



Medicinal Plants of Cholistan Desert for the Management of Inflammatory Disorders: A Review

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ABSTRACT

Introduction: As Cholistan is located in the desert area of Pakistan, there is less availability of allopathic medicines and also limited number of healthcare providers even for conditions like inflammatory diseases. Local people of Cholistan use plant-based medicines for the management of inflammatory diseases.

Objectives of the study: This literature survey was carried out to highlight the potential of plant-based medicines used in the management of inflammation and related disorders in Cholistan region of Pakistan.

Material and Methods: Literature from electronic databases such as Google scholar, Pubmed and Scopus, and publications from 1986 up to 2020 on medicinal plants of Cholistan desert used to treat inflammation and related disorders, were searched to compile all the relevant data.

Results: There are 152 plants indigenous to Cholistan desert, which belong to 38 families and are mainly used by the local healers for inflammatory conditions. The anti-inflammatory potential of 152 plants was reviewed; out of which the use of 83 plants, in this review, is backed by in-vivo and in-vitro experimental studies. Roots, barks, tubers, leaves and fruits are important parts while whole plants are also used. The variation in the effects could be due to the difference in the amount of active ingredients in the mixtures and the amount ingested by the patients.

Conclusion: This review provides help to recognize plant species and assessment of the plant profile used as remedy to treat inflammatory conditions traditionally in Cholistan desert region of Pakistan. These proven benefits of medications extracted from plants are widely used in conventional prescriptions which are less expensive and easily available in healthcare system. A lot of beneficial specifications are compared with the standard pharmacopoeial monographs to assure the reproducibility of their helpful impact. We are confident that the capability of these restorative plants is best fitted towards a potential reconciliation into the medical care network.



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1. Introduction

1.1. Biogeographical Distribution of Cholistan Desert

Pakistan produces an astounding number of natural resources across all ecological pyramids and regions. Pakistan's elevation ranges from 0 to 8611m, resulting in a distinctive biodiversity and a variety of climatic zones. Due to differences in climatic areas,

approximately 6000 species of higher plants have been reported, 600-700 of which are used for therapeutic drives. South Punjab is well-known for the Saraiki dialect belt and its warm deserted environment. Cholistan is Turkish word meaning Desert; i.e arid land having warm climate. Cholistan, in this way, implies Land of the Desert occupying a zone of 26,000km square. Topographically, the Cholistan desert is located between 27° 42' - 29° 45' N and 69° 52' - 75° 24' E, within the southern Punjab territory of Pakistan. The Cholistan desert establishes the south eastern region of Punjab covering the districts of Bahawalpur, Bahawalnagar and Rahimyar Khan (Farooq et al., 2008). The desert is divided into two areas according to environmental conditions by Ancient Hakra River. The northern area includes almost 7,770 km² and is famous as Lesser Cholistan. It is located near the border of irrigated region of canal and extending to saline clay land flats which alternately changes to sand ridges. This purely sandy climatic desert also called Greater Cholistan comprises of area about 8130 km² in the southern area including different types of sand ridges and inter ridges valleys. Its dimensions are around 480 km in length and 32 to 192 km in breadth. Cholistan desert shows a diverse model of alluvial and Aeolian testimonies. The Cholistan Desert have a very important biological role as it has extra ordinary regular variety of seasons and wide range of edaphic conditions. This region has almost 110,000 population of peaceful migrants who initially were Buddhist and Sikh but now almost 95% are converted to Muslims and remaining 5% adopted Hinduism as a religion. The Cholistan desert economy primarily was pastoral and people usually migrate from place to place for centuries. Local people own Saraiki as their language. Agriculture in this area is very small as there is usually only 5 inches rainfall in a year. Due to its indigenous and therapeutic plant species, desert of Cholistan has important role in the area (Hameed et al., 2011) (Farooq et al., 2008).

1.2. Biodiversity Of Flora of Cholistan Desert

Biodiversity of this region is reflected by the diversity of living organisms and genetic difference between them and their communities. Each zone in the Cholistan desert supports distinctive plants and animals with their own niches that are endemic to this region. Cholistan desert's natural flora consists of 152 plant species from 106 genera and 38 families. Some of these species have a high fiscal value and are used in whole or in part for various purposes (Hameed et al., 2011). Many plant species are used as medicinal plants by the indigenous peoples of the area. It is, therefore, necessary to gather data on plants used in folkloric medicine.

1.3. Medicinal Plants and Their Use in the Management of Inflammatory Disorders

Inflammation and related disorders are regarded as major threats to human health, and patients in Pakistan may place an even greater reliance on herbal medicines for treatment. Inflammation is a multifarious biological response of body tissues to potentially harmful stimuli such as damaged cells, pathogens, or irritants. Inflammation is considered as a vital immune response as it is an attempt by the body to heal itself after an injury such as viruses or bacteria, and repair tissue damage. In the absence of inflammation, wound or damage would fester and infection could become deadly. If prolonged for a longer duration, inflammation can become problematic as it shifts the body towards some chronic diseases/disorders (Coussens & Werb, 2002). The causes majorly involve direct damage (sprains, cuts), chemicals (acid), necrosis and ischemia, physical agents (burns and thermal injuries) and allergic reactions. Bacteria give rise to produce inflammation by the release of endotoxins while viruses enter and destroy the cells of the body to initiate inflammation. Generally, physical trauma, radiations, burns, frostbite, corrosive chemicals such as alkali, acids and oxidizing agents can damage tissue and results in initiation of inflammatory process. Lack of oxygen or nutrients due to lack of blood flow to the tissue may also result in inflammation. Malfunction of immunological responses provoke an inappropriate and damaging inflammatory cascade that should be prevented to avoid serious health hazards and diseases (Hotamisligil, 2006). Major advancements in understanding inflammation are the identification of multiple mechanisms responsible for the production of inflammatory syndrome up to a molecular level. Future need is the development of diagnostic tools to identify the mechanisms of inflammatory processes and pharmacological tools that act specifically on these mechanisms in order to take a rational rather than empiric approach to control inflammation. The challenge is indeed great, but so is the need (Woolf, 2004).

Treatments which are presently in use to treat inflammatory conditions includes (NSAIDs) and steroids. These drugs reduce the inflammatory response, but they are not without side effects (Kluger, 1991). Natural medicines derived from plant sources have recently gained increased global interest due to their low adverse effects and tolerability. According to WHO, approximately three-quarters of the population in most developing countries rely on traditional practitioners and herbal medicine to meet their primary health care needs. Plants secondary metabolites are currently being used to treat a variety of diseases and thirty-five percent of them are regarded as leading medicinal agents in marketed drugs. As a result, the development of newer and more substantial drugs of natural origin with fewer side effects is still required (Rates, 2001). The main objective of this article is to collect as much as possible the available information about traditional medicinal plants used to treat inflammatory disorders in Cholistan region of Pakistan. In doing so, our goal is to encourage the rational use of the plants based on traditional uses and their pharmacological evidence profile.

2. Ethnopharmacological Data Collection

Data related to medicinal plants usually used in controlling Inflammation and related disorders in Cholistan region of Pakistan was obtained from published papers on ethnobotanical studies and those evaluating the effect of plants used in the management of inflammation. A literature examination of electronic databases; i.e. Pubmed, Google scholar, Scopus from 1986 to 2020 was carried out using Inflammation, Cholistan flora in Pakistan as keywords for the primary search; and Plant name and Constituents for the secondary searches.

3. Results

3.1. Plants Used in the Management of Inflammatory Disorders

152 plants traditionally used in the management of Inflammation and related disorders were searched (Wariss, Ahmad, Anjum, & Alam, 2014) (Rehman et al., 2015). Plant's detail is tabulated according to their families with their accepted scientific names (based on <http://www.plantlist.org>). For each plant, family name, local/common name, plant part(s) used and experimental evidence of activities are included (Table 1). Out of 152 plants reviewed in this paper, 69 of them have no experimental evidence of their anti-inflammatory effects (Table 1). These plants are used by the local people as conventional remedies for their health-related problems. Inborn information regarding these plants is connected with their history and culture. Cholistan area has many plants which have useful characteristics. The local population knows majority of the plants in this area over many years. They get the information of the useful plants from their elders and the knowledge is transferred generation after generation. Although these medicinal plants are used for useful purposes as unconventional treatment methods but still there is no proper study and documentation of these indigenous plants. The present study, therefore, gathered and compiled all the information related to the indigenous plants in order to preserve the rapidly vanishing traditional knowledge.

