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Medicinal Plants Used Against Malaria: A Case Study Among *Adi* Tribe of Arunachal Pradesh

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Abstract

An outsized number of plants having medicinal properties and their folk uses have remained confined to the Northeastern region of India. The *Adi* tribal community of Pasighat was explored to unveil the indigenous herbal remedy for malaria. Twenty five antimalarial plants belonging to 9 families were reported. The analysis revealed highest fidelity level (FL) value for *Crassocephalum crepidioides* (69%), *Ricinus communis* (65%), *Allium sativum* (64 %). The percentage of respondent's knowledge (PRK) about anti-malarial plants showed *C. crepidioides* (93.24%) as the most commonly known antimalarial species within this region. It was followed by *A. sativum* (94.12%) and *Piper nigrum* (91.53%). Root (34%) is the most commonly utilized in preparation of herbal formulation. All medicine preparations are made using water as the medium and are orally administered in the form of decoction, crude extract, powder and juice. Overall analysis suggested *C. crepidioides*, *R. communis*, *A. sativum* and *P. nigrum* to be used for the development of novel, economical, effective and ecofriendly herbal formulations for management of healthcare.

Keywords: *Medicinal Plant, Malaria, Adi Tribe, Arunachal Pradesh*

Introduction

Malaria is a parasitic disease caused by *Plasmodium falciparum* and *Plasmodium vivax* (Paul et al., 2013). So far, there has been very limited improvement in the control of this disease, leading to both economic and human mortalities (Shankar et al., 2012). It is one of the major devastating problems in Northeast India and this region was also labeled as 'malaria zone' by the Center of Excellence in Disaster Management and Humanitarian Assistance (COEDMHA) and Pacific Disaster Management Information Network (PDMIN) survey team within their report during 2005.

Since immemorial times, the use and knowledge of herbal medicines was a treasured possession and prominent culture in rural India. This treasured medico-lore is then passed down over many generations chiefly by oral transmission (Katuura et al., 2007). Many tribal communities worldwide use herbs to monitor different ailments, many of which are reported to be exceptionally effective and very promising (Shankar et al., 2012). North East India represents an extremely unique ecosystem treasured with medicinal plant wealth and rich tribal assortment related with folk knowledge, including traditional medicinal practices.

A huge number of plant species has been reported to be used in ethno-phytotherapy treatment of malaria worldwide. The North Eastern region of India alone uses at least 68 plants, belonging to 33 families, to treat malaria (Shankar et al., 2012). The success of the quinine as an antimalarial drug, and the synthesis of artemisinin, the most potent antimalarial drug from plant sources, has encouraged the study of plants as antimalarial agents (Saxena et al., 2003). Although several ethno-medicinal survey of North Eastern India has been done by different researchers, the utility of thoroughgoing traditional phytotherapy by ethnic communities is still unexplored (Chakraborty et al., 2012).

Over the past two decades, there has been a tremendous increase in the use of herbal medicine; however, there is still a significant lack of research data in this field. There are over 500 species of important medicinal plants used in different tribes of Arunachal Pradesh, and still more to be added. (Kongsai et al., 2011). The tribes of Arunachal Pradesh use these medicinal plants in their local health practices. The present study was carried out to access the medicinal plant and their uses in treatment of Malaria among *Adi* tribes Pasighat of the East Siang district of Arunachal Pradesh.

Material and Methods

Study Area

East Siang district of Arunachal Pradesh is spread over an area of 4005 sq.km and it is situated between latitude 27°43' N and 29°20' N and longitude

94°42' E and 95°35' E. This district was chosen as the study areas because of high incident of malaria cases. (Average malaria cases was 2817 in 2016 -279 in 2017). The district comprised 17 primary health center (PHC/community health center, CHC) that are equipped with diagnostic and treatment facilities for malaria and serves as reporting center for malaria borne diseases control program. The total population of East Siang district is found to be increased remarkably 87,397 as reported by 2001 census to 99'214 as given by 2011 census over the period of ten years. The district is bound by upper Siang in the North, Dhemaji district of Assam in south, West Siang in the west and Dibang valley in the east. The district is mostly covered by swampy dense forest, forested terrain and perennial stream which are congenial for rapid multiplication and longevity of malaria vector. Agriculture is the primary source of economy and most of the population in the district is engaged in agricultural activities.

