SUMMARY AND OUTLOOK
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The present topic entitled "A comprehensive investigation into some selected species of *Sida* Linn. with reference to their substitutes and adulterants" was undertaken to find out the difference, if any, in the original, substitutes and adulterants as far as the medicinal properties are concerned. Four sites were selected viz. Karimughal, Kolenchery, Kothamangalam and Aluva to identify the natural abundance of the selected taxa. Ecological and phytographical studies of the selected taxa, viz. *Sida rhombifolia* Linn., *Sida rhombifolia* Linn. ssp. *retusa* Linn., *Sida acuta* Burm.f., *Sida cordifolia* Linn., *Sida veronicaefolia* Lamk., *Abutilon indicum* G.Don., *Urena lobata* Linn., *Urena simiata* Linn., *Triumfetta rhomboidea* Jacq. and *Grewia microcos* Linn. were done.

'Bala' root consists of roots of various species of *Sida* Linn. viz. *S. cordifolia*, *S. rhombifolia*, *S. acuta*, *S. veronicaefolia*, *S. retusa* and species of *Urena* Linn., *Grewia* Linn., *Pavonia* Cav. and *Abutilon* Gaertn. In Kerala *S. retusa* is used for medicinal purpose traditionally. The drug is an astringent tonic, cures rheumatism, pulmonary tuberculosis, facial paralysis, sciatica,
leucorrhoea, spermatorrhoea and gonorrhoea. It is one of the ingredients of famous medicine ‘Kshirabala’.

*S. cordifolia* showed dominance in Aluva and Karimughal, *S. rhombifolia* showed dominance in Kolenchery and *S. acuta* showed dominance in Kothamangalam. The dominance of *S. retusa* was lesser in all sites. Low density and low frequency revealed the threats of extinction of this particular taxon.

Leaf morphology of the selected taxa showed considerable variation between and among the taxa. Leaf apex is retuse in *S. retusa*, however, in the other taxa it is mucronate, acute or emarginate. Leaf margin is entire in *G. microcos* while in the other genera it is crenate or serrate. In *G. microcos* marginal ultimate venation is looped, however, in the others it is incomplete. Major venation pattern is semicraspedodromous and the nature of primary vein is moderate in *G. microcos*.

The mericarp morphology of the investigated taxa showed significant difference. In *Sida* species, *Urena* and *Abutilon* the fruit is a schizocarp; however, in *T. rhomboidea* it is capsule and globose. In *G. microcos* fruit is a drupe.

The viability of embryo was only 30% in *S. veronicaefolia*, the seed output and reproductive capacity being 129.10 and 7.75 respectively. This is sufficient for the spread of the species within the ecosystem. The highest reproductive capacity was observed in *S. cordifolia* denoting the abundance of the particular species within the ecosystem. It was observed that the embryo viability
and reproductive capacity of \textit{S. retusa} was 60\% and 18.18 respectively. Therefore the over exploitation of this medicinal herb may lead to its extinction. Text fig.1, 5, 11 and 16 emphasized this contention.

The germination percentage of all the taxa was low under laboratory conditions. Hard seed coat is the main reason for seed dormancy. Weathering may be the reason for reducing the hardness of seed coat under natural environmental conditions or that much percentage is found to be sufficient for the adequate distribution of the taxa within the ecosystem. The seed output was very high in almost all the taxa.

Of the ten taxa studied, \textit{S. rhombifolia}, \textit{S. cordifolia}, \textit{S. acuta}, \textit{A. indicum} and \textit{T. rhomboidea} showed more or less uniform length of guard cells. As the length of guard cells of \textit{G. microcos} Linn. was only 34.036 \textmu m, it is entirely different from all the other nine genera. The other four genera, \textit{S. veronicaefolia}, \textit{S. retusa}, \textit{U. sinuata} and \textit{U. lobata} had more or less similar length of guard cells.

Least value of Stomatal Index was observed in \textit{A. indicum} and the highest in \textit{T. rhomboidea}. \textit{T. rhomboidea} which is an adulterant differs significantly from the other nine taxa. Similarly \textit{G. microcos}, \textit{U. sinuata} and \textit{S. rhombifolia} differ significantly from the other taxa with regard to Stomatal Index.

