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Indian Birthwort (*Aristolochia indica* L.) : An Important Endemic and Endangered Plant with Immense Medicinal Potential

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Abstract :

Aristolochia indica (Family : Aristolochiaceae), commonly known as Indian birthwort is climbing woody shrub having antidote and anti-poisonous properties. Because of its remarkable medicinal value it is used in Ayurveda and indigenous system of medicine. Besides the plant is also reported to have antimicrobial, antioxidant, antibacterial, anti inflammatory, immunomodulator, anti cancerous, anti diabetic and anti venom properties. Natural germination of this plant is very difficult due to low potency of the seeds. Therefore plant is listed as rare and endangered plant species in some parts of India like Assam, Madhya Pradesh and Eastern ghat.

Key words : Antivenom, perianth, phytochemistry, zygomorphic.

Introduction :

Plants with various secondary metabolites have been successfully used for the treatment of infections, disorders and illness.[1] The current interest in and demand for herbs is a worldwide phenomenon, WHO currently encourages, recommends and promotes herbal remedies in national healthcare programmes because such drugs are easily available at low cost and are comparatively safe.[2] From research point of view, natural products are rapidly being utilized as a source for drug discovery and development.[3,4] Therefore, the search for new plants

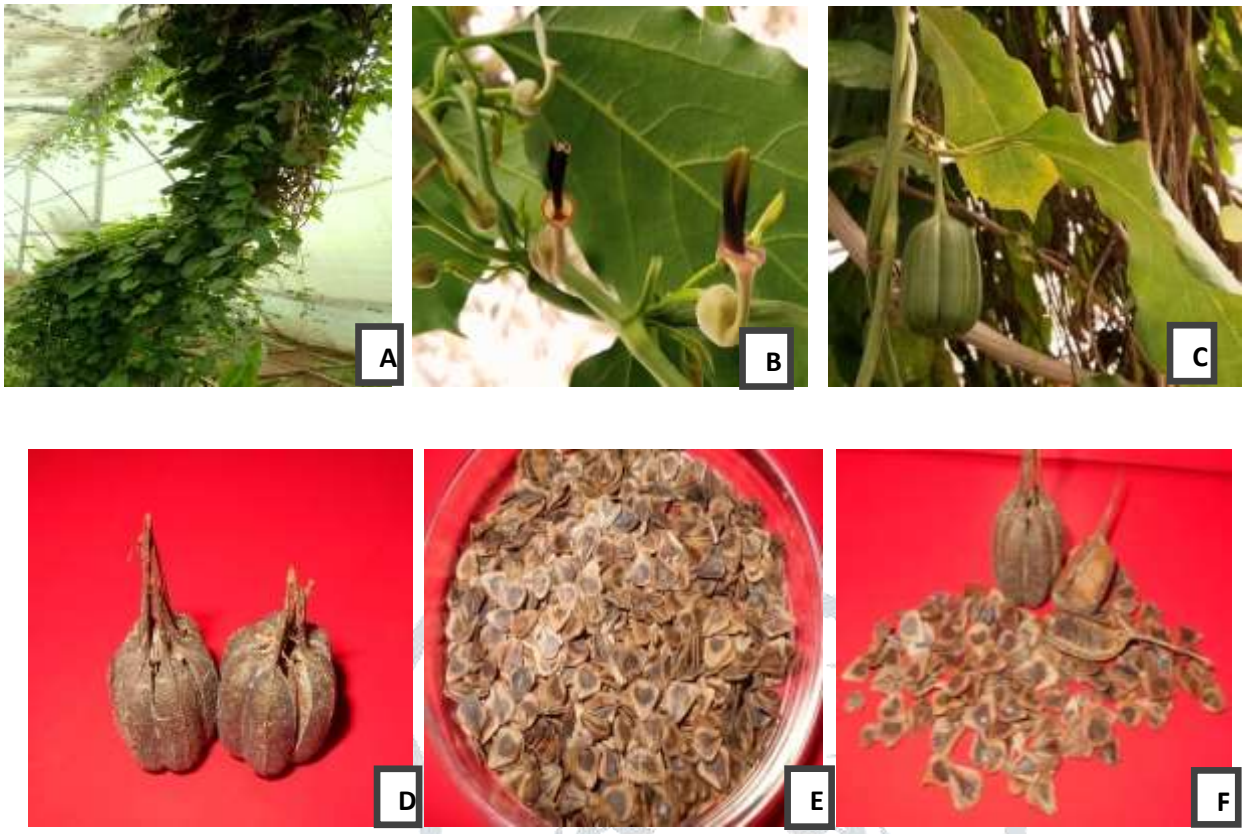
and their secondary metabolites should thus be a priority in present and future efforts towards conservation and utilization.

