

Biodiversity of Medicinal Plants at River Bank of Yamuna, Agra, Uttar Pradesh

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ABSTRACT

In the present study many plants were found to have the medicinal values and are being used to cure various ailments by the local people. The pharmaceutical industries also use this medicinal wealth in several ayurvedic preparations. The survey revealed that herb species like: *Boervaavia* [*Boerhavia*] *diffusa*, *Cyperus rotundus*, *Pendalium* [*Pedalium*] *murex*, *Tribulus terrestris* and *Withania somnifera* are being employed in more than 50 pharmaceutical preparations. The maximum number of medicinal herbs were represented by family Asteraceae and Euphorbiaceae followed by family Solanaceae and Fabaceae. In the survey of medicinal herbs enumeration, botanical name, family, local name and information about the medicinal use of plant species by the local people and pharmaceutical industries have been provided so that possibility of their cultivation may be explored for sustained supply of the authentic drug material. There are seasonal changing beds and borders are trees with medicinal properties that provide shade to delicate plants. Spring brings exuberance and the full bloom of *Barlerias*, summer the flowering of the *Hibiscus*, the monsoon *Ocimum* and *Costus* and winter a profusion of *Andrographis*, *Bacopa*, *Calendula*, *Aloe*, and *Tylophora*. *Cerulean* butterfly, bird sightings are those of the hoopoe, the green bee eater, and doves.

KEYWORDS: *pharmaceutical, biodiversity, medicinal, Yamuna, Agra, Uttar Pradesh, herbs, shrubs and trees*

Introduction

The river Yamuna is one of the sacred rivers of India. Besides Delhi, the Capital of India since Moghul period, two other major cities, Mathura and Agra, within its 200 km distance downstream of Delhi are of greatest historical and cultural importance. However, this very stretch of the river is also one of the most heavily polluted and degraded river stretches in the country. Although the flow of river Yamuna had been diverted at Tajewala (Haryana) more than a century ago, the lean season flows in the river have been totally eliminated downstream of Tajewala (now Hathnikund) over recent decades [1,2]. Delhi receives its water requirements only upstream of Wazirabad barrage through a distributary of the Western Yamuna Canal, and no freshwater flow below the barrage. Rapid growth of Delhi has resulted in the generation of huge quantities of sewage and wastewater that are not treated fully before discharge into the river. The

52 km stretch of the river from Palla to Jaitpur in the NCT of Delhi has lost its life supporting potential. The 22 km stretch from Wazirabad to Okhla is the most polluted segment of the river as it receives outfall from 22 drains which contribute 80% of the pollution load of the river. The vast floodplains, which serve as a floodway and help recharge ground water, have also been gradually eliminated to a great extent and encroached upon by gradual reclamation by dumping solid wastes and construction of various buildings. This has reduced the flood carrying capacity, groundwater recharging capacity, and other biodiversity related ecological functions. [3,4] The morphology of the river and the wetland functions are also altered by embankments, bunds, roads, flyovers, guide bunds and spurs, several bridges and three barrages.

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Withania somnifera

In Agra, within beds of butterfly attracting plants are trees that have been landscaped to resemble mixed deciduous forest communities. There is blossoming of new life in a nearby zone of larval host plants and sericulture and admire fluttering of tasar silk moth. Sacred Grove is used to denote repositories of rare and endemic species, remnants of the primary forest left untouched by the local inhabitants due to the belief that deities reside there. Massive plants occur attracting animals such as the monitor lizard, civet, jungle cat and Nilgai. Spider diversity, their species richness and biodiversity in the vast open areas falling under agro-ecosystem and riparian habitat along the banks of the river Yamuna in Agra. A total of 44 species of Araneae belonging to 29 genera of 11 families including, Salticidae, Oxyopidae, Araneidae, Thomisidae, Tetragnathidae, Hersilidae, Lycosidae, Pholsidae, Gnaphosidae, Sparassidae and Corinnidae were recorded in abundance.[5,6]

