Folk therapeutic uses of ethnomedicinal plants to cure gynecological disorders- A Meta-Analysis of West Bengal State in India

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Reviews

Abstract

Background. The present paper is an ethnopharmacological review of plants used to treat gynecological ailments by the indigenous communities of West Bengal. The review abridged the data collected on the plants used to treat gynecological ailments, the plant parts used, and their modes of preparation and administration documented by reviewing the past studies from West Bengal, India.

Methods. Systematic review of published literature was done to catalogue, collate and synthesize all available documented evidence on the topic through standardized methods of systematic review protocol. We have reviewed different scientific literature published from 2003 to 2021 related to ethnomedicinal plants used for treating gynecological ailments by the indigenous communities of West Bengal state in India. Only those references where field-based surveys reporting first-hand information on ethno-medicinal plants used to treat human ailments were reviewed. In total we retrieved 50 research papers on ethnomedicinal plants of West Bengal and finally after screening 26 research papers were selected which had references of gynecological disorders/problems for analysis.

Result. A total of 114 plant species represented by 63 families and 107 genera were found documented for their traditional therapeutic uses against gynecological ailments by the indigenous communities in the state. Among all the plant parts, roots were the most frequently utilized plant part and herbal remedies for the gynecological ailments were prepared as paste, extract or as solution.

Conclusion. Traditional knowledge of medicinal plants used to treat gynecological ailments in West Bengal is not very common. However, the review is a useful inventory highlighting the medicinal plants particularly for gynecological ailments which can be used as reference for future documentation and research on formulation of new drugs.

Keywords. Gynecological problems; Ethnomedicinal plants; Traditional knowledge; West Bengal

Background

Gynecological diseases generally involving diseases related to the female reproductive organs and are considered a major social problem to public health. Worldwide, women are distressed by a spectrum of gynecological disorders and ailments which are discrepant in nature, with common feature and lack a curative medical treatment (Afrin *et al.* 2021). Promoting both primary and secondary prevention is essential to improve reproductive health of the human society (Izetbegovic *et al.* 2013). Indigenous communities are generally less empowered but traditionally and culturally rich (Gupta 2018). The health care systems of the indigenous communities are still based on traditional knowledge system of curing diseases including the gynecological problems also (Vineeta *et al.* 2021).

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Plant based traditional remedies are the primary therapy for these communities even today (Pala et al. 2019, Raj *et al.* 2018). Different indigenous communities have different mode of preparation and sometimes same to treat different diseases which are passing from generation to generation (Lawal *et al.* 2013, Patel 2012). Even today medical facilities are still inaccessible to many rural and indigenous population of the country. The only alternative in such a situation for these populations to meet their health requirements is from traditional or folk medicines which are cheap, easily available and acceptable. Some medicinal plants are also phytoestrogenic or phytoprogesteronic (van Andel *et al.* 2014). Herbs are considered beautiful allies for women to use throughout their lives because of their high medicinal values and least side effects. From the olden day's herbs are mostly used by women *viz*. preferring herbs for beautifying their skin and now the practice is increasing. They are nourishing, comforting, and have stood the test of time for millions of women over thousands of years (Overk *et al.* 2008). However, for gynecological complaints women are generally bashful to go for medicaments from hospitals. Instead, they prefer to consult private, local medicinal practitioners.

In India, the state of West Bengal has varied climatic conditions and occupies rich biodiversity of medicinal plants along with large number of indigenous communities who follows their own culture and therapies. Traditional health care system is totally based on herbals and its importance in conserving biodiversity providing clues to open a gate to new areas of research is now well recognized. However, information on the uses of plants for medicine is lacking in many interior areas. Developmental activities and changing socio-economic conditions have implications on traditional knowledge. So, it is indeed necessary to conserve these practices of knowledge in particular to indigenous communities who still rely on their traditional health care system including gynecological problems. Review of literature reveals that most of the ethnobotanical-ethnopharmacological studies are documentation of ethnomedicinal plants with their utilization as folk or traditional medicines but rarely the studies or reviews concentrated on listing the medicinal plants used for a particular disease or ailments except a few like for stomach disorders (Biswakarma *et al.* 2017a; Vineeta *et al.* 2018), jaundice and other liver ailments (Biswakarma *et al.* 2017b) and dermatological problems (Vineeta *et al.* 2020). In West Bengal, it was reported that the cuts and wounds, bites and stings, stomach related problems, dermatological problems, liver related problems and gynecological problems are most common among the indigenous communities and were commonly treated through ethnomedicinal plant-based therapies (Pala *et al.* 2019, Raj *et al.* 2018, Roy *et al.* 2022, Vineeta *et al.* 2021). Therefore, this review aims to prepare an annotated list of medicinal plants used to cure gynecological problems by the indigenous communities of West Bengal documented by previous studies.

Material and Methods

Systematic review of published literature from West Bengal during 2001-2021 was done to catalogue, collate and review all the available documented studies on therapeutic uses of ethnomedicinal plants by indigenous communities of West Bengal, India (Anon. 2017, 2018, Berger-Tal *et al.* 2019, Petticrew & Roberts 2006) through standardized methods of systematic review protocol (Haddaway *et al.* 2018). Stepwise process is given in Table 1.

Table 1. Steps of meta-analysis

Step 1	Formulating the research problem and target area of the study	Folk therapeutic uses of ethnomedicinal plants to cure gynaecological disorders in indigenous communities of West Bengal, India- A Meta-Analysis
Step 2	Developing and validating the review	Review protocol by Haddaway *et al.* (2018)
Step 3	Searching the literature	Search engines: Google and Google Scholar, Research Gate, Science Direct, Academia, Springer Link, Web of Science Keywords and strings for the search: • 'Ethnomedicine' OR 'Ethnomedicinal' OR 'Kitchen-garden' OR 'Ethnobotany' OR 'Ethnobotanical' OR 'Ethnopharmacology' OR 'Ethnopharmacological' OR 'Medicinal plants' OR 'Traditional medicines' OR 'Folk medicines' OR 'Neutraceutical' + 'Indigenous/ethnic/forest fringe/tribal/rural community/people' + West Bengal/northern or southern part of West Bengal/Terai region of West Bengal/foothills of eastern Himalayas/Dooars/sub-humid region of West Bengal/Darjeeling Himalayas Additional restrictions in search • Publication language: English • Publication year: 2003-2021
Step 4	Screening for inclusion	The number and Criteria for inclusion/exclusion was noted Screening procedure • Title Screening