Indian birthwort (*Aristolochia indica* L.*)* is one of the most important plant occurring all over the India and possesses a great medicinal value thus, the plant is used in *Siddha*, *Ayurveda*,*Unani* and other indigenous system of medicine. It is a large climbing shrub with woody rootstock. It is commonly known as Ishwarmul in Hindi.

Other vernacular names of this plant are given in table 1.

Table 1

Language	**Vernacular Names**
Hindi	Ishwarmul, Hooka-bel
English	Indian birthwort, Dutchman's pipe
Sanskrit	Ahigandha, Arkamula, Ishwari, Nakuli, Sunanda
Urdu	Zarawand
Bengali	Isarmul, Isheri, Ishormul
Telugu	Iswaraveru, Isvara, Eswaramuli, Govila, Dulagovela
Tamil	Adagam, Isura, Isuraver, Isadesatti, Eesvaramuli
Gujarati	Ruhimula, Sapsan, Iswarimool
Marathi	Sapasan
Malayalam	Iswaramuli, Eswamulla, Garudakkoti, karaleyan
Kannada	Iswaberusa, Toppalu, Ishwari-beru



A. *Aristolochia indica* in natural condition **B.** Flowering **C.** Fruit (unripe) **D.** Dried fruits **E.** Seeds **F.** Fruits and seeds

Taxonomic Classification : (Table 2)

Kingdom	Plantae
Division	Tracheophyta (vascular plants)
Class	Magnoliopsida (Dicotyledones)
Order	Piperales
Family	Aristolochiaceae (Birthwort family)
Genus	*Aristolochia*
Species	*Aristolochia indica* Linn.

Distribution and Botanical Description :

Aristolochia indica is found mainly in the tropical, sub tropical and Mediterranean regions of the world. In India, the plant is distributed in the plains and low-hilly areas including Bengal, Assam, Chittagong.[5] The plant is also found in Sri-Lanka, Bangladesh, Nepal[6,7], China[8], Taiwan [9](Hou 1996), Japan[10,11], Thailand[12] and Malaysia.[13]

The plant grows into a simple bush during the initial years. Leaves are green, simple, glabrous, alternate, entire with less or more undulate margins, oblong-obovate to sub-pandurate, apex of lamina is acuminate, 2-5 inches long and 3-5 nerved present at the base with short petiolated. Flower purple-white color, 3.5- 4.5 cm. long, axillary raceme. The shape of the flower is a funnel shaped and has close resemble to cobra's hood with purplish perianth, having a glabrous, inflated, pale-green, lobed base. The swollen base narrowed into cylindrical tube which is terminating in a funnel shaped mouth structure. The basal surface of the flower is pale-green and the rim of open area (mouth/ lip) is dark purple or brown in colour and the inner surface of the flower is hairy. Flower is zygomorphic and foetid in odour and the blooming period found from June to October. Stamens - 6, adnate and ovary inferior, bicarpellary and have 6 locules with axile placentation. Fruits are oblong-spherical capsule 2-4 cm long having 6 chambers containing numerous numbers of seeds, which are black, flat or compressed, 0.5-0.7 cm, triangular and winged all around. The fruiting season of the plant is between November to March.[14] Root is long and cylindrical having a few irregularly bent. The roots are strongly bitter in taste and have camphoraceous odour.

The potency of *Aristolochia indica* seeds decreases viability after some time as a result natural germination becomes difficult. The plant has been reported to be rare, endemic and endangered in Assam, India.[15,16]

Traditional and Medicinal Uses :

Aristolochia indica is used both internally and externally to treat various diseases. The plant has been used in sickness of *Vata, Pitta* and *Kapha.* According to Ayurvedic and Yunani medicine, the plant is used in snake bite, roots are used to treat bowl complaints in childrens and joint pain and seeds are used in dysphoea of children, inflammation, dry cough and biliousness. In Ayurveda classical texts such as *Charaka samhita* and *Astanga Hydayam* the plant is also used in different Ayurvedic preparations to treat various external and internal diseases such as *Mahavishagarbha talia* for joint pains and stiffness, *Maha Paisacika Ghrta* for intermittent fever, epilepsy and insanity and *Puga khanda* for gastric problems.[17,18]

The drug Ishwari also known as *Nakuli* in *Samhitha Granthas* is obtained from *A. indica*. It also prescribed in *Charaka samhita, Sushruta samhita* and *Samhitha Granthas* to treat different illness and conditions such as *apasmara* (epilepsy), *unmade* (Schizophrenia), *vrana* (wound), *sheetha jwara* (fever with rigor), *ekanga shopha* (oedema), *sarpa visha* (snake bite) etc.

