Available online on 15.12.2023 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Copyright © 2023 The Author(s): This is an open-access article distributed under the terms of the CC BY-NC 4.0 which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited

Open Access Full Text Article

Review Article

A systematic review of the analytical method identified phytomedicine and pharmacological potency of Rosa species with special attention on *Rosa centifolia*

Khushbu Singh*, Vikas Kumar, Amita Verma, Pooja Gadkari

Department of Pharmaceutical Sciences, Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh 211007

Article Info:

Article History:

Received 13 Sep 2023
Reviewed 05 Nov 2023
Accepted 24 Nov 2023
Published 15 Dec 2023

Cite this article as:

Singh K, Kumar V, Verma A, Gadkari P, A systematic review of the analytical method identified phytomedicine and pharmacological potency of Rosa species with special attention on *Rosa centifolia*, Journal of Drug Delivery and Therapeutics. 2023; 13(12):224-237

DOI: http://dx.doi.org/10.22270/jddt.v13i12.6309

*Address for Correspondence:

Khushbu Singh, Department of Pharmaceutical Sciences, Sam Higginbottom University of Agriculture, Technology and Sciences, Naini, Prayagraj, Uttar Pradesh 211007

Abstract

Objective: Globally, Rosa species herbal plants are often used as a natural remedy to prevent and cure various health problems without or with minimal toxic effects. Rosa species are rich in bioactive phytochemicals such as flavonoids, polyphenols, tannins, and alkaloids. Phytomedicines are used to treat various diseases and disorders because of their clinical potency.

Material and method: The searches were performed using various databases, including PubMed (http://www.ncbi.nlm.nih.gov/pubmed), Science Direct (http://www.sciencedirect.com/), Scopus (http://www.scopus.com/), and Google Scholar (http://www.scholar.google.com/).

Result: India is well known for its geographical diversity, a rich collection of medicinally active plants, and numerous traditional herbal drug treatment systems that are acknowledged as "living traditions". However, there is no collective report on the significant Rosa species with respect to the recent advancement in clinically active plant investigation. Hence, the key effort of the present review work is to report the identified phytomedicine and pharmacological activity majorly used Rosa species that have grown in India and other countries throughout the world. This review was completed on the basis of a complete national and international literature survey.

Conclusion: In this review, we provide summarised and collective scientific information on the prominent Rosa species, used plant part, their extract, used analytical methods, biochemical and their respective medicinal activity to develop new ethnomedicine in the future.

Keywords: Rosa species, analytical method, biochemical, pharmacological activity

Introduction

The vast range of medicinal plants distributed around the world is highly remarkable. According to reports, around 70,000 plant species from the lower level of lichens to higher levels of trees have been proven to have the potential for treating various illnesses. Based on WHO, 21,000 medicinal plants are in use for various medical applications. The traditional herbal practitioners are even today known to follow the herbal medicine system in rural areas, approximately 2500 plants for treating basic illness which has been considered as one of the best methods in Indian medical practices [1]. Herbal drugs are naturally rich sources of various secondary metabolites and novel pharmacologically active compounds to improve human health with fewer adverse effects. phytochemical study Plants play an important source of bioactive molecules for the discovery of novel drugs [2]. During the past few years, public interest in medicine obtained from plants has increased exponentially. According to the World Health Organization, 65%-80% of the mass population in developing countries due to lack of access to modern medicine depends basically on plants for primary healthcare needs [3]. Roses are a rich source of Vitamin C and are used in the making of medicaments. It is a fact that there is no other alternative to rose oil present naturally nor has it been prepared by synthetic process [4]. Rose plants are shrubby in appearance with long drooping canes and grayish-green leaves. The shrub is 6.15 cm to 3 meters in height. The flowers are round and bulbous in shape, with highly scented thin overlapping. The branches of the shrub are covered with closely straight prickles [5]. For the production of rose oil two major species of rose are cultivated: Firstly, *Rosa damascena* which is extensively grown in Bulgaria (70–80%), Turkey, Russia, India, and China. Secondly, *Rosa centifolia* is most commonly grown in Morocco, France, and Egypt [6]. Rose flowers have various medicinal activities antibacterial, astringent, tonic, and antioxidant effects used for mild inflammation. Due to its biological activities like immunosuppressive, antioxidant, anti-inflammatory, antiarthritic, analgesic, anti-diabetic, cardioprotective, antimicrobial, gastroprotective, and skin ameliorative effects of Rosehip has traditionally been used against a wide range of ailments [7]. *Rosa centifolia* belongs to the family Rosaceae commonly known as red rose or Pink rose, found across India and has been traditionally used [8]. Roses are known with the title of the king of flowers and it is cultivated systematically. Genus *Rosa* has found approximately 200 species and up to 18,000 cultivars. [2,9].

Material and Method

This review work was conducted using a well-organized search of the available literature on the medicinal plant from the inception till the end of June 2022 to identify all published investigations on the selected plants. The searches were performed using various databases, including PubMed (http://www.ncbi.nlm.nih.gov/pubmed), Science Direct (http://www.sciencedirect.com/), Scopus (http://www.scopus.com/), and Google Scholar (http://www.scholar.google.com/). A literature review of Rosa species reveals the following information on analytical methods and pharmacological potency.

Results

In this study, the introductory databases search related to the rosa species has recognized about "70" publications. Analytical work studies were reviewed outlined in Tables 1, 2, 3, 4, 5, 6 and 7 respectively, in vitro experiments and animal studies were also reviewed. Together pharmacological activity of Rosa species is discussed in a descriptive manner. It was found that research studies conducted on rosa species mostly focused on their flower part, and only a few studies have been reviewed on the other parts of the plant. There are no human trials or any other type of clinical trial reported.

Therapeutic chemical reported in Rosa centifolia

Table 1: Bioactive compound identified in Rosa centifolia by HPLTC

First author/year	Plant name (species name)	Plant part studied	Type of extract (sample)	Technique used	Phytochemical identified	Therapeutic activity	Ref
Camille Dubois et Al., 2022	*R. centifolia*	Stem	Hydroalcoholic extract	HPLC-DAD/ELSD	The three major compounds, isoquercitrin, quercitrin and euscaphic acid found, never identified in R. centifolia previously.	Antioxidant Activities, anti-inflammatory potential. Anti-hyaluronidase and its interesting anti-elastase activity.	10

Table 2: Bioactive compound identified in Rosa centifolia by GC coupled technique

First author/year	Plant name (species name)	Plant part studied	Type of extract (sample)	Technique used	Phytochemical identified	Therapeutic activity	Ref
Jdzef Gdra, Anna Lis* and Danuta Kalemba, 1995	*Rosa centqolia* L	Fresh petals	Hydrodistilled	GC and GC/ MS analysis columns: 30 m x0.32 mm, DB-17,30 m x0.32 mm, DB-Wax, carrier gas: nitrogen	Mainly geraniol (26.70%), citronellol(22.90%) and nerol (l4.26%).	Not mentioned	11
M. khalid Shabbir et al., 2009	*Rosa centqolia* L	Fresh petals	Petroleum ether extract (concentrated oil)	High resolution gas liquid chromatographic (HR-GLC) analysis Column: SP2330 (30m×0.32mm), carrier gas: pure nitrogen	Geraniol, Linalool, Phenylethyl alcohol, Benzaldehyde, Citronellyl acetate, Benzyl alcohol. Geranyl acetate.	Not mentioned	12
M. Aslam Khan and Shoaib-ur-Rehman, 2005	*Rosa centqolia* L	flowers	Hexane extract/ essential oil	Liquid gas chromatographic (LGC) analysis	Geraniol, Eugenol, Rhodinol, Citronellol, Linalool, Citranellyl acetate, Phenyl ethyl alcohol,	Not mentioned	13

The typical essential oil of Rose is Chemically, a mixture of almost 300 compounds such as terpene and phenol derivatives of hydrocarbon compounds [14]. Rosa centifolia (province rose, cabbage rose or Rose de Mai) the important chemical constituents isolated from flower petals by gas chromatography analysis [15,16].

Therapeutic chemicals reported in other species of Rosa

We have found that only some of the species of rose have undergone detailed study in reference to their phytochemical and clinical parameter such as *Rosa damascene, Rosa gallica, and R. canina, Rosa hybrida cv., Rosa sinensis* and some other species.

Table 3: Bioactive compound identified in rosa species by HPLTC

First author/year	Plant name (species name)	Plant part studied	Type of extract (sample)	Technique used	Phytochemical identified	Therapeutic activity	Ref
Tamanna Nazli et al., 2019	*R. damascene*	Flowers	Chloroform extract & ethanolic extract	HPTLC-densitometry analysis; Mobile phase: Toluene: Ethyl acetate 9: 1 (v/v) Column: Silica gel 60F254 ʎ = 254 & 366S nm	In *chloroform* extract: at Rf 0.13(purple), 0.17(pink), 0.23(pinkish purple), 0.26, 0.30(pink), 0.37 & 0.44(purple) under visible light. Ethanol extract: Under UV366nm, Rf 0.48 (dark blue).	Medicinal, cosmetic and aromatic properties	17
Osman Tuncay Ağar et al., 2017	*R. damascena*	Petals	Extract prepared by using the solvents in different Polarity	HPTLC Mobile phase: ethyl acetate: formic acid: acetic acid: water (100:11:11:10, v/v/v/v) Plate: silica gel 60 F254 ʎ = 254 & 366nm	kaempferol 3-O-β-D-glucopyranoside, quercetin 3-O-β-D-glucopyranoside, quercetin 3-O-β-D-galactopyranoside were reported	Anti-HIV, antibacterial, antioxidant, antitussive, hypnotic and antidiabetic,	18
Ludivine Riffault et al., 2014 and 2016	*Rosa _ hybrida cv.* (Jardin de Granville)	Early buds, Buds, flowers, leaves, wood, shoot	EtOH/H2O 9/1 (v/v) extracts	HPTLC: Mobile phase: ACN/ H2O/HCOOH: 50/50/5 (v/v/v). with Neu's reagent Plate: Silica gel F254 ʎ = 254.	Around 60 compounds were identified, mainly gallo-tannins, ellagi-tannins, catechin derivatives and glycoside derivatives of quercetin and kaempferol	Cosmetic purpose and Antiaging property	19,20
Kshipra Misra and Shoma Nandi, et al., 2013	*Rosa sinensis*	Rose petals and buds	Ethanolic extract	HPTLC Mobile phase: chloroform: ethyl acetate: formic acid (9.5: 6: 0.5) silica gel plate 60F254 ʎ = 254 nm	Gallic acid 12.76 mg / g The Rf value of gallic acid was found to be 0.29	Antioxidant activity	21