3.2. Plants to Be Explored for Anti-Inflammatory Potential

Out of all the medicinal plant species of Cholistan desert flora used to treat inflammatory disorders, 69 plants have yet been explored experimentally for anti-inflammatory activities. Family and the plant names need to be explored for anti-inflammatory potential are as follows: **Aizoaceae**; *Limeum indicum* Stocks. ex. T. Anderson (Jangli Lonak), *Sesuvium sesuvioides* (Fenzl.) Verdc. (Barri Ulwaiti), *Zaleya pentandra* (Linn.) (Itsit), **Asclepiadaceae**; *Pentatropis spiralis* (Forssk.) Decne. (Aakari Bel), *Gnaphalium luteo-album* Linn. (Jersey), *Launaea capitata* (Spreng.) Dandy (Alaku), **Boraginaceae**; *Heliotropium crispum* Desf. (Kali Bui), *Heliotropium europaeum* Linn. var (Akreer), **Brassicaceae**; *Farsetia jacquemontii* Hook.f (Fareed Buti), *Malcolmia africana* (Linn.) R. (Sarson Buti), **Capparidaceae**; *Dipterygium glaucum* Decne. (Fehl), *Convolvulus prostratus* Forssk. (Hiran Buti), *Convolvulus scindicus* Stocks. (Hiran Buti), *Convolvulus stocksii* Boiss. (Hiran Buti), **Cucurbitaceae**; *Praecitrullus fistulosus* (Stocks) (Jangli Tindy), **Cyperaceae**; *Cyperus conglomeratus* Rottb. (Monghan), **Euphorbiaceae**; *Chrozophora sabulos* Kar. & Kir (Nilkari), *Euphorbia indica* Lam. (Chinna Ammanpacharisi),

Molluginaceae; *Glinus lotoides* (Linn.) (Phatokar), **Neuradaceae;** *Neurada procumbens* (Linn.) (Chappari), **Nyctaginaceae;** *Boerhavia rubicunda* Steud. (Bashkhira), **Papilionaceae;** *Atylosia platycarpa* Benth. (Sukli Sengha), *Indigofera hochstetteri* Baker (Neel), *Indigofera sessiliflora* DC. (Neela, Tarum), *Sesbania bispinosa* (Jacq.) (Jintar), **Poaceae;** *Aeluropus lagopoides* (Linn.) (Jangli Ghas), *Aristida adscensionis* (Linn.) (Lumb), *Aristida funiculata* Trin (Lumb), *Aristida hystricula* Edgew (Lumb), *Brachiaria ramosa* (Linn.) (Lumb), *Cenchrus biflorus* Roxb. (Bhurrat), *Cenchrus prieurii* (Kunth) Maire (Dhaman), *Cymbopogon jwarancusa* (Jones) Schult. (Khavi, Kittran), *Dactyloctenium aegyptium* (Linn.) (Ghandhala Ghaa), *Dichanthium annulatum* (Forssk.) (Karad), *Digitaria sanguinalis* (Linn.) (Jangli Ghas), *Echinochloa colona* (Linn.) (Sanawakri), *Eragrostis barrelieri* Day. (Heelaagoog), *Eragrostis ciliaris* (Linn.) (Puncho), *Eragrostis japonica* (Thunb.) Trin. (Gangami), *Eragrostis minor* Host (Choti Ghas), *Lasiurus scindicus* Henr. (Sewan, Ghorka), *Leptothrium senegalense* (Kunth) W.D. (Mali, Firri), *Ochthochloa compressa* (Forssk.) (Chimber), *Panicum antidotale* Retz. (Murrot, Bansi), *Pennisetum divisum* (Gmel.) Henr. (Sarkunday Wali Ghas), *Phalaris minor* Retz. (Sitee Buti), *Polypogon monspeliensis* (Linn.) (Dumbi citti), *Saccharum bengalense* Retz. (Sarkanda, Kany), *Schoenefeldia gracilis* Kunth. (Burkil), *Sporobolus ioclados* (Nees ex Trin.) Nees (Chari), *Tragus berteronianus* Schult (Keel), *Tragus roxburghii* Panigrahi (Jangli Ghas), **Polygalaceae;** *Polygala erioptera* DC (Gulpankhi), **Polygonaceae;** *Polygonum plebejum* R. Br. (Charri Hatha), *Rumex dentatus* (Linn.) (Ambrauti), **Portulacaceae;** *Portulaca quadrifida* (Linn.) (Lonak), **Resedaceae;** *Oligomeris linifolia* (Vahl.) Macbride (Cambus), **Rosaceae;** *Potentilla heynii* Roth (Kobana), **Scrophulariaceae;** *Anticharis linearis* (Benth.) (Assmani Buti), **Solanaceae;** *Physalis divaricate* D. Don (Mamooly), *Solanum surattense* (Burm. f.) (Kandiari), **Tiliaceae;** *Corchorus tridens* (Linn.) (Jangli Sili), **Typhaceae;** *Typha domingensis* Pers. (Kundi), **Zygophyllaceae;** *Fagonia bruguieri* var. *laxa* Boiss (Dhman), *Seetzenia lanata* (Willd.) Bullock (Habyan), *Tribulus longipetalus* Viv. subsp. *Longipetalus* (Bhakhra), *Tribulus macropterus* (Boiss.) (Bhakhra), *Tribulus ochroleucus* (Maire) Ozenda & Quezel (Bhakhra).

4. Discussion

4.1. Traditional Knowledge Of Medicinal Plants Used To Treat Inflammatory Disorders

Traditional information and plant-based medicines are used in the management and treatment of inflammatory complaints in Cholistan region of Pakistan. This is significant on the grounds that conventional medications are regularly and rapidly available to the rural population in Pakistan. Government facilities are usually difficult in access and people usually don't have marketed medicines whereas the conventional treatment providers are easy to access whenever there is need and have sufficient stocks of conventional medicines. Logical approval of medications extracted from plants may in the end lead to more far and wide utilization of conventional prescriptions in less expensive medical services frameworks, as in India and China, careful toxicological examinations, clinical investigations and randomized controlled preliminaries on plant-based remedies are in process. African conventional information and medication accordingly can possibly assume an enormous function in essential medical services, especially in poor and segregated zones. These characteristics highlight the importance of proper conventional information and the need to gather and protect population wellbeing practices. The broad variety in plant species utilized by local health care providers in a similar territory, the non-availability of normalized preparations and measurements and the low pace of referral to clinics when a treatment has no positive results is stressing. The poisonousness and adequacy of conventional medicines should be experimentally approved to empower the development of therapeutic effective normalized herbal remedies. This isn't a simple work because of the unpredictable structure of herbal concentrates and the vulnerability about whether single synthetic substances are used to dynamic medications after ingestion and whether more than one compound element acts in combination. This accessible information can offer evidential support for the clinical improvement of various therapeutic plants as enhancing treatment. We accept that the standards for choice should be based on social acknowledgment/recurrence of utilization, viability and harmfulness profile, and accessibility/supportability of the availability chain, perhaps available to every area. A lot of valuable specifications for the normalization of these plants as home grown conventional developments, (for example, pharmacopoeial monographs) would be needed to guarantee the reproducibility of their helpful impact. At last, as a method for offering confidence to the pre-clinical trial proof, medication or clinical examination with the normalized materials

should be done so as to approve their efficacy in management of inflammatory disorders. We trust that as such the helpful capability of these restorative plants can be best fitted, towards a potential reconciliation into the medical care network.

4.2. Mode of Preparation and Route of Administration

The larger part of the treatments depicted in this analysis are focused on the orally administered water-based mixtures. Adekunle, 2008, Musa et al., 2011, and Maroyi, 2013 also mentioned this in their observations. Despite the fact that there was arrangement about the overall method of developing (most ordinarily immersing dried plant material in water), there was a wide variety in the amounts of plant material that was immersed in a particular quantity of water (Adekunle, 2008) (Musa et al., 2011) (Maroyi, 2013). Thus, there will be difference in the amount of particular active ingredient in the mixture and the amount taken by the patients orally. These variations are also observed and noted by Randrianarivelosia et al., 2003, and Ugulu, 2012. This large difference in the quantity of therapeutic ingredient taken orally by the patient and the low consistence makes the chance of subminimum portions (Randrianarivelosia et al., 2003). Most important part of plants are roots followed by bark, tubers and stems, leaves and fruits. Whole plants are least preferred in remedies. (Busmann & Sharon, 2006).

4.3. Ethnochemical Evaluation of Plants of Cholistan Desert

To explore biologically active compounds, extraction of plant constituents is performed by using different techniques to understand their role and mechanism of action in prevention and treatment of different diseases. However, insufficient documented information is available about the phytochemicals derived from medicinal plants. Numerous bioactive moieties and phytochemicals have been isolated and purified by using different chromatographic and spectroscopic methods e.g. High Performance Liquid Chromatography, High Performance Thin Layer Chromatography, Column Chromatography, Optimum Performance Laminar Chromatography, Paper Chromatography, Thin Layer Chromatography, Gas Chromatography, and its detection through Fourier Transform Infra-Red spectroscopy FTIR, Nuclear Magnetic Resonance NMR, and Mass Spectrometry. These phytochemicals are derived from different parts of plants such as barks, seed coat, seed, leaves, stems, flowers, roots and pulps. Plants from Cholistan desert are enriched with some novel phytochemicals but needs further ethnochemical investigations and pharmacological studies to validate the medicinal importance of the constituents. Cholistan desert plants traditionally used to treat inflammatory disorders shown to possess unique phytochemicals. These plants with isolated and purified phytochemicals/ constituents are summarized in Table 2. β -sitosterol, Sitosterol, Kaempferol, Apigenin, Quercetin, Stigmasterol, Lupeol, Isorhamnetin, Gallic acid, Ferulic acid and Vanillic acid are found in most of the plants in the Cholistan region of Pakistan. β -sitosterol, Sitosterol and Stigmasterol are proposed to inhibit the inflammatory cascade by inhibition of NF- κ B pathway (Loizou, Lekakis, Chrousos, & Moutsatsou, 2010). Quercetin, Gallic acid Ferulic acid and Isorhamnetin have potent antioxidant and anti-inflammatory activities (Javed, Jabeen, Aslam, & Awan, 2020) (Chirumbolo, 2014). Plants are reservoirs of natural chemicals with structurally diverse bioactive moieties. The extraction of bioactive compounds from various plant parts, as well as their qualitative and quantitative evaluation, is critical for discovering new biomolecules that can be used directly by pharmaceutical and agrochemical industries, or as a lead molecule to synthesize more potent molecules for the treatment of various diseases.

