



Ethnomedicobotanical study of indigenous knowledge on medicinal plants used for the treatment of reproductive problems in Nalbari district, Assam, India



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ABSTRACT

Ethnopharmacological relevance: Reproductive problems are becoming the most predominant health care problems in many countries. World Health Organization (WHO), in 2012, also exemplified maternal illnesses, for instance, birth asphyxia and post birth difficulties are rising at an alarming rate. In addition, not all abnormalities of the human reproductive system have the same origin; the effects of reproductive problems would likely be affected by both male and female. For easy accessibility and affordability, medicinal plants are playing crucial role in primary healthcare care services in India and their use is moreover, an integral part of the cultural heritage. However, our growing understanding of the human reproductive problems are segregated and scanty for herbal medications.

Aim of the study: To document the local name of the medicinal plants used by both male and female from indigenous knowledge for the treatment of reproductive ailments and to explore their biological and pharmacological confirmation and to address the class of secondary metabolites present therein.

Materials and methods: The results stem in September 2015–April 2016 from an array of informations that were collected by direct interviews of the traditional medicinal practitioners in three villages, viz. Jaha, Niz-Bahjani and Madhupur of the southern Nalbari district, Assam. Both semi-structured and open-ended interview schedule was carried out with purposively selected individuals and focus group discussion (FGD) in the three selected sites for this study. Systematic analysis of fidelity level percentage (FL %), preference ranking percentage (PR %) and formulation scoring (FS) were calculated. Electronic databases such as Google, Google Scholar, and ScienceDirect were also been used to search existing pharmacological citations. Finally, qualitative chemical profiling were executed for the plants whose PR % scores ≥ 65 .

Results: A total of 71 plant species belonging to 48 families and 64 genera are reported to be used for the treatment of several reproductive problems such as, infertility in male, impotence, erectile dysfunctioning, retrograde ejaculation and sexual potency in men and in women, aphrodisiac, metrorrhagia, infertility, dysmenorrhea and/or post birth difficulties under mono (57), di (17) and poly (8) herbal formulations. Herbs (40.85%) were reported as the most common lifeform, whereas leaves (22.54%) and the roots (22.54%) were the commonly used plant parts against different ailments. Extracts of *Abroma augusta* L. (stem) (FL: 66.67%, PR: IM-77.33%, L-65.33, FS: 2), *Morinda angustifolia* Roxb. (bark) (FL: 64.29%, PR: L-68%, FS: 1), *Hodgsonia heteroclita* Roxb. (fruit) (FL: 63.64%, PR: IF-65.33, FS: 0.25) and *Hibiscus mutabilis* L. (stem) (FL: 40%, PR: IM-68%, IIM: 65.33%, IML-68%, FS: 2) were than selected for further phytochemical analysis.

Conclusions: Of the 71 plants used for reproductive management system, the highest number of plants were used for the treatment of irregular menstruation (22) followed by infertility (in both men and women) (19), vaginal disorder and leucorrhoea (9) and sexual potency (8). The qualitative chemical profiling have been exhibited for the presence of alkaloids, carbohydrates, phenolic compounds, flavonoids and phytosterols, in maximum concentrations. Additional, these data may be the most important resource for the new discovery of many bioactive principles.

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1. Introduction

The Northeastern states of India alone covers around one fourth of the entire forest of India (Chhabra, 2002), have been an emerging ecological resources due to the climatic, edaphic and altitudinal deviations, covering an area of about 2,62,379 km² or about 7.7% of India's total geographical area (Chatterjee et al., 2006). The topographic relief in this region is the richest bio-geographical province for ample of India's flora and fauna (Devonshire-Ellis, 2012). Therefore, this region is blessed with a wide range of physiographic and ecoclimatic gateway, been in the spotlight for two of its mega biodiversity (Indo-Burma and Eastern Himalayas) (Bora et al., 2016a, 2016b) and conservation of traditional knowledge, has also been significantly realized by the leading conservation agencies of the world (Dirzo and Raven, 2003; Sarukhan and Dirzo, 2013; Broadbent et al., 2012; Sarukhan et al., 2015).

Natural resources not only has given vital needs like food, clothing, fuel, shelter, and different necessities of sustainable life to the humans, but not the smallest of which were for the medications to cure a wide range of illnesses (López-Sánchez et al., 2016; Bansal, 2005; Asadbeigi et al., 2014). All through the ages, man has investigated the Mother Nature to derive and trust the health benefits of the plants found in their own locality or region (Akan et al., 2008; Baytop, 1999). Native plants are named in their local languages and are important resource for the people of the area (Chirkova et al., 2016). Indigenous knowledge of plants through ethnopharmacological surveys and its documentation is essential for the conservation of natural resources (Polat et al., 2015a, 2015b; Muthu et al., 2006; Aziz et al., 2017; Korkmaz et al., 2016; Mükemre et al., 2015) and utilization of newer medicinal plants to prevent and cure ailments.

Reproductive health is a condition of total mental, physical and social wealth. But, not merely the nonattendance of sicknesses are associated with the reproductive system in all matters to its processes and functions (Glasier et al., 2006). A reproductive disorder which affects both men and women are characterized by abnormal hormone production by the testis or the ovaries or by other endocrine glands. Such diseases can be due to tumors, genetic, infections, socioeconomic parameters or by unknown reasons (Maqbool et al., 2016; Witorsch, 2016). Not all abnormalities of the human reproductive system have the same origin; the effects of reproductive problems would likely been affected by both the sexes. Men, possesses a continuous post-pubertal meiosis life, whereas in women meiosis only continues with a very few oocytes (Joffe, 2016). Despite our growing understanding of the human reproductive problems; segregated and scanty herbal remedies are available for the treatment in men; infertility (Nejatbakhsh et al., 2016), impotence and erectile dysfunctioning (Drewes et al., 2003), retrograde ejaculation and sexual potency (Chauhan et al., 2014; Jefferys et al., 2012) in women; aphrodisiac, metrorrhagia and infertility (Maroyi, 2013), dysmenorrhea (van Andel et al., 2014) or to stimulate uterine contractions (Lans, 2007).

Accordingly, this article has been aimed at collecting ethnobotanical information and documentation of local names with the indigenous knowledge of herbal remedies traditionally used by traditional healers for the treatment of reproductive problems in both male and female in the Nalbari district, Northeastern region of India. Within the scope of the study, questions on the local or common names of the medicinal plants were recorded; the main plant parts, the number of plants used in different formulations as well as their mode of preparations, methods of administrations and a systematic analysis of FL %, PR % and FS were calculated and finally the relevant therapeutic uses of the plants were addressed with existing pharmacological citations. The qualitative phytochemical screening has also been analyzed for the record of newer plants with PR % \geq 65, to address the secondary metabolites present therein. This comprehensive approach not only has significant societal benefits of the list of the plants utilized for reproductive problems, but also might lead to the understanding and

motivation of ethnopharmacological research for new drug discoveries and new remedial strategies for the treatment of the same.

Although earlier studies have reported various medicinal plants used against different diseases viz. dysmenorrhea (Das et al., 2005), women health problem (Bhattacharjya and Borah, 2008), diabetes (Chakravarty and Kalita, 2012), oral health (Deka and Nath, 2014), tonsillitis (Nath, 2016) by the local people of Nalbari district; but, information on the traditional reproductive biomedicine for both male and female together not been reported. Therefore, in this study, we present in-depth information on herbal remedies used by the local villagers and traditional healers for the treatment of reproductive problems both in male and female. Needless to say less availability of health centers, modern facilities and low income levels has lead to the use of herbal medicine for curing different ailments. Thus, the present study will provide baseline information of reproductive herbal medicines used by the local people of Nalbari district and also motivate future research on the phytochemical evaluation and conservation of important medicinal plants.

2. Materials and methods

2.1. Study area

The present study was carried out in Nalbari district extending an area of 2257 square kilometers (26°10' N to 26°47' N latitude and 90°15' E to 91°10' E longitude) and located on the north bank of river Brahmaputra, Assam, India. The north side of the district is flanked by the foothills of Bhutan, while, in the east and west, Kamrup and Barpeta district respectively (Fig. 1). It has a subtropical climate with cold winter and semi dry, hot summer with annual rainfall 1500 mm (c). Vegetation type is luxuriant evergreen and deciduous covered with small pockets throughout the area. The soil is generally soft and sandy, with lowland areas containing clays and high percentage of nitrogen. This nitrogenous soil provides favorable conditions for the production of paddy and also other major crops, such as jute, gram, wheat, mustard and vegetables (Bhattacharjya and Sarma, 2016).

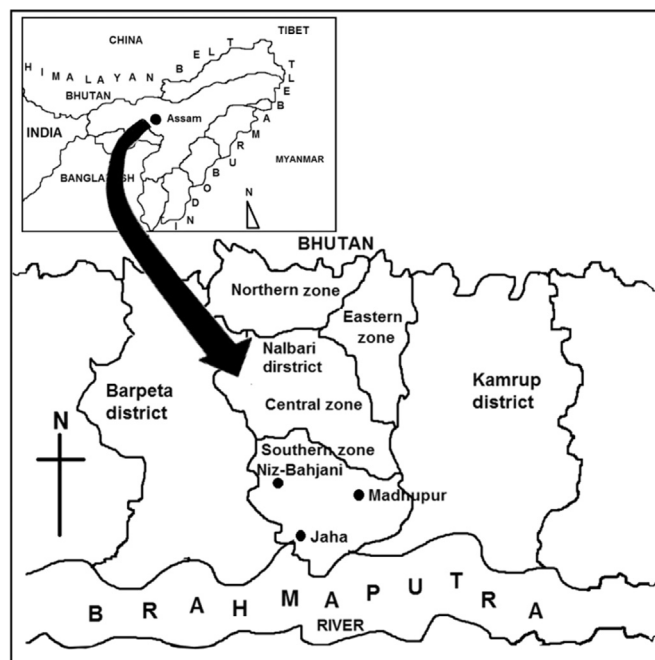


Fig. 1. Map of Nalbari district and its position on the maps of Assam and nearby Megadiverse region (Maps are not to scale).

2.2. Data collection

2.2.1. Interview schedule-based data collection on ethnomedicinal plants

Information related to the ethnomedicobotanical practices were collected during September 2015–April 2016 from different areas of Nalbari district. Prior to the collection of information from local traditional healers and chosen participants, the main study objectives were explained to them and obtain the individual ethical accord for documentation and publication. The purposively selected respondents were five number of traditional healers ('Kaviraj'/'Boidya') from three different villages of Nalbari, viz. Jaha, Niz-Bahjani and Madhupur, and five elderly knowledgeable persons from each of those villages, having practical knowledge on the local plants that are used as herbal remedies. Out of these five traditional healers, two were female and three were male; and among the fifteen knowledgeable persons, eleven were male and four were female members. The respondents' ages were between 45 and 75 years, regardless of gender. Prior to conducting individual interview schedule, standard questionnaires were prepared together with semi-structured and open-ended queries (Martin, 1995; Cotton, 1996; Bruni et al., 1997; Ahmad et al., 2014). Both semi-structured and open-ended interview schedule was carried out at the individual level to gather information on local names of the plants, use of the plant components, technique of preparations, mode of applications, frequency of dosage, and also the diseases cured from these plants. Additionally, FGD was conducted with seven groups (each with eleven members as well as the traditional healers) to achieve further information on medicinal plants at the community level and therefore cross-checking of data collected through semi-structured interview was verified (Mussarat et al., 2014). A questionnaire was pre-tested and finally designed to collect data in Assamese language. The names of the plants were cross-checked and all documented information was then translated into English.