The share of agriculture in the total income of the banks of Agra is also good. Wheat, rice, sugarcane, pulses, oil seeds and potatoes are the main agricultural produce of the state. Sugarcane is an important cash crop and sugar mills and other cane crushers which produce 'gur and khandsari' are common throughout the state. Agra also contributes to the total sugar cane production and is also the largest producer of sugar in the country. Potato is another important crop and 42-45 % potato production in the country is shared by the U .P. The state is the second largest producer of vegetables in the country after West Bengal. Uttar Pradesh is equally important horticulture perspective. The state is known for best varieties of Mango, Guava, *Aegle marmelos* (Bael), Banana etc. The silk produced in Uttar Pradesh is unique and under high demand. 'Sals' are developed on high alluvial terraces with good loamy soil lacking pebbles. *Hardwickia binata*, *Terminalia alata*, *Anogeissus pendula*, *Babul*, *Tectona grandis*, *Syzygium cumini*, *Haldina cordifolia*, *Ficus racemosa*, *Ficus hispida*, *Ficus semi cordata*, *Barringtonia acutangula*, *Bombax ceiba*, *Callicarpa macrophylla*, *Bischofia javanica*, *Syzygium cumini*, *Grewia eriocarpa*, *Glochidion*

multiloculare, *Mallotus nudiflorus*, *Terminalia arjuna*, *Trema orientalis*, *Putranjiva roxburghii*, *Grewia serrulata*, *Tamarix dioica*, *Ardisia solanacea*, *Ficus heterophylla*, *Eranthemum pulchellum*, *Hyptianthera stricta*, *Alhagi maurorum*, *Crotalaria burhia*, *Pedalium murex*, *Pulicaria angustifolia*, *Tribulus terrestris*, *Withania somnifera*, *Capparis decidua*, *Capparis zeylanica*, and *Butea monosperma*, *Acacia* and *Calotropis*, *Flacourtia indica*, *Helicteres isora*, *Anogeissus pendula*, *Wrightia tinctoria*, etc. Species like *Acacia nilotica* subsp. *indica*, *Butea monosperma*, *Grewia tenax*, *Alloteropsis cimicina*, *Apluda mutica*, *Aristida adscensionis*, *Aristida depressa*, *Bothriochloa pertusa*, *Brachiaria ramosa*, *Cenchrus ciliaris*, *Enteropogon dolichostachyus*, *Chrysopogon fulvus*, *Cynodon dactylon*, *Dichanthium annulatum*, *Digitaria* spp., *Echinochloa* spp., *Eragrostis* spp., *Iseilema hackelii*, *Panicum* spp., *Saccharum spontaneum*, are the characteristic species of medicinal value in Yamuna bank of Agra.[7,8]



Butea monosperma

It is commonly seen that species like *Grewia sapida*, *Olox nana*, *Erythrina resupinata*, *Curcuma angustifolia* etc. make their appearance on burnt ground and replacing original vegetation. Graziers intentionally make acute fire for getting new clumps of grasses for their cattles. The encroachment of forest land and conversion of wetlands by villagers and greedy builders for agricultural purposes. Extensive climbers like *Antigonon leptopus*, *Capparis spinosa*, *Ipomoea hederifolia*, *Mukia maderaspatana* and invasive alien weeds like *Lantana camara*, *Eichhornia crassipes*, etc.[9,10]



Antigonon leptopus

Botanical name	Local name	Family	Habit	Part used and formulation	Medicinal use
<i>Abutilon indicum</i>	Kanghil	Malvaceae	Herb	Leaf extract	Itching, wound healing
<i>Acacia catechu</i>	Khair	Fabaceae	Tree	Bark and root decoction	Arthritis
<i>Acacia nilotica</i>	Babool	Mimosaceae	Tree	Bark, gum	Burning sensation
<i>Acalypha indica</i>	Chauriya	Euphorbiaceae	Herb	Leaf paste	Wound healing
<i>Achyranthes aspera</i>	Chirchita	Amaranthaceae	Shrub	Whole plant	Tuberculosis
<i>Adhatoda vasica</i>	Adathoda	Acanthaceae	Shrub	Leaf paste	Piles
<i>Aegle marmelos</i>	Beal	Rutaceae	Tree	Fruit and leaves	Sunstroke, dysentery
<i>Aerva lanata</i>	Geduakichal	Amaranthaceae	Herb	Root paste	Headache
<i>Ailanthus excelsa</i>	Anjan	Simaroubaceae	Tree	Leaf and bark paste	Joint pain and leprosy
<i>Albizia lebeck</i>	Siris	Fabaceae	Tree	Seed paste	Snake bite
<i>Aloe vera</i>	Gwarpatha	Liliaceae	Herb	Dried leaf decoction	Easy and normal delivery
<i>Andrographis paniculata</i>	Kalmegh	Acanthaceae	Herb	Whole plant	Snake bite
<i>Argemone mexicana</i>	Prickly poppy	Papaveraceae	Herb	Root paste	Skin disease
<i>Asparagus racemosus</i>	Shatavari	Liliaceae	Climber	Dried roots	Increase lactation in cattle
<i>Azadirachta indica</i>	Neem	Meliaceae	Tree	All parts paste	Skin disease and blood purifier
<i>Balanites aegyptiaca</i>	Hingot	Balanitaceae	Tree	Fruit extract	Fever, deworming
<i>Bauhinia variegata</i>	Kachnar	Caesalpiniaceae	Tree	Root decoction	Reducing corpulence
<i>Butea monosperma</i>	Palash	Papilionaceae	Tree	Root and bark decoction	Dysentery control
<i>Calotropis procera</i>	Madar	Asclepiadaceae	Shrub	Root paste, latex	Snake bite, toothache
<i>Capparis decidua</i>	Karil	Cappariaceae	Shrub	Leaves, fruits	Dysentery