4.4. Threats to Floral Diversity of Cholistan Desert

The Cholistan desert owns high density of the human and cattle population. Industrialization, agriculture practices and infrastructure developments lead towards the degradation of natural floral diversity of Cholistan desert. Moreover, inhabitants use local flora to meet their basic needs for fuel, fodder and construction of houses and huts (Hameed et al., 2011). Plants like *Calligonum polygonoides*, *Caralluma edulis* are being used extensively and they are now under endangered category. Local inhabitants mostly use plant remedies for the treatment of diseases due to their low cost and negligible side effects (Kavishankar, Lakshmidivi, Murthy, Prakash, & Niranjana, 2011). As a result of the

loss of phytodiversity, natural habitat conservation, traditional ecological knowledge promotion, and documentation of medicinally valuable floral species are all urgently needed.

4.5. Strategies for Sustainable Exploration and Conservation of Medicinal Plants

Material collectors and herb dealers, local traders, herbal practitioners, distributors, and medicine makers are all active in the medicinal plant industry in the Cholistan desert. Medicinal plants play an essential role in the discovery of new pharmaceuticals, with an estimated 70 percent of allopathic medicines deriving directly or indirectly from plant ingredients (Verma and Singh, 2008). Sustainable farming and improved cultivation practices of medicinally significant plants may play a key role in reducing over-exploitation of these rich natural resources while simultaneously satisfying increased demand for these plants on national and international markets. *Acacia nilotica*, *Zizyphus mauritiana*, *Abutilon muticum*, *Calligonum polygonoides*, and other medicinally significant plants are being worked on by a number of groups. Many other native plants, on the other hand, are still not protected, and policymakers, the forest service, and the government should take action to protect these natural resources. Traditional ecological knowledge of tribes and residents of the Cholistan desert must be utilized for long-term medicinal plant study, and farmers participating in medicinal plant cultivation in the region should be given incentives.

5. Conclusion

The review indicated that 152 plant species belonging to 38 families composed the major flora of Cholistan desert in Pakistan; out of which 83 species are reported to have anti-inflammatory potential which is backed by the presence of different phytochemicals isolated or purified from these plants. This review provides baseline data about the flora of Cholistan region of Pakistan with anti-inflammatory potential but more comprehensive studies related to these compounds will enhance pharmaceutical exploration and help in better and new medicinal or pharmacological formulations to treat and manage inflammatory diseases.

Table 1

Plants of Cholistan Desert with Anti-inflammatory Potential

Plant Names	Common Names	Plant Part(s) Used	Models for Pharmacologic Evaluation
Aizoaceae Gisekia pharnaceoides (Linn.)	Baluka Sag (Wariss et al., 2014)	Whole plant (Wariss et al., 2014)	Carragennan-induced paw edema (Gandhimathi, Sathiyasekaran, Perumal, & Rose, 2011)
Trianthema portulacastrum (Linn.)	Wisah (Rehman et al., 2015)	Whole plant (Mandal & Bishayee, 2015)	Anti-inflammatory activity by estimating expressions of intratumor COX-2 (Mandal & Bishayee, 2015), HRBC membrane stabilization assay, Albumin denaturation and Proteinase inhibitory assay (E. Yadav, Singh, Yadav, & Verma, 2018)
Trianthema triquetra Rottler. ex. Willd	Choti Ulwaiti (Rehman et al., 2015)	Whole plant (Sathyaraj & Indumathy, 2020)	Carragennan-induced paw edema (Sathyaraj & Indumathy, 2020)
Amaranthaceae Aerva javanica (Burm. f.) Juss	Bui (Wariss et al., 2014)	Leaves, Stem (A. W. Khan et al., 2012) (Elaseed, Mohamed Osman, & Ahmed, 2015)	Anti-inflammatory activity by enzyme inhibition assay (A. W. Khan et al., 2012), Carragennan-induced paw edema (Elaseed et al., 2015)
Amaranthus graecizans subsp. thellungianus	Bui (Rehman et al., 2015)	Whole plant (Ishtiaq et al., 2017)	Carragennan-induced paw edema (Ishtiaq et al., 2017)
Amaranthus viridis (Linn.)	Chilaka Thotakura (B. Kumar et al., 2011)	Whole plant (B. Kumar et al., 2011), Seeds (Kaur, Dhuna, Kamboj, Agrewala, & Singh, 2006)	Protein denaturation assay (Kaur et al., 2006)
Digera muricata (L.) Mart	Tandula (Rehman et al., 2015)	Whole plant, Roots, Seeds (N. Sharma, Tanwer, & Vijayvergia, 2011)	Carragennan-induced paw edema (N. Sharma et al., 2011)
Asclepiadaceae Calotropis procera subsp. hamiltonii	Aak (Wariss et al., 2014)	Latex (V. Kumar & Basu, 1994), Leaves, Flower (Wariss et al., 2014) (Mossa et al., 1991)	Carragennan-induced paw edema (V. Kumar & Basu, 1994), (Mossa et al., 1991)
Caralluma edulis	Seetu, Pippun	Whole plant (Minhas et al., 2018)	Carragennan, xylene and formalin-induced edema test

(Edgew.) Hook. f.	(Minhas, Khan, & Ansari, 2018)		(Minhas et al., 2018)
Leptadenia pyrotechnica (Forssk.) Decne	Khip (Wariss et al., 2014)	Whole plant, Seeds, Flowers (Wariss et al., 2014) (Rehman et al., 2015)	Carragennan-induced rat paw edema, Acetic acid-induced ulcerative colitis (Saleh Ibrahim Alqasoumi, Soliman, Awaad, & Donia, 2012)
Oxystema esculentum (Linn. f.) R.	Dudhani (Wariss et al., 2014)	Whole plant (D. J. Pandya & Anand, 2011)	Ethanol-induced ulcer (D. J. Pandya & Anand, 2011)
Asphodelaceae	Piazi (Rehman et al., 2015)	Aerial parts (Eddine, Segni, & Ridha, 2015)	Carragennan-induced paw edema (Eddine et al., 2015) (Laouini, Khelef, Ladjel, & Ouahrani, 2015)
Asphodelus tenuifolius Cav.			
Echinops echinatus Roxb	Unt katara (Wariss et al., 2014)	Whole plant, Root (Wariss et al., 2014)	Carragennan, formalin and CFA- induced inflammation assay (Bupinder Singh, Gambhir, Pandey, & Joshi, 1989)
Eclipta alba Hassk	Bhangra (Wariss et al., 2014)	Whole plant, Root (Wariss et al., 2014)	Carragennan, histamin and serotonin-induced edema, Cotton pellet-induced ear edema (S. S. Kumar, Sivakumar, Chandrasekar, & Suresh, 2005)
Asteraceae	Bhattal, Dudhkal (Wariss et al., 2014)	Whole plant (Wariss et al., 2014)	Carragennan and formalin-induced paw edema (Nivsarkar, Mukherjee, Patel, Padh, & Bapu, 2002)
Launaea nudicaulis Less.			
Launaea resedifolia (Linn.) O. Kuntz	Jangli booti (Auzi, Hawisa, Sherif, & Sarker, 2007)	Whole plant (Auzi et al., 2007)	Carragennan-induced paw edema (Auzi et al., 2007)
Oligochaeta ramosa (Roxb.) Magenitz.	Barim Dandi (Zaidi et al., 2012)	Aerial parts (Zaidi et al., 2012)	H. pylori induced ulcer (Zaidi et al., 2012)
Pulicaria crispa (Cass.) Benth. & Hook. f.	Bui (Wariss et al., 2014)	Aerial Parts (Fahmi et al., 2019)	Ethanol- induced ulcer (Fahmi et al., 2019)
Xanthium strumarium (Linn.)	Cocklebur, Leedha (Wariss et al., 2014)	Fruit (T Han et al., 2007), Leaves (Kim et al., 2005)	Corton oil-induced ear edema (T Han et al., 2007), Carragennan-induced paw edema (Kim et al., 2005)
Boraginaceae	Ratanjot (B Singh, Sharma, Meghwal, Sahu, & Singh, 2003)	Aerial parts (B Singh et al., 2003)	Carrageenan-induced paw edema and CFA-induced chronic arthritis (B Singh et al., 2003)
Arnebia hispidissima (Lehm.) A. DC.			
Heliotropium strigosum Willd. Subsp.	Go lakh Pan (Hussain et al., 2010)	Whole Plant (H. Khan, Khan, Gul, Hussain, & Ashraf, 2015), Juice (Hussain et al., 2010)	Carrageenan-induced paw edema, Xylene-induced ear edema (H. Khan et al., 2015)
Brassicaceae	Fareed Buti, Lathia (Wariss et al., 2014)	Aerial parts (Hayat & Uzair, 2019)	In vitro Lipoxigenase enzyme inhibitory assay (Hayat & Uzair, 2019)
Farsetia hamiltonii Royle			
Caesalpiniaceae	Deasi Sana (S. Jain, Jain, Sharma, & Capasso, 1997)	Whole plant (S. Jain et al., 1997)	Carrageenan-induced paw edema (S. Jain et al., 1997)
Cassia italica (Mill.) F.W.Andr. subsp.			
Capparidaceae	Karir (Perianayagam, Sharma, & Pillai, 2008)	Root Bark (Perianayagam et al., 2008)	Carrageenan-induced paw edema (Perianayagam et al., 2008)
Capparis decidua (Forsskal.) Edgew			
Capparis spinosa (Linn.)	Kubber (Al-Said, Abdelsattar, Khalifa, & El-Feraly, 1988)	Whole plant (Al-Said et al., 1988)	Carrageenan-induced paw edema (Al-Said et al., 1988)
Cleome brachycarpa Vahl. ex. DC	Noli, Kastoori (Wariss et al., 2014)	Whole plant (Naeem et al., 2019)	Carrageenan-induced paw edema (Naeem et al., 2019)
Cleome scaposa DC.	Noli, Kastoori (Wariss et al., 2014)	Leaves (Shaheen, Ahmed, Azhar, & Hasan, 2013)	Carrageenan-induced paw edema (Shaheen et al., 2013)
Cleome viscosa (Linn.)	Talwani (Mali, 2010)	Whole plant, roots, seeds (Mali, 2010)	Carrageenan, histamine and dextran-induced paw edema (Mali, 2010)
Caryophyllaceae	Marina (Kong, 2014)	Whole plant (Kong, 2014)	Cotton pellete- induced granuloma, Anti-inflammatory activity by LPS stimulated RAW 264.7 cells (Kong, 2014)
Spergularia marina (Linn.) Griseb.			
Chenopodium album (Linn.)	Bathu (Wariss et al., 2014)	Aerial parts (S. K. Arora, Itankar, Verma, Bharne, & Kokare, 2014)	TPA-induced ear edema (Usman et al., 2010), Anti-inflammatory activity by LPS stimulated RAW 264.7 cells (Amodeo et al., 2019), CFA-induced chronic

