

Revisión / Review

Traditional medicinal uses and biological activities of species of the genus *Desmodium*: a literature review

[Usos medicinales tradicionales y actividades biológicas de las especies del género *Desmodium*: una revisión de la literatura]

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Abstract: The genus *Desmodium* includes about 350 species, distributed in tropical and subtropical regions around the world. The objective of this review was to associate the traditional medicinal uses of the genus *Desmodium* with its biological activities reported in the scientific literature. Traditional medicinal uses and biological activities were described in 56 species. More than 100 traditional medicinal uses have been reported in 43 countries, highlighting the use in inflammatory, gastrointestinal and infectious processes, muscular pain, rheumatic, renal and hepatic affections. Among the 45 biological activities experimentally evaluated, antioxidant, antimicrobial, anti-inflammatory, hepatoprotective and antinociceptive were the most reported. The species with the highest number of studies were *D. gangeticum*, *D. adscendens* and *D. styracifolium*. In conclusion, several traditional medicinal uses have been experimentally supported, demonstrating the pharmacological potential of this genus.

Keywords: *Desmodium*; Traditional uses; Biological activity; Secondary metabolites; Medicinal plants.

Resumen: El género *Desmodium* incluye alrededor de 350 especies, distribuidas en regiones tropicales y subtropicales alrededor del mundo. El objetivo de esta revisión fue asociar los usos medicinales tradicionales del género *Desmodium* con sus actividades biológicas reportadas en la literatura científica. Los usos medicinales tradicionales y las actividades biológicas fueron descritos en 56 especies. Más de 100 usos medicinales tradicionales han sido reportados en 43 países, destacándose el uso en procesos inflamatorios, gastrointestinales e infecciosos, dolores musculares, reumáticos, afecciones renales y hepáticas. Dentro de las 45 actividades biológicas evaluadas experimentalmente, las más reportadas fueron la antioxidante, antimicrobiana, antiinflamatoria, hepatoprotectora y antinociceptiva. Las especies con mayor número de estudios fueron *D. gangeticum*, *D. adscendens* y *D. styracifolium*. En conclusión, varios usos medicinales tradicionales han sido experimentalmente respaldados, demostrando el potencial farmacológico de este género.

Palabras clave: *Desmodium*; Usos tradicionales; Actividad biológica; Metabolitos secundarios; Plantas medicinales.

INTRODUCTION

The genus *Desmodium* belongs to the Fabaceae family and contains about 350 species, most of them are herbs, shrubs or sub-shrubs but rarely trees. They can be perennials or annuals. The genus is native from tropical America and it is currently widely distributed in tropical and subtropical regions of the world, such as East Asia, Mexico and South America. In recent decades this genus has been recognized for its high therapeutic value, which comes from ancient times (Tang *et al.*, 1984; Vanni, 2001; Ma *et al.*, 2011b).

Populations around the world continue using medicinal plants to relieve their health needs despite scientific advances in the fields of medicine and pharmacology. The wide use of this type of therapies in developing countries is attributed to its easy access and low cost, especially for patients with scarce resources (Bonilla *et al.*, 2014). The World Health Organization has strongly promoted the use of medicinal plants as a health-enhancing tool, but at the same time it urges the establishment of scientific bases that prove the safety and efficacy of such use (WHO, 2013).

Until 2011, more than 200 secondary metabolites have been isolated from the genus *Desmodium*. Flavonoids, alkaloids, steroids, terpenoids, phenols, phenylpropanoids, glycosides and volatile oils have been identified, which are related to specific biological activities. Alkaloids and flavonoids are considered to be mainly responsible for most of the activities shown by plants of this genus. Despite all these findings, a low amount of secondary metabolites have been evaluated to determine their biological activity (Ma *et al.*, 2011b). The purpose of this review is to associate the traditional medicinal uses of the genus *Desmodium* with their biological activities reported by scientific literature.

MATERIAL AND METHODS

This review consisted of four stages: search, appraisal, analysis and synthesis.

1. Search: bibliographic documents were obtained from digital databases such as SciELO, ScienceDirect, EBSCOhost, SpringerLink, PubMed, and Google Scholar using the following keywords "*Desmodium*", "activity", "activities", "effects", "traditional", and its translations into Spanish; in addition, Boolean

operators such as AND/OR were used. The resulting search equation was: ("*Desmodium*") AND ("activity" OR "activities" OR "effects" OR "traditional" OR "actividad" OR "tradicional"). A total of 5240 publications were initially retrieved.

2. Appraisal: the publications obtained from the search stage were selected according to their usefulness and relevance based on inclusion and exclusion criteria, the result was 535 useful publications, which were reduced to 290 once the duplicates were deleted. Inclusion and exclusion criteria are shown below:
 - Inclusion criteria: were included original articles, review articles, book chapters, academic degree work, publications released between 2010 and august 2020, publications in English and Spanish only.
 - Exclusion criteria: excludes articles that do not allow access to the full text, duplicate publications, publications that do not allow the correlation of secondary metabolites, groups of compounds or extracts with their biological activity or traditional medicinal use.
3. Analysis: the resulting 290 publications were further examined and information was extracted to correlate the relevant findings.
4. Synthesis: the results obtained were presented in narrative form accompanied by tables.

RESULTS

A total of 5240 publications were identified in the search stage using keywords and Boolean operators combined in a search equation. After applying the inclusion and exclusion criteria, the number of publications selected for the development of the review was reduced to 290 (Figure No. 1).

Traditional medicinal uses and biological activities were reported and studied in 56 species of the genus *Desmodium*. More than 100 traditional medicinal uses of this genus have been reported from a total of 43 countries. The country with the highest number of publications reporting the traditional medicinal uses of this genus was India (70), followed by China (36), Peru (13), Brazil (10), and Pakistan (10). Complete information on the traditional medicinal uses reported in the genus *Desmodium* and its parts used is presented in Table No. 1.

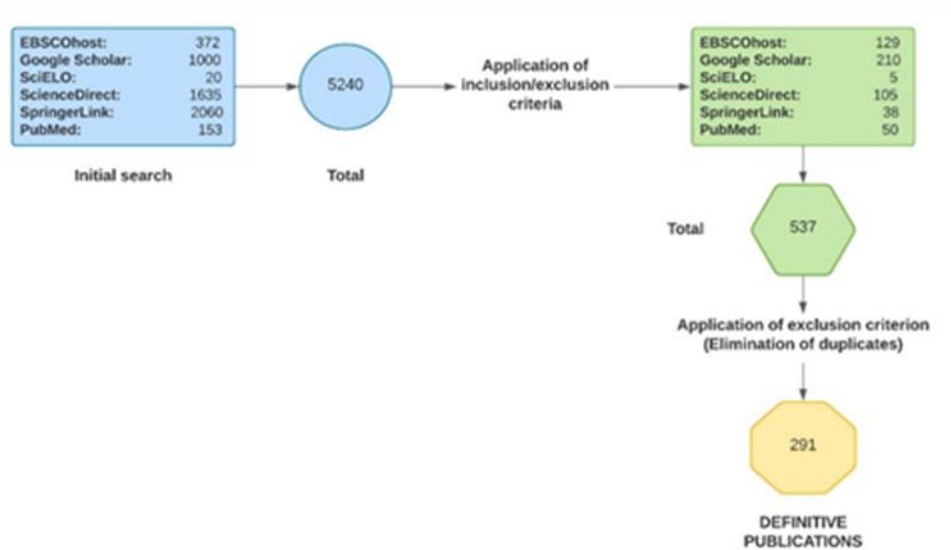


Figure No. 1
Number of publications obtained during search and appraisal stages

Table No. 1
Traditional medicinal uses of the genus *Desmodium*

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium adscendens</i> (Sw.) DC.	Nigeria	-	Muscle cramps, tendon, spinal pain, bronchitis, epilepsy, central nervous system disorders, rheumatism, jaundice, hepatitis, hepatoprotective, asthma, eczema, allergic symptoms, antispasmodic, antihypertensive.	(Seriki, 2019)
	Republic of the Congo	Leaves	Fever, pain, epilepsy.	(Muanda <i>et al.</i> , 2011a)
	Ghana	Whole plant	Asthma and other diseases associated with smooth-muscle contraction.	(Rammal & Soulimani, 2011)
	Ivory Coast	Leaves	Asthma.	(Irié-N'guessan <i>et al.</i> , 2011)
	Brazil	Leaves	Leucorrhoea, body aches, pain, ovarian inflammations, excessive urination, gonorrhoea, diarrhoea.	(Charles <i>et al.</i> , 2016)
	Africa	Leaves	Diseases associated with smooth-muscles, asthma, fever, pain, epilepsy.	
	Africa and South America	Leaves and stems	Asthma, liver related diseases.	(Chuisseu <i>et al.</i> , 2020)
	-	-	Digestive system disorders or abdominal and back pain.	
	-	-	Spasm, rheumatism, jaundice, hepatitis, asthma.	(Adinoyi, 2020)

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium adscendens</i> (Sw.) DC.	Benin	Stem	Diarrhoea, stomach aches, angina, dysentery, ulcer, gastritis, asthma, dysmenorrhoea, childbirth difficulty, early menopause, diabetes, hypertension, hepatitis, urinary infections, headache, tiredness and cancer.	(Toyigbénan <i>et al.</i> , 2018)
	Africa	-	Asthma, to aid parturition, to treat dysmenorrhoea and to improve lactation, hepatoprotective, to manage fever, pain and epilepsy.	(Baiocchi <i>et al.</i> , 2013)
	Africa	-	Asthma and diseases associated with smooth-muscles contraction.	(François <i>et al.</i> , 2015)
	Brazil	Leaves	Gonorrhoea, diarrhoea, body aches, excessive urination and ovarian inflammations.	
	France	-	Hepatoprotective supplement.	
	Africa and South America	Leaves and/or stems	Anti-inflammatory disorders, hepatitis and for the treatment of pain, fever, asthma, seizures, muscle spasms, snake bites.	(van Dooren <i>et al.</i> , 2018)
	Ghana	-	Psychosis.	(Amoateng <i>et al.</i> , 2017)
		Whole plant	Dysmenorrhoea, hemorrhoids, schizophrenia.	
		Leafy stem	Asthma and atopic asthma.	
		Leaves	Infantile diarrhoea, galactagogue, dysentery.	
	Ivory Coast	Leaves	Pregnancy care, diarrhoea, wound.	(Malan <i>et al.</i> , 2015)
	Cameroon	Young leaves	Antidote for snake venom.	(Zielińska-Pisklak <i>et al.</i> , 2015)
	Nicaragua	Young leaves	Antidote for snake venom.	
	Ghana	-	Excessive smooth muscle contraction, especially asthma.	
	Republic of the Congo	-	Analgesic, antipyretic, anticonvulsant.	
	-	Hepatoprotective, appetizer, cholagogue, vulnerary, digestive, depurative, antivomitive, choloretic, antiallergic, calming, fractures.	(Granda Calle, 2015)	
	Apical shoots	Dysentery.		
	Branches	Threatened abortion.		
	Young leaves	Antivenom.		
	Plant and root	Antidote for stings even antiophidic.		
	Roots	Colds.		
	Dry leaves	Irritated skin.		
	-	Asthma, bronchitis, central nervous system disorders, vaginal infections, promote lactation in women, wounds and sores, malaria, diarrhoea, ovarian and uterine problems.	(Adeniyi <i>et al.</i> , 2013)	
Brazil	Whole plant	Anti-inflammatory for the ovaries and/or uterus.	(Yazbek <i>et al.</i> , 2016)	
Peru	Roots	Diarrhoea, vomiting, kidney pain, ovarian inflammation, back pain.	(Valadeau <i>et al.</i> , 2010)	
	Leaves	Liver pain, boils.		

