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Study of medicinal plants in Darbhanga

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Abstract
The plants of medicinal importance are mostly wild whose cultivation is an essential requirement. Therefore, an attempt has been made to study the biodiversity and floristic composition of medicinal plants of Darbhanga. According to WHO, 20,000 plant species are used for medicine out of 2, 50,000 all over the world. Of these eight hundred species are being used commercially. In India, the rural population uses about 8000 herbal plants for medicine. India having a rich traditional knowledge of herbs in the Vedas and ancient days remains marginalized in the fields of research on plants and its medicinal use. The country has a rich herbal heritage and about1, 22,600 hectares of land is under cultivation for medicinal plants.

Keywords: medicinal plants, WHO, Darbhanga, herbal medicines

Introduction
Modern medicines use many ingredients which have side effect on human organs. This has opened up new vistas of research in herbal medicines. Herbal medicines have no side effect in comparison to the synthetic drugs (Cragg, *et al*., 1996: Haslam, 2003) [2]. Important drugs have been analyzed from plants of Indian origin. Darbhanga is located in heart of Mithilanchal in North Bihar, India. It lies between 25.53 degrees 26.27 degrees N and 85.45 degrees 86.25 degrees E at an average elevation of 171 feet (52m). Darbhanga is bounded by Madgubani district on north, by Samastipur district on south, by Saharsa on east and by Sitamarhi and Muzaffarpur on west. This district has a total area of 2279 sq. Km. with a population of 3295789. The main rivers are Kamla Balan and Bagmati (Adhwara). The climatic conditions of Darbhanga are somewhat dry and healthy. The winter, summer and rainy seasons are well marked. The overall rainfall is 1142.3mm with maximum i. e. around 92% of rainfall being received during monsoon months. *Curcuma longa* (turmeric), *Carica papaya* (Papaya) *Acacea catechu*, *Mentha* species, *Nicotiana tabacum* are some of the important plants grown by the farmers of this area. Farmers of this area have adopted the cultivation of *Mentha* species, Amla, Neem, Gurmae, Sarpgandha etc. These plants have great use in traditional therapy by Ayurveda as well as modern medicine.
The fertile land of Mithila has the potential to grow many herbs of therapeutic use. People of this area utilize Tilkor Patta for eating. The Tilkor (*Momoradica monadelpha*) stimulates insulin secretion from pancreas and therefore it is a used as a herbal product for treatment of diabetes. Not only this, one more species Gurich is found in this region which is also an effective medicine for diabetes. Amla, Jamun, *Aloe vera* and Gugal are also found in plenty in this area. These herbs have got extensive use in modern medicine.
The plants of medicinal importance are mostly wild whose cultivation is an essential requirement. In Mithila Ignorance and lack of preservation knowledge has resulted in the extinction of many plants of medicinal importance.

Material and Method
The study was carried out in the eighteen blocks covering almost all the areas of Darbganga. These include: Darbhanga block (DB), Keoti block (KB), Tardih (TB), Hanuman nagar (HnB), Hayaghat (HB), Manigacchi (MB), Singhwara (SB), Jale (JB), Baheri (BaB), Bahadurpur (BhB), Benipur (BnB), Alinagar (AB), Gaura Bauram (GB), Biraul (BrB), Kusheshwar Asthan East (KuB), Kusheshwar Asthan (KB), Kiratpur (KpB) and Ghanshyampur (GhB).

The medicinal plants were collected from November 2016 to October 2017 and identified and their DBH (diameter at breast height) measured with a diameter tape. The height of all plants was determined with a clinometers. In each quadrate all trees (DBH 10 cm) were examined for the presence of climbers (lianas with DBH 2 cm and vines). Trees were also surveyed for epiphytes according to the method described by Addo- Fordjour *et al*. (in press). Trees (DBH 10 cm) were classified into four groups based on their height; understorey (< 20 m), Lowe canopy (20-30 m), upper canopy (30-40 m) and emergent (> 40 m) species. The percentage canopy cover of each plot was determined by a spherical densitometer. At each plot four readings from the four cardinal directions were taken at four different points. The average of all readings for plots in each block (18 readings) was calculated and used as the percentage canopy cover of that forest type (Anning *et al*., 2008) [3].