Chenopodium murale (Linn.)	Kruid (Wariss et al., 2014)	Aerial parts (L. Ibrahim et al., 2007)	arthritis (S. K. Arora et al., 2014)
Chenopodiaceae	Lana (Wariss et al., 2014)	Whole plant (Saleh Ibrahim Alqasoumi et al., 2012)	Carrageenan-induced paw edema (L. Ibrahim et al., 2007)
Haloxylon salicornicum (Moq.) Bunge.			Carrageenan-induced paw edema, Acetic acid-induced ulcerative colitis (Saleh Ibrahim Alqasoumi et al., 2012), (Ullah et al., 2019)
Haloxylon stocksii (Boiss.) Benth. & Hook	Khar, Sajji (Wariss et al., 2014)	Whole plant (Peerzada et al., 2020)	Carrageenan-induced paw edema (Peerzada et al., 2020)
Salsola imbricata Forssk. var. imbricata	Lani (Wariss et al., 2014)	Whole plant (Aslam & Janbaz, 2017), Leaves (Osman, El Kashak, Wink, & El Raey, 2016)	Anti-inflammatory activity by LPS stimulated RAW 264.7 cells (Osman et al., 2016)
Suaeda fruticosa Forssk. ex J. F. Gmelin	Kali Lani (Rehman et al., 2015)	Aerial parts (Oueslati et al., 2012), Leaves (Mzoughi et al., 2018)	Anti-inflammatory activity by LPS stimulated RAW 264.7 cells (Oueslati et al., 2012), Carrageenan-induced paw edema (Mzoughi et al., 2018)
Convulvaceae	Oin (Wariss et al., 2014)	Aerial parts (H. M. I. Abdallah et al., 2017)	Carrageenan-induced paw edema (H. M. I. Abdallah et al., 2017), Cotton pellete-induced granuloma, CFA-induced arthritis (Sunita, Jha, & Pattanayak, 2011)
Cressa cretica (Linn.)			Carrageenan-induced paw edema (Marzouk et al., 2010), Carrageenan-induced granuloma (Rajamanickam et al., 2010)
Cucurbitaceae	Kor Tumma (Wariss et al., 2014)	Aerial parts (Marzouk et al., 2010), Leaves (Rajamanickam, Gurudeeban, Ramanathan, & Satyavani, 2010)	Carrageenan-induced paw edema (Marzouk et al., 2010), Carrageenan-induced granuloma (Rajamanickam et al., 2010)
Citrullus colocynthis (Linn.)			
Cucumis melo var.	Chibbar (Ezzat, Raslan, Salama, Menze, & El Hawary, 2019)	Fruit (Ezzat et al., 2019)	Carrageenan-induced paw edema (Ezzat et al., 2019)
Mukia maderaspatana (Linn.) M.J. Roem.	Gwala Kakri (Kousalya, Priya, & Venkatalakshmi, 2020)	Whole plant (Kousalya et al., 2020)	Protein denaturation assay (Kousalya et al., 2020)
Cyperaceae	Deela (Rehman et al., 2015)	Roots (Rocha et al., 2020) (Dang, Parekar, Kamat, Scindia, & Rege, 2011)	Carrageenan-induced paw edema, Formaldehyde-induced arthritis (Biradar, Kangralkar, Mandavkar, Thakur, & Chougule, 2010), TPA-induced skin inflammation (Rocha et al., 2020), Acetic acid-induced peritonitis (Dang et al., 2011)
Cyperus rotundus (Linn.)			Carrageenan-induced paw edema, Cotton-pellete-induced granuloma (Yaseen et al., 2020)
Ephedraceae	Phog (Yaseen et al., 2020)	Whole plant (Yaseen et al., 2020)	Carrageenan-induced paw edema, Cotton-pellete-induced granuloma (Yaseen et al., 2020)
Ephedra ciliata Fisch.			
Euphorbiaceae	Hazar Dani (S. Ahmad, Perveen, Arshad, & Rehman, 2018)	Whole plant (S. Ahmad et al., 2018)	Acetic acid-induced ulcerative colitis (S. Ahmad et al., 2018)
Euphorbia granulata Forssk.			
Euphorbia prostrata Ait.	Hazar Dani (Wariss et al., 2014)	Whole plant (Singla & Pathak, 1989)	Carrageenan, histamine, bradykinin-induced paw edema (Singla & Pathak, 1989)
Malvaceae	Gidarwar (Tripathi, Chauhan, & Patel, 2012)	Leaves (Rajurkar, Jain, Mataka, Aswar, & Khadbadi, 2009), Whole plant (Tripathi et al., 2012)	HRBC membrane stabilization assay (Rajurkar et al., 2009), Carrageenan-induced paw edema (Tripathi et al., 2012)
Abutilon indicum (Linn.)			
Abutilon muticum (Del.ex DC.)	Kanghi booti (Wariss et al., 2014)	Whole plant (Bhajipale, 2013)	Carrageenan-induced paw edema, Ethanol-induced ulcer, HRBC membrane stabilization assay, Protein denaturation assay (Bhajipale, 2013)
Mimosaceae	Banwali (Wariss et al., 2014)	Root bark (Ashfaq et al., 2016)	Carrageenan-induced paw edema (Ashfaq et al., 2016)
Acacia jacquemontii Benth.			
Acacia nilotica (Linn.) Delile	Kikar (Wariss et al., 2014)	Root bark (Safari et al., 2016)	Formaldehyde-induced paw edema (Safari et al., 2016)
Prosopis cineraria (Linn.)	Jand, Jandi (Wariss et al., 2014)	Leaves (E. Yadav et al., 2018)	Protein denaturation assay (E. Yadav et al., 2018)
Prosopis juliflora (Swartz) DC.	Maskit, Babul (SivaKumar et al., 2009)	Root bark (SivaKumar et al., 2009)	Carrageenan, histamine, serotonin-induced paw edema (SivaKumar et al., 2009)
Molluginaceae	Padi (Sadique, Chandra, Thenmozhi, & Elango, 1987)	Whole plant (Sadique et al., 1987)	Carrageenan-induced paw edema, Cotton pellete-induced granuloma, HRBC membrane stabilization assay (Sadique et al., 1987)
Mollugo cerviana (L.) Seringe			
Mollugo nudicaulis Lamk	Pita, Gohun (Sahu, Das, Tripathy,	Whole plant (Lee, Son, Kim, Kim, & Kim, 2019)	Carrageenan-induced paw edema, Cotton pellete-induced granuloma (Sahu et al., 2011), MIA-induced osteoarthritis (Lee et al., 2019)