2.2.2. Field-based data collection

Interview scheduled data collection was followed by field trips and identification of medicinal plants in wild habitats/home gardens with local experts. Plant samples were collected for herbarium preparation. Photographs were taken in the natural habitat for easy identification of the plant species. Plants were categorized into herbs, shrubs, trees and climbers using the Raunkiaer's life form of classification system (Raunkiaer, 1934). Dried herbarium specimens were tagged properly and were identified with the help of standard literature (Kanjilal et al., 1939–40; Phukan et al., 2003; Chowdhury et al., 2005) and a group of collected herbarium specimens were deposited with their voucher number in the Department of Botany, Birjhora Mahavidyalaya, Bongaigaon, Assam, India.

2.3. Data analysis

Data collection was followed by data entry and analysis in IBM SPSS statistics v21 software. The collected plant species were listed by their local name (Assamese), voucher specimen numbers, scientific name, family, life form, plant parts used, modes of preparation, and methods of administrations (Muthu et al., 2006). Herbal formulations used by the traditional healers were recorded and further analysis was done for those herbal medicinal plants. Further, FL, PR and FS were calculated to verify the importance of medicinal utility (Mutheeswaran et al., 2011; Wubetu et al., 2017).

2.3.1. Fidelity Level (FL)

FL is a procedure to find out the foremost favored plants used for curing an ailment. FL values are invariably calculated in terms of percentage of the informant's claim for the use of a plant species for a particular ailment. FL value calculated by using the formula $FL = Ip/Iu \times 100$, where Ip denotes the number of respondents who claim for the

use of a plant species for a particular ailment and Iu signifies the total number of respondents who claimed the same plant for any ailment (Friedman et al., 1986).

2.3.2. Preference Ranking (PR)

Highest number of plants reported against a particular disease were selected for PR. Among those plants scoring, $\geq 65\%$ in PR given by the respondents were selected for qualitative phytochemical analysis. Further, the qualitative chemical profiling are analyzed for those plants and/or components, which were not reported earlier. This technique was carried out with five knowledgeable respondents from each village following standard method to identify the most preferred species (Cotton, 1996). Informants selected for PR were asked to present the values (5=best, 4 = very good, 3 = good, 2 = less used, 1 = least used, 0=don't know) to each and every plant species. The average scores or values given to the plant were summed up and placed accordingly for various ailments.

2.3.3. Formulation Scoring (FS)

A single plant which is used for a particular disease named as monoherbal formulations (MFs), formulations with two plants are diherbal formulations (DFs) and more than two are allotted for polyherbal formulations (PFs). Scoring given to the MFs is 1, for DFs, 0.5 and for PFs 0.25 is given. The number of times a plant is cited in the different formulations, the score adds up.

2.3.4. Preparation of plant extracts for qualitative phytochemical screening

Plant material of *A. augusta* (stem), *M. angustifolia* (bark), *H. heteroclita* (fruit) and *H. mutabilis* (stem) growing in various parts of Nalbari district, were collected during September 2015 - April 2016, at their flowering stage. Plant material was washed properly for 3–4 times in running tap water and lastly by distilled water. Stem of *A. augusta* and *H. mutabilis*, bark of *M. angustifolia* and the fruit of stem parts of *H. heteroclita* were taken separately, and chopped into small pieces and shade dried and were powdered for extraction respectively.

2.3.5. Preparation of plant extracts

10 g of powders of respective plant parts was soaked with 100 ml of hexane, chloroform and ethanol: water (50:50) separately for 72 h. and shaken in a rotary shaker. The extracts were filter using Whatmann no. 1 filter paper. The continuous extraction was repeated with recovering solvents until the filtrate color becomes colorless. The extracts were collected and concentrated farther in Rotavapor under reduce pressure and dried by anhydrous Na_2SO_4 and were stored at 5°C in sealed glass vial until used for analysis.

2.3.6. Yield of the extracts

The yield of the extracts was calculated by the formula, $(W^E/W^D) \times 100$, where W^E is the weight of the solvent free extract and W^D is the dry weight of the plant materials.

2.3.7. Qualitative chemical profiling analysis of extracts

The qualitative phytochemical screening of the extracts of *A. augusta* (stem), *M. angustifolia* (bark), *H. heteroclita* (fruit) and *H. mutabilis* (stem) were selected, which were not reported earlier based on the score obtained, $\geq 65\%$ in PR (Table 1) to address the presence of secondary metabolites therein. Eleven different qualitative tests were carried out to determine the presence of alkaloids, reducing sugars, glycosides, saponins, proteins and amino acids, phenolic compounds, flavonoids, terpenoids, fixed oils and fats and phytosterols in hexane, chloroform and ethanol: water (50:50) extracts of *A. augusta* (stem), *M. angustifolia* (bark), *H. heteroclita* (fruit) and *H. mutabilis* (stem) respectively (Table 5) following the standard protocols (Iyenger, 1995; Waiganjo et al., 2013; Siddiqui and Ali, 1997) (Tables 2 and 4).

Table 1

List of collected ethnomedicobotanical plants of monoherbal formulations (MFs), diherbal formulations (DFs) and poly herbal formulations (PFs) used in Nalbari district, Assam (with modes of preparation, methods of administrations, FL (%), PR (%) and FS values) against different reproductive ailments.

Sl. No.	Local name (Assamese)/ Voucher specimen no.	Botanical name, Family Name (Wild (W) or Cultivated (C)) and Life form	Parts used	Disease cured/ Modes of preparation/ Methods of administrations	Relevant ethno botanical/ pharmacological citation	FL value (%)	^a PR value (%)	FS value (Mono-1, di-0.5, poly-0.25)
1	Aakan (SI/F/068) + khejur (SI/J/069) Aakan (SI/F/068) + Bhringraj (SI/J/070) Aakan (SI/F/068)	<i>Calotropis gigantea</i> (L.) R. Br.; Asclepiadaceae /W Sh + <i>Phoenix dactylifera</i> L.; Arecaceae /C /P <i>C. gigantea</i> (L.) R. Br.; Asclepiadaceae /W Sh + <i>Eclipta prostrata</i> L.; Asteraceae /W /H <i>C. gigantea</i> (L.) R. Br.; Asclepiadaceae /W /Sh	Fruits of <i>P. dactylifera</i> , latex of <i>C. gigantea</i> Roots of <i>C. gigantea</i> and leaves of <i>E. prostrata</i> Roots	Impotence and Erectile Dysfunction (DFs): Fruites of <i>P. dactylifera</i> without seeds are filled with the latex of <i>C. gigantea</i> and covered with wheat flour and heat it in hot sand. Once the flour burns, grind it with little water and prepare pea sized tablets. Given one tablet twice in a day with milk after meal for 3 months. Vaginal disorders (DFs): Powder of <i>C. gigantea</i> root and <i>E. prostrata</i> leaves mixed in equal proportion and form small pills. One tablet given twice daily with warm milk after meal for 3 months. Infertility in Male (MFs): Dry root powder of <i>C. gigantea</i> mixed with a glass of cow milk and given twice a day for 3 months after meal.	Singh and Singh (2014); Abedi et al. (2014); Shil et al. (2014)	<i>C. gigantea</i> (57.14), <i>P. dactylifera</i> (50), <i>E. prostrata</i> (42.86)	IML-46.67, IIM-73.33, EDF-64, VD-68	<i>C. gigantea</i> (2), <i>P. dactylifera</i> (0.5), <i>E. prostrata</i> (0.5)
2	Aakhrot (SI/J/053)	<i>Juglans regia</i> L.; Juglandaceae /C /T	Seeds	Spermatorrhoea (MFs): ~10 g of ash prepared from the peel of the fruit can be given to the patient with water every morning and evening for at least 15 days.	Present report	50	S-34.67	1
3	Aam (SI/J/039)	<i>Mangifera indica</i> L.; Anacardiaceae /C /T	Seeds and stems	Vaginal disorders (MFs): ~10 g dried seed powder of <i>M. indica</i> boil with ~250 ml cow milk and given every morning and evening for 20 days. Pain in testicles (MFs): ~50 g of <i>M. indica</i> stem with knots grind with ~60 ml cow's urine and form a paste. From this paste is applied in the testes externally for 7 days.	Ballabh et al. (2008); Yadav et al. (2006)	28.57	VD-50.67, PT-52	2
4	Aasukath (SI/J/013)	<i>Morinda angustifolia</i> Roxb; Rubiaceae /C /T	Barks	Leucorrhoea (MFs): ~50 g of bark grind and mixed with 250 ml of water and boiled. Make the mixture to a concentration of ~50 ml and given twice a day in empty stomach till the disease is cured.	Present work	64.29	L-68	1
5	Ahot (SI/J/)	<i>Ficus religiosa</i> L.;	Barks	Vomiting tendency	Joshi and Joshi	40	VP	1.5

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Table 1 (continued)

Sl. No.	Local name (Assamese)/ Voucher specimen no.	Botanical name, Family Name (Wild (W) or Cultivated (C)) and Life form	Parts used	Disease cured/ Modes of preparation/ Methods of administrations	Relevant ethno botanical/ pharmacological citation	FL value (%)	^a PR value (%)	FS value (Mono-1, di-0.5, poly-0.25)
	010)	Moraceae /W /T		during pregnancy (MFs): Ash of <i>F. religiosa</i> bark soak in water in 1:2 ratio and filtered liquid of ~25 ml given once in a day after breakfast during the initial 2–3 months.	(2000); Krishnamurthy (2001)		–29.33	
6	Akarkara (SI/J/050) Akarkara (SI/J/050) + Bogamushli (SI/J/051) + Ashwagandha (SI/J/052)	<i>Anacyclus pyrethrum</i> DC; Asteraceae /W /H <i>A. pyrethrum</i> DC; Asteraceae /W /H + <i>Chlorophytum borivilianum</i> Santapau and Fernandes; Asparagaceae /C /H + <i>Withania somnifera</i> (L.) Dunal.; Solanaceae /W /H	Roots of <i>A. pyrethrum</i> Roots of <i>C. borivilianum</i> , <i>W. somnifera</i> and <i>A. pyrethrum</i>	Irregular menstruation (MFs): ~50 ml of <i>A. pyrethrum</i> root decoction is given every morning and evening, before meal for 15 days which helps in stabilizing the menstrual cycle. Aphrodisiac (PFs): Equal quantities of dry roots of <i>C. borivilianum</i> , <i>W. somnifera</i> and <i>A. pyrethrum</i> grind together and one teaspoon of powder given every morning and evening with warm cow milk for 1 month.	Usmani et al. (2016) Sharma (2009); Kenjale et al. (2008); Mirjalili et al. (2009)	<i>A. pyrethrum</i> (37.50), <i>C. borivilianum</i> (40), <i>W. somnifera</i> (66.67)	IM–44, A–76	<i>A. pyrethrum</i> (1.75), <i>C. borivilianum</i> (0.25), <i>W. somnifera</i> (2.25)
7	Amita (SI/F/012)	<i>Carica papaya</i> L.; Caricaceae /C /Sh	Roots	Increase breast milk (MFs): ~50 g of fresh root grind with 250 ml cow milk and boiled. Make the concentration to 100 ml and given after breakfast for 30 days after delivery.	Sayed et al. (2007); Retnani et al. (2015)	57.14	IBM –53.33	1
8	Amlokhi (SI/J/021)	<i>Phyllanthus emblica</i> L.; Euphorbiaceae /W /T	Fruits and seeds	Infertility in female (MFs): ~20 ml of fruit juice mixed with 5 g of sugar and 10 g honey. This mixture is given to the patient twice a day. It also relieves vaginal inflammation. Retrograde ejaculation (MFs): ~10 g <i>P. emblica</i> fruits without seed are dried and grind properly with ~20 g of sugar. ~250 g of water added to this. Administer this mixture in the morning for 15 days. Leucorrhoea (MFs): ~20–30 g of <i>P. emblica</i> seeds grind with water. After filtering the water, 2 teaspoon of honey and sugar added to it. It shows results within 3 days.	Jayram et al. (2014) Present work Rahman (2014);	80	IF–44, L–60, RE–64	3.5
9	Anantamul (SI/D/057) + Bhim kol (SI/J/036) + Jira	<i>Hemidesmus indicus</i> (L.) R. Br.; Apocynaceae /W /H + <i>Musa balbisiana</i>	Roots of <i>H. indicus</i> , <i>M. balbisiana</i> peels and seeds of <i>C.</i>	Sexual potency (PFs): ~20 g dry root of <i>H. indicus</i> wrap with <i>M.</i>	Marandi et al. (2015); Mathew and Negi (2017)	<i>H. indicus</i> (66.67), <i>M. balbisiana</i> (50), <i>C. cyminum</i> (28.57)	SP –58.67	<i>H. indicus</i> (0.25), <i>M. balbisiana</i> (0.25), <i>C. cyminum</i> (0.25)

