name	Reported Biological Properties
47	28.147	28.2	654205	0.09	265531	Diethyl Phthalate	AM, AO, AI, AC
48	28.261	28.325	1041964	0.14	379988	1-Hexadecanol	AM, IR
49	28.465	28.525	1891589	0.25	725111	Heptadecane	AM, AC
50	28.678	28.785	523306	0.07	120851	Unknown	No biological data
51	29.08	29.17	636237	0.08	157190	1-Heptatriacotanol	AO, AC, AM
52	29.238	29.275	482538	0.06	174735	Cyclooctasiloxane, hexadecamethyl-	AM
53	29.435	29.475	658784	0.09	166712	Bicyclo[2.2.1] heptan-2-ol, 2-allyl-1,7,7-trimet	AO, AM, AI
54	29.627	29.73	3125867	0.41	491223	1,4,4,7a-Tetramethyl-2,4,5,6,7,7a-hexahydro-1	AM, IR
55	29.789	29.835	956598	0.12	358141	7-(2-Hydroxypropan-2-yl)-1,4a-dimethyldecah	AM, IC
56	29.907	29.955	897972	0.12	263599	2-Butanone, 4-(2,6,6-trimethyl-1-cyclohexen-1	AM, AC
57	30.079	30.125	492295	0.06	167322	Tridecanol, 2-ethyl-2-methyl-	AC, AI, AM
58	30.457	30.485	687751	0.09	278318	3-Buten-2-one, 4-(4-hydroxy-2,2,6-trimethyl-7	AO, AI, AM
59	30.507	30.54	312944	0.04	212416	hexadecyl acrylate	AC, AI, AO, AM
60	30.641	30.67	1388066	0.18	573417	Heptadecane	AC, AM, AI
61	30.712	30.755	566153	0.07	202253	Dodecane, 2,6,10-trimethyl-	AO, AC
62	31.123	31.17	538622	0.07	286277	Acetic acid, 3,7,11,15-tetramethyl-hexadecyl e	AC, AM, AI
63	31.371	31.455	2618348	0.34	486232	Unknown	No biological data
64	31.843	31.94	10212686	1.33	2818700	Tetradecanoic acid	AC, AM, AI
65	32	32.1	5345018	0.7	1405926	6-Hydroxy-4,4,7a-trimethyl-5,6,7,7a-tetrahydr	AC, AM,
66	32.17	32.235	2222633	0.29	953710	1-Nonadecene	AO, AI, AM,
67	32.272	32.31	800679	0.1	408329	Heneicosane	AC, AV, AM, AI
68	32.373	32.425	1580319	0.21	480850	Tetrapentacontane	AC, AV, AM, AI
69	32.615	32.65	566304	0.07	257172	Decanoic acid, 9-oxo-, methyl ester	AC, AM, AI
70	32.693	32.725	460292	0.06	233089	2-Hexadecene, 3,7,11,15-tetramethyl-, [R-[R*	AC, AO, AM, AI
71	32.792	32.83	24529886	3.19	12228545	Neophytadiene	AC, AI, AM, AO
72	32.861	32.89	2450783	0.32	1364405	2-Pentadecanone, 6,10,14-trimethyl-	AC, AM, AO

Supplementary Table 3. Continued...

