Chapter - IX

List of Publication / Presentation of papers related to the thesis work

Paper Published:


Paper Presented:


Studies on the Foliar Epidermal Characters of *Pogostemon benghalensis* (B) O.Ktz. (*Lamiaceae*) in Assam

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An investigation of leaf epidermal characters of *Pogostemon benghalensis* was conducted in Assam. Based on leaf-margin morphology two variants were recognized and the epidermal features, specially epidermal cells architecture, stomatal characters and trichome characters were studied by following standard method. The epidermal cells architecture and trichome complex showed no significant variation except slight differences in sizes. But, the stomatal size, stomatal frequency and stomatal index showed significant variation between the variants. The leaf-epidermal features analysis revealed intervarietal variation in one hand correlations between them on the other.

**INTRODUCTION**

The foliar epidermal characters play an important role in the field of taxonomic and phylogenetic studies of taxa (Stace, 1965). The use of quantitative microscopy of leaves in distinguishing taxa is found useful in the members of Solanaceae (Pandey, 1982). Rao and Raju (1985) made a survey on the foliar trichome of the family Euphorbiaceae.

*Pogostemon benghalensis* (*Lamiaceae*) is a semicultivated, aromatic and shrubby plant. This plant is found in Assam and other states of North-Eastern region of India. The young stem is quadrangular, leaves opposites, ovate, sub-acute, exstipulate, margin serrate and flowering occur during January to March months. The plant has several ethnomedicinal applications. A curry prepared from the tender shoot and leaves of *P. benghalensis* is eaten in dysentery, diarrhea and post-delivery repairing of female (Gogoi *et al.*, 2003). The ash of the whole plant mixed with mustard oil is used to kill worms in animal wounds. (A.K. Singh, 2003).

*P. benghalensis* of this region generally shows variation in leaf-margin morphology. The present study was conducted to determine the variation of leaf-epidermal characters of the plant in this region.

**STUDY AREA**

Assam, of the states in the North Eastern region of India with an area of 78,435 sq. Km. between 24°10' - 27°50' N latitude and 89°40' - 95°42' E longitude (Borthakur *et al.*, 1995). It is a riverian state and major rivers are Brahmaputra and its tributaries. The climate of this region is typically tropical and subtropical. Average rainfall is 2000 mm. with seasonal variation (N. Sharma 2004). The forests are generally evergreen, semi-evergreen to deciduous type.

**METHODS**

Altogether 20 samples of *Pogostemon benghalensis* were collected from different agro-climatic regions of Assam. The samples were grown under same environmental conditions. Herbarium sheets were made for identification. For authentic identification, flora and monographs have been consulted specially Flora of Assam Vol. I-V, Kanjilal *et al.* (1934-40).

On the basis of leaf-margin morphology samples were classified into two groups as Variant-I and Variant-II.

For foliar micro-morphological characters fresh leaves of both variants were fixed in FAA. Both the epidermal strips were obtained by peeling and scraping respectively. The strips were cleaned in 5% sodium hypochlorite (NaOCl) for 5 minutes, washed in water, stained in 1% saframine for 1 minute and mounted in glycerine. The slides were examined under compound microscope and micro-photographs of the epidermis were taken at (10 x 40) x magnification. The quantitative data were based on the average of 20 readings. Descriptive statistics of mean and standard deviation was calculated for all the variables. For the terminology used in this study was followed as adopted by Metcalfe and Chalk (1950).

**RESULT**

On the basis of leaf-margin morphology the samples were classified into following two groups :

- **Variant - I**: Leaf-margin biserrate (Photo-plate A),
- **Variant - II**: Leaf-margin serrate (Photo-plate B).
DISCUSSION AND CONCLUSION

The leaf epidermal morphology of the variants investigated was summarized in Table No. 1. The leaf-margin morphology of both variants is shown in photo-plate A & B. The leaf epidermal cells architecture and stomatal structure of the variants are shown in photo-plate C-F. The wall of the epidermal cells was sinusoid. It was observed that the epidermal cells architecture and trichome complex of the variants showed no significant variation except slight difference in size of epidermal cells. Likewise in both the variants stomata was diacytic type.

The stomatal size, stomatal frequency and stomatal index showed significant variation between the variants. The stomatal size observed in case of Variant-I: 2.7 ± 0.25 x 1.5 ± 0.22, whereas in case of Variant-II: 2.1 ± 0.28 x 1.1 ± 0.25. Stomatal frequency observed on the lower surface of Variant-I: 12 ± 1.3, whereas in case of Variant-II: 30 ± 1.8. Likewise, stomatal index observed on lower surface of Variant-I: 19.35 ± 1.5 and in case of Variant-II: 23 ± 0.86, but on the upper surface both the variants showed same stomatal index.

