

Folkloric use of plants for treatment of epilepsy in India

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Abstract

Epilepsy is a common chronic neurological disorder prevalent world wide. It requires long term treatment with available antiepileptic agents but the associated side effects and incomplete success rates in treatment are some challenges in front of mankind. Traditional treatment of epilepsy through various plants is also very popular in rural and tribal belts of India. An attempt was made to gather information about antiepileptic plants being used by different indigenous communities all over the country. It has revealed use of total 159 plants for treatment of epilepsy and its related symptoms in India. Out of these, 55 plants have been evaluated for their anticonvulsant potential in various biological studies. There is an urgent need for scientific evaluation of rest of the 104 plants for their antiepileptic potential to obtain a safe, efficient and cost-effective treatment for this serious brain disorder.

Keywords: *Anti-convulsant, Ethnobotany, Seizure, Alkaloid, Secondary metabolites*

Introduction

Man has been dependent on natural resources for the treatment of various health problems since prehistoric times. Plants remained the foremost important source for this purpose. India has a very rich biological and cultural diversity and indigenous people of India have been using different plants singly or in combination for treatment of various medical conditions.

Epilepsy is a major Central Nervous System disorder and its most important symptom is recurrent unprovoked seizures. Traditional healers also associate other symptoms such as loss of consciousness, dizziness, abrupt falling down, frothing from mouth, tongue biting, confusion, memory loss and restlessness under epilepsy. In earlier days, most of the time, it was believed to be caused by witchcraft and many exorcists were contacted for its treatment. Later on, plants were started being used for treatment of epilepsy and associated symptoms.

In modern era, many synthetic drugs like phanytoin, barbiturates, pyrimidon, succinamides, dizepines, benzodiazepines, carbamazepine, topiramate *etc.* are being used as anticonvulsant/antiepileptic drugs. However, their side effects, chronic toxicity, serious drug interactions and adverse effects on cognition and behavior still require a safe & effective drug for this unpleasant disorder. Plants have proved to provide effective solutions for various diseases, for example discovery of drugs like quinine, artemisin, digoxin, atropine, strychnine, rauwolfine and many more. Primary healthcare need is mostly satisfied through folk or herbal remedies in developing countries due to their safety profile, efficacy and cost-effectiveness (Muralidharan *et al.*, 2009). In view of this, an attempt was made to collect information about plants being used for treatment of epilepsy among folklore of India and scientific studies done so far to validate their antiepileptic/anticonvulsant potential.

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Methodology

An extensive literature search was carried out to look for plants being used ethnomedicinally for treatment of epilepsy by different tribes of India. After consulting work of Jain (1991), more than 1000 references published on ethnomedicinal plants of India were also consulted. Out of them, 108 references were providing information about plants being used for epilepsy in various parts of the country. Articles were also consulted to check for scientific validation studies done on these folk claims (Nsour *et al.*, 2000; Junior *et al.*, 2008; Golwala *et al.*, 2010; Romeiras *et al.*, 2012; Asif, 2013; Fathima *et al.*, 2015). Correct botanical identity of plants were adopted from well known websites (Website 1 & 2). A list of plants with their scientific names, family, part used and references for the information along with information about scientifically proven antiepileptic/anticonvulsant potential of the plants is given in Table 1.

Result & Discussion

A total of 159 plants were found to be used traditionally for treatment of epilepsy either individually or in combination among various tribes of India. Out of these, 7 plants belong to Pteridophyta and one belongs to Gymnosperm groups. Rest 151 plants belong to Angiosperm group out of which 133 are Dicots and 18 are Monocots. Among the plant parts, maximally used for treatment were roots; leaves and whole plants; while petiole, latex, twig, wood and cotyledon were least used parts (Table 1). Antiepileptic plants

were maximally reported from West Bengal, Bihar, Orissa, Sikkim, Chhattisgarh and Jharkhand region, then from Madhya Pradesh, Andhra Pradesh and Maharashtra states and Northeastern states of India *i. e.* Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Arunachal Pradesh.