Peak#	R.Time	F.Time	Area	Area%	Height	Name	Reported Biological Properties
73	32.924	32.955	641392	0.08	314847	2-(1,4,4-Trimethyl-cyclohex-2-enyl)-ethanol	AC, AM,
74	32.997	33.045	1555793	0.2	801824	6-Octadecenoic acid	AC, AO, AI
75	33.113	33.15	8103249	1.05	4447598	Neophytadiene	AC, AM, AI
76	33.168	33.23	1482824	0.19	417215	Unknown	No biological data
77	33.353	33.435	11814490	1.54	6456882	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	AC, AM, AI
78	33.618	33.67	428783	0.06	150518	Unknown	No biological data
79	33.725	33.745	478750	0.06	304936	Diisodecyl phthalate	AM, AC, AI
80	33.853	33.88	1164919	0.15	712647	9-Octadecenal, (Z)-	AM, AC, AO
81	33.922	33.96	8464775	1.1	4844839	Hexadecanoic acid, methyl ester	AC, AM, AI
82	33.989	34.05	601253	0.08	309395	Benzenepropanoic acid, 3,5-bis (1,1-dimethyle	AC, AM, AI
83	34.189	34.225	804274	0.1	368416	Phytol	AO, AM, AC
84	34.313	34.35	734334	0.1	438204	1,4-Dibutyl benzene-1,4-dicarboxylate	AC, AI, AM
85	34.627	34.7	80591245	10.48	10708307	n-Hexadecanoic acid	AC, AM, AI
86	34.781	34.83	1738136	0.23	910150	1-Nonadecene	AO, AI, AC, AM
87	35.215	35.28	538845	0.07	275933	Heptadecanoic acid, methyl ester	AC, AM, AO
88	35.512	35.65	1313259	0.17	235941	9,12-Octadecadienoic acid (Z, Z)-	AM
89	35.772	35.795	565831	0.07	222014	Cyclooctasiloxane, hexadecamethyl-	AM, AC
90	35.843	35.925	3024133	0.39	1108683	l-(+)-Ascorbic acid 2,6-dihexadecanoate	AO, AM
91	36.08	36.17	1249319	0.16	432453	cis-1-Chloro-9-octadecene	AO, AC, AI
92	36.226	36.27	5186546	0.67	2190441	9,12-Octadecadienoic acid (Z, Z)-, methyl este	AO, AC, AM
93	36.327	36.39	8264642	1.07	3277295	9,12,15-Octadecatrienoic acid, 2,3-dihydroxyp	AC, AO, AI, AM
94	36.541	36.65	39967942	5.2	12015059	Phytol	AO, AM, AC
95	36.776	36.835	3304139	0.43	1321488	Methyl stearate	AM, AC, AI
96	37.171	37.195	29908936	3.89	3574439	9,12-Octadecadienoic acid (Z, Z)-	AC, AM, AO
97	37.28	37.495	34425609	4.48	5057084	9,12,15-Octadecatrienoic acid, (Z, Z, Z)-	AC, AO, AI
98	37.66	37.84	13108766	1.7	2580099	Octadecanoic acid	AO, AC, AM
99	38.06	38.11	874842	0.11	313839	1-Nonadecene	AC, AM, AO
100	38.189	38.28	2393440	0.31	678576	Tetracosane	AO, AC, AM
101	39.396	39.45	1232547	0.16	340956	3-Hydroxydecanoic acid	AC, AI, AM
102	39.515	39.59	2548528	0.33	746808	Undec-10-ynoic acid, octadecyl ester	AC, AM, AC
103	39.627	39.695	343065	0.04	123279	Eicosanoic acid	AM
104	39.948	39.995	390391	0.05	115204	Arachidonoyl dimethylaminoethanol	AD
105	40.186	40.235	3763078	0.49	1625677	Dotriacontane	AM, AC, AI

Supplementary Table 3. Continued...