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Table 1 (continued)

Sl. No.	Local name (Assamese)/ Voucher specimen no.	Botanical name, Family Name (Wild (W) or Cultivated (C)) and Life form	Parts used	Disease cured/ Modes of preparation/ Methods of administrations	Relevant ethno botanical/ pharmacological citation	FL value (%)	^a PR value (%)	FS value (Mono-1, di-0.5, poly-0.25)
	(SI/J/058)	Colla; Musaceae /C /H + <i>Cuminum cyminum</i> L.; Apiaceae /C /H	<i>cyminum</i>	<i>balbisiana</i> peel and placed it on fire. After complete burning of the peel, roots are collected from them and grind with roasted <i>C. cyminum</i> seeds. ~15 g sugar and a teaspoon of <i>ghee</i> (clarified butter) added to the mixture and ~5 g of this paste given to the patient thrice a day for a month.				
10	Anarosh (SI/J/014) + Ahot (SI/J/010)	<i>Ananas comosus</i> (L.) Merr.; Bromeliaceae /C /H + <i>F. religiosa</i> L.; Moraceae /W /T	Leaves	Irregular menstruation (DFs): ~15 g juice of pineapple (unripe fruit) mixed with equal amount of <i>F. religiosa</i> bark powder and jiggery and given regularly for 2–3 months.	Ososki et al. (2002); Sarwat et al. (2012)	<i>A. comosus</i> (11.11); <i>F. religiosa</i> (40)	IM–64	<i>A. comosus</i> (0.5); <i>F. religiosa</i> (1)
11	Aparajita (SI/D/059)	<i>Clitoria ternatea</i> L.; Fabaceae /C /Cl	Stems and leaves	Easy delivery (MFs): ~20 g freshly grind stem and ~50 g leaf extract mixed properly and form a paste and soaked by cotton which is placed on the lower abdomen. It causes immediate delivery and pacifies pain.	Present work	40	ED–52	1
12	Arjun (SI/F/060)	<i>Terminalia arjuna</i> (Roxb.) Wight & Arn.; Combretaceae /W /T	Barks	Metrorrhagia (MFs): 3–4 teaspoon full <i>T. arjuna</i> powder of its bark boiled with cow milk then filtered. Little amount of sugar candy added to it and given ~30 ml of it thrice a day for 10 days. Spermatorrhoea (MFs): Decoction of its bark ~5 m with cow's milk regularly twice a day can be advised to the patient for 6–7 days.	Jadhav and Bhutani (2005); Paarakh (2010)	62.50	MT –77.33, S–74.67	2
13	Ashok (SI/J/025) + Dhan (SI/J/026) Ashok (SI/J/025) + Dimaru (SI/D/027) + Majuphal (SI/D/028) + Babul (SI/J/029)	<i>Saraca asoca</i> (Roxb.) de Wilde.; Caesalpiniaceae /W /T + <i>Oryza sativa</i> L.; Poaceae /C /Gr <i>S. asoca</i> (Roxb.) de Wilde; Caesalpiniaceae /W + <i>Ficus racemosa</i> L.; Moraceae /W /T + <i>Quercus infectoria</i> Oliv.; Fagaceae /C /H + <i>Acacia nilotica</i> L.; Mimosaceae /W /T	Barks of <i>S. asoca</i> , <i>F. racemosa</i> , <i>Q. infectoria</i> , <i>A. nilotica</i> , seeds of <i>O. sativa</i> and <i>H. vulgare</i>	Leucorrhoea and Metrorrhagia (DFs): ~5 g of <i>S. asoca</i> bark's powder mixed with 25 g of <i>sathi</i> rice (<i>Oryza sativa</i>) (rice crop which matures in 60 days) powder and 5 g sugar candy powder and 1gm honey and prepare a paste. This mixture is given thrice a day in the menstrual days till the end of those days. Irregular menstruation (MFs): ~100 g <i>S. asoca</i> bark boiled in 400 ml water, till the water is reduced	Pradhan and Joseph (2009); Joseph et al. (2010); Nautiyal et al. (2008)	<i>S. asoca</i> (57.14), <i>O. sativa</i> (80), <i>H. vulgare</i> (40), <i>F. racemosa</i> (66.67), <i>Q. infectoria</i> (25), <i>A. nilotica</i> (60)	MT –57.33, L –69.33, VD –66.67	<i>S. asoca</i> (2), <i>O. sativa</i> (0.5), <i>H. vulgare</i> (0.5), <i>F. racemosa</i> (0.25), <i>Q. infectoria</i> (0.25), <i>A. nilotica</i> (5.25)

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Table 1 (continued)

Sl. No.	Local name (Assamese)/ Voucher specimen no.	Botanical name, Family Name (Wild (W) or Cultivated (C)) and Life form	Parts used	Disease cured/ Modes of preparation/ Methods of administrations	Relevant ethno botanical/ pharmacological citation	FL value (%)	^a PR value (%)	FS value (Mono-1, di-0.5, poly-0.25)
				to 1/4th. ~100 ml cow's milk added to this and boil the solution for 30 min. This solution should be taken twice a day from the 4th day of menstrual cycle. Vaginal disorder (PFs): Equal quantities of the bark of <i>S. asoca</i> , <i>F. racemosa</i> , <i>Q. infectoria</i> , <i>A. nilotica</i> grinded together. Then 60 g of this powder boiled with 500 ml of water and boil the mixture till it reduces to 1/4th. ~1 ml of this solution should be injected with a syringe, at night in the vagina. Urination for at least 1 h. should be avoided. Within 7 days of this treatment, vaginal opening will squeeze and comes to the normal shape.				
14	Ashwagandha (SI/J/052)	<i>W. somnifera</i> (L.) Dunal; Solanaceae /W /H	Roots and whole plant of <i>W. somnifera</i>	Metrorrhagia and Leucorrhoea (MFs): An equal quantity of <i>W. somnifera</i> root powder mixed with sugar candy. Two teaspoon full of this added to ~250 ml of cow milk and given thrice a day to the patient for 7 days. Sexual potency (MFs): Whole plant (dry) grind with equal amount of sugar candy and 3 teaspoonful of this mixture with cow milk given this paste to the patient before the breakfast for 2 months.	Ch et al. (2006); Ilayperuma et al. (2002)	66.67	L-48, MT -69.33, SP -61.33	2.25
15	Ataich (SI/J/063) + Aada (SI/J/062)	<i>Aconitum heterophyllum</i> Wall.; Ranunculaceae /W /H + <i>Zingiber officinale</i> Roscoe.; Zingiberaceae /C /H	Stems of <i>A. heterophyllum</i> , rhizomes of <i>Z. officinale</i>	Sexual potency (DFs): ~1.5 g of dry stem powder, 125 mg <i>Loha bhasma</i> (iron ash), and 500 mg bark powder of <i>Z. officinale</i> mixed in equal proportion and 5 mg tablets given this paste to the patient twice for 7 days after meal.	Singh et al. (2010)	<i>A. heterophyllum</i> (33.33), <i>Z. officinale</i> (83.33)	SP-68	<i>A. heterophyllum</i> (0.5), <i>Z. officinale</i> (1)
16	Babul (SI/J/029)	<i>A. nilotica</i> L.; Mimosaceae /W /T	Barks, leaves, seeds and buds	Irregular menstruation (MFs): ~40 g bark powder mixed with 500 ml water and boiled to a concentration of 100 ml. ~10 ml of this juice is given 2–3 times a day for 3 days.	Patil and Biradar (2011); Rehman et al. (2011); Roozbeh and Darvish (2016); Jain et al. (2005); Farzana and Tharique (2014)	60	IM -29.33, MT -54.67, VD -45.33, S -42.67, SP -58.67	5.25

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				Metrorrhagia (MFs): Equal quantity of dry leaves and wheat grind together to form a powder. Two teaspoon of this powder is given thrice a day for 4 days. Vaginal disorder (MFs): ~15 g bark powder added to 400 ml water and boiled to a concentration of 100 ml. Two teaspoonful of this powder is given thrice a day for 4 days. Sexual potency (MFs): Cooked the seed with <i>ghee</i> (clarified butter) and one teaspoon of this paste is given once a day for 45 days. It thickens the seminal fluid within 30 days. Spermatorrhoea (MFs): Grind all the parts (bud, leaf, bark and seed) of the plant in equal quantities and one teaspoonful of this powder is given thrice a day for 20 days to the patient after meal.				
17	Bakphul (SI/J/047)	<i>Sesbania grandiflora</i> (L). Poir; Fabaceae /W /T	Barks	Leucorrhoea (MFs): ~50 g fresh bark extract juice is applied to vaginal area. This also relieves from itching.	Present work	60	L-44	1
18	Basak (SI/F/040) + Gajar (SI/J/041) + Mula (SI/J/042) Basak (SI/F/040) + Tiyoh (SI/D/043) Basak (SI/F/040) + Ghritakumari (SI/D/044) + Kalhari (SI/J/045) + Hatisur or Apang (SI/F/046) Basak (SI/F/040)	<i>Justicia adhatoda</i> L.; Acanthaceae /W Sh + <i>Daucus carota</i> L.; Apiaceae /C /H + <i>Raphanus sativus</i> (L.) Domin; Brassicaceae /C /H <i>J. adhatoda</i> L.; Acanthaceae /W Sh + <i>Cucumis sativus</i> L.; Cucurbitaceae /C /Cl <i>J. adhatoda</i> L.; Acanthaceae /W Sh + <i>Aloe barbadensis</i> (L.) Burm.f.; Asphodelaceae /C /H + <i>Dichrostachys cinerea</i> Wight et Arn; Fabaceae /W /T + <i>Heliotropium indicum</i> L.; Boraginaceae /W /H <i>J. adhatoda</i> L.; Acanthaceae /W /Sh	Leaves of <i>J. adhatoda</i> , seeds of <i>D. carota</i> and <i>R. sativus</i> Dried flowers of <i>J. adhatoda</i> and fruits of <i>C. sativus</i> Roots of <i>J. adhatoda</i> , <i>A. barbadensis</i> , <i>D. cinerea</i> , <i>H. indicum</i> Leaves of <i>J. adhatoda</i>	Irregular menstruation (PFs): ~30 g of <i>J. adhatoda</i> leaves, 15 g each of seeds of <i>D. carota</i> and <i>R. sativus</i> cooked together in 250 ml of water and reduce it to 1/4th. This decoction ~2 ml with 100 ml milk can be given to the patient to drink for 2 months. Spermatorrhoea (DFs): ~25 g dried flowers of <i>J. adhatoda</i> and ~10 g fruit of <i>C. sativus</i> grind together and given this paste with 2 teaspoon honey, thrice a day for 15 days. Easy delivery (PFs): Equal amount of roots of <i>J. adhatoda</i> , <i>A. barbadensis</i> , <i>D. cinerea</i> , <i>H. indicum</i> powder in equal amount are boiled	Adnan et al. (2015); Jain et al. (2004); Present work Present work Ch et al. (2006)	<i>J. adhatoda</i> (75), <i>D. carota</i> (100), <i>R. sativus</i> (33.33), <i>C. sativus</i> (25), <i>A. barbadensis</i> (57.14), <i>D. cinerea</i> (50), <i>A. aspera</i> (33.33)	MT -57.33, S -42.67, IM-72, ED-60	<i>J. adhatoda</i> (2), <i>D. carota</i> (0.25), <i>R. sativus</i> (0.25), <i>C. sativus</i> (0.5), <i>A. barbadensis</i> (0.25), <i>D. cinerea</i> (0.25), <i>A. aspera</i> (1.75)