		• Abstract Screening • Full text Screening
Step 5	Assessing quality	Field based ethno-medicinal surveys reporting first-hand information on ethno-medicinal plants
Step 6	Extracting data	The full-text review was processed in a synoptic table on ethnomedicinal plant species, indigenous community, plants parts used, mode of preparation and therapy.
Step 7	Analysing and synthesizing data	Synthesis of information based on available data and Meta-analysis
Step 8	Reporting the findings	

Systematic and progressive screening of the collected publications was done after removing the duplicates. The stepwise screening with three levels: title, abstract and full text was carried out with fixed exclusion and inclusion criteria. We could find a total 50 research papers on ethnomedicinal plants from West Bengal but after screening with gynecological reference we found only 26 publications with this reference (Fig.1). The published scientific names the medicinal plant species were verified from online source like http://www.the plantlist.org and http://www.tropicos.org. The information found from the selected publications was used to prepare a comprehensive list of species with scientific names, local/ vernacular name(s), part used purpose of uses, mode of application and sources. For many species different synonyms were used in different publications. In those cases, only valid botanical names were retained, and synonyms were merged with the valid botanical name.

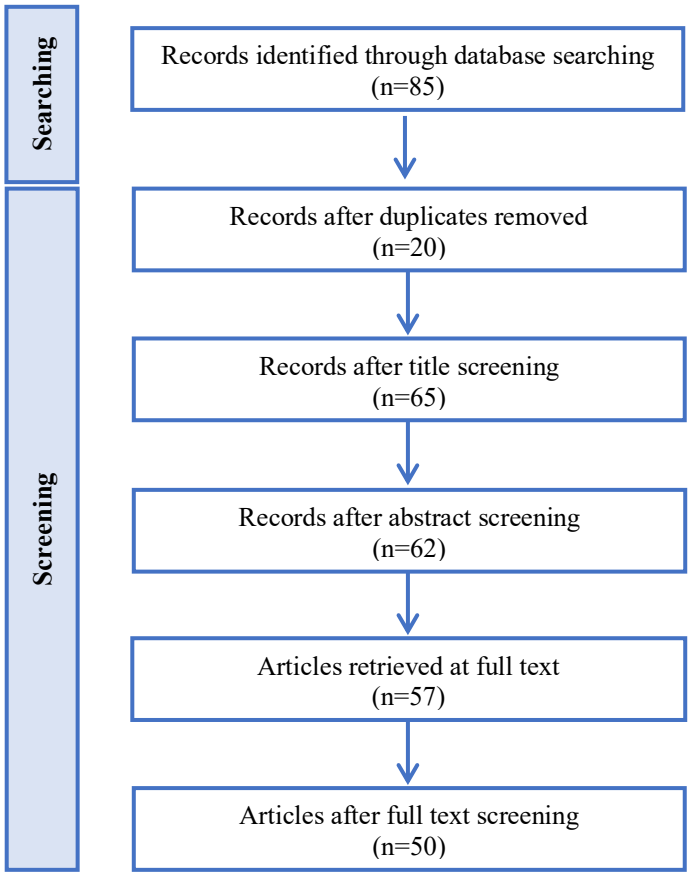

Figure 1. Flowchart that illustrates the review process and articles retrieved related to ethnomedicinal plants to cure gynaecological disorders in indigenous communities of West Bengal

Results and Discussion

Ethnomedicinal plant diversity

The ethnomedicinal documentations of West Bengal were mostly general (i.e., list of plant species with the disease they cure) for a particular location, region or district without any inter-community analysis or any other analysis. However, the studies did mention the indigenous communities of their study area. Only few studies focused ethnomedicinal plant species for a particular disease (Biswakarma *et al.* 2017a, b, Vineeta *et al.* 2020). The analysis resulted into a list of 114 plant species represented by 63 families and 107 genera which were used to treat different gynecological problems suffered by the indigenous communities in West Bengal (Table 2, Fig. 2).

Table 2. Ethnogynecological plant species of West Bengal with their uses and mode of application

Family Name Botanical Name	Habitat/ Part used	Used to treat	Mode of application	References
Acanthaceae				
Acanthus ilicifolius L.	H, R	Abortifacient	Root paste is taken orally	Chaudhury *et al.* 2018
Andrographis glandulosa Nees	H, L	Leucorrhea	Leaf decoction taken orally	Chaudhury *et al.* 2018
Barleria cristata (L.)	H, L	Abortifacient	Crushed root with rice alcohol induce abortion	Mitra & Mukherjee 2009
Aloaceae				
Aloe vera (L.) Burm. f.	H, L	Leucorrhea	Mucilage of a mature leaf mixed with 1-2 pinch sugar	Banerjee *et al.* 2016
Amaranthaceae				
Achyranthes aspera L.	H, R, L	Abortifacient, Placenta retention	Root paste mixed with lukewarm water to stop bleeding after abortion, for fatal placenta retention, mature leaves are fried with 10ml of ghee and take in every after 3 hours and continued for 3 days	Ghosh *et al.* 2013 Mandal *et al.* 2014, 2020 Mitra & Mukherjee 2009
Aerva aspera L.	H, R	Dysmenorrhea	Roots are pounded with pepper into a paste for making peels to be taken once a day for 25 days	Mondal & Mallick 2016
Aerva lanata L. Juss ex Schult	H, R	Abortifacient, Dysmenorrhea	Fresh root is used as a stick for inducing abortion, Root powder is taken orally to treat dysmenorrhea	Mitra & Mukherjee 2009 Chaudhury *et al.* 2017, 2018
Alternanthera philoxiroides (Mart) Griseb.	H, Wp	Abortifacient	A piece of fresh plant used as stick to induce abortion	Mitra & Mukherjee 2009
Amaranthus spinosus L.	H, Wp, R	Menorrhagia, Leucorrhea	Whole plant is used for menorrhagia and Root decoction is taken orally for leucorrhea	Chaudhury *et al.* 2018
Amaranthus viridis L	H, R	Abortion	Raw root taken orally	Mondal & Samanta 2014
Annonaceae				
Annona reticulate (L.)	T, S	Abortifacient	Seed powder with black pepper seed	Mitra & Mukherjee 2009
Annona squamosa (L.)	T, S	Abortifacient	Seeds used as Abortifacient	Bose 2011 Dey *et al.* 2009
Anacardiaceae				
Semecarpus anacardium (L.)	T, R	Abortifacient	Fresh root bark is used to induce abortion	Mitra & Mukherjee 2009
Apocynaceae				
Hemidesmus indicus (L.) R. Br. ex Schult.	H, R	Leucorrhea	Root powder is taken orally	Chaudhury *et al.* 2017, 2018
Rauvolfia tetraphylla L.	T, R	Leucorrhea	Root powder is taken orally	Chaudhury *et al.* 2018