Data Collection

The folk medicines or ethno medicinal studies the most reliable method is one involving field survey among the Adi community inhabiting Pasighat, Arunachal Pradesh. It involves meeting with the herbalist and expert in the field for getting firsthand information. The detailed information about the plant and part used in the treatment of different ailment were collected using standard questionnaire. The informants were 100 in total that are actively using herbal medicine in daily use. Moreover, the herbal medical practitioner were also interviewed.

The interviewed population comprised of herbal medicine sellers, traditional herbal medicinal practitioners, housewives and farmers. Though individual from all age group (except children below 18 years) were to be interviewed on their knowledge of plant used in the treatment of malaria, most of the mainly to families which have a strong connection with traditional agricultural activities, majority of the respondent were females including herbs seller, farmer and housewives, some of whom were involved in farming, while the male were mostly traditional doctor and farmers.

Data Analysis

The following quantitative and qualitative ethnobotanical methods were used for data analysis. Fidelity level (FL) was calculated to know the percentage of informants claiming the use of a plant species for the same major purpose. It was calculated for reporting ailments as:

$$FL (\%) = N_p/N \times 100$$

The N_p is the total number of informants that are claiming to use a plant species to treat malaria and N is the number of informants that use the plants as a medicine to treat any disease (Alexiades, 1996).

The percentage of respondents having knowledge (PRK) regarding the use of a species (frequency of citation) in the treatment of malaria was estimated using the formula:

$$\text{PRK (\%)} = \text{Np/Nt} \times 100$$

The Np is the total number of informants that are claiming to use a plant species to treat malaria and Nt is the total number of individuals interviewed (Yaniv et al., 1987).

Results and Discussion

The present ethno-pharmacological survey result revealed a total of 25 plants species belonging to nine different families used by the local community of East Siang District Pasighat Arunachal Pradesh, for the treatment of malaria (Table 14.1). While, maximum contributions were reported from Lamiaceae (3 plants) and Asteraceae (3 plants) (Fig. 14.1). The respondent had good knowledge about malaria and could readily identify it from other fevers on the basis of locally accepted characteristics symptoms that included headache, fever, chills, joint