Jain (1991) has compiled ethnobotanical data published up to year 1991 in his Dictionary which provides information about 43 antiepileptic plants being used in country. After 1991, many researchers all over the country have started documenting folklore information about plants and animals. Literature search of published data on ethnomedicine after 1991 has revealed use of 140 plant species for epilepsy treatment out of which 24 species were common both before and after 1991. It elucidates expansion of information about another 116 plants being used for epilepsy after 1991 among various indigenous communities of India. Documentation of folk knowledge about various ailments is therefore, quite necessary to catch the dynamism going on in the field of ethnomedicine in modern generation.

There are many herbal formulations prevalent in markets for treatment of epilepsy and majority of them contain extracts of *Withania somnifera*, *Bacopa monnieri*, *Asparagus racemosus*, *Rauvolfia serpentina*, *Nardostachys jatamansi*, *Centella asiatica*, *Acorus calamus*, *Piper longum* *etc.* (Fathima *et al.*, 2015). It is interesting to note that use of these plant species for treatment of epilepsy have also been reported in Indian folklore (Table 1).

Table 1: List of plants used for treatment of epilepsy in ethnomedicine

S. No.	Botanical name & family	Part used	References
1	<i>Abelmoschus crinitus</i> Wall. (Malvaceae)	wp	Singh & Krishna, 2012a,b
2	* <i>Abutilon indicum</i> (Malvaceae)	rt	Jain, 1991; Aminuddin & Girach, 1995
3	* <i>Achillea millefolium</i> L. (Asteraceae)	wp	Rana & Samant, 2011
4	<i>Achyranthes aspera</i> L. (Amaranthaceae)	wp, rt	Kumar <i>et al.</i> , 2004; Sharma <i>et al.</i> , 2013

5	<i>Acmella paniculata</i> (Wall. ex DC.) R. K. Jansen syn. <i>Spilanthes paniculata</i> Wall. ex DC. (Asteraceae)	infl	Tirkey, 2004
6	* <i>Acorus calamus</i> L. (Acoraceae)	rh, px	Sharma <i>et al.</i> , 2013; Rana <i>et al.</i> , 2013; Panda & Misra, 2011; Sarma & Saikia, 2010; Hynniewta & Kumar, 2008; Silja <i>et al.</i> , 2008; Arya & Agarwal, 2006; Jain, 1991
7	<i>Actiniopteris radiata</i> (Sw.) Link (Pteridaceae)	wp	Sikarwar <i>et al.</i> , 2012; Sikarwar <i>et al.</i> , 2008
8	<i>Adiantum lunulatum</i> Burm. f. syn. <i>Adiantum philippense</i> L. (Pteridaceae)	rt	Chhetri, 2005
9	<i>Ageratum conyzoides</i> (L.) L. (Asteraceae)	rt, lf	Narain & Singh, 2006
10	* <i>Allium cepa</i> L. (Liliaceae)	bb	Ningthoujam <i>et al.</i> , 2013
11	* <i>Allium sativum</i> L.	bb	Sharma <i>et al.</i> , 2013; Ningthoujam <i>et al.</i> , 2013; Vedavathy <i>et al.</i> , 1997
12	* <i>Alstonia scholaris</i> (L.) R. Br. (Apocynaceae)	lf	Maliya, 2007
13	<i>Amberboa ramosa</i> (Roxb.) Jafri (Asteraceae)	wp	Jain, 1991
14	<i>Anacyclus pyrethrum</i> (L.) Lag. (Asteraceae)	infl	Kumar <i>et al.</i> , 2014
15	<i>Anisomeles malabarica</i> (L.) R. Br. ex Sims (Lamiaceae)	wp	Sivasankari <i>et al.</i> , 2014
16	<i>Argemone mexicana</i> L. (Papaveraceae)	rt, st, lf, bk, fr	Varghese, 1996; Narain & Singh, 2006
17	<i>Argostemma verticillatum</i> Wall. (Rubiaceae)	wp	Sood & Thakur, 2004
18	<i>Arisaema flavum</i> (Forssk.) Schott. (Araceae)	bb	Rana & Samant, 2011
19	* <i>Artemisia absinthium</i> L. (Asteraceae)	wp	Kumar <i>et al.</i> , 2015
20	<i>Artemisia nilagirica</i> (C. B. Clarke) Pamp.	wp	Sharma <i>et al.</i> , 2013
21	* <i>Artemisia vulgaris</i> L.	lf	Rudrapal <i>et al.</i> , 2012
22	* <i>Asparagus officinalis</i> L. (Asparagaceae)	rt	Barua <i>et al.</i> , 2007
23	<i>Asparagus racemosus</i> Willd. (Asparagaceae)	rt	Sharma <i>et al.</i> , 2013; Sharma <i>et al.</i> , 2012; Negi <i>et al.</i> , 2011; Mahanta <i>et al.</i> , 2009; Aditya <i>et al.</i> , 2009; Silja <i>et al.</i> , 2008;
24	* <i>Bacopa monnieri</i> (L.) Wettst. (Plantaginaceae)	lf, wp, rt	Sharma <i>et al.</i> , 2013; Shukla <i>et al.</i> , 2013; Panda & Misra, 2011; Kumari & Singh, 2009; Panda, 2009a; Panda, 2009b; Aditya <i>et al.</i> , 2009; Shukla <i>et al.</i> , 2009; Silja <i>et al.</i> , 2008; Jadeja, 1999; Satapathy & Brahmam, 1996; Jain, 1991
25	<i>Balanites aegyptiaca</i> (L.) Delile (Zygophyllaceae)	fr	Jain <i>et al.</i> , 2010; Jadhav, 2009