Arecaceae				
Phoenix acaulis Roxb	P, R, Fr	Menorrhagia, Dysmenorrhea	Root powder and raw fruit is consumed	Chaudhury *et al.* 2018
Aristolochiaceae				
Aristolochia indica (L.)	Cr, R	Abortifacient	Fresh root stick is used to induce abortion or fresh root paste with asafoetida is used as abortifacient	Mitra & Mukherjee 2009
Asclepiadaceae				
Calotropis gigantean (L.)	H, R	Leucorrhea	Consume root paste used orally	Chaudhury *et al.* 2018
Hemidesmus indicus R. Br.	H, R	Increase lactation	Root powders with cow milk are given to mother to promote production of breast milk	Mondal & Mallick 2016
Asparagaceae				
Asparagus racemosus Willd.	H, R, L	Leucorrhea	Root and leaf both used to treat	Chaudhury *et al.* 2018
Asteraceae				
Centratherum anthelminticum (L.) O. Kuntze	H, S	Abortifacient	Pills made by seeds paste of *Centratherum anthelminticum* and *Ferula assafoetida* seeds	Maiti *et al.* 2013
Spilanthes calva DC.	H, L	Induce lactation	Cooked young leaves are taken to increase lactation	Ghosh 2003
Avicenniaceae				
Avicennia marina (Forssk.) Vierh.	T, L	Abortifacient	Leaf extract with a glass of lukewarm goat milk	Mitra & Mukherjee 2009
Bombacaceae				
Bombax ceiba (L.)	T, S, B	Abortifacient	Seed powder with molasses and asafoetida, solution made from the bark is used in excessive menstrual	Ghosh *et al.* 2013 Mandal *et al.* 2020 Mitra & Mukherjee 2009
Boraginaceae				
Ehretia laevis Roxb.	T, Fr	Leucorrhea	Soaked fruit consumed directly	Chaudhury *et al.* 2018
Bromeliaceae				
Ananus comosus (L.)	H, L	Abortifacient	Young leaves with black pepper made into paste and given to pregnant women to induce abortion	Mitra & Mukherjee 2009
Buddlejaceae				
Buddleja asiatica Lour.	Sh, L, Fl, St	Abortifacient	Leaves, flowers and stems induce abortion	Saha *et al.* 2013
Caesalpiniaceae				
Caesalpinia pulcherima Standl.	T, R, L	Abortifacient	Bark in abortifacient, dried leaf infusion for abortion	Mitra & Mukherjee 2009 Saha *et al.* 2013
Cannabaceae				
Cannabis sativa L.	H, L	Dysmenorrhea	Consume leaf powder orally	Chaudhury *et al.* 2018

Caricaceae				
Carica papaya L.	T, La	Mensuration and abortion	Latex as cleansing agent during menstruation and abortion	Ghosh *et al.* 2013 Mandal *et al.* 2020
Combretaceae				
Terminalia arjuna (Roxb. ex DC) Wight & Arn.	T, B	Stop bleed during labor	Make a paste of the bark and consume	Mukherjee & Moktan 2021
Compositae				
Eupatorium album L.	H, Fr	Leucorrhea	Soaked fruit consumed directly	Chaudhury *et al.* 2018
Costaceae				
Cheilocostus speciosus (J.Koenig) C.D.Specht	H, R	Leucorrhea	Root powder is taken orally	Chaudhury *et al.* 2018
Cucurbitaceae				
Coccinia grandis (L.) Voigt.	Sh, L	Gonorrhea	Leaf extraction used in Gonorrhea	Sinhababu & Banerjee 2013a
Trichosanthes anguina (L.)	Cl, L	Menstrual problem	Leaf juice is used in menopausal problems	Paul 2021
Solena amplexicaulis (Lam.) Gandhi	Cl, R	Leucorrhea	Root powder is taken orally	Chaudhury *et al.* 2018
Cuscutaceae				
Cuscuta reflexa (Roxb.)	Cl, Wp	Abortifacient	Plant extract mixed with *Persicaria lapathifolia* helps to induce abortion	Mitra & Mukherjee 2009
Dipterocarpaceae				
Shorea robusta Gaertn.	T, L	Gonorrhea	Leaves used for Gonorrhea	Bose 2011
Equisetaceae				
Equisetum debile Roxb. ex Vaucher.	Cr, Wp	Gonorrhea	Aerial parts of plant used for Gonorrhea	Saha *et al.* 2013
Euphorbiaceae				
Baliospermum solanifolium (Brum.) Suresh	H, R	Leucorrhea	Root powder is used orally	Chaudhury *et al.* 2017, 2018
Emblica officinalis Geart.	T, Fr	Leucorrhea	Dried fruits powder is mixed with salt and sugar and made into a solution to drink	Mandal *et al.* 2014
Euphorbia fusiformis Buch.-Ham. ex D.Don	H, Tu	Poor lactation	Tuber paste consumed orally	Chaudhury *et al.* 2018
Euphorbia hirta L.	H, L	Menstrual problem	Leaves used to treat menstrual problems and extract used to stop irregular periods	Chaudhury *et al.* 2018
Jatropha gossypiifolia L.	Sh, Fr	Abortifacient	Fruit powder consumed directly	Chaudhury *et al.* 2018
Mallotus philippensis Muell Arg.	T, R	Pain	Women patients after childbirth	Dey & De 2010