Table 4: Bioactive compound identified in rosa species by HPLC

First author/year	Plant name (species name)	Plant part studied	Type of extract (sample)	Technique used	Phytochemical identified	Therapeutic activity	Ref
Y. S. Velioglut and G. Mama', 1991	*Rosa damascena* Mill	Petales	ethanol-acetic acid-water extract (10:1:9).	HPLC UltroPac prepared column (250 **X** 4.6 mm) of Spheri 10-RP18 (10 pm) solvent A, formic acid-water (595 v/v), solvent B, methanol; elution profile 0-10 min, 17- 22% B (linear gradient) 190-370 nm.	The main anthocyanin was cyanidin 3,5-diglucoside, which accounted for over 95% **of** the total anthocyanins. Also identified were several kaempferol and quercetin glucosides, galactoside, arabinosides, and rhamnosides. total anthocyanins was 285 mg/kg of fresh petals.	Antiradical activity.	22
N. Demir et al., 2013	*Rosa canina, Rosa dumalis, Rosa gallica, Rosa dumalis* *subsp.boissieri and Rosa hirtissima*	Rosehip	methanol/water/formic acid (50:48.5:1.5) extract	RP-HPLC-DAD mobile phase: (A) water/acetic acid (98:2) and (B) water/acetonitrile/acetic acid (78:20:2). Column: C18 (250 _ 4.6 mm I.D.) λ = 280, 320 and 360 nm. SPME/GCeMS Column: DB-Wax column (60 m _ 0.25 mm _ 0.25 mm; J&W Scientific, Folsom, CA, USA) Carrier gas: He	Rosehip fruits are characterized by high levels of ascorbic acid and the sample of RG contained about 160.30 mg/100 g dry weight. The levels of ascorbic acid in other samples ranged from 65.75 to 136.14 mg/100 g which is noteworthy. Rose hips were also rich in some phenolic compounds including gallic acid, catechin, procyanidin-B2, chlorogenic, t-caffeic, p-coumaric, ferulic, and sinapic acids.	Antioxidant activity	23
Vlasta Cunja et al., 2014	*R. canina, R. glauca, R. rubiginosa, R. sempervirens*	Petal and Leaf	Ethanolic extract	High-performance liquid chromatography/mass spectrometry	Leaves contain seven different anthocyanins and 31 flavonols in petals; 30 flavonols, 14 phenolic acids, and their derivatives; 15 flavanols; and 20 hydrolysable tannins	Not mention	24
Nilgun Gokturk Baydar et al., 2013	*Rosa damascena Mill*	Fresh and spent flowers, and green leaves	Methanolic extract	HPLC Mobile phase: solvent A contained 3% acetic acid in water and solvent B	Gallic acid in the flower extracts, and (+)-catechin and (−)-epicatechin in the leaf extract were the most abundant	Antioxidant and antiradicalproperties	25

				contained methanol Column: Eclipse XB C-18 column (5 µm, 4.6 mm × 250 mm, Wallborn, Germany)	phenolic compounds. Leaf extracts exhibited more antiradical activity at a concentration of 50 _g/ml		
Poonam Kumari et al., 2018	*Rosa hybrida* L.	Rose petal	Methanolic extract	HPLC Mobile phase: solvent A: water (0.1 % formic acid) and solvent B: acetonitrile (0.1% formic acid) Column: C-18 columnn ʎ = `280 nm.	Presence of five major phenolic compounds in rose petal extract, *viz*. quercetin, catechin, epicatechin, rutin and 3-hydroxy cinnamic acid.	Health-promoting properties	26
Shahla Shameh et al., 2018	*R. foetida* *Herrm, R. hemisphaerica Herrm, R. webbiana Wall. ex Royle,* *R. × damascena Herrm, R. canina L., R. moschata Herrm;*	Fresh flowers	Methanolic extract	HPLC 1% aqueous acetic acid solution (solvent A) and acetonitrile (solvent B). 250 nm (quercetin and chlorogenic acid), 272 nm (gallic acid, cinnamic acid, and apigenin), and 310 nm (caffeic acid, rutin, and *p*-coumaric acid), respectively Column: (250 mm ×4.6 mm, C18, ZORBAX Eclipse XDB) ʎ = 250, 272 and 310	The amounts of phenolic acids varied in the studied species in this order: gallic acid from 22.71 to 38.54 µg/g DW, caffeic acid from 1.50 to 64.18 µ/g DW, chlorogenic acid from 24.37 to 135.22 µg/g DW, p-coumaric acid from 20.68 to 647.28 µg/g DW, and cinnamic acid from 0.136 to 0.360 µg/g DW. quercetin, catechin, epicatechin, rutin and 3-hydroxy cinnamic acid	Antioxidant activity	27

Table 5: Bioactive compound identified in rosa species by UPLC

First author/year	Plant name (species name)	Plant part studied	Type of extract (sample)	Technique used	Phytochemical identified	Therapeutic activity	Ref
Andrzej Cendrowski et al., 2017	*Rosa rugosa*	petals	Ethanolic extract	UPLC-photodiode detector-quadrupole/time of flight-mass spectrometry (UPLC-PDA-Q/TOF-MS) UPLC BEH C18 column (1.7 _m, 2.1 mm _ 100 mm consisted of solvent A (2.0% formic acid, *v*/*v*) and solvent B (100% of acetonitrile) Wavelength: ellagitannins at 254 nm, flavan-3-ols at 280 nm, phenolics at 320 nm and flavonol glycosides at 360 nm.	Phenolic acids, flavonols, flavan-3-ols and hydrolisable tannins (gallotannins and ellagitannins). R. rugosa petals contains up to 2175.43 mg polyphenols per 100 g fresh weight, therein 1517.01 mg ellagitannins per 100 g fresh weight were found.	Valuable raw material for the food industries	28

Table 6: Phytochemical reported in Rosa centifolia by MS coupled technique

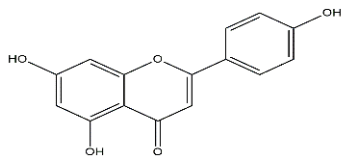
First author/year	Plant name (species name)	Plant part studied	Type of extract (sample)	Technique used	Phytochemical identified	Therapeutic activity	Ref
Tania C.S.P. Pires et al., 2018	*Rosa damascena* *R. gallica and R. canina*	Dry petals	Hydro methanolic extracts	LC-DAD-ESI/MSn (Dionex Ultimate 3000 UPLC, Thermo Scientific, San Jose, CA, USA)	Quercetin- Kaempferol-glucuronide A Kaempferol-rhamnoside A Quercetin-(p-coumaroyl) Hexoside A were reported.	Antioxidant, antiproliferative, and antibacterial	29
A. Maciag and D. Kalemba, 2014	Rosa rugosa	Dry petals	Aqueous extract	Gas chromatography coupled with mass 111 spectrometry (GC–FID–MS). non-114 polar capillary column Rtx-1ms (60 m _ 0.25 mm, 0.25 m film thickness), carrier gas – helium	b-Phenylethanol, citronellol, geraniol, and nerol were the main volatile constituents of primary hydrolate. b-Phenylethanol, citronellic acid, and geranic acid were the main volatile constituents of secondary hydrolate	Not mentioned	30
Zeinab Alizadeh and Mohammad Fattahi, 2021	*Rosa damascene*	Fresh flowers	Methanolic extract	GC/MS analysis Column: silica capillary column (30 *m* × 0.250 mm, 0.25 µm film thickness) carrier gas: helium	Geraniol, citral, methyl linoleate, *n*-heneicosane, and *n*-octane were the major components of essential oils. Carotenoid content ranged from 0.002 to 0.055 mg/g DW	Antioxidant activities	31
Tsanaktsidis C.G. et al., 2012	*R. damascene*	Rose flower	Aqueous extract	Gas Chromatograph – Mass Spectrograph (GC-MS) Column: HP-5MS Carrier Gas: He	2-phenethyl alcohol, citronellol, nerol, and geraniol, and 59 other detectable aromatic components	Not mentioned	32
Yi-zhong Cai et al., 2005	*Rosa chinensis*	Flowers	Methanolic extract	Liquid chromatography-mass spectrometry (LC-MS)	Total of 36 known and unknown phenolics were identified quercetin/kaempferol mono- and diglycosides, and cyanidin	antioxidant power	33
Daniela Nedeltcheva-Antonova et al.,	Rosa damascena Mill.	Not mention	Derivatizatised product	GC/MS Two fused silica capillary columns (J &W Scientific, Folsom, CA) Helium (99.999%) was used as a carrier gas	132 compounds, mainly mono- and sesquiterpenoids were identified. The main constituents, representing 80.0–95.5% of the total content of the detected compounds.	Not mentioned	34