In the present study both the Variant-I and Variant-II are easily distinguishable based on gross leaf-margin morphology. That variation in gross morphology serves diagnostic purposes among angiosperm groups is well documented (Davis and Heywood, 1963; Metcalfe and Chalk, 1979). However, it is equally significant to delimit taxa with micromorphological characters in addition (Stace, 1980). Stomatal characters (viz. stomatal type, stomatal index, stomatal size, etc.) come in handy in delimiting taxa at the infraspecific level (Obute and Omotayo, 1999).

The leaf epidermal features analysis revealed intervarietal variation in one hand and correlation on the other. In conclusion, these bring out the fact that a genetic variability exists in the natural population of *Pogostemon benghalensis* in this region. Characters like stomatal size, stomatal frequency and stomatal index can be used to separate the variants in addition to leaf margin morphology. Further studies like isoenzyme technique can be conducted to unravel the genetic diversity existing in the plant.

ACKNOWLEDGEMENT

The authors are grateful to the Director, Regional Laboratory, Jorhat, Assam (India), for his keen interest in the work. The authors also express gratefulness to Dr. H. Phukon, Principal, Sibsagar Girls' College, Sivasagar, Assam, India, for this kind permission to one author (B Dutta) to undertake the investigation. The first author is also grateful to U.G.C. New Delhi, for providing financial support in the form of M.R.P.

REFERENCES


**Table 1: Summary of leaf epidermal morphology in the Variants of *Pogostemon benghalensis* studied:**

<table>
<thead>
<tr>
<th>Characters</th>
<th>Variant - I</th>
<th>Variant - II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Epidermal cells:</td>
<td>Sinuous, More sinus, Larger,</td>
<td>Sinous, More sinus, Smaller,</td>
</tr>
<tr>
<td>Shape on upper surface:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape on lower surface:</td>
<td>2.7 ± 0.25 x 1.5 ± 0.22,</td>
<td>2.1 ± 0.28 x 1.1 ± 0.25,</td>
</tr>
<tr>
<td>Size:</td>
<td>2 ± 0.2, 12 ± 1.3,</td>
<td>3 ± 0.5, 30 ± 1.8,</td>
</tr>
<tr>
<td>2. Stomata:</td>
<td>Diacytic type,</td>
<td>Diacytic type,</td>
</tr>
<tr>
<td>Stomatal size:</td>
<td>19.35 ± 1.5,</td>
<td>23 ± 0.86,</td>
</tr>
<tr>
<td>(length ± S.D. x breadth ± S.D.) μm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stomatal frequency per microscopic Field under (10x40) X magnification: (Mean ± S.D.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper surface:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower surface:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stomatal Index (S.I.) % ± S.D.:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper surface:</td>
<td>Less than one,</td>
<td>Less than one,</td>
</tr>
<tr>
<td>Lower surface:</td>
<td>19.35 ± 1.5,</td>
<td>23 ± 0.86,</td>
</tr>
<tr>
<td>3. Trichomes:</td>
<td>Multi-cellular, simple, consist of single row of cells; basal cell is granular;</td>
<td>Multi-cellular, simple, consist of single row of cells; basal cell is granular;</td>
</tr>
</tbody>
</table>
Plate A. Variant-I
Plate B. Variant-II
Plate C. Variant-I: Lower epidermis
Plate D. Variant-II: Lower epidermis
Plate E. Variant-I: Upper epidermis
Plate F. Variant-II: Upper epidermis

Photo-Plate A & B : Leaf morphology of Pogostemon benghalensis, Variant - I & II,
Photo-Plate C-F: Micro-photographic views of leaf-epidermis of Pogostemon benghalensis, Variant - I & II.


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PLANT FOLK MEDICINES PRACTICED AMONG THE DEORIES OF ASSAM

B. DUTTA¹, S.C. NATH² AND C.M. SARMAH³

INTRODUCTION

Assam, a state in the North Eastern region of India, with a geographical area of 78,438 sq. km. (88°02′ - 96°01′ E latitude and 24°55′ - 28°0′ N longitudes) with hills and plains, is known for its rich floras and diverse forests and vegetations due to its unique topography, climate and altitude patterns (Mao, A.A and Hynniewta, T.M. 2000). This region of India is also a homeland of people belonging to more than 100 ethnic tribes and sub-tribes (Dutta and Nath, 1998) which are still maintaining their tribal solidarities with a primitive state of economic life.