Ricinus communis L.	Sh, L	After child delivery it comforts	Hot compression is to be applied	Chaudhury *et al.* 2018
Sauropus compressus Mull. Arg.	Sh, L	Retained placenta	Fresh leaves for treatment of retained placenta	Saha *et al.* 2013
Fabaceae				
Abrus precatorius L.	H, S	Abortifacient	Seed powder with lukewarm water help to induce abortion	Mitra & Mukherjee 2009
Butea monosperma (Lam.) Taub.	T, B, Fl, R	Menorrhagia, Leucorrhea	Bark powder in menorrhagia and Leucorrhea, flowers paste taken orally for white discharge.	Bose 2011 Rahaman & Karmakar 2015 Chaudhury *et al.* 2018
Cajanus cajan (L.) Millsp.	Sh, F	Poor lactation	Fruit paste used orally	Chaudhury *et al.* 2018
Cassia fistula L.	T, B	Leucorrhea	Bark Powder is taken orally	Chaudhury *et al.* 2018
Clitoria ternatea (L.)	V, R	Infertility	Root used to treat infertility	Ghosh *et al.* 2013
Crotalaria prostrata Rott.exWilld.	H, R	Abortifacient	Fresh root tip is smashed and placed inside the vagina	Maiti *et al.* 2013
Dalbergia sisoo DC.	T, L	Gonorrhea	Leaf extract used to treat Gonorrhea	Bose 2011 Chaudhury *et al.* 2018
Desmodium gangeticum (L.) DC.	H, R	Abortifacient	Fresh root tip is smashed and placed inside the vagina	Maiti *et al.* 2013
Desmodium triflorum (L.) DC.	H, R	Abortifacient	Fresh root tip is placed inside the vagina	Maiti *et al.* 2013
Mimosa pudica (L.)	H, L	Vaginal and uterine complaints	Leaves is used for vaginal and uterine complaints	Saha *et al.* 2013
Mimosa pudica L.	H, L, R	Leucorrhea	Leaves (10 g) are mixed with one spoonful of sugar and one glassful of water and resulted solution taken for 2 weeks to treat Leucorrhea; Root decoction is also used	Chaudhury *et al.* 2018
Pterocarpus marsupium Roxb.	T, R	Dysmenorrhea	Root powder is taken orally	Chaudhury *et al.* 2018
Uraria lagopodoides (L.) DC.	H, Wp	Abortifacient	Consumed whole plant	Chaudhury *et al.* 2018
Hypoxidaceae				
Curculigo orchioides Gaertn.	H, R, Wp	Leucorrhea, Gonorrhea	Roots made into paste and taken orally; whole plant powder consumed directly	Rahaman & Karmakar 2015 Chaudhury *et al.* 2018
Lauraceae				
Cinnamomum zeylanicum Blume.	T, B	Abortifacient	Bark and roots of *Hemidesmus indicus* boiled with a glass of cow milk	Paul 2021
Lamiaceae				
Coleus amboinicus Lour	H, L	Vaginal discharge	Leaves extract used to treat vaginal discharge	Sinhababu & Banerjee. 2013b
Leonotis nepetaefolia (L.) R. Br.	H, R	Breast inflammation	Apply root paste	Dey and De 2010
Leonurus sibiricus L.	H, Wp	Menstruation	Whole plant use to treat in painful menstruation	Sinhababu & Banerjee. 2013b
Mentha longifolia (L.) Huds.	H, L	Menstruation	Leaf extract to treat menstrual disorders	Sinhababu & Banerjee. 2013b
Ocimum sanctum L.	Sh, R	Vaginal discharge	Root mixed with 1/4th quantity of black pepper and made into small tablets to treat white discharge	Banerjee *et al.* 2016

Liliaceae				
Gloriosa superb (L.)	H, R	Abortifacient	Root paste with black pepper seed	Mitra & Mukherjee 2009
Loganiaceae				
Strychnos nux-vomica	T, Fr	Dysmenorrhea	Consumed dried fruit powder	Chaudhury *et al.* 2018
Loranthaceae				
Dendrophthoe falcate (L.f) Ettingsh.	Cl, St	Abortifacient	Stem with black pepper and *Plumbago indica* root	Mitra & Mukherjee 2009
Lygodiaceae				
Lygodium flexuosum (L.) Sw.	H, L	Leucorrhea	Consumed leaf paste	Chaudhury *et al.* 2017, 2018
Lythraceae				
Woodfordia fruticosa (L.) Kurz	T, R	Leucorrhea	Root powder is taken orally	Chaudhury *et al.* 2017, 2018
Marattiaceae				
Abroma augustum (L.) *L.f.*	Sh, R, L	Mensuration, Leucorrhea	Root extract is used to treat the menstrual disorder, young petiole decoction used to cure Leucorrhea	Ghosh *et al.* 2013 Mistry 2015
Angiopteris evecta (G. Forst.) Hoffm.	F, Rh	Leucorrhea	Rhizome sap with palm candy consumed	Bose *et al.* 2015
Hibiscus rosa-sinensis L.	H, R, Fl	Abortifacient Menstruation disorder, Dysmenorrhea	Root bark paste with black pepper induce abortion, *Ferula asafoetida*, rhizome of *Nymphea pubescens* and *Sesamum indicum* are crushed together and made into small tablets to treat menstrual disorder, consume flower paste directly	Banerjee *et al.* 2016 Mallick & Mallick 2012 Mitra & Mukherjee 2009 Chaudhury *et al.* 2018 Chatterjee & Mukherjee 2016
Sida cordifolia L.	Sh, So	Leucorrhea	Tender shoot used to treat Leucorrhea	Saha *et al.* 2013
Malvaceae				
Byttneria herbacea Roxb	H, R	Leucorrhea	Root powder is used orally	Chaudhury *et al.* 2018
Pentapetes phoenicea L.	H, L	Relief labor pain	Leaf paste is given	Mukherjee & Moktan 2021
Sida rhombifolia L.	Sh, L, R	Leucorrhea, Abortifacient	Fresh leaves (10 g) mixed with sugar candy (5 g), water (200 ml) and 20 ml of this solution consumed every morning for a week to stop white discharging during urination, Smashed tip portion of the root with the powder of Piper nigrum is placed inside the vagina	Mandal *et al.* 2014 Maiti *et al.* 2013
Meliaceae				
Toona ciliate M. Roem.	T, B	Menstrual disorder	Bark used in menstrual disorder	Saha *et al.* 2013
Soymida febrifuga (Roxb.) A. Juss.	T, R	Leucorrhea	Root powder is used orally	Chaudhury *et al.* 2018