Nyctaginaceae	Sundeepkumar, & Banerjee, 2011)		
<i>Boerhavia procumbens</i> Banks ex Roxb.	Bishkhira (Rehman et al., 2015)	Whole plant (Bokhari, Khan, & Haq, 2016)	Carrageenan-induced paw edema (Bokhari et al., 2016)
<i>Boerhavia repens</i> (Linn.)	Bishkhapara (Wariss et al., 2014)	Whole plant (Dey, Abu, Shakar, Rahman, & Amin, 2012)	Carrageenan-induced paw edema (Dey et al., 2012)
Orobanchaceae	Phaphorr (Jia et al., 2014)	Whole plant (Jia et al., 2014)	DSS-induced colitis (Jia et al., 2014), Anti-inflammatory activity by LPS stimulated RAW 264.7 cells (Kyung et al., 2012)
<i>Cistanche tubulosa</i> (Schrenk) Hook. f.			
Oxalidaceae	Khatti Buti (Srikanth, Swetha, & Veeresh, 2012)	Whole plant (Juvekar, Sakat, Wankhede, Juvekar, & Gambhire, 2009)	Ethanol-induced ulcer, Albumin denaturation assay, HRBC membrane stabilization assay (Srikanth et al., 2012), Carrageenan-induced paw edema, Cotton pellete-induced granuloma (Juvekar et al., 2009)
<i>Oxalis corniculata</i> L.			
Papilionaceae	Jawahar, Jhansa (Wariss et al., 2014)	Whole plant (E. Shaker, Mahmoud, & Mnaa, 2010)	Aspirin-induced ulcer (E. Shaker et al., 2010), Formalin-induced paw edema (Neamah, 2012)
<i>Alhagi maurorum</i> Medic			
<i>Crotalaria burhia</i> Buch.-Ham. ex Benth.	Chag, Khip (Kataria, Shrivastava, Kaur, & Sharma, 2012)	Whole plant (Kataria et al., 2012)	Carrageenan-induced paw edema (Kataria et al., 2012), Cotton pellete-induced granuloma (Talaviya, Vyas, Sharma, Indoria, & Suman, 2014)
<i>Indigofera argentea</i> (Burm. f.)	Neel (Javed et al., 2020)	Whole plant (Javed et al., 2020)	Carrageenan-induced paw edema, HRBC membrane stabilization assay (Javed et al., 2020)
<i>Melilotus officinalis</i> (Linn.) Pall.	Sinji (Rehman et al., 2015)	Whole plant (Liu et al., 2018)	Anti-inflammatory activity by LPS stimulated RAW 264.7 cells (Liu et al., 2018)
<i>Rhynchosia capitata</i> (Heyne ex Roth) DC	Jumby Bean (Rammohan, Reddy, Bhaskar, Gunasekar, & Zyryanov, 2020)	Whole plant (Rammohan et al., 2020)	LPS-enhanced leukocyte migration assay (Rammohan et al., 2020)
<i>Tephrosia purpurea</i> (Linn.) Pers.	Jhill (Rehman et al., 2015)	Whole plant (Shenoy et al., 2010), Seeds (Anbarasi & Vidhya, 2015)	Carrageenan-induced paw edema, Cotton pellete-induced granuloma (Shenoy et al., 2010), HRBC membrane stabilization assay, Protein denaturation assay (Anbarasi & Vidhya, 2015)
Poaceae	Dhaman (P. Singariya, P. Kumar, & K. Mourya, 2012)	Whole plant (Premlata Singariya et al., 2012)	Anti-inflammatory activity by COX-1 and COX-2 assay (Premlata Singariya et al., 2012)
<i>Cenchrus ciliaris</i> (Linn.)			
<i>Cenchrus setigerus</i> Vahl	Dhaman (P. Singariya, P. Kumar, & K. Mourya, 2012)	Whole plant (P Singariya et al., 2012)	Anti-inflammatory activity by COX-1 and COX-2 assay (P Singariya et al., 2012)
<i>Cynodon dactylon</i> (Linn.) Pers.	Khabbar, Talla (Garg & Paliwal, 2011)	Whole plant (Garg & Paliwal, 2011)	Carrageenan, histamine, serotonin, dextran-induced paw edema (Garg & Paliwal, 2011)
<i>Panicum turgidum</i> Forssk.	Murrot (A. A. Zaki, Ali, El-Amier, & Khan, 2016)	Aerial parts (A. A. Zaki et al., 2016)	Anti-inflammatory activity by LPS stimulated RAW 264.7 cells (A. A. Zaki et al., 2016)
<i>Sacharum spontaneum</i> (Linn.)	Sachi Sir (Lapuz et al., 2016)	Root bark (Lapuz et al., 2016)	Carrageenan-induced paw edema (Lapuz et al., 2016)
<i>Stipagrostis plumosa</i> (Linn.)	Burkil (Abdelkader, Orabi, Shama, & Assaf, 2016)	Aerial parts (Abdelkader et al., 2016)	Carrageenan-induced paw edema (Abdelkader et al., 2016)
Polygonaceae	Phog (Wariss et al., 2014)	Whole plant (Wariss et al., 2014)	Anti-inflammatory activity by LPS stimulated RAW 264.7 cells (Swarnkar, Khunteta, Gupta, Jain, & Paliwal, 2019)
<i>Calligonum polygonoides</i> (Linn.)			
Portulacaceae	Lonak (Wariss et al., 2014)	Whole plant (Chan et al., 2000)	Carrageenan-induced paw edema (Chan et al., 2000)
<i>Portulaca oleracea</i> (Linn.)			
Rhamnaceae	Beri (E. M. Abdallah, 2016)	Leaves (E. M. Abdallah et al., 2016)	Carrageenan-induced paw edema (E. M. Abdallah et al., 2016)
<i>Zizyphus</i>			

mauritiana Lam.	Elsharkawy, & Ed-dra, 2016)		
Zizyphus nummularia (Burm. f.)	Beri, Ber (S. D. Ray, Ray, Zia-Ul-Haq, De Feo, & Dewanjee, 2015)	Root bark (S. D. Ray et al., 2015), Leaves (Goyal, Ghosh, Nagori, & Sasmal, 2013)	Anti-inflammatory activity by LPS stimulated RAW 264.7 cells, Xylene-induced ear edema, Cotton pellete-induced granuloma (S. D. Ray et al., 2015), Carrageenan, dextran, histamine, serotonin-induced paw edema, Carrageenan-induced peritonitis (Goyal et al., 2013)
Zizyphus spinachristi (Linn.)Willd.	Beri (Alhakmani, Khan, & Ahmad, 2014)	Fruit, Seeds (Alhakmani et al., 2014)	Protein denaturation assay (Alhakmani et al., 2014)
Salvadoraceae Salvadora oleoides Decne	Jal, Pilu, Wan (Wariss et al., 2014)	Leaves (Natubhai, Pandya, & Rabari, 2013)	Carrageenan, histamine, serotonin-induced paw edema (Natubhai et al., 2013)
Solanaceae Nicotiana plumbaginifolia Viv.	Jangli Tambakoo (Rehman et al., 2015)	Leaves (Shajib et al., 2018)	Carrageenan, formalin-induced paw edema (Shajib et al., 2018)
Withania coagulens (Stocks)	Paneer (Rehman et al., 2015)	Fruit (R. Jain, Kachhwaha, & Kothari, 2012)	Cotton pellete-induced granuloma, Formalin-induced arthritis (R. Jain et al., 2012)
Withania somnifera (Linn.)	Aksen (Wariss et al., 2014)	Roots (Giri, 2016)	Carrageenan-induced paw edema, CFA-induced arthritis (Giri, 2016)
Tamaricaceae Tamarix aphylla (Linn.)	Ukhan, Moora (Wariss et al., 2014)	Whole plant (Abo-Dola, Lutfi, Bakhiet, & Mohamed, 2015)	Carrageenan-induced paw edema, Cotton pellete-induced granuloma, HRBC membrane stabilization assay (Abo-Dola et al., 2015)
Tamarix dioica Roxb. ex Roch	Lai (Wariss et al., 2014)	Whole plant, flower (Iqbal, Din, Bakht, Khan, & Shah, 2019)	Carrageenan-induced paw edema, Xylene-induced ear edema (Iqbal et al., 2019)
Tiliaceae Corchorus depressus (Linn.) Stocks	Bao Phali (Wariss et al., 2014)	Root (Bhatt et al., 2019)	Albumin denaturation assay (Bhatt et al., 2019)
Zygophyllaceae Fagonia schweinfurthii	Dhman (Saleh I Alqasoumi, Yusufoglu, & Alam, 2011)	Whole plant (Saleh I Alqasoumi et al., 2011)	Carrageenan-induced paw edema (Saleh I Alqasoumi et al., 2011)
Peganum harmala (Linn.)	Harmal (Khlifi et al., 2013)	Seeds (Khlifi et al., 2013)	Anti-inflammatory activity by LPS stimulated RAW 264.7 cells (Khlifi et al., 2013)
Tribulus terrestris (Linn.)	Gokshur (Chhatre, Nesari, Somani, Kanchan, & Sathaye, 2014)	Whole plant (Chhatre et al., 2014)	Carrageenan-induced paw edema, Anti-inflammatory activity by LPS stimulated RAW 264.7 cells (Chhatre et al., 2014)
Zygophyllum simplex (Linn.)	Alethi, Lonak (Kakrani, Kakrani, & Saluja, 2011)	Aerial parts, Flowers (Kakrani et al., 2011)	Carrageenan-induced paw edema (Kakrani et al., 2011)

Table 2
Plants with their Isolated or Identified Phytochemicals

Plant Names	Identified/ Isolated Compound
Aizoaceae Gisekia pharnaceoides (Linn.)	Dimethoxyflavone derivatives (N. Khalid, Choudhary, Uzair, Imran, & Qaisar, 2018), Kaempferol (Gandhimathi et al., 2011)
Trianthema portulacastrum (Linn.)	Dimethylflavone, Leptorumol (Kokpol et al., 1997), Trianthenol (Nawaz, Malik, & Ali, 2001), β -sitosterol, Stigmasterol (Moawad et al., 2020), Kaempferol-3-O-6''-O-E-feruloyl- β -D-glucopyranosid (Abuzaid et al., 2020)
Trianthema triquetra Rottler. ex. Willd	N/A
Amaranthaceae Aerva javanica (Burm. f.) Juss	3-hydroxy-4 methoxybenzaldehyde, Ursolic acid, acryl amide (A. W. Khan et al., 2012), Kaempferol galactoside derivatives, p-coumaric acid, Caffeic acid, Gallic acid, Hexacosyl ferulate (Mussadiq et al., 2013), Steriod, Ecdysteroids derivatives (Saleem et al., 2013), Aervfuranoside (Musaddiq et al., 2017)
Amaranthus subsp. thellungianus	N/A
Amaranthus viridis (Linn.)	Quercetin, Lutein, Rutin, β -carotene, Squalene, Spinasterol, Trilinolein, Polyprenol, Phytol (Ragasa, Austria, Subosa, Torres, & Shen, 2015), Triacontanol, Palmitic acid, Cycloeucaenol, Oleanolic acid (Hue et al., 2017), Ferulic acid, Chlorogenic acid, Gulonic acid, Kaempferol (Kumari, Elancheran, & Devi, 2018)