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium adscendens</i> (Sw.) DC.	Peru	Aerial parts	Symptoms of hepatitis and liver injuries.	(Roumy <i>et al.</i> , 2020)
	Belize	-	Diabetes.	(Ferrier <i>et al.</i> , 2018)
	Nicaragua	Leaves, whole plant, roots	Skin conditions.	(Giovannini <i>et al.</i> , 2016)
	Central America	-	Skin conditions, kidney diseases, urinary problems.	
	-	Leaves	Treatment of wounds, stomach ailments, and other infections.	(Lakkakula <i>et al.</i> , 2017)
	Brazil	-	Leucorrhoea, body aches, pains, ovarian inflammations, excessive urination, gonorrhoea, diarrhoea.	
	Republic of the Congo	-	Fever, pain, epilepsy.	
	Cameroon	-		
	Ghana	Leaves	Prevent respiratory infections. Wounds, bronchial asthma, constipation, dysentery.	
	Ghana	Leaves and stems	Cancer of prostate, breast, throat, brain, liver.	(Agyare <i>et al.</i> , 2018)
	Ecuador	Leaves, stems, whole plant, fruit	Leishmaniasis.	(Gachet <i>et al.</i> , 2010)
	Brazil	Whole plant	Kidney problems.	(Tribess <i>et al.</i> , 2015)
	Nicaragua	Leaves, whole plant, roots	Snake bite.	(Giovannini & Howes, 2017)
	<i>Desmodium axillare</i> (Sw.) DC.	-	-	Constipation and other gastrointestinal ailments, bronchial asthma, inflammations, coughs and colds.
-		Leaves	Treatment of snake bites and wounds in general.	
-		Leaves, whole plant	Cough, asthma, bronchitis, tuberculosis, allergies, contraceptives, analgesic, wounds, venereal diseases, muscle pains, joint aches, kidney disorders, constipation, impotency, central nervous system disorders.	(Fomogne-Fodjo <i>et al.</i> , 2014)
Panama		Stems	Facilitate childbirth, postpartum aid to expel the placenta.	(Locklear <i>et al.</i> , 2018)
Peru		Leaves	Leishmaniasis.	(Odonne <i>et al.</i> , 2013)
Belize		-	Diabetes.	(Ferrier <i>et al.</i> , 2018)
<i>Desmodium barbatum</i> (L.) Benth.	Tanzania	Leaves and stems	Abortion inducer.	(Nikolajsen <i>et al.</i> , 2011)
	Nicaragua	Leaves and roots	Skin conditions.	(Giovannini <i>et al.</i> , 2016)
<i>Desmodium canescens</i> (L.) DC. <i>Desmodium caudatum</i> (Thunb.) DC.	Tanzania	-	Treatment of peptic ulcers.	(Macha <i>et al.</i> , 2018)
	-	Roots	Rheumatic backache, diarrhoea, icterohepatitis, abscesses, anthelmintic.	(Li <i>et al.</i> , 2014a)
	Japan	Roots	Rheumatic backache, diarrhoea, icteric hepatitis, abscesses, anthelmintic.	(Sasaki <i>et al.</i> , 2014)

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium caudatum</i> (Thunb.) DC.	China	Whole plant	Febrile diseases, rheumatic arthritis, bacillary dysentery.	(Ma <i>et al.</i> , 2011a)
	China	Whole plant or root	Fever, gastroenteritis, dysentery, rheumatic arthritis.	(Li <i>et al.</i> , 2019)
	China	Whole plant or roots	Rheumatic backache, stomach pain, lymphadenitis, nephritis.	(Xu <i>et al.</i> , 2020)
	China	-	Fever, dysentery, gastroenteritis, rectal prolapse, snake bites, mastitis, boils carbuncle.	(Guo <i>et al.</i> , 2016)
<i>Desmodium confertum</i> DC.	Nepal	Leaves	Eye problems.	(Rokaya <i>et al.</i> , 2010)
<i>Desmodium delotum</i> J.F. Macbr.	Ethiopia	Leaf apex	Eye illness.	(Tolossa <i>et al.</i> , 2013)
<i>Desmodium elegans</i> DC.	India	-	Epilepsy, carminative.	(Paniagua-Zambrana <i>et al.</i> , 2020)
<i>Desmodium gangeticum</i> (L.) DC.	China	Leaves	Antidotes, hemorrhoids.	(Zhi <i>et al.</i> , 2014)
	Pakistan	Roots	Carminative, tonic, diuretic, chronic fever, cough, vomiting, asthma, snake bite.	(Haq <i>et al.</i> , 2011)
	Himalayan region	Whole plant	Bronchitis.	(Amber <i>et al.</i> , 2017)
	India	Roots	Epilepsy, carminative.	(Bhat <i>et al.</i> , 2013)
	Pakistan	Roots and leaves	Earache, stomach pain, joint pain.	(Aziz <i>et al.</i> , 2017)
	India	Roots	Epilepsy.	(Sharma <i>et al.</i> , 2013)
	Pakistan	Roots	Scorpion sting and snake bite.	(Butt <i>et al.</i> , 2015)
	India	Leaves	Cuts, teeth cleaning, wounds.	(Gairola <i>et al.</i> , 2014)
	Pakistan	Roots and leaves	Cough, asthma.	(Kayani <i>et al.</i> , 2014)
	Pakistan	Leaves	Anticancer.	(Hussain <i>et al.</i> , 2019)
	Pakistan	-	Rheumatism.	(Alamgeer <i>et al.</i> , 2018)
	India	-	Asthma.	(Bhanisana Devi <i>et al.</i> , 2015)
	<i>Desmodium gangeticum</i> (L.) DC.	Indonesia	Leaves	Rheumatism.
India		-	Snake bites, asthma, bronchitis, cough, dysentery, eye infection, fever, vomiting.	(Paniagua-Zambrana <i>et al.</i> , 2020)
India		-	Scorpion sting, snake bites, diabetes mellitus, ulcer.	(Al-Asmari <i>et al.</i> , 2020)
India		Root	Typhoid fever, urinary discharges, piles, inflammations, treatment of ischemic heart disease and other heart diseases.	(Das <i>et al.</i> , 2014)
India		-	Typhoid, piles, asthma, bronchitis, bitter tonic, febrifuge, digestive, anticatarrhal, antiemetic, in inflammatory conditions of chest and in other inflammatory conditions. Digestive disorders, edema, diarrhoea, intermittent fever, malaria, urinary tract infections.	(Lagudu & Owk, 2016)
India		Whole plant	Bronchitis, asthma, inflammations, dysentery.	(Basheer & Satish, 2018)

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
	India	Whole plant	Thermogenic, nerve tonic, aphrodisiac, demulcent, anthelmintic, cardiac tonic, febrifuge, anti-inflammatory, diuretic, hemostatic, rejuvenating and useful in neuromuscular and ophthalmic disorders, loss of appetite, flatulence, diarrhoea, dysentery, nausea, piles, angina pain, cardiac disorders, tuberculosis, cough, seminal weakness, urinary disorders, fever, debility and gout. Treatment of heart diseases, especially in angina pectoris and myocardial infarction. Strengthens heart muscles and reduces cholesterol. Typhoid, pneumonia.	(Priyadharshini, 2016)
		Root		
	India	Root, bark and leaves	Fever, kidney disorders.	(Gurrapu & Mamidala, 2017)
	India	-	Typhoid, piles, inflammation, asthma, bronchitis, dysentery.	(Srivats <i>et al.</i> , 2012)
	India	-	Snake bite, ulcer, diabetes mellitus.	(Kurian <i>et al.</i> , 2010b)
	India	-	Anthelmintic, antidiarrhal, diuretic, expectorant, astringent, febrifuge, nerve tonic, antidiarrhoeal, bronchodilator, vasopressor, analgesic, antipyretic, cardiogenic, stimulant, antioxidant, anti-inflammatory.	(Meena <i>et al.</i> , 2010)
	India	-	Fever, cataract, typhoid, piles, bronchitis, dysentery, asthma.	(Ragavan, 2017)
	-	-	Bitter tonic, febrifuge, digestive, antidiarrhal, antiemetic.	(Suriyavathana <i>et al.</i> , 2010)
	-	Roots	Antiulcer.	(Singh <i>et al.</i> , 2018)
	-	-	Obesity.	(Sharma & Chandola, 2013)
	India	Leaves	Tonic to increase immunity, fever.	(Bhuyan & Rajak, 2019)
	Benin	Root and stem	Diarrhoea, stomach aches, angina, dysentery, ulcer, gastritis, asthma, dysmenorrhoea, childbirth difficulty, early menopause, diabetes, hypertension, hepatitis, headache, tiredness and cancer.	(Toyigbénan <i>et al.</i> , 2018)
	Vietnam	-	Wound ulcers, snake bites, diuretic, edema, asthma, stomatitis, arthritis, eczema, hair loss, neurological disorders, premature ejaculation, tonic.	(Ha <i>et al.</i> , 2018b)
<i>Desmodium gangeticum</i> (L.) DC.	-	-	Typhoid fever, urinary discharges, piles, inflammation, asthma, bronchitis, vomiting, dysentery, hemicrania.	(Venkatachalam & Muthukrishnan, 2012)
	-	-	Diabetes.	(Giovannini <i>et al.</i> , 2016)
	Pakistan	Whole plant, roots	Scorpion sting and snake bite.	(Butt <i>et al.</i> , 2015)

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium gangeticum</i> (L.) DC.	India	Whole plant	Bitter tonic, febrifuge, digestive, anticephalalgic, antiemetic, in inflammatory conditions of chest and other inflammatory conditions.	(Thirunavoukkarasu <i>et al.</i> , 2013)
	India	-	Bitter tonic, febrifuge, digestive, anticephalalgic, antiemetic, in inflammation of chest.	(Mahesh <i>et al.</i> , 2012)
	-	Root	Gastric ulcer, mouth ulcer, snake bite, scorpion sting.	
	Bangladesh	Leaves	Toothache, chest pains, fungal infections.	(Jahan <i>et al.</i> , 2010)
	-	-	Antidote in snake bite, asthma, bronchitis, cough, diarrhoea, dysentery, fever, mouth ulcer, rheumatism, sedative, abortion, to cure premature ejaculation, toothache, typhoid, vomiting.	(Nagarkar <i>et al.</i> , 2013)
	India	-	Bitter tonic, febrifuge, digestive, anticephalalgic, antiemetic, in inflammatory conditions of chest.	(Bisht <i>et al.</i> , 2014)
	-	-	Digestive, inflammatory, and cardiovascular disorders.	(Hitler <i>et al.</i> , 2014)
	-	-	Bitter tonic, febrifuge, digestive, anticephalalgic, antiemetic, in inflammatory conditions of chest.	(Yasmeen & Sujatha, 2013)
	Vietnam	-	Hemostatic, antiseptic, urinary discharges, detoxification, antiophidic, antiedema.	(Dat <i>et al.</i> , 2015)
	India	-	Bitter tonic, febrifuge, digestive, antiemetic, antipyretic and anticephalalgic, in inflammatory conditions of chest and other inflammatory conditions.	
	-	-	Abscesses, acne, cataract, dysentery, eye diseases, infections and liver diseases.	(Srivastava <i>et al.</i> , 2013)
	India	Leaves	Scabies, ringworm.	(Wagh & Jain, 2010)
	India	Roots	Antipyretic, diuretic, astringent, aphrodisiac, expectorant, debility.	(Sivasankari <i>et al.</i> , 2014)
	India	Leaves	Boils.	(Sharma <i>et al.</i> , 2014)
	Papua New Guinea	Leaves	Diarrhoea.	(Prescott <i>et al.</i> , 2015)
	Zambia	Roots	Febrifuge.	(Chinsembu, 2015)
	Saudi Arabia	Roots	Scorpion sting.	(Al-Asmari <i>et al.</i> , 2017)
	Benin	Leaves and whole plant	Strengthening.	(Towns & van Andel, 2016)
	India	Stems and roots	Fever, headache.	(Venkatachalapathi <i>et al.</i> , 2018)
	Bangladesh	Whole plant	Wound, edema.	(Fahim Kadir <i>et al.</i> , 2014)
India	Leaves	Diarrhoea, dysentery, piles.	(Shanmugam <i>et al.</i> , 2012)	
Himalayan region	Root	Bronchitis.	(Amber <i>et al.</i> , 2017)	
India	Root	Dysentery.	(Panda, 2014)	
India	-	Febrifuge, digestive, anticephalalgic, antiemetic, anti-inflammatory.	(Jamuna <i>et al.</i> , 2014)	