Menispermaceae				
Cissampelos pareira L.	Sh, R	Leucorrhea	Root powder is used orally	Chaudhury *et al.* 2018
Moraceae				
Ficus benghalensis (L.)	T, Wp, Fl	Gonorrhea, Leucorrhea	Whole plant is used to treat Gonorrhea, soaked fruit consumed directly	Saha *et al.* 2013 Chaudhury *et al.* 2017, 2018 Chatterjee & Mukherjee 2016
Myrtaceae				
Psidium guajava L.	T, L	Menstrual disorder	Leaves extract is used to treat menstrual disorder	Banerjee *et al.* 2016
Nyctaginaceae				
Boerhavia diffusa (L.)	H, Wp	Leucorrhea	Whole plant extraction useful in treatment	Sinhababu & Banerjee 2013b
Nymphaeaceae				
Nelumbo nucifera Gaertn**.**	H, S	Habitual abortion	Seeds are crushed with water and the solution is consumed	Paul 2021
Nymphaea rubra Roxb. ex Andrews.	H, Rh	Leucorrhea, Menorrhagia	Rhizome used in the treatment of female diseases, Root of *Nymphaea rubra* and stilt roots of *Ficus religiosa* are grinded together to make a paste of it.	Bose *et al.* 2015 Chatterjee & Mukherjee 2016
Orobanchaceae				
Aeginetia indica L.	H, B	Poor lactation	Bark Powder is taken orally	Chaudhury *et al.* 2018
Plumbaginaceae				
Plumbago rosea L.	H, R	Abortifacient	Candle is made from root paste and keep of onside overnight to induce abortion	Mitra & Mukherjee 2009
Plumbago zeylanica L.	H, R	Abortifacient	Fresh root tip is placed inside the vagina	Maiti *et al.* 2013
Piperaceae				
Piper betleoides C. DC.	V, L	Induce lactation	Leaves used to induce lactation.	Saha *et al.* 2013
Piper longum (L.)	V, Fr, L	Menstrual disorder, Leucorrhea	Fruits used for menstrual disorder, for Leucorrhea fresh leaves (10 g) and equal amount of inflorescence are mixed with one glassful of water and taken daily for 7 days.	Mandal *et al.* 2014 Saha *et al.* 2013
Poaceae				
Cynodon dactylon (L.) Pers.	H, So, R	Abortifacient, Menstrual disorder	Shoots are crushed with polished rice in cold water and the paste is eaten in empty stomach, roots mixed with young rhizome of turmeric and candy sugar (10 g) are mixed together to make tablets	Banerjee *et al.* 2016 Paul 2021
Desmostachya bipinnata (L.) Stapf	Sh, R	Leucorrhea	Root powder is used orally	Chaudhury *et al.* 2018

Eleusine indica (L.) Gaertn	H, R	Vaginal discharge	The root paste is used to treat vaginal disease	Ghosh *et al.* 2013 Mandal *et al.* 2020
Polygonaceae				
Persicaria barbata (L.) H.Hara	H, L	Prevent pregnancy	Leaf extract taken orally to prevent pregnancy	Ghosh *et al.* 2013 Mandal *et al.* 2020
Rhamnaceae				
Ziziphus mauritiana Lam.	T, S	Leucorrhea	Paste of seeds is good for Leucorrhea	Ghosh *et al.* 2013
Rubiaceae				
Coffea bengalensis B. Heyne ex Schult.	T, Fl	Pregnancy	Flower is used in childbirth	Bose *et al.* 2015
Hedyotis scandens (Roxb.)	Sh, Wp	Pregnancy	Plant extract used in childbirth	Saha *et al.* 2013
Ixora parviflora Lam.	Sh, B	Leucorrhea	Consumed bark decoction directly	Chaudhury *et al.* 2018
Meyna spinosa Roxb. Ex Link.	T, Fr, S	Abortifacient	*Meyna laxiflora* with seed and bulb of *Allium sativum* and asafoetida helps to induce abortion	Mitra & Mukherjee 2009
Salicaceae				
Cardiospermum halicacabum L.	V, R	Abortifacient	Consume raw root directly	Chaudhury *et al.* 2018
Flacourtia indica (Burm.f.) Merr	T, L	Leucorrhea	Leaf juice orally	Chaudhury *et al.* 2018
Sapotaceae				
Madhuca indica J.F. Gmel.	T, Fl	Abortifacient	*Ferula assafoetida* is thoroughly mixed with *Manduca indica* liquor and is taken orally by the pregnant women	Maiti *et al.* 2013
Smilaceae				
Smilax zeylanica L.	Cl, R	Leucorrhea	Root powder is used orally	Chaudhury *et al.* 2018
Solanaceae				
Physalis peruviana L.	Sh, L	Leucorrhea	Fresh leaves decoction used to treat	Mistry 2015
Saururaceae				
Houttuynia cordata Thunb.	H, Wp	Irregular menstruation	Whole plant used to treat irregular menstruation	Saha *et al.* 2013
Selaginellaceae				
Selaginella semicordata (Wall. ex Hook. & Grev.) Spring.	Cr, Wp	Leucorrhea	Plant juice with black piper used to treat Leucorrhea.	Bose *et al.* 2015
Theaceae				
Schima wallichii Choisy.	T, B	Gonorrhea	Bark used for treatment	Bose *et al.* 2015
Urticaceae				
Boehmeria rugulosa Wedd	H, B	Colic pain during pregnancy	Bark extract used in treatment	Saha *et al.* 2013

Verbenaceae				
Callicarpa arborea (Roxb.)	T, B	Gonorrhea	Bark is used to treat Gonorrhea	Saha *et al.* 2013
Tectona grandis (L.f.)	T, L	Irregular menstrual cycle	Leaf sap used to treat irregular menstrual cycle	Bose *et al.* 2015
Zingiberaceae				
Curcuma caesia Roxb.	H, Fr	Dysmenorrhea	Fruits are meshed with salt and consumed to relief from periodic pain	Raj *et al.* 2018
Zingiber zerumbet (L.) Sm	H, Rh	Pregnancy	Rhizomes with leaves *of Rauwolfia serpentina* are crushed. This extract is mixed with half cup of water and consumed twice a day after meal for 2 days which helps to boost pregnancy	Raj *et al.* 2018

Cl- Climber; Cr- Creeper; F- Fern; H- Herb; Sh- Shrub; T- Tree; V- Vine; B- Bark; Fl- Flower; Fr- Fruit; L- Leaves; La- Latex; R- Root; Rh- Rhizome; S- Seed; So- Shoot; St- Stem; Wp- Whole plant