Digera muricata (L.) Mart	Cyclohexanol, Tridecanoic acid, Benzyl benzoate, Eicosenoic acid, Isopropyl myristate, Hexadecanoic acid, Octadecanoic acid (Ramalashmi, 2019), Rutin, Hyperoside (Ghaffar, Tung, Rahman, Nadeem, & Idrees, 2019)
Asclepiadaceae	Dimethoxyflavone-4'-O- β -glucopyranoside, β -dihydroxy-19-methoxy-5 α -card-20(22)-enolide, β -anhydroepidigitoxigenin-3 β -O-glucopyranoside, Uzaringenine, β -anhydroepidigitoxigenin (K. H. Shaker, Morsy, Zinecker, Imhoff, & Schneider, 2010), Calotropoceryl acetate derivatives, Taraxasterol, Stigmasterol, Octadec-7-enoic acid (S. R. Ibrahim et al., 2012), Quercetin, Kaempferol, Isorhamnetin, Glucopyranosides (Nenaah, 2013), Cardenolides calactin, Afroside, Uscharin, Calotoxin, 12 β -hydroxycoroglaucigenin, Calactoprocin, Procegenin A, Procegenin B (Mohamed et al., 2015), Proceraside (S. R. Ibrahim et al., 2014)
Caralluma edulis (Edgew.) Hook. f.	N/A
Leptadenia pyrotechnica (Forssk.) Decne	Kaempferol, Polyoxypregnane derivatives (Youssef Moustafa, Khodair, & Saleh, 2009), Gallic acid, Vanillic acid, Caffeic acid, Epicatechin, Quercetin, Vernolic acid, Phytol, Squalene, Taraxerol, β -sitosterol, Pregnane glycosides derivatives, Isorhamnetin (Verma, Jha, Chaudhary, Singh, & Kumar, 2014)
Oxystelma esculentum (Linn. f.) R.	Lupeol, Kaempferol (D. J. Pandya & Anand, 2011), Epicatechin (D. Pandya & Anand, 2013), Polyhydroxypregnane glycosides (A. I. Hamed et al., 2004), Oxysine (Trivedi, Khare, & Khare, 1989), Oxyline (Srivastava, Khare, & Khare, 1991), Stigmasterol (Devang & Indermeet, 2011)
Asphodelaceae	trans-N-feruloyltyramine, Luteolin, Apigenin, Chrysoeriol (Faidi et al., 2014), Glucopyransoylbianthrone (Khalfaoui et al., 2018), Asphorodin (Safder et al., 2009), Asphorins (Safder et al., 2012)
Echinops echinatus Roxb	D-glucopyranoside (Yadava & Singh, 2006), Echinacin, Echinaticin (U. Singh, Pandey, Singh, & Singh, 1988), Apigenin 7-O- β -D-glucoside (Chaudhuri & Thakur, 1986), 7-hydroxyechinazolinone (Chaudhuri, 1992), Echinopsine, Echinopsidine, Echinazolinone (Chaudhuri, 1987), Echinocide, Kaempferol, Myrecetin (S. Singh, Upadhyay, Pandey, Singh, & Pandey, 2006), Taraxasterol acetate (Sing, Ram, Pandey, Joshi, & Gambhir, 1991)
Eclipta alba Hassk	Luteolin (Tambe et al., 2017), Eclalbasaponin (A. Ray, Bharali, & Konwar, 2013), Wedelolactone, Demethylwedelolactone (Diogo et al., 2009), 2-thiophene carbaldehyde, Dodecanoic acid, 9-octadecenamide, Loliolide (Naik, Gurushanthaiah, Kavimani, & Mahesh, 2019), Lanosteroid (Tomer et al., 2009)
Asteraceae	Scopoletin, Lupeol, β -amyrin, β -sitosterol, D-glucopyranoside, Stigmasterol, Hydroxyflavone, Methoxyflavone, Kaempferol (Mansoor & Anis, 2013), Cholistaqiunate, Trideca-12-ene-4,6-diene-2,8,9,10,11-pentaol, Cholistafaside, Nudicholoid (Saleem et al., 2012), Nudicaulin A, B, C, D, Elaidic acid, Oleanolic acid, Apigenin (Riaz et al., 2012), DL-Limonene, β -ocimene, L-Linalool, Citronellal, Citronellyl acetate, trans-caryophyllene, Germacrene B (Al-Mahrezi et al., 2011)
Launaea nudicaulis Less.	Apigenin, Luteolin (Moussaoui, Zellagui, Segueni, Touil, & Rhouati, 2010), Cichoriin, Esculetin, Scopoletin, Isoscopoletin (Rhouati, Ahmed, & Ouahrani, 2006)
Launaea resedifolia (Linn.) O. Kuntz	N/A
Oligochaeta ramosa (Roxb.) Magenitz.	N/A
Pulicaria crispa (Cass.) Benth. & Hook. f.	Guaianolide sesquiterpenes derivatives (Stavri et al., 2008), Sesquiterpene lactones (Dendougui, Benayache, Benayache, & Connolly, 2000), 2-isopropyl-4-methylphenol, Isobutyric acid 2-isopropyl-4-methylphenylester (Ezoubeiri et al., 2005), Heneicosane, Tetratriacontane, Heptacosane (Elshiekh & Mona, 2005)
Xanthium strumarium (Linn.)	Caffeic acid, Quinic acid derivatives, Xanthiazone (Ma, Huang, Hsu, & Chang, 1998), Xanthatine (Nibret, Youns, Krauth-Siegel, & Wink, 2011), 7-caffeoylquinic acid, Chlorogenic acid, Protocatechuic acid, Raffinose, Neochlorogenic acid methyl ester (H. N. Yoon, Lee, Kim, Suh, & Lim, 2013), Caffeoylxanthiazonoside (Peng et al., 2014), Ferulic acid, Formononetin, 7-hydroxymethyl-8,8-dimethyl-4,8-dihydrobenzotriazine-3,5-dione-11-O- β -D-glucopyranoside, Ononin (Ting Han, Li, Zhang, Zheng, & Qin, 2006), Xanthinosin, 4-oxo-bedfordia acid (J. H. Yoon et al., 2008)
Boraginaceae	Shikonin derivatives (B Singh et al., 2003), Arnebacene, Arnebidin, Vanillic acid (Ahmed, Saad, & El-Karim, 2014), Naphthaquinones derivatives (B Singh, Sahu, Jain, & Singh, 2004)
Arnebia hispidissima (Lehm.) A. DC.	β -sitosterole, o-phthalic acid bis-(2-ethyl decyl)-ester, 4-hydroxybenzoic acid (Shah et al., 2014)
Heliotropium strigosum Willd. Subsp.	Squalene, Linolenic acid, Iso-leucin, Glutamic acid, Tyrosine, Glycine, Oleic acid (Hayat et al., 2015), Hexadecanoic acid derivatives, Methyl esters, Ethyl
Brassicaceae	
Farsetia hamiltonii Royle	