Huihua Wan et al., 2019	'Yellow Island' and 'Garden City', Yunzheng Xiawei', 'Wangri qinghuai'and 'Pink Fan' (PF), and 'Chacok' (CH)	Powdered flower	Verious solvent used for the extraction	HPLC and LC-MS λ = 520 nm for anthocyanin and 350 nm for flavonols.	Four anthocyanins, 20 flavonols, and 10 carotenoids were detected in petals of tested cultivars. Major individual anthocyanin,flavonol, and carotenoid were cyanidin/pelargonidin 3,5-diglucoside, kaempferol 3-O-rhamnoside, and (9Z)-violaxanthin, respectively.	Not mentioned	35
Mounia Chroho et al., 2022	*Rosa damascena*	Flowers	Hydroethanolic	HPLC-MS RP C18 column Mobile phase: 0.1% of formic acid in water (A), and acetonitrile (B) λ=200–400 nm	Valoneic acid dilactone and ellagic acid were identified. Ellagitannins are hydrolysable tannins formed from gallic acid esterified with hexahydroxydiphenic acid (HHDP) Flavonoids: Quercetin and kaempferol	antiviral, bacteriostatic effect, antioxidant, anticancer, and anti-inflammatory activities	36
Tarek M. Galal et al., 2022	*R. damascena* (Taif's rose)	Leaves and stems	Aqueous and methanolic extract	HPLC-MS system For Flavonoids, phenolic acid and alkaloid different solvent system used, column: RP18 λ = 280 nm, 325 & 226 nm respectively	Taif's rose contains flavonoid components: luteolin, apigenin, quercetin, rutin, kaempferol, and chrysoeriol; phenolics: ellagic acid, catechol, resorcinol, gallic acid, and phloroglucinol; alkaloids such as berbamine, jatrorrhizine, palmatine, reticuline, isocorydine, and boldine.	Antimicrobial	37
Marta Olech et al., 2020	Rosa rugosa Thunb	Dry leaves	Methanolic extract	LC-MS/MS-MRM HPLC system: for phenolics Column: Eclipse XDB-C18 water-methanol and water-acetonitrile mobile phases for flavonoid : column ; Kinetex XB-C18 Mathnol: water-MeOH and water-ACN Gradients MS Nitrogen was used as a nebulizer and collision gas	The presence of a large amount of phenolic compounds was detected in rose leaves (786.44 _g/g and 14.46 _g/g of phenolic acids and flavonoid aglycones, respectively). Isoferulic acid and five aglycones were revealed for the first time in this plant material. Moreover, 15 phenolic acids and six aglycones were found in the rose achenes, including eight phenolic acids and four aglycones that had not been previously reported in this rose organ.	Potential commercial use in pharmaceutical, food, or cosmetic industry.	38

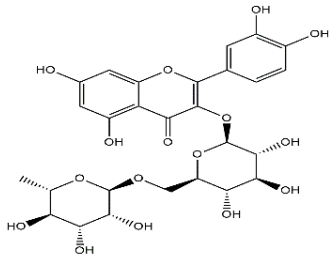
Table 7: Bioactive compound identified in rosa species by FTIR

First author/year	Plant name (species name)	Plant part studied	Type of extract (sample)	Technique used	Phytochemical identified	Therapeutic activity	Ref
Mohammed Ali et al, 2016	*R. damascene*	Flowers	Methanolic extract	FT-IR spectrophotometer, UV spectrophotometer, 1H (300 MHz) and 13C (75 MHz) NMR spectrophotometer	Four new compounds identified as *n*-cosan-5β-ol (1), (*cis*)- 6, 10, 14-trimethylpentadec-3-en-7β,11β-diol (damascene, 2), 7-hydroxy-4-(3'-methyl butanol)- coumarin-3-en-one (rosacoumari, 3) and cedr-6-en- 12-ol-14-oic acid (rosa cedrenoic acid, 4)	Abdominal and chest pains, menstrual bleeding, digestive problems.	39

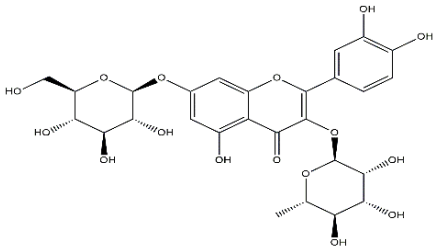
Rosa gallica L., Rosa centifolia L., Rosa damascena Mill. was declared that the solid residue of extract contains mainly straight-chain saturated hydrocarbons with high molecular weight (C-15-C-31) and the esters of carboxylic acids and a homologous series between them exist [40]. The study showed phenolic and flavonoid content where Ascorbic Acid standard drugs [41]. French city is known as the PERFUME CAPITAL of the world. R. canina, R. gallica, R. rugosa, Rosehip Aqueous and ethanolic extract evaluated for in vitro total antioxidant capacity [42]. Rose (*Rosa spp.*) petals were evaluated the micro (Co, Cu, Fe, Mn, Mo, Ni and Zn), macro (Ca, Mg, Na and P) and toxic elements (As, Cd and Cr) of organically cultivated rose. The study concluded that rose petals are a promising potential nutritional supplement in the human diet [43]. According to the analytical studies review some of the most important phytochemicals are mentioned. The structural presentation of the identified compound is shown in Fig. 1



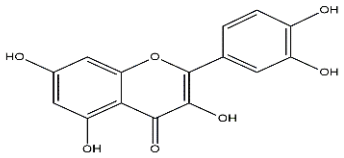
Apigenin
Chemical Formula: $C_{15}H_{10}O_5$
Exact Mass: 270.05
Molecular Weight: 270.24
m/z: 270.05 (100.0%), 271.06 (16.5%), 272.06 (2.3%)
Elemental Analysis: C, 66.67; H, 3.73; O, 29.60



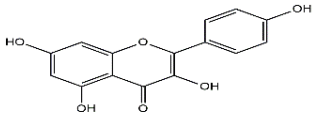
Rutine
Chemical Formula: $C_{27}H_{30}O_{16}$
Exact Mass: 610.15
Molecular Weight: 610.52
m/z: 610.15 (100.0%), 611.16 (30.2%), 612.16 (7.7%), 613.16 (1.4%)
Elemental Analysis: C, 53.12; H, 4.95; O, 41.93



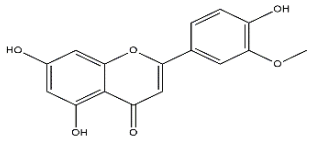
Quercetin 3-O-rhamnoside 7-O-glucoside
Chemical Formula: $C_{27}H_{30}O_{16}$
Exact Mass: 610.15
Molecular Weight: 610.52
m/z: 610.15 (100.0%), 611.16 (30.2%), 612.16 (7.7%), 613.16 (1.4%)
Elemental Analysis: C, 53.12; H, 4.95; O, 41.93



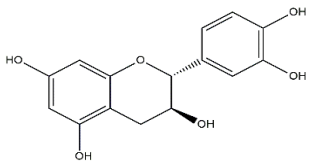
Quercetin
Chemical Formula: $C_{15}H_{10}O_7$
Exact Mass: 302.04
Molecular Weight: 302.24
m/z: 302.04 (100.0%), 303.05 (16.6%), 304.05 (2.7%)
Elemental Analysis: C, 59.61; H, 3.33; O, 37.06



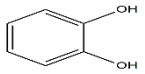
Kaempferol
Chemical Formula: $C_{15}H_{10}O_6$
Exact Mass: 286.05
Molecular Weight: 286.24
m/z: 286.05 (100.0%), 287.05 (16.6%), 288.05 (2.5%)
Elemental Analysis: C, 62.94; H, 3.52; O, 33.54



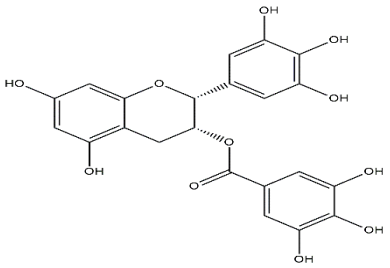
Chrysoeriol
Chemical Formula: $C_{16}H_{12}O_6$
Exact Mass: 300.06
Molecular Weight: 300.26
m/z: 300.06 (100.0%), 301.07 (17.7%), 302.07 (2.7%)
Elemental Analysis: C, 64.00; H, 4.03; O, 31.97



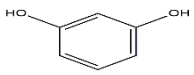
Catechin
Chemical Formula: $C_{15}H_{14}O_6$
Exact Mass: 290.08
Molecular Weight: 290.27
m/z: 290.08 (100.0%), 291.08 (16.5%), 292.09 (1.3%), 292.08 (1.2%)
Elemental Analysis: C, 62.07; H, 4.86; O, 33.07



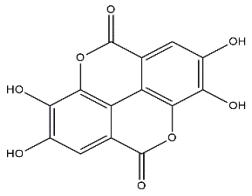
Catechol
Chemical Formula: $C_6H_6O_2$
Exact Mass: 110.04
Molecular Weight: 110.11
m/z: 110.04 (100.0%), 111.04 (6.6%)
Elemental Analysis: C, 65.45; H, 5.49; O, 29.06



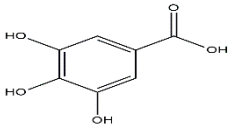
Epigallocatechin gallate
Chemical Formula: $C_{22}H_{18}O_{11}$
Exact Mass: 458.08
Molecular Weight: 458.37
m/z: 458.08 (100.0%), 459.09 (24.4%), 460.09 (5.1%)
Elemental Analysis: C, 57.65; H, 3.96; O, 38.40



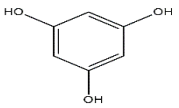
Resorcinol
Chemical Formula: $C_6H_6O_2$
Exact Mass: 110.04
Molecular Weight: 110.11
m/z: 110.04 (100.0%), 111.04 (6.6%)
Elemental Analysis: C, 65.45; H, 5.49; O, 29.06



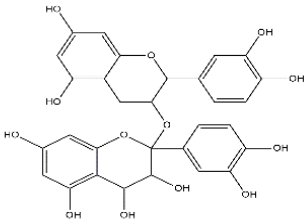
Ellagic acid
Chemical Formula: $C_{14}H_6O_8$
Exact Mass: 302.01
Molecular Weight: 302.19
m/z: 302.01 (100.0%), 303.01 (15.5%), 304.01 (2.8%)
Elemental Analysis: C, 55.64; H, 2.00; O, 42.36