Deories, of mongoloid race, are one of such ethnic tribes of Assam. They belong to four different sub-groups viz. Dibongia, Tengapaniya, Borgonja and Patargonga (Goswami, 1991) and represent about 12% of total tribal population of the state (Kar, 2001). Presently they are found in the upper Brahmaputra valley regions of Assam and are predominant in the districts like Dibrugarh, Dhemaji, Jorhat, Lakhimpur, Tinsukia, Sivasagar and Sunitpur. Although they are today an integral part of Assamese culture, Deories still maintain their tribal solidarities with their own dialects, food habits, socio-religious taboos and myths.

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They generally live in isolated pockets and remote areas. Traditional agriculture is the sole mean of livelihood of these people and they depend mostly on their surrounding plant communities for their day to day needs including medicaments. Thus, there is ample scope to explore medicinal plants and plant products used by these people for the treatment of disease remedies. Ethnobotanic studies conducted both area and plant wise have by far, reported a large number of folklore medicinal plants from Assam (Baruah et al., 2006; Baruah and Kalita, 2007; Borthakur et al., 2004; Deka et al., 2006; Dutta and Nath, 1999; Nath & Begum, 1998). However, such information so far reported from the Deories of the region are known to be very limited (Dutta & Nath, 1998), although some general observations of these people have been covered by some studies (Gogoi & Das, 2003; Islam, 2000; Purkayasha, et al., 2005, 2007). Thus, an ethno-medico-botanical study has been conducted with an objective of tapping and documentation of the medicinal plantlores of these people residing in the state.

The study area comprises Dibrugarh, Sivasagar and Jorhat districts of Assam between 94°00′ – 95°44′ E latitude and 25°8′ – 27°3′ N longitude. The area includes the famous river-island Majuli and reserve forest of Panidihing. The climate of the study area is typically tropical to sub-tropical; the average rainfall, temperature and humidity being 200mm, 24°C and 89.3% respectively. The forests are generally evergreen, semi-evergreen to deciduous types.

METHODOLOGY

The study was performed during 2006 – 2007 covering 16 villages under 5 administrative circles, viz. Demow, Moran, Dibrugarh, Jorhat and Majuli. Information were collected during field trips on the basis of interviews with the village heads, medicine-men, women folks and elderly persons whose empirical knowledges were widely respected. The plant specimens were identified consulting the floras (Islam, 1989; Kanjilal et al., 1934-1940; Hooker, 1872-1897) and herbarium specimens at the Herbaria of the Botanical Survey of India, Shillong and the North East Institute of Science and Technology, Jorhat, Assam, India. The information were compared with those of some important Indian medicinal plant literatures (Chopra et al., 1956, 1968; Dastur, 1951; Kirtikar and Basu, 1951). All the specimens collected were deposited in the Herbarium of North East Institute of Science & Technology, Jorhat – 785006, Assam, India.

RESULTS

The folk uses of identified plants are arranged disease-wise in alphabetical order. For each species, the botanical name, followed (under parentheses) by family name and vernacular name is provided. Parts of plants used, purpose and mode of administrations are also given.

A. Burn

1. Whole plant of Impatiens balsamina L. (Balsaminaceae, Dem-deuka), in he form of paste is applied locally.
2. Tender shoots and leaves of Lygodium japonicum Thumb. (Schizaceae, Kopow-lota) are ground to paste and applied as poultice
B. Cuts and Wounds

1. Paste of tender shoots of *Abutilon indicum* (L.) Sweet. (Malvaceae, Saun-borial) is applied locally for healing wound.

2. Leaf paste of *Eupatorium odoratum* Linn. (Asteraceae, Garmany-bon) is applied locally to stop bleeding and healing wounds.

3. Paste of the leaves of *Mikania scandens* Willd. (Asteraceae, Prem-lota) is applied locally for healing wounds.

C. Diabetes

1. Infusion (100ml) of the leaves of *Azadirachta indica* A. Juss. (Meliaceae, Mohaneem) is given orally once a day for two months.

2. Infusion (100ml) of the bark of *Syzygium cumini* (L.) Skeels. (Myrtaceae, Jamuk) is given orally once a day on empty stomach for three months.

3. Infusion (100ml) of the stem of *Tinospora cordifolia* (Willd.) Miers. (Menispermaceae, Haguni-lota) is given orally once in every alternate day for three months.