(continued)

Discussion

An account of 63 species belongs to 37 families were observed in the rehabilitated ravine areas at Agra. The documented plants were categorized according to their life form viz., trees (34.92%), shrubs (26.98%), herbs (23.8%), climbers (11.15%) and grasses (3.18%) were found in the representative blocks. The present study reveals that the distributions of species were mainly belong to the families of Euphorbiaceae, Apocynaceae, Solanaceae and Caesalpiniaceae. Documented plants were categorized according to their life form viz., herbs (42.5%), trees (23.6%), shrubs (21.6%), climbers (10.4%) and grasses (2%) were found in the representative blocks. Some species were *Acalypha indicata*, *Procera*, *Cannabis sativa*, *Croton bonplandianum* and *Daturastramonium*. Their Phytochemical qualitative analysis confirmed the presence of different phytochemicals such as alkaloids, flavonoids, phenols, saponins, terpenoids, natural tannins, contaminated aqueous extraction, ethanolic their habitats.[11,12]



Croton bonplandianum

Allium sativum, commonly known as Garlic, is used in many forms to cure many ailments [13]. Tar, obtained from *Pinus nigra*, has been reportedly used for foot and mouth disease, mouth sores, mange, replant for snakes, mice and ticks. *Aloe vera* has been used as medicine for treatment of indigestion, foot fungus, wounds and inflammation. *Asparagus racemose* also called Satavar is used to treat lactation and reproductive ailments. *Azadirachta indica* or Neem treats urticaria, wounds and tumours. The plants part used for medicines is differed from plant to plant. The mode/ formulation of intake includes plants applied as a paste, powder, decoction, extracts and juices and other applied as oil, smoke and chew. From this study at Yamuna ravine areas, leaf is most frequently used plant part which accounts 28 % followed by root (20 %), Fruit (14%), Seed (11%), whole plant (9%), bark (8 %), flower (6%) and Gum (4%). The ethno-medical uses and information were also collected from traditional healers and local dwellers (elder people) of sample region. Crushing, homogenizing with ingredients and chewing were the commonly used forms of herbal preparation. Drinking, smoke inhalation and strap and hold on were the most frequently used methods of application. During the field visit the survey of data collection was made in different places i.e. waste lands, barren lands playground, road side and agricultural fields. The current over-exploitation and soil compaction due to climatic and biotic factors seems to limit the ability of some species to propagate.[14,15] There is no considerable diversity of medicinal plants in unprotected area and other open areas during rainy season also due to heavy biotic pressure viz., grazing and felling and it is a considered as a serious problem in ravine lands.



Pinus nigra

This clearly shows the diversity and distribution pattern medicinal plants in rehabilitated areas through effective protection efforts. Majority of the identified medicinal plants play ecological roles by protecting soils from erosion through reducing erosive forces of the rain drop and through reducing velocity of run-off water. Some of these plants have also cultural and economic values, means they are used to make stool (bench), bed, milk container, butter container and other culturally used home furniture. In addition large trees like Ficus spp and Neem have social and economic value, used as shed during community meeting, as fodder for animals (especially for goats and camels), for house and fence constructions. Most trees and shrubs of those medicinal plants are commonly used for fuel wood. Most of the medicinal plants had no market value. This could be explained by various reasons. It was observed that few medicinal plants such as *Aloe vera*, Ber, Neem and Bael, had market value. However their market price was not still attractive.[16,17] They were supplied to the market in different forms, but the most common parts sold in the market were leaves, roots, seeds and fruits. The present study revealed that the rehabilitated ravine lands have rich diversity of medicinal plants as compared to outside unprotected ravines. Therefore, there is immediate need to conserve these important plant species for sustainable uses for the future. Efforts should be taken to start sustainable cultivation and harvesting programs in the ravine regions