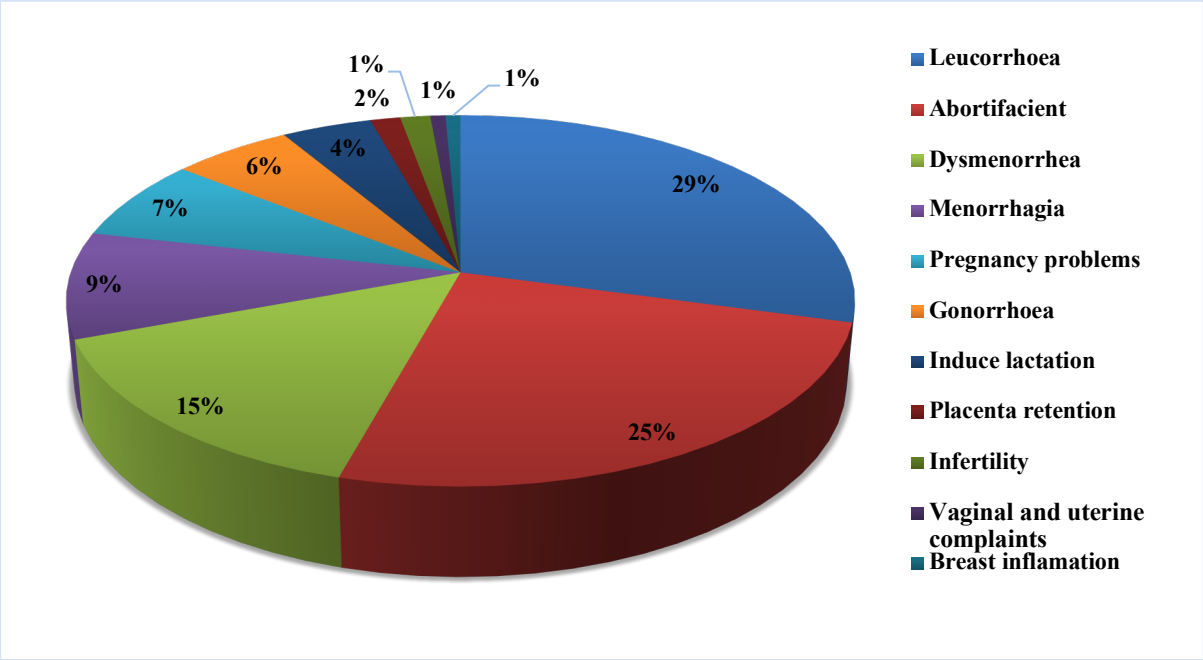

Figure 2. Major disease cured through ethnomedicinal plants

The prominent families were Fabaceae (12 species, 11 genera) followed by Euphorbiaceae (8 species, 7 genera), Malvaceae (6 species, 5 genera), Amaranthaceae (6 species, 5 genera), Lamiaceae (5genera, 5 species), Rubiaceae (4 genera, 4 species) and so on (Fig. 3).

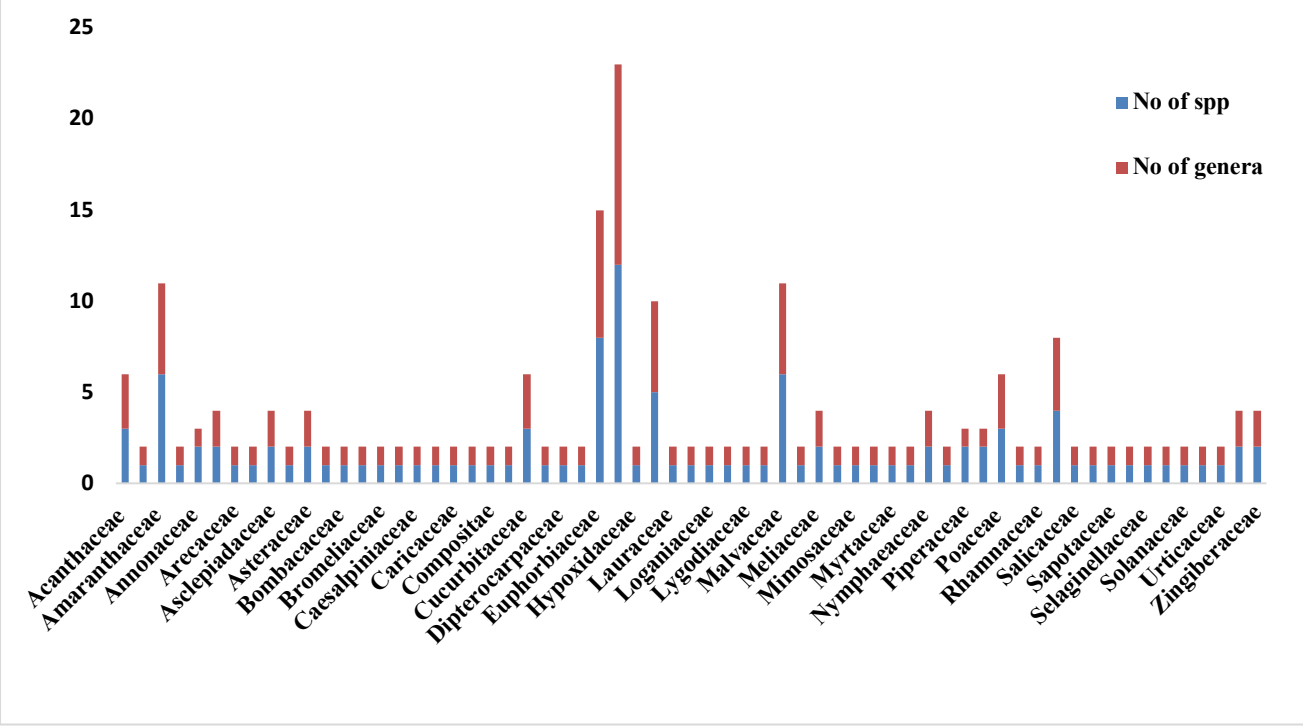

Figure 3. Recorded families, their species and no. of genera

There are number of ethnomedicinal plants reported by many previous studies from West Bengal. The richness of these plant species varied from region to region like 43 plant species from Bankura (Sinhababu & Banerjee 2013a), 115 plant species from Jalpaiguri (Bose *et al.* 2015), 35 plant species from Naxalbari (Biswakarma *et al.* 2015) and 74 plants species for treatment of dermatological problems (Vineeta *et al.* 2020). Other regions of the India also reported like 70 plant species from Madhya Pradesh (Rakesh *et al.* 2010), 25 plant species from Odisha (Dash &

Satapathy 2016). The annotated list we prepared from the selected publications was dominated by herbs (*Barleria cristata, Achyranthes aspera, Alternanthera philoxiroides, Calotropis gigantean,* etc.) with 53 species followed by trees (*Avicennia marina, Bombax ceiba, Caesalpinia pulcherima, Terminalia arjuna, Shorea robusta* etc.) with 32 species and shrubs (*Ocimum sanctum, Cajanus cajan, Ricinus communis, Jatropha gossypiifolia, Sauropus compressus* etc.) with 14 species (Fig. 4). Similar result was also reported in other parts of the country (Balamurugan *et al.* 2017, Dash & Satapathy 2016).