D. Diarrhoea and Dysentery

1. Infusion (100ml) of the leaves of *Houttuynia cordata* Thumb. (Piperaceae, Masandari) is given orally twice a day for five days in dysentery.

2. Juice of the rhizome of *Kaempferia angustifolia* Rose. (Zingiberaceae, Guti-dorab) mixed with honey is applied on the nipple of mother’s breast in infant diarrhea.

3. Decoction (50ml) of the rhizome of *Lasia spinosa* (L.) Thw. (Araceae, Seng-mora) is given orally twice a day for five days in dysentery.

4. Infusion (5ml) of the leaves of *Mentha viridis* L. (Lamiaceae, Poduna) is given orally to children in diarrhea.

5. Decoction prepared by boiling the tender leaves of *Psidium guajava* L. (Myrtaceae, Madhuri) is given orally in dysentery.

6. Infusion (100ml) of the leaves of *Vitis repens* Lamk. (Vitaceae, Nol-tenga) is given orally twice a day for three days in dysentery.

E. Fever

1. Tender shoots of *Cissampelos pareira* L. (Menispermaceae, Tubuki-lota) in the form of paste is given to children to apply on forehead in high fever.

2. Infusion (100ml) of the leaves (50gm) of *Citrus aurantiifolia* (Christm.) Swingle (Rutaceae, Kazi-nemu) mixed with powder of a few fruits of *Piper nigrum* L. (Piperaceae, Jaluk) is given orally twice a day for 3-4 days in pneumonia.

3. Stem infusion (100ml) of *Hedyotis scandens* Roxb. (Rubiaceae, Hed-bhedali) mixed with little amount of the fruit powder of *Piper nigrum* L. (Piperaceae, Jaluk) is given orally twice a day for three days.

4. Infusion (50-100ml) of the rhizome of *Kaempferia rotundata* L. (Zingiberaceae, Harbajoy) is given orally once a day in pneumonia.

5. Infusion (50-100ml) of the tubers (25gm) of *Kyllinga brevifolia* Rottb. (Cyperaceae, Keya-bon) and the roots (25gm) of *Abutilon indicum* L. (Malvaceae, Saun-borial)
mixed with the powder of a few fruits of *Piper nigrum* L. (Piperaceae, Jaluk) is given orally twice a day for three days in pneumonia.

6. Infusion (100ml) of the roots (50gm) of *Leucas piuknetii* (Roth.) Spreng. (Lamiaceae, Dron-bon) mixed with little amount of the fruit powder of *Piper nigrum* L. (Piperaceae, Jaluk) is given orally twice a day for five days in pneumonia.

7. Infusion (50-100ml) of the leaves of *Nyctanthes arbor tristris* L. (Oleaceae, Sewaliphul) is given orally once a day.

8. Infusion (100ml) of fleshy roots (50gm) of *Pandanus odorus* Salish. (Pandanaceae, Keya-kothal) mixed with a few fruits powder of *Piper nigrum* L. (Piperaceae, Jaluk) is given orally once a day for five days in pneumonia.

9. Infusion (50-100ml) of the roots of *Solanum spinale* Roxb. (Solanaceae, Titakuchi) mixed with a pinch of fruit powder of *Piper nigrum* L. (Piperaceae, Jaluk) is given orally once a day.

**F. Fracture of Bone**

1. Stem of *Cissus quadrangularis* L. (Vitaceae, Har-jura-lota) is made into paste and applied externally in the form of plaster.

2. Tender shoots of *Hemidesmus indicus* R. Br. (Asclepiadaceae, Gakhiri-lota) are made into paste and applied in the form of plaster.

3. Leaves of *Paederia foetida* L. (Rubiaceae, Bhedai-lota), tender shoots of *Pouzolzia indica* Gaud. (Urticaceae, Borali-bokua) and leaves of *Plantago major* Forsk. (Plantaginaceae, Shinga-bon) taken together in equal amounts are made into paste and applied locally in the form of plaster.

**G. Gynecological Disorder**

1. Infusion (50ml) of the whole plants (50gm) of *Cynodon dactylon* Pers. (Poaceae, Dubori-bon) is given orally to women once a day for five days in painful menstrual bleeding.

2. Infusion (100ml) made from the leaves of *Hedyotis lineata* Roxb. (Rubiaceae, Kasidoria) mixed with the powder of a few fruits of *Piper nigrum* L. (Piperaceae, Jaluk) is given orally to women for five days in severe menstrual bleeding.

