New Records, Ethno-pharmacological Applications & Indigenous Uses of *Gloriosa superba* L. (Glory lily) Practices by Tribes of Pachmarhi Biosphere Reserve, Madhya Pradesh, Central India

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Abstract: *Gloriosa superba* Linn. (Glory lily), is a medicinal plant belongs to the family liliaceae. It is one of the important species which are used for several ethno-medicinal purposes by tribes of PBR. The present paper deals with the new records of *Gloriosa superba* L. species in five villages of Hoshangabad Districts of PBR. An ethno-medicinal study was conducted to document the indigenous medicinal knowledge (ethno-medicinal/ethno-pharmacological) of *Gloriosa superba* L use by tribal communities & traditional healers in Pachmarhi Biosphere Reserve from December 2010 to November 2011. PBR is the most luxuriant forest and rich in medicinal plant resources. The forest area is dominated by a number of tribes such as *Koorku*, *Bharia*, *Gond* and *Mawasi* who depends solely on their surrounding forests for most of their requirements from food to medicines. In view of the ongoing cultural and economic changes brought in by the process of globalization, the immediate need was felt to document in details the under explored ethno-medicinal practices of *Gloriosa superba* L. by tribes of PBR. Data were collected from 230 randomly selected traditional healers/informants using semi-structured interviews and observations. This paper reports tribals indigenous knowledge of *Gloriosa superba* to cure around 55 ailments/diseases were identified & documented. Healers indigenous knowledge was positively correlated with their reported age but not with their educational level. High degree of consensus (ICF) was observed among traditional healers for *Gloriosa* Tubers (ICF 0.62; FL 81.82%) followed by leaves (ICF 0.55; FL 75%), Whole plant (ICF 0.52; FL 68%), Seeds (ICF 0.38; FL 42%), Fruits (ICF 0.31; FL 38%), Flowers (ICF 0.28; FL 33%) & Stem (ICF 0.9; FL 15%) in treating various ailments. The survey was conducted in the forest and different villages of Pachmarhi Biosphere Reserve such as Dokrikheda, Badianhoni, Chhotianhoni, Panarpani, Badkachhar, Matkuli, Pagara, Bariam, Amkhedi, Neemghan, Singanama, Tekapar, Chaka, Pisua, Monhgaun, Kadari, Binoura, Kherghat, Parraspani, Rorighat, Kajari, Bori, Choorna, Tamia, Rathed and Chimtipur in various seasons. Our results showed that *Gloriosa superba* used by healers/tribals are under serious threat due to several factors, which indicates the need for urgent attention towards his conservation and sustainable utilization.
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Key words: *Gloriosa superba*, Pachmarhi Biosphere Reserve (PBR), Tribals, Traditional Knowledge, Ethno-medicinal, Traditional Medicinal Practitioner (TMP), Traditional healer, Local tribe.

Abbreviations: Pachmarhi Biosphere Reserve_PBR; Traditional Medicinal Practitioner_TMP; Informant Consensus Factor_ICF; Fidelity level_FL

1. Introduction

India is blessed with the eighteen world's hot spots of biodiversity and is seventh among the sixteen mega diverse countries, where 70% of the world's species occur collectively (Sanjappa *et al.*, 2005). About 60% of the world's population and 80% of developing countries populations relay on traditional medicine, mostly plant drugs for their primary healthcare needs (Gaur and Tiwari, 2003). Ethno-medicinal studies are a suitable source of information regarding useful medicinal plants that can be targeted for domestication and management (Kunwar *et al.*, 2003). A number of important modern pharmaceuticals have been derived from plants are used by indigenous people (Balick, J. M. & P. A. Cox, 1996). A number of modern drugs like aspirin, atropine, ephedrine, digoxin, morphine, quinine, reserpine and tubocurarine are examples which are originally discovered through observations of traditional cure methods of indigenous peoples (Gilani, A. H. & A. U. Rahman, 2005). In recent years, interest has been focused on the indigenous uses of medicinal plants in the scientific quest for discovery of newer & more effective medicines. Plants have been used in the traditional healthcare system from time immemorial, particularly among the

tribal communities. Numerous wild and cultivated plants play vital role in their culture, customs, traditional healthcare system, rituals etc, and this interrelationship has evolved over generations of experience and practice. Ayurveda, which is one of the oldest system of traditional healthcare system and yet living traditions practiced widely in India, Sri Lanka and other countries has a sound philosophical and sound basis (Dahanukar and Thatte, 2000). Traditional people around the world possess unique knowledge of plant resources on which they depend for food, medicine and general utility including tremendous botanical expertise. Traditional medicine based on herbal remedies has always played a key role in the health care systems of many countries. Ethno-medicinal plants, as a group comprise approximately 8000 species and account for about 50% of all the higher flowering plants species in India (Gadil *et al.,* 1998). Plants are important sources of therapeutic drugs and play a significant role in the survival of the tribal and ethnic communities. India is rich in cultural and floristic diversity and also store house of ethno-botanical knowledge. Indian populations still rely on plant-based medicines as they are abundantly available, economical, and have little or no side effects (Dubey *et al.,* 2004; Sinha, 1996). The traditional systems of medicine together with folk medicine systems continue to serve a large portion of inhabitants, particularly in rural and tribal areas regardless of the dawn of modern medicine. Out of about 15,000 species of higher plants in India, medicinal uses have been attributed to 1500 species. India has second largest tribal population in the world after Africa (Kosalge and Fursule, 2009). Tribal people provide considerable information about the use of many plants or plant parts as a medicine, according to World Health Organization (WHO) as many as 80% of the world's population depend on traditional medicine for their primary healthcare needs.

At present, there is a worldwide movement for assessing the plant resources and researchers for new plants which are of medicinal and economical value and importance. Researchers are focusing mainly on ethnobotanical and ethnomedicinal investigation to fulfill the increasing demand of herbal products. Medicinal plants are now under great pressure due to their excessive collection and exploitation (Laloo *et al.,* 2000). Continuous exploitation of several medicinal plant species and substantial loss of their habitats have resulted in the population decline of many high value medicinal plant species over the years (Kala and Sajwan, 2007). The degree of threat to natural populations of medicinal plants has increased because more than 90% of medicinal plant raw material for herbal industries in India and also for export is drawn from natural habitats (Dhar *et al.,* 2002). The primary threat to medicinal plants is those used by human beings that affect any kind of biodiversity (Rao *et al.,* 2004). The weakening of customary laws has often proved to be easily diluted by modern socio-economic forces (The Netherlands, 2003). There are many other potential causes of rarity in medicinal plant species, such as habitat specificity, narrow range of distribution, land use disturbance, introduction of non-natives, habitat alteration, climatic changes, heavy livestocks grazing, explosion of human population, fragmentation and degradation of population, population bottleneck and genetic drift (Kala, C. P., 2000, 2003; Oostermeijer *et al.,* 2003).

Documentation of traditional knowledge on ethno-medicinal use of plants has been considered as a high priority (Anonymous, 1994; Pieroni, 2005) to support the discoveries of drugs benefiting been the primary inhabitants of natural habitats, holds tremendous amount of traditional knowledge on the use of mankind. In India various communities use over 50% of the plant species of any ecosystem in ethnomedicine & in general over 7500 species are utilized in primary health care by various tribes (Badola, H. K. and Aitken, S., 2003). The tribal populations who have various biotic resources (Hamil F. A. *et al.,* 2000; Uniyal, S. K. *et al.,* 2006), which may have greater importance to the ongoing research and discoveries in the field. It is well acknowledged in the literature (Cox, P. A. & Ballick, M., 1994; Farnsworth *et al.,* 1985; Kirtikar, K. R. & Basu, B. D., 2001) that their age old practices of using plants to cure numerous ailments have way to further discovery of many life saving drugs. The population of Tribals in Madhya Pradesh is 122.33 Lakh constituting 20.27% of the total population of Madhya Pradesh (603.85 Lakh. There were 46 recognized Scheduled Tribes and three of have been identified as "Special Primitive Tribals Groups in the state (Census 2011 Govt. of India).

PBR is constituted in the central part of the India. The total area of PBR is 4981.72 sq. km. It is located at longitude 22° 11' to 22° 50' N & Latitude 77° 52' E. It covers parts of three civil districts, viz., Chhindwara (29.26%), Hoshangabad (59.55%) & Betul (11.26%). It includes three wildlife conservation units viz., Satpura National park (524.37 sq. km.), Bori sanctuary (485.72 sq. km.) and Pachmarhi Sanctuary (491.63 sq. km). These altogether has been notified as Satpura Tiger Reserve (Annonymous, 1996). In PBR the flora of Pachmarhi & Bori forest ranges consists of 101 families consisting of 452 genera and 778 species. The species consists of 247 trees and shrubs as well as 531 herbs (Mukherjee, A.K., 2001) which may offer incredible scope for the development of pharmaceutical sector as potential commercial hub economy of the state. Ethno-

medicinal explorations and simultaneous prioritization of pharmaceutically important plant species for conservation through *ex-situ* cultivation have been identified as vital aspects for the drug industrial development (Badola, H.K. & Aitken, S., 2003; Badola, H.K. & Pal, M., 2002; Dhar, U. *et al.* 2002). In Madhya Pradesh, particularly in PBR ethno-medicinal uses of plants are not sufficiently taken up, specially targeting the remotely located tribal areas in the state. Ethno-medicinal studies on *Gloriosa superba* available in PBR mostly confined to simple preliminary stage. The PBR in Madhya Pradesh, India inhabits the largest population of the *Gond*, *Bharia Korku* & *Mawasi* tribes. The PBR, known for its vast plant wealth is one of the least attended areas on ethnomedicinal aspects, for being sacred and restricted especially to outsiders.

The Pachmarhi Biosphere Reserve (PBR) in Central India is known to harbor some thick forests inhabited by tribal communities (Chandra Prakash Kala, 2011). Such rich forest has provided ample opportunities to its inhabitants for observing and scrutinizing the various medicinal plant species for developing their own traditional knowledge. The *Baiga, Bharia, Korku, Gond, Mawasi, Gour, Keer, Kotwar* & *Muria* are the most backward tribes of this region. Each ethnic group has more or less similar ecological acumen, habitation pattern and economic activity. They exhibit much commonness in matters of speech, stress, ornamentation, social customs, religious beliefs & practices (Anil kumar & Yadev, D. K., 2011). They are engaged in a varied range of occupation such as hunting, fishing & agriculture. All of them collect & consume wild plants for food and medicines in various degrees. The objectives of the present study is to provide field based assessment and documentation on (i) to record and identify the *Gloriosa superba* L. in PBR (ii) to document the indigenous uses, traditional knowledge & ethnomedicinal importance of *Gloriosa superba* practices by Tribals, TMP, Local herbal healers, local people & Medicine men (Vaidhyya). The present study makes exhaustive efforts in reporting, investigating and documenting the ethnomedicinal importance of *Gloriosa superba* L. in PBR. The reporting areas, describe detailed practices along with quantitative analysis of data. This study will present an updated & much improved document of the traditional pharmaceutical knowledge of tribes of PBR. This efforts should be seen serving not only as a sound base for resource assessment but an opportunity for developing scientific guidelines on access and benefit sharing regime on ethno-medicinal uses of *Gloriosa superba* by the community people.

1.1. Tribes of Madhya Pradesh – a brief history, diversity & distribution in PBR

Tribals in Madhya Pradesh constitute a sizeable population. According to Census of India (2011), the population of Tribes in Madhya Pradesh does 122.33 Lakhs constitute 20.27% of the total population of Madhya Pradesh (7, 25, 97,565 Million). There were 46 recognized scheduled tribes and three of them identified as "Special Primitive Tribal Groups" in the State. Madhya Pradesh has a substantial tribal population (Tribal Development Deptt., Govt. of Madhya Pradesh). The differences in the tribal communities spread over in various parts of the state including PBR. It's clearly seen not only on the basis of their heredity, lifestyle and cultural traditions, but also from their social economic structure, religious beliefs and their language and speech. Due to the different linguistic, cultural, geographical environment & its peculiar complications, the diverse tribal world of Madhya Pradesh has been largely cut off from the main stream of development (ENVIS-MP, 2008). Veteran social activist and freedom fighter *Guru Radha Kishan* lived between tribals in East Nimar and learned *Korku* to work between them to improve the conditions of widespread poverty and exploitations by money lenders & shrewd traders (http://www.answers.com/topic/madhya-pradesh). Being aware of this primarily cultivators community & their concern with numerous socio-economic challenges in the day to day life, encouraged these innocent people to earn their livelihood through agriculture or even as seasonally employed agricultural labourers. So that the communities will be in the main stream of nation (Shrivastava, Divya, 2008**).** The main tribal groups in Madhya Pradesh are *Gond, Korku, Bharia, Baiga, Halba, Kaul, Moriya,* and *Mawasi*. The population density of *Gond, Korku, Bharia, Mawasi,* was highest in PBR of Madhya Pradesh (Census 2011); (Table 1).

Table 1: Demographic profile of the different tribes in Madhya Pradesh.

S. No.	Name of Tribes	Population	Districts Inhabited
1.	Gond	5349883	All districts mainly spread on both banks of Narmada river in Vindhya & Satpura (Hoshangabad, Betul & Chhindwara).
2.	Korku	66781	Hoshangabad, Betul & Chhindwara
3.	Bharia	195490	Chhindwara
4.	Mawasi	113291	Hoshangabad, Betul

Source: Census of India, 2011. (Districts of PBR; Hoshangabad, Betul, Chhindwara)

Tribes of PBR have preserved their culture and tradition despite outside cultural influence. Their culture is distinguished by the composite remains of the *Scythian* & *Dravidian* culture. The tribal population of Madhya Pradesh has carried on the practice of farming and cultivation in order to

supplement their income (Jain, A.K. and Patole, S.N., 2001). Mostly they live in the forests and are fully dependent on the forest products, herbs, wood, etc. for their livelihood. Besides, some tribal communities are working with agricultural fields as a landless labour or some have agricultural land. Among the various tribes resides in PBR, *Bharia* tribe is one of the ancient tribe which has resided mainly in the forest areas. *Bharia* tribe is found in the Patalkot hill and its adjoining areas in PBR. The people of this tribal community are known for their usage of medicinal plants to treat different kinds of diseases (Pandey, G.D. & Tiwary, R.S., 2000). *Gond* tribe stands first in terms of population in PBR area, also in Madhya Pradesh among the other major tribes of India (Census, 2011). They mainly found in Vindhyan hills and Satpura mountain range. *Gond* tribal people mostly live in the hilly areas of forest. The *Gond* inhabitants are working in agricultural fields & hunting. They collect wild fruits and herbs from the forest for their livelihood (Kala, C.P., 2011). Another tribe of PBR is the *Boneya* tribe & identified as *Korku*, form a major part of Madhya Pradesh. The *Gonds* & *Korkus* are two primitive tribes that call Pachmarhi region their home. They are primitive because of the fact that they live in small cave or lack shelters huts and are content with simple lifestyles (Acharya, 2008).