26	<i>Bauhinia racemosa</i> Lamk. (Caesalpiniaceae)	sb, rt	Pal & Jain, 1998; Rao & Henry, 1996
27	<i>Betula alnoides</i> Buch. -Ham. ex D. Don (Betulaceae)	bk	Chhetri, 2005
28	* <i>Boerhavia diffusa</i> L. (Nyctaginaceae)	rt, wp	Sharma <i>et al.</i> , 2013; Jain, 1991
29	* <i>Borassus flabellifer</i> L. (Arecaceae)	pt, px	Jain, 1991
30	<i>Boswellia serrata</i> Roxb. ex Colebr. (Burseraceae)	px	Jain, 1991
31	* <i>Butea monosperma</i> (Lamk.) Taub (Fabaceae)	rt	Aditya <i>et al.</i> , 2009
32	* <i>Caesalpinia bonduc</i> (L.) Roxb. syn. <i>Caesalpinia bonducella</i> (L.) Fleming (Caesalpiniaceae)	rb	Abhayankar <i>et al.</i> , 2009
33	<i>Caesalpinia crista</i> L.	rt	Singh, 2006
34	<i>Caesalpinia mimosoides</i> Lam.	sd	Silja <i>et al.</i> , 2008
35	* <i>Calotropis gigantea</i> (L.) Dryand. (Asclepiadaceae)	bk, fl, rt, px	Sharma <i>et al.</i> , 2013; Sikarwar <i>et al.</i> , 2012; Singh, 2006; Jain, 1991
36	* <i>Calotropis procera</i> (Aiton.) Dryand. (Asclepiadaceae)	fl, la, px	Aditya <i>et al.</i> , 2009; Kumar <i>et al.</i> , 2005; Jain, 1991
37	* <i>Cannabis sativa</i> L. (Cannabaceae)	lf, bk, px	Rana & Samant, 2011; Jain, 1991
38	* <i>Canscora alata</i> (Roth) Wall. syn. <i>Canscora decussata</i> (Roxb.) Schult. & Schult (Gentianaceae)	tw, wp	Talukdar & Talukdar, 2013; Khanna <i>et al.</i> , 2005
39	<i>Careya arborea</i> Roxb. (Lecythidaceae)	rt	Singh & Krishna, 2012a
40	* <i>Carissa caranda</i> * L. (Apocynaceae)	px	Jain, 1991
41	<i>Cassia fistula</i> L. (Caesalpiniaceae)	sd, px	Sharma <i>et al.</i> , 2013
42	<i>Cassine glauca</i> (Rottb.) Kuntze (Celastraceae)	bk, px	Jain, 1991
43	<i>Catharanthus pusillus</i> (Murray) G. Don. (Apocynaceae)	lf	Pal & Jain, 1998
44	* <i>Celastrus paniculatus</i> Willd. (Celastraceae)	rt	Varghese, 1996
45	* <i>Centella asiatica</i> (L.) Urb. (Apiaceae)	lf, wp	Aditya <i>et al.</i> , 2009; Singh & Debnath, 2008
46	<i>Ceriscoides turgida</i> (Roxb.) Tirveng. syn. <i>Gardenia turgida</i> Roxb. (Rubiaceae)	px	Jain, 1991
47	<i>Cheilanthes farinosa</i> (Forssk.) Kaulf (Pteridaceae)	rh, lf	Singh & Singh, 2014; Singh <i>et al.</i> , 2005
48	<i>Chloroxylon swietenia</i> DC. (Rutaceae)	sb	Rao & Henry, 1996
49	<i>Cinnamomum camphora</i> (L.) J. Presl. (Lauraceae)	lf	Ningthoujam <i>et al.</i> , 2013
50	* <i>Cissampelos pareira</i> L. (Menispermaceae)	px	Jain, 1991
51	* <i>Cissus quadrangularis</i> L. (Vitaceae)	st	Punjani, 2004
52	* <i>Citrus maxima</i> (Burm.) Merr. syn. <i>Citrus grandis</i> (L.) Osbeck. (Rutaceae)	lf	Sharma <i>et al.</i> , 2012