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				together with water to form a paste and apply on belly bottom and abdomen and vaginal area 5 months onwards. Metrorrhagia (MFs): ~ 5 g juice of its leaves with same amount of sugar candy mix properly and given thrice a day before meal for one 7 days.				
19	Bat gos (SI/J/064)	<i>Ficus benghalensis</i> L.; Moraceae /W /T	Leaves and buds	Metrorrhagia (MFs): ~35 g young leaves of <i>F. benghalensis</i> boiled with 150–200 ml of water and strain the solution; patients are given ~15 ml of this solution twice a day for 7 days. Vaginal disorder (MFs): Fresh juice of buds soaks by a piece of cotton and applied it in the vagina for 4 days. The treatment is repeated after 15 days interval in acute cases.	Uma et al., (2009) Joseph and Raj (2011)	100	MT –38.67, VD –49.33	2
20	Bhatghilla (SI/F/061) + Aada (SI/J/062)	<i>Oroxylum indicum</i> (L.) Vent.; Bignoniaceae /W /T + <i>Z. officinale</i> Roscoe.; Zingiberaceae /C /H	Barks of <i>O. Indicum</i> ; rhizomes of <i>Z. officinale</i>	Post-delivery weakness (DFs): ~500–650 mg of bark powder of <i>O. indicum</i> mixed with same amounts of <i>Z. officinale</i> and jiggery and make pea sized tablets. One tablet is given in the morning and afternoon for 15 days. Reduce labour pain (DFs): ~500 mg of bark powder of <i>O. indicum</i> mixed with same amounts of <i>Z. officinale</i> and make pea sized tablets. It is very effective in curing immediately labour pain.	Samy et al. (2008); Krishna et al. (2014)	<i>O. Indicum</i> (25), <i>Z. officinale</i> (83.33)	PDW –46.67, RLP –54.67	<i>O. Indicum</i> (0.5), <i>Z. officinale</i> (1)
21	Bhim kol (SI/J/036)	<i>M. balbisiana</i> Colla; Musaceae /C /H	Roots	Vomiting tendency during pregnancy (MFs): Fresh root (~250 ml) grind and ~50 ml of the filtered extract is given daily for initial 2 months of pregnancy before bed time.	Present report	50	VP –54.67	0.25
22	Bhomora (SI/F/022)	<i>Terminalia bellirica</i> (Gaertn.) Roxb.; Combretaceae /W /T	Fruits	Impotence in male (MFs): ~50 g of dry fruit powder mixed with equal quantity of <i>ghee</i> and given half spoon of this paste mixture	Present work	42.86	IIM –69.33	1.5

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23	Bhuikumura (SI/J/024)	<i>Hodgsonia heteroclita</i> Roxb.; Cucurbitaceae /W /Cl	Fruits	before going to bed for 5–6 months. Impotence in male (MFs) ~100 g of fruit juice given to the patient after meal for 2–3 months. Infertility in female (MFs): ~100 g of fruit juice given twice a day after meal for 3–4 months.	Present work	63.64	IF–76, IIM –77.33	0.25
24	Bhumi Amlakhi (SI/D/002)	<i>Phyllanthus urinaria</i> (auct. Non L.); Euphorbiaceae /W /H	Whole plant	Irregular menstruation (MFs): Whole plant grind with little water and ~10 ml of juice extract with honey given in empty stomach for 3–4 months.	Jadhav and Bhutani (2005); Okafor et al. (2008)	28.57	IM –53.3	1
25	Dalim (SI/J/056)	<i>Punica granatum</i> L.; Punicaceae /C /Sh	Leaves	Prolapse of uterus (MFs): ~10 g powder of shade dried <i>P. granatum</i> leaves mixed with a glass of cow milk and given twice a day after meal for 3 months.	Rahman et al. (2006)	44.44	PU–52	1
26	Daruharidra (SI/D/019)	<i>Berberis aristata</i> Dc.; Berberidaceae /W /Sh	Leaves and stems	Irregular menstruation (MFs): ~50 g of leaves and stem grind with 100 ml of water and filtered juice is given twice a day for 3–4 months.	Subbalakshmi and Paranjape (2013)	60	IM –65.33	1.25
27	Devdaru (SI/D/035) + Halodhi (SI/J/033)	<i>Polyalthia longifolia</i> (Sonner) Thw.; Annonaceae /C /T + <i>Curcuma domestica</i> Valet.; Zingiberaceae /C /H	Barks of <i>P. longifolia</i> , rhizomes of <i>C. domestica</i>	Metrorrhagia (Uterine bleeding) (DFs): Dry bark of <i>P. longifolia</i> (~250 g) grind with ~100 g rhizome of <i>C. domestica</i> and make small sundry pills. Two pills are given daily after breakfast for 3 months.	Jadhav and Bhutani (2005); Saha et al. (2005)	<i>P. longifolia</i> (100); <i>C. domestica</i> (63.64)	MT –86.67	<i>P. longifolia</i> (0.5); <i>C. domestica</i> (1.5)
28	Dhaiphul or Agni montha (SI/J/031) + Nageshwar or Nahar (SI/F/007) + Ronga mokua or Ronga bhet (SI/J/032) + Halodhi (SI/J/033) + Ashok (SI/J/025) + Kalmegh (SI/J/034) + Silikha (SI/J/020) + Amlokhi (SI/J/021) + Bhomora (SI/F/022)	<i>Woodfordia fruticosa</i> (L.) Kurz.; Lythraceae /C Sh + <i>Mesua ferrea</i> L.; Calophyllaceae /W /T + <i>Nymphaea rubra</i> Roxb. Ex Andrews; Nymphaeaceae /W /H + <i>C. domestica</i> Valet.; Zingiberaceae /C /H + <i>S. asoca</i> (Roxb.) de Wilde; Caesalpiniaceae /W /T + <i>Andrographis paniculata</i> L.; Acanthaceae /W /H + <i>Terminalia chebula</i> Retz.; Combretaceae /W /T + <i>P. emblica</i> L.;	Flowers of <i>W. fruticosa</i> , <i>M. ferrea</i> and <i>N. alba</i> , rhizomes of <i>C. domestica</i> , barks of <i>S. asoca</i> , whole plant of <i>A. paniculata</i> , fruits of <i>T. chebula</i> , <i>P. emblica</i> and <i>T. bellirica</i>	Irregular menstruation (PFs): Five to six flowers of <i>W. fruticosa</i> , <i>M. ferrea</i> and <i>N. rubra</i> each, ~50 g rhizome of <i>C. domestica</i> , ~50 g bark of <i>S. asoca</i> , ~50 g of whole plant of <i>A. paniculata</i> , ~50 g dry fruit powder of <i>T. chebula</i> , <i>P. emblica</i> and <i>T. bellirica</i> each, grind with little water and make a paste. Given one spoon of this paste twice daily after breakfast for 4–5 months.	Sahu et al. (2010); Modak et al. (2015); Smits et al. (1990); Yu et al. (2002); Okafor et al. (2008); Jadhav and Bhutani (2005); Fruit of <i>T. bellirica</i> : Present work	<i>W. fruticosa</i> (60), <i>M. ferrea</i> (71.43), <i>N. rubra</i> (66.67), <i>C. domestica</i> (63.64), <i>A. paniculata</i> (60), <i>T. chebula</i> (50), <i>P. emblica</i> (80), <i>T. bellirica</i> (42.86)	IM–56	<i>W. fruticosa</i> (0.25), <i>M. ferrea</i> (2.25), <i>N. rubra</i> (0.25), <i>C. domestica</i> (1.5), <i>A. paniculata</i> (0.25), <i>T. chebula</i> (0.5), <i>P. emblica</i> (3.5), <i>T. bellirica</i> (1.5)

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29	Dubori bon (SI/D/011)	Euphorbiaceae /W /T + <i>T. bellirica</i> (Gaertn.) Roxb.; Combretaceae /W /T <i>Cynodon dactylon</i> (L.) Pers.; Poaceae /W /G	Whole plant	Metrorrhagia(MFs): ~100 g of <i>C. dactylon</i> grind with 100 ml of cow milk and filtered juice is given in empty stomach for 3–4 months.	Bora et al. (2016)	60	MT–56	1.5
30	Era gos (SI/J/016) + Xon-Borial (SI/J/017) + Siddhalota (SI/J/018) + Daruharidra (SI/D/019) + Silikha (SI/J/020) + Amlakhi (SI/J/021) + Bhomora (SI/F/022) + Keturi (SI/J/023) + Bhuikumura + Raktajoba (SI/D/003)	<i>Ricinus communis</i> L.; Euphorbiaceae /W Sh + <i>Sida acuta</i> L.; Malvaceae /W Sh + <i>Hodgsonia heteroclita</i> (Roxb.); Cucurbitaceae /Cl + <i>Tinospora cordifolia</i> (Willd) Miers.; Menispermaceae /W /Cl + <i>B. aristata</i> Dc.; Berberidaceae /W Sh + <i>T. chebula</i> Retz.; Combretaceae /W /T + <i>P. emblica</i> L.; Euphorbiaceae /W /T + <i>T. bellirica</i> (Gaertn.) Roxb.; Combretaceae /W /T + <i>Curcuma aromatic</i> Salisb.; Zingiberaceae /W /H + <i>Hibiscus rosa-sinensis</i> L.; Malvaceae/C /Sh <i>Psoralea corylifolia</i> L.; Fabaceae /W /H	<i>R. communis</i> and <i>S. acuta</i> roots, fruits of <i>H. heteroclita</i> , leaves and stems of <i>T. cordifolia</i> and <i>B. aristata</i> , fruit of <i>T. chebula</i> , <i>P. emblica</i> and <i>T. bellirica</i> , rhizomes of <i>C. aromatica</i> , flowers of <i>H. rosa-sinensis</i>	Infertility in female (PFs): Equal quantity of <i>R. communis</i> root, fruits of <i>H. heteroclita</i> , leaves and stem of <i>T. cordifolia</i> and <i>B. aristata</i> , root of <i>S. acuta</i> , fruit of <i>T. chebula</i> , <i>P. emblica</i> and <i>T. bellirica</i> , rhizome of <i>C. aromatica</i> , flower of <i>H. rosa-sinensis</i> grind together and make a paste. One spoon of this mixture is given daily after breakfast for 6–7 months.	Sandhyakumary et al. (2003); <i>H. heteroclita</i> fruits: Present work; Jain et al. (2004); Rahmatullah et al. (2012); Maurya et al. (2004); Dhyan et al. (2010); Rahman et al. (2014); Priya and Saravanan (2012); Lans (2007)	<i>R. Communis</i> (60), <i>H. heteroclita</i> (63.64), <i>S. acuta</i> (30), <i>T. cordifolia</i> (58.82), <i>B. aristata</i> (60), <i>T. chebula</i> (50), <i>P. emblica</i> (80), <i>T. bellirica</i> (42.86), <i>C. aromatica</i> (66.67), <i>H. rosa-sinensis</i> (50)	IF –65.33	<i>R. communis</i> (0.25), <i>H. heteroclita</i> (0.25), <i>S. acuta</i> (0.25), <i>T. Cordifolia</i> (0.5), <i>B. aristata</i> (1.25), <i>T. chebula</i> (0.5), <i>P. emblica</i> (3.5), <i>T. bellirica</i> (1.5), <i>C. aromatica</i> (0.25), <i>H. rosa-sinensis</i> (2)
31	Habucha (SI/D/067)	<i>Psoralea corylifolia</i> L.; Fabaceae /W /H	Seeds	Infertility in female (MFs): After the menstrual cycle, seed oil extract applies in the vagina for 2 days.	Present work	33.33	IF –50.67	1
32	Halodhi (SI/J/033) + Ronga joba (SI/D/003) + Siddhalota (SI/J/018)	<i>C. domestica</i> Valet.; zingiberaceae /C /H + <i>H. rosa-sinensis</i> L.; zingiberaceae /C /H + <i>T. cordifolia</i> (Willd) Miers; Menispermaceae /C /Cl	Rhizomes of <i>C. domestica</i> , flowers of <i>H. rosa-sinensis</i> , stems of <i>T. cordifolia</i>	Metrorrhagia (PFs): ~100 g rhizome of <i>C. domestica</i> , five flowers of <i>H. rosa-sinensis</i> , ~50 g of dry stem of <i>T. cordifolia</i> , grind together and mixed paste is given (~50 g) before bed time. Dysmenorrhea (MFs): Fresh rhizome of <i>C. domestica</i> grind with jiggery in equal proportion and paste is given in empty stomach once in a day for 3 months.	Saha et al. (2005); Hegde et al. (2007); Vidyasagar and Prashantkumar (2007)	<i>C. domestica</i> (63.64), <i>H. rosa-sinensis</i> (50), <i>T. cordifolia</i> (58.82)	IF –78.67, D –57.33, MT –70.67	<i>C. domestica</i> (1.5), <i>H. rosa-sinensis</i> (2), <i>T. cordifolia</i> (0.5)
33	Hatisur or Apang (SI/F/046) Hatisur or Apang (SI/F/046) + Dubori bon (SI/D/011)	<i>H. indicum</i> L.; Boraginaceae /W /H <i>H. indicum</i> L.; Boraginaceae /W /H + <i>C. dactylon</i> (L.) Pers.; Poaceae /W /Gr	Roots of <i>H. indicum</i> Leaves of <i>H. indicum</i> and whole plant of <i>C. dactylon</i>	Vaginal disorder (MFs): Fresh roots of <i>H. indicum</i> grinded and juice extract soaked by cotton. This cotton in the vaginal opening. Helps in vaginal pain and blockage in menstrual flow.	Chinsembu, (2016) Vidyasagar and Prashantkumar (2007) Nag et al. (2007)	<i>H. indicum</i> (33.33), <i>C. dactylon</i> (60)	VD–52, ED–40, MT –81.33	<i>H. indicum</i> (1.75), <i>C. dactylon</i> (1.5)