Nakuli has been mentioned for the preparation of *taila* (medicated oil) for *sheetha jwara* and *ghrta* (medicated ghee) for *jwara, unmada* and *apasmara* in *Caraka samhita*.[19] In *Sushruta samhita* the drug has been prescribed for the preparation of *lepa* for *Sarpa visha*.[20] *Acharya Vagbhata* used this drug as *lepa* for *ekanga shopha* and preparation of oil for *sheetaja jwara*.[21]

The government of Sri Lanka published a Ayurvedic pharmacopeia of so many herbal preparations among which the plant *A. indica* is also used. In the pharmacopeia *A. indica* (sapsanda) is ingredient of only ten preparations, in these preparations there are six *thaila* (herbal oil), two *kashaya* (herbal decoction), one *guliya* (herbal pil) and one *kwatha* (alcohol based infusion).[22]

In the classical text the plant parts also mentioned in their ingredient list of some preparations. In *Charak Samhita*, roots of the *A. indica* used as an ingredient in *Palamkash adithailam* for epilepsy, *Mritha Sanjeevaniagada* and *Paramaagada* for snake poison and other kind of poisonous bites, *Agurvadithailam* (medicated oil) for fever. In *Ashtanga Hridaya*, roots of the *A. indica* also used as an ingredient in a compound preparation for inflammation (external use), tumor (external use) and medicated ghee for snake bite.[23]

The plant is known as snakeroot and traditionally has been used for snake bite and postpartum infections. Crushed seeds are mixed with water and applied locally to reduce inflammation. Whereas, powdered root mixed is with honey which helps to treat cough, leprosy and ulcers. Juice extracted from the whole plant is also used to control diarrhoea. Paste made from leaves is used in the treatment of scabies.[24] However, dried leaves when taken with lukewarm water helps in treatment of anaemia, respiratory disorders and alleviate fever.[25]

Other traditional uses of different parts of this plant is given in the below table 3.

Table 3

S.No.	Plant Parts	Uses
1.	Whole plant	Ulcer, leprosy, fever, bowl troubles, cholera and poisonous bites[26,7]
2.	Leaves	Skin diseases[27]; diarrhea, bowl complaints, intermittent fever, inflammation and snake bite.
3.	Roots	Antidote of poisonous bites of snake, insects and scorpion strings, leprosy[27]; wound healing, scabies, bronchial asthma, cough, indigestion, gas troubles from stomach.
4.	seeds	Inflammation, biliousness, dry cough and dyspepsia[28]

Phytochemistry : A variety of chemical compounds have been found in the various parts of the plant. Table 4 depicted the list of chemical constituents of the plant. (Table 4)

Table 4 - Chemical constituents of different parts of *A. indica* L.

S.No.	Plant part	Phytochemical
1.	Leaves	Alkaloids, steroids, tannins, triterpenoids, caumarines and phenolic compounds[29]
2.	Stem	Trans-pinocarveol, a-pinene, pinocarvone[7]
3.	Roots	Ishwarane, aristolochene[30]; aristolindiquinone, aristololide, 2-hydroxy-1-methoxy-4Hdibenzoquinoline-4,5-(6H)-dione, cephradione, aristolactum IIa, β-sitosterol-β-D-glucoside aristolactum glycoside I, stigmastenones II and III, methylaristolate, ishwarol, ishwarone, aristolochene[31,32]; lignin, savinin.

4.	Flower	Steroids, carbohydrates, flavonoids and saponins[29]
5.	Fruit	Alkaloids, anthroquinones, anthracene derivatives, coumarines, polyuronoids, triterpenoides, tannins, essential oils and kampherol[33]

Pharmacological Profile : From various research article studies it was found that the almost all the parts of the *A. indica* are used to treat different aliments and diseases. (Table 5)

Table 5 – Partial list of pharmacological activitiy of *A. indica* L.