The relationship between tree size (DBH) and height in the forest blocks was determined by Pearson correlation analysis. These analyses were performed using Minitab 15 software at a significance level of 5%. The diversity of plant species in the forest types was quantified using the Shannon-Wiener species diversity index (Gimaret-Carpentier *et al*., 1998; Blanc *et al*., 2000; Parthasarathy, 2001). The Jaccard s index of similarity (*I*) was calculated for each pair wise plot comparison (Blanc *et al*., 2000) and this was used to generate a dendrogram showing floristic similarities. The index is given by

$$I = \frac{C}{Ux + Uy + C} \times 100$$

Where

C = number of species common to both plot X and Y
Ux = number of sp[ecies found only in plot X
Uy = number of species found only in plot y.

Epiphytes were excluded from all the above mentioned analyses since their densities could not be determined. Importance value index of the species was calculated as the sum of the species relative density, relative frequency and relative dominance.

Besides these areas, some indigenous plants of Darbhanga used as medicine are also identified, and their medicinal values have been summarized.

Results and Discussion

Important medicinal plants in Darbhanga collected in rural areas of eighteen blocks, their habit and the families they belong have been presented in Table-1

Table 1: Important Medicinal plants of Darbhanga

Species	Family	Habit
Acacia kamerunensis Gand.	Fabaceae	Liana
Acacia pentagona (Schum. & Thonn.) Hooker f.	Fabaceae	Liana
Acanthaceae sp.	Acanthaceae	Herb
Afromomum sp.	Zingiberaceae	Herb
Afzelia bella Harms	Fabaceae	Tree
Aidia genipiflora (DC.) Dandy	Rubiaceae	Shrub
Alafia barteri Oliv.	Apocynaceae	Liana
Albizia adianthifolia (Schum.) W.F. Wight	Fabaceae	Tree
Albizia glaberrima (Schum. & Thonn.) Benth.	Fabaceae	Tree
Albizia zygia (DC.) J.F. Macbr.	Fabaceae	Tree
Alstonia boonei De Wild.	Apocynaceae	Tree
Amphimas pterocarpoides Harms	Fabaceae	Tree
Anchomanes difformis (Blume) Engl.	Araceae	Herb
Antiaris toxicaria (Rumph ex Pers.) Leschen.	Moraceae	Tree
Antrocaryon micraster A. Chev. & Guillaum.	Anacardiaceae	Tree
Baphia nitida Lodd.	Fabaceae	Tree
Baphia pubescens Hook.f.	Fabaceae	Tree
Blighia sapida Kon.	Sapindaceae	Tree
Blighia welwitschii (Hiern) Radlk.	Sapindaceae	Tree
Bombax buonopozense P.Beauv.	Bombacaceae	Tree
Bridelia atroviridis Müll.Arg.	Euphorbiaceae	Tree
Bridelia grandis Pierre ex Hutch.	Euphorbiaceae	Tree
Broussonetia papyrifera Vent.	Moraceae	Tree
Bussea occidentalis Hutch.	Fabaceae	Tree
Calpocalyx brevibracteatus Harms	Fabaceae	Tree
Calycobolus africanus (G.Don) Heine	Convolvulaceae	Tree
Calyptrochilum emarginatum Schltr.	Orchidaceae	Epiphyte
Capsicum sp.	Solanaceae	Herb
Ceiba pentandra (L.) Gaertn.	Bombacaceae	Tree