53	<i>Clematis gouriana</i> Roxb. ex DC. (Ranunculaceae)	lf	Kamble et al. , 2009
54	<i>Cleome gynandra</i> L. syn. <i>Gynandropsis pentaphylla</i> (L.) DC. (Cleomaceae)	lf	Ghatapanadi et al. , 2011
55	<i>Clerodendrum viscosum</i> Vent. (Lamiaceae)	rt	Sharma et al. , 2013
56	<i>Coldenia procumbens</i> L. (Boraginaceae)	rt	Varghese, 1996
57	<i>Colebrookea oppositifolia</i> Sm. (Lamiaceae)	rt	Sharma et al. , 2013; Jain, 1991
58	<i>Combretum nanum</i> Buch. -Ham. ex D. Don. (Combretaceae)	rt	Panda & Padhy, 2008
59	* <i>Coriandrum sativum</i> L. (Apiaceae)	sd	Vijayakumar et al. , 2015
60	<i>Croton persimilis</i> Mull. -Arg. syn. <i>Croton oblongifolius</i> Roxb. ; <i>Croton roxburghii</i> N. P. Balakr. (Euphorbiaceae)	rt,px	Varghese, 1996; Jain, 1991
61	<i>Curculigo orchioides</i> Gaertn. (Hypoxidaceae)	rt	Singh et al. , 2002; Kumari & Singh, 2009; Jain, 1991
62	<i>Cuscuta reflexa</i> Roxb. (Cuscutaceae)	st, wp	Behera et al. , 2006; Satapathy & Brahmam, 1996; Jadhav, 2006; Jadhav, 2014
63	* <i>Cymbopogon citratus</i> (DC.) Stapf syn. <i>Andropogon citratus</i> DC. (Poaceae)	lf	Jeeva et al. , 2006
64	<i>Cymbopogon martini</i> (Roxb.) W. Watson	wp	Talukdar & Talukdar, 2013
65	* <i>Cynodon dactylon</i> (L.) Pers. (Poaceae)	wp	Kumari & Singh, 2009; Kumar & Yadav, 2006; Talukdar & Talukdar, 2013; Mahajan, 2007
66	<i>Datura metel</i> L. (Solanaceae)	lf,rt	Sharma et al. , 2013; Aditya et al. , 2009; Jain, 1991
67	<i>Desmodium gangeticum</i> (L.) DC (Fabaceae)	wp	Rao et al. , 2006
68	<i>Desmodium heterocarpon</i> (L.) DC	rt	Pal & Jain, 1998
69	<i>Dioscorea oppositifolia</i> L. (Dioscoreaceae)	tu	Kamble et al. , 2009
70	<i>Dodonaea viscosa</i> (L.) Jacq. (Sapindaceae)	lf	Rao & Henry,1996
71	<i>Drimia indica</i> (Roxb.) Jessop (Liliaceae)	bb	Bhatti & Vashishtha, 2008
72	<i>Dryopteris cochleata</i> (D. Don) C. Chr. (Dryopteridaceae)	lf, rh	Singh & Singh, 2014; Singh et al. , 2005; Shah & Singh, 1990
73	<i>Echinops echinatus</i> Roxb. (Asteraceae)	wp	Aditya et al. , 2009
74	* <i>Elettaria cardamomum</i> (L.) Maton (Zingiberaceae)	sd	Silja et al. , 2008
75	<i>Entada rheedii</i> Spreng. syn. <i>Entada pursaetha</i> DC. (Mimosaceae)	px	Jain, 1991
76	<i>Equisetum diffusum</i> D. Don (Equisetaceae)	rt	Kholia, 2014
77	* <i>Eryngium foetidum</i> L. (Apiaceae)	wp, lf	Singh & Sundriyal, 2003; Hynniewta & Kumar, 2008
78	<i>Erythrina stricta</i> Roxb. (Fabaceae)	sb	Jamir & Takatemjen, 2010