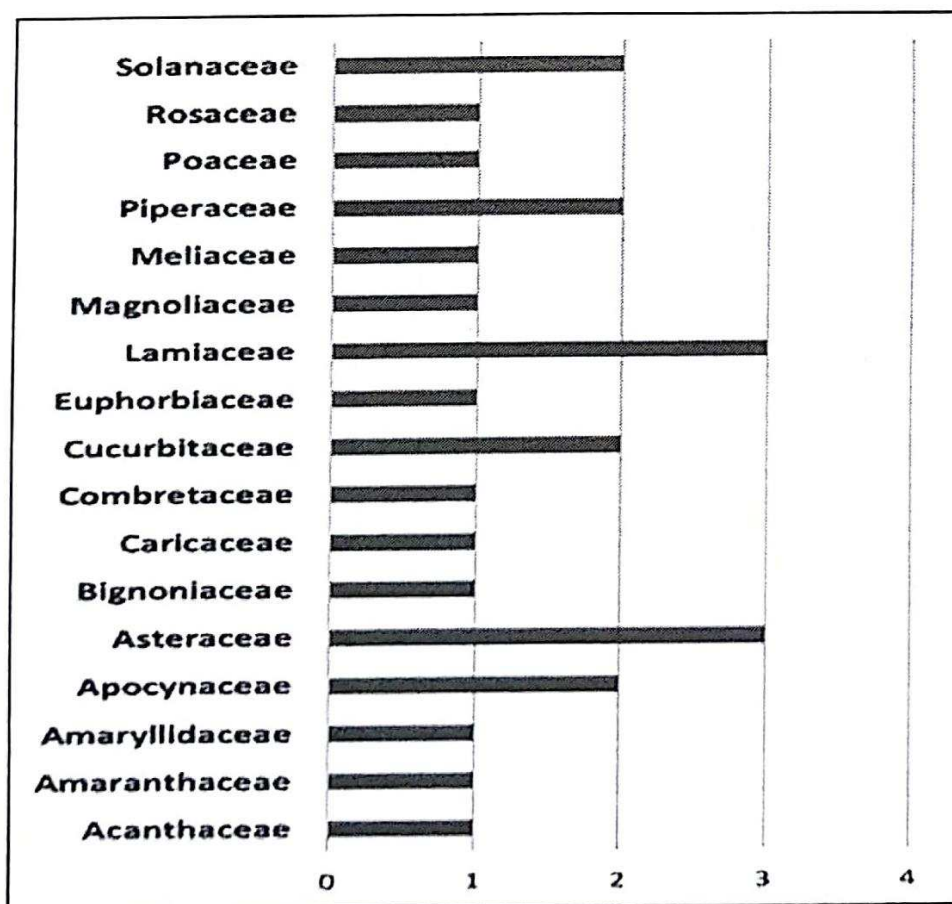


Fig. 14.1 Frequency of Families of Antimalarial Plant used by Adi Tribe of Eastern Himalayas

Table 14.1 Medicinal Plants Used to Treat Malaria Among the *Adi* tribe of Northeast India

Collection No.	Plants (Voucher No.)	Family (Habit)	Local name	Part used	Mode of preparation and administration
FP/APU/2017/01	<i>Achyranthes aspera</i> L.	Amaranthaceae (H)	Apamarga, Datiun	Rt, St	Decoction made of root and stem is taken orally thrice a day.
FP/APU/2017/02	<i>Ajuga integrifolia</i> Buch.-Ham.	Lamiaceae (H)	Niakantha	Rt	One cup of root decoction assorted with honey and administered orally after breakfast.
FP/APU/2017/03	<i>Allium sativum</i> L.	Amaryllidaceae (H)	Bekuk	Rt	Rhizomes are crushed into paste & boiled in water for 1 hour. Decoction is supplemented with sugar & taken orally twice a day
FP/APU/2017/04	<i>Alstonia scholaris</i> (L.) R. Br	Apocynaceae (T)	Chhatwan	Br	The small piece of bark is boiled in 100 ml of water for half an hour. Approximately 20 ml of filtrate is recommended orally, twice a day for 2 weeks.
FP/APU/2017/05	<i>Andrographis paniculata</i> L.	Acanthaceae (H)	Kalmegh	Wp	Plant dried and kept overnight in water, taken internally as syrup.
FP/APU/2017/06	<i>Artemisia indica</i> Willd.	Asteraceae (H)	Titepati	Rt	Low concentration root decoction is mixed with honey. It is recommended to be taken once a day for 10 days.
FP/APU/2017/07	<i>Azadirachta indica</i> A. Juss	Meliaceae (T)	Silly	Lf	Leaves are pounded into small globules (approx. 500 mg each) and mixed in 50 ml of water prior to oral administration. Globules recommended twice a day for 15 days. Sometimes the globules are also dried in sun to obtain powder.
FP/APU/2017/08	<i>Capsicum annuum</i> L.	Solanaceae (H)	Mirsi	Fr	Swallow four fruits 3 times a day for 3 days
FP/APU/2017/09	<i>Carica papaya</i> L.	Caricaceae (H)	Omrii	Wp	Powdered, juice & boiled. Taking raw fruits & as decoction
FP/APU/2017/10	<i>Catharanthus roseus</i> (L.) G. Don	Apocynaceae (S)	Belang appun	Rt	Decoction
FP/APU/2017/11	<i>Clerodendrum colebrookianum</i> L.	Lamiaceae (S)	Ongin	Lf	Leaves are boiled in water to make a decoction & taken twice a day
FP/APU/2017/12	<i>Crassocephalum crepidioides</i> (Benth) S. Moore	Asteraceae (H)	Gende	Wp	Decoction

contd...