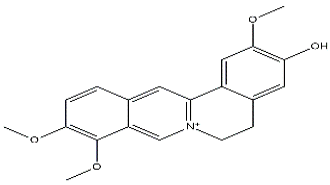
Gallic Acid
Chemical Formula: $C_7H_6O_5$
Exact Mass: 170.02
Molecular Weight: 170.12
m/z: 170.02 (100.0%), 171.02 (7.6%), 172.03 (1.3%)
Elemental Analysis: C, 49.42; H, 3.55; O, 47.02



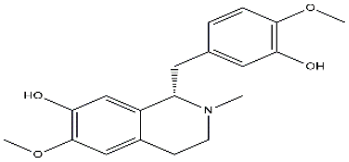
Phloroglucinol
Chemical Formula: $C_6H_6O_3$
Exact Mass: 126.03
Molecular Weight: 126.11
m/z: 126.03 (100.0%), 127.04 (6.7%)
Elemental Analysis: C, 57.14; H, 4.80; O, 38.06



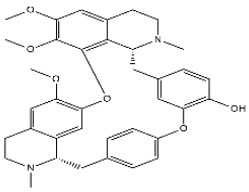
Proanthocyanidins
Chemical Formula: $C_{30}H_{26}O_{13}$
Exact Mass: 594.14
Molecular Weight: 594.52
m/z: 594.14 (100.0%), 595.14 (33.2%), 596.14 (7.9%)
Elemental Analysis: C, 60.61; H, 4.41; O, 34.98



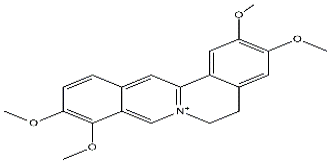
Jatrorrhizine
Chemical Formula: $C_{20}H_{20}NO_4$
Exact Mass: 338.14
Molecular Weight: 338.38
m/z: 338.14 (100.0%), 339.14 (22.2%), 340.15 (2.3%)
Elemental Analysis: C, 70.99; H, 5.96; N, 4.14; O, 18.91



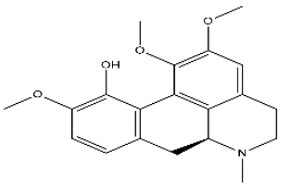
Reticuline
Chemical Formula: $C_{19}H_{23}NO_4$
Exact Mass: 329.16
Molecular Weight: 329.39
m/z: 329.16 (100.0%), 330.17 (21.0%), 331.17 (2.9%)
Elemental Analysis: C, 69.28; H, 7.04; N, 4.25; O, 19.43



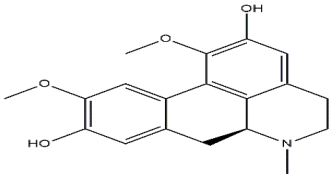
Berbamine
Chemical Formula: $C_{37}H_{40}N_2O_6$
Exact Mass: 608.29
Molecular Weight: 608.72
m/z: 608.29 (100.0%), 609.29 (41.4%), 610.30 (8.1%), 611.30 (1.5%), 610.29 (1.5%)
Elemental Analysis: C, 73.00; H, 6.62; N, 4.60; O, 15.77



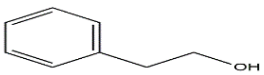
Palmatine
Chemical Formula: $C_{21}H_{55}NO_4^+$
Exact Mass: 352.15
Molecular Weight: 352.40
m/z: 352.15 (100.0%), 353.16 (23.1%), 354.16 (3.5%)
Elemental Analysis: C, 71.57, H, 6.29, N, 3.97, O, 18.16



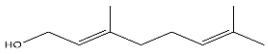
Isocorydine
Chemical Formula: $C_{20}H_{24}NO_4$
Exact Mass: 341.16
Molecular Weight: 341.40
m/z: 341.16 (100.0%), 342.17 (22.0%), 343.17 (3.1%)
Elemental Analysis: C, 70.36; H, 6.79; N, 4.10; O, 18.75



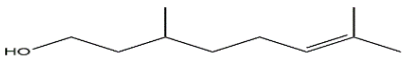
Boldine
Chemical Formula: $C_{19}H_{21}NO_4$
Exact Mass: 327.15
Molecular Weight: 327.37
m/z: 327.15 (100.0%), 328.15 (20.9%), 329.15 (2.9%)
Elemental Analysis: C, 69.71; H, 6.47; N, 4.28; O, 19.55



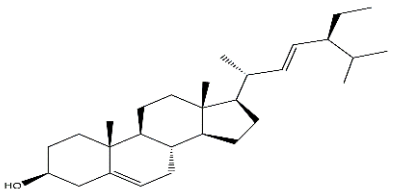
2-Phenylethanol
Chemical Formula: $C_8H_{10}O$
Exact Mass: 122.07
Molecular Weight: 122.16
m/z: 122.07 (100.0%), 123.08 (8.8%)
Elemental Analysis: C, 78.65; H, 8.25; O, 13.10



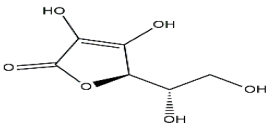
Geraniol
Chemical Formula: $C_{10}H_{18}O$
Exact Mass: 154.14
Molecular Weight: 154.25
m/z: 154.14 (100.0%), 155.14 (11.1%)
Elemental Analysis: C, 77.87, H, 11.76, O, 10.37



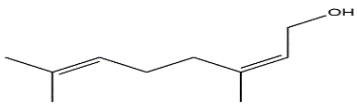
Citronellol
Chemical Formula: $C_{10}H_{20}O$
Exact Mass: 156.15
Molecular Weight: 156.27
m/z: 156.15 (100.0%), 157.15 (10.8%)
Elemental Analysis: C, 76.86; H, 12.90; O, 10.24



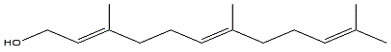
Stigmasterol
Chemical Formula: $C_{29}H_{48}O$
Exact Mass: 412.37
Molecular Weight: 412.69
m/z: 412.37 (100.0%), 413.37 (31.4%), 414.38 (4.9%)
Elemental Analysis: C, 84.40, H, 11.72, O, 3.88



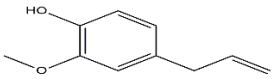
Ascorbic Acid
Chemical Formula: $C_6H_8O_6$
Exact Mass: 176.03
Molecular Weight: 176.12
m/z: 176.03 (100.0%), 177.04 (6.8%), 178.04 (1.4%)
Elemental Analysis: C, 40.92; H, 4.58; O, 54.50



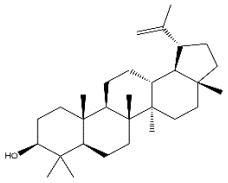
Nerol
Chemical Formula: $C_{10}H_{18}O$
Exact Mass: 154.14
Molecular Weight: 154.25
m/z: 154.14 (100.0%), 155.14 (11.1%)
Elemental Analysis: C, 77.87; H, 11.76; O, 10.37



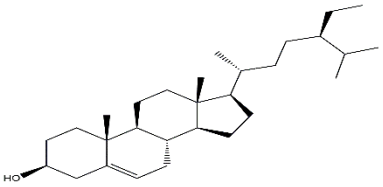
Farnesol
Chemical Formula: $C_{15}H_{26}O$
Exact Mass: 222.20
Molecular Weight: 222.37
m/z: 222.20 (100.0%), 223.20 (16.6%), 224.21 (1.3%)
Elemental Analysis: C, 81.02; H, 11.79; O, 7.20



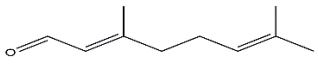
Eugenol
Chemical Formula: $C_{10}H_{12}O_2$
Exact Mass: 164.08
Molecular Weight: 164.20
m/z: 164.08 (100.0%), 165.09 (11.0%)
Elemental Analysis: C, 73.15; H, 7.37; O, 19.49



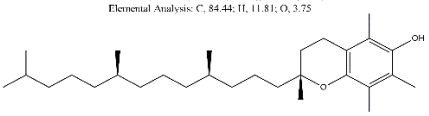
Lupeol
Chemical Formula: $C_{30}H_{50}O$
Exact Mass: 426.39
Molecular Weight: 426.72
m/z: 426.39 (100.0%), 427.39 (33.1%), 428.39 (5.3%)
Elemental Analysis: C, 84.44; H, 11.81; O, 3.75



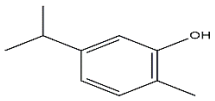
Beta-Sitosterol
Chemical Formula: $C_{29}H_{50}O$
Exact Mass: 414.39
Molecular Weight: 414.71
m/z: 414.39 (100.0%), 415.39 (32.0%), 416.39 (5.0%)
Elemental Analysis: C, 83.99; H, 12.15; O, 3.86



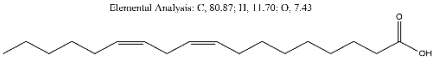
Citral
Chemical Formula: $C_{10}H_{16}O$
Exact Mass: 152.12
Molecular Weight: 152.23
m/z: 152.12 (100.0%), 153.12 (10.9%)
Elemental Analysis: C, 78.90; H, 10.59; O, 10.51



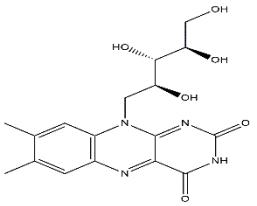
VITAMIN E
Chemical Formula: $C_{29}H_{50}O_2$
Exact Mass: 430.38
Molecular Weight: 430.71
m/z: 430.38 (100.0%), 431.38 (31.4%), 432.39 (5.4%)
Elemental Analysis: C, 80.87; H, 11.70; O, 7.43



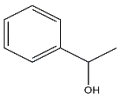
Carvacrol
Chemical Formula: $C_{10}H_{14}O$
Exact Mass: 150.10
Molecular Weight: 150.22
m/z: 150.10 (100.0%), 151.11 (11.0%)
Elemental Analysis: C, 79.96; H, 9.39; O, 10.65