3. Infusion (100ml) of the bark (50gm) of *Litsea polyantha* Juss. (Laureaceae, Sualu) and the tender leaves (10Nos.) of *Bambusa balooa* Roxb. (Poaceae, Voluka-bah) mixed with milk (100ml) and sugar-candy is prescribed orally in severe bleeding of women during menstruation.

4. Infusion (100ml) of the tender leaves (50gm) of *Phlogoganthus thrysiflorus* (Roxb.) Nees (Acanthaceae, Tita-phul) and the tender shoots (50gm) of *Calamus rotang* L. (Arecaecae, Jati-bet) is given orally to women for three days in abdominal pain during menstruation.

5. Decoction (100ml) of the whole plants (100gm) of *Scoparia dulcis* (Scrophulariaceae, Ceni-bon) is given orally to women twice a day for three days during bleeding at two to three months pregnancy period.
6. Tender leaves (100gm) of *Smilax macrophylla* Roxb. (Smilacaceae. Tikoni-boru) are roasted with cow-ghee and given orally to women on empty stomach for seven days in irregular menstruation.

7. Infusion (100ml) prepared from about 100gm roots of *Abelmoschus moschatus* Medic. (Malvaceae, Garkhia-korai) mixed with the powder of a few fruits of *Syzygium aromaticum* (L) Mers.(Myrtaceae, Long) is given orally once a day for a week in leucorrhea.

8. A decoction (100ml) prepared from the stem of *Tinospora cordifolia* (Willed.) Miers. (Menispermaceae, Haguuliota), the root of *Abutilon indicum* (L) Sweet (Malvaceae, Saun-borial) and the whole plant of *Achyranthes aspera* L. (Amaranthaceae, Holh-bon) taken together in equal amounts, mixed with milk (100ml) and sugar candy is given orally twice a day in leucorrhea.

H. Piles

1. Paste of the roots of *Curculigo orchioides* Gaertn. (Amaryllidaceae, Bon-tamuli) is applied locally in bleeding piles.

I. Respiratory Disorder

1. Infusion (50ml) of the roots of *Abrus precatorius* L. (Papilionaceae, Latu-moni) is given orally twice a day for three days in cough.

2. A garland is made from the rhizome of *Acorus calamus* L. (Araceae, Boch) and prescribed to children to put around the neck in cold and cough.

3. An infusion of the tender leaves of *Adhatoda zeylanica* Medik. (Acanthaceae, Boga-bahek) mixed with a small amount of honey is given orally twice a day for five days in cough.

J. Skin Disease

1. Leaf-paste of *Desmodium latifolium* D.C. (Papilionaceae, Bioni-habota) is applied locally in skin-wart (pyoderma).

2. Paste of the rhizome of *Kaempferia galanga* L. (Zingiberaceae, Gathion) is applied locally in scabies.

3. Root of *Plumbago zeylanica* L. (Plumbaginaceae, Agyachit) is made into paste and applied locally in scabies.

4. Dry root powder of *Rauwolfa serpentina* Benth. (Apocynaceae, Arogson) mixed with coconut-oil is applied externally in scabies.

5. A paste of the fruit-pulp of *Sapindus mukorossi* Gaertn. (Sapindaceae, Monisal) prepared with an equal amount of the roots of *Clerodendron viscosum* Vent. (Verbenaceae, Dhopat-tita), is applied locally for seven days in alopecia.

K. Stomach Disorder

1. Infusion (100ml) of the roots of *Croton caudatus* Geisel. (Euphorbiaceae, Lota-mahudi) prepared with the seed cotyledons of *Mangifera indica* L. (Anacardiaceae, Aam) is given orally once a day for a week in gastritis.

2. Infusion the leaves of *Elephantopus scaber* Linn. (Asteraceae, Uvuta-bon) is given orally in stomachache due to indigestion.
3. An infusion (50ml) of the whole plants of *Hedyotis lineata* Roxb. (Rubiaceae, Kasi-doria) mixed with an equal amount of cow milk is given orally in stomachache due to indigestion.

4. Rhizomes of *Zingiber zerumbet* (L.) Sm. (Zingiberaceae, Borahu) are eaten raw in stomachache.

**L. Throat Problems**

1. Paste of the roots of *Aristolochia roxburghiana* L. (Aristolochiaceae, Nila-kantha) is kept inside the mouth for few minutes in tonsillitis.

2. Dry leaves of *Carica papaya* L. (Caricaceae, Amita) and *Zizyphus jujube* Lam. (Rhamnaceae, Bogori) are made in the form of cigarette and the smoke is inhaled in tonsillitis.