Centrocema pubescens Benth.	Fabaceae	Herb
Chromolaena odorata (L.) King & Robinson	Asteraceae	Herb
Chrysophyllum perpulchrum Mildbr. ex Hutch. &	Sapotaceae	Tree
Dalziel *Chrysophyllum* sp.	Sapotaceae	Tree
Cissus sp.	Vitaceae	Liana
Combretum bipindense Engl. & Diels	Combretaceae	Liana
Combretum smeathmannii G.Don	Combretaceae	Liana
Combretum sp.	Combretaceae	Liana
Cordia millenii Baker	Boraginaceae	Tree
Cordia senegalensis Juss.	Boraginaceae	Tree
Corynanthe pachyceras K.Schum.	Rubiaceae	Tree
Rhaphidophora africana N.E.Br.	Araceae	Vine
Dalbergia hostilis Benth.	Fabaceae	Liana
Diospyros viridicans Hiern	Ebenaceae	Tree
Entandrophragma angolense (Welw.) DC.	Meliaceae	Tree
Ficus asperifolia Miq.	Moraceae	Shrub
Ficus exasperata Vahl	Moraceae	Shrub
Ficus sur Forssk.	Moraceae	Tree
*Ficus tessellata*Warb.	Moraceae	Epiphyte
Ficus thonningii Blume	Moraceae	Epiphyte
Ficus trichopoda Baker	Moraceae	Epiphyte
Ficus umbellata Vahl	Moraceae	Epiphyte
Ficus vogelii Miq.	Moraceae	Epiphyte
Funtumia elastica (Preuss) Stapf	Apocynaceae	Tree
Griffonia simplicifolia (Vahl ex DC.) Baill.	Fabaceae	Liana
Guarea cedrata (A.Chev.) Pellegr.	Meliaceae	Tree
Hippocratea sp.	Celastraceae	Liana
Hymenostegia afzelii (Oliv.) Harms	Fabaceae	Tree
Khaya anthotheca (Welw.) C.DC.	Meliaceae	Tree
Khaya grandifolia C.DC.	Meliaceae	Tree
Khaya ivorensis A.Chev.	Meliaceae	Tree
Lannea welwitschii (Hiern) Engl.	Anacardiaceae	Tree
Lecaniodiscus cupanioides Planch. ex Benth.	Sapindaceae	Tree
Leptoderris sp.	Fabaceae	Liana
Lovoa trichilioides Harms	Meliaceae	Tree
Macaranga heudelotii Baill.	Euphorbiaceae	Tree
Mansonia altissima (A.Chev.) A.Chev.	Sterculiaceae	Tree
Marantocloa leucantha (K.Schum.) MilneRedh.	Marantaceae	Herb
Microdesmis puberula Hook.f.	Pandaceae	Tree
Microsorum punctatum (L.) Copel.	Polypodiaceae	Epiphyte
Microsorum scolopendria Copel.	Polypodiaceae	Epiphyte
Milicia excelsa (Welw.) C.C.Berg.	Moraceae	Tree
Millettia chrysophylla Dunn	Fabaceae	Liana
Morinda lucida Benth.	Rubiaceae	Tree
Morus mesozygia Stapf	Moraceae	Tree
Motandra guineensis (Thonn.) A.DC.	Apocynaceae	Liana
Myrianthus arboreus P.Beauv.	Cecropiaceae	Tree
Olyra latifolia L.	Poaceae	Herb
Panicum maximum Jacq.	Poaceae	Grass
Parquetina nigrescens (Afzelius) Bullock	Asclepiadaceae	Liana
Pennisetum purpureum K.Schum.	Poaceae	Grass
Piptadeniastrum africanum (Hook.f.) Brenan	Fabaceae	Tree
Pisonia aculeata L.	Nyctaginaceae	Liana