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
	India	Roots	Snake bite.	(Upasani et al., 2018)
	-	-	Tonic, febrifuge, digestive, anticatarrhal, antiemetic, in inflammatory conditions of chest.	(Sankar et al., 2013)
	Pakistan	Roots	Diarrhoea, chronic fever, cough, vomiting, asthma, snake bite, scorpion stings.	(Awan et al., 2011)
	India	Roots	Treatment of snake bite.	(Upasani et al., 2017)
	India	Root	Rheumatism.	(Padal et al., 2013)
	India	-	Antipyretic, diuretic, astringent, anthelmintic, laxative, and in the treatment of mental disorders.	(Mahajan et al., 2017)
	India	Root	Mouth ulcer, dysentery.	(Vedpal et al., 2016)
		Leaves	Prevent hair fall, in infections and cure eczema.	
	China	Root		
		Leaves	Diarrhoea, toothache.	
	Uganda	Root	Headache.	
			Premature ejaculation.	
	India	-	Jaundice, rheumatism, fever, paralysis, filariasis, inflammations.	(Yadav et al., 2013)
	-	-	Antipyretic, diuretic, astringent, anthelmintic, laxative, treatment of dementia.	(Mahajan et al., 2015)
	-	-	Asthma, bronchitis, piles, diuretic, bitter tonic, febrifuge, digestive, anticatarrhal, antiemetic.	(Antony et al., 2010)
	Pakistan	Root	Cough, cold, asthma.	(Abbas et al., 2017)
	India	Root	Asthma.	(Jeyaprakash et al., 2011)
	India	Leaves	Burns.	(Wagh & Jain, 2020)
	-	Root	Aphrodisiac.	(Singh et al., 2012)
	-	-	Bitter tonic, febrifuge, digestive, anticatarrhal, antiemetic, in inflammatory conditions of chest, ischemic heart disease, antiulcer.	(Venkatachalam & Muthukrishnan, 2013)
	India	Root	Scorpion sting.	(Suthari et al., 2018)
<i>Desmodium gangeticum</i> (L.) DC.	China	Whole plant	Diuresis.	(Hu et al., 2020)
<i>Desmodium griffithianum</i> Benth.	China	Whole plant	Against snake venom.	(Gao et al., 2019)
<i>Desmodium gyrans</i> (L. f.) DC.	India	Leaves	Antiseptic to cuts and wounds.	(Gogoi & Zaman, 2013)
	-	Leaves	Diuretic, febrifuge, tonic.	(Vipin et al., 2015)
	India	Roots	Asthma, cough, antidysenteric, emollient.	
	-	-	Wound healing, cardioprotective.	
<i>Desmodium heterocarpon</i> (L.) DC.	India	Whole plant	Cough, fainting, seizures.	(Joshi & Tyagi, 2011)
	India	Whole plant	Cough.	(Suthari et al., 2018)
	China	Whole plant	Mumps, epidemic encephalitis B, kidney and vesical stone.	(Hong et al., 2015)
	India	Leaves	Urinary diseases.	(Singh et al., 2014)
	-	-	Tonic, blood purification, ulcer, scurvy, energetic, kidney stone, diuretic.	

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium heterophyllum</i> (Willd.) DC.	Nepal	Leaves Roots	Tonic, cough. Diarrhoea, skin diseases.	(Mall <i>et al.</i> , 2015)
	Thailand	Whole plant	Edema.	(Khuankaew <i>et al.</i> , 2014)
	Indonesia	Leaves Whole plant	Postpartum symptoms and lack of appetite. Scabies, itching.	(Bahtiar <i>et al.</i> , 2017)
	-	Leaves and roots	Diarrhoea, dysentery, seizures, antispasmodic, sympathomimetic, cough, asthma, wounds.	(Ha <i>et al.</i> , 2018a)
<i>Desmodium incanum</i> (Sw.) DC.	Sri Lanka	-	Stomach aches, sores.	(Mohotti <i>et al.</i> , 2020)
	-	-	Ringworm, infections, healing of wounds and pains, colds, kidney troubles.	(Pitkin <i>et al.</i> , 2019)
	Brazil	Whole plant	Kidney problems.	(Tribess <i>et al.</i> , 2015)
<i>Desmodium intortum</i> (Mill.) Urb.	Brazil	Roots	Fever, expectorant, depurative.	(Magalhães <i>et al.</i> , 2019)
	Brazil	Aerial parts	Endocrine, nutritional, and metabolic diseases, mental and behavioral disorders, diseases of the digestive system.	(Rossi-Santos <i>et al.</i> , 2018)
	Belize	Leaves	Snake bite.	(Giovannini & Howes, 2017)
	Brazil	-	Dysentery.	(Bieski <i>et al.</i> , 2015)
	Brazil	Whole plant	Infectious diseases.	(Bolson <i>et al.</i> , 2015)
	South Africa	-	Septic wounds, sores, heartburn, stomach problems, prevent miscarriage, impotence.	(Mhlongo & Van Wyk, 2019)
	Ecuador	Leaves and roots	Reduce bleeding after delivery.	(Torri, 2013)
<i>Desmodium laburnifolium</i> (Poir.) DC.	India	Roots	Dermatological and digestive disorders.	(Negi <i>et al.</i> , 2018)
<i>Desmodium laxiflorum</i> DC.	Guinea	Leaves	Diabetes.	(Diallo <i>et al.</i> , 2012)
	India	Leaves and stems	Menstrual cycle irregularity, uterus infection.	(Taid <i>et al.</i> , 2014)
<i>Desmodium microphyllum</i> (Thunb.) DC.	India	-	Eye problems, fever, cough, headache, boils, blisters, wounds.	(Thakur <i>et al.</i> , 2016)
<i>Desmodium molliculum</i> (Kunth) DC.	India	Roots	Female reproductive problems.	(Gairola <i>et al.</i> , 2014)
	Ecuador	-	Diuretic, anti-inflammatory, emmenagogue, blood purifier, wounds treatment.	(Salazar Toaquiza, 2015)
	Peru	-	Anti-inflammatory, antiseptic and wound healer.	(Acero-Carrión <i>et al.</i> , 2012)
	-	-	Blood purifier, diuretic, detoxification, gastritis, reduces inflammation of the urinary tract, detoxifies the liver, antiallergic, antispasmodic, antiviral.	(Saucedo Estela & Tocto Céspedes, 2018)
	-	-	Antirheumatic, anti-inflammatory, antiasthmatic, antipyretic, calming, sudorific.	(Gordillo <i>et al.</i> , 2019)
-	Leaves and stems	Treatment of the symptoms of respiratory diseases, anti-inflammatory, asthma, liver disorders.		
Peru	Whole plant	Inflammation of the ovaries, inflammation of the uterus.	(Bussmann & Glenn, 2010)	

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium molliculum</i> (Kunth) DC.	Peru	Whole plant, except the root	Diuretic, anti-inflammatory, emmenagogue, blood purifier, asthma, wounds treatment.	(Barreto Yaya, 2018)
	Peru	-	Diuretic, blood purifier, antihemorrhagic, antidysenteric, anti-inflammatory of the urinary tract, liver and kidneys.	(Cancho Arias, 2018)
	Peru	Whole plant	Inflammation of the kidneys, ovaries and uterus, diarrhoea, stomach ache, gastritis, wounds cleansing, scars.	(Bussmann <i>et al.</i> , 2010)
	-	-	Contraceptive, diuretic, antihemorrhagic, blood purifier, anti-inflammatory of the urinary tract, liver and kidneys.	(Acaro Chuquicaña, 2013)
	Peru	Branches	Salpingitis, liver conditions, washing wounds, anti-inflammatory, renal problems.	(Castañeda <i>et al.</i> , 2017)
	Ecuador	Plant without root	Vaginal disorders, abdominal pain, menstrual cramps and related disorders, ovary inflammation, promoting labor and childbirth recovery.	(Tinitana <i>et al.</i> , 2016)
	Peru	Aerial part	Liver problems and pain, stomach ache, gastritis, general digestive problems, inflammation, blood depurative.	(Carraz <i>et al.</i> , 2015)
	Peru	-	Kidney problems.	
	Peru	Whole plant	Liver problem and pain, hepatitis, kidney problems, stomach ache, general digestive problems, intestinal spasms with diarrhoea.	(Gonzales de la Cruz <i>et al.</i> , 2014)
	Colombia	Branches	Inflammations of the ovaries, liver diseases, agent to fight infections in wounds, reduce blows, relieve the pains associated with kidney problems.	(Paniagua-Zambrana <i>et al.</i> , 2020)
	Ecuador	Whole plant		
	Peru	Leaves	Intestinal pain, white and yellow vaginal discharge.	
	Peru	Whole plant	Clean and disinfect wounds, regulate blood and to treat pimples, inflammations, bellyache. Inflammation, diarrhoea, stomach ache, gastritis, washing wounds.	(Monigatti <i>et al.</i> , 2013)
	Ecuador	Whole plant	Kidney and urinary tract inflammation, infection, stomach inflammation, ovary and vaginal inflammation, wounds, liver problems.	
	Ecuador	-	Skin infections (scabies).	(Landeta, 2015)
-	-	Nervousness.	(Olivera & Principe, 2018)	
-	-	Promote lactation, arthritis.		
Africa	-	Detoxify the body.		
-	Leaves	Seizures, venereal ulcers, vaginal infections.		