FP/APU/2017/13	<i>Michelia champaca</i> L.	Magnoliaceae (T)	Singgam	Br	Juice is extracted from stem bark. Powdered bark or decoction is taken orally in water
FP/APU/2017/14	<i>Momordica balsamina</i> L.	Cucurbitaceae (H)	Kerala	Lf, Rt	Relish , especially during rainy season
FP/APU/2017/15	<i>Momordica foetida</i> schumach	Cucurbitaceae (H)	Baat Kerala	Lf	Relish , especially during rainy season
FP/APU/2017/16	<i>Ocimum tenuiflorum</i> L.	Lamiaceae (H)	Tulsi	Lf, Rt	Leaf & root decoction is supplemented with honey. It is recommended twice a day before meal
FP/APU/2017/17	<i>Oroxylum indicum</i> L.	Bignoniaceae (T)	Aki rokmi	Rt, St	Powdered bark is taken for 5-6 days
FP/APU/2017/18	<i>Piper longum</i> L.	Piperaceae (C)	Pipla	Fr, Rt	Few pieces of fruit and root are grounded into powdered form and boiled in a liter of water until the volume is reduced up to 500 ml. 2-3 spoons of mixture are prescribed orally before meals.
FP/APU/2017/19	<i>Piper nigrum</i> L.	Piperaceae (C)	Jhaluk	Sd	5gm of seed powder are mixed in 10ml of hot water along with honey & taken orally thrice a day
FP/APU/2017/20	<i>Prunus persica</i> L.	Rosaceae (T)	Sibeng lambeng	Rt	Decoction
FP/APU/2017/21	<i>Ricinus communis</i> L.	Euphorbiaceae (H)	Aeni	Lf	Leaf decoction supplemented with sugar is administered orally once a day.
FP/APU/2017/22	<i>Saccharum officinarum</i> L.	Poaceae (H)	Ukhu, Kuwer	St	A glass of juice extract of stem portion is taken twice a day after meals.
FP/APU/2017/23	<i>Solanum spirale</i> Roxb.	Solanaceae (S)	Bangko	Lf, St & Fr.	Hot infusion
FP/APU/2017/24	<i>Spilanthes acmella</i> L.	Asteraceae (H)	Marshang	Wp	Powdered
FP/APU/2017/25	<i>Terminalia chebula</i> Retz.	Combretaceae (T)	Harro	Fr, Br	5-10 g of fruit and bark are cut into small pieces and dissolved in 100 ml of water. The decoction is taken orally before meal.

pains, sweating and loss of appetite, weakness, lethargy, vomiting, thirst, shivering and bitter taste in the mouth. The majority of the study informant's mentioned that nearly all plant materials were affordable and accessible for the treatment of malaria. Additionally, maximum contributions were reported from herb (Fig. 14.2).

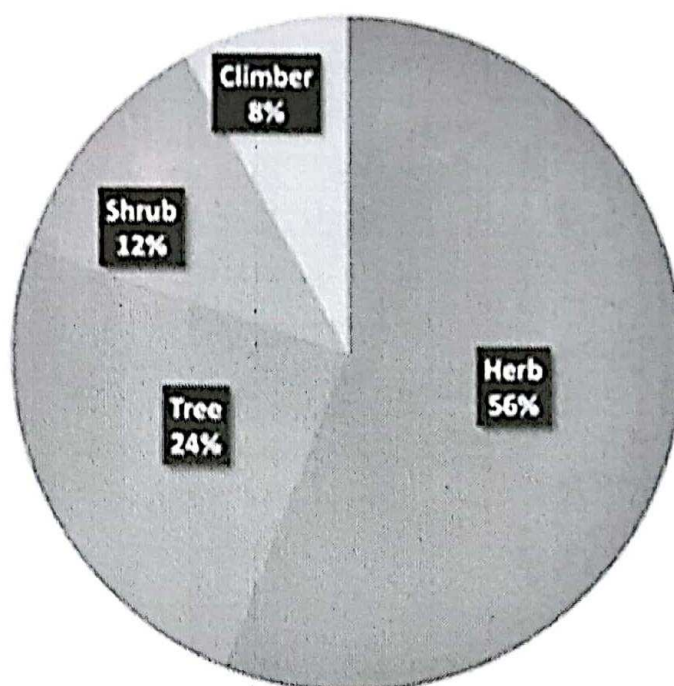


Fig.14.2. Plant Habit: Pie Chart Displaying the Life Forms of the plants used by Adi Tribe of Eastern Himalaya in Treatment of Malaria

The analysis revealed highest fidelity level (FL) value for *Crassocephalum crepidioides* (69%), *Ricinus communis* (65%), *Allium sativum* (64 %) (Table 14.2). The percentage of respondent's knowledge (PRK) about anti-malarial plants showed *Crassocephalum crepidioides* (93.24%) as the most commonly known antimalarial species within this region. It was followed by *Allium sativum* (94.12%) and *Piper nigrum* (91.53%).