79	<i>*Evolvulus alsinoides</i> (L.) L. (Convolvulaceae)	wp, lf, px	Sivasankari <i>et al.</i> , 2014; Shali, 2014; Kumari & Singh, 2009; Singh <i>et al.</i> , 2002; Kumar <i>et al.</i> , 2004; Pal & Jain, 1998
80	<i>Excoecaria agallocha</i> L. (Euphorbiaceae)	wd smoke	Ravindran <i>et al.</i> , 2005
81	<i>Ficus racemosa</i> L. (Moraceae)	fr	Tiwari <i>et al.</i> , 2012
82	<i>*Flacourtia indica</i> (Burm. f.) Merr. (Salicaceae)	st	Sharma <i>et al.</i> , 2013
83	<i>Flemingia macrophylla</i> (Willd.) Merr. syn. <i>Flemingia congesta</i> W. T. Aiton (Fabaceae)	rt	Tirkey, 2006
84	<i>Flemingia strobilifera</i> (L.) W. T. Aiton syn. <i>Flemingia bracteata</i> (Roxb.) Wight; <i>Flemingia fruticulosa</i> Benth.	rt	Sharma <i>et al.</i> , 2013; Pal & Jain, 1998
85	<i>Galium verum</i> L. (Rubiaceae)	wp	Kumar <i>et al.</i> , 2015
86	<i>Globba orixensis</i> Roxb. (Zingiberaceae)	tu	Rao & Henry, 1996
87	<i>*Hemidesmus indicus</i> (L.) R. Br. ex Schult. (Asclepiadaceae)	rt	Kumar & Goel, 2008; Viswanathan, 1997
88	<i>Holarrhena pubescens</i> Wall. ex G. Don syn. <i>Holarrhena antidysenterica</i> (Roth) Wall. ex A. DC. (Apocynaceae)	px	Jain, 1991
89	<i>Indigofera cassioides</i> DC. (Fabaceae)	px	Jain, 1991
90	<i>Indigofera coerulea</i> Roxb.	rt	Murugesan <i>et al.</i> , 2011
91	<i>*Indigofera tinctoria</i> L.	wp, px	Sivasankari <i>et al.</i> , 2014, Jain, 1991
92	<i>Inula cappa</i> DC. (Asteraceae)	rt	Sharma <i>et al.</i> , 2013
93	<i>Ipomoea eriocarpa</i> R. Br. (Convolvulaceae)	wp	Shukla <i>et al.</i> , 2010
94	<i>Lawsonia inermis</i> L. (Lythraceae)	lf	Kalita <i>et al.</i> , 2005
95	<i>Leptodermis lanceolata</i> Wall. (Rubiaceae)	sd	Sood &, Thakur, 2004
96	<i>Lygodium flexuosum</i> (L.) Sweet (Lygodiaceae).	lf	Tirkey, 2004
97	<i>Maerua oblongifolia</i> (Forssk.) A. Rich (Capparaceae)	rt	Thakor, 2009
98	<i>Martynia annua</i> L. (Martyniaceae)	lf, wp	Kumar & Desai, 2014; Sharma <i>et al.</i> , 2013; Salam <i>et al.</i> , 2013; Aditya <i>et al.</i> , 2009; Katewa & Jain, 2006; Jain, 1991
99	<i>Merremia tridentata</i> (L.) Hallier. f. (Convolvulaceae)	fr	Vedavathy <i>et al.</i> , 1997
100	<i>Mesua ferrea</i> L. (Calophyllaceae)	fl	Purkayastha <i>et al.</i> , 2007
101	<i>Mikania micrantha</i> Kunth (Asteraceae)	lf	Pal & Jain, 1998
102	<i>Mimosa himalayana</i> Gamble (Mimosaceae)	rt	Pal & Jain, 1998
103	<i>*Mimosa pudica</i> L.	rt	Aditya <i>et al.</i> , 2009; Jeeva <i>et al.</i> , 2006; Jain, 1991
104	<i>*Morinda citrifolia</i> L. syn. <i>Morinda bracteata</i> Roxb. (Rubiaceae)	sb	Pal & Jain, 1998
105	<i>*Moringa oleifera</i> Lamk. (Moringaceae)	rt, px	Kalita & Bora, 2008; Jain, 1991