Peak#	R.Time	F.Time	Area	Area%	Height	Name	Reported Biological Properties
106	40.395	40.43	467923	0.06	209014	2-((8Z,11Z)-Heptadeca-8,11-dien-1-yl)-4,5-di	AC, AM
107	40.483	40.555	1111961	0.14	357199	(E)-13-Docosenoic acid	AO, AC
108	40.603	40.665	2193891	0.29	932778	Methyl 18-methylnonadecanoate	AO, AM, AC
109	40.729	40.78	1560201	0.2	558104	Cyclononasiloxane, octadecamethyl-	AO, AM, AI
110	40.817	40.85	358055	0.05	170436	Cyclohexane, eicosyl-	AO, AC, AM
111	40.906	40.955	4421676	0.58	2019602	4,8,12,16-Tetramethylheptadecan-4-olide	AO, AM, AC
112	41.171	41.25	2842560	0.37	760411	Eicosanoic acid	AO, AM, AI
113	41.47	41.495	363914	0.05	198342	1-Heptacosanol	AC, AM, AO
114	41.533	41.6	6572710	0.85	3410735	Dotriacontane	AO, AM, AC
115	41.843	41.875	341631	0.04	211332	Heneicosanoic acid, methyl ester	AC, AM, AI
116	41.922	41.985	447015	0.06	144487	Pimelic acid, ethyl 2-ethylbutyl ester	AO, AC, AM
117	42.259	42.295	1397962	0.18	814692	Tetracosamethyl-cyclododecasiloxane	AO, AC, AM
118	42.449	42.48	1230355	0.16	696132	Palmitoyl chloride	AO, AC, AM
119	42.557	42.625	10741514	1.4	5693429	Dotriacontane	AO, AM, AI
120	42.66	42.67	315186	0.04	219442	Squalene	AO, AC
121	42.704	42.795	6088920	0.79	2647194	Hexadecanoic acid, 2-hydroxy-1-(hydroxymet	AO, AC, AM
122	42.848	42.875	616420	0.08	499858	Bis(2-ethylhexyl) phthalate	AO, AC
123	43.026	43.065	1881291	0.24	892960	2-Eicosen-5-olide	AO, AC, AM
124	43.099	43.135	389013	0.05	252772	Unknown	No biological data
125	43.184	43.225	334631	0.04	213747	1-Heptatriacotanol	AO, AC, AM
126	43.43	43.46	12458142	1.62	6405419	Unknown	No biological data
127	43.502	43.67	22915571	2.98	6229171	3-Hydroxy-4',5-dimethoxystilbene	AO, AC, AM
128	43.692	43.775	699566	0.09	297939	Cyclopropanebutanoic acid, 2-[[2-[[2-[(2-pent	AO, AC, AM
129	43.988	44.015	409643	0.05	263022	Tetrapentacontane	AO, AC, AM
130	44.117	44.22	1148150	0.15	334088	Perylene, eicosahydro-	AO, AC, AI
131	44.347	44.45	15316273	1.99	6368825	Tetrapentacontane	AO, AC, AM
132	44.592	44.755	5970758	0.78	1485642	Tetracosamethyl-cyclododecasiloxane	AO, AC, AM
133	44.812	44.88	927965	0.12	291902	Pregnan-20-one, 5,6-difluoro-3-hydroxy-, (3.b	AO, AC, AM
134	44.971	45.025	1561528	0.2	402753	2-Methylheptacosane	AO, AC, AM
135	45.231	45.285	7239524	0.94	2924872	13-Docosenamide, (Z)-	AO, AC
136	45.329	45.35	372703	0.05	175614	5.alpha. -Dihydroprogesterone	AO, AC, AM
137	45.399	45.44	9504696	1.24	4117847	Dotriacontane	AO, AC, AM
138	45.57	45.625	60117744	7.82	20159274	Squalene	AO, AC

Supplementary Table 3. Continued...