This study reveals that the majority of species were belonging to the families of Euphorbiaceae, Apocynaceae, Solanaceae and Cesalpiniaceae.[18,19]

The identified /documented indigenous plant species have high drought tolerant capacity and ability to grow under harsh environment. Sustainable management of rehabilitated Yamuna ravines with proper protection definitely enhances the species richness and conservation biodiversity through vegetation cover induced microclimates modification. The preparations of medicines are from leaves, root, bark, fruit, flowers and seeds. The mode/ formulation of intake includes plants applied as a paste, powder, decoction, extracts and juices and other applied as oil, smoke and chew. Indigenous knowledge and their uses have to be analysed to develop appropriate management measures.



Bael

Due respect must be given to the indigenous botanical knowledge of the local / traditional practitioners to ensure equality in benefit sharing and increased participation in conservation. Therefore, awareness creation campaigns

are timely needed to improve local community's knowledge on the importance and management of medicinal plants. In situ conservation has come to be widely regarded as the only viable and cost effective measure to allow the species to follow the natural evolutionary course in interaction with their habitat and within themselves.

Results

Based on the results it was found that 118 species had useful medicinal uses to treat different human and livestock ailments. Various plant parts were being used for curing different types of serious diseases such as tuberculosis, leprosy, asthma, piles, dengue fever, typhoid, blood bleeding etc in human beings and domestic animals.[20,21]

Phytochemical techniques played a significant role in searching raw materials and resources for pharmaceutical industry. Preliminary Phytochemical tests are helpful in finding and locating chemical constituents which are source of pharmacologically active principles.



Acalypha indica

Hence during the present study. Phytochemical screening of six native plants of Agra in Yamuna bank i.e. *Achyranthus aspera*, *Acalypha indica*, *Euphorbia hirta*, *Lindenbergia indica*, *Parthenium hysterophorus* and *Peristrophe bicalyculata* were carried out by employing standard methods for conducting Qualitative phytochemical analysis for studying the presence of active compounds like Alkaloids, Tannins, Saponins, Glycosides, Phenols, Flavonoids, Anthroquinone, Terpenoids and Steroids. Ethanolic extract of *Achyranthus aspera* showed all of these phytocompounds except Tannins in comparison to other extracts. However ethanolic extracts of all plant species revealed the presence of most of the phytocompounds in comparison to other extracts tested. Successive isolation of phytocompounds from plant materials depended on the type of solvent used in extraction procedure. The qualitative changes in the Phytochemical analysis of tested plant species are correlated to methods of preparation. The plants tested are found to be potential due to the presence of various active principles among which *Achyranthus aspera* is found to be constituted of various primary & secondary metabolites which can be quantified for application in pharmaceutical industry.[22,23]

Medicinal plants, also called medicinal herbs, have been discovered and used in traditional medicine practices since prehistoric times. Plants synthesize hundreds of chemical compounds for functions including defense against insects, fungi, diseases, and herbivorous mammals. Numerous phytochemicals with potential or established biological activity have been identified. However, since a single plant contains widely diverse phytochemicals, the effects of using a whole plant as medicine are uncertain. Further, the phytochemical content and pharmacological actions, if any, of many plants having medicinal potential remain unassessed by rigorous scientific research to define efficacy and safety

The earliest historical records of herbs are found from the Sumerian civilization, where hundreds of medicinal plants including opium are listed on clay tablets, c. 3000 BC. The Ebers Papyrus from ancient Egypt, c. 1550 BC, describes over 850 plant medicines. The Greek physician Dioscorides, who worked in the Roman army, documented over 1000 recipes for medicines using over 600 medicinal plants in *De materia medica*, c. 60 AD; this formed the basis of pharmacopoeias for some 1500 years. Drug research sometimes makes use of ethnobotany to search for pharmacologically active substances, and this approach has yielded hundreds of useful compounds. These include the common drugs aspirin, digoxin, quinine, and opium. The compounds found in plants are of many kinds, but most are in four major biochemical classes: alkaloids, glycosides, polyphenols, and terpenes.