106	* <i>Murraya koenigii</i> Spreng syn. <i>Bergera koenigii</i> L. (Rutaceae)	lf	Silja <i>et al.</i> , 2008
107	* <i>Nardostachys jatamansi</i> (D. Don) DC. (Caprifoliaceae)	rt, px	Bhatti & Vashishtha, 2008; Chhetri, 2005; Jain, 1991
108	* <i>Nerium oleander</i> L. syn. <i>Nerium indicum</i> Mill. (Apocynaceae)	rt	Ghosh, 2009
109	* <i>Ocimum americanum</i> L. (Lamiaceae)	lf	Jain, 1991
110	* <i>Ocimum basilicum</i> L.	px	Jain, 1991
111	<i>Oroxylum indicum</i> (L.) Kurz. (Bignoniaceae)	lf, sd, bk, px	Sharma <i>et al.</i> , 2013; Sanglakpam <i>et al.</i> , 2012; Khumbongmayum <i>et al.</i> , 2005; Singh, 2006; Jain, 1991
112	<i>Oxalis corniculata</i> L. (Oxalidaceae)	wp	Sharma <i>et al.</i> , 2013
113	* <i>Paeonia emodi</i> Royle (Paeoniaceae)	lf, rt	Rana <i>et al.</i> , 2013; Jain, 1991
114	<i>Pavetta indica</i> L. (Rubiaceae)	rt, rb	Sharma <i>et al.</i> , 2013; Rao & Henry, 1996
115	<i>Piper longum</i> L. (Piperaceae)	fr	Purkayastha <i>et al.</i> , 2007
116	* <i>Plectranthus amboinicus</i> (Lour.) Sprengel syn. <i>Coleus amboinicus</i> Lour. ; <i>Coleus aromaticus</i> Benth. (Lamiaceae)	lf	Kumari & Singh, 2009
117	<i>Polygala crotalarioides</i> Buch. -Ham. ex DC. (Polygalaceae)	px	Jain, 1991
118	<i>Punica granatum</i> L. (Lythraceae)	lf	Sharma <i>et al.</i> , 2013; Samal <i>et al.</i> , 2010a,b
119	* <i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz. (Apocynaceae)	rt	Kumar <i>et al.</i> , 2014; Sharma <i>et al.</i> , 2013; Kumari & Singh, 2009
120	* <i>Ricinus communis</i> L. (Euphorbiaceae)	lf, fr, sd, rt	Sharma <i>et al.</i> , 2013; Pattanaik <i>et al.</i> , 2008; Purkayastha <i>et al.</i> , 2005; Ragupathy & Newmaster, 2009
121	<i>Rosa multiflora</i> Thunb. (Rosaceae)	fl	Kumar <i>et al.</i> , 2015
122	* <i>Ruta chalepensis</i> L. (Rutaceae)	lf	Silja <i>et al.</i> , 2008
123	* <i>Salvadora persica</i> L. (Salvadoraceae)	rt	Kshirsagar <i>et al.</i> , 2003
124	<i>Sapindus emarginatus</i> Vahl (Sapindaceae)	fr, px	Aditya <i>et al.</i> , 2009; Jain, 1991
125	<i>Sapindus mukorossi</i> Gaertn.	fr, cotyledon	Shukla <i>et al.</i> , 2014; Dominic & Ramanujam, 2012; Singh & Kumar, 2009; Chhetri, 2005; Dolui <i>et al.</i> , 2004
126	<i>Selaginella bryopteris</i> Baker. (Selaginellaceae)	wp	Sikarwar, 2013
127	<i>Selinum vaginatum</i> C. B. Clarke (Apiaceae)	rt	Rana <i>et al.</i> , 2013
128	<i>Semecarpus anacardium</i> L. f. (Anacardiaceae)	fr, sd oil	Jain, 1991
129	<i>Senna obtusifolia</i> (L.) H. S. Irwin & Barneby syn. <i>Cassia obtusifolia</i> L. (Caesalpinaceae)	wp	Rao & Henry, 1996
130	<i>Senna tora</i> (L.) Roxb. syn. <i>Cassia tora</i> L.	px	Jain, 1991