Caesalpinaceae		iso-allocholate (Hayat & Uzair, 2019)
<i>Cassia italica</i> (Mill.) F.W.Andr. subsp.		β -sitosterol, (22E)-3- β -hydroxycycloart-22-en-24-one, Uvaol, Daucosterol, Methyl 3,4-dihydroxybenzoate, Emodin, 4-hydroxyphenyl-O- β -D-glucopyranoside, Aloin B, Rutin (Asfour, Ibrahim, & Mohamed, 2015), Anthraquinone derivatives (Kazmi, Malik, Hameed, Akhtar, & Ali, 1994), Benzoic acid derivatives (Al-Haidari & Al-Oqail, 2020)
Capparidaceae		β -sitosterol triacontenate (Upadhyay, Ahmad, Tripathi, Rohtagi, & Jain, 2010), Stachydrine (Rathee, Rathee, Rathee, & Rathee, 2012), 14-N-acetylisocodonocarpine, 15-N-acetylcapparidine (V. U. Ahmad, Ismail, Arif, & Amber, 1992), Capparidesterpenolide, Decidua terpenolides A, B, C, D and E, Isocodonocarpine, 14-N-acetylisocodonocarpine, 15-N-acetylcapparidine (Pradeep Singh, Mishra, Srivastava, Jha, & Khosa, 2011), Simiarenol, Lupeol, Taraxerol, β -sitosterol (Anjum et al., 2020)
<i>Capparis decidua</i> (Forsskal.) Edgew		p-methoxy benzoic acid, β -carotene, Lutein, α , γ -tocopherol, Rutin (Tlili, Khaldi, Triki, & Munné-Bosch, 2010), Flazin, Guanosine, Capparidine A, B, 1H-indole-3-carboxaldehyde, 4-hydroxy-1H-indole-3-carboxaldehyde, Chrysoeriol, Apigenin, Kaempferol, Cinnamic acid, Thevetiaflavone, 5-hydroxymethylfuraldehyde, Vanillic acid (H. Zhou et al., 2010), Capparidine, Protocatechuic aldehyde, E-butenedioic acid, Syringic acid, Ethyl 3,4-dihydroxybenzoate, 5-hydroxymethylfurfural, 5-hydroxymethyl furoic acid, 2-furoic acid, protocatechuic acid, Succinic acid (Yang et al., 2010), Capparidine, Capparidine 26-O- β -D-glucoside, Cadabicine 26-O- β -D-glucoside hydrochloride (Fu et al., 2008), Isoginkgetin, Ginkgetin (H.-F. Zhou et al., 2011), g -sitosterylglucoside-6'-octadecanoate, 3-methyl-2-butenyl- g -glucoside (Khanfar, Sabri, Abu Zarga, & Zeller, 2003), Corchoionoside C, (6S,9S)-roseoside, spionoside A, B, (6S)-hydroxy-3-oxo- α -ionol glucosides derivatives (Calis, Ayse, Lorenzetto, & Ruedi, 2002)
<i>Capparis spinosa</i> (Linn.)		
<i>Cleome brachycarpa</i> Vahl. ex. DC		Cleocarpone (V. U. Ahmad, Qazi, Zia, Xu, & Clardy, 1990), 3, 5, 4` trihydroxy-3`-methoxy flavone, Roseoside, Methoxyflavone derivatives, Buchairol, Teucladiol, Quercetin, Kaempferol (Afifi, 2014), Thunbergol, α -eudesmol, Elemol, 3Z-cembrene A, 10-epi- γ -eudesmol (Rassouli, Dadras, Bina, & Asgarpanah, 2014), Brachycarpone (V. U. Ahmad & Alvi, 1986), Deacetoxybrachycarpone (V. U. Ahmad, Alvi, & Khan, 1986), Isorhamnetin 3-rutinoside, Apigenin 6,8-di-C-glucoside, Flavonoid glycosides (Sharaf, El-Ansari, & Saleh, 1997)
<i>Cleome scaposa</i> DC.		N/A
<i>Cleome viscosa</i> (Linn.)		Lactam nonanoic acid {Jana, 2011 #205}, Coumarinlignoids derivatives (N. Yadav, Chanda, Chattopadhyay, Gupta, & Pal, 2010), Visconoside C, Quercetin, Astragalin, Kaempferol (Nguyen et al., 2017), Visconoside A, B, Flavonol glycosides derivatives (Phan et al., 2016), Cleomiscosins A, B and C (A. B. Ray et al., 1985), Nevirapine (Chatterjee et al., 2013)
Caryophyllaceae		β -sitosterol glucoside, Tricin, Dihydroferulic acid, Vanillic acid, 4-hydroxybenzoic acid, Uracil, 8- hydroxy cuminoic acid, 8-hydroxy cuminoic acid, Uracil (El-Dien, Shawky, Aly, Abdallah, & Abdel-Salam, 2014), 2,4-di-tert-butylphenol, N-hexacosanoylanthranilic acid, Tryptophan, 4-hydroxybenzyl glucopyranoside, Luteolin, Apigenin (Cho et al., 2016)
<i>Spergularia marina</i> (Linn.) Griseb.		Flavonoid glycoside derivatives (DellaGreca, Di Marino, Zarrelli, & D'Abrosca, 2004), 3-hydroxy-13-apo- α -caroten, 3-oxo-13-apo- α -caroten, 16-apocarotenoid (Nahar & Sarker, 2005), β -sitosterol, Lupeol, 3-hydroxy nonadecyl heneicosanoate (Jhade, Padmaa, & Usha, 2009), Chenoalbicin (Nahar & Sarker, 2005)
<i>Chenopodium album</i> (Linn.)		
<i>Chenopodium murale</i> (Linn.)		Kaempferol derivatives, Herbacetin, Quercetin, Gallic acid, Coumarin, Scopoletin (El-Sayed, Awaad, Hifnawy, & Mabry, 1999), Trimethoxy flavone derivatives, Sitosterol, Stigmasterol (B. Ahmad & Jan, 2003)
Chenopodiaceae		Triterpenes, Alkaloids, Cycloheximide derivatives, Coumarins, Sterol derivatives (Bibi et al., 2010), Piperidine, Halosaline, Anabesine, Hordenine, N-methyltyramine, Haloxine, Aldotripiperideine, Haloxynine (El-Shazly, Dora, & Wink, 2005), 5-hydroxy-3-methoxy-4H-pyran-4-one (Gibbons et al., 2000)
<i>Haloxylon stocksii</i> (Boiss.) Benth. & Hook		N/A
<i>Salsola imbricata</i> Forssk. var. imbricata		Akebonic acid, Pseudoginsenoside, Silphioside, Boussingoside, Salsolins A, B, Hydroxyoleanolic acid (Hameed et al., 2011), Isorhamnetin glycosides, Isovanillic acid, Ferulic acid, p-hydroxy benzoic acid (Osman et al., 2016), Salisomide, Salisoflavan (Saleem et al., 2009)
<i>Suaeda fruticosa</i> Forssk. ex J. F. Gmelin		Isorhamnetin derivatives (Oueslati et al., 2014), Pectin polysaccharide (Mzoughi et al., 2018), Dopamine and tyramine derived amides (J. Khan et al., 2015)

Convolvulaceae Cressa cretica (Linn.)	Quercetin, Kampferol, Scopoletin, Caffeoylquinic acid, Creticane, Cressatetracosanoate, Cressanonacontanoic acid, Cressatetracontanoic acid, Cressatriacontanoic acid, Cressanaphthacene, Syringaresinol-h-d-glucoside (Priyashree, Jha, & Pattanayak, 2010)
Cucurbitaceae Citrullus colocynthis (Linn.) Cucumis melo var.	Cucurbitacin glycosides, Isosaponarin, Isovitexin, Isoorientin (Delazar et al., 2006), Oleic acid, Linoleic acid (Rahuman, Venkatesan, & Gopalakrishnan, 2008) Chromone derivatives, α -spinasterol, Stigmasta, β -friedoolean (S. R. Ibrahim, 2014), Cucurbitane- Triterpenoids derivatives (C. Chen, Qiang, Lou, & Zhao, 2009)
Mukia maderaspatana (Linn.) M.J. Roem.	Dichloroacetic acid, 4-methylpentyl ester, 2-Butyn-1-ol, 4-methoxy, Flavonoids, Steroids, Phenol (Gomathy, 2012)
Cyperaceae Cyperus rotundus (Linn.)	Hexahydroxyflavane, Cassigarol E, Scirpusin A, B (Tran et al., 2014), Tetrahydronaphthalin derivatives (Z. Zhou & Yin, 2012), Sesquiterpene, monoterpenes derivatives, 4-cymene (Jin, Lee, Kim, & Kim, 2011), Steroid glycosides, Khellin, Visnagin, Ammiol, Coumarin, Salicylic acid, Caffeic acid, Protocatechuic acid, Tricin, Isorhamnetin (Sayed, Mohamed, Farag, Mohamed, & Proksch, 2007), Rotunduside, Fructose-amino acid conjugate (Sayed et al., 2008)
Ephedraceae Ephedra ciliata Fisch.	N/A
Euphorbiaceae Euphorbia granulata Forssk. Euphorbia prostrata Ait.	N/A Gallic acid, Corilagin, 1,2,3-tri-O-galloyl-D-glucose, Geraniin, Tellimagradin I, II, Rugosin A, E, D G (L. Chen, Chen, & Wei, 1992), Ellagitannins derivatives (Yoshida, NAMBA, CHEN, LIU, & OKUDA, 1990)
Malvaceae Abutilon indicum (Linn.) Abutilon muticum (Del.ex DC.)	Luteolin, Chrysoeriol, Luteolin, Chrysoeriol, Apigenin, Quercetin (Matlawska & Sikorska, 2002), Alantolactone, Isoalantolactone (P. V. Sharma & Ahmad, 1989), Abutilin A, β -sitosterol, Oleanic acid, (24R)-5 α -stigmastane-3,6-dione, Daucosterol, 2,6-dimethoxy-1,4-benzoquinone, Vanillic acid (Kuo et al., 2008) Mutiniseide, Cephacoside, Lupeol, β -sitosterol, Stigmasterol, Methyl-4-hydroxybenzoate, Taraxacin, Ursolic acid (Ali et al., 2009), Pentahydroxy flavones, Benzoic acid, 1-tricosanol, Triacontyl palmitate (Shahid, Akram Kashmiri, Adnan, & Ali, 2012)
Mimosaceae Acacia jacquemontii Benth. Acacia nilotica (Linn.) Delile Prosopis cineraria (Linn.) Prosopis juliflora (Swartz) DC.	Cetyl- triacontanol, β -sitosterol, Stigmasterol (Pahup Singh, Khandelwal, Sharma, & Sharma, 2010) Umbelliferone (R. Singh et al., 2010), Niloticane (Eldeen, Van Heerden, & Van Staden, 2010), Gallocatechin 5-O-gallate, Gallic acid, Catechin, Catechin 5-O-gallate, Digallic acid, <u>Kaempferol</u> (Salem, Davidorf, & Abdel-Rahman, 2011), Catechin-5-galloyl ester, Naringenin (S. A. Khalid, Yagi, Khristova, & Duddeck, 1989) Patulitrin, Sitosterol, Spicigerine, Prosogerin A, Prosogerin B, Campesterol, Sitosterol, Stigmasterol, Spicigerine, Prosogerin C, Prosogerin D, Prosogerin E, Gallic acid, Patuletin, Patulitrin, Luteolin, Rutin (Preeti, Avatar, & Mala, 2015), Methyl 5-tridecyloctadec4-enoate, Nonacosan-8-one, Lupeol (Soni, Basak, Parasher, & Dobhal, 2015) Juliflorine, Juliprosinene, Mesquitol, Seco-juliprosopinal, Juliprosine, Isojuliprosine (M. Ibrahim, Nadir, Ali, Ahmad, & Rasheed, 2013)
Molluginaceae Mollugo cerviana (L.) Seringe Mollugo nudicaulis Lamk	N/A N/A
Nyctaginaceae Boerhavia procumbens Banks ex Roxb. Boerhavia repens (Linn.)	N/A Boerharotenoids A, B, Boeravinone derivatives (Nazir et al., 2011), Eupalitin derivatives, Kaempferol (J. Li et al., 1996)
Orobanchaceae Cistanche tubulosa (Schrenk) Hook. f.	Phenylethanoid glycosides, Syringalide A 3-O- α -L-rhamnopyranoside, Campneoside I, Iridoids, Iridoid glycosides, Phenylethyl oligosaccharides, Terpenes, Lignans (Al-Snafi, 2020)
Oxalidaceae Oxalis corniculata L.	β -sitosterol, Betulin, 4-hydroxybenzoic acid, Ethyl gallate, Methoxyflavones, Apigenin, 7-O- β -D-glucopyranoside, Vitexine derivatives, Palmitic acid, Oleic, Linoleic, Linolenic, Stearic acids (Srikanth et al., 2012), Corniculatin A (M. Ibrahim, Hussain, et al., 2013)
Papilionaceae Alhagi maurorum Medic Crotalaria burhia Buch.-	Oleanane triterpene glycosides (A. Hamed et al., 2012), Flavanenol, Isorhamnetin, Methylorobol, Quercetin (S. Ahmad et al., 2010), Lupeol (Laghari, Memon, Nelofar, & Khan, 2011) N/A