Pteris sp.	Pteridaceae	Fern
Pycnanthus angolensis (Welw.) Warb.	Myristicaceae	Tree
Ricinodendron heudelotii (Baill.) Pierre ex Pax	Euphorbiaceae	Tree
Atropa belladonna L.	Solanaceae	Herb
Digitalis spp. Linn.	Scrophulariaceae	Herb
Rauwolfia serpentine Benth. Ex Kurtz.	Apocyanaceae	Undershrub
Catheranthus roseus	Apocyanaceae	Herb
Rinorea oblongifolia (C.H. Wright) Marquand ex Chipp	Violaceae	Tree
Salacia elegans Welw. ex Oliv.	Celastraceae	Liana
Salacia owabiensis Hoyle	Celastraceae	Liana
Salacia sp.	Celastraceae	Liana
Smilax kraussiana Meisn.	Smilacaceae	Liana
Sterculia oblonga Mast.	Sterculiaceae	Tree
Sterculia rhinopetala K.Schum.	Sterculiaceae	Tree
Sterculia tragacantha Lindl.	Sterculiaceae	Tree
Terminalia superba Engl. & Diels	Combretaceae	Tree
Trichilia monadelpha (Thonn.) J.J.de Wild.	Meliaceae	Tree
Trichilia prieureana A.Juss.	Meliaceae	Tree
Trilepisium madagascariense DC.	Moraceae	Tree

In Mithilanchal area of Bihar which includes Darbhanga and Madhubani, the major plants used in indigenous system of medicines have been presented in Table-2.

Table 2: Major Plants used as Indigenous Medicines in Darbhanga

Species	Family	Used in Diseases
Calotropis gigantica	Asclipiadaceae	Liver, intestine spleen, piles
Adhotoda vasica	Acanthaceae	T.B., Cough, Hyperplasia
Clitoria ternatia (Aprajita)	Fabaceae	Swelling, Mental headache, Jaundice
Achyranthus Aspera	Nyctaginaceae	Appetite, Eyesight
Nelumbian speciosum	Nymphaeaceae	Skin diseases, piles
Cucumis utilissimus	Cucurbitaceae	Urinary disorder, Gall bladder, cholesterol
Nerium odorum	Apocyanaceae	Skin diseases, joint pain
Strychros Nuxvomica	Loganiaceae	Nervous system, Joint pain, Dysentery
Cucumis melo	Cucurbitaceae	Urinary disorder, kidney pain
Daucus Carota	Umbelliferae	Bile, nervous system, Asthma
Leucas cephalotus	Lemiaceae	Rheumatism, Cough, Anorexia
Calendula officinalis	Asteraceae	Asthma, Cough, tooth, Skin disease
Aloe vera	Liliaceae	Liver, spleen, Skin disease
Ricinus Communis	Euphorbiaceae	Heart pain, joint pain, piles
Mentha spp	Lemiaceae	Urinary disorder, Worm killer
Eclipta alba	Asteraceae	Cough, Skin diseases, Liver, spleen
Moringa pterygosperma	Moringaceae	Anticancer, painkiller, ulcer, cough, liver, spleen, fever
Aconitum napellus	Ranunculaceae	Neuralgia and Rheumatism
Cassia anguistifolia	Caesalpinaceae	Laxative used in habitual constipation
Withania somnifera	Solanaceae	Diuretic, Rheumatism, applied to ulcer carbuncle

Family dominance of medicinal plant species in the Darbhanga has been presented in Table-3.

Table 3: Family Dominance of Medicinal Plants

Family	Number of Species
Fabaceae	18
Moraceae	13
Euphorbiaceae	4
Apocyanaceae	6
Combretaceae	4
Stercullariaceae	4
Meliaceae	8
Celastraxeae	4
Poaceae	3
Bombaceae	2

Solanaceae	2
Polypodiaceae	2
Rubiaceae	2
Marantaceae	1
Ppandaceae	1
Asclepiadaceae	1
Nyctaginaceae	1
Ebenaceae	1
Acanthaceae	1
Zingiberaceae	1
Rubiaceae	2
Araceae	2
Anacardiaceae	2
Sapindaceae	2
Boraginaceae	2
Cecropiaceae	1
Bombaceae	2
Convulvulaceae	1
Orchidaceae	1
Asteraceae	1
Sapotaceae	2
Vitaceae	1

A total of 101 adult plant species were identified in the eighteen blocks of Darbhanga. These belonged to 32 families, 71 genera and 5 life forms (Table 1 and Figure 1). Fabaceae, Moraceae, Meliaceae and Apocyanaceae were the overall diverse families (in terms of species richness) of the adult species, contributing 44.5% of all the species in the study (Figure 1). Trees were the most dominant life form (46.5%) followed by lianas (14.8%), herbs (9.9%), epiphytes (7.9%), shrubs (2.9 %) and the others (3.7%).