131	* <i>Sesbania grandiflora</i> (L.) Pers (Fabaceae)	lf, fl	Kumar <i>et al.</i> , 2014; Pragasam <i>et al.</i> , 2008
132	<i>Sida cordifolia</i> L. (Malvaceae)	rb	Kumar & Goel, 1998
133	<i>Spermadictyon suaveolens</i> Roxb. syn. <i>Hamiltonia suaveolens</i> (Roxb.) Roxb. (Rubiaceae)	fl, sd	Sood & Thakur, 2004
134	<i>Sphaeranthus indicus</i> L. (Asteraceae)	wp	Upadhyay <i>et al.</i> , 2010
135	<i>Stachys sericea</i> Cav. (Lamiaceae)	wp	Dutt <i>et al.</i> , 2015
136	* <i>Strychnos nux-vomica</i> L. (Loganiaceae)	bk	Shukla <i>et al.</i> , 2010; Kadavu & Dixit, 2009; Nayak <i>et al.</i> , 2004
137	<i>Syzygium heyneanum</i> (Duthie) Gamble (Myrtaceae)	sb	Ravisankar & Henry, 1992
138	<i>Taxus baccata</i> L. (Taxaceae)	lf	Dolui <i>et al.</i> , 2004
139	<i>Terminalia alata</i> Roth (Combretaceae)	bk	Panda & Padhy, 2008
140	* <i>Terminalia arjuna</i> (Roxb. ex DC.) Wt. & Arn.	st	Rao & Henry, 1996
141	<i>Thymus serpyllum</i> L. (Lamiaceae)	wp	Gupta <i>et al.</i> , 2013
142	<i>Toddalia asiatica</i> (L.) Lam. (Rutaceae)	lf	Upadhyay <i>et al.</i> , 2009
143	<i>Tragia involucrata</i> L. (Euphorbiaceae)	px	Jain, 1991
144	* <i>Trema orientalis</i> (L.) Blume (Cannabaceae)	sb	Jamir & Takatemjen, 2010
145	<i>Trichosanthes cucumerina</i> L. syn. <i>Trichosanthes anguina</i> L. (Cucurbitaceae)	fr	Baruah & Kalita, 2007
146	<i>Trichosanthes tricuspidata</i> Lour.	fr	Shali, 2014
147	<i>Trigonella foenum-graecum</i> L. (Fabaceae)	sd	Kumar <i>et al.</i> , 2014
148	<i>Tylophora indica</i> (Burm. f.) Merr. (Asclepiadaceae)	lf	Vedavathy <i>et al.</i> , 1997
149	<i>Typha domingensis</i> Pers. syn. <i>Typha</i> <i>angustata</i> Bory & Chaub. (Typhaceae)	px	Jain, 1991
150	<i>Valeriana hardwickii</i> Wall. (Caprifoliaceae)	rt	Jain, 1991
151	* <i>Valeriana jatamansi</i> Jones	px, rh	Arya & Agarwal, 2006; Jain, 1991
152	<i>Verbena officinalis</i> L. (Verbenaceae)	wp	Kumar <i>et al.</i> , 2015
153	<i>Vetiveria zizanioides</i> (L.) Nash (Poaceae)	rt, px	Sharma <i>et al.</i> , 2013; Purkayastha <i>et al.</i> , 2007; Jain, 1991
154	* <i>Vitex negundo</i> L. (Lamiaceae)	rb, rt, lf, px	Sharma <i>et al.</i> , 2013; Ansarali & Sivadasan, 2009; Dolui <i>et al.</i> , 2004; Jain, 1991
155	<i>Vitis vinifera</i> L. (Vitaceae)	fr	Jain, 1991
156	* <i>Withania somnifera</i> (L.) Dunal (Solanaceae)	rt	Jadhav, 2014; Jain, 1991
157	<i>Wrightia tinctoria</i> R. Br. (Apocynaceae)	rt	Vedavathy <i>et al.</i> , 1997
158	* <i>Zea mays</i> L. (Poaceae)	rt	Pal & Jain, 1998
159	* <i>Ziziphus jujuba</i> Mill. syn. <i>Ziziphus</i> <i>mauritiania</i> Lamk. (Rhamnaceae)	fr	Purkayastha <i>et al.</i> , 2007