3. About 100ml decoction prepared by boiling the leaves of *Rubus moluccans* L. (Rosaceae, Jetuli-poka) and *Psidium guajava* L. (Myrtaceae, Modhuri) together in equal amounts, is given orally as tea for three days in cholitis of tongue.

4. Decoction of the inflorescences of *Spilanthes paniculata* DC. (Asteraceae, Huhoni) is given for gargling in pharyngitis.

5. Infusion (50ml) of the roots of *Zanthoxylum nitidum* (Roxb) DC. (Rutaceae, Tezmuri) is prescribed orally in pharyngitis.

**M. Urinary Problem**

1. Infusion (100ml) of the tuberous roots of *Asparagus racemosus* Willd. (Liliaceae, Satamul) mixed with sugar-candy is given orally to clear urinary obstruction.

2. Infusion (100ml) prepared from the rhizome of *Costus speciosus* (Koen.) Smith. (Zingiberaceae, Jam-lakhuti) mixed with milk (100ml) is given orally on empty stomach for three days in burning sensation of the urinary tract.

3. Decoction (100ml) prepared by boiling the roots (50gm) of *Smilax macrophylla* Roxb. (Liliaceae, Tikoni-borua) mixed with cow milk (100ml) is given orally for three days in burning sensation of the urinary tract.

**DISCUSSION**

As a result of an intensive effort to tape and document the folk-lore medicinal uses of plants among the Deories, an ethnic group residing in Assam, 62 species covering 54 prescriptions and 13 broad diseases are reported. Most drugs are prepared using different plants in combination where *Piper nigrum* is a common ingredient. Many of the information reported in this communication, particularly for *Kaempferia angustifolia*, *K. rotunda*, *Litsea polyantha*, *Lasia spinosa*, *Lygodium japonicum* are found to be new to the literature of Indian Medicinal Plants (Chopra et al., 1956, 1968; Dastur, 1951; Kirtikar and Basu, 1951). Likewise, uses of plant species like *Asparagus racemosus*, *Abutilon indicum*, *Adhatoda zeylanica*, *Cissus quadrangularis*, *Costus speciosus*, *Paeonia foetida* and *Smilax macrophylla* are found to be similar to the uses by other tribes in North-East India (Borthakur and Goswami, 1995, Dutta and Nath, 1999, Hajra and Baishya, 1981) indicating authenticity of their usefulness in the treated diseases.

Plant species used are generally obtained from their wild sources. However, some plant species, *viz.* *Abrus precatorius*, *Adhatoda zeylanica*, *Asparagus racemosus*, *Azadirachta indica*,
PLANT FOLK MEDICINES PRACTISED AMONG THE DEORIES OF ASSAM

Paederia foetida, Cissus quadrangularis, Costus speciosus, Kaempferia angustifolia, K. galang, K. rotunda, Paederia foetida, Philogacanthus thrysiflorus, Plumbago zeylanica, Rauwolfia serpentina, Solanum spirale are observed to be grown by many people in their homestead gardens, indicating conservation strategies of drug plant by indigenous people.

Most drugs are utilized in the fresh state, as poultice, decoction, infusion, poultice etc. The methods and periods of administration are also widely different. Detailed studies on these folk drugs are deserved to identify the bioactive compounds and investigate their pharmacological effects.

REFERENCES


Studies on Diversity of *Costus speciosus* (Koenig.) Sm. (Zingiberaceae) in Assam

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An investigation on the diversity of *Costus speciosus* (Koenig.) Sm. was conducted in Assam. Based on general superficial morphology, three morphological variants were recognized and general morphological characters specially stem size and height, leaf-morphology and leaf-epidermal features were studied by following standard methods. The general morphology as well as leaf-epidermal features analysis revealed there is an inter-varietal variation in *Costus speciosus* (Koenig.) Sm. in Assam.

**Keywords:** *Costus speciosus*, Zingiberaceae.

**INTRODUCTION**

Assam, a state in the North-Eastern region of India, with a geographical area of 78,438 sq. km (88° 25' - 96° 0' E latitude and 24° 5' - 26° 0' N longitudes) with hills and plains, is known for its rich flora and diverse forests and vegetation due to its unique topography, climate and altitude patterns. Average rainfall is 2000 mm with seasonal variation (Sharma, 2004). The mean maximum temperature is 37°C in summer and 12°C in winter. The forests are generally evergreen, semi-evergreen to deciduous type.