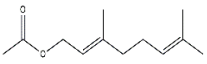
Linoleic Acid
Chemical Formula: $C_{18}H_{32}O_2$
Exact Mass: 280.24
Molecular Weight: 280.45
m/z: 280.24 (100.0%), 281.24 (19.5%), 282.25 (1.9%)
Elemental Analysis: C, 77.09; H, 11.50; O, 11.41



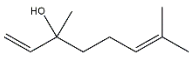
Riboflavin
Chemical Formula: $C_{17}H_{20}N_4O_6$
Exact Mass: 376.14
Molecular Weight: 376.36
m/z: 376.14 (100.0%), 377.14 (20.3%), 378.14 (3.1%)
Elemental Analysis: C, 54.25; H, 5.36; N, 14.89; O, 25.51



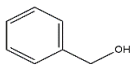
Phenylethanol
Chemical Formula: $C_8H_{10}O$
Exact Mass: 122.07
Molecular Weight: 122.16
m/z: 122.07 (100.0%), 123.08 (8.8%)
Elemental Analysis: C, 78.65; H, 8.25; O, 13.10



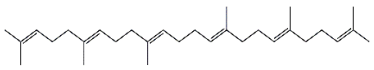
Geranyl acetate
Chemical Formula: $C_{12}H_{20}O_2$
Exact Mass: 196.15
Molecular Weight: 196.29
m/z: 196.15 (100.0%), 197.15 (13.3%), 198.15 (1.2%)
Elemental Analysis: C, 73.43; H, 10.27; O, 16.30



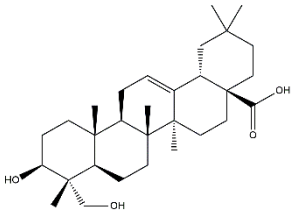
Linalool
Chemical Formula: $C_{10}H_{18}O$
Exact Mass: 154.14
Molecular Weight: 154.25
m/z: 154.14 (100.0%), 155.14 (11.1%)
Elemental Analysis: C, 77.87; H, 11.76; O, 10.37



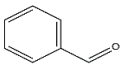
Benzyl Alcohol
Chemical Formula: C_7H_8O
Exact Mass: 108.06
Molecular Weight: 108.14
m/z: 108.06 (100.0%), 109.06 (7.7%)
Elemental Analysis: C, 77.75; H, 7.46; O, 14.80



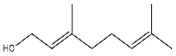
Squalene
Chemical Formula: $C_{30}H_{50}$
Exact Mass: 410.39
Molecular Weight: 410.72
m/z: 410.39 (100.0%), 411.39 (32.4%), 412.40 (5.3%)
Elemental Analysis: C, 87.73; H, 12.27



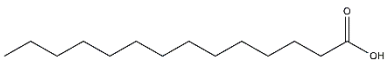
Hederagenin
Chemical Formula: $C_{30}H_{48}O_4$
Exact Mass: 472.36
Molecular Weight: 472.70
m/z: 472.36 (100.0%), 473.36 (33.2%), 474.36 (6.1%)
Elemental Analysis: C, 76.23; H, 10.24; O, 13.54



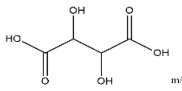
Benzaldehyde
Chemical Formula: C_7H_6O
Exact Mass: 106.04
Molecular Weight: 106.12
m/z: 106.04 (100.0%), 107.05 (7.7%)
Elemental Analysis: C, 79.22; H, 5.70; O, 15.08



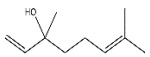
Geraniol
Chemical Formula: $C_{10}H_{18}O$
Exact Mass: 154.14
Molecular Weight: 154.25
m/z: 154.14 (100.0%), 155.14 (11.1%)
Elemental Analysis: C, 77.87; H, 11.76; O, 10.37



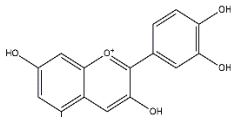
Myristic acid
Chemical Formula: $C_{14}H_{28}O_2$
Exact Mass: 228.21
Molecular Weight: 228.37
m/z: 228.21 (100.0%), 229.21 (15.2%), 230.22 (1.1%)
Elemental Analysis: C, 73.63; H, 12.36; O, 14.01



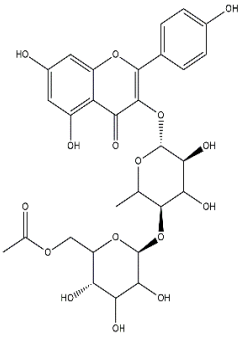
Tartaric acid
Chemical Formula: $C_4H_6O_6$
Exact Mass: 150.02
Molecular Weight: 150.09
m/z: 150.02 (100.0%), 151.02 (4.6%), 152.02 (1.3%)
Elemental Analysis: C, 32.01; H, 4.03; O, 63.96



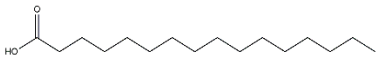
Linalool
Chemical Formula: $C_{10}H_{18}O$
Exact Mass: 154.14
Molecular Weight: 154.25
m/z: 154.14 (100.0%), 155.14 (11.1%)
Elemental Analysis: C, 77.87; H, 11.76; O, 10.37

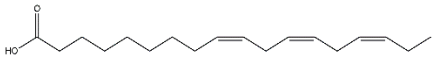


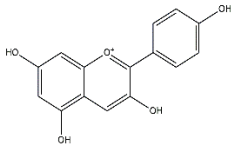
Cyanidin
Chemical Formula: $C_{15}H_{11}O_6^+$
Exact Mass: 287.06
Molecular Weight: 287.24
m/z: 287.06 (100.0%), 288.06 (16.6%), 289.06 (2.5%)
Elemental Analysis: C, 62.72; H, 3.86; O, 33.42



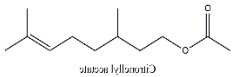
Multiflorin A
Chemical Formula: $C_{30}H_{32}O_{16}$
Exact Mass: 636.17
Molecular Weight: 636.55
m/z: 636.17 (100.0%), 637.17 (32.0%), 638.18 (5.1%), 638.17 (3.3%), 639.18 (1.6%)
Elemental Analysis: C, 54.72; H, 5.07; O, 40.21

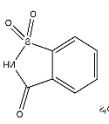


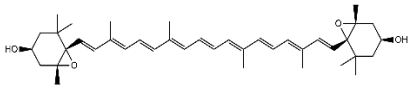




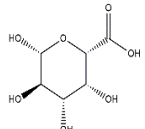
Pelargonidin
Chemical Formula: $C_{15}H_{11}O_5^+$
Exact Mass: 271.06
Molecular Weight: 271.24
m/z: 271.06 (100.0%), 272.06 (16.4%), 273.07 (1.3%), 273.06 (1.0%)
Elemental Analysis: C, 66.42; H, 4.09; O, 29.49



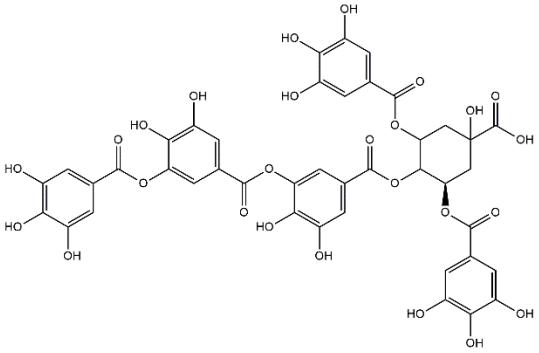




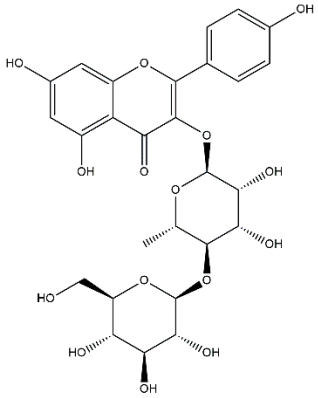
Violaxanthin
Chemical Formula: $C_{40}H_{56}O_4$
Exact Mass: 600.42
Molecular Weight: 600.87
m/z: 600.42 (100.0%), 601.42 (44.3%), 602.42 (9.9%), 603.43 (1.7%)
Elemental Analysis: C, 79.96; H, 9.39; O, 10.65



Pectin
Chemical Formula: $C_6H_{10}O_7$
Exact Mass: 194.04
Molecular Weight: 194.14
m/z: 194.04 (100.0%), 195.05 (6.9%), 196.05 (1.6%)
Elemental Analysis: C, 37.12; H, 5.19; O, 57.69



Tannin
Chemical Formula: $C_{42}H_{32}O_{26}$
Exact Mass: 952.12
Molecular Weight: 952.69
m/z: 952.12 (100.0%), 953.12 (46.8%), 954.12 (15.4%), 955.13 (4.1%)
Elemental Analysis: C, 52.95; H, 3.39; O, 43.66



Multiflorin B
Chemical Formula: $C_{27}H_{30}O_{15}$
Exact Mass: 594.16
Molecular Weight: 594.52
m/z: 594.16 (100.0%), 595.16 (30.1%), 596.17 (4.4%), 596.16 (3.1%), 597.17 (1.3%)
Elemental Analysis: C, 54.55; H, 5.09; O, 40.37

Figure 2: structure of some bioactive phytochemical with basic properties of Rosa species

Reported activity in Rosa centifolia

Antidiabetic activity

A. Thilagavathy et al., 2018; Bioassy guided fractionation study of hydroalcoholic extract of *Rosa centifolia was performed in this study* Flavonoids, proteins, and alkaloids are reported to be determined at 254 nm, 280 nm, and 418 nm respectively. [44].

Antihypercholesterolemic activity

This study aimed to investigate whether the hydroalcoholic extract of *Rosa centifolia* exhibited the maximum inhibition of the enzyme under analysis with a ratio of 1.4117. [45].

Nephrotoxicity activity

The ethanolic extract of petals of R. centifolia is effective in doxorubicin-induced nephrotoxicity in rats. The effect of the ethanolic extract on the petals of R. centifolia might be credited to its antioxidant properties [46].