Peak#	R.Time	F.Time	Area	Area%	Height	Name	Reported Biological Properties
139	45.828	45.87	5752497	0.75	2328036	(E, E, E)-3,7,11,15-Tetramethylhexadeca-1,3,6,	AO, AC, AM
140	45.916	46.06	6536649	0.85	1413057	. alpha. -Tocospiro A	AO, AC
141	46.2	46.38	18276988	2.38	3623533	Progesterone	AO, AC, AM
142	46.473	46.53	4771823	0.62	1512244	Pregna-4,6-diene-3,20-dione	AO, AC, AM
143	46.581	46.69	10118951	1.32	3606293	Tetrapentacontane	AO, AC, AM
144	46.862	46.91	689659	0.09	279777	Linoleic acid (2E,6E,10E)-3,7,11,15-tetrameth	AO, AC
145	46.962	47.065	1254346	0.16	286460	2,2,4-Trimethyl-3-(3,8,12,16-tetramethyl-hept	AO, AC, AM
146	47.178	47.24	1282064	0.17	286808	Benztropine	AO, AC, AM
147	47.282	47.35	816933	0.11	292986	. delta. -Tocopherol	AO, AC, AM
148	47.442	47.51	633103	0.08	175022	Tetracosane	AO, AC, AM
149	47.581	47.62	2166101	0.28	668940	4-Oxo-. beta. -isodamascol	AO, AC, AM
150	47.65	47.71	1237644	0.16	492154	9,19-Cyclo-9. beta. -lanostane-3. beta.,25-diol	AO, AC, AM
151	47.777	47.805	728362	0.09	252816	1H-3a,7-Methanoazulene, 2,3,6,7,8,8a-hexahy	AO, AC, AM
152	47.856	47.905	1520494	0.2	526954	2,6,10,15,19,23-Pentamethyl-2,6,18,22-tetrac	AO, AC
153	48.022	48.075	7727474	1.01	2343272	Tetrapentacontane	AO, AC, AM
154	48.14	48.265	9212624	1.2	2453703	Unknown	No biological data
155	48.321	48.375	613960	0.08	240668	3.beta. -Acetoxystigmasta-4,6,22-triene	AO, AC, AM
156	48.5	48.59	1629446	0.21	268503	Pregna-5,16-dien-20-one, 3-(acetyloxy)-16-me	AO, AC, AM
157	48.654	48.73	1561742	0.2	448172	beta. -Tocopherol	AO, AC, AM
158	48.936	49.02	6592299	0.86	1498390	gamma. -Tocopherol	AO, AC, AM
159	49.059	49.135	512081	0.07	167905	Rhodopin	AO, AC, AM
160	49.343	49.4	4207880	0.55	1252269	Cholesta-4,6-dien-3-ol, (3. beta.)-	AO, AC, AM
161	49.458	49.54	2730161	0.36	645726	beta. -Guaiene	AO, AC, AM
162	49.611	49.67	720210	0.09	246932	Epilupeol	AO, AC, AM
163	49.801	49.885	6753108	0.88	1475723	Tetrapentacontane	AO, AC, AM
164	49.936	49.985	377660	0.05	113570	1-Hexacosanol	AO, AC, AM
165	50.069	50.135	2177669	0.28	508586	9-Octadecenethioic acid, 12-hydroxy-, S-t-but	AO, AC, AM
166	50.181	50.245	614132	0.08	184435	Cyclopenta[d]anthracene-8,11-dione, 1,2,3,3a,	AO, AC, AM
167	50.467	50.57	75878127	9.87	12732982	Vitamin E	AO, AC, AM
168	50.673	50.77	1909254	0.25	375137	4,8,13-Cyclotetradecatriene-1,3-diol, 1,5,9-tri	AO, AC, AM
169	50.89	50.915	407733	0.05	74843	Unknown	No biological data

Supplementary Table 3. Continued...

Peak#	R.Time	F.Time	Area	Area%	Height	Name	Reported Biological Properties
170	51.359	51.41	420666	0.05	106526	Cardanol C19:1 (TMS)	AC, AC, AM
171	51.736	51.81	453903	0.06	105083	6S-2,3,8,8-Tetramethyltricyclo [5.2.2.0(1,6)] un	AO, AC

Note: AG: Analgesic; AI: Anti-inflammatory; AO: Antioxidant; AC: Anticancer; AD: Anti-diabetic; AM: Antimicrobial; AF: Antifungal; IM: Immunomodulatory; VEM: vitamin E metabolite; CYP: Cytoprotective CL: Cholesterol-lowering; AP: Antiproliferative: PP: Potential Plasticizer PA: Progestogenic Activity

Supplementary Table 4. Identification of compounds by the GC-MS analysis of the methanolic extract of the bark of *Cryptolepis buchanani* and their biological activities