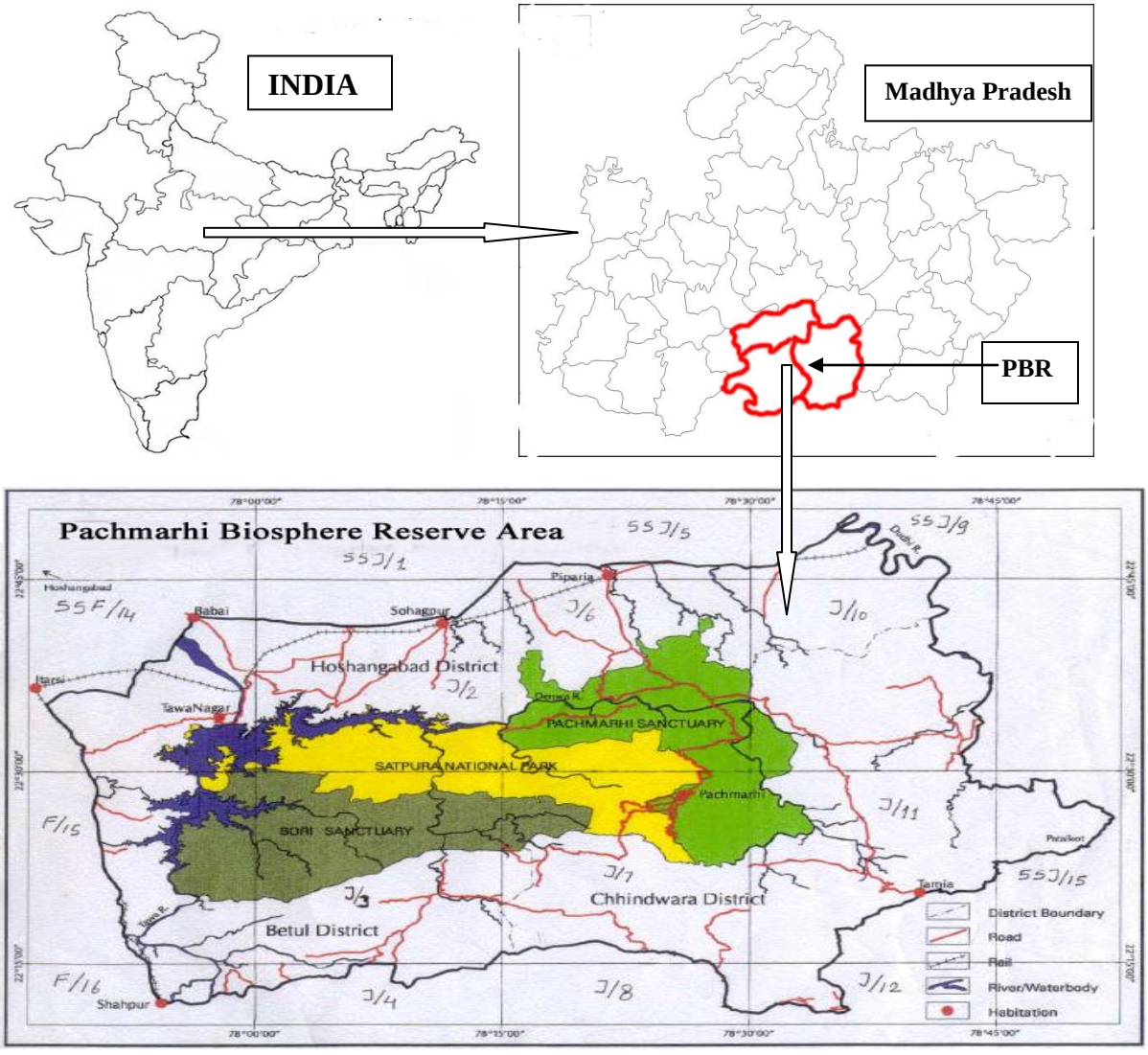
1.2. Selection of Gloriosa superba for this study with reference to PBR

Gloriosa superba is a native of tropical Asia and Africa. The genus derives its name from the Latin word gloriosus, referring to the flower. It is found growing throughout tropical India, from the North-West Himalayas to Assam and the Deccan peninsula, extending up to an elevation of 2120 M. In Karanataka, it is commomly found growing all along the Western Ghats; it also found growing in Madagascar, Srilanka, Indo-China and on the adjacent island (Kavina *et. al.*, 2011). The distribution of *Gloriosa superba* in Madhya Pradesh is limited. The earlier investigator M. Oommachan (1977) & Acharya (2008), who reported this medicinal herb in Berasia region of Bhopal Districts. & Patalkot region of (Chhindwara Districts) PBR respectively. *Gloriosa superba* is one of the endangered species among the medicinal plants (Badola, 2002; Shanmugam Hemaiswarya, 2009) which is striking tuberous climbing plant with brilliant wavy edged yellow and red flower that appears from November to March every year (Rajak & Rai, 1990). It is one of the seven upavishas in the Indian medicine, which cure many ailments but may prove fatal on misuse (Joshi, 1993). Every parts of the *Gloriosa* are used as medicinal purposes. It is one of the reputed medicines in Yunani system of medicine. The medicinal importance of this miraculous herb is also described in Many Indian Mythological literature, viz., *Ayurveda, Charaka Samhita, Sushruta Samhita, Rajanighantu, Dhanvantari Nighantu, Madanadi Nighantu, Bhavaprakasha, and Chakradatta.*

Ethnic groups are the repositories of the knowledge of herbal medicine. The tribes of Pachmarhi Biosphere Reserve have preserved a large bulk of traditional knowledge of medicinal uses of plants growing around them. It is important to document the valuable information because this knowledge is handed down to generations through words of mouth and is extensively used for the treatment of common diseases and conditions. Therefore, a need and gathering of knowledge and documenting the *Gloriosa superba* used by these tribes is important because of modernization and cultural practices. After review of available literature it is revealed that 50 plant species have been reported medicinally in Pachmarhi Biosphere Reserve area (EPCO, 2002). The habitat of these medicinal plants including *Gloriosa superba* are fragile and under constant anthropogenic pressure of over exploitation. These medicinal plants are used by tribes for various ethno-medicinal purposes. Although, only few workers have documented the uses of various medicinal plants in Pachmarhi Biosphere Reserve (Oommachan, M., 1990; Pathak, 2001; EPCO, 2001, 2002; Acharya *et al.*, 2008; Ballendra pratap singh & Ravi upadhyay, 2010, 2011). Since, there is no intensive and extensive studies have been carried out and reported of this region with reference to *Gloriosa superba*. This is the first report on the ethno-medicinal practices of the varied tribes residing in and around Pachmarhi wild life century (Hoshangabad District.) with reference to *Gloriosa superba*, in PBR. Although, Acharya *et al.*, 2008 described the ethno-medicinal importance of *Gloriosa superba* in Patalkot area of Chhindwara District in PBR. In this paper we are first time reporting the *Gloriosa superba* L. in Pachmarhi wild life century (Hoshangabad) villages viz., Baagra Tawa, Chhotianhoni, Dokrikheda, Panarpaani and Matkuli. (Table 2). None of the earlier investigator (Oommachan, M., 1990; Pathak, 2001; EPCO, 2001**,** 2002; Acharya *et al.*, 2008; Ballendra pratap singh & Ravi upadhyay, 2010, 2011; Kala, C.P., 2011) reported this species in Pachmarhi wild life century in Hoshangabad districts. of PBR.

Gloriosa superba is a commercially imperative medicinal plant which has diverse medicinal applications. Eventually due to over-exploitation of this plant for pharmaceutical use by local people, tribals, herbal healer, TMP, scientists & research scholars has depleted from its natural habitat in PBR. According to our present survey the status of this medicinal herb is endangered in PBR, which also supports the IUCN Red List (2001) status of this

valuable herb. In our present investigation as per discussion with tribals & local people we come to know that this glorious herb was found abundance once upon a time in Pachmarhi region of PBR. Now-a-days this herb is rare in this region. Few of these findings are also resembles with the findings of Acharya (2008). There is a greater need of a "community-based" approach in conservation of this species. Awareness among the local community is one of the most important tasks. Universities, Colleges, Conservationists, Botanists, entrepreneurs, NGOs and other agencies should come forward and adopt a village of their respective region. These can play a vital role in conservation of important medicinal plant including *Gloriosa superba*. (Acharya, 2008). Therefore, in this paper, an attempt has been made to (i) to record the *Gloriosa superba* L. in several villages of PBR. (ii) to collect and document the traditional medicinal knowledge (Ethno-pharmacological applications) & indigenous uses of *Gloriosa superba* from local herbal healers of different communities (tribes) to cure various ailments/diseases residing in Pachmarhi Biosphere Reserve, Madhya Pradesh, India. So, that the principle objectives of the study were (i) to record & identify the *Gloriosa superba* L. used by varied tribes of Pachmarhi Biosphere Reserve for curing various ailments/diseases (ii) to document the indigenous knowledge and ethno-medicinal uses of the *Gloriosa superba* L. practices by TMP, local herbal healer, tribals & local people.



***Source*: EPCO, 2001**

Figure 1: Pachmarhi Biosphere Reserve; Geographical location of the study site; Map of PBR illustrating the geographical position of different Districts & Sanctuaries.

2. Materials and Methods

2.1. Study area

Pachmarhi Biosphere Reserve area is constituted in the Central part of India. It is often recognized as "Genetic Express Highway" linking two biological hot spots of the country viz. Eastern Himalayas and Western Ghats, also as confluence of northern and southern type of vegetation. The total area of Pachmarhi Biosphere Reserve is 4926.28 sq. km., of which 524.37 sq. km. is under the core zone and remaining 4462.93 sq. km. comprises the buffer zone. It is lies between 22° 10' to 22° 50' N Longitude and 77° 45' to 78° 56' E Latitude. It covers parts of three civil districts, viz., Chhindwara (29.19%), Hoshangabad (59.55%) and Betul (11.26%). It includes three wildlife conservation units viz., Satpura National Park (524.37 sq. km.), Bori Sanctuary (485.72 sq. km.) and Pachmarhi Sanctuary (491.63 sq. km.); (EPCO, 2001). In general the temperature of PBR ranges from 11 to 42°C (Jayson, 1990). It is one of the highly biodiversity-rich areas with high floristic diversity and unique plant life forms because of the varied spectrum of variations of the latitude, altitude, rainfall, topography, soil type and other climatic aspects. The variation in climate occurs from place to place. The PBR is cool in summer and has heavy rainfall in rainy season; where as low lands in Narmada basin are uncomfortably hot in summer with less rainfall. The mean daily temperature ranges from 26 to 42℃ and 9.7℃ to 25℃ depending upon season. In PBR the flora of Pachmarhi & Bori forest ranges consists of 101 families consisting of 452 genera and 778 species. The species consists of 247 trees & shrubs as well as 531 herbs. Out of 101 families 36 are restricted to Pachmarhi range & 4 to Bori range (Mukherjee A.K., 2001). It is equally known for its cultural diversity, as it is inhabited by number of tribal and non tribal communities. The major tribal groups inhabited in PBR are *Gond, Korku, Bharia,* and *Mawasi*. Because of numerical strength the *Gond* tribe dominates the central part of India, which was known as Gondwana state, as the *Gond* ruled this part of India in the past (Kala, C.P., 2011).

During past years extensive surveys of different remote areas of PBR have been explored by various researchers (Oomachand M, 1990, 1992; Pande & Shrivastava, 1993; Vasudeva & Bir, 1993; Pathak, 2001; Acharya, 2008; Ballendra pratap singh & Upadhyay, 2010, 2011, 2012; Kala, C.P., 2011). The study area concentrates in and around the deep forest pockets of tribal villages which comes under Pachmarhi Biosphere Reserve (PBR) located in Hoshangabad & Chhindwara Districts of Madhya Pradesh, India (Fig. 1). The main tribes of the study area are *Koorku, Bharia, Gond,* and *Mawasi*. They depend solely on their surrounding forests for most of their requirements from food to medicines. Ethno-botany of Pachmarhi Biosphere Reserve is known through the earlier works of M.Oommachan et al. 1990; Pande & Shrivastava, 1993; Vasudev & Bir 1993; Pathak, 2001, Acharya, 2008 and Ballendra Pratap Singh & Ravi Upadhyay, 2010, 2011; Kala, C.P., 2011).

2.2. Data collection

The present study is the outcome of exhaustive field survey undertaken for the period of one year from December 2010 to November 2011. For the present study, villages in buffer zone & core zone areas of PBR were surveyed. A total of twenty three villages of PBR namely Amkhedi, Badianhoni, Bariam, Badkachhar, Bori, Chhotianhoni, Chaka, Choorna, Chimtipur, Dokrikheda, Kadari, Kherghat, Kajari, Matkuli, Panarpani, Pagara, Pisua, Paraaspani, Rorighat, Rathed, Singanama, Tamia and Tekapar were selected for indigenous & traditional ethno-pharmacological uses of *Gloriosa superba*. The selected villages were dominated by tribal communities, mostly *Gond, Korku, Bharia & Mawasi* with their offshoots. The door to door questionnaire survey was conducted in the selected villages of PBR in various seasons (Fig. 5). In most of the villages, generally the male members were available for interviews; however female had also co-operated during the interview. Kala, C.P. (2011) had also been observed the similar phenomenon on his earlier studies on PBR.