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				Metrorrhagia (DFs): A mixture of ~15 g fresh leaves of <i>H. indicum</i> and ~5 g whole plant of <i>C. dactylon</i> grinded together in 100 ml water. The strain mixture of ~10 ml with one teaspoon honey given to the patient twice a day for 7 days. Easy delivery (MFs): Fresh leaf paste of <i>H. indicum</i> can be applied on belly area, urinary bladder and vagina, twice a day, before 7 days of delivery.				
34	Jowain (SI/F/048) Jowain (SI/F/048) + Piyaj (SI/D/049)	<i>Trachyspermum ammi</i> (L.) Sprague; Apiaceae /C /H <i>T. ammi</i> (L.) Sprague; Apiaceae /C /H + <i>Allium cepa</i> L.; Amaryllidaceae /C /H	Fruits of <i>T. ammi</i> and <i>A. cepa</i>	Irregular menstruation (MFs): ~5 g of <i>T. ammi</i> dry fruit powder mix with 30 g of jiggery and boiled in ~100 ml of water. The mixture is given every morning for a month. This helps in cleaning the uterus and regularizing the menstrual cycle. Sexual potency in male (DFs): ~3 g <i>T. ammi</i> dry fruit powder mixed with 10 ml of <i>A. cepa</i> juice and is given for thrice a day. Within 21 days its results can be noticed. This also helps in curing immediate discharge and low sperm counts.	Rajith et al. (2012); Sarwat et al. (2012) Malviya et al. (2011)	<i>T. ammi</i> (33.33), <i>A. cepa</i> (50)	IM-36, SP -57.33	<i>T. ammi</i> (1.5), <i>A. cepa</i> (0.5)
35	Mahaneem (SI/J/065) + Akarkara (SI/J/050) Mahaneem (SI/J/065) + sandalwood gos (SI/J/066)	<i>Azadirachta indica</i> A. Juss.; Meliaceae /C /T + <i>A. pyrethrum</i> DC; Asteraceae /C /H <i>A. indica</i> A. Juss.; Meliaceae /C /T + <i>Santalum album</i> L.; Santalaceae /C /T	Leaves of <i>A. indica</i> and <i>A. pyrethrum</i> Seeds of <i>A. indica</i> and <i>S. album</i> , wood of <i>S. album</i>	Prolapse of Uterus (DFs): ~10 ml leaf juices of <i>A. indica</i> and 3 ml of <i>A. pyrethrum</i> juice mixture properly and given it for 15 days an empty stomach. Leucorrhoea (DFs): Equal quantities of seeds of <i>A. indica</i> and <i>S. album</i> wood grind together and ~10 g of this mixed paste is given to the patient once a day.	Present work Azad et al. (2014)	<i>A. indica</i> (66.67), <i>A. pyrethrum</i> (37.50), <i>S. album</i> (25)	L -62.67, PU-64	<i>A. indica</i> (1), <i>A. pyrethrum</i> (1.75), <i>S. album</i> (0.5)
36	Methi-sak (SI/D/015)	<i>Trigonella foenum-graecum</i> L.; Fabaceae /C /H	Seeds	Dysmenorrhea (MFs): Grind ~50 g seed and soak in 100 ml of water overnight and given in empty stomach for 2 months.	Younes et al. (2014)	100	D -41.33	1
37	Nageshwar or Nahar gos (SI/F/007)	<i>M. ferrea</i> L.; Calophyllaceae /W /T	Flowers (pollen)	Irregular menstruation (MFs): Pollen of 3–4 <i>M. ferrea</i>	Modak et al. (2015) Flower Pollen: Present work	71.43	IM-40, IF -49.33	2.25

(continued on next page)

Table 1 (continued)

Sl. No.	Local name (Assamese)/ Voucher specimen no.	Botanical name, Family Name (Wild (W) or Cultivated (C)) and Life form	Parts used	Disease cured/ Modes of preparation/ Methods of administrations	Relevant ethno botanical/ pharmacological citation	FL value (%)	^a PR value (%)	FS value (Mono-1, di-0.5, poly-0.25)
38	Narikol (SI/J/009)	<i>Cocos nucifera</i> L.; Areaceae /C /T	Endocarp	flower mixed with ~250 ml of cow milk and given twice a day during first three days of menstruation period. Infertility in female (MFs): Pollen of 3–4 <i>M. ferrea</i> flower mixed with ~250 ml of cow milk and given in empty stomach for 3–4 months. Vomiting tendency during pregnancy (MFs): Ash of burned endocarp of mature coconut soak in water (1:2 ratio) and filtered liquid of ~25 ml given once in a day after breakfast during the initial 2–3 months.	Westfall (2003)	100	VP –21.33	1
39	Olot-komol (SI/D/001)	<i>Abroma augusta</i> L.; Sterculiaceae /C /Sh	Leaves and stems	Irregular menstruation (MFs): ~50 g of dry or fresh stem grind and soak overnight in 100 ml of warm water, ~20 ml of filtered juice given twice a day for 3 months after meal. Leucorrhoea (MFs): 1. Five to seven fresh leaves and 50 g of stem crush together and boil in 250 ml of water and concentrate to 100 ml. ~10 ml is given daily once for 3–4 months.	Present work Naher et al. (2013)	66.67	IM –77.33, L–65.33	2
40	Pategoja (SI/J/030)	<i>Kalanchoe pinnata</i> (Roxb.) Pers.; Crassulaceae /C /H	Leaves	Leucorrhoea (MFs): Ten fresh leaves burnt over fire and grind with honey and a paste is prepared. One teaspoon of this paste should be taken before lunch and dinner for 4–5 months.	Okwu and Uchenna (2009); Leaf: Present work	80	L–57.33	1
41	Polash (SI/J/008)	<i>Butea monosperma</i> L. Taub; Papilionaceae /W /T	Roots	Infertility in female (MFs): Fresh ~50 g of root grind with <i>ghee</i> prepared from cow milk and form a paste and give after lunch during the first three days of menstruation period. Process continues for 5–6 months. Easy delivery (MFs): Fresh root are crushed and soak in ~100 ml of water for 3–4 h. Give the filtered juice twice a day from the seven month of pregnancy.	Kasture et al. (2000); Nag et al. (2007)	33.33	IF–36, ED–36	2
42	Rakta Jaba (SI/D/003) +	<i>H. rosa-sinensis</i> L.; Malvaceae /C Sh +	Flowers of <i>H. rosa-sinensis</i> and	Irregular menstruation (DFs):	Sen et al. (2011); Nivsarkar et al.	<i>H. rosa-sinensis</i> (50); <i>C. limon</i> (25)	IF –78.67,	<i>H. rosa-sinensis</i> (2); <i>C. limon</i> (1.5) (continued on next page)

Table 1 (continued)

Sl. No.	Local name (Assamese)/ Voucher specimen no.	Botanical name, Family Name (Wild (W) or Cultivated (C)) and Life form	Parts used	Disease cured/ Modes of preparation/ Methods of administrations	Relevant ethno botanical/ pharmacological citation	FL value (%)	^a PR value (%)	FS value (Mono-1, di-0.5, poly-0.25)
	Nemu (SI/D/004)	<i>Citrus limon</i> (L.) Burn.f.; Rutaceae /C /Sh	fruits of <i>C. limon</i>	Five flowers of <i>H. rosa-sinensis</i> grind with 25 ml of <i>C. limon</i> juice and filtered juice. Give this to the every alternate day for six months after breakfast. Infertility in female (MFs): Five to seven flowers of <i>H. rosa-sinensis</i> grind with 25 ml water and filtered juice given twice daily for 3 months. Vomiting tendency during pregnancy (MFs): Juice of <i>C. limon</i> is given to reduce the vomiting tendency of pregnant women.	(2005); Padalia et al. (2015); Kia et al. (2014)		Vp –74.67, IM –49.33	
43	Satamul (SI/J/037) Satamul (SI/J/037) + Bisallyakarni (SI/D/038)	<i>Asparagus racemosus</i> Wild.; Asparagaceae /W /H <i>A. racemosus</i> Wild; Asparagaceae /W /H + <i>Tridax procumbens</i> L.; Asteraceae/W /H	Roots of <i>A. racemosus</i> , leaves of <i>A. tricolor</i>	Infertility in female (MFs): ~250 g of <i>A. racemosus</i> root grind with ~100 ml of milk and filtered extract given twice a day in (~50 ml) for 3 months. Dysmenorrhea (DFs): ~250 g of <i>A. racemosus</i> root grind with 5–7 leaves of <i>T. procumbens</i> and honey is added to this extract; mixture is given once in a day in empty stomach for 2 months.	Wani et al. (2011); Rahman and Gulshana (2014)	<i>A. racemosus</i> (72.73), <i>T. procumbens</i> (45.45)	IF –66.67, D –74.67	<i>A. racemosus</i> (1.5), <i>T. procumbens</i> (0.5)
44	Shimalu gos (SI/J/005)	<i>Bombax ceiba</i> L.; Bombacaceae /C /T	Roots	Infertility in male (MFs): Fresh roots (~50 g) grind and soak overnight in 100 ml of water. Given once during bedtime for 2–3 months. Impotence in male (MFs): Fresh roots (~50 g) grind and mix with 250 ml of cow milk and boil. Make the mixture of this concentration to 100 ml and given once during bedtime for 6 months. Leucorrhoea (MFs): ~100 g of fresh root grind and boil in 400 ml of water. Make the mixture this concentration to ~100 ml and give it twice a day in ~50 ml amount for 4–5 months.	Rahman et al. (2014); Jain et al. (2004)	62.5	L –62.67, IIM–52, IML–36	3
45	Sthalapaddma (SI/J/006)	<i>Hibiscus mutabilis</i> L.; Malvaceae /C /Sh	Stems and Flowers	Infertility in male (MFs): ~50 g of stem are	Present work Matsui et al. (1967)	40	IM–68, IIM –65.33,	2 (continued on next page)