The foliar epidermal characters play an important role in the field of taxonomic and phylogenetic studies of taxa (Stace, 1965). Beside the gross morphological characters the leaf epidermal characters variation is an important character which can successfully be used to determine the inter-varieties relationship of different plants. The use of quantitative microscopy of leaves in distinguishing taxa is found useful in the members of Solanaceae (Pandey, 1982). Rao and Raju (1985) made a survey on the foliar trichome of the family Euphorbiaceae.

*Costus speciosus* (Koenig.) Sm. belongs to family Zingiberaceae. It is known as ‘Jamliakhuti’ locally, ‘Keukand’ in Hindi and ‘Kusha’ in Sanskrit (Mandal et al., 2007). It is a succulent perennial herb, growing up to 3.5 m high and having an erect stem. The plant possesses horizontal rhizomatous rootstock. It has an extensive distribution in India and is more common in Bengal, North Eastern Region and humid tropics of South India. It thrives well on moist soil and shady localities under mixed deciduous forests. In Assam this plant is found in wild as well as in semi-cultivated state. The plant propagates vegetative means through rhizomes or seeds dispersed by birds. Rhizome is the plant part used as medicine. In Ayurveda the rhizomes were ascribed to be bitter, astringent, cooling, purgative, anti-helmintic, expectorant and tonic (Mandal et al., 2007). Ethno-medicinally in Assam the plant is used in curing ailments like burning sensation of urinary tract, constipation, fever, inflammation, worm infection and disease like asthma, bronchitis and anaemia (Borthakur & Goswami, 1995). The plant has attained importance recently as a source of disogenin, a precursor in synthesis of steroidal hormones from the rhizome (Sarin et al., 1974).

*Costus speciosus* (Koenig.) Sm. of this region generally shows variation in general morphology. The present study was conducted to determine the diversity of the species in this region.

**METHODOLOGY**

Altogether 20 samples of *Costus speciosus* (Koenig.) Sm. were collected from different agro-climatic regions of Assam. The samples were grown under same environmental conditions. Herbarium sheets were made for identification. For authentic identification local flora and monographs have been consulted.

On the basis of stem characters and leaf morphology samples were classified into three groups as Variant-I, Variant-II and Variant-III.

For foliar micro-morphological characters fresh leaves of all three variants were fixed in 5% formaldehyde solution. Both the epidermal strips were obtained by peeling and scraping respectively. The strips were cleaned in 5% sodium hypochlorite (NaOCl) for 5 minutes, washed in water, stained in 1% safranine for 1 minute and mounted in glycerine. The slides were examined under compound microscope and micro-photographs of the epidermis were taken at (10 x 40) X magnification. The quantitative data were based on the average
of 10 readings. Descriptive statistics of mean and standard deviation was calculated for all the variables. For the terminology used in this study was followed as adopted by Metcalfe and Chalk (1950).

RESULTS

On the basis length and diameter of stem the samples were classified into following three groups (Photograph - A):
Variant-I: Stem long, white in colour and diameter thick,
Variant-II: Stem long, red in colour and diameter thin,
Variant-III: Stem short, white in colour and diameter thick,

DISCUSSION AND CONCLUSION

The general morphology and leaf micro-morphology of the variants investigated are summarized in Table No. 1 and Table No. 2 respectively. In case of stem length, the variants have shown significant variation (3.5 m, 3 m and 2 m for VR-I, VR-II and VR-III respectively). Likewise, for stem diameter, Variant-II is thin (7 cm), Variant-I and Variant-II are thick (10 cm). In case of leaves, the Variant-I and Variant-III have shown same general structure; but, in case of Variant-II leaves are linear.

Type of stomata is parateratracytic and epidermal cells are polygonal for all the variants investigated. It is observed that the epidermal cells architecture and trichome complex of the variants have shown no significant variation except slight difference in size of epidermal cells.

The stomatal size, stomatal frequency and stomatal index showed significant variation among the variation. The stomatal size observed in case of variant-I: 2.7 ± .25 x 1.5 ± .22, Variant-II: 2.1 ± .28 x 1.1 ± .25, and Variant-III: 2.7 ± .25 x 1.5 ± .15. Stomatal frequency observed on the lower surface of Variant-I: 6 ± 1.3, Variant-II: 8 ± 1.8 and Variant-III: 6 ± 1.5. Likewise, stomatal index observed on lower surface of Variant-I: 11.35 ± 1.5, Variant-II: 6.80 ± .89, and Variant-III: 15.70 ± 1.3; but on the upper surface all the variants showed more or less same stomatal index.