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium motorium</i> (Houtt.) Merr.	India	Roots Leaves Leaves and fruits Whole plant Flower	Emollient, laxative, antidiarrheal, antirheumatic, to treat cough, asthma, fever. Tonic, febrifuge, diuretic, aphrodisiac. Wounds. Diabetes mellitus.	(Chitra Devi & Narmathabai, 2011)
	Thailand	Whole plant	Menstrual disorders, tuberculosis, sexual impotence, headache and boils. Prevent cancer of the stomach and intestines, treat nerve damage and strengthening the immune system.	
<i>Desmodium multiflorum</i> DC.	Nepal	Roots	Peptic ulcer, indigestion.	(Mall et al., 2015)
	China	Root	Eliminate excessive body heat and detoxify the body, anti-itch, infantile malnutrition.	(Hu et al., 2020)
<i>Desmodium oblongum</i> Wall. ex Benth.	China	-	Cough, cold, headache, impotence.	(Li et al., 2017b)
	Thailand	Roots	Tonic, lumbago.	(Khuankaew et al., 2014)
<i>Desmodium oojeinense</i> (Roxb.) H. Ohashi	India	Bark	Low blood pressure.	(Joshi & Tyagi, 2011)
	India	Bark	Anthelmintic, astringent to the bowels, dysentery, leucoderma, ulcers, blood diseases, skin diseases, burning sensations, anemia.	(Jayadevaiah et al., 2012)
	-	-	Diarrhoea, dysentery, febrifuge, diabetes, anemia, leucoderma, ulcers.	(Nirawane et al., 2017)
<i>Desmodium oxyphyllum</i> DC.	-	-	Febrile diseases, cough, asthma, hepatitis, bleeding wounds.	(Wang et al., 2015)
<i>Desmodium podocarpum</i> DC.	China	Whole plant	Febrile diseases, cough, bleeding wounds.	(Zhu et al., 2011)
	India	Whole plant	Cough.	(Dutt et al., 2015)
	-	-	Febrile diseases, cough, asthma, hepatitis, bleeding wounds.	(Qin et al., 2015)
<i>Desmodium polycarpon</i> (Poir.) DC.	India	Leaves	Stomach ache.	(Dutt et al., 2015)
<i>Desmodium polycarpum</i> (Poir.) DC.	Pakistan	Roots	Fever, cardiac tonic, diuretic, loss of appetite, flatulence, diarrhoea, dysentery, nausea, piles, helminthiasis, cough.	(Amjad et al., 2017)
<i>Desmodium pulchellum</i> (L.) Benth. in Miq.	-	Leaves	Cold, fever, malaria, enlargement of liver and spleen, rheumatism, bone pains, swelling due to contusion or sprain, ulcers and skin sores in hemorrhages.	(Rahman et al., 2013)
	-	Roots	Reduce excessive menstrual flow.	
	-	Bark	Diarrhoea, poisoning, eye diseases.	
	China	Whole plant	Rheumatic fever, infant seizures, toothache, to dissolve internal blood clots, to aid digestion.	

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium pulchellum</i> (L.) Benth. in Miq.	-	Bark	Diarrhoea, hemorrhages, eye diseases.	(Reyad-ul-ferdous <i>et al.</i> , 2015)
	-	Roots	Burning sensations in the abdomen.	
	-	Flowers	Dental cavities.	
	-	Stem bark	Headache, hypotensive.	
	China	-	Seizures (in children), rheumatic fever, to dissolve internal blood clots and generate new red blood cells, rheumatism, toothache.	
	Philippines	Leaves	Pocks, ulcers.	
	Malaysia	Roots	Puerperium.	
	India	Leaves	Malaria, enlargement of liver and spleen, rheumatism, bone pains, swelling.	(Bhuyan & Rajak, 2019)
	India	Whole plant	Stomach pain, amebic dysentery.	(Dey & De, 2012)
	Bangladesh	Leaves and branches	Edema.	(Fahim Kadir <i>et al.</i> , 2014)
	India	Leaves	Wounds.	(Padal <i>et al.</i> , 2013)
	-	-	Cold, fever, malaria.	(Noor <i>et al.</i> , 2013)
	-	Leaves	Ulcers.	
	-	Bark	Diarrhoea, eye afflictions, malaria, swelling, rheumatism.	
	China	-	Schistosomiasis.	
-	-	Cold, fever, malaria.	(Ahmed <i>et al.</i> , 2013)	
-	Leaves	Ulcers.		
-	Bark	Diarrhoea, eye afflictions, malaria, swelling, rheumatism.		
China	-	Schistosomiasis.		
<i>Desmodium racemosum</i> DC. <i>Desmodium ramosissimum</i> G. Don	India	Leaves	Menorrhagia.	(Lingaraju <i>et al.</i> , 2013)
	China	Whole plant	Stomach ache, infantile malnutrition.	(Hu <i>et al.</i> , 2020)
	Nigeria	Leaves	Diarrhoea, dysentery, fever, pulmonary troubles, cough, venereal diseases, jaundice.	(Alli <i>et al.</i> , 2011)
	Benin	Stem	Diarrhoea, stomach aches, angina, dysentery, ulcer, gastritis, asthma, dysmenorrhoea, childbirth difficulty, early menopause, diabetes, hypertension, hepatitis, urinary infections, headache, tiredness and cancer.	(Toyigbénan <i>et al.</i> , 2018)
	Madagascar	-	Dental cavities, diarrhoea, abdominal pain, cough.	(Paniagua-Zambrana <i>et al.</i> , 2020)
	Madagascar	Leaves	Diarrhoea.	(Rakotoarivelo <i>et al.</i> , 2015)
	Nigeria	Leaves	Analgesic, dysentery, diarrhoea, fever, pulmonary, eye, and ear problems, cough, venereal diseases, jaundice.	(Ezealigo, 2016)
	Benin	Leaves	Malaria.	(Yetein <i>et al.</i> , 2013)
	China	-	Diuretic, anti-inflammatory, detoxifying.	(Li <i>et al.</i> , 2014c)
	<i>Desmodium repandum</i> (Vahl) Poir. in F. Cuvier	Rwanda	Leaves	Liver diseases.
Uganda		Leaves	Tuberculosis.	(Tabuti <i>et al.</i> , 2010)
Uganda		Leaves	Diarrhoea.	(Namukobe <i>et al.</i> , 2011)

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
	Uganda	Leaves	Treatment of symptoms of tuberculosis.	(Obakiro <i>et al.</i> , 2020)
<i>Desmodium retroflexum</i> DC.	India	Roots	Emmenagogue.	(Kumar <i>et al.</i> , 2012)
<i>Desmodium salicifolium</i> (Poir.) DC.	Uganda	Leaves	Tuberculosis.	(Bunalema <i>et al.</i> , 2014)
<i>Desmodium salicifolium</i> (Poir.) DC.	-	Leaves, whole plant	Respiratory problems, malaria, yellow fever.	(Fomogne-Fodjo <i>et al.</i> , 2014)
	Uganda	Leaves	Treatment of symptoms of tuberculosis.	(Obakiro <i>et al.</i> , 2020)
<i>Desmodium sequax</i> Wall.	Philippines	Leaves	Wounds.	(Galvez, 2015)
<i>Desmodium setigerum</i> (E. Mey.) Benth. ex Harv.	Angola	Whole plant	Hemorrhoids.	(Lautenschläger <i>et al.</i> , 2018)
	South Africa	-	Lice, septic wounds, sores, stomach problems.	(Mhlongo & Van Wyk, 2019)
<i>Desmodium strangulatum</i> Wight & Arn.	Indonesia	Leaves	Bone fractures.	(Silalahi <i>et al.</i> , 2015)
<i>Desmodium styracifolium</i> (Osbeck) Merr.	China	Aerial parts	Heat clearing, urinary diseases (red urine, heat strangury, stone strangury, slow and painful urination, edema and small quantify of urination, bladder and kidney stones). Rheumatism, pyrexia, dysentery, wounds, cough, malaria, hepatitis, cholelithiasis, jaundice, hemoptysis, stomatitis, laryngitis, urticaria.	(Wagner <i>et al.</i> , 2015)
	Vietnam	Whole plant	Urolithiasis, kidney problems, urethral infection, edematous nephritis, hepatitis.	(Giang Phan <i>et al.</i> , 2010)
	China	Aerial parts	Treatment of renal stones due to its heat clearing and diuretic properties.	(Xiang <i>et al.</i> , 2015)
	China	-	Treatment of urolithiasis.	(Mi <i>et al.</i> , 2012)
	China	Aerial parts	Pyretic strangury, urolithiasis, painful urination, oliguria.	(Cheng <i>et al.</i> , 2018)
	China	-	Diuretic, treatment of urinary stones.	(Xie <i>et al.</i> , 2018)
	China	-	Renal diseases (kidney stone or kidney damage).	(Xie <i>et al.</i> , 2019)
	-	Rhizome	Emmenagogue, stomachic.	(Alok <i>et al.</i> , 2013)
	China	-	Urination disorders, urolithiasis, edema, jaundice.	(Chen <i>et al.</i> , 2020)
	China	-	Diuretic, heat clearing, treatment of renal stones, hepatitis, cardio/cerebrovascular diseases.	(Zhou <i>et al.</i> , 2012)
	Vietnam	Aerial parts	To treat liver, kidney, urethra, bladder stones, painful urination, frequent urination, difficult urination due to urinary tract infection, edema, jaundice, carbuncles, itching.	(Woerdenbag <i>et al.</i> , 2012)
	-	Aerial parts	Jaundice, reddish urine, strangury, difficult and painful urination, edema with scanty urine.	(Xi & Gong, 2017)
	China	Aerial parts	Inflammation, pyrexia, kidney stone.	(Liu <i>et al.</i> , 2020c)

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium styracifolium</i> (Osbeck) Merr.	China	-	Treatment of kidney stone due to its heat clearing and diuretic properties, treatment of urolithiasis, cardio/cerebrovascular diseases, hepatitis.	(Zhou <i>et al.</i> , 2018)
	China	Whole plant	Treatment and management of urinary stones.	(Kasote <i>et al.</i> , 2017)
	China	Whole plant	Hepatitis, cholecystolithiasis.	(Li & Xing, 2016)
	China	Whole plant	Headache, cough.	(Li <i>et al.</i> , 2017a)
<i>Desmodium tiliaefolium</i> D.	-	Aerial parts	Jaundice, hepatitis, liver cirrhosis, cholelithiasis.	(Liu <i>et al.</i> , 2020b)
	China	Aerial parts	Cholelithiasis, urolithiasis.	(Liu <i>et al.</i> , 2017)
	India	Whole plant	Stomach ache, emmenagogue, stomachic, purgative.	(Dutt <i>et al.</i> , 2015)
<i>Desmodium tortuosum</i> (Sw.) DC.	Angola	Leaves	Prevents abortion.	(Lautenschläger <i>et al.</i> , 2018)
<i>Desmodium triflorum</i> (L.) DC.	Indonesia	Leaves	Wounds, diarrhoea.	(Bahtiar <i>et al.</i> , 2017)
	-	Leaves	Central nervous system stimulation, seizures, diuretic, high fever, bone fractures, diarrhoea.	(Revanasiddappa <i>et al.</i> , 2019)
	Taiwan	-	Dysmenorrhea, muscle spasm, cough, pain, poisoning.	(Chien <i>et al.</i> , 2020)
	Bangladesh	-	Eye diseases, stomach troubles.	(Apu <i>et al.</i> , 2012)
	India	Whole plant	Pruritus, skin eruption, wounds and cuts.	(Sundarrajan & Arumugam, 2017)
	-	Leaves	Diarrhoea, seizures, galactagogue, wounds and abscesses difficult to heal.	(Gavalapu <i>et al.</i> , 2013)
	-	-	Sores, itch, dysentery, laxative.	
	India	Leaves	Dysentery.	(Shanmugam <i>et al.</i> , 2012)
	India	Leaves	Boils, eye ailments, spleen disorders, wounds.	(Gairola <i>et al.</i> , 2014)
	India	Whole plant	Stomach pain, piles.	(Dey & De, 2012)
	China	Whole plant	Stomach ache, cold.	(Li <i>et al.</i> , 2017a)
	India	Leaves	Wounds.	(Kumar <i>et al.</i> , 2013)
	-	Leaves	Diarrhoea, seizures, antispasmodic, sympathomimetic, central nervous system stimulation, curare-mimetic activity, diuretic, galactagogue, wounds and abscesses difficult to heal.	(Bhosle, 2013)
	-	-	Sores, itch, cough, asthma, dysentery, laxative, high fever, bone fractures.	
India	Leaves	Wounds, dysentery, abscesses.	(Sambandan & Dhatchanamoorthy, 2012)	
	Roots	Diuretic, cough, asthma.		
Thailand	Whole plant	Abscesses, psoriasis.	(Neamsuvan & Bunmee, 2016)	
Thailand	Whole plant	Aphthous ulcer, diarrhoea.	(Neamsuvan & Ruangrit, 2017)	