Table 1 (continued)

Sl. No.	Local name (Assamese)/ Voucher specimen no.	Botanical name, Family Name (Wild (W) or Cultivated (C)) and Life form	Parts used	Disease cured/ Modes of preparation/ Methods of administrations	Relevant ethno botanical/ pharmacological citation	FL value (%)	^a PR value (%)	FS value (Mono-1, di-0.5, poly-0.25)
				crushed and soak overnight in 100 ml of water and given ~50 ml twice a day for 4–5 months. Impotence in male (MFs): Five flowers are grind with water (~250 ml) and given in empty stomach for 2–3 months. Sexual Potency (DFs): ~10 g seed powder of <i>L. usitatissimum</i> with equal quantities of black pepper powder <i>P. nigrum</i> mixed with 5 ml honey and given this paste once in a day for 20 days.			IML–68	
46	Tisi (SI/D/054) + Jaluk (SI/J/055)	<i>Linum usitatissimum</i> L.; Linaceae /C /H + <i>Piper nigrum</i> L; Piperaceae /C /Cl	Seeds of <i>L. usitatissimum</i> and fruits of <i>P. nigrum</i>	Sexual Potency (DFs): ~10 g seed powder of <i>L. usitatissimum</i> with equal quantities of black pepper powder <i>P. nigrum</i> mixed with 5 ml honey and given this paste once in a day for 20 days.	Altair and Edrah (2015); Dalal et al. (2013)	<i>L. usitatissimum</i> (33.33), <i>P. nigrum</i> (57.14)	SP –58.67	<i>L. usitatissimum</i> (0.5), <i>P. nigrum</i> (0.5)
47	Tokma (SI/D/071)	<i>Hyptis suaveolens</i> (L.) Poit; Lamiaceae /W /H	Seeds	Infertility and Impotence in male (MFs): Seeds are soaked overnight in 100 ml of water and given ~50 ml twice a day for 4–5 months.	Gupta and Sharma (2006) Seed: Present work	50	IIM –34.67, IML –42.67	1

H-Herb, Sh-Shrub, T-Tree, Cl-Climber, Gr-Grass, P-Palm.

^a Infertility in female-IF, Irregular menstruation-IM, Leucorrhoea-L, Impotence in male-IIM, Vomiting tendency during pregnancy-VP, Infertility in male-IML, Metrorrhagia-MT, Increase breast milk-IBM, Dysmenorrhea-D, Retrograde ejaculation-RE, Vaginal disorder-VD, Pain in testicles-PT, Spermatorrhoea-S, Prolapse of Uterus-PU, Easy delivery-ED, Sexual potency-SP, Erectile Dysfunction-EDF, Post-delivery weakness-PDW, Reduce labour pain-RPL, Aphrodisiac-A.

3. Results

3.1. Ethnomedicinal plants, modes of preparation and utilization pattern

The present ethnomedicinal study revealed that the local people of the southern Nalbari district, Assam, India have been using different medicinal formulations (MFs, DFs and PFs) from local herbs. Total 71 medicinal plants were found to be used in different formulations (57 MFs, 15 DFs and 8 PFs) for curing 19 ailments. These seventy one plant species belonging to 48 families and 64 genera. Thirty one plant

species were found to be cultivated in the home garden of traditional healers and local villagers, while rest 40 species they collected from the wild form (Table 1). Plant local and trinomial names, and voucher specimen numbers, family name, plant parts used, respective formulations (MFs, DFs and PFs), methods of preparation and modes of administrations are tabulated in Table 1. Among the reported plant species 29 (40.85%) were herbs, 12 (16.90%) were shrubs, 5 (7.04%) were climbers, 22 (30.99%) were trees and 2 (2.82%) were grasses and 1 (1.41%) was palm (Fig. 2). Maximum numbers of plants (16) (22.54%) were used for their leaves and roots, 13 (18.31%) plants were used for their seed, 10 (14.08%) plants were used for their bark, 9

Table 2

FL (%) values of list of collected ethnomedicobotanical plants used against reproductive problems.

FL (%) value	Medicinal Plants used
91–100%	<i>Cocos nucifera</i> , <i>Trigonella foenum-graecum</i> , <i>Polyalthia longifolia</i> , <i>Daucus carota</i> , <i>Ficus benghalensis</i>
81–90%	<i>Zingiber officinale</i>
71–80%	<i>Mesua ferrea</i> , <i>Phyllanthus emblica</i> , <i>Oryza sativa</i> , <i>Kalanchoe pinnata</i> , <i>Asparagus racemosus</i> , <i>Justicia adhatoda</i>
61–70%	<i>Abroma augusta</i> , <i>Bombax ceiba</i> , <i>Morinda angustifolia</i> , <i>Curcuma aromatica</i> , <i>Hodgsonia heteroclita</i> , <i>Ficus racemosa</i> , <i>Nymphaea rubra</i> , <i>Curcuma longa</i> , <i>Withania somnifera</i> , <i>Hemidesmus indicus</i> , <i>Terminalia arjuna</i> , <i>Azadirachta indica</i>
51–60%	<i>Hibiscus rosa-sinensis</i> , <i>Cynodon dactylon</i> , <i>Carica papaya</i> , <i>Ricinus communis</i> , <i>Tinospora cordifolia</i> , <i>Berberis aristata</i> , <i>Saraca asoca</i> , <i>Musa balbisiana</i> , <i>Aloe barbadensis</i> , <i>Dichrostachys cinera</i> , <i>Sesbania grandiflora</i> , <i>Allium cepa</i> , <i>Juglans regia</i> , <i>Piper nigrum</i> , <i>C. gigantea</i> , <i>Acacia nilotica</i>
< 50%	<i>Citrus limon</i> , <i>Hibiscus mutabilis</i> , <i>Butea monosperma</i> , <i>Ficus religiosa</i> , <i>Ananas comosus</i> , <i>Sida acuta</i> , <i>Terminalia chebula</i> , <i>Terminalia bellirica</i> , <i>Quercus infectoria</i> , <i>Tridax procumbens</i> , <i>Mangifera indica</i> , <i>Raphanus sativus</i> , <i>Cucumis sativus</i> , <i>Heliotropium indicum</i> , <i>Anacyclus pyrethrum</i> , <i>Chlorophytum borivilianum</i> , <i>Linum usitatissimum</i> , <i>Punicagranatum</i> , <i>Cuminum cyminum</i> , <i>Clitoria ternatea</i> , <i>Oroxylum indicum</i> , <i>Santalum album</i> , <i>Psoralea corylifolia</i> , <i>Eclipta prostrata</i> , <i>Phyllanthus urinaria</i>

Table 3

Ethnomedicinal plants scoring more than 65 PR % value and plants with star marks (*) were selected for preliminary photochemical analysis.

Medicinal Plant name	Village-1					Village-2					Village-3					Total score	Score %
	Jaha					Niz- Bahjani					Madhupur						
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E		
Irregular menstruation																	
*Abroma augusta	5	3	3	5	4	5	5	4	3	5	5	3	0	4	4	58	77.33
Berberis aristata	3	4	2	4	3	5	4	2	3	4	2	3	5	1	4	49	65.33
Saraca asoca	4	5	3	2	5	3	3	3	5	4	3	2	5	2	2	51	68.00
Impotence in female																	
*Hodgsonia heteroclita	5	0	5	3	2	5	4	5	4	4	3	5	4	5	3	57	76.00
*Hibiscus mutabilis	3	4	4	3	4	5	3	5	5	4	3	5	4	4	3	59	78.67
Asparagus racemosus	5	3	5	2	3	3	1	5	3	2	4	3	4	3	4	50	66.67
Leucorrhoea																	
Abroma augusta	3	3	5	2	4	5	4	5	2	4	3	4	0	2	3	49	65.33
*Morinda angustifolia	3	5	5	3	5	4	2	4	3	3	4	2	3	0	5	51	68.00
Impotence in male																	
*Hibiscus mutabilis	4	0	4	2	4	0	5	3	5	2	4	5	5	2	4	49	65.33
*Hodgsonia heteroclita	0	3	5	5	3	5	4	1	5	5	4	4	5	5	4	58	77.33
Terminalia bellirica	3	3	4	3	3	5	5	4	4	4	2	5	1	3	3	52	69.33

Table 4

Top thirteen formulation scoring (FS) plants from the list of collected ethnomedicinal plants against reproductive problems.

Sl. No.	Plants	Scoring
1	<i>Acacia nilotica</i>	5.25
2	<i>Terminalia chebula</i>	3.5
3	<i>Bombax ceiba</i>	3
4	<i>Saraca asoca</i>	2.50
5	<i>Withania somnifera</i>	2.50
6	<i>Mesua ferrea</i>	2.25
7	<i>Abroma augusta</i>	2
8	<i>Phyllanthus urinaria</i>	2
9	<i>Butea monosperma</i>	2
10	<i>Justicia adhatoda</i>	2
11	<i>Terminalia arjuna</i>	2
12	<i>Ficus benghalensis</i>	2
13	<i>Calotropis gigantea</i>	2

(12.68%) were used for fruits, 7 (9.86%) were used for stem, 5 (7.04%) used for flowers, 3 (4.23%) plants were used as a whole, 3 (4.23%) were used for their rhizome, followed by 1 plant (1.41%) used for latex, 1 (1.41%) for endocarp and 1 (1.41%) for bud (Fig. 3). In few formulations, different plant parts of a particular species were found to be used more than one time. Maximum numbers of ethnomedicinal plants were recorded for Fabaceae family (five plants); followed by Euphorbiaceae, Malvaceae, Moraceae, Poaceae, Combretaceae, Zingiberaceae, Apiaceae (three species of each). Herbal medicines were prescribed in different modes including paste, decoction, juice, extraction, powder and oil. The most common mode of medicinal preparation was juice (52.11%) form followed by paste (18.31%), decoction (15.49%), pill (5.63%), extraction (4.23%), powder (2.28%) and oil (1.41%) (Fig. 4), in many formulations, some ingredients such as *ghee* (clarified butter), honey, jiggery, milk were added to enhance the taste as well as the effectiveness of those medicinal preparations. Oral route of administration was found to be the most favored for different formulations followed by external application. Among nineteen different reproductive problems, highest numbers of plants (22) were found to be used for curing irregular menstruation followed by fifteen plants for curing infertility in females, and nine plants for curing sexual potency, leucorrhoea and vaginal disorder each (Fig. 5). The majority of wild plants such as *A. augusta*, *Bombax ceiba* L., *M. angustifolia*, *Tinospora cordifolia* (Willd) Miers., *Quercus infectoria* Oliv., *Woodfordia fruticosa* (L.) Kurz., *Polyalthia longifolia* (Sonner) Thw. were cultivated by the traditional healers or the local villagers in their home gardens. Some

rare plants such as *Andrographis paniculata* L., *Asparagus racemosus* Wild., *Oroxylum indicum* (L.) Vent., *T. cordifolia*, *Mesua ferrea* L. were also found to be used in many formulations.