Along with other epidermal characters, palisade ratio is found to be a diagnostic feature for recognizing the adulterant. In the case of \textit{S. retusa} the
palisade ratio seems to be significantly different. The lowest value of palisade ratio was observed in *S. cordifolia*.

Evidences from present studies provide more information regarding adulterants and substitutes to a certain extent. Further studies such as DNA sequencing may provide more evidence to solve the problem of exploiting the substitutes, eliminating the adulterants and keeping the quality better.

*S. retusa*, *U. lobata* and *T. rhomboidea* were subjected to chemical analysis for determining the biological properties particularly in terms of antioxidant property. It was found that despite minor differences, the said properties show almost near corroboration between and among the three species tested for. These plants may have the same property. However, their activity profile in the human body system may be different. The reappearance of similar properties in the distantly related plants is a frequent phenomenon in the plant kingdom. Instead of treating them as adulterants we have to consider them as related resources. Hence it is apparent that both *Urena lobata* the popular substitute, and *Triumfetta rhomboidea* which is an adulterant may be used in the Ayurvedic formulations in place of *Sida retusa*. However, detailed phytochemical studies will be rewarding.

The foregoing account reveals the imperative necessity of the sustainable management of our herbal resources, especially in the context of the present day world economic order with liberalization and globalization. Urgent attention has to be given for the conservation, cultivation and commercialization of medicinal
plants and their substitutes. A deeper study will reveal much more about the dry
plant materials where the identity is not determined satisfactorily. Further,
emphasis must be given to the application of ethnopharmacology in the medicinal
agriculture and herbal agrobusiness. Kerala being a state with its rich herbal
genetic resources, new discoveries, technological advancement and explorations
will provide remedies for our increasing needs of care and cure.
KEY TO THE TAXA

1a Leaf margin crenate or serrate, major venation pattern actinodromous, marginal ultimate venation incomplete, nature of primary vein weak, palisade ratio below 12.................................................................2

1b Leaf margin entire, major venation pattern semicraspedodromous, marginal ultimate venation looped, nature of primary vein moderate, palisade ratio above 12................................. G. microcos L.

2a Fruit schizocarp........................................................................................................3

2b Fruit capsule, globose with hooks, Stomatal Index above 29, leaf texture coriaceous, three lobed leaf, base rounded.......................T. rhomboidea Jacq.

3a. Mericarp 5-10, seeds one in each mericarp.........................................................4

3b Mericarp 15-20, Seeds more than one in each mericarp. Texture of the leaf coriaceous, Stomatal Index below 18, palisade ratio below 6......................A. indicum G.Don.

4a Mericarp with barbed bristles..................................................................................5

4b Mericarp with out barbed bristles............................................................................6

5a. Palisade ratio above 5, Stomatal Index below 26, leaf margin crenate.................................U. lobata L

5b Palisade ratio below 5, Stomatal Index above 26, leaf margin serrate with sinuous..............................U. sinuata L.

6a Palisade ratio above 7.............................................................................................7

6b Palisade ratio below 7.............................................................................................9

7a Leaf apex retuse, texture chartaceous, pedicels as long as petioles. Stomatal Index above 23.......................S. retusa L

7b Leaf apex mucronate or acute, pedicels longer than petioles. Stomatal Index below 23..........................8

8a. Leaf apex mucronate, base obtuse, texture chartaceous, erect woody undershrub, palisade ratio above 10...........S. rhombifolia L.
8b  Leaf apex acute, base cordate, texture coriaceous, procumbent with long slender and trailing stem, palisade ratio below 10........................................... S. veronicaefolia Lamk.

9a  Stomatal Index above 25, palisade ratio above 5 leaf apex acute, leaf base obtuse, texture chartaceous, stipule of each pair different...............................S. acuta Burm.f.

9b  Stomatal Index below 18, palisade ratio below 4, leaf apex emarginate, base cordate, texture coriaceous, stipules of each pair not different...............................S. cordifolia L.