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References	
<i>Desmodium triflorum</i> (L.) DC.	India	Leaves -	Swelling. Diarrhoea, wounds, abscesses, inflammation, cough, bronchitis, fever, stomach ache, piles, dysentery.	(Sureshkumar <i>et al.</i> , 2017)	
	India	Leaves	Body ache, body swelling.	(Chander <i>et al.</i> , 2014)	
	Mauritius	Whole plant	Diarrhoea, urinary tract infection.	(Samoisy & Mahomoodally, 2016)	
	Sri Lanka	-	Snake bites.	(Dharmadasa <i>et al.</i> , 2016)	
	Colombia	Whole plant Leaves and flowers	Pulmonary affections, depurative of blood, laxative, against herpes. To strengthen the uterus.	(Paniagua-Zambrana <i>et al.</i> , 2020)	
	India	-	Abscesses, eruptions, body ache, breast pain, colic, diarrhoea, dysentery, menorrhoea, sores, spleen complaints, nail disorders, toothache.		
	Mauritius	-	Pulmonary infections.	(Suroowan <i>et al.</i> , 2019)	
	-	Leaves	Treatment of seizures, diarrhoea, galactagogue, antispasmodic, sympathomimetic, central nervous system stimulation, curare-mimetic activity, diuretic, wounds and abscesses difficult to heal, sores, itch, to reduce high fever.	(Bhosle, 2011)	
	-	Whole plant			
	-	Roots			
	-	-			
	-	-		It is given to children to treat asthma and coughs, bone fractures. Promoting labor, in the treatment of vertigo, carminative, tonic, diuretic. Dysentery, laxative.	
	-	-		Cooling, expectorant, galactagogue, cough, bronchitis, wounds, abscesses, sores, pruritus, dysentery, flatulence and burning sensation, in stomach ache, dermatosis, diarrhoea, ophthalmia, rheumatism, tonic, diuretic, tumor.	(Singh <i>et al.</i> , 2016)
China	Whole plant	Haemostasis.	(Gao <i>et al.</i> , 2019)		
India	Leaves and roots	Wounds, abscesses, dysentery, diuretic.	(Sharma & Kumar, 2021)		
<i>Desmodium triquetrum</i> (L.) DC.	China	-	Antispasmodic in infants, to expel helminths and to treat indigestion, splenic abscesses, chronic cough, tuberculosis, diuretic, hepatitis, chronic metabolic diseases.	(Vedpal <i>et al.</i> , 2019)	
	Laos	Whole plant	Combat liver parasites.		
	-	Leaves	Piles.	(Joshi <i>et al.</i> , 2018)	
	-	Leaves	Diabetes, obesity, flu, fever, sore throat, nephritis, cholestatic hepatitis, enteritis, bacillary dysentery, pregnant vomiting, prostatic hyperplasia.	(Wu <i>et al.</i> , 2014)	

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium triquetrum</i> (L.) DC.	-	-	Prevents fainting from the heat (heat stroke), fever, colds, cough, tonsillitis, parotitis, acute nephritis, edema, enteritis, dysentery, hookworm infection, tapeworm infection in the liver, trichomonal vaginitis, vomiting in pregnancy, galactagogue, malnutrition in children, jaundice, hepatitis, tuberculosis, scleroderma, hemorrhoids, rheumatism. Wounds and abscesses that do not heal well. Dysentery, laxative.	(Thandar & Tun, 2015)
	- Sri Lanka	Leaves		
	Bangladesh	Leaves and stems	Boils, toothache, body pain, tuberculosis, gingivitis.	(Fahim Kadir et al., 2014)
	Myanmar	Roots, barks, leaves and fruits	Lung diseases, urinary diseases, gynecological diseases, analgesic.	(Aung et al., 2016)
<i>Desmodium umbellatum</i> (L.) DC.	India	-	Fever.	(Arora, 2018)
<i>Desmodium uncinatum</i> (Jacq.) DC.	Uganda	Leaves and flowers	Against helminths, yellow fever, diarrhoea, toothache.	(Namukobe et al., 2011)
<i>Desmodium velutinum</i> (Willd.) DC.	India	Root	Scorpion sting.	(Suthari et al., 2018)
	Nigeria	-	Fever.	(Fred et al., 2012)
	-	-	Headache.	
	-	Leaves	Diarrhoea, aphrodisiac.	
	-	-	Aches, pains, diarrhoea, haematuria, diuretic, laxative, cough, fever.	(Ebana et al., 2016)
	-	-	Diarrhoea, fever, anti-inflammatory, antinephrolithic, antibacterial, antitumor, antiulcer, antilipidaemic, analgesic, antimalarial, aphrodisiac.	(Eze-Steven & Ude, 2019)
	Nigeria	Leaves with flower	Infertility, irregular menstruation, general body vitality.	(Atawodi et al., 2014)
	Angola	Leaves	Infertility women.	(Lautenschläger et al., 2018)
	Guinea-Bissau	Leaves and root	Cholera.	(Frazão-Moreira, 2016)
	India	Leaves	Body pain.	(Sukumaran et al., 2020)
Guinea-Bissau	Leaves and roots	Intestinal problems.	(Catarino et al., 2016)	
<i>Desmodium velutinum</i> (Willd.) DC.	Benin	Roots	Latent jaundice.	(Allabi et al., 2011)
	Republic of the Congo	Leaves	Female infertility.	(Tchicailat-Landou et al., 2018)
	Burkina Faso	Bark	Diabetes.	
	Thailand	Stems and leaves	Hypertension.	(Khuankaew et al., 2014)
	-	Leaves, root, stem	Analgesic, venereal diseases, eye treatments, diarrhoea, dysentery, vermifuge, tuberculosis or related symptoms.	(Fomogne-Fodjo et al., 2014)
	-	-	Aches, pains, fever, analgesic.	(Chinenye et al., 2018)
Benin	Roots	Male infertility.	(Agbodjento et al., 2020)	

Species	Country or place where was reported	Part(s) used	Traditional medicinal uses	References
<i>Desmodium zonatum</i> Miq.	China	Leaves	Burns, scalds.	(Zheng <i>et al.</i> , 2013)

The symbol - indicates the absence of information.

A total of 45 different biological activities were studied in this genus. The five most studied biological activities were antioxidant (46), antimicrobial (34), anti-inflammatory (16), hepatoprotective (13), and antinociceptive (9). Complete information of the biological activities studied in the genus *Desmodium* is presented in Table No. 2.

Table No. 2
Experimentally demonstrated biological activity of the genus *Desmodium*

Species	Demonstrated biological activity	Part(s) used	Type of extract	Groups of compounds / Secondary metabolites	References
<i>Desmodium adscendens</i> (Sw.) DC.	Antioxidant	Leaves	Aqueous methanolic.	-	(Muanda et al., 2011a)
	Immunoactivity	Leaves and stems	Aqueous.	-	(Rammal & Soulimani, 2011)
	Antihistamine	Whole plant	Hydroglyceric.	-	(Martini & Solimé, 2014)
	Airway relaxant	Leaves	Aqueous.	-	(Irié-N'guessan et al., 2011)
		Leaves	Methanolic.	-	
		Leaves	Aqueous ethanolic.	-	
	Antinociceptive	Leaves	Aqueous.	-	(Charles et al., 2016)
	Antioxidant and hepatoprotective	Leaves	Aqueous.	-	(Chuisseu et al., 2020)
	Renoprotective and cardioprotective	Leaves	Aqueous.	-	(Adinoyi, 2020)
	<i>Desmodium adscendens</i> (Sw.) DC.	Antimicrobial (<i>Staphylococcus aureus</i> ,	Leaves	Aqueous.	-
<i>Bacillus subtilis</i> ,		Leaves	Aqueous methanolic.	-	
<i>Escherichia coli</i> ,					
<i>Pseudomonas aeruginosa</i> , <i>Candida albicans</i>)					
Hepatoprotective		Leaves and twigs	Aqueous.	• D-pinitol	(Magielse et al., 2013)
Renoprotective (against oxidative stress)		Aerial parts	Hydroalcoholic.	-	(François et al., 2015)
Antiulcer		Stems and	Methanolic.	-	(Ayoola et al., 2018)
Antioxidant		leaves Stems and leaves	Methanolic.	-	
Antipsychotic		Whole plant	Ethanolic.	-	(Amoateng et al., 2017)
Antioxidant		Leaves	Aqueous ethanolic.	-	(Zielińska-Pisklak et al., 2015)
Alexiteric		Leaves	Aqueous.	-	(Granda, 2015)
		Leaves	Ethanolic.	-	
		Leaves	Hexane.	-	
Antimicrobial (<i>C. albicans</i> , <i>Candida parapsilosis</i> , <i>Candida krusei</i> , <i>S. aureus</i> , <i>Enterobacter cloacae</i> , <i>Enterococcus faecalis</i> , <i>E. coli</i> , <i>Klebsiella pneumoniae</i> , <i>P. aeruginosa</i> , <i>Acinetobacter baumannii</i>)		Roots	Methanolic.	-	(Adeniyi et al., 2013)
Antioxidant		Stems, leaves	Crude methanol.	-	(Konan et al., 2012)
	Stems, leaves	Ethyl acetate.	-		
	Stems, leaves	<i>n</i> -butanol.	-		
Antibacterial (<i>S. aureus</i> , <i>Bacillus cereus</i> , <i>E. coli</i>)	Whole plant	Chloroform / methanol.	-	(Lakkakula et al., 2017)	

Species	Demonstrated biological activity	Part(s) used	Type of extract	Groups of compounds / Secondary metabolites	References
	Antibacterial (<i>S. aureus</i> , <i>K. pneumoniae</i> , <i>Moraxella catarrhalis</i> , <i>Mycobacterium smegmatis</i> , <i>Mycobacterium aurum</i>)	Whole plant	Methanol / dichloromethane.	-	(Fomogne-Fodjo et al., 2014)
<i>Desmodium affine</i> Schltld.	Antifungal (<i>Microsporium gypseum</i>)	Leaves	Methanolic.	-	(de Morais et al., 2017)
<i>Desmodium barbatum</i> (L.) Benth.	Antifungal (<i>M. gypseum</i>)	Leaves	Methanolic.	-	(de Morais et al., 2017)
<i>Desmodium canescens</i> (L.) DC.	Antiulcer	Aerial parts	Ethanollic.	-	(Macha et al., 2018)
<i>Desmodium caudatum</i> (Thunb.) DC.	Antimicrobial synergism against methicillin-resistant <i>S. aureus</i> (MRSA)	-	-	• Sophoraflavanone B	(Mun et al., 2013)
	Anti-inflammatory	-	-	• 2'-hydroxyl yokovanol	(Li et al., 2014a)
	Antioxidant	-	-	• 2'-hydroxyl neophellamuretin	
				• 1,3,5,6-tetrahydroxyxanthone	
	Antifungal (<i>Trichophyton</i> sp.)	Roots	-	• New compound isolated*	(Sasaki et al., 2012b)
	Antibacterial (MRSA)	Roots	-	• Sophoraflavanone B	(Mun et al., 2014)
	Antibacterial (<i>S. aureus</i>)	-	-	• Sophoraflavanone B	(Farhadi et al., 2019)
	Antiplatelet	-	-	• Swertisin	(de Almeida Chaves et al., 2019)
				• Lupeol	
	Analgesic	Whole plant	Ethanollic.	-	(Ma et al., 2011a)
	Anti-inflammatory	Whole plant	Ethanollic.	-	
	Antipyretic	Whole plant	Ethanollic.	-	
	Antioxidant	Whole plant	-	• Descaudatine A	(Xu et al., 2020)
				• 8-dimethylallyltaxifolin	
	Anticancer	Whole plant	-	• Nothofagin	
				• 2'-hydroxyl neophellamuretin	
				• 2"-O-rhamnosylswertisin	