Following the method of Jain and Goel (1995), the information regarding the ethno-medicinal usage of *Gloriosa superba* by local tribes for various ailments and diseases was collected directly by contacting the tribals, local people, herbal doctors and the persons who have knowledge about this medicinal herb. Individuals who were indicated to know and practice at least one medicinal plant species were considered as traditional healers in this study. In total 230 informants (95 males & 30 females) were interviewed, which included 35 Koorku, 25 Gonds, 32 Bharia, 15 Mawasi, 39 tribal healers/TMP/vaidhyyas, 17 Graziers and remaining 67 included people belonging to different categories like villages, farmers, housewives, teachers, shopkeepers & forest officials, contractors etc. of which 40 were males and 27 were females. In present investigation out of 230 informants, 125 healers identified and registered. In this paper out of 125 identified healers/TMP, 25 healers/TMP/informants were selected randomly and considered as the study subject & their information is incorporated in Table 5. Through questionnaire survey and interviews the information was collected on the indigenous & ethno-medicinal uses of this medicinal herb. The plant material was collected in its flowering

state and data on age, sex, level of education, occupation, religion, ethnicity, human diseases treated, vernacular names of plants in different language, degree of management (wild/ cultivated), abundance, parts used, condition of plant part used (fresh/dried), methods of remedy preparations (decoction, paste, powder and juice, form of usage either fresh or dried), remedy preservation (storage), dosage prescriptions, routes of remedy administration, noticeable adverse effects of remedies, use of antidotes for adverse effects, indigenous knowledge transfer, other uses of this species, location of use, existing threats to this species and traditional conservation practices were gathered during the interviews. Some of the information was described in Table 3. The age of respondents ranges between 26 years to 80 years and the number of male respondents was higher (68%) as compared to the female respondents (33%). Most of the traditional healers were reluctant to reveal any information but a few consented for collection from the forest. In field studies, medicinal uses of *Gloriosa superba* were collected with the help of interview of traditional medicinal practitioners (vaiddhyyas), age-old people and tribal medicine men actively engaged in ethnomedicinal practices. Most of them belong to families, which still have a strong connection with traditional agriculture and medicinal practices for their livelihood. They also reveal information regarding the ethnomedicinal usage of *Gloriosa superba* & agreed for field trips to collect this medicinal plant species (Fig. 2). Friendly chats made with teenagers, youngsters and school children of both genders helped a lot in confidence building with tribal people. In some villages, the informants were not much cooperative to reveal the secret of their ethnomedicinal knowledge to the strangers unless they were taken into confidence, which experienced rather as difficult task, besides language problem. Data were further crossed checked. Survey was undertaken in core & buffer zone villages of forest area of PBR as well as surroundings natural habitats and the agricultural areas of villages. The help of local representatives were taken to approach this medicinal herb growing in different areas or specimens available in the villages with elderly people in some cases. The restrictions on the collection of any specimens, especially by the outsiders, for being the landscape as protected/sacred/restricted, suggested adopting the above strategy of field identification. The respondents were selected randomly and prior informed consent was obtained from each respondents. Besides the local people were encouraged to give their views and perceptions on various uses of this medicinal herb. Participant observations were also employed and information was collected on this herb by participating in various cultural activities of the local tribal people. Attempts were made to observe the *Gloriosa superba* used in the various socio-cultural practices of the local people including child birth, death ceremony & marriage & festivals (Fig. 5H). The knowledgeable tribal people including herbal healers, TMP, medicine men, villagers & forest officials were also requested to accompany during the forest survey for identification of *Gloriosa superba* & associated indigenous knowledge about this medicinal herb. The plant material & data were collected through interviews and queries were immediately recorded in field notebook with photograph of all the specimens (Fig. 3).

During our survey, it was observed that women of the tribal areas also have good knowledge of plants. In forest with the ambient vegetation before them, tribals are promoted to remark on the utility of the *Gloriosa superba* especially when accompanied by a group. Both sexes were present in large and small groups. This all resulted in heterogeneity of information, like when will tuber sprout, when shall flowering and fruiting take place, when shall they go into dormant phase? etc. The secondary information were collected from non tribal people like forest official, government physician, reason being their long association with tribes of that area (Fig. 5F).

In order to determine the authenticity of information collected during field visit, repeated verification of data from different informants at different times was done. Thus, only the specific and reliable information cross checked with at least 25 informants has been incorporated in the present study (Table 5). The author (AKK) also made observations in the field on the general habitats of this medicinal herb collected by accompanying traditional healers/tribals/local people, translators & field assistants (Fig. 3).

The plant material was collected and carefully handled for identification with the help of available authenticated literature, especially Oommachan, M. (2001) & Flora of Madhya Pradesh Vol. – I by Verma *et al.,* (1993). Plant material was preserved by making herbaria following the routine method of plant collection and herbarium technique (Jain and Rao 1977). The voucher specimens were carefully numbered & deposited in the Herbarium of Botany Department, Government Motilal Vigyan Mahavidyalaya, Bhopal (M.P.), India. The medicinal value of *Gloriosa superba* was enumerated in the following pattern: (a) Botanical name, (b) Family, (c) Vernacular Name in different language, (d) Parts used and, (e) Mode of preparation/Mode of administration (f) Location of use (Table 6). The gathered field information were systematized and analyzed to draw a clear and updated picture of the medicinal use of *Gloriosa superba* L. in PBR region.

2.3. Data analyses

Facilities in MS excel spread sheet were utilized to make simple calculations, determine proportions and draw bar graphs. Informants consensus factor (ICF) values were determined following (Trotter *et al.,* 1986) to evaluate the consensus among traditional healers. These values were calculated as ICF = nuc – np/ nuc – 1, where, nuc = number of use citations, np = number of parts of *Gloriosa* used for each citation. Moreover, the level of fidelity (F1) was computed to determine the most important parts of *Gloriosa* used by the healers according (Friedman *et al.,* 1986) as: F1 (%) = (PF/ TP) 100, where PF = frequency of citation of a parts of *Gloriosa* for a specific ailments & TP = total no. of citations of that part.

Chi – square (x^2) Spearman Rank Correlation & Binomial Tests were also employed to analyze ethno-medicinal data using SPSS 20.0.0 IBM Software Package. Chi – square test was used determine if there was a significant difference ($p < 0.05$) on i) mean no. of parts of *Gloriosa* reported by each healer versus districts (villages) & ii) the abundance of *Gloriosa superba* with respect to plant part used, condition of plant part used (fresh/dried), marketability and added values of the *Gloriosa superba*.

The Spearman Rank Correlation test was employed to evaluate whether there was significant ($p < 0.05$) correlation between i) the diversity of *Gloriosa* species recorded at different places & altitude in PBR ii) the age of traditional healers and the no. of parts of *Gloriosa* reported for ethno-medicinal purposes; iii) the education level of healers and the number of ethno-medicinal uses of *Gloriosa superba* reported.

The Binomial Test was used to evaluate whether i) the indigenous knowledge of *Gloriosa* was transferred to generations; ii) modernization had any influence on the transfer of the indigenous knowledge of *Gloriosa*; iii) traditional healers/tribals were present during collection and processing of remedies, iv) mixtures of species were used with *Gloriosa superba* frequently in herbal remedies preparation, v) healers were preserving (storing) remedies, vi) dosage prescriptions were not similar for different age groups, vii) remedies were devoid of adverse effects after administration if taken in prescribed amount, viii) healer were using antidotes for noticeable adverse effects, ix) mainly tubers and seeds of this medicinal herb are marketable, x) the herb is endangered in study area, xi) this medicinal herb had added values; & xii) few traditional healers were practicing conservation of this species.

3. Results

3.1. Particular of traditional healers/TMP/Medicine men/Tribals

All of the traditional healers/TMP/Medicine men (vaidhyya)/local people/tribals in the study area were male, female, Hindus, Muslims, self employed traditional medicinal practitioners. These people mainly belong to *Gond, Bharia, Koorku,* and *Mawasi.* The secondary informants were government servants, shopkeepers, forest officials. Their reported ages ranged from 24 to 87 and each traditional healer/informants had a mean family member number nine. The majority of 62% were illiterate and those could read and write constituted 33% while 14% attended grades one to four.

3.2. Records & status of *Gloriosa superba* in PBR

In the present investigation we reported *Gloriosa superba* L. in Pachmarhi wild life century (Hoshangabad Districts.) villages viz., Baagra Tawa; 5 K.M. away from Tawa Dam (Longitude 22° 36' 28.46" N; Latitude 77° 59' 17.56 E), Chhotianhoni (Longitude 22° 38' 37.17" N; Latitude 78° 21' 14.50" E), Dokrikheda; near Dam (Longitude 22° 38' 45.40" N; Latitude 78° 21' 28.57" E), Panarpaani (Longitude 22° 30' 11.11" N; Latitude 78° 27' 07.52" E), Matkuli (Longitude 22° 35' 07.03" N; Latitude 78° 27' 58.37" E) of PBR (Table 2). None of the earlier investigator (M Oommachan, 1990; Vasudeva & Bir, 1993; Pathak, 2001; EPCO, 2001, 2002; Acharya *et al.,* 2008; Ballendra pratap singh & Ravi upadhyay, 2010, 2011) reported this species in Pachmarhi wild life century in Hoshangabad Districts. of PBR. Acharya *et al.,* (2008) reported *Gloriosa superba* in Patalkot area of Chhindwara District, viz., Gaildubba, Rathed, Harra-ka-char, Chimtipur, Kareyam, Jaitpur, Bijouri, Chhindi and Sidhouli in PBR. According to our present survey the status of this medicinal herb is endangered in PBR, which also supports the IUCN Red List (2001) status of this valuable herb & earlier investigation of Acharya (2008).

3.3. Reported human/veterinary ailments and consensus of Healer/TMP/Tribals

A total of fifty five ailments (49 ailments of human & 6 ailments of veterinary) were treated by traditional healers using *Gloriosa superba* alone or in combination of different plant species. High degree of consensus (ICF = 0.62) was observed among the traditional healers in treating ulcer, piles, wounds, skin infection and related diseases (Table 3). These ailments are treated by the use of *Gloriosa superba* in the form of paste or juice in combination with coconut oil, honey, *Brassica campestris* oil & cow urine. Traditional healer/Medicine men advice these herbal preparation to patients as orally or applied externally (topically) on the affected area. These traditional medicines are prepared by mixing with water & milk to treat such ailments (Table 6).

Cough cold, insect bite & vocal abstractions shared the second highest degree of consensus (ICF = 0.55) (Table 3). Freshly pounded and squeezed leaves of *Gloriosa superba* taken with warm water & honey, reported to be used in treating patients suffering from these ailments. The dried leaves of *Gloriosa superba* with honey is also used in treating vocal abstractions.

FIGURE 2

FIGURE 3

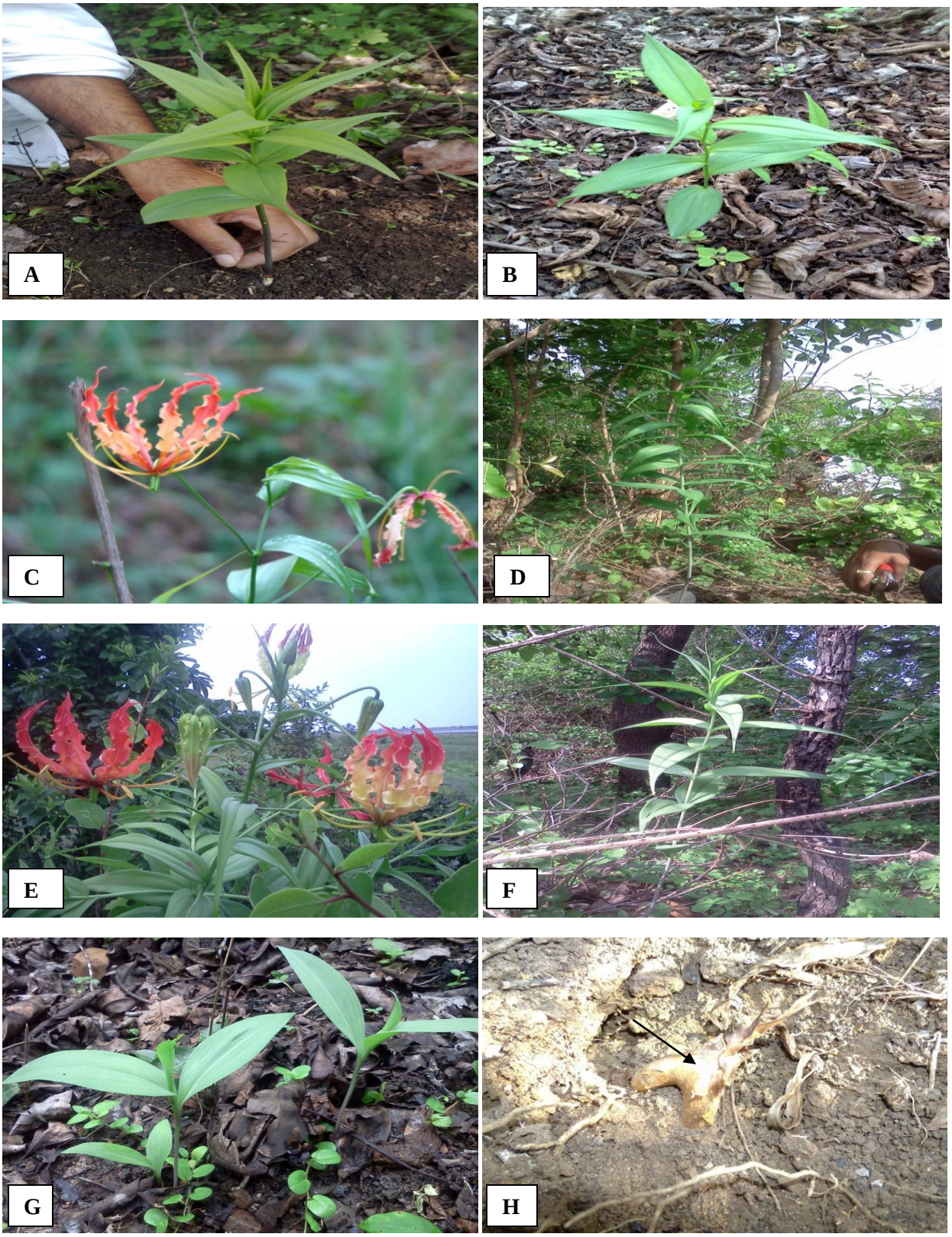


FIGURE 4

FIGURE 5

Legend to Figures

Legend to Figure 2: Different parts of *Gloriosa superb*a used in herbal medicine preparations; (A) Field grown sprouted tuber (B) Immature fruit (C) Seeds (D) A twig (stem) with leaves & sprouted tuber (E) Tuber, leaves, flower (F) Flower

Legend to Figure 3: Collection of *Gloriosa superba* from field (natural habitat) in PBR; **(**A) Investigator (AKK) with herbal healers in Baagra tawa (B) A tribal (Mr. Basodi) collecting *Gloriosa* in Chhotianhoni (C) TMP Mr. Kanahaiyya Lal in Dokrikheda (D) Investigator (AKK) in Matkuli (E) A tribal Halkey bhaiyya showing *Gloriosa* tuber in Panarpaani (F) Mr. Kanahaiyya Lal (Vaidhyya) with investigator in Badkachhar (G) A local herbal healer Mr. Seetha ji with *Gloriosa* in Singanama (H) Medicine man Mr. Bhura with *Gloriosa* in Paraspaani.