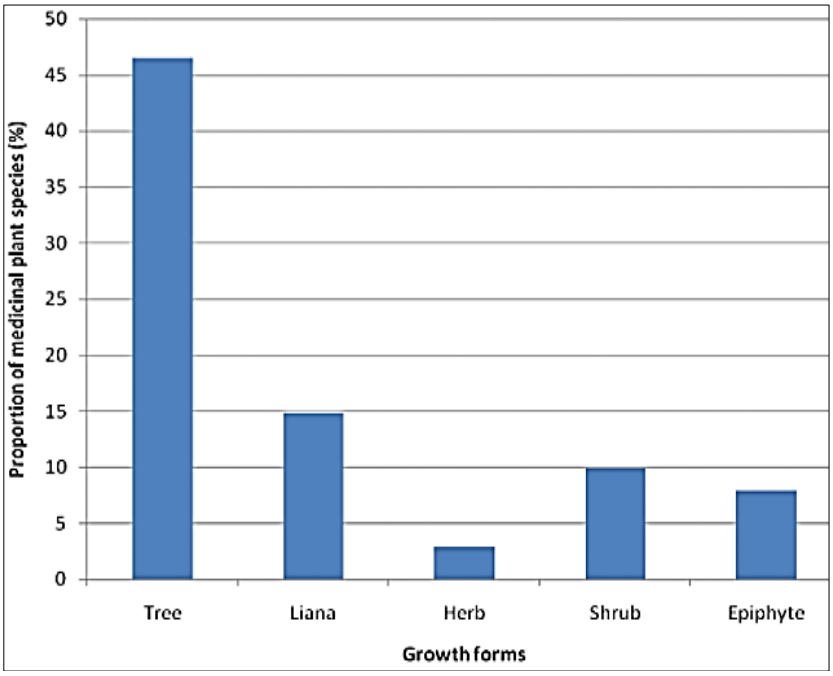

Fig 1: Composition of Medicinal Plant Species in the Various Life forms Identified in Darbhanga

Generally, species richness among all life forms was highest in the DB (90.5%) followed by the KB (87.6%), HNB (77%), HB (73%), BnB (70.25%) and GB (68.95%). Fabaceae, Moraceae and Meliaceae and Meliaceae were the most diverse families distributed in all the eighteen blocks of Darbhanga. The most important families in the DF were Fabaceae, Moraceae and Meliaceae and Apocyanaceae (Figure 2).