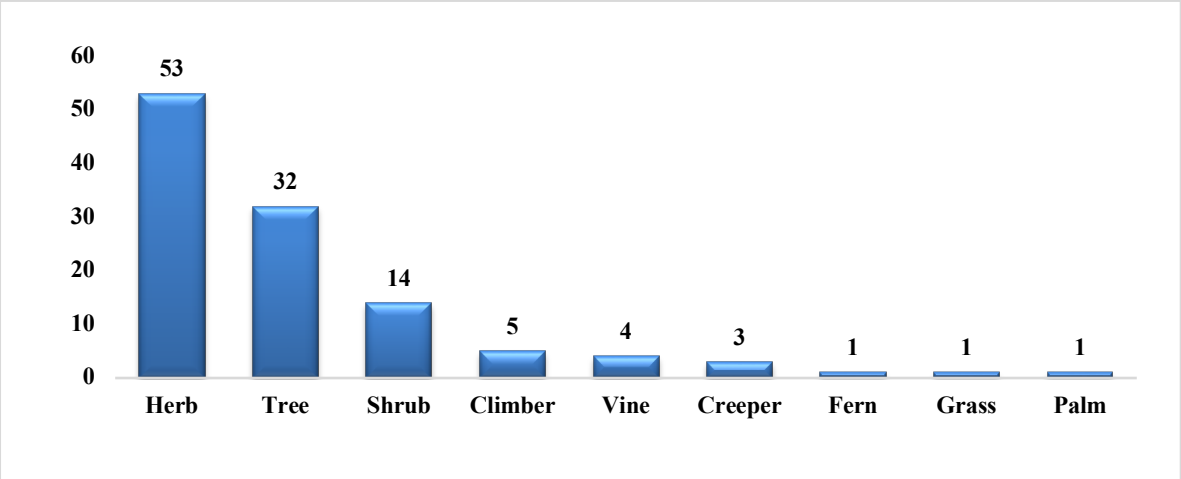

Figure 4. Life form of reported flora

Plant part used

All the parts of the plants were either used to prepare the herbal formulations or used as such (Table 2). Among the plant parts roots were prominently used (like *Achyranthes aspera, Aerva lanata, Semecarpus anacardium, Aristolochia indica, Caesalpinia pulcherima*, etc.) with 37 % usage of total listed plants followed by leaves (*Barleriaeristata, Spilanthes calva*, *Sida rhombifolia, Pentapetes phoenicea, Mimosa pudica*, etc.) with 26 % usage and whole plants (*Alternanthera philoxiroides, Cuscuta reflexa, Boerhavia diffusa, Hedyotis scandens, Selaginella semicordata*, etc.) with 13 % usage (Fig. 5).

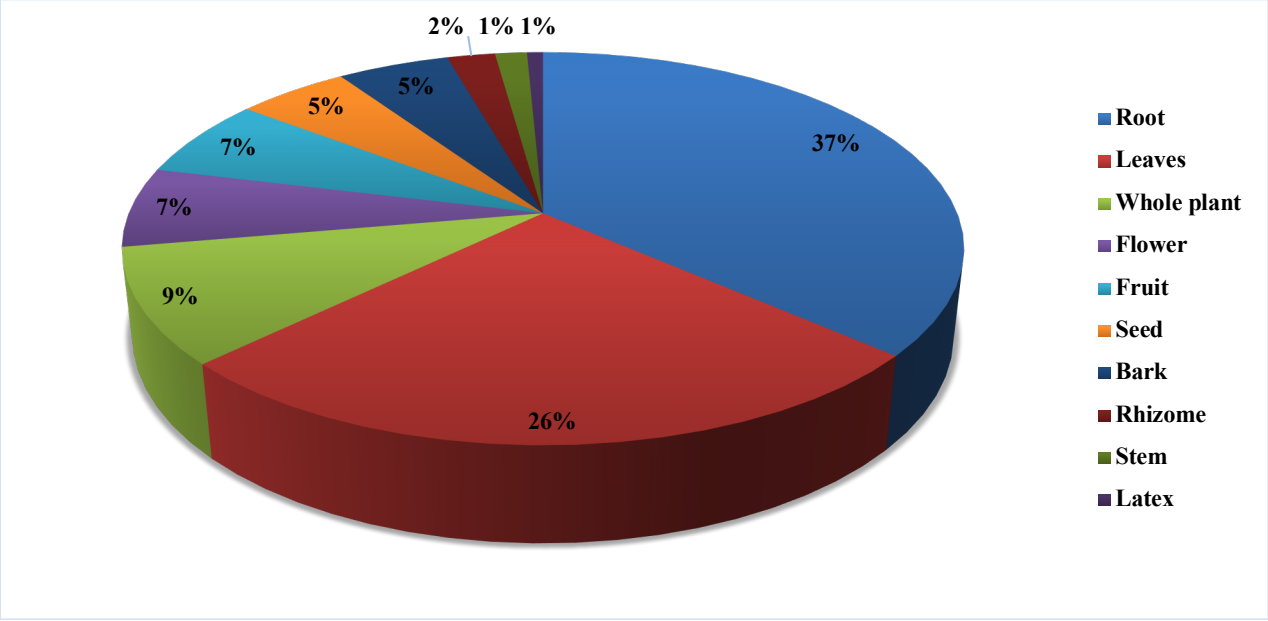

Figure 5. Plant part used

The other plant parts like flowers (*Buddleja asiatica, Butea monosperma*, etc.) and fruits (*Meyna spinosa* and *Piper longum, etc.*) with 9 % usage, seeds (*Annona reticulate, Annona squamosa, Bombax ceiba, etc.*) and bark (*Bombax ceiba, Cinnamomum zeylanicum, Toona ciliate, etc.*) with 7 % usage, rhizomes (*Angiopteris evecta* and *Nymphaea*

rubra, etc.) with 3 % usage, stem (*Dendrophthoe falcate, Sida cordifolia, Buddleja asiatica, etc.*) were found to have usage of 2 % while, plant exudates like latex (*Carica papaya*) have usage of 1 % only. Roots are major portion of the plant used traditionally for the treatment of gynecological disorder by the indigenous communities of West Bengal while, bark, leaves, roots, branches, stem, fruits and seeds were frequently utilized plant parts as were also reported from elsewhere (Bussmann & Glenn 2010, Choudhury *et al.* 2012, Ignacimuthu *et al.* 2008, Ogbe *et al.* 2009, Sadeghi & Mahmood 2014). Additionally, some plant species have medicinal value in their flowers, rhizomes, tubers and heart-wood also.