3.2. Quantitative analysis of FL, PR and FS

High FL value shows the plant's ethnomedicinal use approved by the number of respondents. FL value indicates the informant's choice for a particular plant for the treatment of a given disease. FL was categorized into different groups viz. < 50%, 51–60%, 61–70%, 71–80%, 81–90%, 91–100%. Highest fidelity value was reported for *Cocos nucifera* L., *Trigonella foenum-graecum* L., *P. longifolia*, *Daucus carota* L., *Ficus benghalensis* L. (Table 1). PR of selected monoherbal plants were tabulated in Table 1. Highest formulation scoring was reported for *Acacia nilotica* L. (5.25) followed by *Terminalia chebula* Retz. (3.5), *B. ceiba* (3), *Saraca asoca* (Roxb.) de Wilde. and *Withania somnifera* (L.) Dunal. (2.50), *M. ferrea* (2.25), *A. augusta*, *Phyllanthus urinaria* (auct. Non L.), *Butea monosperma* L., *Justicia adhatoda* L., *Terminalia arjuna* (Roxb.) Wight & Arn., *F. benghalensis* and *Calotropis gigantea* (L.) R. Br. (2) (Table 1)

3.3. Yield of the extracts

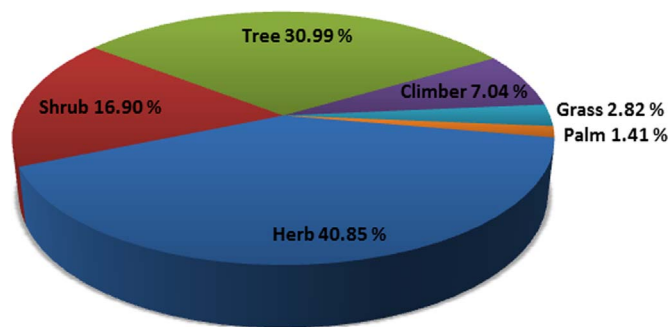
Hexane, chloroform and ethanol: water (50:50), solvents were taken for the extraction on the basis of their polarities. The different yield was due to the polar and non-polar phytochemicals, were present in the plant body that extracted by the different solvents. The rate of the yield increased from non-polar to polar, hexane to ethanol: water (50:50) extracts. In the stem of *A. augusta*, maximum yield observed in the ethanol: water extract (5.87%), medium observed in chloroform (3.03%) and the minimum in the hexane (1.29%). Bark of *M. angustifolia* showed 6.14% in ethanol: water, 4.01% in chloroform and 2.31% in hexane extracts respectively. In case of the fruit of *H. heteroclita*, 3.64%, 2.93% and 1.05% yield was observed for ethanol: water, chloroform and hexane. A similar result has also been found in the stem part of *H. rosa-sinensis*, the maximum yield was achieved by ethanol: water extract (6.77%), medium was noticed in chloroform (5.04%) and minimum was hexane (2.28%).

3.4. Preliminary qualitative chemical profiling analysis of extracts

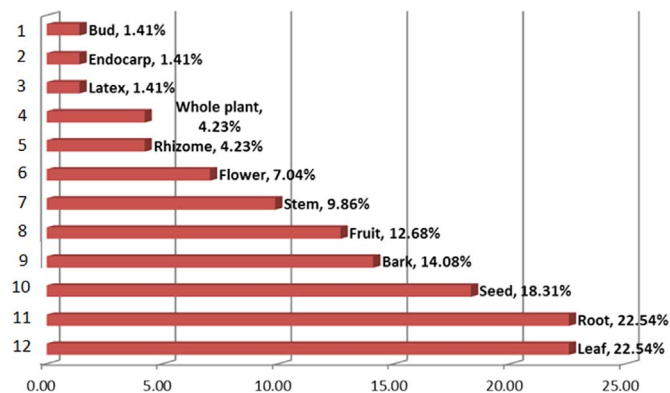
After analyzing the extracts of *A. augusta* (stem), *M. angustifolia* (bark), *H. heteroclita* (fruit) and *H. mutabilis* (stem), for specific

Table 5Preliminary qualitative chemical profiling analyses of *A. augusta* (stem), *M. angustifolia* (bark), *H. heteroclita* (fruit) and *H. mutabilis*(stem).

Name of the Phytochemical	Specific test followed	Solvent used for extraction	Observation for <i>A. augusta</i> (stem)	Observation for <i>M. angustifolia</i> (bark)	Observation for <i>H. heteroclita</i> (fruit)	Observation for <i>H. mutabilis</i> (stem)
Alkaloids	Wagner's test	Hexane	+	—	—	—
		Chloroform	-	—	+	—
		ethanol: water (50:50)	+	+	+	+
Reducing Sugars	Fehling's test	Hexane	—	+	—	+
		Chloroform	++	+	—	+
		ethanol: water (50:50)	+++	++	+	++
Anthraquinones	Borntrager's test	Hexane	+	—	—	+
		Chloroform	+	—	—	+
		ethanol: water (50:50)	++	—	+	++
Saponins	Froth test	Hexane	—	+	—	+
		Chloroform	—	++	—	++
		ethanol: water (50:50)	++	+++	+	++
Proteins and Amino acids	Ninhydrin	Hexane	—	—	—	—
		Chloroform	+	—	+	—
		ethanol: water (50:50)	++	—	++	—
Phenolic compounds	Ferric Chloride Test	Hexane	+	+	—	+
		Chloroform	++	++	++	+++
		ethanol: water (50:50)	++	++	+++	+++
Flavonoids	Alkaline Reagent test	Hexane	+	+	—	+
		Chloroform	+++	+++	+++	++
		ethanol: water (50:50)	+++	+++	+++	+++
Terpenoids	Salkowski's test	Hexane	—	—	+	+
		Chloroform	+	+	+	+
		ethanol: water (50:50)	+	++	++	++
Fixed oils and fats	Saponification test	Hexane	+	+	+	—
		Chloroform	—	+	—	—
		ethanol: water (50:50)	—	—	—	—
Detection of Phytosterol	Liebermann-Burchard's Test	Hexane	+	—	+	—
		Chloroform	++	++	+++	+++
		ethanol: water (50:50)	+++	++	+++	+++
Glycosides	Keller-Killiani Test	Hexane	+	—	—	+
		Chloroform	+	—	—	+
		ethanol: water (50:50)	++	—	+	++

**Fig. 2.** Displayed percentage distribution of various lifeforms of medicinal plants used for reproductive problems.

phytochemical qualitatively, in Table 5, it has been found that; alkaloids (very minimal concentration), carbohydrates, glycosides (except the bark of *M. angustifolia*), saponins, phenolic compounds, flavonoids, terpenoids, and phytosterols are present in ethanol: water (50:50) extracts of four plant samples; fixed oils and fats are completely absent in ethanol: water (50:50). Proteins and Amino acids were only present in *A. augusta* and *H. heteroclita*.

**Fig. 3.** Percentage distribution of various plant parts used.

4. Discussion

4.1. Ethnomedicinal plants, modes of preparation and utilization pattern

Several reproductive disorders were reported during the interview schedule and group discussions with traditional healers and/or local

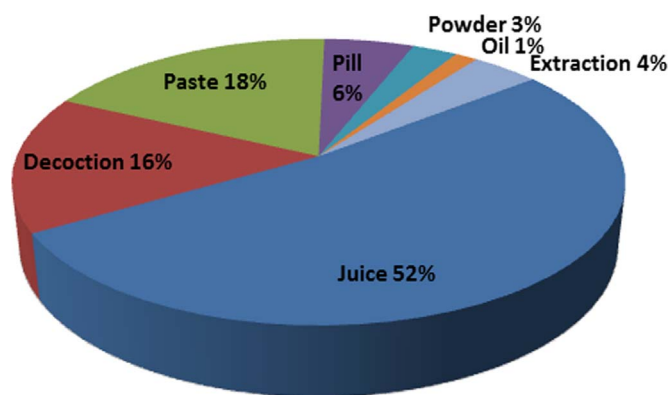


Fig. 4. Percentage distribution of various modes of preparation of medicinal plants used for reproductive problems.

respondents of the study area. It was observed that traditional healers used highest number of MFs for curing a single ailment. In other cases, DFs and PFs were also prescribed for the fact that two or more plants produce a greater effect than the sum of their individual effects (Giday et al., 2010). Previous report has also suggested that, di and polyherbal treatments might attain fast and better result in comparison to monoherbal treatment, as in di or poly more photochemically active compounds are present (Teklehaymanot et al., 2007).

Herbs were also found to be the most common life form (41%) in other parts of the world (Ahmad et al., 2014; Ibrar et al., 2007; Jan et al., 2011; Modak et al., 2015; Talukdar and Gupta, 2014). Leaf (22.54%) and roots (22.54%) were mostly used plant components in different formulations. The leaves were informed as most frequently used part in several ethnobotanical studies (Abo et al., 2008; Anonymous, 2001; Cornara et al., 2009; Gonzalez et al., 2010; Kadir et al., 2012a; Mahishi et al., 2005; Nasir and Ali, 2002; Telefo et al., 2011). Pharmacologically, leaves are more proactive against certain diseases than that of other plant parts, because of the main photosynthetic area in plants (Passalacqua et al., 2007). Moreover, collection of the leaves in comparison, to flowers, fruits, and roots is easier and became the leading reason for its extensive use as ethnomedicine (Giday et al., 2009; Telefo et al., 2011). Previous reports also revealed that the roots are widely used for curing reproductive disorders (Deka and Kalita, 2013; Modak et al., 2015; Taid et al., 2014). Most of the medicinal plants enlisted in this study belongs to Fabaceae family, in accordance with (Kadir et al., 2012a; Marles and Farnsworth, 1995; Modak et al., 2015) earlier studies. Wild plants are found to be widely used than that of the cultivated one. *A. paniculata* was found to be the most commonly used reproductive medicine in earlier studies

(Jarukamjorn and Nemoto, 2008; Kuppusamy and Murugan, 2010; Krishnamoorthy et al., 2013). In the Unani practice of medicine, it is also considered a gastric and liver tonic, aperients, astringent, carminative, antihelminthic, antipyretic and anti-inflammatory. Additionally, is suggested for curing scabies, gonorrhoea, leprosy, skin eruptions and seasonal fevers for its blood purifying activity (Kumar et al., 2004). Similarly, *A. racemosus* reported as an important traditional medicine for gonorrhoea (Modak et al., 2015; Sharma and Sharma, 2013), *W. somnifera* have antifertility properties (Iuvone et al., 2003; Leyon and Kuttan, 2004; Tohda et al., 2005), *Hibiscus rosa-sinensis* L. stated for curing against irregular menstrual cycle (Alam, 1992), gonorrhoea (Whistler, 1985), regulate menstruation which cause abortion (Burkhill, 1966), abnormal abortion (Nath et al., 1992), antifertility (Krishnamurthy, 1980), aphrodisiac (Alami and Macksad, 1976), menorrhagia (Bourdy and Walter, 1992). Among three species (*Terminalia bellirica* (Gaertn.) Roxb., *T. chebula* and *Phyllanthus emblica* L.), commonly known as *Triphala* in Ayurveda were also been frequently used in different reproductive herbal medicines. For example, *T. bellirica* is used for curing low density of semen (Rahmatullah and Biswas, 2012), impotency (Rahmatullah et al., 2010c, 2010b), to increase sperm production (Biswas et al., 2011), gonorrhoea and syphilis (Islam et al., 2011a); *T. chebula* was reported as an excellent medicine for curing sexual disorders (Mollik et al., 2010), and to increase sexual desire (Rahmatullah et al., 2010a, 2010b, 2010c), and to increase the sperm count (Islam et al., 2011b); and *P. emblica* used for curing gonorrhoea (Rahmatullah et al., 2010b), leucorrhoea (Rahmatullah et al., 2010c), syphilis (Islam et al., 2011a). More than half (52%) of the formulations were prescribed in the juice form, followed by paste, decoction and others. Equally, juice and decoction forms are the two commonly used modes of ethnomedicinal preparation reported in previous studies (Taid et al., 2014; Modak et al., 2015; Talukdar and Gupta, 2014).