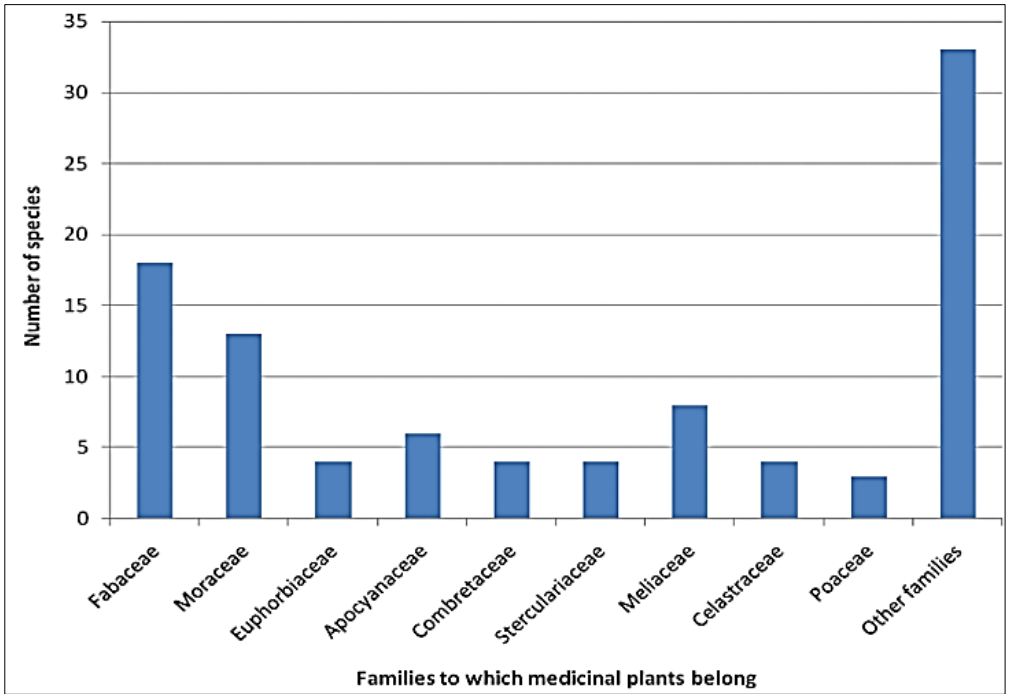

Fig 2: Family Dominance of Medicinal Plant Species in Darbhanga

In forest areas of TB, MB, BaB, BhB, AB, BrB, KuB, KpB and GB the medicinal plant species were in the range of 48 to 59.8%. In the forest area of other blocks the incidence of medicinal plant species were low in the range of 40.30 to 29.97%. *C. odorata* was the most dominant species of herb in terms of number of individuals accounting for 69% of individual herbs in the DB and 45% of all the herbs in the forest areas of eighteen blocks.

Studies on biodiversity, floristic composition and structure in the forests of eighteen blocks of Darbhanga are instrumental in the sustainability of forests since they play a major role in the conservation of medicinal plant species, and the management of forest ecosystems as a whole (Tilman, 1988; Ssegawa and Nkuutu, 2006) [8]. That notwithstanding, only a few studies (Hall and Swaine, 1981; Vordzogbe *et al*., 2005; Anning *et al*., 2008) [3] in this regard have been conducted in forest areas. For this reason, the results of this study cannot be compared with a wide range of other similar studies in different blocks of Darbhanga.

Furthermore, the dominance of Fabaceae, Moraceae and Meliaceae and Apocyanaceae in some semi-deciduous forests has been reported (Vordzogbe *et al*., 2005; Anning *et al*., 2008) [3]. Thus, the semi-deciduousness of the forest reserve in Darbhanga as well as the dominance of these species (*C. mildbraedii* and *T. scleroxylon*) (Hall and Swaine, 1981) has been maintained for more than two decades. The presence of some species such as *A. barteri*, *B. bespubescens*, *C. mildbraedii* and *G. simplicifolia* in all the eighteen blocks may indicate their wider range of ecological adaptation. Floristic composition did not vary much between the various forest types of Darbhanga. Plant diversity (*H*) was quantitatively higher in the DB than in the other forest types which continue to be disturbed by human activities. This is buttressed by the density of plant species which was also significantly greater ($p = 0.000$) in the DB compared to the other blocks. Logging and farming activities in all the eighteen blocks have affected plant diversity through the removal of plant species, creation of gaps, and consequently a reduction in the canopy cover of these forests. Both canopy gaps and farming activities Darbhanga have favoured the growth of invasive species among the native species, with *C. odorata* and *B. papyrifera* which have been identified as notorious invasive weeds being common phenomena. Though invasive species have been found to exert severe negative consequences on biodiversity, displacing native species and disrupting community structure. This could be attributed to the early stage of invasion in the Darbhanga, indicating that invasion is yet to have it full impact on the flora of the area.

Conclusion

The forest reserve of Mithila looks floristically rich and structurally complex in the face of logging, farming activities and invasion in some parts of the forest. Thus, there is the need to curb the anthropogenic activities and plant invasion so as to protect the integrity of the forest including medicinal plants.

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