Aloe vera

Medicinal plants are widely used in non-industrialized societies, mainly because they are readily available and cheaper than modern medicines. The annual global export value of the thousands of types of plants with medicinal properties was estimated to be US\$2.2 billion in 2012. In 2017, the potential global market for botanical extracts and medicines was estimated at several hundred billion dollars. In many countries, there is little regulation of traditional medicine, but the World Health Organization coordinates a network to encourage safe and rational usage. Medicinal plants face both general threats, such as climate change and habitat destruction, and the specific threat of over-collection to meet market demand. The World Health Organization estimates, without reliable data, that some 80 percent of the world's population depends mainly on traditional medicine (including but not limited to plants); perhaps some two billion people are largely reliant on medicinal plants. The use of plant-based materials including herbal or natural health products with supposed health benefits, is increasing in developed countries[24].

Medicinal plants demand intensive management. Different species each require their own distinct conditions of cultivation. The World Health Organization recommends the use of rotation to minimise problems with pests and plant diseases. Cultivation may be traditional or may make use of conservation agriculture practices to maintain organic matter in the soil and to conserve water, for example with no-till farming systems



Azadirachta indica

Medicinal plants are often tough and fibrous, requiring some form of preparation to make them convenient to administer. According to the Institute for Traditional Medicine, common methods for the preparation of herbal medicines include decoction, powdering, and extraction with alcohol, in each case yielding a mixture of substances. Decoction involves crushing and then boiling the plant material in water to produce a liquid extract that can be taken orally or applied topically.

In most of the developing world, especially in rural areas, local traditional medicine, including herbalism, is the only source of health care for people, while in the developed world, alternative medicine including use of dietary supplements is marketed aggressively using the claims of traditional medicine. As of 2015, most products made from medicinal plants had not been tested for their safety and efficacy, and products that were marketed in developed economies and provided in the undeveloped world by traditional healers were of uneven quality, sometimes containing dangerous contaminants.

Plant medicines have often not been tested systematically, but have come into use informally over the centuries. By 2007, clinical trials had demonstrated potentially useful activity in nearly 16% of herbal medicines; there was limited in vitro or in vivo evidence for roughly half the medicines; there was only phytochemical evidence for around 20%; 0.5% were allergenic or toxic; and some 12% had basically never been studied scientifically. The pharmaceutical industry has roots in the apothecary shops of Europe in the 1800s, where pharmacists provided local traditional medicines to customers, which included extracts like morphine, quinine, and strychnine.

Conclusions

Plant medicines can cause adverse effects and even death, whether by side-effects of their active substances, by adulteration or contamination, by overdose, or by inappropriate prescription. Many such effects are known, while others remain to be explored scientifically. There is no reason to presume that because a product comes from nature it must be safe: the existence of powerful natural poisons like atropine and nicotine shows this to be untrue. Further, the high standards applied to conventional medicines do not always apply to plant medicines, and dose can vary widely depending on the growth conditions of plants: older plants may be much more toxic than young ones, for instance



Capparis decidua

A home remedy (sometimes also referred to as a granny cure) is a treatment to cure a disease or ailment that employs certain spices, herbs, vegetables, or other common items. Home remedies may or may not have medicinal properties that treat or cure the disease or ailment in question, as they are typically

passed along by laypersons (which has been facilitated in recent years by the Internet). Many are merely used as a result of tradition or habit or because they are effective in inducing the placebo effect[23,24]

One of the more popular examples of a home remedy is the use of chicken soup to treat respiratory infections such as a cold or mild flu. Other examples of home remedies include duct tape to help with setting broken bones; duct tape or superglue to treat plantar warts; and Kogel mogel to treat sore throat. In earlier times, mothers were entrusted with all but serious remedies. Historic cookbooks are frequently full of remedies for dyspepsia, fevers, and female complaints. Components of the aloe vera plant are used to treat skin disorders

Plant-based treatments in Ayurveda may be derived from roots, leaves, fruits, bark, or seeds; some examples of plant-based substances include cardamom and cinnamon. In the 19th century, William Dymock and co-authors summarized hundreds of plant-derived medicines along with the uses, microscopic structure, chemical composition, toxicology, prevalent myths and stories, and relation to commerce

Herbal medicine (also herbalism) is the study of pharmacognosy and the use of medicinal plants, which are a basis of traditional medicine. Herbal medicines are safe because they are natural, herbal medicines and synthetic drugs may interact, causing toxicity to the consumer. Herbal remedies can also be dangerously contaminated, and herbal medicines without established efficacy, may unknowingly be used to replace prescription medicines.[25]

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