Mode of Preparation

Various plant parts with different mode of preparation were used for curing gynecological diseases/disorders (Table 2). Different therapies were reported for the disease, and it is varied from one indigenous group to another indigenous group, they use it according to their culture, knowledge and skill. Therapies of the region were standardized by the communities through trial and error but were mostly practiced with religious and mythical beliefs as was also reported by studies elsewhere (Alagesaboopathi 2014, van der Merwea *et al.* 2001). Some are taken as direct raw oral consumption of the plant while, others after preparation of formulations either orally or externally. Similar application of therapies was also reported from elsewhere (Gupta & Solanki 2013; Suresh *et al.* 2013). All the reported plants were used either singly or as mixture and in some cases whole plants were also used (Table2). The usage of species from plant parts to mode of preparation varies between regions and between indigenous groups. They use same species but their mode of preparation as well as administration of recipe was completely different from other indigenous groups. The mode of administration of the herbal treatments varied greatly, ranging from oral administration (drinking, chewing and eating), topical application, insertion, washing, and rubbing. Similarly, the method of preparation varied widely, which include infusion, decoction, maceration, squeezing, burning, boiling (in water), soaking, grinding/pounding, drying and pulverization into powder and many other variant methods. However oral administration appears to be the most widely used method for herbal medicine administration. Similar frequency of plant part utilization with different therapeutic preparation was also reported elsewhere (Akour *et al.* 2016, van Andel *et al.* 2014).

Gynecological problems treated through ethnomedicinal plants

The studies reported 11 gynecological disease/disorders which were treated with the traditional knowledge of ethnopharmacology by the indigenous communities (Table 2, Fig. 2). Leucorrhea was found treated with maximum number of about 29 % of the total listed species (like *Cassia fistula, Lygodium flexuosum, Woodfordia fruticosa, Angiopteris evecta, Sida cordifolia,* etc.) followed by Abortifacient (like *Barleria cristata, Achyranthes aspera, Aerva lanata, Alternanthera philoxiroides*, etc.) with about 25 % of total listed species, Dysmenorrhea (*Curcuma caesia, Aerva lanata, Aerva aspera, Phoenix acaulis, Cannabis sativa,* etc.) with about 15 % of the total listed species. Similar studies also reported by Azi *et al.* 2018, Dash & Satapathy 2016.

Cultural aspects of Ethnomedicine

Indigenous communities are culturally practicing ethnomedicine with their traditions and beliefs. They treat themselves and by traditional practitioners (Vineeta *et al.* 2020). It is necessary to make a holistic view of all the cultural dimensions of the health of a community. Their beliefs on communal traditional therapy were embarked through trial and error but were mostly practiced with religious and mythical beliefs (Alagesaboopathi 2014). Their beliefs on their therapeutic treatment were reported so strong that they avoid alternative until its emergency. They are closely interacting with forest which helps to get raw material from it for their livelihood including therapeutic use and well-being. Simultaneously, they were also trying to transmit the rich heritage of knowledge as heirloom to their next generation orally without any textual documentation (Guissou *et al.* 2015, Hong *et al.* 2015, Mallick & Mallick 2012, Vineeta *et al.* 2020). The traditional practitioners and senior individuals of the indigenous communities were reported instrumental in preserving their folklore, traditions and transmitting the knowledge to their next generation (Mondal & Biswas 2012, Sharma *et al.* 2012).

Mode of harvesting

The communities collect the required medicinal plants by themselves from the forest or wild. The harvesting method followed was mostly destructive. Those species where root and whole plant are used for treatments are completely uprooting. However, bark, stem, seed, fruit and flower of medicinal trees were collected either by plucking or cutting directly from the branches. Continuous and indiscriminate collection affects the growth potential of plants and their population. The destructive pattern of harvesting completely eliminates the plants from the population and particularly many shrubs and herbs are threatened in their natural habitat. Similar harvesting pattern of medicinal plants were also reported from elsewhere and all these studies have warned about

threatened status of many important medicinal plants in their natural habitats (Bhat *et al.* 2013, Gairola *et al.* 2014, Mir *et al.* 2014).

Need for conservation of ethnomedicinal knowledge

It is an alarming time to think about the indigenous communities, their culture and their traditional knowledge of plants. They preserve this tradition of using plant-based medicine and passing through their generation, orally but younger generation are moving out of their places for employment and by this way they are now ignoring and moving away from traditional herbal cure system. They have less interest in their traditional culture, customs and values. Earlier the people from rural or indigenous area preferred to consult their older generation or vaidyas for primary healthcare, but in the past few decades there is an increase in accessibility, availability, and affordability towards the allopathic medicinal system, the local community is also opting for such options. The changing lifestyle and socioeconomic scenarios of the inhabitants create a situation where they reluctant to live with their traditional heritage leading to the vanishing of the knowledge (Singh & Bharti 2015). Younger generations are more dependent on allopathic medicines rather than plant-based medicines as these drugs are easy to get and use. Ethnomedicinal knowledge of plants gives a base data to much scientific research for new drugs.

Conclusion and Recommendation

It is evident while analyzing the research papers that indigenous communities of West Bengal are practicing ethnogynecological therapies and these traditional therapies were standardized by the communities through trial and error. We inventoried a total of 114 ethnogynecological plant species from the retrieved literature of West Bengal, India. We found Leucorrhea was treated with highest number of plant species. Herbs were prominent in our prepared inventory. The roots were most frequently used in different gynecological ailments. The therapies were recommended either as oral consumption or as topical application in pure form or in mixed form to be administered directly or processed as paste, extract, decoction, solution and powder form. The plant extract is mainly administered in solution form either for oral consumption or external application. Our analysis also revealed that the therapies were prominently based on single plant species either with single plant part(s) or also as admixture of two or more than two species. Most of the studies highlighted the importance of preserving ethnomedicinal knowledge for future generations before it vanishes completely. This meta-analysis summarized the published ethnogynecological information of West Bengal state which will help in developing the baseline data for future analysis. Such studies can further lead to scientific assessment of the traditional medicines used which may provide a lead in drug development leading to national and global recognition of ethnomedicinal plants and its associated traditional knowledge in terms of their ecological, social, and economic perspectives.

Declarations

Ethics approval and consent to participate: Not Applicable

Consent to publish: This manuscript does not contain any personal data and does not require publishing permission.

Competition of interests: The authors declare that they have no conflicts of interest concerning this article.

Author's contribution: Vineeta collected data, analyzed and wrote the manuscript. Gopal Shukla, Jahangeer A Bhatt and Sumit Chakravarty revised the manuscript. All authors read and approved the final manuscript

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