Legend to Figure 4: *Gloriosa superba* growing in natural habitat at different places in PBR; (A) Baagra tawa (B) Chhotianhoni (C) Dokrikheda (D) Matkuli (E) Panarpaani (F) Paraspaani (G) Singanama (H) Exploited tuber of *Gloriosa superba* in natural habitat in Neemghaan (PBR).

Legend to Figure 5: Semi-structured interviews for data collection by Investigator AKK; (A) A tribal with Investigator at Badianhooni (B) A tribal with investigator at Matkuli (C) A tribal with investigator at Dokrikheda (D) A TMP Mr. Kanahaiyya lal Ji with investigator at Beejanwada (E) Investigator with one of Buddhists in Buddha temple at Pachmarhi (F) Investigator with forest officials visiting the natural habitat of *Gloriosa superba* Panarpaani (G) A medicine man with Investigator (H) Investigator AKK with villagers in religious ceremony during data collection.

Table 2. *Reporting of *Gloriosa superba* L. in different areas of PBR

S. No.	Village/Tribal area*	Longitude & Latitude	Status
1.	Baagra Tawa (Near Tawa Reservoir)	22° 36’ 28.46” N; 77° 59’ 17.56 E	Endangered
2.	Chhotianhoni	22° 38’ 37.17” N; 78° 21’ 14.50” E	Endangered
3.	Dokrikheda (Near Dam)	22° 38’ 45.40” N; 78° 21’ 28.57” E	Endangered
4.	Matkuli	22° 35’ 07.03” N; 78° 27’ 58.37” E	Endangered
5.	Panarpaani	22° 30’ 11.11” N; 78° 27’ 07.52” E	Endangered

***Note:** This information is being reported by us for the first time, none of the earlier investigator reported *Gloriosa* in PBR (M Oommachan, 1990; Vasudeva & Bir, 1993; Pathak, 2001; EPCO, 2001, 2002; Acharya *et al.*, 2008; Ballendra Pratap Singh & Ravi upadhyay, 2010, 2011)

Table 3. Healers consensus factor & fidelity levels of different parts of *Gloriosa superba*

S.No.	Ailments	ICF	Parts of *Gloriosa superba*	Fidelity level (%)
1.	Ulcer, piles, wounds, skin infection & related diseases	0.62	Tubers	81.82
2.	Cough, cold, insect bite & vocal abstractions	0.55	Leaves	75.43
3.	Stimulant, tonic & veterinary use	0.52	Whole plant	68.01
4.	Bodyache & labour pain	0.38	Seeds	42.80
5.	As a tonic, diuretic and for abortion purpose	0.31	Fruits	38.12
6.	Facilitate parturition & added uses (ornamental value)	0.28	Flowers	33.11
7.	Gastric discomfort, Gastric ulcer	0.9	Stems	15.01

On the other hand consensus factor among traditional healers for stimulant, tonic & veterinary use of *Gloriosa* was 0.55. The whole plant powder of *Gloriosa superba* prepared with *Terminalia belerica* seed powder & leaves powder of *Hemidesmus indicus* is used as stimulant & tonic. *Gloriosa* is also having veterinary applications used by tribals of PBR. The whole plant of *Gloriosa* with *Phyllanthus niruli* in wheat straw used as fodder for cattles, to increase the milk secretion. Through the drenching this preparation is also given to animals in liquid form. This medicinal herb is also used with normal green grass as a fodder for animals to cure bloat, foot rot. The whole plant is hanging with rope in animals places to restrict to allow the harmful animals insects/pathogens.

The consensus factor among tribals for bodyache, labour pain & use of *Gloriosa superba* as antidandruff agent was 0.38. Fermented seeds of *Gloriosa* with traditional drink used as medicine for bodyache due to exhaustion & labour pain. Tribal womens also use to clean hair with the paste prepared from ¼ tola seeds of *Gloriosa superba* in ½ tola seeds of *Terminalia belerica*, which worked as antidandruff agent. The consensus factor for the *Gloriosa* as a tonic, diuretic & for abortion purposes is 0.31 among tribals of PBR. The immature fruit paste is prepared in 50 mg of lime juice is taken as tonic & also act as diuretic. Traditional medicinal practitioners of PBR advice raw fruits

crushed squeezed & the milky extract mix with decoction of Turmeric (*Curcuma longa*) & sugar, given to females for aborting unwanted pregnancy.

The use of *Gloriosa* flower to facilitate parturition and other uses in religious ceremonies/ festivals were still another indigenous use of this species with considerable consensus among tribals/traditional healers with an ICF value of 0.28. The decoction prepared from flower juice of *Gloriosa* with the paste of immature seeds of *Solanum nigrum* L. is applied externally to facilitate parturition. Flowers are used by local & tribal people in religious ceremonies & festivals like Nagpanchaami, Basantpanchaami & Teeja in PBR. Tribals use flowers during wedding rituals & prayers (pujas) for newly constructed houses. Flowers are placed in several locations around house to create an auspicious environment. This is a popular herb having high ornamental value to provide colors in home, home gardens, nurseries & conservatories.

Last but not the least gastric discomfort & gastric ulcer is having 0.9 ICF values among TMT/tribals of PBR. The use of one teaspoon juice of stem mix with one cup of milk was taken early in the morning for a week is effective against gastric discomfort because of liver or gall bladder disorders. The dried powder of stem of *Gloriosa* & leaves of *Allium cepa* L. is taken with honey is effective against gastric ulcer.

The medicinal value of *Gloriosa superba* was enumerated in Table 6. In the following patterns (a) Botanical name (b) Family (c) Vernacular name in Hindi & regional language (d) Part used (e) Diseases/ailments (f) Mode of preparation/mode of administration (g) Location of use. A total of 55 and more ailments/diseases/ conditions have been cured by the ethno-pharmacological applications of the *Gloriosa superba* used by the Traditional medicinal practitioners & tribals in PBR.

3.4. Indigenous knowledge & diversity of *Gloriosa superba* in PBR

The correlation between the age of traditional healers and the number of uses of *Gloriosa superba* by each healer was highly significant. The statistical details are presented in Table 4. Older traditional healers mentioned more number of ethno-medicinal uses than younger healers. Cross tabulation of the results on the mean no. of uses reported by each traditional healer/tribal/informants versus locations also showed highly significance difference. However, no significant correlation was observed between the education level of traditional healers & the number of uses reported by each healer. Low diversity of *Gloriosa superba* was recorded in different villages of PBR. Highly significant negative correlation was observed between altitude where *Gloriosa* was collected and the no. of medicinal uses recorded.

Table 4. Statistical test of significance

Type of test	Variables treated	r	χ^2	df	p-value
Chi-square	Mean no. of uses Vs Villages/locations		278.401*	28	0.0001
	Gloriosa abundance Vs part used		233.128*	77	0.0001
	Gloriosa abundance Vs condition used		168.170*	13	0.0001
	Gloriosa abundance Vs Marketability		167.539*	9	0.0001
	Gloriosa abundance Vs Added values		18.344	5	0.0002
Spearman Rank Correlation	Diversity of *Gloriosa* Vs Altitude	-0.280**			0.0001
	Age of healers Vs Parts of *Gloriosa* for ethno-medicinal purpose	0.445**			0.0001
	Education level of healers Vs no. of ethno-medicinal uses of *Gloriosa*	0.056*			0.484

Significant at 0.05 level (two tailed); ** Correlation is significant at the 0.01 level (two tailed).

According to traditional healers, extensive indigenous plant use knowledge was retained and transferred orally to selected family members. Most of the traditional healer reported that modernization had no effect on the transfer of the indigenous knowledge to generations. The majority of the traditional healers also reported that there were no taboos associated with *Gloriosa superba* collection & uses in the study area.

Table 5. Detail information about the informants of the study area

S. No.	Name	Age	Sex	Occupation	Tribes	Tribal area*
1.	Mr. Kanahayya Lal	38	M	TMP (Vaidhyya)	Brahmin	Beejanwada
2.	Halkey bhaiyya	40	M	Local tribe	Gond	Chhotianhoni
3.	Basodi das	75	M	Tribal healer	Koorku	Dokrikheda
4.	Rama bai	62	F	Local tribe	Bharia	Badianhoni
5.	Ram lal	85	M	TMP	Mawasi	Chaka
6.	Udai singh	65	M	Medicine man	Gond	Pisua
7.	Nahar singh	51	M	Traditional healer	Koorku	Monhgaun
8.	Gajodhar prasad	48	M	Forest officials	Brahmin	Matkuli
9.	Karojiya	55	F	Local tribe	Bharia	Kadari

10.	Devi bai	65	F	Tribal healer	Mawasi	Binoura
11.	Taniadhan	72	M	TMP	Gond	Kherghat
12.	Panna sai	62	M	Tribal healer	Bheel	Parraspani
13	Mohan shukla ji	60	M	TMP (Vaidhyya)	Maharaj	Rorighat
14.	Deva	25	M	Local tribe	Gurjar	Kajari
15.	Chameli bai	80	F	TMP	Meena	Bori
16.	Dinesh Prajapati	45	M	Rtd. Teacher	Balhaee	Choorna
17.	Dahariya singh	50	M	Forest officials	Baghela	Tamia
18.	Kamala	38	F	Medicine women	Koorku	Rathed
19.	Prahalad umat	63	M	Local tribe	Bharia	Chimtipur
20	Ghotu ram	83	M	TMP (Vaidhyya)	Mawasi	Panarpani
21.	Vesain ji	30	M	Local tribe	Devasi	Beejanwada
22.	Pramod soni	48	M	Govt. officials &	Soni	Badkachnaar
23.	Ramsawroop ji	52		Medicine man	Sirohi	Pagara
24.	Hera bai	68	F	TMP	Gond	Neemghan
25.	Laxmi	51	F	Local tribe	Bheel	Singanama

*Note: Villages/ Tribal areas in Pachmarhi Biosphere Reserve

Table 6. Enumeration of medicinal value of *Gloriosa superba* L.