Antitussive

In this study evaluated the anti-tussive potential of the ethanolic extract of "Rosa centifolia" in a sulfur dioxide gas-induced mouse model [47].

Anti-arthritic activity and anti-inflammatory activity

Battiwala Archana J et al., 2013; *Rosa centifolia* flowers aqueous extract Evaluated for anti-inflammatory and anti-arthritic activity in male albino rats [48]. Another study was carried out to evaluate the anti-inflammatory and antiarthritic activity of aqueous extract of Rosa centifolia (RC) [49].

Antidepressant activity

The antidepressant activity with an aqueous extract of Rosa *centifolia* was investigated in the forced swim test and tail suspension test, The aqueous extract of *Rosa centifolia* has significant antidepressant activity at a high dose level (100 mg/kg) [50].

Antimicrobial activity

The Study was conducted to identify microbiota of *Rosa centifolia* that might be accountable for the loss of their actual fragrance. The starch hydrolysis and glucose fermentation tests performed for characterization involved endospore staining, catalase, and motility tests [51].

Antiaging activity

A completely different study was performed on dye extracted from rosa centifolia. The dye-sensitized solar cells based on ZnO nanorods show maximum photoelectric conversion efficiency of 0.76% [52]. According to the various scientific evidence, it is confirmed that various organs (flower petals, hips, leaf, steam) of the wild rose could be a rich source of antioxidants because of the high medicinally active secondary metabolites such as phenolic compositions and some well-known antioxidant compounds. Further analytical and preclinical studies are necessary to evaluate potentially active secondary metabolites of Rosa centifolia.

Activity reported in other species of Rosa

Antidiabetic

A review reported that in Iran, the Rosa damascene plant is commonly known as "Gole Mohammadi". The antimicrobial, antioxidant, analgesic, anti-inflammatory, anti-diabetic, and anti-depressant properties have been confirmed [53]. Cell proliferation and cytotoxicity assay (in-vitro) was performed on pancreatic b-cells, bTC6. The protective action of the crude extract on streptozotocin-induced death in bTC6 cells was evaluated [54]. In This study, we evaluated the antidiabetic and antihyperlipidemic activity of *Rosa canina* fruit extract in streptozotocin-induced diabetic rats [55]. The processing method browning was applied such as components of green tea polyphenols can be changed, the red rose flower determines whether the processed or non-processed rose flower has an anti-diabetic effect on the streptozotocin-induced diabetic mouse [56]. The oligosaccharide from *Rosa canina* fruits was isolated and characterized by a combination of FTIR, NMR, and Mass spectrometry analysis. Wistar rats were used for diabetic study (type 2) [57]. The methanolic extract of *Rosa damascena* Mill. Flowers were studied, in contrast to the acarbose (α-glucosidase inhibitor), in normal and diabetic rats [58]. Rosa damascena Mill. Hydrosol effect study in streptozotocin (STZ)-induced diabetic rats, hematology, clinical biochemistry, lens enzymatic activity, and lens pathology were evaluated [59].

Antioxidant

This study, reveals that rose residue (Damask rose (*Rosa damascena*) flower residue) is rich in phenolic content and has a noticeable antioxidative effect [60] The *in-vitro* method was used to evaluate the antioxidant capacity of hips collected from four rose species (Rosa ca nina, *R. corymbifera*, *R. micrantha*, and *R. sempervirens*) [61]. Rosa *alba* L. and *Rosa damascene* Mill

herbal plant phytochemical profile and antioxidant capacity of extract (hydrosols), obtained by water-steam distillation method [62]. stated that Rosa damascene (white rose) methanolic extract from Iran shows antimicrobial activities, total phenolics content, antioxidant properties, and the blood sera Ferric-Reducing Antioxidant Power (FRAP) of the crude extracts were determined using standard methods [63]. Extracts of flower petals of roses antioxidant compounds and their antioxidant activity were studied [64]. A natural antioxidant symbol of beauty and love is the rose (*Rosa chinensis* Jacq.). The purpose of this study was to know the secondary metabolic compounds and total antioxidant capacity of methanol extracts of rose flowers [65]. The petals of the evaluated roses are excellent sources of nutritional compounds and antioxidants [66]. Antioxidant capacity of was studied using samples from seven industrial-scale plantations (Kazanlak, Zelenikovo, Moskovets, Bratsigovo, Strelcha, Mirkovo and Gurkovo) in Bulgaria for *Rosa damascena* petals and leaves, representing different climatic conditions, during two successive growing seasons (2009 and 2010) [67]. This pilot explorative study evaluated the changes in urinary phenolic excretion in healthy volunteers to whom different doses of phenolics from edible roses (Gourmet Roses™) have been added to a meal [68]. In this work, the dried Rose petals were taken to analyse the nutritional value and antioxidant activity [69].

Antiviral and antimicrobial activity

Rose geranium (Pelargonium graveolens) and petals of rose (Rosa damascena) essential oils (EOs) and extracts have beneficial antimicrobial and antiviral properties and they can be used as natural preservatives [70].

Anticancer activity

this study carried out to investigate Rosa damascene (Taif rose) biological and phytochemical potency in both fresh and dry rose [71]. studies on Rosa canina pseudo fruits (rose hips) have found that rose hips also contain flavonoids that may be health-promoting compounds [72]. *R. damascena* shows the perfuming effect, and numerous other pharmacological activities including anti-HIV, antibacterial, antioxidant, antitussive, hypnotic, antidiabetic, and relaxant action on tracheal chains have been reported for this plant [73].

Conclusion

Rosa species with special consideration of *Rosa centifolia* it is concluded that this herbal drug carries various bioactive phytochemical and broad medical properties. Broad-spectrum phytopharmacological properties of Rosa species are established through analytical and pre-clinical studies, further human research is expected to evaluate and ensure its properties. Although Rosa species were found clinically active in antioxidant, antiarthritic antitussive antiaging antimicrobial, and antiviral, multiple literature reported noteworthy antiproliferative, anticholestramich and antidiabetic effects. In conclusion, there is considerable evidence available for the efficiency, potency and safety of Rosa species to use medicinally, however, it is suggested to conduct advanced study, confirmatory experiments and clinical trials with existing authenticated and standardized plant products.

Acknowledgement

The authors of this study have valuable involvement in the literature search.

Conflict of interest

There is no conflict of interest.

References:

1. Prasathkumar M, Anisha S, Dhrisya C, Becky R, Sadhasivam S. Therapeutic and pharmacological efficacy of selective Indian medicinal plants - A review. Vol. 1, Phytomedicine Plus. Elsevier B.V.; 2021. https://doi.org/10.1016/j.phyplu.2021.100029

2. Bergfeld FACP;, Donald V, Belsito DE, Cohen CD, Klaassen DC, Liebler ;, et al. Safety Assessment of Rosa centifolia-derived Ingredients as Used in Cosmetics The Expert Panel for Cosmetic Ingredient Safety members are: Chair, Wilma F [Internet]. Available from: https://www.cir-

3. Sheikh ZA, Shakeel S, Gul S, Zahoor A, Khan SS, Zaidi FH, et al. A novel HPTLC method for quantitative estimation of biomarkers in polyherbal formulation. Asian Pac J Trop Biomed. 2015;5(11):955-9. https://doi.org/10.1016/j.apjtb.2015.06.016

4. Kaul K, Karthigeyan S, Dhyani D, Kaur N, Sharma RK, Ahuja PS. Morphological and molecular analyses of Rosa damascena × R. bourboniana interspecific hybrids. Sci Hortic. 2009 Sep 17;122(2):258-63. https://doi.org/10.1016/j.scienta.2009.05.027

5. Priya Ashokrao T, Kiran D. International Journal of Ayurveda and Pharma Research A BRIEF REVIEW ON THERAPEUTIC EFFECTS OF-"ORNAMENTAL PLANT" ROSE [Internet]. Vol. 12, Issue. 2017. Available from: http://ijapr.in

6. Nasir MH, Nadeem R, Akhtar K, Hanif MA, Khalid AM. Efficacy of modified distillation sludge of rose (Rosa centifolia) petals for lead(II) and zinc(II) removal from aqueous solutions. J Hazard Mater. 2007 Aug 25;147(3):1006-14. https://doi.org/10.1016/j.jhazmat.2007.01.131 PMid:17363153

7. Kuppusamy P, Yusoff MM, Parine NR, Govindan N. Evaluation of in-vitro antioxidant and antibacterial properties of Commelina nudiflora L. extracts prepared by different polar solvents. Saudi J Biol Sci. 2015;22(3):293-301. https://doi.org/10.1016/j.sjbs.2014.09.016 PMid:25972750 PMCid:PMC4423715

8. Khaleghi A, Khadivi A. Morphological characterization of Damask rose (Rosa × damascena Herrm.) germplasm to select superior accessions. Genet Resour Crop Evol. 2020 Dec 1;67(8):1981-97. https://doi.org/10.1007/s10722-020-00954-z

9. Adnan N, Othman N. The Relationship between Plants and the Malay Culture. Procedia Soc Behav Sci. 2012;42:231-41. https://doi.org/10.1016/j.sbspro.2012.04.186

10. Dubois C, Plainfossé H, Delcroix M, Trinel M, Verger-Dubois G, Azoulay S, et al. Anti-Aging Potential of a Rosa centifolia Stem Extract with Focus on Phytochemical Composition by Bioguided Fractionation. Chem Biodivers. 2022 Jul 1;19(7). https://doi.org/10.1002/cbdv.202200158 PMid:35604399

11. Góra J, Lis A, Kalemba D. Chemical composition of the essential oil of rosa centifolia l. petals. Journal of Essential Oil Research. 1995;7(1):89-90. https://doi.org/10.1080/10412905.1995.9698472

12. Shabbir MK, Nadeem R, Mukhtar H, Anwar F, Mumtaz MW. PHYSICO-CHEMICAL ANALYSIS AND DETERMINATION OF VARIOUS CHEMICAL CONSTITUENTS OF ESSENTIAL OIL IN ROSA CENTIFOLIA. Vol. 41, Pak. J. Bot. 2009.