1	7.19	7.275	588866	0.05	89297	Silane, dimethyl[(methylsilyl)methyl]-	No known biological activity
2	7.949	8.19	1231520	0.11	151924	1,2-Cyclopentanedione	AO
3	9.348	9.43	524293	0.05	158531	2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3-one	AO
5	10.093	10.17	3667336	0.33	423166	Hexanoic acid	AM
6	11.961	12.04	318201	0.03	83928	2-Pentenoic acid, 2,3-dimethyl-	AM
8	13.242	13.365	662101	0.06	158516	2,5,7,10-Tetraoxa-6-silaundecane, 6,6-dimethyl-	No known biological activity
9	13.55	13.7	589433	0.05	101485	Benzyl oxy tridecanoic acid	AM
10	13.782	13.83	388349	0.04	129510	3,5-Dimethylhexanoic acid	AM
11	14.553	14.76	3287375	0.3	475354	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	AO, AM, AI
12	15.238	15.285	507544	0.05	220413	Succinic acid, 2-decyl 3-pentyl ester	AI
13	15.605	15.69	2076656	0.19	378107	Octanoic acid	AM, AF
14	15.811	15.97	785199	0.07	134111	Methyl salicylate	AA, AI, AM
15	17.074	17.13	954220	0.09	254807	4-Vinylphenol	AM, AO
16	17.234	17.415	9063012	0.82	1381847	5-Hydroxymethylfurfural	AO, AC, CYP
17	17.456	17.53	334122	0.03	100314	4-Decenal, (E)-	AM
18	17.729	17.79	426340	0.04	159235	2-Decenal, (E)-	A
19	18.264	18.335	1644701	0.15	384116	Nonanoic acid	AM, AF, IC
20	19.201	19.325	3265519	0.3	732329	2-Methoxy-4-vinylphenol	AM, IR
21	19.636	19.86	1118710	0.1	116081	Fumaric acid, monoamide, N, N-dimethyl-, 2-ethylhexyl ester	AM
22	19.922	20.025	605123	0.05	182829	4,4,6-Trimethyl-cyclohex-2-en-1-ol	AO
23	20.207	20.385	1406392	0.13	224773	Phenol, 2,6-dimethoxy-	AM
24	20.449	20.565	1052519	0.1	278017	2(3H)-Furanone, dihydro-5-pentyl-	AM
25	20.61	20.7	439237	0.04	124238	4-Methylcyclohexyl ethylphosphonofluoridate	No known biological activity
27	21.121	21.175	461842	0.04	130816	4-Hexenoic acid, 3-hydroxy-2-methyl-, methyl ester, (R*, R*)-	AM
28	21.784	21.92	1112641	0.1	142190	Vanillin lactoside	AO, AI
29	22.753	22.865	995513	0.09	189257	3,5-Dimethoxybenzaldehyde	AO
30	23.102	23.26	1077885	0.1	213455	Phenol, 2-methoxy-4-(1-propenyl)-, (Z)-	AM
31	24.66	24.73	633931	0.06	112014	9-Oxononanoic acid	AI

Supplementary Table 4. Continued...