S.No.	Plant parts	Activity	Extract/ Form	Reference
1.	Whole plant	a. Antimicrobial	Butanolic extract	34
		b. Antibacterial	Ethanolic and aqueous extract	35
		c. Antivenom	Methanolic extract	36
		d. Anti-inflammatory	Dried plant extract	14
			Methanolic extract	37
		e. Anticancer	Chloroform extract	38
		f. Antidiabetic	Methanolic extract	37
		g. Anti fertility	Ethanolic and Petrolium ether extract	39

2.	Leaves	a. Antibacterial	Methanolic, petroleum ether, acetone and aqueous extract	40
		b. Antioxidant	Acetone extract Methanol extract	38 41
		c. Antivenom	Paste Juice	42 43
		d. Antimicrobial	Methanolic, choloform and petroleum ether extract	44
3.	Stem	a. Antibacterial	Methanolic, petroleum ether, acetone and aqueous extract	40
4.	Roots	a. Antivenom b. Interceptive	Paste Petrolium ether, chloroform and alcohaol extract	42 45
		c. Anti-implantation	Alcoholic extract	45
		d. Antifertility	Crude alcoholic extract	46
		e. Antimicrobial	Ethanolic extract	47
		f. Anti diarrheal	Ethanolic and aqueous extract	48
5.	Seeds	a. Anti-implantation	Benzene extract	49

Micropropagation Study :

An efficient protocol of *in vitro* regeneration for the plant *A. indica* reported, Shoot differentiation from leaf base and internode, multiple shoots formation from shoot tip and nodal explants and regeneration from the callus were observed in Murashig and Skoog's (MS) supplemented with cytokinins and auxins at various concentration.[50] Micropropagation of the plant through axillary buds and cultured in MS medium containing different concentration of KN, BA, GA_3 and Adenine sulphate (Ads) alone as well as in combinations (KN+GA_3 , KN+BA, KN+Ads). The adenine sulphate stimulate the regeneration alone and also in combination.[51] *In vitro* plant regeneration of *A. indica* using the shoot tip and nodal explants and inoculated in MS medium fortified with different cytokinins at different concentration. The nodal explants showed higher growth rate than the apical buds.[52]

Micropropagation of the plant using different explants like shoot tips, nodal segments, intermodal segments & tender leaves.[53] Tissue culture of the Indian birthwort through the nodal explants and cultured on various nutrient medium viz. MS medium containing BA, Woody Plant Medium (WPM), Gamborg (B_5) medium, Nitsch and Nitsch (NN) medium and Schenk & Hildebrandt (SH) medium supplemented with different cytokinins (BA,TDZ, Ads) and auxins (IBA, IAA, NAA).[54] Effect of various culture media viz. MS medium, White's medium, Gamborg (B_5) medium etc. on *in vitro* regeneration of ishwarmul through various explants viz. cotyledons, stem segments and leaf base. Leaf base showed highest callusing efficiency and multiple shooting in from the callus. IBA was found to be the best for rooting.[55]

Chromosome Study :

The karyomorphology of three species of *Aristolochia* including *A. indica* were studied. *A. indica* contain diploid chromosomes (2n = 12). In these 12 somatic chromosomes six are median and six are metacentric chromosomes.[15] One pair of chromosome with secondary constriction was previously reported in the plant which is probably indicated a primitive nature of *A. indica*.[56]

Conclusion :

Aristolochia indica is well known as an important medical plant in the traditional *Ayurvedic* and *Yunani* system of medicine and it is used in numerous diseases (e.g. poisonous bites, joint pain, dry cough and diabetes). Additionally, it is ethnopaharmacologically important in the Indian state of Karnataka (Uttara Kannada), Southern part of Tamilnadu, Seshachalam hills (Andhra Pradesh), Vizianagaram (Andhra Pradesh) and in other regions. *Aristolochia indica* is part of the traditional tribal medicine (e.g. the Kurumba tribals, ethnic people of Rapur forest, and others). The Aristolochic acid (AA) is the chief ingredient of the plant. This AA, contribute to carcinogenic and genotoxic properties and other harmfull effects. Plant posses immunomodulatory, anti-inflammatory, anti-venomous, antipyretic, antispermatogenic, abortifacient and antifertility properties. The previous phytochemical investigations reveals the presence of alkaloids, tannins, steroids, flavonoids, cadiac glycosides, essential oil and saponins. The vegetative cuttings and seeds showed poor germination.[22] Thus the natural population of the plant is on decline and therefore, there is urgent need for conservation of this medicinally important plant.