Species	Demonstrated biological activity	Part(s) used	Type of extract	Groups of compounds / Secondary metabolites	References
	Antibacterial (MRSA and methicillin-sensitive <i>S. aureus</i>)	Roots	-	<ul style="list-style-type: none"> Leachianone G Sophoraflavanone B 8-(γ,γ-dimethylallyl)-5,7,4'-trihydroxydihydroflavonol Yukovanol 	(Sasaki <i>et al.</i> , 2012a)
<i>Desmodium caudatum</i> (Thunb.) DC.	Anti-Alzheimer's disease	Roots	-	<ul style="list-style-type: none"> Citrusinol 8-prenylquercetin 3β, 23, 28- trihydroxy-12-oleanene 23-caffeate 3β, 23, 28- trihydroxy-12-oleanene 3β-caffeate Kaempferol 5'-methoxy-9-O-β-D-xylopyranosyl(-)-isolariciresinol 	(Guo <i>et al.</i> , 2016)
<i>Desmodium congestum</i> Benth.	Antibacterial (Gram-positive bacteria, MRSA)	Whole plant	-	<ul style="list-style-type: none"> 5'-O-methyl-3-hydroxyflemingin A 5'-O-methylflemingin C 	(Rees <i>et al.</i> , 2015)
<i>Desmodium cuneatum</i> Hook. & Arn.	Antifungal (<i>M. gypseum</i>)	Leaves	Methanolic.	-	(de Morais <i>et al.</i> , 2017)
<i>Desmodium elegans</i> DC.	Antifungal (<i>Microsporium canis</i> y <i>Fusarium solani</i>) Monoamine oxidase inhibitor	Aerial parts Aerial parts Aerial parts Leaves	Dichloromethane. Ethyl acetate. Methanolic. -	<ul style="list-style-type: none"> - - - Total alkaloidal extract Desmodeleganine Bufotenin Hydroxy-N, N-dimethyltryptamine N¹²-oxide 2-(5-methoxy-1H-indol-3-yl)-N, N-dimethylethylamine 	(Zhi <i>et al.</i> , 2014)

Species	Demonstrated biological activity	Part(s) used	Type of extract	Groups of compounds / Secondary metabolites	References	
<i>Desmodium gangeticum</i> (L.) DC.	Wound healing	Aerial parts	Aqueous.	-	(Jain et al., 2010)	
	Antimutagenic Antimicrobial (<i>P. aeruginosa</i> , <i>B. subtilis</i> , <i>E. coli</i> , <i>C. albicans</i>)	Aerial parts	Methanolic.	-	(Hasmukhlal et al., 2016)	
		Leaves	Methanolic.	-	(Lagudu & Owk, 2016)	
		Leaves	Hexane.	-		
		Leaves	Chloroform.	-		
	Anti-inflammatory Memory enhancing (Anti-Alzheimer's disease)	Barks	Ethanollic.	-	(Basheer & Satish, 2018)	
		Roots	Ethanollic.	-	(Priyadharshini, 2016)	
	<i>Desmodium gangeticum</i> (L.) DC.	Cardiotonic Antioxidant (cardioprotective)	Roots	Chloroform.	-	(Kurian et al., 2010a)
			Roots	Chloroform.	-	(Srivats et al., 2012)
		Antioxidant (cardioprotective)	Roots	Ethyl acetate.	-	(Kurian et al., 2010b)
Anti-Alzheimer's disease and neuroprotective		-	-	-	(Obulesu & Rao, 2011)	
Antioxidant		Whole plant	Acetone / water / acetic acid.	-	(Lee et al., 2015)	
Antimutagenic Anti-inflammatory		Aerial parts	Methanolic.	-	(Thakkar et al., 2015)	
		Roots and aerial parts	Aqueous.	-	(Ragavan, 2017)	
Antinociceptive		Roots and aerial parts	Aqueous.	-		
Neuroprotective		Roots and aerial parts	Aqueous.	-		
<i>Desmodium gangeticum</i> (L.) DC.		Antioxidant	Leaves	Ethanollic.	-	(Suriyavathana et al., 2010)
	Antidiabetic	Aerial parts	Aqueous.	-	(Mukherjee, 2019)	
	Cardioprotective	Roots	Methanolic.	-	(Kurian & Paddikkala, 2012)	
	Antioxidant	Whole plant	Ethanollic.	-	(Tsai et al., 2011)	
	Antioxidant	Leaves	Ethanollic.	-	(Venkatachalam & Muthukrishnan, 2012)	
	Antioxidant	Leaves	Ethanollic.	-	(Sagar & Upadhyaya, 2013)	
	Antinociceptive	Leaves	Ethanollic.	-		
	Anti-inflammatory	Leaves	Ethanollic.	-		
	Anti-inflammatory	Leaves	Ethanollic.	-	(Sagar et al., 2010)	
	Antinociceptive	Leaves	Ethanollic.	-		
<i>Desmodium gangeticum</i> (L.) DC.	Gastroprotective (Antiulcerogenic)	Roots	Ethanollic.	-	(Mahesh et al., 2012)	
	Neuroprotective and memory enhancing	Whole plant	Hydroalcoholic.	-	(Changdar et al., 2019)	
	Antinociceptive	Stems	Methanolic.	-	(Jahan et al., 2010)	
	Anti-inflammatory	Roots	Aqueous.	-	(Nagarkar et al., 2013)	
	Anti-inflammatory	Aerial parts	Aqueous.	-	(Bisht et al., 2014)	
	Cardioprotective	Roots	Aqueous.	-	(Hitler et al., 2014)	
	Anti-inflammatory	Whole plant	Ethanollic.	-	(Yasmeen & Sujatha, 2013)	
	Antidiabetic	Leaves	-	• Methyl salicylate β -D-glucopyranoside	(Dat et al., 2015)	

Species	Demonstrated biological activity	Part(s) used	Type of extract	Groups of compounds / Secondary metabolites	References
	Anticancer	Leaves	-	• Salicin	(Srivastava et al., 2013)
	Antibacterial (<i>K. pneumoniae</i> , <i>E. coli</i> , <i>Salmonella typhi</i> , <i>Streptococcus mutants</i> , <i>P. aeruginosa</i>)	Whole plant	Methanolic.	-	(Karthikeyan et al., 2012)
		Whole plant	Ethanollic.	-	
		Whole plant	Chloroform.	-	
		Whole plant	Aqueous.	-	
	Antioxidant	Roots	Aqueous.	-	(Jamuna et al., 2014)
	Antioxidant and cardiac antihypertrophic	Roots	Methanolic.	-	(Sankar et al., 2013)
	Antimicrobial (<i>B. cereus</i> , <i>Aeromonas hydrophila</i> , <i>C. albicans</i> , <i>Aspergillus flavus</i> , <i>Aspergillus terreus</i> , <i>Penicillium chrysogenum</i>)	Roots	Methanolic.	-	(Hemlal & Ravi, 2012)
	Antidepressant and anxiolytic	Roots	-	• Alkaloids	(Mahajan et al., 2017)
	Anti-inflammatory	Roots and aerial parts	-	• (17Z,20Z)-hexacos-17,20-dien-9-one	(Yadav et al., 2013)
				• Gangenoid	
	Antiamnesic	Roots	Chloroform.	• Alkaloids	(Mahajan et al., 2015)
	Antiasthmatic	Roots	Chloroform.	-	(Antony et al., 2010)
		Roots	Ethanollic.	-	
		Roots	Hydroalcoholic.	-	
	Renoprotective	Whole plant	Ethanollic.	-	(Yasmeen et al., 2011)
	Antidiabetic	Whole plant	Ethanollic.	-	
	Antioxidant	Whole plant	Ethanollic.	-	
	Hepatoprotective	Leaves	Ethanollic.	-	(Venkatachalam & Muthukrishnan, 2013)
	Antioxidant	Leaves	Aqueous.	-	(Waisundara & Watawana, 2014)
<i>Desmodium gyrans</i> (L. f.) DC.	Antibacterial (<i>E. coli</i> , <i>S. typhi</i> , <i>K. pneumoniae</i> , <i>Vibrio cholerae</i> , <i>S. aureus</i>)	Leaves	Methanolic.	-	(Kalirajan et al., 2012)
		Leaves	Aqueous.	-	
	Wound healing	Leaves	Aqueous.	-	
<i>Desmodium heterocarpon</i> (L.) DC.	Anticoagulant	Leaves	Methanolic.	-	(Vipin et al., 2015)
	Antioxidant	Whole plant	Ethanollic.	-	(Tsai et al., 2011)
	Antimicrobial	Whole plant	Methanolic.	-	(Al Hasan et al., 2011)
	Antioxidant	Whole plant	Methanolic.	-	
<i>Desmodium heterophyllum</i> (Willd.) DC.	Antidiabetic	Aerial parts	-	• Genistein	(Ha et al., 2018a)
				• Dalbergioidin	
	Antibacterial (<i>S. aureus</i>)	Stem bark	Crude aqueous.	-	(Mohotti et al., 2020)
		Stem bark	Crude organic.	-	

Species	Demonstrated biological activity	Part(s) used	Type of extract	Groups of compounds / Secondary metabolites	References
<i>Desmodium incanum</i> (Sw.) DC.	Antifungal (<i>Trichophyton rubrum</i> , <i>Trichophyton mentagrophytes</i> , <i>M. gypseum</i>)	Leaves	Methanolic.	-	(de Morais et al., 2017)
	Antibacterial (<i>S. aureus</i> , <i>K. pneumoniae</i> , Group D Streptococcus)	Leaves Blossoms Leaves Blossoms	Methanolic. Methanolic. Aqueous. Aqueous.	- - - -	(Pitkin et al., 2019)
<i>Desmodium intortum</i> (Mill.) Urb.	Antioxidant	Whole plant	Ethanollic.	-	(Tsai et al., 2011)
<i>Desmodium leiocarpum</i> (Spreng.) G. Don	Antifungal (<i>M. gypseum</i>)	Leaves	Methanolic.	-	(de Morais et al., 2017)
<i>Desmodium microphyllum</i> (Thunb.) DC.	Antioxidant	Whole plant	Ethanollic.	-	(Tsai et al., 2011)
<i>Desmodium molliculum</i> (Kunth) DC.	Anti-inflammatory	Whole plant	Ethanollic.	-	(Acero-Carrión et al., 2012)
	Hepatoprotective	Whole plant	Hydroalcoholic.	-	(Saucedo & Tocto, 2018)
	Hepatoprotective	Leaves and stems	Aqueous.	-	(Gordillo et al., 2019)
	Wound healing	Leaves	Hydroethanollic.	-	(Castañeda, 2020)
<i>Desmodium molliculum</i> (Kunth) DC.	Hepatoprotective	Whole plant	Hydroalcoholic.	-	(Saucedo et al., 2019)
	Diuretic	Leaves	Hydroalcoholic.	-	(Cancho, 2018)
	Antibacterial (<i>S. aureus</i>)	-	Ethanollic.	-	(Bussmann et al., 2010)
	Contraceptive and post-coital	Leaves	Ethanollic.	-	(Acero Chuquicaña, 2013)
	Antioxidant	Leaves	Methanolic.	-	(Wang et al., 2017)
	Antibacterial (<i>S. aureus</i>)	Stems, leaves and flowers	Hydroalcoholic.	-	(Landeta, 2015)
	Antibacterial (<i>E. coli</i>)	Leaves and stems	Ethanollic.	-	(Olivera & Principe, 2018)
<i>Desmodium motorium</i> (Houtt.) Merr.	Antioxidant	Whole plant	Crude methanolic extract.	-	(Chowdhury et al., 2013)
		Whole plant	<i>n</i> -hexane fraction.	-	
		Whole plant	Carbon tetrachloride fraction.	-	
		Whole plant	Dichloromethane fraction.	-	
	Antimicrobial	Whole plant		-	
		Whole plant	Crude methanolic extract.	-	
		Whole plant	<i>n</i> -hexane fraction.	-	
		Whole plant	Carbon tetrachloride fraction.	-	
		Whole plant	Dichloromethane fraction.	-	