32	25.27	25.43	3353722	0.3	824596	2,4-Di-tert-butylphenol	AM, AO
33	26.169	26.37	1016249	0.09	144515	2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-, (R)-	AO
34	26.46	26.68	1260530	0.11	168420	3,5-Dimethoxybenzyl alcohol	AM
35	26.793	26.88	375906	0.03	92723	Nonanedioic acid, dimethyl ester	AM
36	27.297	27.345	426510	0.04	70766	8-Nonenoic acid	AM
37	27.419	27.555	5751145	0.52	1345695	Phenol, 4-ethenyl-2,6-dimethoxy-	AM, IR
38	27.639	27.715	1042653	0.09	313334	Dodecanoic acid	AC, AM
39	28.133	28.195	900098	0.08	319589	Diethyl Phthalate	AM, AO
40	28.258	28.315	1433964	0.13	535720	1-Nonadecene	AO, AI
41	28.406	28.44	610457	0.06	169978	Nonanedioic acid, monomethyl ester	AM
42	29.237	29.28	448586	0.04	168749	Cyclooctasiloxane, hexadecamethyl-	AM
43	29.5	29.55	631575	0.06	244796	Octanoic acid, 6,6-dimethoxy-, methyl ester	AM
44	29.787	29.835	933718	0.08	360378	2-Naphthalenemethanol, decahydro-. alpha.,. alpha.,4a-trimethyl-8-methylene-, [2R-(2. alpha.,4a. alpha.,8a. beta.)]-	AO
45	30.507	30.565	1110698	0.1	537743	hexadecyl acrylate	AC, AI
46	30.712	30.825	1370404	0.12	493469	(E)-2,6-Dimethoxy-4-(prop-1-en-1-yl) phenol	AM
47	31.07	31.1	563979	0.05	316039	Methyl tetradecanoate	AM
48	31.233	31.26	336835	0.03	132802	2-Propanone, 1-hydroxy-3-(4-hydroxy-3-methoxyphenyl)-	AO
49	31.513	31.715	11303963	1.02	1679274	(E)-4-(3-Hydroxyprop-1-en-1-yl)-2-methoxyphenol	AO, AM
50	31.823	31.87	5651272	0.51	1995127	Tetradecanoic acid	AC, AM
51	31.993	32.055	1376516	0.12	556205	Loliolide	AO, AI
52	32.168	32.23	3319711	0.3	1349099	1-Nonadecene	AO, AI
53	32.273	32.305	426401	0.04	206968	Heneicosane	AC, AV
54	32.389	32.425	727642	0.07	300443	6-Octadecenoic acid, methyl ester, (Z)-	AM
55	32.697	32.725	474083	0.04	161516	Tetrahydroedulan	No known biological activity
56	32.781	32.815	1829707	0.17	989881	Neophytadiene	AC, AI
57	32.859	32.89	1132665	0.1	634359	2-Pentadecanone, 6,10,14-trimethyl-	AC, AD
58	33.001	33.05	2447099	0.22	1061585	6-Octadecenoic acid	AC, AO
59	33.111	33.165	1409051	0.13	682656	Phthalic acid, isobutyl tridec-2-yn-1-yl ester	AM
60	33.207	33.24	1568847	0.14	708335	Pentadecanoic acid	AC, AM
61	33.35	33.385	743840	0.07	312861	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	AC, AM
63	33.653	33.68	333541	0.03	241830	Methyl hexadec-9-enoate	AM
64	33.93	33.965	25046005	2.27	13459204	Hexadecanoic acid, methyl ester	AC, AM
65	33.994	34.045	476619	0.04	251502	Benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, methyl ester	AO, AI
66	34.078	34.135	330302	0.03	141280	Methyl 5,11,14-eicosatrienoate	AI
67	34.202	34.29	1445853	0.13	379256	Palmitoleic acid	AC, AM
68	34.703	34.76	126429545	11.46	12369266	n-Hexadecanoic acid	AC, AM
69	34.783	34.82	1740605	0.16	1085770	1-Nonadecene	AC, AI
70	35.052	35.13	652385	0.06	199367	trans-Sinapyl alcohol	AC, AI
71	35.223	35.265	1055694	0.1	532999	Heptadecanoic acid, methyl ester	AC, AM

Supplementary Table 4. Continued...