In the present study the three variants are easily distinguishable based on gross morphology characters. That variation in gross morphology serves diagnostic purposes among angiosperm groups is well documented (Davis and Heywood, 1963; Metcalfe and Chalk, 1979). However, it is equally significant to delimit taxa with micro morphological characters in addition (Stace, 1980). Stomatal characters (viz. stomatal type, stomatal index, stomatal size, etc.) come in handy in delimiting taxa at the infraspecific level (Obute and Omctayo, 1996).

The general morphology and leaf epidermal features analysis revealed inter-varietal variation in one hand and correlation on the other. In conclusion, these bring out the fact that a genetic variability exists in the natural population of Costus speciosus (Koenig.) Sm. in this region. Characters like stomatal size, stomatal frequency and stomatal index can be used to separate the variants in addition to gross morphology. Further studies like isoenzyme technique and karyotype analysis can be conducted to unravel the genetic diversity existing in the plant.

ACKNOWLEDGEMENT

The authors are grateful to the Director, Regional Research Laboratory, Jorhat, Assam, India, for his keen interest in the work. The authors also express gratefulness to Dr. (Mr. Ms.) H. Phukan, Principal, Sibsagar Girls’ College,

(A) Photograph of Costus speciosus (Koenig.) Sm., three varieties: VR-I, VR-II & VR-III
Table 1: Summary of general morphology in the Variants of *Costus speciosus* (Koenig.) Sm. studied.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Variant-I</th>
<th>Variant-II</th>
<th>Variant-III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stem:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length (average):</td>
<td>3.5 m</td>
<td>3 m</td>
<td>2 m</td>
</tr>
<tr>
<td>Diameter (average):</td>
<td>10 cm</td>
<td>7 cm</td>
<td>10 cm</td>
</tr>
<tr>
<td>Colour:</td>
<td>White</td>
<td>Red</td>
<td>White</td>
</tr>
<tr>
<td><strong>Leaf:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape:</td>
<td>Lancelate</td>
<td>Lancelate</td>
<td>Lancelate</td>
</tr>
<tr>
<td>Size (length x breadth):</td>
<td>41 x 15.8 cm</td>
<td>29 x 7 cm</td>
<td>34 x 11 cm</td>
</tr>
</tbody>
</table>

Table 2: Summary of leaf epidermal morphology in the Variants of *Costus speciosus* (Koenig.) Sm. studied.

<table>
<thead>
<tr>
<th>Characters</th>
<th>Variant-I</th>
<th>Variant-II</th>
<th>Variant-III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Epidermal cells structure:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape on upper surface:</td>
<td>Polygonal</td>
<td>Polygonal</td>
<td>Polygonal</td>
</tr>
<tr>
<td>Shape on lower surface:</td>
<td>Polygonal</td>
<td>Polygonal</td>
<td>Polygonal</td>
</tr>
<tr>
<td><strong>2. Stomata:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stomatal size:</td>
<td>2.7 ± 25 x 1.5 ±.22,</td>
<td>2.1 ± 28 x 1.1 ±.25,</td>
<td>2.7 ± 25 x 1.5 ±.15</td>
</tr>
<tr>
<td>Stomatal frequency:</td>
<td>1 ± .02, (EC=35)</td>
<td>2 ± .05, (EC=67)</td>
<td>1 ± .03, (EC=30)</td>
</tr>
<tr>
<td>Field under (10 x 10)X magnification:</td>
<td>6 ± 1.3, (EC=40)</td>
<td>8 ± 1.8, (EC=68)</td>
<td>6 ± 1.5, (EC=32)</td>
</tr>
<tr>
<td>Stomatal type:</td>
<td>Paratetracytic,</td>
<td>Paratetracytic,</td>
<td>Paratetracytic,</td>
</tr>
<tr>
<td>Stomatal Index (S.I.) ± S.D:</td>
<td>2.70 ± 1.23,</td>
<td>2.80 ± .25,</td>
<td>7.60 ± 1.15,</td>
</tr>
<tr>
<td>Field under (10 x 10)X magnification:</td>
<td>11.35 ± 1.5,</td>
<td>6.80 ± .89,</td>
<td>15.70 ± 1.3</td>
</tr>
</tbody>
</table>

NB: S.D. = Standard Deviation, EC = Epidermal Cell No

Sivasagar, Assam, India for his/her kind permission to one author (Bimal Dutta) to undertake the investigation. The first author is also grateful to U. G. C., New Delhi for providing financial support in the form of MRP.

**REFERENCES**


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(B) Leaf-epidermal Structures Microphotographs under High Power magnification: VR-I, VR-II & VR-III, Costus speciosus (Koenig) Sm.


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