References :

1. Wyk BEV, Wink M. Medicinal plants of the world. Brazil, *Pretoria*. 2004.
2. Handa SS. Herbal raw materials and traditional remedies. *Eastern Pharmacist.* 1995; 38: 23-25.
3. Buss AD, Waigh RD. Natural products as leads for new pharmaceuticals. Berger's medicinal chemistry and drug discovery. 1995; ed 5: 983-1033.
4. Zhong Shu Y. Recent natural products based drug development: A pharmaceutical industry perspective. *J Nat Prod.* 1998; 61: 1053-1071.
5. Dey A, De JN. *Aristolochia indica* L. : a review. *Asian Journal of Plant Science.* 2011; 10 (2) : 108-116. DOI - 10.3923/ajps.2011.108.116
6. Murugan R, Shivanna KR, Rao RR. Pollination biology of *Aristolochia tagala*, a rare species of medicinal importance. *Curr Sci.* 2006; 91 : 795-798.

7. Kanjilal PB, Kotoky R, Couladis M. Chemical composition of stem oil of *Aristolochia indica* L. *J Essential Oil Res*, 2009; 21 : 1-2. DOI - https://doi/1041-2905/09/0001-01$14.00/0
8. Hwang SM, Kelly LM, Gilbert MG. Aristolochiaceae. In: Wu, ZY & Peter, HR (eds) *Flora of China*, Beijing: Science Press & St. Louis: Missouri Botanical Garden Press, 2003; 5 : 246–269
9. Hou D. *Aristolochia*. In: Huang, TC (ed.) *Flora of Taiwan*, Taipei: Epoch Publishing, 1996; 2 : 636–642.
10. Murata J. Aristolochiaceae. In: Iwatsuki (ed.), *Flora of Japan, K., KODANSHA*, 2006; 2a : 366–387.
11. Watanabe K, Kajita T, Murata J. Chloroplast DNA variation and geographical structure of the *Aristolochia kaempferi* group (Aristolochiceae). *Am J Bot.* 2006; 93(3): 442–453.
12. Phuphathanaphong L. Aristolochiaceae. In: Smitinand, T & Larsen, K (eds.) *Flora of Thailand*, Bangkok: *The Chutima Press.* 1987 ; 5 : 1–31.
13. Hou D. Aristolochiaceae. In: Steenis, C (ed.) *Flora Malesiana*, National Herbarium of the Netherlands, 1984; 10(1) : 53–108.
14. Das R, Kausik A, Pal TK. Anti-inflammatory activity study of antidote *Aristolochia indica* to the venom of *Heteropneustes fossilis* in rat. *J Chem Pharm Res.* 2010; 2 : 554-562.
15. Sarma B, Tanti B. Karyomorphology of three species of *Aristolochia* – rare and endemic plants of Assam, India. *Caryilogia, International Journal of Ctology. Cytosystematics and Cytogenetics.* 2015; 68(2) : 154-158. DOI- http:s//doi.org/10.1080/00087114.20 15.1032604
16. Sarma B, Baruah PS, Tanti B. Habitat distribution modeling for reintroduction and conservation of *Aristolochia indica* L. a threatened medicinal plant in Assam, India. *Journal of Threatened Taxa.* 2018;10(11):12531-12537.
17. Acharya Agnivesa, Charaka Samhita. Acharya Jadavji Trikamji, Varanasi: Choukambha Sanskrit Sansthan 2004; 738, 422,472,476.
18. Acharya Vagbhata, Ashtanga Hrudaya. Pt. Bhisagacharya Harishastriparadkarvaidya.Varanasi: Nirnay Sagar Press 2002;.569, 707, 956.
19. Acharya Jadavji Trikamji, Editor. *Charaka Samhita* (Acharya Agnivesa). Varanasi:

Choukambha Sanskrit Sansthan; 2006; 422,472,476.