13. Khan MA, Shoaib-Ur-Rehman A. Extraction and Analysis of Essential Oil of Rosa species [Internet]. 1560. Available from: http://www.ijab.org

14. Mileva M, Ilieva Y, Jovtchev G, Gateva S, Zaharieva MM, Georgieva A, et al. Rose flowers-a delicate perfume or a natural healer? Vol. 11, Biomolecules. MDPI AG; 2021. p. 1-32. https://doi.org/10.3390/biom11010127 PMid:33478154 PMCid:PMC7835869

15. Priya Ashokrao T, Kiran D. International Journal of Ayurveda and Pharma Research A BRIEF REVIEW ON THERAPEUTIC EFFECTS OF-"ORNAMENTAL PLANT" ROSE [Internet]. Vol. 12, Issue. 2017. Available from: http://ijapr.in

16. Jena J, Kumar A, Jitendra J, Vineeta T, Ashok K, Brijesh K, et al. ROSA CENTIFOLIA: PLANT REVIEW IJRPC 2012, 2(3) ROSA CENTIFOLIA: PLANT REVIEW. Article in International Journal of

Research in Pharmacy and Chemistry [Internet]. 2012; Available from: www.ijrpc.com

17. Nazli T, Raheem A, Subhani S, Ahmad Ansari S, Meena R. PHYSICO-CHEMICAL AND HPTLC STUDIES OF ROSA DAMASCENA. World Journal of Pharmaceutical Research www.wjpr.net [Internet]. 2019;8:541. Available from: www.wjpr.net

18. Naegeli H, Mevissen M, Walkenhorst M, Ayrle H, Kupper J. Recent challenges in veterinary pharmacotherapy - could medicinal plants be an option? In: 65th International Congress and Annual Meeting of the Society for Medicinal Plant and Natural Product Research (GA 2017). Georg Thieme Verlag KG; 2017. https://doi.org/10.1055/s-0037-1608012

19. Riffault-Valois L, Destandau E, Pasquier L, André P, Elfakir C. Complementary analytical methods for the phytochemical investigation of 'Jardin de Granville', a rose dedicated to cosmetics. Comptes Rendus Chimie. 2016 Sep 1;19(9):1101-12. https://doi.org/10.1016/j.crci.2015.11.021

20. Riffault L, Destandau E, Pasquier L, André P, Elfakir C. Phytochemical analysis of Rosa hybrida cv. "Jardin de Granville" by HPTLC, HPLC-DAD and HPLC-ESI-HRMS: Polyphenolic fingerprints of six plant organs. Phytochemistry. 2014 Mar;99:127-34. https://doi.org/10.1016/j.phytochem.2013.12.015 PMid:24461781

21. Mehrotra S, Kirar V, Misra K, Paul NS. QUANTITATIVE ESTIMATION OF GALLIC ACID IN ROSA SINENSIS, EMBLICA OFFICINALIS AND SYZYGIUM AROMATICUM BY HPTLC. INTERNATIONAL RESEARCH JOURNAL OF PHARMACY. 2013 Aug 10;4(7):87-9. https://doi.org/10.7897/2230-8407.04719

22. Velioglut YS, Mama' G. Characterization of Flavonoids in Petals of Rosa damascena by HPLC and Spectral Analysis. Vol. 39, Food Chem. I W l. https://doi.org/10.1021/jf00003a007

23. Demir N, Yildiz O, Alpaslan M, Hayaloglu AA. Evaluation of volatiles, phenolic compounds and antioxidant activities of rose hip (Rosa L.) fruits in Turkey. LWT. 2014;57(1):126-33. https://doi.org/10.1016/j.lwt.2013.12.038

24. Cunja V, Mikulic-Petkovsek M, Stampar F, Schmitzer V. Compound Identification of Selected Rose Species and Cultivars: an Insight to Petal and Leaf Phenolic Profiles. Vol. 139, J. AMER. SOC. HORT. SCI. 2014. https://doi.org/10.21273/JASHS.139.2.157

25. Baydar NG, Baydar H. Phenolic compounds, antiradical activity and antioxidant capacity of oil-bearing rose (Rosa damascena Mill.) extracts. Ind Crops Prod. 2013 Jan;41(1):375-80. https://doi.org/10.1016/j.indcrop.2012.04.045

26. Kumari P, Raju DVS, Singh KP, Prasad K V., Panwar S. Characterization of phenolic compounds in petal extracts of rose. Indian Journal of Horticulture. 2018 Jun 1;75(2):349-51. https://doi.org/10.5958/0974-0112.2018.00060.9

27. Shameh S, Hosseini B, Alirezalu A, Maleki R. Phytochemical composition and antioxidant activity of petals of six Rosa species from Iran. J AOAC Int. 2018;101(6):1788-93. https://doi.org/10.5740/jaoacint.18-0111 PMid:30005718

28. Cendrowski A, Scibisz I, Kieliszek M, Kolniak-Ostek J, Mitek M. UPLC-PDA-Q/TOF-MS Profile of polyphenolic compounds of liqueurs from rose petals (Rosa rugosa). Molecules. 2017 Nov 1;22(11). https://doi.org/10.3390/molecules22111832 PMid:29077047 PMCid:PMC6150333

29. Pires TCSP, Dias MI, Barros L, Calhelha RC, Alves MJ, Oliveira MBPP, et al. Edible flowers as sources of phenolic compounds with bioactive potential. Food Research International. 2018 Mar 1;105:580-8. https://doi.org/10.1016/j.foodres.2017.11.014 PMid:29433250

30. Maciąg A, Kalemba D. Composition of rugosa rose (Rosa rugosa thunb.) hydrolate according to the time of distillation. In: Phytochemistry Letters. Elsevier Ltd; 2015. p. 373-7. https://doi.org/10.1016/j.phytol.2014.10.024

31. Alizadeh Z, Fattahi M. Essential oil, total phenolic, flavonoids, anthocyanins, carotenoids and antioxidant activity of cultivated Damask Rose (Rosa damascena) from Iran: With chemotyping approach concerning morphology and composition. Sci Hortic. 2021 Oct 15;288. https://doi.org/10.1016/j.scienta.2021.110341

32. Tsanaktsidis CG, Tamoutsidis E, Kasapidis G, Itziou A, Ntina E. Preliminary Results on Attributes of Distillation Products of the Rose Rosa damascene as a Dynamic and Friendly to the Environment Rural Crop. APCBEE Procedia. 2012;1:66-73. https://doi.org/10.1016/j.apcbee.2012.03.012

33. Cai YZ, Xing J, Sun M, Zhan ZQ, Corke H. Phenolic antioxidants (hydrolyzable tannins, flavonols, and anthocyanins) identified by LC-ESI-MS and MALDI-QIT-TOF MS from Rosa chinensis flowers. J Agric Food Chem. 2005 Dec 28;53(26):9940-8. https://doi.org/10.1021/jf052137k PMid:16366678

34. Nedeltcheva-Antonova D, Stoicheva P, Antonov L. Chemical profiling of Bulgarian rose absolute (Rosa damascena Mill.) using gas chromatography-mass spectrometry and trimethylsilyl derivatives. Ind Crops Prod. 2017 Dec 1;108:36-43. https://doi.org/10.1016/j.indcrop.2017.06.007

35. Wan H, Yu C, Han Y, Guo X, Luo L, Pan H, et al. Determination of flavonoids and carotenoids and their contributions to various colors of rose cultivars (Rosa spp.). Front Plant Sci. 2019 Feb 1;10. https://doi.org/10.3389/fpls.2019.00123

PMid:30809238 PMCid:PMC6379320

36. Chroho M, Bouymajane A, Oulad El Majdoub Y, Cacciola F, Mondello L, Aazza M, et al. Phenolic Composition, Antioxidant and Antibacterial Activities of Extract from Flowers of Rosa damascena from Morocco. Separations. 2022 Sep 1;9(9). https://doi.org/10.3390/separations9090247

37. Galal TM, Al-Yasi HM, Fawzy MA, Abdelkader TG, Hamza RZ, Eid EM, et al. Evaluation of the Phytochemical and Pharmacological Potential of Taif's Rose (Rosa damascena Mill var. trigintipetala) for Possible Recycling of Pruning Wastes. Life. 2022 Feb 1;12(2). https://doi.org/10.3390/life12020273 PMid:35207560 PMCid:PMC8876584

38. Olech M, Pietrzak W, Nowak R. Characterization of free and bound phenolic acids and flavonoid aglycones in Rosa rugosa Thunb. leaves and achenes using LC-ESI-MS/MS-MRM methods. Molecules. 2020 Apr 1;25(8). https://doi.org/10.3390/molecules25081804 PMid:32326454 PMCid:PMC7221549

39. Ali M, Sultana S, Jameel M, Mohammed Ali C, Jameel M. Phytochemical investigation of flowers of Rosa damascena Mill. ~ 179 ~ International Journal of Herbal Medicine. 2016;4(6):179-83.