Ham. ex Benth.		
Indigofera argentea (Burm. f.)		Quercetin, Gallic acid, Caffeic acid, Chlorogenic acid, Benzoic acid, Ferulic acid, p-coumaric acid (Javed et al., 2020)
Melilotus officinalis (Linn.) Pall.		Hexadecanoic acid, Lupanone, Lupeol, Betulinic acid, Oleanolic acid, Kaempferol (Anwer, Mohtasheem, Azhar, Ahmed, & Bano, 2008), Melilofficinaside, Coumarin, Uridine, Methyl- α -D-fructofuranoside (Ilhan, Ali, Khan, & Küpeli Akkol, 2019), Azukisaponin V (S. S. Kang, Lim, & Lee, 1987), Soyasapogenols B (S.-S. Kang, Lee, & Lee, 1987)
Rhynchosia capitata (Heyne ex Roth) DC		N/A
Tephrosia purpurea (Linn.) Pers.		7,4'-dihydroxy-3',5'-dimethoxyisoflavone, Tephropurpurin, Purpurin, Pongamol, Lanceolatin B, Maackiain, Medicarpin (Chang et al., 1997), Tephrosins A, B, Tephrosone (Chang et al., 2000), Terpurinflavone, Lanceolatin A, B, Semiglabin (Juma et al., 2011), Tephropurpulin A, Isoglabratephrin, Glabratephrin (Hegazy, Abd El-Razek, Nagashima, Asakawa, & Paré, 2009), Benzofuran derivatives (Shill et al., 2015)
Poaceae		Stigmastadiene, Fagarsterol, δ 4-sitosterol-3-one, Ethyl iso-allocholate (Singariya et al., 2012)
Cenchrus ciliaris (Linn.)		Sterols and phytol derivatives (P Singariya et al., 2012), Hexadecanoic acid derivatives, Pentadecanoic acid, Octadecanoic acid, Eicosane Tetracontane (S. Arora & Kumar, 2017)
Cenchrus setigerus Vahl		
Cynodon dactylon (Linn.) Pers.		Apigenin, Luteolin (Annapurna et al., 2013), p-coumaric acid (Karthikeyan, Devadasu, & Srinivasa Babu, 2015)
Panicum turgidum Forssk.		Phenyl alkanoid glycosides and steroidal saponins derivatives (A. Zaki, El-Amier, Ali, Khan, & Khan, 2015), Paniculignan, Tetracentronside B (A. A. Zaki et al., 2016)
Sacharum spontaneum (Linn.)		3,3',4',5-tetra hydroxy-6,8-dimethoxy flavone, 3,5-dihydroxy-4'-methoxy-7-oxyglucopyronoside flavone, 3,3',4',5,7- penta hydroxy flavone (Devi & Muthu, 2015)
Stipagrostis plumosa (Linn.)		Tricin, Luteolin, Benzoic acid derivatives, Orientin-7-O-glucoside, Apigenin, Isoorientin (Hussein et al., 2018)
Portulacaceae		Portulene, Lupeol, β -sitosterol, Daucosterol (Elkhayat, Ibrahim, & Aziz, 2008), Chlorogenic, Caffeic, p-coumaric, Ferulic, Rosmarinic acids, Quercetin, Kaempferol (Erkan, 2012), Homoisoflavonoids (Yan et al., 2012), Portulacerebroside B, C, D, Portulaceramide A (Lei, Li, Liu, Zhang, & Liu, 2015), β -sitosterol, N,N`- dicyclohexylurea, Allantoin (Oyedeki, Bolarinwa, & Oladosu, 2013)
Portulaca oleracea (Linn.)		
Rhamnaceae		Mauritine L, M, Nummularines H, B, Hemsine A (Panseeta et al., 2011), Quercetin, Kaempferol, Sitosterol, Stigmasterol, Lanosterol, Diosgenin (Nag & Chouhan, 2008)
Zizyphus mauritiana Lam.		
Zizyphus nummularia (Burm. f.)		Zizynummin, Nummularine B, M, N, T, O (Kaleem, Muhammad, Khan, & Rauf, 2014)
Zizyphus spina-christi (Linn.)Willd.		Quercetin, Hyperoside, Betulinic acid, Christinin A, B, C, D, p-hydroxybenzoic acid, Kaempferol, p-coumaric acid, Apigenin, Chlorogenic acid, Syringic acid (Kaleem et al., 2014), Nummularine-U, Spinanine-B, C, Mauritine-F, Nummularine-D, E, Amphibine-D (Tuenter, Foubert, Staerk, Apers, & Pieters, 2017)
Salvadoraceae		Salvadoside, Salvadoraside, Syringin, Liriodendrin, Sitosterol, Butanediamide, Benzyl nitrile, Eugenol, Thymol, Isothymol, Eucalyptol, Isoterpinolene, β -caryophyllene, Lignin glycosides, Salvadoreua, Benzylisothiocynate (Akhtar, Siddique, Bi, & Mujeeb, 2011)
Salvadora oleoides Decne		
Solanaceae		Polymethoxylavones derivatives, Cholrogenic acid, Butyric acid (Shajob et al., 2017)
Nicotiana plumbaginifolia Viv.		
Withania coagulens (Stocks)		Withanolides, Dimeric lignan, Bispicropodophyllin glucosides, Sitosterol- β -D-glucosides (Maurya, Akanksha, & Jayendra, 2010)
Withania somnifera (Linn.)		Withanolides, β -sitosterol, Stigmasterol, β -sitosterol glucoside (Misra et al., 2008)
Tamaricaceae		Aphyllaic acid, Tamarixoic acid, Dimethyleneoxy diferulic acid, β -sitosterol (Akhlaq & Mohammed, 2011), Ellagitannin, Phyllagallin, Gallotannins, Flavogallonic acid dilactone (Orabi, Yoshimura, Amakura, & Hatano, 2015)
Tamarix aphylla (Linn.)		
Tamarix dioica Roxb. ex Roch		Tamaridone, Tamadone, p-coumarate, Gardenins A, B, C, E, Nevadensin A, Apigenin, Gardenin B, Volatile oils (Parmar et al., 1994)
Tiliaceae		Itosterol, Apigenin, Luteolin, α -amyrin derivatives, Cordepressic acid, Cordepressenic acid, Cordepressin (M. S. Khan, Javed, Khan, Shamsi, & Siddiqui, 1991), Cycloartane triterpene glycosides, Flavonol glycosides (Zahid et al., 2002)
Corchorus depressus (Linn.) Stocks		
Zygophyllaceae		N/A
Fagonia schweinfurthii		

Peganum harmala (Linn.)	Quinazoline alkaloids derivatives (S.-G. Li et al., 2018), Harmaline, Hispidin (Benarous et al., 2015), Oxamide, Harmalol (Ayoub, Rashan, Khazraji, & Adaaay, 1989)
Tribulus terrestris (Linn.)	Furostanol saponins (Wang, Ohtani, Kasai, & Yamasaki, 1997), Tribulosin, β -sitosterol-D-glucoside (Deepak et al., 2002), Steroidal saponins (Su et al., 2009), Coumaroylquinic acid derivatives (Hammoda et al., 2013), Terrestrisamide, 25R-spirost-4-en-3,12-dione, tribulusterine, N-p-coumaroyltyramine, Hecogenin, Aurantiamide acetate, Xanthosine, fatty acid ester, Ferulic acid, Vanillin, p-hydroxybenzoic acid, β -sitosterol (Wu, Shi, & Kuo, 1999)
Zygophyllum (Linn.)	simplex Isorhamnetin derivatives, Kaempferol, Sitosterol glucoside, Quinovic acid 3- α -L-rhamnoside (Hassanean & Desoky, 1992), Rutinoside, Myricitrin, Luteolin, Vanillic acid, Ferulic acid (H. M. Abdallah & Esmat, 2017), p-hydroxy benzoic acid, p-hydroxy acetophenone (Amin, El-Hawary, Fathy, Mohammed, & Khan, 2011)

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Conflicts of Interest

None

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