Botanical name		*Gloriosa superba* Linn.		
Family		Liliaceae		
Vernacular name		**English:** Glory lily, Flame lily; **Hindi:** Kalihari, **Sanskrit:** Agnisikha; **Tamil:** Kallappai Kilangu; **Kannada:** Akkatangiballi; **Malayalam:** Kithonni; **Telugu:** Adivi-nabhi; **Marathi:**Indai; **Gujarati:** Dudhio; **Bengali:** Bishalanguli		
Distribution in Hoshangabad Districts. of PBR		Matkuli (Longitude 22° 35' 07.03" N; Latitude 78° 27' 58.37" E), Baagra tawa (Longitude 22° 36' 28.46" N; Latitude 77° 59' 17.56 E), Chhotianhoni (Longitude 22° 38' 37.17" N; Latitude 78° 21' 14.50" E), Dokrikheda (Longitude 22° 38' 45.40" N; Latitude 78° 21' 28.57" E), Panarpaani (22° 30' 11.11" N; Latitude 78° 27' 07.52" E)		
S. No.	**Part used**	**Diseases/ Ailments**	**Mode of Administration / Mode of preparation**	**Location of use**
1..	Tuber	Scorpion's sting, Snake bite, Poisonous insect bite & Dog bite.	(i) Extract of half tuber is taken orally by the tribals as antidote in dog bite. (ii) Powder of one tuber is divided in three parts and each part is taken orally daily for three days as antidote in snake bite, scorpion bite and in poisonous insects bite. (iii) Also, rhizome fried with mushroom act as antidote on snake bite. To drive the snake away from the vicinity of the house during summer months, the rhizome is crushed to mix into with water to sprinkle around the house. (iv) Tribals of Dokrikheda tying & wrapping up the young & tender rhizome on the surface act as antidote to snake bite.	Dokrikheda
		Worms infection, Ring worms infection, Stomachache, Painful teeth (Toothache), Diarrhoea & Dysentery.	(i) One tea spoon powder is taken orally by the tribals. (ii) One tea spoon rhizome powder taken with water for one week relieves stomachache & expels gas. (iii) Rhizome decoction as a gargle relieves toothachache. (iv) Juice from boiled tubers used as gargle to kill worms in stomach on drinking. (v) The tribals of Bariam & Badkachhar use decoction of tuber, mixed in equal amount in local liquor. One cup of this mixture taken daily for 3-4 days in the morning for easy expulsion of guinea-worms. (vi) Tribals of Pisua use decoction of rhizome powder for two days, twice a day in diarrhoea, dysentery and stomachache.	Badianhooni, Chhotianhoni, Bairam, Badkachhar, Pisua
		Skin eruptions & related diseases, Parasitic skin infections, Itching, Small pox, Eczema, Scabies	(i) Specially, the tribals of Panarpaani use powder of rhizome with coco-nut oil & honey in parasitic skin infections. (ii) Paste of the tuber is applied externally to remove the skin eruptions & related diseases. (iii) The tribals of Bori & Chhotianhooni used to prepare paste from tubers of *Gloriosa* in *Brassica campestris* oil is applied locally in eczema and other skin diseases. (iv) Tribals of Chaka, Choorna and Chimtipur use juice of crushed tubers, twice daily for 2-4 weeks in skin infection & in Itching.	Panarpaani, Bori, Chhotianhooni, Chaka, Choorna, Chimtipur
		Ulcer, Piles, Chronic ulcer, Wounds, Haemorrhoids, Boils	(i) Tribals used to prepare rhizome paste, applied on the cuts & wounds. (ii) Rhizome paste with *Brassica campestris* & coco-nut oil is applied to wounds to speed up healing and prevent infections. This also applied with massage to keep hair black & healthy. (iii) Dried rhizomes are chewed to cure ulcers and bleeding piles (iv) Decoction of tubers is helpful to control piles; tuber paste is applied externally to cure boils. (v) Medicine men (Vaidhyyas) of this region used to advice people that decoction of tuber paste in cow urine applied externally to heal wounds and chronic ulcers.	Amkhedi, Badianhoni, Tamia, Kajari
		Gonorrhea, Abdominal pain, Labour pain, Abdominal disorders, Low semen	(i) In gonorrhea and in low semen tribal use 1 tola leaves of *Centella asiatica*, 1 tola leaves of *Alternanthera sessilis* & 1 tola leaves of *Gloriosa* is mixed together and taken once daily in the morning on an empty stomach for 3 days. (ii)Tuber paste mixed paste mixed with babchi (*Psoralea coryliafolia*) seeds, Black cumin (*Nigella sativa*) and purple Fleebane (*Vernonia anthelmintica*) is applied externally.	Matkuli, Singanama
		Nasal bleeding	Powdered rhizome boil with *Brassica campestris* oil externally applied to stop nasal bleeding.	Kherghat, Neemghaam
		Paralysis, rheumatism, arthritic conditions, swellings of the joints sprains & dislocations, Fractured bone, Sciatica	(i) Decoction of tuber taken with cow's milk for seven days. (ii) Crushed rhizome is tied around the fractured bone to heal. (iii) Poultice formed from crushed bulbs is applied to heal bone fractures, dislocation of wounds.	Panarpaani, Badkachhar
		Stomachache, Earache, Toothache (teeth & gum infection)	(i) Decoction of tuber orally in case of stoma-ache and toothache. (ii) Tuber juice mix with leaf juice of *Acalypha indica* (kuppi) dropped in earache. (iii) Gargle with tuber decoction with water is used to treat teeth and gum infection.	Matkuli, Pagara, Bariam
		Impotence, To increase seminal, Tonic, To induce sleep	(i)Tuber juice mixed with onion juice and lime used as paste to increase seminal and for sexual desire & also this paste is much beneficial in impotence as tonic.	Singanama, Pisua, Chaka
		Postnatal complaints, To induce abortion, Delayed puberty, Delayed child birth, Menstrual problems in women, To avoid painful delivery, Uterine contractions, Leprosy, Blood disorders, Leucorrhoea, Bleeding in females, Sterility problems in women.	(i)Roots are tied together along with a copper coin and placed in women's naval during child birth which is believed to expedite the expulsion of the placenta after child birth. (ii) Curry prepared from tuber and shoot tips is given to female during child delivery as their slipperiness is believed to help delivering child. (iii) One fourth cup of extract of tuber is taken orally by the women in leucorrhoea. (iv) Basically, Korku & Bharia tribes apply tuber extract to navel and vagina to avoid painful delivery. (v) Many traditional healer advice women to put leaves & tuber pieces of *Gloriosa* to tie in waist & lower abdomen. (vi) Some TMP advice to put *Gloriosa* tubers paste in last month of delivery & remove the paste just after the delivery in order to harmful effects.	Kadari, Kherghat, Paraspaani, Pagara, Rorighat, Neemghan
		Asthma, Leucoderma treatment, Sexual debility, Acute bronchitis.	(i) One tea spoon tuber powder is taken by the tribals twice a day for 3-4 days to cure asthma & sexual debility. (ii) Equal amount of root powder of *Dioscorea pentaphylla* is mixed with one tea spoon root powder of *Gloriosa* is taken orally twice a day for 15 days to cure asthma and acute bronchitis. (iii) Tribals used to prepare the paste of leaves of *Gloriosa* with *Berberis aristata* (Daru haldi) in equal amount & applied externally over the chest to relief from asthma. (iv) The same paste is used in the treatment of skin eruptions.	Badianhooni, Tamia, Matkuli, Chaka, Pisua
		To make arrow poison, For suicidal purpose & to commit homicide, As suicidal agent	Tuber crushed and mixes with *Azadirachtia indica* leaves & *Nerium indicum* leaves and finally mixed with Castor oil used as poison. It is also known as suicidal agent to commit suicide.	Beejanwada, Badianhoni, Pisua, Singanama, Tekapar
		For curing Boldness & General body toner	(i)Tribals and local people of PBR (specially the tribals from Beejanwada, Badianhooni & Pisua) make a paste of rhizome in Sesam oil & in coco-nut oil used for curing boldness & used as general body toner.	Choorna, Rathed, Chimtipur
		To avoid & reduce pain from harmful insects/ poisonous insects, Wound (blister) for rapid burst	(i) The extract of tuber mixed with salt, ghee, honey & *Mentha piperita* (Piperment) is applied affected area.	Rathed, Chimtipur, Bori
		Leucorrhoea	(i) Rhizome powder mixed with rice wash water and sugar candy is taken for a week in leucorrhoea	Pagara, Chaka
		Moisturizer	(i) Seed husk is applied for hair wash as moisturizer	Paraspaani

		Veterinary uses; Food poisoning, Skin infection, Foot & mouth disease. For lactation in cows.	(i) Fresh rhizomes & leaves are used to stimulate lactation in cows. (ii) Decoction of one inch tuber is given to animals through drenching tube in food poisoning. (iii) The local people and tribals and villagers use to prepare paste of tubers mixed with curd in an equal amount give to the domestic animals and cattles to become strong to work in field and in skin infection. (iv) Tuber juice cures sores in mouth and tongue of an infant and treats foot and mouth disease in cattle.	Panarpaani, Kadari, Kherghat, Chhotianhoni, Bariam
		Indigestion & altitude sickness, Urinary tract infections	(i) Raw bulbs are taken in case of indigestion and in altitude sickness. (ii) One tea spoon tuber juice taken for 15 days before breakfast cures urinary tract infections	Dokrikheda, Tekapar, Rorighat, Singanama
		Crop management; crop infected by weeds & worms	(i) Farmers of PBR use juice prepared from *Gloriosa* tubers and leaves of *Azadirachtia indica*. Sprinkling this juice over the crops for worms killing & over the poisonous weeds viz., *Parthenium*, *Lantana*.	Matkuli, Pagara, Choorna, Bariam
2.	Leaves	Pimples and skin eruptions/skin diseases, Eczema	(i) Tribals use combination of young leaves & roots are useful in treatment of skin diseases (topical application). (ii) A paste made of leaves and ginger is used externally in eczema & other skin afflictions.	Chimtipur, Rathed, Tamia
		To stop bleeding & infections	Mashed leaf petiole extract applied on the cuts and wounds to stop bleeding and infections.	Bori, Kajari
		Arthritis, Swelling of the joints, Relieve gout pain, Rheumatic swelling.	(i) One tola juice obtained from crushed leaves is massaged twice daily on the affected area for three days. (ii) Half tola leaf juice in 50 ml. of coco-nut oil applied topically relief in rheumatic pain.	Rorighat, Paraspaani, Kherghat
		To increase immunity, To cure insects bite	(i) Fresh leaves are soaked in fresh water for whole night after early morning the water used to drink to give a more immunity to cure insect bite.	Kadari, Pisua
		Head lice killing	The paste prepared from 1 tola leaves of *Gloriosa* & 1 tola leaves of *Azadirachtia indica* & one tola leaves of *Centella asiatica* is used in head lice killing.	Chaka, Tekapar
		Worms infection, Germicide	(i) 20 mg leaf juice of *Gloriosa superba*, 125 mg of juice from *Withania somnifera*, 60 mg of *Piper cubeca* & 50 mg of juice from *Rauwolfia serpentina* is mixed together. 2 tea spoon of the mixture is taken with water daily 2-3 months. This going to relief in a worms infection and used as germicide.	Singanama, Neemghan, Bariam,
		Chronic ulcers, haemorrhoids, tumor	(i) The upper surface of leaves is warmed, simmered with butter and tide locally on tumor. The tumor (cyst) will burst and healing starts. If leaves are tied from its lower surface than tumor will be suppressed inside the body. (ii) Leaf ash, when administered orally is useful in healing ulcers.	Pagara, Matkuli, Badkachhar
		Intermittent fever, Cough, Cold, Throat pain, Sinusitis & nose blockade, To improve vocal abstractions, Fungal infections	(i)Two tea spoonful of juice obtained from crushed fresh leaves is taken 2-3 times daily with warm water for 3-7 days. (ii) Chewing of dried leaves of *Gloriosa* for releasing the breathing problems and also to improve vocal abstractions. (iii) Paste of fresh leaves mixed in lime juice used for fungal infections and other skin diseases.	Panarpaani, Chootianhoni, Dokrikheda
		Impotence, nocturnal seminal emissions, Reduces burning	(i) 50 mg of leaf juice of *Gloriosa* with 20 mg of *Aloe barbadensis* leaf juice reduces burning during sexual ejaculations when administered orally. (ii) The paste prepared from one tola leaves mixed with two tola leaves of *Hemidesmus indicus*, administered orally effective in impotence & in nocturnal seminal emission.	Chimtipur, Kherghat, Badianhooni
		Liver related problem, To stop vomiting	(i) Leaf juice mixed with ginger juice (Two tea spoonful) is given to stop vomiting and also used in liver related problems.	Choorna, Singanama
		Asthma	(i) Oral administration of young leaves and roots is beneficial in asthma.	Bori, Matkuli
		Malaria, Earache	(i) ½ tola juice obtained from crushed leaves is taken orally twice daily for 4 days for 4 weeks for malaria & same extract is dropped in ear in case of earache.	Kajari, Tamia, Dokrikheda, Neemghan
		Enema & Dropsy of the Scrotum	(i) One tea spoon juice obtained from crushed leaves mix with vines is taken 2-3 times daily for one week.	Badkachhar, Bariam
		Shoe bite	Tribal of PBR use to put leaves mixed with leaves of *Hemidesmus indicus* in shoes for shoe bite	All parts of study area
		Veterinary use; Cure itching and Skin diseases in Cattles	(i) The extract of fresh leaves applied on whole body to cure itching & skin disorders in cattles & domestic animals	All parts of study area except Tamia
		General body pains, Body toner, As a sexual stimulant, As a tonic	(i) The paste prepared from *Asparagus racemosus*, *Chlorophytum borivilianum* and leaves of *Gloriosa superba* used as tonic to overcome physical weakness and act as sexual stimulant. (ii) The decoction of *Gloriosa* & *Chlorophytum borivilianum* used orally as tonic which energies in physical weakness & applied externally in general body pains.	Chhotianhooni, Matkuli, Bori, Chimtipur, Pagara, Singanama
		Cuts & wounds, Ulcer, Piles, Eczema	(i) Mixture of leaf extract of *Gloriosa* & *Pterocarpus marsupium* is applied externally to heal cuts & wounds. (ii) Leaf juice mix with black pepper is given for one month, is good remedy for piles. (iii) Fresh leaf boiled in mustard oil is applied externally to heal cuts & wounds & the same decoction is also effective in Eczema.	Matkuli, Kadari, Tekapar, Panarpaani, Neemghan
3.	Stem	Gastric discomfort, Gastric ulcers	(i) One tea spoon juice of stem mix with one cup of milk taken early in the morning for a week is effective against Gastric discomfort because of liver or gall bladder disorders. (ii) The dried powder of stem & leaves of *Allium cepa* L. is taken with honey is effective against Gastric ulcers.	Choorna, Rathed, Rorighat, Panarpaani, Pisua, Singanama
		For blood clotting in wounded region	(i) The decoction of stem with leaves of *Pedalium murex* L. applied over wounded region for blood clotting in wounded region. (ii)Decoction also applied over wounded region for relieving pain.	Paraspaani, Chhotianhooni
		Body pain, Eye irritation	(i) The boiled water prepare from stem of *Gloriosa* & *Sesamum indicum* applied externally over the whole body which relieves body pain from labour (ii) This boiled water after cooling, applied externally through cloth over the eyes in case of eye irritation.	Rathed, Chaka, Pisua, Pagara
		Cough release, Appetizing agent, Throat infection	(i) The juice of fresh stem of *Gloriosa* mix with *Zingiber officinale* taken orally used as appetizing agent. (ii) Stems cut into small fragments soak with honey, in few days later it is eatable to release out chest deposited cough to cure throat infection.	Badkachhar, Dokrikheda, Kajari
4.	Seeds	Piles	(i) The paste of seeds of *Gloriosa* and *Amorphophallus paeoniifolius* is applied locally as well as taken orally by the tribals to cure piles.	Chimtipur, Bariam, Rorighat, Tekpar
		Weakness, To increase lactation	(i) ¼ tola seed juice of *Gloriosa* and ½ tola leaf juice of *Vitex negundo* L.; one tea spoonful of this mixture taken daily in the morning in weakness and to increase lactation.	Dokrikheda, Singanama
		Boils	(i) Seeds are crushed and then mixed with powdered black pepper and ½ tola juice of leaves of *Azadirachtia indica* and applied to boils daily three times for a week.	Tamia, Pagara
		Cold and Cough	(i) Herbal healers advice; the seed paste mixed with honey is given to patient in cold and cough during sleeping times and finally throat get freeness in awake period which reduces cold and cough.	Matkuli, Choorna, Badianhooni, Pisua
		As a freshener to relieve pain	(i) The seeds of *Cuminum cimimum* & *Gloriosa superba* are soaking with cold water after one hour it is filtered. The filtrate is drunk orally to get freshness and the pain is relieved.	Panarpaani, Kadari
		Body ache, Labour pain	(i) Fermented seeds are taken with traditional drink as medicine during body ache due to exhaustion. It is also given to gastric patients.	Rathed, Choorna, Chaka,
		To cure cracked feet	(i) Tribal of PBR applied externally juice of Immature seeds over the feet to cure cracked feet.	Badianhooni, Matkuli, Bori
		Mumps, Antidandruff agent	(i) ¼ tola Paste of seeds with 50 mg lemon juice applied externally for 1 month to cure mumps. (ii) ¼ tola seed paste of *Gloriosa* with ½ tola *Terminalia belerica* seeds used for cleaning hair and worked as anti-dandruff agent.	Chimtipur, Kherghat, Paraspaani
		Stomach pain	(i) Tribals used to wrap seeds of *Gloriosa* as small pack in a cloth and tied around the neck of the children, which is believed to cure stomach pain. (ii) Seeds chewed to treat viral fever in adult.	Chhotianhooni, Neemghan
		To prevent bleeding from gums	(i) The juice of immature seeds prepared in dry paste of lemon, massaged over gums to stop bleeding.	Panarpaani, Pisua
5.	Fruit	As a tonic, Diuretic	(i) The one tola paste of immature seeds with 50 mg of juice of lime is taken as tonic as well as diuretic. (ii) Immature fruits are taken as stimulant in case of physical weakness.	Singanama, Rorighat, Chhotianhooni, Matkuli
		To stop vomiting sensation	(i) *Gloriosa* Fruits are crushed and 1 tea spoon juice mixed with fresh lemon juice & taken this mixture orally to stop vomiting sensation in adult.	Tamia,Beejanwada, Dokrikheda
		Diarrhoea, Dysentery	(i) Juice of fruits is boiled with water and concentration is further mixed with water and raw egg, treats diarrhea and dysentery.	Chaka, Bariam, Badkachhar, Tekapar
		Bronchial coughs	(i) The paste of *Gloriosa* fruits in barley water with honey is prescribed in bronchial coughs.	Singanama, Kadari
		For abortion purpose	(i) Raw fruits are crushed squeezed and the milky extract mix with decoction of *Zingiber officinale* and sugar, given to females for aborting unwanted pregnancy.	All parts of study area
		Body pain	(i) Immature fruits crushed and mixed with lime water and sugar, taken in very minute quantity during serve body pain	Bori, Pisua, Parasapaani
6.	Flower	Irregular menstruation, Painful menstruation, Burning sensation in the uterus.	(i) 125 mg of juice from *Withania somnifera*, 60 mg of *Piper cubeba*, and 50 mg of juice of *Rawalfia serpentine* is mixed together with 10 mg juice of flower of *Gloriosa superba* is taken with water twice daily for one week.	Pagara, Kherghat, Panarpaani, Dokrikheda, Chimtipur
		Toothache	Tincture of flower relieves toothache	Neemghan
		Religious ceremonies, Festivals, Ornamental purposes, For providing colors in conservatories	(i) Flowers are used by local & tribal people used in religious ceremonies & festivals like Naagpanchami & Basantpanchaami etc. in India.	All parts of study area