Species	Demonstrated biological activity	Part(s) used	Type of extract	Groups of compounds / Secondary metabolites	References
<i>Desmodium oblongum</i> Wall. ex Benth.	Anticancer	Whole plant	-	<ul style="list-style-type: none"> • 4'-hydroxy-8-isobutyryl-7-methoxy-6-methyl-flavone • 4',7-dimethoxy-8-isobutyryl-6-methyl-flavone • 4',7-dimethoxy-8-isobutyryl-flavone 	(Li et al., 2017b)
<i>Desmodium oojeinense</i> (Roxb.) H. Ohashi	Hepatoprotective	Stem bark	Ethanol.	-	(Jayadevaiah et al., 2012)
<i>Desmodium oxyphyllum</i> DC.	Anticancer	Whole plant	-	<ul style="list-style-type: none"> • (3R)-7-hydroxy-4'-methoxy-5-methoxycarbonyl-isoflavanone • (3R)-8-hydroxy-4'-methoxy-7-methoxycarbonyl-isoflavanone • (3R)-7,2',4'-trihydroxy-3'-methoxy-5-methoxycarbonyl-isoflavanone • 3,5,7,4'-tetrahydroxy-coumaronochromone 	(Li et al., 2014b)
	Anticancer	Whole plant	-	<ul style="list-style-type: none"> • (3R) 4',7-methoxy-5-methoxycarbonyl-isoflavanone 	(Wang et al., 2015)
<i>Desmodium paniculatum</i> (L.) DC.	Sedative	Leaves	Methanolic.	-	(Rashid et al., 2013)
	Thrombolytic	Leaves	Methanolic.	-	(Sayeed et al., 2014)
<i>Desmodium pauciflorum</i> (Nutt.) DC.	Analgesic and anti-inflammatory	Leaves	Ethanol.	-	(Hassan et al., 2013)
<i>Desmodium podocarpum</i> DC.	Analgesic, anti-inflammatory and antipyretic	Whole plant	Petroleum ether fraction.	-	(Zhu et al., 2011)
	Anticancer	Whole plant	-	<ul style="list-style-type: none"> • 2',4-hydroxy-3,4'-dimethoxychalcone • 2',3-hydroxy-4,4'-dimethoxychalcone 	(Qin et al., 2015)

Species	Demonstrated biological activity	Part(s) used	Type of extract	Groups of compounds / Secondary metabolites	References
<i>Desmodium pulchellum</i> (L.) Benth. in Miq.	Anti-liver fibrosis	-	-	• Total alkaloids	(Hu, 2012)
	Antidiarrhoeal	Leaves	Methanolic.	-	(Rahman <i>et al.</i> , 2013)
	Cardioprotective	Leaves	Petroleum ether.	-	
		Leaves	Crude methanolic extract.	-	(Reyad-ul-ferdous <i>et al.</i> , 2015)
		Leaves	Ethanollic.	-	
		Leaves	Hexane soluble fraction.	-	
Leaves	Aqueous soluble fraction.	-			
Anti-inflammatory	Barks	Ethanollic.	-	(Noor <i>et al.</i> , 2013)	
Antidiabetic	Barks	Ethanollic.	-		
<i>Desmodium pulchellum</i> (L.) Benth. in Miq.	Antinociceptive	Barks	Crude ethanolic extract.	-	(Ahmed <i>et al.</i> , 2013)
		Barks	Petroleum ether fraction.	-	
		Barks	Carbon tetrachloride fraction.	-	
<i>Desmodium ramosissimum</i> G. Don	Antibacterial (<i>B. subtilis</i> , <i>E. coli</i> , <i>P. aeruginosa</i> , <i>S. typhi</i> , <i>S. aureus</i>)	Leaves	Aqueous.	-	(Alli <i>et al.</i> , 2011)
		Leaves	Methanolic.	-	
		Leaves	Hexane.	-	
	Antioxidant	Whole plant	Methanolic extract.	-	(Ezealigo, 2016)
		Whole plant	<i>n</i> -hexane fraction.	-	
		Whole plant	Ethyl acetate fraction.	-	
Whole plant	<i>n</i> -butanol fraction.	-			
Whole plant	Aqueous fraction.	-			
<i>Desmodium renifolium</i> (L.) Schindl.	Antioxidant	Whole plant	Ethanollic.	-	(Tsai <i>et al.</i> , 2011)
	Anticancer	Whole plant	-	• Renifolin E	(Li <i>et al.</i> , 2014c)
• Renifolin F					
<i>Desmodium salicifolium</i> (Poir.) DC.	Antibacterial (<i>S. aureus</i> , <i>K. pneumoniae</i> , <i>M. catarrhalis</i> , <i>M. smegmatis</i> , <i>M. aurum</i>)	Leaves	Methanol / dichloromethane.	-	(Fomogne-Fodjo <i>et al.</i> , 2014)
		Stems	Methanol / dichloromethane.	-	
<i>Desmodium sambuense</i> (D. Don) DC.	Neurogenesis	Whole plant	-	• 3 β ,23,28-trihydroxy-12-oleanene 3 β -caffeate	(Cheng <i>et al.</i> , 2019)
	Neuritogenic	-	-	• (3 <i>S</i> ,4 <i>R</i>)-23,28-dihydroxyolean-12-en-3-yl (2 <i>E</i>)-3-(3,4-dihydroxyphenyl)acrylate	(Bian <i>et al.</i> , 2018)

Species	Demonstrated biological activity	Part(s) used	Type of extract	Groups of compounds / Secondary metabolites	References
<i>Desmodium scorpiurus</i> (Sw.) Poir. in F. Cuvier	Antioxidant	Whole plant	Ethanol.	-	(Tsai et al., 2011)
<i>Desmodium sequax</i> Wall.	Antioxidant	Whole plant	Ethanol.	-	(Tsai et al., 2011)
<i>Desmodium styracifolium</i> (Osbeck) Merr.	Antioxidant Angiotensin-converting enzyme inhibitor	Leaves Aerial parts	Ethanol. -	- • Vicenin 2 • Carlinoside • Vicenin 1 • Schaftoside • Vicenin 3	(Galvez, 2015) (Zhang et al., 2015)
	Inhibitors of calcium oxalate kidney stone formation	Whole plant	Aqueous.	-	(Rodgers et al., 2014)
	Antioxidant	Whole plant	Methanol.	-	(Sun et al., 2018)
	Antilithic and antioxidant	Aerial parts	Petroleum ether fraction.	-	(Xiang et al., 2015)
		Aerial parts	<i>n</i> -butyl alcohol fraction.	-	
	Antilithic and antioxidant	Whole plant	Aqueous.	-	(Mi et al., 2012)
	Antioxidant	Seeds	<i>n</i> -butanol.	-	(Cheng et al., 2017)
		Seeds	Chloroform.	-	
	Antioxidant	Seeds	<i>n</i> -butanol.	-	(Cheng et al., 2018)
	Hepatoprotective	-	-	• Schaftoside	(Liu et al., 2020a)
	Regulation of urinary stone formation and renoprotective	-	-	• Total flavones	(Xie et al., 2018)
	Renoprotective	-	-	• Total flavones	(Xie et al., 2019)
	Renoprotective	Aerial parts	Ethanol.	-	(Hou et al., 2018)
	Alcohol dehydrogenase inhibitor	Whole plant	-	• Formononetin • Aromadendrin	(Liu et al., 2015)
	Antiuro lithiatic and antioxidant	Aerial parts	-	• Total flavonoids	(Zhou et al., 2018)
	Hepatoprotective and hypolipidemic	-	-	• Schaftoside	(Liu et al., 2020b)
	Protection against the formation of cholesterol gallstones, hepatoprotective and hypolipidemic	-	-	• Schaftoside	(Liu et al., 2017)
<i>Desmodium subsericeum</i> Malme	Antifungal (<i>T. rubrum</i> , <i>M. gypseum</i>)	Leaves	Methanol.	-	(de Morais et al., 2017)
<i>Desmodium tortuosum</i> (Sw.) DC.	Antioxidant	Whole plant	Ethanol.	-	(Tsai et al., 2011)

Species	Demonstrated biological activity	Part(s) used	Type of extract	Groups of compounds / Secondary metabolites	References
<i>Desmodium triangulare</i> (Retz.) Merr.	Anti-inflammatory	Roots	Methanolic.	-	(Jayaseelan et al., 2013)
<i>Desmodium triflorum</i> (L.) DC.	Antioxidant	Whole plant	Ethanollic.	-	(Tsai et al., 2011)
	Antiurolihiatic	Whole plant	Ethanollic.	-	(Revanasiddappa et al., 2019)
	Antioxidant	Whole plant	Ethyl acetate fraction.	-	(Lai et al., 2010)
	Anthelmintic	Whole plant	<i>n</i> -hexane fraction.	-	(Gavalapu et al., 2013)
		Leaves	Aqueous.	-	
		Roots	Aqueous.	-	
		Leaves	Methanollic.	-	
		Roots	Methanollic.	-	
		Leaves	Aqueous / methanollic / petroleum ether.	-	
		Roots	Aqueous / methanollic / petroleum ether.	-	
	Anticonvulsant and antioxidant	Leaves	Aqueous.	-	(Bhosle, 2013)
	Anticonvulsant and antioxidant	Leaves	Ethanollic.	-	(Gowda et al., 2012)
	Anticonvulsant and antioxidant	Leaves	Ethanollic.	-	(Bhosle, 2011)
<i>Desmodium triquetrum</i> (L.) DC.	Neuroprotective	Roots	Aqueous.	-	(Joshi et al., 2018)
	Anti-inflammatory	Leaves	Methanollic.	-	(Kalyani et al., 2011a)
	Antioxidant	Leaves	Ethanollic.	-	
	Hypolipidemic	Whole plant	-	<ul style="list-style-type: none"> • 6'-<i>O</i>-<i>cis</i>-<i>p</i>-coumaroyl-3,5-dihydroxyphenyl-β-<i>D</i>-glucopyranoside • Tadehaginoside 	(Wu et al., 2014)
<i>Desmodium triquetrum</i> (L.) DC.	Antioxidant	Whole plant	-	<ul style="list-style-type: none"> • Polyphenols 	(Zhang et al., 2020)
	Hepatoprotective	Leaves	Ethanollic.	-	(Kalyani et al., 2011b)
	Antioxidant	Leaves	Ethanollic.	-	
<i>Desmodium uncinatum</i> (Jacq.) DC.	Antioxidant	Whole plant	Ethanollic.	-	(Tsai et al., 2011)