40. Medicines Agency E. Assessment report on Rosa gallica L. , Rosa centifolia L., Rosa damascena Mill., flos [Internet]. 2013. Available from: www.ema.europa.eu

41. Zahid K, Ahmed M, Khan F. Phytochemical screening, antioxidant activity, total phenolic and total flavonoid contents of seven local varieties of Rosa indica L. Nat Prod Res. 2018 May 19;32(10):1239-43. https://doi.org/10.1080/14786419.2017.1331228 PMid:28539055

42. Koczka N, Stefanovits-Bányai É, Ombódi A. Total Polyphenol Content and Antioxidant Capacity of Rosehips of Some Rosa Species. Medicines. 2018 Aug 4;5(3):84. https://doi.org/10.3390/medicines5030084 PMid:30081545 PMCid:PMC6165473

43. dos Santos AMP, Silva EFR, dos Santos WNL, da Silva EGP, dos Santos LO, Bruna BR, et al. Evaluation of minerals, toxic elements and bioactive compounds in rose petals (Rosa spp.) using chemometric tools and artificial neural networks. Microchemical Journal. 2018 May 1;138:98-108. https://doi.org/10.1016/j.microc.2017.12.018

44. Thilagavathy A, Dsouza S, Shriraksha A, Singh KG. ANTI-INFLAMMATORY AND ANTIHYPERCHOLESTEROLEMIC ACTIVITY OF ROSA CENTIFOLIA, CORIANDRUM SATIVUM AND CYNODON DACTYLON. Int J Pharm Sci Res [Internet]. 2019;10(2):966. Available from: http://dx.doi.org/10.13040/IJPSR.0975-8232.10

45. Nagar D., Katare V., Sen S., Delouri A., Nema S. Evaluation of Antioxidant Activity of Rosa indica Linn . *Asian Journal of Dental and Health Sciences*, 2023; *3*(1):5–7. https://doi.org/10.22270/ajdhs.v3i1.34

46. Nimbal SK, Gadad PC, Koti BC. Effect of ethanolic extract of Rosa centifolia against doxorubicin induced nephrotoxicity in albino rats. J Ayurveda Integr Med. 2021 Oct 1;12(4):657-62. https://doi.org/10.1016/j.jaim.2021.07.020 PMid:34801355 PMCid:PMC8642703

47. Anand Sankar R, Nikhila C, Lakshmiprasanna VC, Mobeena SK, Karunakar K, Bharathi N. EVALUATION OF ANTI-TUSSIVE ACTIVITY OF ROSA CENTIFOLIA. IJPSR. 2011;2(6).

48. Archana B, Chandragopal S S, Kumar S. Evaluation of Anti-Inflammatory and Anti-Arthritic Activity of Rosa Centifolia (Linn.) Flowers in Experimental Rats. International Journal for Pharmaceutical Research Scholars. 2013.

49. Kumar R, Nair V, Gupta YK, Singh S. Anti-inflammatory and anti-arthritic activity of aqueous extract of Rosa centifolia in experimental models in rats. 2015. https://doi.org/10.1111/1756-185X.12625 PMid:26222375

50. kiran kakumani L, Naga Phani K, Chandrasekhar varma A, Kumar Uppala P, krithika Devi B. PHARMACOLOGICAL EVALUATION OF ANTIDEPRESSANT ACTIVITY OF AQUEOUS EXTRACT OF ROSA CENTIFOLIA PETALS IN MICE.

51. Singh A, Kumari N, Varghese BA, Rashmi T, Ghosh P, Suman A. Study of Microbial Diversity of Rosa Centifolia [Internet]. Article in International Journal of PharmTech Research. 2016. Available from: https://www.researchgate.net/publication/311887063

52. Thambidurai M, Muthukumarasamy N, Velauthapillai D, Lee C. Rosa centifolia sensitized ZnO nanorods for photoelectrochemical solar cell applications. Solar Energy. 2014;106:143-50. https://doi.org/10.1016/j.solener.2014.01.045

53. Mahboubi M. Rosa damascena as holy ancient herb with novel applications. Vol. 6, Journal of Traditional and Complementary Medicine. National Taiwan University; 2016. p. 10-6. https://doi.org/10.1016/j.jtcme.2015.09.005 PMid:26870673 PMCid:PMC4737971

54. Fattahi A, Niyazi F, Shahbazi B, Farzaei MH, Bahrami G. Antidiabetic Mechanisms of Rosa canina Fruits: An In Vitro Evaluation. J Evid Based Complementary Altern Med. 2017 Jan 1;22(1):127-33. https://doi.org/10.1177/2156587216655263 PMid:27352916 PMCid:PMC5871216

55. Taghizadeh M, Rashidi AA, Taherian AA, Vakili Z, Sajad Sajadian M, Ghardashi M. Antidiabetic and Antihyperlipidemic Effects of Ethanol Extract of Rosa canina L. fruit on Diabetic Rats: An Experimental Study With Histopathological Evaluations. J Evid Based Complementary Altern Med. 2016 Oct 1;21(4):NP25-30. https://doi.org/10.1177/2156587215612626 PMid:26498488

56. Ju JE, Joo YH, Chung N, Chung SY, Han SH, Lee YK. Anti-diabetic effects of red rose flowers in streptozotocin-induced diabetic mice. Vol. 57, Journal of the Korean Society for Applied Biological Chemistry. Korean Society for Applied Biological Chemistry; 2014. p. 445-8. https://doi.org/10.1007/s13765-014-4186-x

57. Rahimi M, Sajadimajd S, Mahdian Z, Hemmati M, Malekkhatabi P, Bahrami G, et al. Characterization and anti-diabetic effects of the oligosaccharide fraction isolated from Rosa canina in STZ-Induced diabetic rats. Carbohydr Res. 2020 Mar 1;489. https://doi.org/10.1016/j.carres.2020.107927 PMid:32062396

58. Gholamhoseinian A, Fallah H, Sharifi far F. Inhibitory effect of methanol extract of Rosa damascena Mill. flowers on α-glucosidase activity and postprandial hyperglycemia in normal and diabetic rats. Phytomedicine. 2009 Oct;16(10):935-41. https://doi.org/10.1016/j.phymed.2009.02.020 PMid:19380218

59. Demirbolat I, Ekinci C, Nuhoğlu F, Kartal M, Yildiz P, Geçer MÖ. Effects of orally consumed rosa damascena mill. Hydrosol on hematology, clinical chemistry, lens enzymatic activity, and lens pathology in streptozotocin-induced diabetic rats. Molecules. 2019;24(22). https://doi.org/10.3390/molecules24224069 PMid:31717650 PMCid:PMC6891380

60. Liu W ya, Chen L yu, Huang Y ying, Fu L, Song L yuan, Wang Y yu, et al. Antioxidation and active constituents analysis of flower residue of Rosa damascena. Chin Herb Med. 2020 Jul;12(3):336-41. https://doi.org/10.1016/j.chmed.2020.05.005 PMid:36119007 PMCid:PMC9476380

61. Fascella G, D'Angiolillo F, Mammano MM, Amenta M, Romeo F V., Rapisarda P, et al. Bioactive compounds and antioxidant activity of four rose hip species from spontaneous Sicilian flora. Food Chem. 2019 Aug 15;289:56-64. https://doi.org/10.1016/j.foodchem.2019.02.127 PMid:30955649

62. Georgieva A, Dobreva A, Tzvetanova E, Alexandrova A, Mileva M. Comparative Study of Phytochemical Profiles and Antioxidant Properties of Hydrosols from Bulgarian Rosa Alba L. and Rosa Damascena Mill. Journal of Essential Oil-Bearing Plants. 2019 Sep 3;22(5):1362-71. https://doi.org/10.1080/0972060X.2019.1699867

63. Dehghan Kashani A, Rasooli I, Rezaee MB, Owlia P. Antioxidative Properties and Toxicity of White Rose Extract.

64. Yang H, Shin Y. Antioxidant compounds and activities of edible roses (Rosa hybrida spp.) from different cultivars grown in Korea. Appl Biol Chem. 2017 Apr 1;60(2):129-36. https://doi.org/10.1007/s13765-017-0261-4

65. Simatupang NT, Limanan D, Yulianti E, Ferdinal F. Methanolic Extracts of Rose Flowers (Rosa chinensis Jacq.): Phytochemical Evaluation and Total Antioxidant Capacity. 2021.

66. Prata GGB, Oliveira De Souza K, Lopes MMA, Oliveira LS, Aragao FAS, Alves RE, et al. Nutritional Characterization, Bioactive Compounds and Antioxidant Activity of Brazilian Roses (Rosa spp). Vol. 19, J. Agr. Sci. Tech. 2017.

67. Ginova A, Mihalev K, Kondakova V. Antioxidant Capacity of Petals and Leaves from Different Rose (Rosa damascena Mill.) Plantations in Bulgaria [Internet]. Available from: www.ijpab.com

68. Devecchi A, Demasi S, Saba F, Rosato R, Gambino R, Ponzo V, et al. Compositional Characteristics and Antioxidant Activity of Edible Rose Flowers and Their Effect on Phenolic Urinary Excretion. Pol J Food Nutr Sci. 2021;71(4):383-92. https://doi.org/10.31883/pjfns/142639

69. Vijayanchali SS. NUTRIENT, PHYTONUTRIENT AND ANTIOXIDANT ACTIVITY OF THE DRIED ROSE PETALS [Internet]. Vol. 6, Journal of Research, Extension and Development. 2017. Available from: https://ssrn.com/abstract=3345537

70. Androutsopoulou C, Christopoulou SD, Hahalis P, Kotsalou C, Lamari FN, Vantarakis A. Evaluation of essential oils and extracts of rose geranium and rose petals as natural preservatives in terms of toxicity, antimicrobial, and antiviral activity. Pathogens. 2021 Apr 1;10(4). https://doi.org/10.3390/pathogens10040494 PMid:33921899 PMCid:PMC8074127

71. Abdel-Hameed ESS, Bazaid SA, Salman MS. Characterization of the phytochemical constituents of taif rose and its antioxidant and anticancer activities. Biomed Res Int. 2013;2013. https://doi.org/10.1155/2013/345465 PMid:24282813 PMCid:PMC3825121

72. Winther K, Campbell-Tofte J, Vinther Hansen AS. Bioactive ingredients of rose hips (Rosa canina L) with special reference to antioxidative and anti-inflammatory properties: in vitro studies. Botanics. 2016 Feb;11. https://doi.org/10.2147/BTAT.S91385

73. Boskabady MH, Saberi Z, Amini S. Pharmacological Effects of Rosa Damascena The effect of statin therapy on asthma View project Data Mining View project [Internet]. Article in Iranian Journal of Basic Medical Sciences. 2011. Available from: https://www.researchgate.net/publication/236047718