* Plants showing anti-convulsant activity

Anticonvulsant potential of many phyto-extracts have been evaluated in various animal models like pentylenetetrazole (PTZ), maximal electroshock (MES), kainic acid (KA) and bicuculline, pilocarpine, strychnine or N-methyl-D-aspartate (NMDA)-induced convulsions. In the present paper, out of these 159 plants, 55 plants have been found to demonstrate anticonvulsant activity in various animal studies (Nsour *et al.*, 2000; Junior *et al.*, 2008; Golwala *et al.*, 2010; Romeiras *et al.*, 2012; Asif, 2013; Fathima *et al.*, 2015) and this potential could be scientifically explained by direct or indirect pharmacologic mechanisms acting against epileptic symptoms. It suggests that folk medicinal claim to treat epilepsy by rest of 104 plants still needs scientific validation. These potential plants could be investigated for their antiepileptic potential in various animal models and plants with positive response could be further explored for active constituents.

Plants possess various medicinally important phyto-constituents like alkaloids, flavanoids, coumarins, terpenoids, saponins *etc.* Many of these secondary metabolic compounds also possess anti-epileptic potential, for example alkaloids like piperine present in *Piper* species, Raubasine in *Rauvolfia serpentina*, flavanoid like fisetin in Grapes & Onions; terpenoids like cannabidiol, delta-8-tetrahydrocannabinol, delta-9-tetrahydrocannabinol in *Cannabis sativa*, baccoside-A in *Bacopa monnieri*, citronellol in *Cymbopogon* species have demonstrated antiepileptic/anticonvulsant potential in different animal models (Zhu *et al.*, 2014). Similarly, other potential plants should be thoroughly investigated for search of anti-epileptic molecules.

Conclusion

The healing power of ethnomedicinal plants for treatment of various diseases is under scientific appraisal all over the world. Epilepsy affects approximately 50 million people worldwide and

toxicity, adverse drug interaction and expensive nature of present synthetic drugs require novel safe and cost-effective molecules for its treatment. Indian folklore describe use of 159 plant species for its treatment but only about 34% of them have been therapeutically validated. The rest of the 104 folk medicinal plants could be explored scientifically and further research on isolation of bioactive compounds could provide an effective treatment for epilepsy and associated symptoms.

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Symbols for Plant parts as used in Table 1:

bb: bulb; bk: bark; fl: flower; fr: fruit; infl: inflorescence; la: latex; lf: leaf; pt: petiole; px: part not specified; rb: root bark; rh: rhizome; rt: root; sb: stem bark; sd: seed; st: stem; tw: twig; tu: tuber; wd: wood; wp: whole plant

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