72	35.535	35.61	874819	0.08	229268	Oleic Acid	AM, AI
73	35.779	35.805	410424	0.04	166909	Cyclooctasiloxane, hexadecamethyl-	AM
74	35.86	35.96	3708029	0.34	1159129	l-(+)-Ascorbic acid 2,6-dihexadecanoate	AO, AM
76	36.241	36.285	22196828	2.01	8734218	n-Nonadecanol-1	AM
77	36.35	36.4	27471484	2.49	10470180	9-Octadecenoic acid, methyl ester, (E)-	AO, AC
78	36.432	36.49	1400699	0.13	612664	9-Octadecenoic acid, methyl ester, (E)-	AO, AC
79	36.529	36.61	1860046	0.17	742415	Phytol	AO, AM
80	36.781	36.85	6971167	0.63	2663710	Methyl stearate	AM, AC
81	37.273	37.31	66527333	6.03	5991597	9,12-Octadecadienoic acid (Z, Z)-	AC, AO
82	37.399	37.615	58132115	5.27	7678177	Oleic Acid	AC, AO
83	37.758	37.875	16448938	1.49	3069771	Octadecanoic acid	AO, AC
84	38.07	38.125	1468738	0.13	506775	1-Nonadecene	AO, AI
85	38.201	38.27	1298620	0.12	335414	Tetracosane	AO, AC
86	38.778	38.85	580314	0.05	185808	Nonadecanoic acid, methyl ester	AM
87	39.237	39.335	1137527	0.1	279495	Tributyl acetylcitrate	PP
88	39.654	39.71	965109	0.09	319574	1-Pentamethyldisilyloxytetradecane	No known biological activity
89	39.972	40.015	803462	0.07	285461	1,5-Cyclooctadiene, 1-t-butyl-	No known biological activity
90	40.194	40.295	2576375	0.23	657946	Tetrapentacontane	AO, AC
91	40.49	40.555	2211865	0.2	736472	3-Hydroxy-4',5-dimethoxystilbene	AO, AM
92	40.614	40.675	2745112	0.25	1049594	Methyl 18-methylnonadecanoate	AO, AM
93	40.736	40.775	619483	0.06	305795	Cyclononasiloxane, octadecamethyl-	AO, AM
94	40.831	40.875	1055134	0.1	506294	6-Pentyltetrahydro-2H-pyran-2-ol	AM
95	40.915	40.96	2363551	0.21	1106361	4,8,12,16-Tetramethylheptadecan-4-olide	AO, AM
96	40.985	41.02	421483	0.04	274159	3,3-Dimethyl-4-(3,3,4,4-tetramethyloxetan-2-ylidene) butan-2-one	No known biological activity
97	41.183	41.255	2141347	0.19	712971	Eicosanoic acid	AO, AM
98	41.291	41.33	341084	0.03	184886	1-Ethynylcyclododecanol	No known biological activity
99	41.475	41.505	670602	0.06	316217	1-Heptacosanol	AC, AM
100	41.537	41.575	1080666	0.1	603948	Dotriacontane	AO, AM
101	42.077	42.175	75017754	6.8	5126421	gamma. -Sitosterol	AC, AI,CL
102	42.273	42.31	2339559	0.21	720617	Germanicol	AI, AM
103	42.323	42.4	1083819	0.1	362393	Germanicol	AI, AM
104	42.562	42.625	2018757	0.18	977658	Tetracosane	AO, AC
105	42.711	42.8	7631123	0.69	2829612	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester	AO, AC
106	42.823	42.84	450846	0.04	371894	Methyl 20-methyl-heneicosanoate	AM
107	42.853	42.88	466275	0.04	415859	Bis(2-ethylhexyl) phthalate	AO, AC
108	43.215	43.325	89955005	8.16	7692483	beta. –Amyrin	AI, AC
109	43.445	43.46	16083781	1.46	3726700	Germanicol	AI, AM
110	43.507	43.585	56070775	5.08	11388354	3-Hydroxy-4',5-dimethoxystilbene	AO, AM
111	43.74	44.02	132702589	12.03	12419971	Lanosterol	AM, AI
112	44.101	44.225	2859017	0.26	640999	(E)-3,3'-Dimethoxy-4,4'-dihydroxystilbene	AO, AC
113	44.343	44.44	5805267	0.53	1305041	Tetrapentacontane, 1,54-dibromo-	AM

Supplementary Table 4. Continued...