			(ii) Popular plant for providing colors in green houses and conservatories. Immature flowers are beautiful to be hold. (iii) Flowers are used by tribals in various religious ceremonies having high ornamental value. (iv) During wedding rituals and pujas (Prayers) for newly constructed houses, flowers are placed in several locations around the house to create an auspicious environment.	
		Paralysis	(i) One tola juice obtained from crushed flower mixed with *Brassica campestris* oil is massaged twice daily to the affected area for 2-3 days.	Dokrikheda, Badianhooni
		Facilitate parturition	(i) The decoction prepared from flower juice of *Gloriosa* with the paste of immature seeds of *Solanum nigrum* L. is applied externally to facilitate parturition.	All parts of study area
		Dog bites	(i) The paste prepared from ¼ tola flower & tuber in 1 tola juice of *Azadirachtia indica* leaves applied externally on bite area followed by 3 times washing with cold water is effective against dog bite.	Chhotianhooni, Pisua, Singanama, Paraspaani, Bariam
		Intermittent fever /Bone fever	(i)The juice of flower of *Gloriosa* with *Celastrus paniculatus* wild. (Maalkangani) given to patients suffering from bone fever. According to tribal healer such patient going to recover within seven days.	Matkuli, Chaka, Pisua, Tamia, Rorighat
		Un-sleepness	The juice of flower & immature seeds drink is used in the un-sleepness.	Kadari
		Body pain	Inflorescence is powdered and mixed with water and taken to relieve body pain.	Dokrikheda, Panarpaani
7.	Whole plant	Leucorrhoea, Mensorrhagia, Low semen count, Weakness in sexual functioning	(i) One fourth cup decoction of whole plant is taken by tribal women once in day for days to cure leucorrhoea and mensorrhagia. During this period salt chilli and chapaties made from wheat and maize is strictly prohibitive while chapaties made from "Joa" (*Hordeum vulgare*) flour is taken in the meal. (ii) One tola leaves of are mixed together, 2.5 tolas of the mixture is taken once daily in the morning on an empty stomach for 3 days.	Bariam, Kherghat, Chhotianhooni, Choorna, Tekpar, Singanama
		Stimulant & tonic	The powder prepared from whole plant of *Gloriosa superba* with *Terminallia belerica* seeds powder & with powder leaves of *Hemidesmus indicus* is used as stimulant and as tonic.	Singanama, Chimtipur, Bori
		Fever, Asthma & Cough	Whole plant is boiled and decoction is given with honey to treat fever, asthma, cough	Pisua
		Itch & ringworm, Infections of worms, Skin diseases, Earache Loss of appetite,	(i) One tea spoon decoction of whole plant with ripe fruit is taken orally & applied locally over the infected area. (ii) The juice of whole plant is mixed with castor oil applied to itch and skin diseases & more effective in earache, when dropped in ears. (iii)Decoction of whole plant is mixed in local liquor and one teaspoon of this mixture is taken daily for 3-4 days in the morning for easy expulsion of worms.	Dokrikheda, Badianhooni, Chhotianhooni
		Gonorrhea & sexually transmitted diseases	(i) Thirty grams of powder is taken in earthen pots and add some water in it, stay it overnight. This extract is taken early in the morning for 7 days in gonorrhea & sexually transmitted diseases. (ii)The paste prepared from *Pterocarpus marsupium* and this medicinal herb is applied locally to cure gonorrhea.	Panarpaani, Badkachhar, Matkuli
		Mosquito/ Insects repellent & Skin wounds treatments	(i) Tribals burn this medicinal herb with *Glycine max* (soyabean) straw to create smoke which act as mosquito/ insects repellent during rainy seasons. (ii) The ash after burning *Gloriosa* used with coconut oil to heal wounds. They believe that wounds going to heal within 7 days.	Pagara, Bariam, Neemghan
		Arrow poisons, suicidal agent & homicide	(i) Five tola leaves of *Nerium indicum*, ½ tola leaves of *Azadirectica indica* & Paste of whole plant act an arrow poison for suicidal agent.	All parts of study area
		General body toner	(i) The whole plant is crushed and mixed with Camphor in *Brassica campestris* oil massaged over whole body as general boy toner by tribal women (ii)Tribal women's massage this whole paste over the chest to tight & increase the breast size (iii) The paste of whole plant (Half cup) in 50 ml. of coco-nut oil is also used by tribal women's as body toner gel.	Singanama, Tekapar, Chaka, Pisua, Kadari
		Nostril, (For respiratory) problems	(i) This medicinal herb boiled, get decoction, inhalation of steams to relieve from nostril problem.	Kherghat, Paraspaani
		Jaundice	(i) Tribal use 1 tea spoonful paste of this medicinal herb, prepared in milk with sugar, twice a day for 15 days to cure jaundice.	Rorighat, Kajari
		As a cosmetic cream	(i)The decoction of whole plant mixed in coco-nut oil and in *Centella asiatica* powder, applied externally over the face act as a cosmetic cream.	Bori and Choorna, Tamia
		Urinary problem/ Stomachache/ Toothache	(i) 1/4 cup juice of whole plant mixed with 1 cup curd is taken twice daily for urinary problems. (ii) Powder of whole plant boiled with rice starch is used for fever & stomachache. (iii) Dried powder of whole plant mixed with black pepper, massage on gums for toothache.	Bariam, Neemghan, Paraspaani, Badkachhar
		As a tonic to increase sexual power/sexual desire, To increase semen count	(i) According to Tribals/ traditional healer of this region, one tea spoonful colloidal paste of the whole plant prepared in a half tola of *Asparagus racemosus* roots (Shatavari) & 1 tola roots of *Chlorophytum Borivilianum* (Safed mushli) is taken daily during night time to increase the sexual power/ sexual desire. (ii) 1 teaspoonful juice of whole plant with *Ludwigia prostrata* leaf juice taken orally once daily at night before sleeping for 15-28 days.	All parts of study area except Bairam, Neemghan
		To stop bleeding from wounds & cuts	(i) The whole plant is crushed and and mixed with one cup gum of *Cryptolepis buchananii* & applied externally on cuts and wounds to stop bleeding.	Pagara, Chaka
		To kill harmful weeds, Pathogenic worms of food crops.	(i) Different parts of *Gloriosa* (Kalihari) having harmful alleolepathic effects on germination and seedling vigour of many obnoxious weeds viz., *Parthenium, Lantana* & *Echinocloa crussgalli.* (ii) Farmers/Villagers and tribals of this region spray the plant extract mix with *Azadirectica indica* over the crops against detrimental effects of pathogens. (iii) In our survey it observed that the farmers/local people of (Khaperkheda, Bankhedi, Sohagpur, Babai, and Chaadon in PBR) involved in organic farming are using different parts of this medicinal plant in order to repel harmful insects & pathogenic worms. It was also observed that the tribal, farmers & local people used to store extract of this medicinal herb for a longer duration (6 months) & used as biopesticide against these harmful food crop pathogens/insects.	Matkuli, Panarpaani, Singanama, Kherghat, Badianhooni, Bori, Tamia, Neemghan
		Arthritis & Rheumatism	(i)Two teaspoon extract prepared from the flower of *Madhuca indica* and this medicinal herb is taken orally daily by the tribals early in the morning for 1 to 3 months to cure arthritis & rheumatism.	Bori, Beejanwada, Matkuli
		Nerve weakness convulsion	(i) ½ tola whole plant is mixed with ½ tola ginger, ½ tola black pepper. One teaspoon of this mixture taken twice daily for 1-2 months.	Rathed, Tamia, Pisua, Dokrikheda
		Veterinary use; To increase milk secretion, As a fodder, To cure blot & foot rot	(i) The whole plant of *Gloriosa* with *Phyllanthus niruli* in wheat straw used as fodder for cattle to increase the milk secretion. Through the drenching this preparation is also given to animals in liquid form. (ii) The whole plant is hanging with rope in animals places to restrict to allow the harmful animal insects/pathogens. (iii) This medicinal herb is also used with normal green grass as a fodder for animals to cure bloat, Foot rot	All parts of study area of PBR

Note: 1 Tola = 11.4 gram (Local measure)

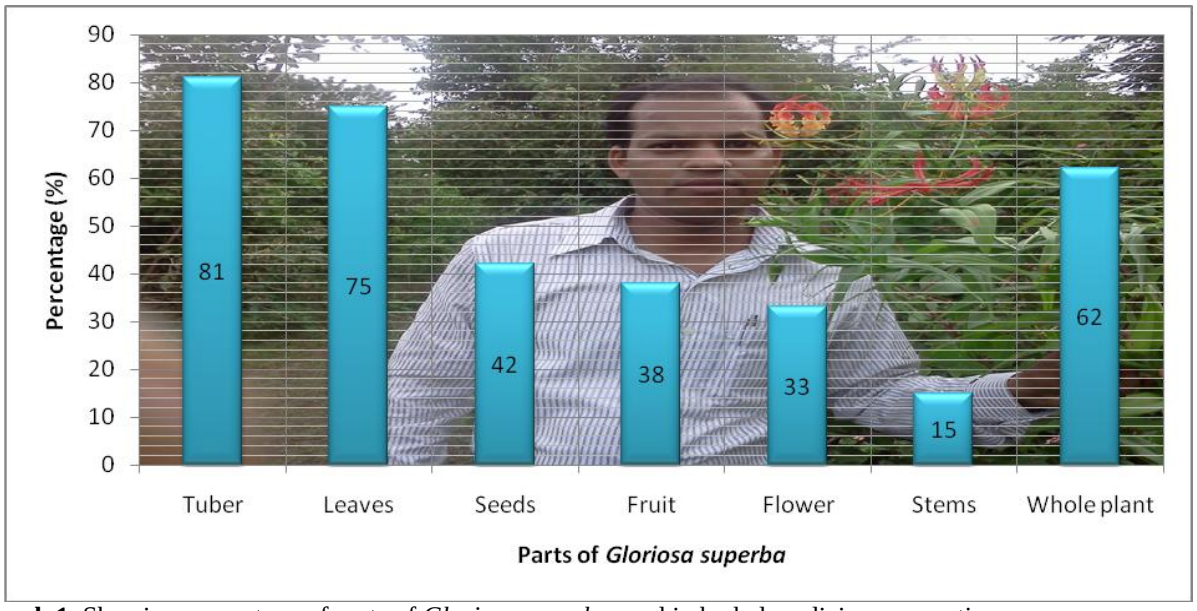
3.5. Plant parts used, methods of preparation & administration routes & applications

Traditional medicinal practitioners & tribals of PBR are using different parts (% of parts shown in Graph 1) of this medicinal herb to prepare various herbal remedies for curing various human & veterinary ailment/diseases (Table 6). The most frequent being rhizome (81%) followed by leaves (75%), whole plant (62%), seeds (42%), fruits (38%), flower (33%), powder (31%), squeezed (24%), stems (15%).

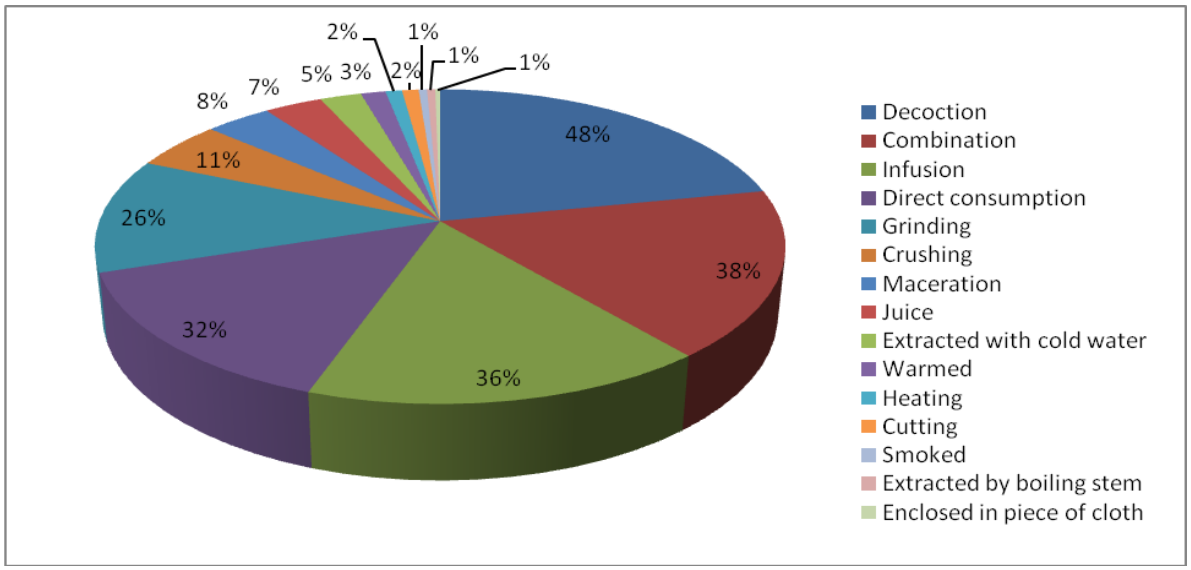
During methods of preparation of herbal remedies, in many cases (52%) a combination of methods were used. The most common method was decoction (48%), followed by combination (38%), infusion (36%), direct consumption (32%), grinding (26%), crushing (11%), maceration (8%), juice (7%), extracted with cold water (5%), warmed (3%), heating (2%), cutting (2%), smoked (1%), extracted by boiling stem (1%) & enclosed in piece of cloth (1%) (Graph 2).