Species	Demonstrated biological activity	Part(s) used	Type of extract	Groups of compounds / Secondary metabolites	References
	Hepatoprotective	Aerial parts	Crude methanolic extract.	<ul style="list-style-type: none"> • (2S, 3S, 4R, 7R, 8Z)-1-O-β-D-glucopyranosyl-2-[(R)-2'-hydroxyarachidoylamino]-docosan-8-ene-3,4,7-triol • Spiraeamide • Isovitexin • Vitexin • Vicenin 3 	(Tsafack et al., 2018)
		Aerial parts	Ethyl acetate fraction.		
		Aerial parts	n-butanol fraction.		
<i>Desmodium velutinum</i> (Willd.) DC.	Hepatoprotective	Stems	Ethanol.	-	(Eze-Steven et al., 2014)
	Antipyretic	Leaves	Ethanol.	-	(Fred et al., 2012)
	Hypolipidemic	Leaves	Aqueous.	-	(Steven & Ude, 2017)
	Hypoglycemic	Leaves	Methanolic.	-	(Ozougwu & Akuba, 2018)
	Antibacterial (<i>E. coli</i> , <i>P. aeruginosa</i> , <i>S. aureus</i>)	Leaves	Ethanol.	-	(Ebana et al., 2016)
	Hypolipidemic	Leaves	Aqueous.	-	(Eze-Steven & Ude, 2019)
	Antiplasmodial	Leaves	Dichloromethane.	-	(Traoré-Coulibaly et al., 2013)
		Leaves	Ethanol.	-	
	Antibacterial (<i>S. aureus</i> , <i>K. pneumoniae</i> , <i>M. catarrhalis</i> , <i>M. smegmatis</i> , <i>M. aurum</i>)	Leaves	Methanol / dichloromethane.	-	(Fomogne-Fodjo et al., 2014)
	Antioxidant	Stems	Methanol / dichloromethane.	-	
		Stem bark	Methanolic.	-	(Chinenye et al., 2018)

The symbol - indicates the absence of information, the symbol * indicates that the chemical name of the secondary metabolite is not reported



Figure No. 2

Some of the *Desmodium* species located in Cuenca, Ecuador

A) *Desmodium adscendens*; B) *Desmodium molliculum*

The antioxidant, antimicrobial, anti-inflammatory, antinociceptive, anti-inflammatory and hepato-protective biological activities were the most mentioned in this review. The extensive study of these activities has made it possible to correlate them

with several of their traditional medicinal uses. Although antioxidant activity was the most evaluated, it is not possible to establish a direct relationship with specific traditional medicinal uses. However, it is known that antioxidant activity is closely related to

other biological activities because it prevents cell deterioration by inhibiting free radicals and other oxidant agents like hydroxyl radicals, peroxy radicals, hypochlorous acid, and superoxide radicals (Chuisseu et al., 2020; Muanda et al., 2011a). Free radical-mediated diseases like asthma, rheumatoid arthritis, aging, cardiovascular, mutagenic, inflammation-associated diseases, among others, could be attenuated by the potent scavenger potential of reactive oxygen species from extracts of the genus (Galvez, 2015; Kalyani et al., 2011a; Kurian et al., 2010b; Zielińska-Pisklak et al., 2015).

In this review, the antioxidant activity was determined in extracts from *D. adscendens* (Figure No. 2), *D. caudatum*, *D. gangeticum*, *D. heterocarpon*, *D. intortum*, *D. microphyllum*, *D. molliculum* (Figure No. 2), *D. motorium*, *D. ramosissimum*, *D. renifolium*, *D. scorpiurus*, *D. sequax*, *D. styracifolium*, *D. tortuosum*, *D. triflorum*, *D. triquetrum*, *D. uncinatum* and *D. velutinum*. Their benefits are attributed to phenolic and nitrogen compounds such as flavonoids, anthocyanins, carotenoids, polyphenols and tannins (François et al., 2015; Galvez, 2015; Kalyani et al., 2011a; Muanda et al., 2011a). Specific metabolites have also been determined in several species largely responsible for the antioxidant potential. Li et al. (2014a), determined that a xanthone compound, 1,3,5,6-tetrahydroxanthone, is primarily responsible for the antioxidant activity in *D. caudatum*. This compound is uncommonly found in the genus *Desmodium*. Compounds such as descaudatine A, nothofagin, 8-dimethylallyltaxifolin and 8-prenylquercetin, described as potent antioxidants, have also been isolated from this species (Guo et al., 2016; Xu et al., 2020). Rastogi et al. (2011), indicate that caffeic acid and chlorogenic acid might be responsible for the antioxidant activity of *D. gangeticum*. In *D. sequax* chlorogenic acid is the main component of the antioxidant activity (Tsai et al., 2011). Many of the studies suggest that the effect is evidenced in a concentration-dependent manner and that the antioxidant potential varies depending on the solvent used in the extraction because each extract possesses unique chemical constituents (Sankar et al., 2013; Li et al., 2014a; Ezealigo, 2016).

Antimicrobial activity has been mainly studied in *D. caudatum*, *D. adscendens*, *D. gangeticum* and *D. molliculum*. It has been determined that extracts from different species of the genus *Desmodium* possess inhibitory effects on the growth of bacteria and fungi even at low concentrations (MIC values lower than 125 µg/mL),

several of which are important clinical pathogens. Thus, *D. adscendens* has inhibitory properties on *E. coli*, *A. niger*, *P. aeruginosa*, *B. subtilis*, *S. aureus*, *C. albicans* and *K. pneumoniae* (Muanda et al., 2011b; Adeniyi et al., 2013; Landeta, 2015). *D. gangeticum*, *D. gyrans* and *D. ramosissimum* also showed a strong antimicrobial activity on the same strains (Lagudu & Owk, 2016) and over *S. typhi*, *S. mutants* (Alli et al., 2011; Karthikeyan et al., 2012) and *V. cholerae* (Kalirajan et al., 2012). Pitkin et al. (2019), reported that *D. incanum* proved to be very potent in decreasing the growth of *K. pneumoniae*, *S. aureus* and group D *Streptococcus*. These findings support the widely use in worldwide traditional systems of medicine, where are mainly used to treat diseases associated with the respiratory tract, such as tuberculosis and bronchitis (Fomogne-Fodjo et al., 2014), in gastrointestinal and urinary tract infections (Muanda et al., 2011b), also in the treatment of wounds and abscesses and other skin conditions and infections in general and related symptoms (Alli et al., 2011; Sasaki et al., 2012b; Lagudu & Owk, 2016; Lakkakula et al., 2017).

Chemical constituents which are attributed to the antimicrobial action, in a general way are flavonoids, tannins, alkaloids, saponins, steroids and astragalin (Adeniyi et al., 2013; Landeta, 2015). Further studies have determined a relationship between structure and activity in flavonoids, it is suggested that the amphipathic features of these molecules play an important role in the antibacterial properties. Hydrophobic substituents like prenyl groups, alkyl chains, alkylamino chains and nitrogen or oxygen containing heterocyclic moieties usually improve the activity (Farhadi et al., 2019). Flavonoids and prenylated flavonoids isolated from *D. caudatum* demonstrated effectiveness against methicillin-resistant *S. aureus*, an important example of these molecules is sophoraflavanone B (Mun et al., 2013; Mun et al., 2014). This kind of molecules was described even as potent antifungal agents by Sasaki et al. (2012b), its efficacy was tested against strains of *A. niger*, *Penicillium* sp., *Rhizopus* sp. and *Tricophyton* sp.

Another important activity widely studied in the genus is the anti-inflammatory. *D. gangeticum* and *D. caudatum* are the most cited in this review for this activity, nevertheless, more authors that reported this potential in other species. It has been suggested that the anti-inflammatory effect relays in secondary metabolites such as flavonoids, saponins, pterocarpinoids, alkaloids and their N-oxides (Sagar et al., 2010; Rastogi et al., 2011; Zhu et al., 2011

Basheer & Satish, 2018). Several mechanisms have been described by which extracts of *Desmodium* species achieve the anti-inflammatory effect. Flavonoids are described as molecules with the ability to inhibit the cyclooxygenase pathway (Sagar et al., 2010; Zhu et al., 2011). 2'-hydroxyl yokovanol and 2'-Hydroxyl neophellamuretin, phenolic compounds isolated from *D. caudatum*, showed inhibitory effects on the synthesis of pro-inflammatory cytokines (Li et al., 2014a). Studies on this activity in *D. gangeticum* and *D. molliculum* demonstrated the decrease in pro-inflammatory mediators like TNF- α , IL-1 β , IL-6, COX-2 (Ragavan, 2017), the inhibition of Th2 lymphocytes and eosinophils, the concentration of IL-4, IL-5, IL-8 and IgE, a fundamental mediator in the pathophysiology of asthma (Acero-Carrión et al., 2012). All of the above explains the traditional use given to it in traditional medicine, it is employed to treat febrile diseases, wounds, rheumatic diseases, among others (Ma et al., 2011a; Zhu et al., 2011; Li et al., 2014a).

The determination of the antinociceptive potential has been of interest and cited by several authors, studied in some species of *Desmodium*, but mainly in *D. gangeticum*. Species from this genus have been traditionally used to treat body ache, pains, general inflammations, diseases associated with smooth muscles, fever, malaria, and rheumatism (Ahmed et al., 2013; Charles et al., 2016). Anti-inflammatory, antinociceptive and antipyretic activities of many plants have been attributed to their secondary metabolites such as saponin, terpenoids, flavonoids and steroids (Ahmed et al., 2013). Regarding the possible mechanisms of action associated with the activity, many agree that the extracts probably inhibit the central synthesis of prostaglandins such as cyclooxygenase, lipooxygenase or induce the nitric oxide synthesis, additionally, modify intracellular signalling pathways in immune cells (Ma et al., 2011a; Ahmed et al., 2013; Charles et al., 2016). A preliminary research conducted by Charles et al. (2016), showed that procyanidins, a class of flavonoids obtained from *D. adscendens*, modules the arachidonic acid pathway, inhibits the gene transcription, protein expression and activity of inflammatory enzymes, as well the secretion of anti-inflammatory mediators.

The importance of the study of hepatoprotective activity of the genus *Desmodium* is associated with its traditional medicinal used in Latin America and Africa, *D. adscendens*, by example, has been used in management of asthma and liver related diseases (Chuisseu et al., 2020), *D. styracifolium* is

used to treat jaundice hepatitis, liver cirrhosis and cholelithiasis (Liu et al., 2020b). In our review this activity is more cited in this species but also in *D. molliculum*. Phytoconstituents suggested for this activity are steroids, triterpenoids and flavonoids (Kalyani et al., 2011b; Jayadevaiah et al., 2012). Lipid peroxidation is considered the main molecular mechanism involved in the oxidative damage of cell structures and the pathogenicity and maintenance of hepatitis. C-glicosyl flavonoids and cerebrosides, isolated from *D. uncinatum*, showed a potent inhibitory activity in lipid peroxidation (Tsafack et al., 2018).

There is an important relationship between antioxidant and hepatoprotective effects, due to the inhibition of oxidative stress and capacity to protect membrane integrity on liver cells. Besides, *D. adscendens* revealed anti-HCV activity in cell culture (Chuisseu et al., 2020).

One of the specific molecules over which the hepatoprotective potential has been demonstrated has been schaftoside, a flavonoid common in some *Desmodium* species, which can decrease the lipid accumulation and the hepatic inflammation by altering eicosanoids metabolic pathway (Liu et al., 2020a; Liu et al., 2020b). D-pinitol is another important molecule, found in the genus *Desmodium*, with radical scavenging activity, this contributes to the protective effect of extracts, however, it does not show a curative effect (Chuisseu et al., 2020). In all the cases, the hepatoprotective potential was evidenced by reduction of biochemical indicators such as SGOT, SGPT, ALP, total bilirubin, by increasing the levels of total proteins and it was confirmed by histopathological examinations on liver sections (Jayadevaiah et al., 2012; Venkatachalam & Muthukrishnan, 2013; Gordillo et al., 2019).

CONCLUSIONS

The genus *Desmodium* includes a wide variety of species with an important medical value. Lots of medicinal traditional uses have been supported by through the study of biological activity in laboratory. However, there are still a lot of them that have not yet been demonstrated, our review could be used as a referent for further investigations.

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