114	44.657	44.87	62351347	5.65	4931057	9,19-Cyclolanost-25-ene-3,24-diol	AC, AM
115	45.012	45.16	40301488	3.65	5436036	Lanosterol	AM, AI
116	45.235	45.285	8911965	0.81	4032423	13-Docosenamide, (Z)-	AO, AC
117	45.375	45.415	339930	0.03	212109	Tetracosane	AO, AC
118	45.542	45.585	1417860	0.13	621668	Squalene	AO, AC
119	45.905	45.92	432539	0.04	143434	alpha. -Tocospiro A	AO, AC
120	46.021	46.065	378202	0.03	188890	26,27-Dinorergost-5-ene-3,24-diol, (3. beta.)-	AI
121	46.199	46.305	5321909	0.48	886063	Unknown	No data available
122	46.521	46.555	12702200	1.15	3304625	(E)-17-(2,6-Dihydroxy-6-methylhept-4-en-2-yl)-16-hydroxy-4,4,10,13,14-pentamethylhexadecahydro-3H-cyclopenta[a] phenanthren-3-ol	AO
123	46.634	46.685	2081031	0.19	808039	9,19-Cyclolanost-24-en-3-ol, acetate, (3. beta.)	AO, AI, AM, AC
124	47.134	47.18	604600	0.05	241483	Propanoic acid, 2-(3-acetoxy-4,4,14-trimethylandrost-8-en-17-yl)-	AO, AP , AM
125	47.411	47.49	5692458	0.52	1589630	Pregn-4-ene-3,20-dione, 16-hydroxy-, (16. beta.)	PC
126	47.662	47.735	15850865	1.44	3989159	(E)-17-(2,6-Dihydroxy-6-methylhept-4-en-2-yl)-16-hydroxy-4,4,10,13,14-pentamethylhexadecahydro-3H-cyclopenta[a] phenanthren-3-ol	AO
127	47.8	47.86	3721664	0.34	1119486	(E)-17-(2,6-Dihydroxy-6-methylhept-4-en-2-yl)-16-hydroxy-4,4,10,13,14-pentamethylhexadecahydro-3H-cyclopenta[a] phenanthren-3-ol	AO
128	47.906	47.96	609109	0.06	224428	Cholesta-4,6-dien-3-ol, (3. beta.)-	AM, AF
129	48.164	48.275	29121691	2.64	5393080	Epilupeol	AI, AC, AO, AM
130	48.319	48.395	752317	0.07	261353	Stigmasta-4,7,22-trien-3. alpha. -ol	AM, AO,
131	48.65	48.72	668062	0.06	191687	(R)-6-Methoxy-2,8-dimethyl-2-((4R,8R)-4,8,12-trimethyltridecyl) chroman	AO,AI, VEM
132	48.927	49.02	1203781	0.11	252555	gamma. -Tocopherol	AO
133	49.075	49.14	508559	0.05	144039	(Unknown)	No data available
134	49.347	49.4	5607234	0.51	1571541	beta. -Sitosterol acetate	AC, AO, AM
135	49.453	49.535	3502267	0.32	918165	Epilupeol	AI, AC, AO, AM
136	49.614	49.675	3340881	0.3	848235	Epilupeol	AI, AC, AO, AM
137	49.727	49.84	994387	0.09	193820	beta. -Sitosterol acetate	AC, AO, AM, IM
138	49.943	50	937293	0.08	230145	Lupeol	AI, AC, AO, AM
139	50.397	50.505	8243651	0.75	1745385	Vitamin E	AO, AI
140	51.137	51.255	541722	0.05	114266	Epilupeol	AI, AC, AO, AM
141	51.377	51.505	1058189	0.1	195796	Benzaldehyde, 2-hydroxy-4-methoxy-3,6-dimethyl-	AM, AF, AO
142	51.81	51.975	6409223	0.58	563680	Ursolic aldehyde	AC, AI, AM

Note: AG: Analgesic; AI: Anti-inflammatory; AO: Antioxidant; AC: Anticancer; AD: Anti-diabetic; AM: Antimicrobial; AF: Antifungal; IM: Immunomodulatory; VEM: vitamin E metabolite; CYP: Cytoprotective CL: Cholesterol-lowering; AP: Antiproliferative: PP: Potential Plasticizer PA: Progestogenic Activity