20. Acharya Jadavji Trikamji Editor. Sushruta Samhita (Acharya Sushruta). Varanasi: Choukambha Orientalia; 2003; 592.
21. Bhisagacharya Harishastri Paradkar Editor. Ashtanga Hrudaya (Acharya Vagbhata). Varanasi: Nirnay Sagar Press; 2002; 569,707.
22. Wijesinghe W, Senaka Pilapitiya S, Hettiarchchi P, Wijerathne B and Siribaddana S. Regulation of herbal medicine use based on speculation? A case from Sri Lanka, *Journal of Traditional and Complementary Medicine*, (2016) : 1-3.
23. Rajashekharan S, Pushpangadan P, Ratheesh Kumar PK, Jawahar CR, Nair CPR And Sarada Amma L. Ethno-Medico-Bot Anical Studies Of Cheriya Arayan-And Valiya Arayan- (*Aristolochia indica*, Linn; *Aristolochia tagala*, Cham). *Ancient Science of Life*, 1989; 9 (2) : 99-106.
24. Neelima, M., G.P. Prasad, G. Sudarsanam, G.P. Pratap and B. Jyothi, Ethnobotanical studies in Rapur forest division of Nellore district in Andhra Pradesh. *Life Sci. Leaflets*, 2011; 11: 333-345.
25. Binorkar SV, Parlikar GR, Kulkarni AB. Bio-efficacy and phyto-pharmacological activities of *Aristolochia Indica. Spatula DD, 2015*, 5(3) : 1-6.
DOI: 10.5455/spatula.20151124064158
26. Krishnaraju AV, Rao TVN, Sundaraju D, Vanisree M, Tsay HS, Subbaraju GV. Assessment of bioactivity of Indian medicinal plants using Brine shrimp (*Artemia salina*) lethality assay. *Int J Applied Sci Eng.* 2005; 3 : 125-134.
27. Nehra A, Srivastava DK, Verma P, Singh J. Organogenesis and in-vitro plantlets production of *Aristolochia indica* (Ishwarmul). *International Journal of Plant Sciences.* 2017; 9(23) : 4259-4261.
28. Shah NS, Husaini AM, Shirin F. Micropropagation of the Indian birthwort *Aristolochia indica* L. *International Journal for Biotechnology and Molecular Biology Research.* 2013; 4(6) : 86-92.
29. Mohammad F, Bairy S, Kumar NKS. Analytical standards for root and leaf of Ishwari- *Aristolochia indica* Linn. *Journal of Science and Innovative Research.* 2015; 4(2) : 94-99. www.jsirjournal.com

30. Govindachari TR, Mohamed PA, Parthasarathy PC. Ishwarane and aristolochene, 2 new sesquiterpene hydrocarbons from *Aristolochia indica* D. *Tetrahedron.* 1970; 26 : 615-619.
31. Achari B, Chakrabarty S, Bandyopadhyay S, Pakrashi SC. A new 4,5-dioxoaporphine and other constituents of *Aristolochia indica. Heterocycles.* 1982; 19 : 1203-1206.
32. Achari B, Bandyopadhyay S, Saha CR Pakrashi SC. A phenanthroid lactone,steroid and lignans from *Aristolochia indica*. *Heterocycles*. 1983; 20 : 771-774.
33. Bawankule D, Chaturvedi A. Phytochemical investigation of *Aristolochia indica* L. an ethno-medicine on snake bite. *Int J of Life Sciences.* 2014; A2 : 172-174. http://www.ijlsci.in
34. Ravikumar S, Nazar S, Nuralshiefa A, Abideen S. Antibacterial activity of traditional therapeutic coastal medicinal plants against some pathogens. *J Environ Biol.* 2005; 26: 383-386.
35. Venkatadri B, Arunagirinathan N, Rameshkumar MR, Latha R, Dhanasezhian A, Agastian P. *In vitro* antibacterial activity of aqueous and ethanol extracts of *Aristolochia indica*_and *Toddalia asiatica* against multi-drug resistant bacteria. *Indian J Pharm Sci.* 2015; 77(6) : 788-791.
36. Meenatchisundaram S, Parameswari G, Michael A. Studies on antivenom activity of *Andrographis paniculata* and *Aristolochia indica*_plant extracts against *Dablia russelli* venom by *in vivo* and *in vitro* methods. *Indian Journal of Science and Technology.* 2009; 2(4) : 76-79.
37. Janani N, Revathi K. *In vitro* evaluation of *Aristolochia indica* for its anti-inflammatory and anti-cancer efficacy. *International Journal of Current Research in Medical Science.* 2018; 4(6) : 23-30. DOI-http://dx.doi.org/10.22192/ijcrms.2018.04.06.004
38. Subramaniyan V, Saravanam R, Baskaran D, Ramalalingam S (2015). In vitro free radical scavenging and anticancer potential of *Aristolochia indica*_L. against MCF-7 cell line. *International Journal of Pharmacy and Pharmaceutical Science.* 2015; 7(6) : 392-396.
39. Pandey D, Bisht M, Singh NY. Antifertility and antiestrogenous activity of sesquiterpene from the roots of *Aristolochia indica* L. *Indian J Exp Biol.* 1993; 15 : 1197-1198.
40. Murugan M, Mohan R. Efficacy of different solvent extracts of *Vitex trifolia* L. and *Aristolochia indica* L. for potential antibacterial activity. *Science Research Reporter*. 2012; 2(1) : 110-114.