58% percent of the traditional medicines were administered orally, 41% topically and only 10% through vaccine, bath, enema, eyewash & necklace (ca. 2% for each mode) (Graph 3). In general, the results seem to follow the pattern of medicinal plant uses in Africa (Nanyingi, M.O. *et al.*, 2008; http:// www.ipni.org). In various herbal remedies preparation, rhizome occupies the top position which is concordant with the results from Krog M *et al.* (2006). The study finds the used administrations are not standardized in general, but depend on the age and physical

appearance of the patient, illness & diagnosis of the diseases (Jha A *et al.*, 2004; Addis G *et al.*, 2001). Children are given small doses of medicine than considered in case of adult patients, which further depend on the type of illness and treatment realized appropriate by the local medicine man. The type of disease and level of its severity further decide the course of the frequency of treatments. In the present investigation *Gloriosa superba* is used either raw or in dried form as medicine. Especially the underground part rhizome is used in the dried form which is cut into small pieces, either makes decoction or powder. The study revealed that different parts of *Gloriosa* were used to cure different ailments/ diseases.



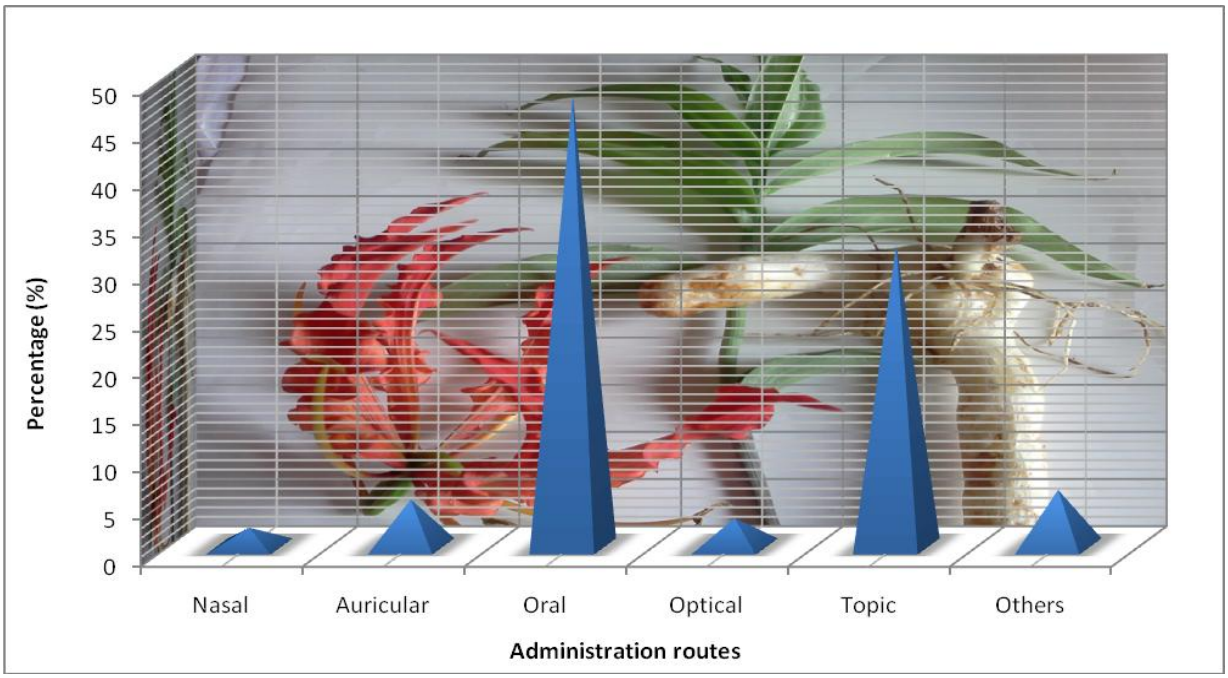
Graph 1. Showing percentage of parts of *Gloriosa superba* used in herbal medicine preparations.



Graph 2. Percentage of methods used in herbal remedies preparation from *Gloriosa superba*.

External applications as well as internal consumption are involved in the treatment of diseases. Analysis of data discovered that the administration of remedial preparations were mainly Oral (48%), followed by External application (32%), Nasal (2%), Auricular (5%), Optical (Eye wash; 3%) & Dental (4%) as major administration routes of ethno-medicinal used (Graph 3). While, other administration routes are Bath, Enema, Necklace, Vaccine which constitute 6% for traditional remedies of *Gloriosa* in treating various patients. It was observed that some of the preparations include combination of two or more species with *Gloriosa superba*. It was also observed that

different parts of *Gloriosa superba* cures same ailments/diseases or different ailments. Most of the traditional healers are not preserving or storing medicinal preparations for use at another time, while some are preserving to use. According to healers preparations were preserved to patients differently for different age groups. The dosage prescription for children was mostly lower than for adults. Dosages were estimated using teaspoons, cups, glasses, pinches & handfuls. The amounts of remedy and prescription rates were generally depend on the degree & duration of the ailments. Treatments duration varied from day to weeks and months.



Graph 3. Administration routes of herbal remedies prepared from *Gloriosa superb*

Traditional healers also indicated that their remedies were devoid of any adverse effects. However, some mild adverse effects like abdominal pain, diarrhea, inflammation, and vomiting, unconsciousness and high rate of breathing were reported for some of the remedial preparations. All most all of the informants were using antidotes for noticeable adverse effects of traditional medicine applied.

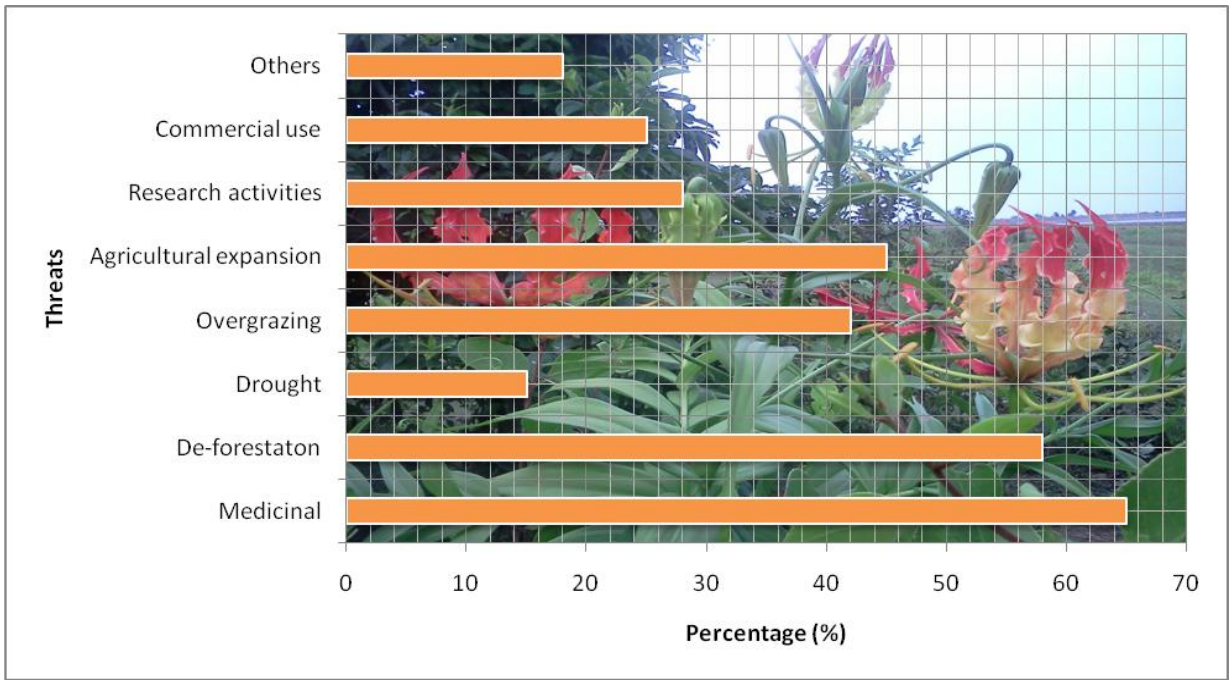
3.6. Threats to Gloriosa superba and their conservation in PBR

Highly significant difference was observed between *Gloriosa superba* parts used for medicinal purposes and the distribution of this medicinal herb in PBR region. The indigenous communities of PBR use *Gloriosa* as a source of medicine, food, fodder as well as ornamental purposes. The continuous increase in human population is one of the causes for concern in meeting the daily requirements of food and medicine as the economy & livelihood of human societies, which put further pressure on natural habitats of *Gloriosa* in PBR.

The most cited threats to *Gloriosa superba* in PBR were medicinal purposes (65%) followed by deforestation (58%), agricultural expansion (45%), overgrazing/over browsing (42%), research activities (28%), commercial use (25%). There are many other potential causes of rarity of this medicinal herb species (21%), such as habitat specificity, narrow range of distribution, land use distributions, introduction of non-natives, habitat alteration, climatic changes, heavy live stock grazing, explosion of human population, fragmentation and degradation of population, population bottleneck & genetic drift. Additionally, natural enemies (i.e. pathogens, herbivores and seed predators) could substantially limit the abundance of this medicinal herb in PBR. The percentages of various threats to *Gloriosa superba* in different villages of PBR were reported in Graph 4. Moreover, the absence of practice by tribals, local people & traditional healers to conserve or recuperate *Gloriosa* in this area was higher. In present investigation it was noted that apart from the medicinal value, *Gloriosa superba* is having added values like ornamental value & use in religious ceremony/ festivals by tribals in PBR. These activities put further pressure on the natural habitats of this medicinal herb.

In present investigation it was found that over exploitation coupled with continuous depletion of *Gloriosa* from its natural habitat not only affected supply & loss of genetic diversity but have seriously affected the livelihood of indigenous people of PBR. Moreover, harvesting for commercial use, coupled with the destructive

harvesting of underground part rhizome (Fig. 4H), low seed set, habitat specificity & slow growing nature of this herb was the crucial factors in meeting the goal of sustainability of *Gloriosa* in PBR region. The weakening of customary laws, which have regulated the use of natural resources, is among the causes of threatening the medicinal plant species. As the information collected from tribals & traditional healers, according to their beliefs, around 15 years back, the distribution of this medicinal herb was higher & found in abundance in many core & buffer areas of PBR. The over exploitation of medicinal purpose & for other indigenous uses, further more rising demand with shrinking habitats may lead to the local extinction of this medicinal herb.



Graph 4. Showing percentage of threats of *Gloriosa superba* in different villages of PBR.

4. Discussion

In the present investigation we reported *Gloriosa superba* L. in Pachmarhi wild life century (Hoshangabad Districts.) villages viz., Baagra Tawa; 5 K.M. away from Tawa Dam, Chhotianhoni , Dokrikheda, Panarpaani, Matkuli of PBR. None of the earlier investigator (M Oommachan, 1990; Vasudeva & Bir, 1993; Pathak, 2001; EPCO, 2001, 2002; Acharya *et al.,* 2008; Ballendra pratap singh & Ravi upadhyay, 2010, 2011) reported this species in Pachmarhi wild life century in Hoshangabad Districts. of PBR. Acharya *et al.,* (2008) reported *Gloriosa superba* in Patalkot area of Chhindwara District, viz., Gaildubba, Rathed, Harra-ka-char, Chimtipur, Kareyam, Jaitpur, Bijouri, Chhindi and Sidhouli in PBR. According to our present survey the status of this medicinal herb is endangered in PBR, which also supports the IUCN Red List (2001) status of this valuable herb & earlier investigation of Acharya (2008). This is also the first report on the ethno-medicinal practices of the varied tribes residing in and around Pachmarhi wild life century (Hoshangabad District.) with reference to *Gloriosa superba*, in PBR. Although, Acharya *et al.,* 2008 described the ethno-medicinal importance of *Gloriosa superba* in Patalkot area of Chhindwara District in PBR.

In the present investigation *Gloriosa superba* has been documented for their ethno-pharmacological application against various ailments/diseases used by tribals of PBR. Herbal remedies are considered the oldest form of health care known to mankind on this earth. Prior to the to the development of modern medicine, the traditional systems of medicine that have evolved over the centuries with in various communities, are still maintained as a great traditional knowledge base in herbal medicines (Vijeesh, P. and Vellumani, K., 2011). Traditionally, this treasure of knowledge has been passed on orally from generation to generation without any written document and is still retained by various indigenous groups around the world (Dwivedi, S. *et al.*, 2008). The different parts of this medicinal herb used for ethno-medicinal purposes are leaves, tuber, stem, flower, seeds (fruits), and the complete aerial parts. However, tubers were found most frequently part of *Gloriosa* used in herbal medicine preparations, as it contains purgative, cholagogue, anthelmintic, bitter, acrid, astringent and germicidal properties (Jomy C. *at al.,* 2008).

A remarkable traditional medicinal knowledge of *Gloriosa* was documented from the study area. Older traditional healers/tribals had greater knowledge and use of ethno-medicinal knowledge of *Gloriosa* than younger traditional healers. This may indicate that the indigenous medicinal knowledge of this species was declining among the younger generation, which could be attributed to the low interest of the younger generation to inherit and use ethno-medicinal knowledge. Another study by Estomba D *et al.,* (2006) also showed that medicinal plant knowledge and use increased with age when the community suffered an important erosion of ethno-medicinal plant knowledge.

The indigenous medicinal knowledge of *Gloriosa superba* and use was independent of the educational level of traditional healers. This suggests that traditional healers could inherit the knowledge and use of ethno-medicine from parents as long as they belong to a knowledgeable family member irrespective of their educational status. This finding is in agreement with the work of Yineger H *et al.,* (2007), who reported that, the proportion of healers who transferred their knowledge and those who did not was similar irrespective of their educational level. Results also revealed that many of the traditional healers/medicine men/tribals reported to transfer their knowledge and use of ethno-medicinal knowledge about *Gloriosa superba* orally to their favorite family member. Such transfer of indigenous knowledge is liable to erosion as it could vanish when knowledgeable elders die before the knowledge is transferred or resettlements of individuals or communities (Addis G *et al.,* 2002).

