

Fossil leaves resembling modern *Terminalia chebula* Retzius from the Lower Siwalik sediments of Arunachal Pradesh, India

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Abstract

Two fossil leaf compressions, collected from the Lower Siwalik sediments (Middle to Upper Miocene) exposed at road-cutting section of Pinjoli area, West Kameng district, Arunachal Pradesh are described. The fossil leaves resemble closely with those of the modern taxon *Terminalia chebula* Retzius (Combretaceae) and has been assigned to *Terminalia palaeochebula* Awasthi & Prasad, earlier reported from Assam and Nepal.

The present day distribution of the modern equivalent of the fossils clearly indicates the prevalence of tropical deciduous forests in the area during the deposition of sediments.

Keywords: Leaf compressions, *Terminalia palaeochebula*, Lower Siwalik, Arunachal Pradesh

INTRODUCTION

Among the Siwalik sectors of India, Eastern Himalayan region especially Arunachal Pradesh has received little attention for palaeobotanical study in relation to phytostratigraphy and palaeoenvironment. The leaf fossils earlier recorded from the Siwalik Sectors of Arunachal sub-Himalaya are dominated by angiosperms comparable to modern day *Zizyphus mauritiana* (Rhamnaceae), *Dioscorea oppositifolia* (Dioscoreaceae), *Syzygium* sp. (Myrtaceae) and *Terminalia catappa* (Combretaceae), *Fissistigma bicolor* (Anonaceae), *Calophyllum* sp. (Clusiaceae), *Dipterocarpus* sp., *Shorea ridleyana*, *S. bracteolata* (Dipterocarpaceae), *Amesoneuron* sp. (Arecaceae) *Bambusa* sp. (Poaceae) (Joshi *et al.* 2003; Singh & Prakash 1980; Joshi & Mehrotra 2007).

The Siwalik sediments in the foothill regions of Arunachal Pradesh are represented by Dafla Formation (Lower Siwalik), Subansiri Formation (Middle Siwalik) and Kimin Formation (Upper Siwalik). Lower Siwalik sediments, from where the present fossil specimens were collected, are characterized by interbanded medium to fine grained sandstone, shale and siltstone. In the present article, compressed leaves comparable to modern day *Terminalia chebula* Retzius (Combretaceae) is described for the first time from the Siwalik strata of Arunachal Pradesh and Eastern Himalaya as well.

MATERIAL AND METHODS

The leaf compressions described in this paper have been collected from Lower Siwalik sediments of East Pinjoli, West Kameng district. The fossil specimens were studied morphologically with the help of hand lens and incident light microscope (Axioskop 40). The fossil leaves have been compared with the herbarium specimens kept at CUH, Department of Botany, University of Calcutta and the modern leaves collected from the forest in the vicinity of the fossil locality. The terminologies adopted by Dilcher (1974) have been followed for description of leaf compressions. The fossil specimens (PPL/ CU/ B₅₂₋₅₃) are preserved in the repository of Palaeobotany-Palynology section, Department of Botany, University of Calcutta.



PLATE I: 1. *Terminalia palaeochebula* Awasthi & Prasad fossil leaf showing shape, size and venation pattern; 2. *Terminalia chebula* Retzius modern leaf showing similar shape, size and venation pattern; 3. Part of *T. palaeochebula* fossil leaf showing details of venation; 4. Part of *T. chebula* leaf showing similar details of venation.

SYSTEMATIC DESCRIPTION

Combretaceae

Terminalia L.

Terminalia palaeochebula Awasthi & Prasad (1990)

(Plate- 1, Figures 1-4)

Leaves simple; lamina symmetric, elliptic; 8 – 9 cm x 4.7 – 6.3 cm, entire, apex totally broken, base symmetric, normal, obtuse, coriaceous; petiole normal, seemingly 0.3 cm long; venation pinnate, eucamptodromous; primary vein (1^o) single, prominent, almost straight; secondary veins (2^o) about 6 – 7 pairs visible with acute angle of divergence nearly 60^o, uniformly curved, sub-opposite to alternate, 0.9 to 1.5 cm apart; tertiary veins (3^o) fine, angle of origin RR, almost percurrent, branched, oblique in relation to midvein, straight, branched, alternate to opposite, closely placed; further details of tertiary veins and cuticular features not clearly visible.

Specimen nos.: B₅₂₋₅₃

Locality: Pinjoli area, West Kameng District, Arunachal Pradesh

Horizon: Lower Siwalik (Middle-Upper Miocene), Dafla Formation

DISCUSSION

The main diagnostic features of the present fossil leaves such as elliptic shape, obtuse base, entire margin, eucamptodromous venation, acute angle of divergence of secondary veins; RR (right-right angle of 3^o origin), branched, percurrent, closely placed tertiaries indicate a closer affinity with the leaves of extant genus *Terminalia* L. (Combretaceae). Thorough examination of the available species of this genus establishes a close similarity of the fossil with the leaves of modern *Terminalia chebula* Retzius.

So far, three fossil leaves resembling the extant taxon *Terminalia chebula* Retzius have been described from the Tertiary sediments of India and Nepal. These are *Terminalia palaeochebula* (Awasthi & Prasad 1990) from the Siwalik sediments of Surai Khola, Nepal, *Terminalia kachchhensis* from the Tertiary sediments of Kachchh (Lakhanpal *et al* 1984) and *Terminalia palaeochebula* Awasthi and Prasad from the coal bearing Oligocene sediments exposed in Makum coalfield, Assam (Awasthi & Mehrotra 1995). The present fossil leaf comes closest with the described fossil leaves from Nepal in shape, size, margin and venation pattern and hence they are described under the same species *Terminalia palaeochebula* Awasthi & Prasad.

The modern comparable taxon, *Terminalia chebula* Retzius is a small to large tropical deciduous tree found in sub-Himalayan tracts from Punjab eastward ascending to about 1,600 m, common in Bengal, Assam, Garo Hills, Western Ghats and Srilanka (Brandis 1971).

Plant fossils are often used as reliable indicators of the past climates and forest types especially those are strikingly similar to modern taxa. The present-day distribution of the modern equivalent taxon of the fossils indicates the tropical deciduous forest in the area during sedimentation in contrast to the present day tropical semi evergreen forest type. Foliar physiognomic characters such as absence of drip tip, large leaf size and entire margin also suggest that the climate was tropical, humid with heavy rainfall in this part of Eastern Himalaya during Lower Siwalik (Middle-Upper Miocene) sedimentation.

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