4.2. Quantitative analysis of FL, PR and FS

The practice of treating reproductive problems using different plant species among the local communities residing in Nalbari district has been reported and summarized. Earlier observation been indicated the unique use of the weed species infesting the different summer and winter crop fields as medicinal plants for curing some child and woman reproductive diseases from the Nalbari district (Bhattacharjya and Borah, 2008). A number of ethnomedicinal plants those are being presently documented in this study, also reported to be used in other parts of India and other countries against parallel medical conditions. In Kamrup district of Assam, native people does use root paste of *H. rosa-sinensis* (FL: 50%, PR: IF-78.67%, FS-2) for curing irregular

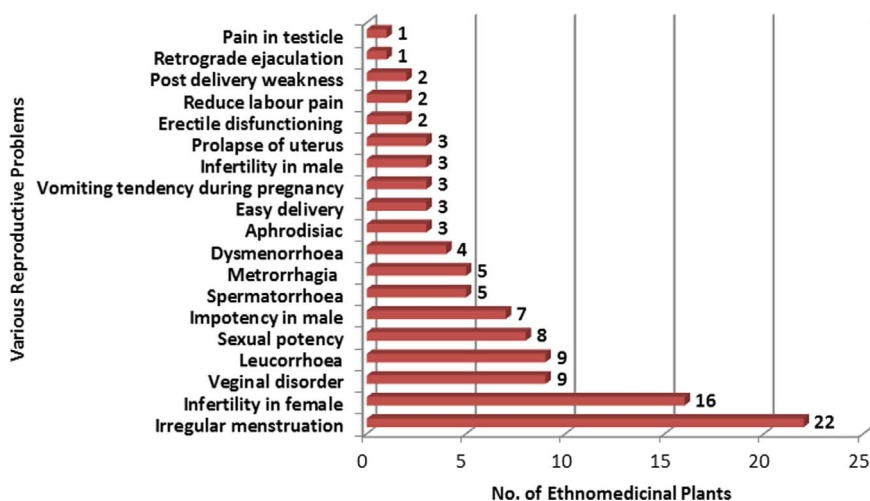


Fig. 5. Various reproductive problems cured by ethnomedicinal practice.

menstruation, latex of *Carica papaya* L. (FL-57.14%, PR: IBM-53.33%, FS-1) for easy delivery; juice of *Cynodon dactylon* (L.) Pers. (FL: 60%, PR: MT-56%, FS:1.5) against uterine bleeding; roots of *A. augusta* (FL: 66.67%, PR: IM-77.33%, L-65.33, FS: 2) against gonorrhoea, root and leaf juice of *Ricinus communis* L. (FL: 60%, PR: IF-65.33%, FS: 0.25) for increasing breast milk; fruits of *B. ceiba* (FL-62.5%, PR: L-62.67, IIM-52, IML-36, FS:3) for curing infertility in female; (Choudhury et al., 2011) and for other gynaecological disorder (Deka and Kalita, 2013). Other species viz. *T. arjuna* (FL: 62.50%, PR: MT-77.33%, S-74.67%, FS: 2) is also in consumption for erectile dysfunction, leucorrhoea. *Mangifera indica* (FL: 28.57%, PR: VD-50.67%, PT-52%, FS: 2) for impotency, *T. bellirica* (FL: 42.86%, PR: IIM-69.33%, FS:1.5) for impotency, *S. asoca* (FL: 57.14%, PR: VD-66.67%, MT-57.33%, L-69.33%, FS: 2) for fertility enhancement, *M. ferrea* (FL: 71.43%, PR: IM-40%, IF: 49.33%, FS: 2.25) for impotency (Deka and Kalita, 2013) are applied in routine practice. Some rare but medicinally important plant species such as *A. paniculata* (FL: 60%, PR: IM-56%, FS-0.25) was reported in the treatment of certain sexual disorder (Deka and Kalita, 2013) for curing low sperm count and vaginitis in the traditional Bangladeshi and Chinese medicine respectively (Hossain et al., 2014). Likewise, *A. racemosus* (FL: 72.73%, PR: IF-66.67%, D-74.67%, FS: 1.5), an important ingredient in Ayurvedic formulation been used to treat sexual dysfunctions (Dalal et al., 2013), for easy delivery and to check abortion (Deka and Kalita, 2013) and is also found to be useful to increase fertility in both male and female (Taid et al., 2014). In India, it has been observed that several species of different genera are popularly used as an antifertility medicine, for example, leaves of *Azadirachta indica* A. Juss. (FL: 66.67%, PR: L-62.67%, PU-64, FS: 1), fruits of *Ananas comosus* (L.) Merr. (FL: 11.11%, PR: IM-64%, FS: 0.5), flowers of *H. rosa-sinensis* (FL: 50%, PR: IF-78.67%, D-57.33%, MT-70.67%, FS: 2), seed of *C. papaya* (FL-57.14%, PR: IBM-53.33, FS: 1) (Das, 1980), stem of *W. somnifera* (FL: 66.67%, PR: L-48%, MT-69.33%, SP-61.33%, FS: 2.25) (Tohda et al., 2005), bark extraction of *B. monosperma* (FL: 33.33%, PR: IF-36%, ED-36%, FS:2) (Ramakrishna and Saidulu, 2014), leaf and root extract of *Hemidesmus indicus* (L.) R. Br. (FL: 50%, PR: SP-58.67%, FS: 0.25), juice extract of *C. dactylon* (FL: 60%, PR: MT-56%, FS: 1.5), root juice of *Clitoria ternatea* L. (FL: 40%, PR: ED-52%, FS: 1) (Taid et al., 2014). Among the different reported species against infertility, some were highly preferred by the respondents, viz. *H. heteroclita* (76%), *H. rosa-sinensis* (78.67%), *A. racemosus* (66.67%) and *H. mutabilis* (68%). Comparative study showed that, stem of *H. mutabilis* used against infertility in male was not previously reported (Matsui et al., 1967), but received high PR value. Also, the bark of *M. angustifolia* (FL: 64.29%, PR: L-68%, FS: 1) against leucorrhoea, fruits of *H. heteroclita* (FL: 63.64%, PR: IF-76%, IIM-77.33%, FS: 0.25) against impotence in male and stem of *A. augusta* (FL: 66.67%, PR: IM-77.33%, L-65.33%, FS: 2) against the irregular menstruation were reported for the first time in the present study. Highest numbers of plants were reported for curing irregular menstruation. Among those, *A. augusta* was found to be very much significant in terms of FL and PR values; exhibiting its acceptance compared to rest of the species stated in the present study, most interestingly the use of stem part is not been recorded in earlier studies (Choudhury et al., 2011; Deka et al., 2011; Naher et al., 2013). Species were also ranked according to their formulation scoring (FS), i.e., the number of times a particular species used in different formulations for curing different diseases. Highest FS score was achieved by the *A. nilotica* (5.25) followed by *T. chebula* (3.5), *B. ceiba* (3), *S. asoca*, *W. somnifera* and *M. ferrea* (2.5), *A. augusta*, *P. urinaria*, *B. monosperma*, *J. adhatoda*, *T. arjuna*, *F. benghalensis*, *C. gigantea* (2). Among these *F. benghalensis* (100%), *J. adhatoda* and *M. ferrea* (70–80%), *B. ceiba*, *W. somnifera*, *A. augusta* and *T. arjuna* (60–70%), *A. nilotica*, *S. asoca* and *C. gigantea* in this study showed significant FL value. Further, we can also consider *A. augusta*, *S. asoca*, *H. heteroclita*, *H. rosa-sinensis*, *A. racemosus*, *M. angustifolia*, *H. mutabilis*, *T. bellirica*, *T. arjuna* and *W. somnifera* as

medicinally important plants w.r.t their PR values. In different formulations they were used in DFs and PFs and found to be very effective against reproductive ailments. It can be assumed that in mostly preferred DFs and PFs, there were certain plants with high FS value, contributing more efficacious towards curing a particular disease. Therefore, it is essential to find out those plants and plant parts along with their important pharmacological significance. Identification of specific plant parts with their phytochemical screening and pharmacological investigation would further be helpful in order to cross-check traditional knowledge of local people against reproductive disorders.

4.3. Qualitative chemical profiling analysis of extracts

Various phytochemicals have been found in a variety of herbs and herbal extracts that contains alkaloids, carbohydrates, glycosides, saponins, proteins and amino acids, phenolic compounds, flavonoids, terpenoids, fixed oils and fats and phytosterols that can be of the valuable therapeutic index. For example, the alkaloids and glycosidic compounds contained in plants are used as medicine for aphrodisiac, spermatogenic and neuroprotective supplements (Ageel et al., 1994; Vyas and Raval, 2016; Hoseinpourafard et al., 2016; Adhikari et al., 2014). Saponins are stimulating agents as tonic been used in Chinese and Japanese medical herbs (Anupa et al., 2014). In fact, steroids are of interest in pharmacological research due to sex hormones (Jesus et al., 2016). The plant extracts containing flavonoids have been documented which helps to stops bleeding and prolapse of the uterus (Ponnusamy et al., 2016).

Phytochemical qualitative analysis of the extracts of *A. augusta* (stem), *M. angustifolia* (bark), *H. heteroclita* (fruit) and *H. mutabilis* (stem) indicated the presence of different phytochemical constituents in Table 5 can be responsible for scoring more than 65% PR value and curing the diseases, in Table 3. It was reported in earlier works (Burns, 2016; De Storme and Geelen, 2014; Santana et al., 2016; Anthony et al., 1996; Chauhan et al., 2014; Focho et al., 2009; Ciftci et al., 2012; Kang et al., 2002; Leung and Wong, 2013) that the presence of alkaloids, carbohydrates, glycosides, saponins, proteins and Amino acids, phenolic compounds, flavonoids, terpenoids, fixed oils and fats and phytosterols, account for maintaining healthy reproductive function. Hence, the presence of the secondary metabolites may be responsible for aforementioned efficacy in a similar way.

5. Conclusion

Present investigation is represented by an array of information about the rich indigenous knowledge of traditional medicine and ethnomedicobotanical potential of the various plants used by the local healers. A contribution of total 71 plants against 19 different reproductive ailments is enlisted (six male, eleven female and two common male and female reproductive disorders). The traditional healers have marked ten plants (*A. augusta*, *S. asoca*, *Berberis aristata*, *H. heteroclita*, *A. racemosus*, *M. angustifolia*, *H. mutabilis*, *T. bellirica*, *T. arjuna* and *W. somnifera*) with high scores that were also been accepted by the consent of their patients in southern Nalbari district. Further, extracts from selected plant species prepared for their qualitative chemical profiling analyses, have confirmed their therapeutic efficacy against infertility in female, leucorrhoea, impotency in male and irregular menstruation. The information developed in the present work would convince to be a very important resource for the exploration of many bioactive principles and to obtain the understanding of drug leads for reproductive problems.

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