The agreement among traditional healers/ tribals on the ethno-medicinal use of *Gloriosa superba* was high for ulcer, piles, wounds, skin infection followed by cough, cold, insect bite, vocal abstractions, stimulant, tonic & veterinary use, bodyache & labour pain, as a tonic, diuretic and for abortion purpose, facilitate parturition & added uses (ornamental value), gastric discomfort and gastric ulcer. This may indicate that the incidence of such diseases was relatively high in the study area. But consensus among the traditional healers/ tribals was not observed for the majority of the diseases reported, which might be due to individual differences in the indigenous knowledge or the diverse backgrounds of healers/TMP/tribals.

High fidelity level was recorded on the use of different parts of *Gloriosa superba*. A *Gloriosa* tuber was having 81.82% fidelity level to treat ulcer, piles, wounds, skin infection & related diseases. Low fidelity level for other parts of *Gloriosa* against the aforementioned ailments shows that the tubers were mostly used by healers/tribals to treat the same ailments. But tribals of Aravalli hills (Rajasthan) are using the paste of this tuber for curing wounds & asthma (Katewa S.S., 2003). The roots & rhizome of this plant have been used in traditional Indian medicine for many purposes (Finnie & van Staden, 1994). Tubers frequently used by traditional healers to treat ulcer, piles, wounds, skin infection was indicated to have antibacterial, mutagenic, anthemirtic, laxative, alexiteric (Kavina *et al.,* 2011; Haroon *et al.,* 2011) properties. The significant analgesic, anti-inflammatory and wound healing actions of *Gloriosa* tubers may be attribute to the phytoconstituents present in it (Jomy C. John *et al.,* 2008). Shanmugam Hemaiswarya *et al.,* (2009) reported the antimicrobial and mutagenic properties of the root tubers of *Gloriosa* against aforementioned ailments, which validate its traditional use in the study area. This use of tubers to treat ulcer & piles in study area was also supported by the earlier finding of Evans *et al.,* (1981). Earlier works by Ramar Perumal Samy *et al.* (2008) scientifically prove the snake venom neutralizing potential of *Gloriosa* tuber used by some indigenous groups in southern Tamilnadu.

The second highest fidelity level (75%) of leaves of *Gloriosa* used by TMP/herbal healers/tribals to treat cough, cold, insect bite & vocal abstractions. Which was also indicating that leaves of this medicinal herb was used to treat many respiratory disease including common ailments such as cold & cough (Alok Jain *et al.,* 2004). Apart from the aforementioned ailments, leaves of Glory lily have more medicinal qualities, namely for curing asthma, its juice is effective against lice and also against many skin disorders (Radha AKG). Leaves were second most important part of the *Gloriosa* to cure many important respiratory disorders (cough, cold & vocal disorders) in the study area. This finding was agreement with the results of Garima *et al.,* (2008), who reported the medicinal use of *Gloriosa* leaves in Asthma treatment. Rural communities in sacred groves of Pudukottai district in Tamilnadu use *Gloriosa* leaves in headlice killing (Munisamy Anbarashan, 2011), this results is also coincides with result of the present investigation. The main phyto-constituent present in *Gloriosa* leaves is cholidonic acid (Kavina, J., 2011).

Fidelity level (68%) for whole plant as stimulant and to treat many veterinary ailments/diseases by traditional healers in study area, which is third after the tuber & leaves. Medicinally the whole plant is very much important in traditional herbal practices & to act as stimulant, tonic (Ravindra Ade & Mahendra K Rai, (2009). This finding was supported by earlier works of Ballendra pratap singh & Ravi Upadhyay (2011) who reported the veterinary uses of various ferns in PBR. *Gloriosa superba* is an

imperative medicinal plant whole plant was used in the herbal medicine preparations, which contain two important alkaloid, colchicine & colchicoside (Evans *et al.*, 1981). After whole plant, seeds fidelity level (42%) to treat bodyache & labour pain was also important. Purgative and inflammatory activities were reported from seeds of this medicinal herb (Gupta, 1990). The rural women of Garhwal Himalaya use *Gloriosa* seeds for the treatment of chronic ulcer & parasitic skin diseases (Bhagwati Uniyal & Vandana Shiva, 2005). The demand of seeds of *Gloriosa* in pharma industries at home and abroad has been rapidly increasing due to colchicine, which has diverse medicinal applications in herbal drug preparation (Sivakumar G & Krishnamurthy KV, 2000). This results are agreement with earlier findings of Nadkarni (2002), who reported that *Gloriosa* seeds are relieving rheumatic pain and as muscle relaxant. Fruit fidelity level to act as a tonic, diuretic & use for abortion purpose was 38%. Fruits of *Gloriosa* were used in different ethno-medicine preparations by tribals/herbal healers in study area is having considerable importance. A fruits of some important plant species like *Prunus domestica, Annona squamosa, Eugenia jambolna, Cuminum cyminum* has got medicinal properties described as by Siddha system of medicine in curing diseases in common (The Wealth of India Vol. 1-12). They act as quick & efficient remedies and the most easily available food, each and every fruit is known for its medicinal properties it possesses which acts as time being remedies (Siddha Materia Medica). Fidelity level (33%) for flowers to facilitate parturition & for ornamental purposes & use in religious ceremonies in study area was also important. Except miscellaneous pharmaceutical product and other therapeutic preparations, flowers are also popular for providing color in greenhouses & conservatories even immature flowers are beautiful to behold (Floridata, 2004). This result in present investigation for the use of *Gloriosa* flower as ornamental purpose also supports the claims of Floridata (2004). Apart from the colchicine & its derivatives, flowers contain luteolin, N-formyl-de-Ac-colchicine, β & γ- lumicolchicines, 3-demethyl colchicines & 2-methyl colchicine (Daniel, M., 2005). So more over in the world market they are considered as rich source of colchicines and gloriosine (Srivastava & Chandra, 1975; Prajapati *et al.*, 2003). These phyto-constituents present in flowers make this medicinal herb more effective in herbal durg formulations. Whereas low fidelity level (15%) for *Gloriosa* stem to treat gastric discomfort & gastric ulcer was observed in the study area. Best of our knowledge, none of the earlier ethno-medicinal studies describe the ethno-medicinal uses of stem of this medicinal herb. This is the first report on ethno-medicinal uses of *Gloriosa* stem in PBR.

Low diversity of *Gloriosa superba* was reported by traditional healers. The diversity of this medicinal herb decreased with increasing altitude. A study conducted by Ohlemuller R & Wilson J.B., (2000) in New Zealand also showed that altitude had by far the strongest effect on species richness. PBR provide an excellent piece of rich biodiversity. The tribal community is solely depends on the forest products, not only this, they have their own herbal health care system. In this, these peoples use various plants and their products to combat with numerous human diseases. There are few reports reciting the ethno-medicinal uses of higher plants found in this PBR area (Acharya, 2008; Ballendra pratap singh & Ravi upadhyay, 2010, 2011). However, similar reports on the use of member of lower plant group as medicine are very scars (Benjamin and Manickam, 2007). Ballendra pratap singh & Ravi Upadhyay (2010, 2011) studied the effect of ecotourism on Pachmarhi wild life sanctuary & ethno-veterinary uses of some Ferns in PBR. The author had attempted here to gain the indigenous knowledge of tribal peoples about the use of *Gloriosa superba* in medicine system of the community. There is no doubt that this medicinal herb has several medicinal properties and has been worshipped among local people as a magical herb owing to its medicinal properties (Neuwinger, 1994; Burkill, 1995). The wild medicinal plants are widely used by the local people of the Patalkot in Tamia forest of PBR for ethno-medicinal purpose (Pandey, R. K. & Shrivastava, J. L. (1993). Ethno-medicinal importance of some tuberous medicinal plants of Rajsthan and their active constituents would be helpful in treating various kinds of diseases & ailments in human (Shweta swarnkar & Katewa, S. S., 2008).

Preservation of remedies was reported by the most of the healers/TMP, while some are not preserving in the study area. Since the remedies were used mainly in their fresh forms. This might also be attributed to the less availability of *Gloriosa* in natural habitat. In North Peru, Bussmann, R. & Sharon, D. (2006) reported that some remedies were prepared using dried plant material when fresh material was not available, and when the plant material had to be transported from other regions.

Traditional healers reported that they prescribed different doses of remedies for different age groups. Preferably, more amounts of remedies were given for adults than children to treat the same disease. Though such prescription differences were practiced, still the amount prescribed by healers for both children and adults might not confirm with the

standard prescriptions in modern medical literature (Seifu, T. *et al.,* 2006).

Though the majority of healers reported that the remedies used to treat ailments had no adverse effect on patients, few healers noted the presence of some side effects in some remedies prepared from *Gloriosa superba*. A similar study conducted by (Yineger, H. *et al.,* 2007) also showed that most of the remedies reported by healers had no serious adverse effects except vomiting and temporary inflammations. The low recognition of adverse effects by traditional healers/TMP for the majority of remedy preparations coupled with the presence of antidotes in few remedies, even reported adverse effects, and might sometimes worsen the health problem of patients. The aqueous paste and decoction obtained from the leaves of *Andrographis paniculata* are also widely used as antidote in snakebite by indigenous people of Southern India (Thirumalai, T *et al.,* 2010).

According to present investigation, the *Gloriosa superba* used by healers to treat human & veterinary ailments was reported to be rare & endangered in PBR. The abundance of this medicinal herb in study area differed significantly with respect to the plant part used, plant condition used, marketability & multiple use of this species. This might be due to impact of such factors on anthropogenic pressure and the survival of this medicinal herb.

The findings of current study showed that *Gloriosa superba* was under serious threat mainly due to medicinal use & deforestation. A similar study conducted by (Anita Jain *et al.,* 2005) at Sitamata wildlife sanctuary in Chittorgarh & Udaipur district in Rajasthan also showed that medicinal use play an important role in depletion of any plant species. Another study by (Yineger, H., 2005) at Bale Mountains National park, Southeastern Ethiopia, also showed that deforestation for various purposes and agricultural expansion & intensification were the principal threats to medicinal plant species. A study by (Ji, H. *et al.,* 2005) also indicated that over exploitation and deforestation were the main causes for the depletion of medicinal plants in northwest Yunnan, China.

The study also announced that the *Gloriosa superba* is traditionally used by the various tribal communities (*Gond, Bharia, Mawasi, and Koorku*), villagers & local people of Pachmarhi Biosphere Reserve for medicinal and daily purposes for curing various ailments and diseases/conditions (Table 6). It is evident from the present study that the tribals, local people and Traditional medicinal practitioners are using this herb to cure various ailments/diseases. The *Gloriosa superba* uptake orally in the way of Decoction, Inhalation, Extraction, Colloidal paste, or applied outside body in the form of paste and powder and make with extraction. Some experienced tribals & traditional medicinal practitioners have shared their knowledge with authors about the cure of some important ailments/diseases as mentioned in (Table 6). This information on *Gloriosa superba* is being reported by us for the first none of the earlier investigators i. e. (Vasudeva & Bir, 1993; Pathak, 2001; EPCO, 2001, 2002; Acharya, 2008; Ballendra Pratap Singh & Ravi Upadhayay 2010, 2011) reported before in PBR.

The medicinal value of *Gloriosa superba* was enumerated in Table 6. In the following pattern: (a) Botanical name, (b) Family, (c) Vernacular Name in Hindi & regional Language (d) Parts used and, (e) Mode of preparation & mode of administration (f) Location of use. A total of 55 ailments/diseases /conditions have been cured by the ethno-pharmacological applications of *Gloriosa superba* used by Traditional medicinal practitioners & Tribals in PBR. Traditional medicinal practitioners & Tribals of PBR are using different parts (% of parts shown in as Graph 1) of this medicinal herb to prepare various herbal remedies to cure various veterinary & human ailments and diseases. A study by (Mohammed Rahmatullah *et al.,* 2011) at Noakhali & Feni district in Bangladesh also showed that parts of various medicinal plants are widely used to cure human & veterinary ailments.

Further the study shows that knowledge and usage of *Gloriosa superba* to prepare different herbal medicine for the treatment of various ailments/diseases among tribes of PBR is still a major part of their life & culture. These highly interesting findings require further research to justify scientifically the ethno-pharmacological claims of this medicinal herb practices in PBR. In the present paper, first hand information on ethno-medicinal uses of & records of *Gloriosa superb*a collected from the different localities of Pachmarhi Biosphere Reserve was presented. This information was also checked with available literature of Oommachan, M., 1990; Pathak, 2001; EPCO, 2001, 2002; Acharya *et al.,* 2008; Ballendra pratap singh & Ravi upadhyay, 2010, 2011.The ethno-medicinal information provided in this study is new, as they have not been reported earlier. Thus, the information presented provides enough opportunities to study active principles of *Gloriosa superba* in terms of searching the modern drugs. Although these herbal remedies and their efficacy is claimed to be high detail clinical and experimental studies are needed for better utilization of ethno-botanical knowledge.

5. Conclusion

The study indicates that, the tribes and local people of PBR have plenty of knowledge of medicinal properties of *Gloriosa superba* used to cure various

diseases. The knowledge and usage of herbal medicines prepared from this medicinal herb among tribal communities of PBR is still a major roll of their tradition. In present study we found that *Gloriosa superba* used to treat many ailments/diseases but accurate knowledge of this herb and their medicinal properties are held by only a few elder individuals. The young people are not interested to know about this miracle medicine system with reference to *Gloriosa superba*. There is a possibility of losing this wealth of knowledge in the near future, it is important for documentation of an ancient medicinal knowledge of *Gloriosa superba* for future generations. The results of the present study provide evidence that *Gloriosa superba* continue to play an important role in the healthcare system of tribal community of PBR. Elder peoples still depend on natural medicine but due to lack of interest among younger generation as well as their tendency to migrate cities for sophisticated jobs and modern life styles, so that it is very important to document the medicinal value of *Gloriosa superba* for future generations. Therefore, we recommended for further research to isolate the bio active principles from this medicinal herb responsible for the treatment of various veterinary & human ailments/diseases.

In present investigation it was observed that *Gloriosa superba* was under threat, traditional healers do not practice any conservation measures to ensure the sustainability of this valuable medicinal resource. Therefore, interventions are required to mitigate the underlying threats of this valuable medicinal herb & ensure his conservation & sustainable utilization.

6. Competing interests

The authors declare that they have no competing interests.

7. Authors' contributions

AAK, SG and AB conceptualized and designed the study. AKK collected field data, computed them for statistical analysis and contributed in primary manuscript drafting. AB, SG, SK participated in the data analysis, drafting as well as enrichment of the manuscript. All the authors took part in approving the final manuscript.

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