Most of the herbal drugs were orally administered either as a crude plant extract or decoction in water medium supplemented with locally available honey. Root (34%) was the most commonly used plant parts (Fig 14.3). The crude extracts or decoction used for treating malaria was prepared from single plant species. The details on traditional mode of usage of each plant were depicted in Table 14.1. The fresh plant materials (10g fresh leaves/root in 1000ml, 20g, and whole plant in 1000 ml) were used for the preparation of decoction and the oral dose were variable. Maximum of the herbals drugs were administered twice a day

usually in morning and evening and the treatment continued until the patient's recovery. Different plant parts were used for making ant-malarial herbals formulation. However, root is the most prominently used parts of plant.

Table 14.2 Fidelity Level (FL) and Percentage of Respondent Knowledge (PRK) of Antimalarial Plants Used by *Adi* Community of Eastern Himalaya

Collection No.	Plants (Voucher No.)	FL%	PRK
FP/APU/2017/01	<i>Achyranthes aspera</i> L.	67.16	0.63
FP/APU/2017/02	<i>Ajuga integrifolia</i> Buch.-Ham.	93.24	0.69
FP/APU/2017/03	<i>Allium sativum</i> L.	90.28	0.65
FP/APU/2017/04	<i>Alstonia scholaris</i> (L.) R. Br.	94.12	0.64
FP/APU/2017/05	<i>Andrographis paniculata</i> L.	91.30	0.63
FP/APU/2017/06	<i>Artemisia indica</i> Willd.	88.57	0.62
FP/APU/2017/07	<i>Azadirachta indica</i> A.juss	90.77	0.59
FP/APU/2017/08	<i>Capsicum annuum</i> L.	82.09	0.55
FP/APU/2017/09	<i>Carica papaya</i> L.	91.53	0.54
FP/APU/2017/10	<i>Catharanthus roseus</i> (L.) G. Don	86.89	0.53
FP/APU/2017/11	<i>Clerodendrum colebrookianum</i> L.	86.67	0.52
FP/APU/2017/12	<i>Crassocephalum crepidioides</i> (Benth) S. Moore	84.75	0.72
FP/APU/2017/13	<i>Michelia champaca</i> L.	89.09	0.49
FP/APU/2017/14	<i>Momordica balsamina</i> L.	82.76	0.48
FP/APU/2017/15	<i>Momordica foetida</i> schumach	83.93	0.47
FP/APU/2017/16	<i>Ocimum tenuiflorum</i> L.	85.19	0.46
FP/APU/2017/17	<i>Oroxylum indicum</i> L.	71.19	0.42
FP/APU/2017/18	<i>Piper longum</i> L.	80.00	0.40
FP/APU/2017/19	<i>Piper nigrum</i> L.	68.52	0.37
FP/APU/2017/20	<i>Prunus persica</i> L.	77.78	0.35
FP/APU/2017/21	<i>Ricinus communis</i> L.	62.50	0.35
FP/APU/2017/22	<i>Saccharum officinarum</i> L.	75.56	0.34
FP/APU/2017/23	<i>Solanum spirale</i> Roxb.	73.33	0.33
FP/APU/2017/24	<i>Spilanthes acmella</i> L.	72.09	0.31
FP/APU/2017/25	<i>Terminalia chebula</i> Retz.	53.57	0.30

The traditional healing practices in *Adi* tribe of East Siang District Arunachal Pradesh were insufficiently documented and authors made effort to document. The healing practices used by *Adi*, community with detailed of methodology and dosages, to cope up with the objective authors made interaction with villager in different villages in Pasighat East Siang district of Arunachal Pradesh to know

about genuine and reliable traditional healer in the area and come in contact with 5 traditional healers who are engaged in herbal treatment. During course of interaction 20 different herbs and there were found using in various treatment.