41. Bhatnagar S, Maharana S. Phytochemical, cytotoxicand antioxidant activities of leaf extractsof *Aristolochia indica* (Linn). *Advances in Biology and BioMedicine.* 2016; 1(1) : 1-5. https://www.researchgate.net/publication/289893668
42. Jeeva S, Kiruba S, Mishra BP, Venugopal N, Dhas SSM, Regini GS, Kingston C, Kavitha A, Sukumaran S, Raj ADS, Laloo RC. Weeds of Kanyakumari district and their value in rural life. *Int J Trad Knowl.* 2006; 5(4) : 501-509.
43. Kritikar KR, Basu BD. Indian medicinal plants. 2003; 3 : 2122-2124.
44. Rajanna L, Sharma GSS. *In vitro* antimicrobial efficacy of *Aristolochia indica*_Linn: an important medicinal plant. *Research and Reviews : Journal of Botany*. 2017; 6(3) : 1-6.
45. Pakrashi A, Pakrasi P. Biological profile of p-coumaric acid isolated from *Aristolochia indica*_Linn. on fertility of female mice. *Experientia.* 1978; 34 : 1192-1193.
46. Pakrashi A, Pakrasi P. Antifertility efficacy of the plant *Aristolochia indica*_Linn. on mouse. *Contracepation*. 1979; 20 : 49-54.
47. George M, Pandali KM. Investigation on plant antibiotics. Part IV. Further research for antibioticsresistance in Indian medicinal plants. *Indian J Med Res.* 1949; 37 : 169-181.
48. Dharmalingam SR, Madhappan R, Ramamurthy S, Chidambaram K, Srikant MV, Shanmugham S, Senthil Kumar KL. Investigation on antidiarroheal activity of *Aristolochia indica* Linn. root extract in mice. *Afr J Tradit Complement Altern Med*, 2014; 11(2) : 292-294. DOI-http://dx.doi.org/10.4314/ajtcam.v11i2.11
49. Dar NA, Mittal DK. Effect of *Aristolochia indica*_seed extracts on ovarian and uterine activities in albino rats. *World Journal of Pharmacy and Pharmaceutical Sciences.* 2019; 8(10) : 874-879. DOI-10.20959/wjpps201910-14826
50. Selvakumar V, Rajappan AP. Stimulation of micropropagation of the medicinal plant *Aristolochia indica* L. through nodal explants by adenine sulphate. *The Asian Journal of Plant Science and Biotechnology*. 2008 ; 2 (1) : 39-41.
51. Soniya EV, Sujitha M. An efficient in vitro propagation of *Aristolochia indica* . *BIOLOGIA PLANTARUM*. 2006; 50(2) : 272-274.

52. Chandra Prabha A, Rama Subbu R, Kulloli SK. Micropropagation of *Aristolochia indica* L. (Aristolochiaceae). *Ecol Env and Cons.* 2008; 14(1) : 409-411.

53. Theriappan P, Saranya Devi K, Dhasarathan P. Micropropagation studies of medicinal plant *Aristolochia indica. International Journal of Current Research.* 2010 ; 11 : 200-204

54. Shah NS, Husaini AM, Shirin F. Micropropagation of the Indian birthwort *Aristolochia indica* L. *International Journal for Biotechnology and Molecular Biology Research.* 2013; 4(6) : 86-92. DOI - 10.597/IJBMBR2013.0166

55. Nehra A, Srivastava DK, Verma P, Singh J. Organogenesis and in-vitro plantlets production of *Aristolochia indica* (Ishwarmul). *International Journal of Plant Sciences,* 2017; 9(23) : 4259-4261.

56. Sharma AK, Verma B. The somatic chromosomes of five species of Aristolochia. *Phyton Rev Internac Bot Expt* Argentina. 1959; 12:101–108.