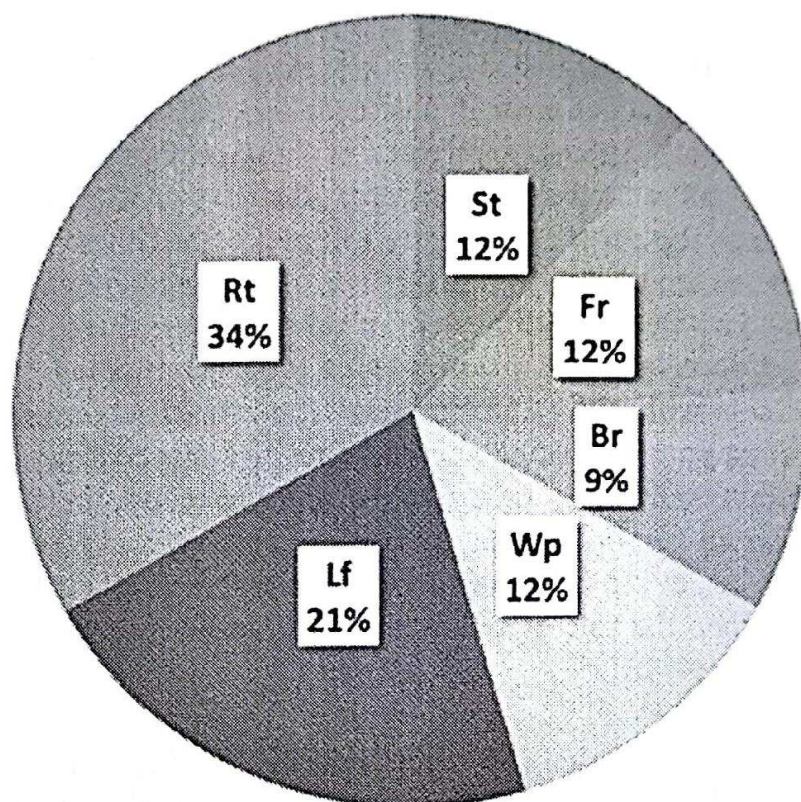


Fig. 14.3. Plant Parts Used: Pie Chart showing the Percentage of the Utilization of Different Plant Parts Against Treatment of Malaria Among the *Adi* Tribe of Eastern Himalaya

Note: Lf: leaves, Wp: whole plant, Br: bark, Fr: fruit, St: stem, Rt: root.

These herbs were belonging to herbs, shrubs and tree either from locally available sources or adapted through cultivation in their small herbal gardens. Prevalent disease are treated by the *Adi* healers are jaundice, malaria, menstrual disorder, joint pain, skin disease etc. prior to these certain other plants used by *Adi* tribes of Pasighat were described. However, most of the plant involved in traditional practice described in this paper is different and some of the plants are reported in this communication, they are for other disease.

The description of all above mentioned plant is on the basis of ethno medicinal knowledge. Plant is used by *Adi* community in different places on the basis of availability of that plant and the proper knowledge about efficacy of that plant against the particular disease. For safe uses of different medicinal plant, we need ran demised clinical trials for some of the manual therapies and further research is need to ascertain the efficacy and safety of several other practices and

medicinal plant. We have to develop a proper study about the traditional medicine and the ratio of curative measurement applied to different patients on the use of those plants. The study on such type of documentation is of great importance for North- Eastern Institute of Flock Medicine in the sense that the institute will get sufficient information on traditional healer and mode administration of medicine for treating ailments on one hand and sufficient tools for providing authenticity of drugs used in healing practice through pharmacology, phytochemistry and other pharmaceutical constants. Similarly, services of these traditional healers are of great importance to public as they are rendering their services to public in very remote places where the people are really in need of health services. These traditional healers need to be involved in all sorts of training to youngster as well as refreshing their knowledge with healers of other communities. Though they are acquiring and correlating their knowledge with established records and information available with other communities. The role of government for the existence of this system of medicine should be to give due recognition of their contribution and involvement, to delineate the specific scope, limit and role of traditional healers in public health promotion, to undertake research and development activities, to provide orientation and support to folk role healers, to monitor and strengthen the role of folk healers and to do proper follow-up.

Conclusion

The current work revealed the competency of traditional medicines in treatment of malaria. The knowledge on utilization of the medicinal plants and its properties is held by few traditional healers and commoners. So, there is a crucial need for detailed investigation of the knowledge held by tribal communities before they are lost in the debris of modernization. However, the efficacy of the reported medicinal plants needs to be evaluated further, using phytochemical and pharmacological methods. Plants with higher fidelity level and PRK should be given priority to carry out bioassay as well as toxicity studies. From the current study, it might be suggested that *Crassocephalum crepidioides*, *Ricinus communis*, *Allium sativum* and *Piper nigrum* are promising species that should be taken into account for further pharmacological studies. The results also suggest that this species may be used for the development of novel, economical and effective herbal formulations for healthcare management.

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