

Fossil fruit of *Hibiscus esculentus* L. of family Malvaceae from Deccan Intertrappean cherts of India

V.D. KAPGATE

Department of Botany, D.D. Bhojar Arts & Science College, Mouda (M.S.) 441 104, India.
Email: vdkapgate65@gmail.com

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ABSTRACT

Kapgate VD 2017. Fossil fruit of *Hibiscus esculentus* L. of family Malvaceae from Deccan Intertrappean cherts of India. The Palaeobotanist 66(2): 211–216.

Malvaceous fossil fruit belonging to the genus *Hibiscus esculentus* L. is reported from the Deccan Intertrappean exposures of Mohgaonkalan, Chhindwara District, Madhya Pradesh, India. The fruit is characterized by pentalocular, pentangular, pentaribbed dicot five seeded capsule with loculicidal dehiscence.

Key-words—Dicot, Fruit, *Hibiscus esculentus*, Malvaceae, Deccan Intertrappean, Mohgaonkalan, Madhya Pradesh.

भारत की दक्कन अंतःट्रेपी चर्टों से प्राप्त माल्वेसी कुटुंब की *हिबिस्कस एसकुलेंटस* एल. का जीवाश्म फल
वी.डी. कपटे

सारांश

भारत में मध्य प्रदेश के छिंदवाड़ा जिले के मोहगांवकलां की दक्कन अंतःट्रेपी अनावरणों से *हिबिस्कस एसकुलेंटस* एल. का माल्वेसीयस जीवाश्म फल प्राप्त हुआ है। फल कोष्ठ—विदारक स्फुटन सहित पंचकोष्ठक, पंचकोणी, पंच अस्थिमय द्वि पांच बीज उगे आवरण से अभिलक्षित है।

सूचक शब्द— द्वि, फल, *हिबिस्कस एसकुलेंटस*, माल्वेसी, दक्कन अंतःट्रेपी, मोहगांवकलां, मध्य प्रदेश।

INTRODUCTION

THERE are limited records of petrified capsular fruits from the Mohgaonkalan Assemblage. So far, only multilocular capsular fruits are reported from these beds. They are *Enigmocarpon parijai* (Sahni, 1943; Mahabale & Deshpande, 1957; Patil, 1972; Biradar & Mahabale, 1976); *Indocarpa intertrappea* (Jain, 1964); *I. mahabalei* (Nambudiri, 1969); *Harrisocarpon sahanii* (Chitaley & Nambudiri, 1973); *Sahnioocarpon harrissii* (Chitaley & Patil, 1973; Patil & Karekar, 1986; Tidwell & Chitaley, 1987); *Daberaocarpon gerhardii* (Chitaley & Sheikh, 1973); *Deccanocarpon arnoldii* (Paradkar, 1975); *Enigmocarpon sahnii* (Chitaley & Kate, 1977); *Euphorbiocarpon drypeticides* (Mehrotra et al., 1984); *Phyllanthocarpon singhpurii* (Mistri & Kapgate, 1920); *Duabungocarpon deccanii* (Kadoo &

Kolhe, 2002); *Chitaleocarpon intertrappea* (Kapgate et al., 2006); *Laganiocarpon deccanensis* (Kokate et al., 2013b); *Lagerstroemiocarpon harrissii* (Kokate et al., 2013a). The present fruit is distinct in having pentalocular, pentangular, pentaribbed and single seed in each locule.

MATERIAL AND METHOD

Mentioned fruit is investigated by serial sectioning by peels of chert collected from the Deccan Intertrappean exposures of central India and compared anatomically with those of extant genera. The transverse, longitudinal and oblique sections of the samples were prepared. All the sections of these specimens are stored in the Museum of the Department of Botany, Institute of Science, Nagpur, Maharashtra.

SYSTEMATICS

Order—MALVALES

Family—MALVACEAE

Genus—HIBISCOCARPON gen. nov.

Hibiscocarpum mohgaonensis sp. nov.

(Pl. 1.1–5; Pl. 2.1–6; Fig. 1.1–12)

Description—Petrified, pentalocular, five ribbed, five seeded, dehiscent dicot capsular fruit is spherical to pentangular (Pl. 1.1–4). Transversely exposed fruit is 950 μm to 1.33 mm in size (Pl. 1.1–2; Fig. 1.1, 3) while oblique longitudinally exposed fruit is 850 μm to 1 mm in size (Pl. 1.4; Fig. 1.4). It is slightly narrow at apical and basal end and broad in the middle (Pl. 1.1–4; Fig. 1.1–4) region. It has broad, well preserved pericarp. Five septa meeting in the central region reflect on the pentalocular nature (Pl. 1.1, 2; Fig. 1.2) of the fruit. Each locule contains well developed seeds. Each locule has one seed with embryo with two cotyledons, plumule and radicle (Pl. 1.3, Pl. 2.2, 6). Fruit wall breaks at locular side showing loculicidal dehiscence (Pl. 2.2, 5; Fig. 1.1, 3)

Pericarp—Pericarp is smooth and spongy without any outgrowths. It is slightly wavy showing ridges and furrow at some places, pentangular in nature with line of dehiscence (Pl. 1.1–3). Pericarp is 150–190 μm thick against each chamber. Pericarp has three zones—outer and inner are thin, 25 to 30 μm thick, consist of 2 to 3 layers of compact parenchymatous cells, while middle zone is broad, 80 to 150 μm thick, multilayered having bigger parenchymatous cells which are loosely arranged with wide air spaces. Each cell is 10 to 15 μm in size. Few canals and vascular bundles are present in the middle zone (Pl. 2.4; Fig. 1.9). Pericarp shows five segment splits at angular region of locule indicating loculicidal dehiscence (Pl. 1.2; Pl. 2.2, 5; Fig. 1.1, 3).

Locule—The fruit is with five locules. Each locule is separated by five septa. Locules are rounded to triangular in transverse section (Pl. 1.1, 2) while elongated to oval in vertical section (Pl. 1.3, 4). Locules are 275 to 350 μm and 25 to 50 μm in size (Pl. 1.1, 2, 3). Each locule consists of single seed (Pl. 1.1–4; Pl. 2.2, 6).

Septa—Five septa divide the fruit into five locules. They are 200 to 350 μm long and 50 to 70 μm broad (Pl. 1.1, 2). Septa join the central axis at angular region. Tissue of septa is similar to the pericarp (Pl. 2.1). Single vascular bundle is present at the junction of central axis and septa (Pl. 2.3; Fig. 1.7). Vascular bundle shows spiral to reticulate thickening (Fig. 1.11, 12).

Seed—Single seed present in each locule. Seeds are free from wall of the fruit. Each chamber has vertically placed single seed which is considerably large in size. It is

oval to spherical in shape, 200 to 250 μm in diameter (Pl. 1.1, 4; Pl. 2.2). Seed coat is thin, membranous, 30 to 40 μm thick. Testa is thick made up of 2 to 3 layered compact cells of parenchyma while tegmen is thin and soft. Lumen of the seed shows endospermous tissue (Pl. 1.4; Pl. 2.2). Embryo is embedded inside the endospermous tissue. Embryo is curved and of dicot type consisting of two large cotyledons, plumule and radical (Pl. 1.2; Pl. 2.6; Fig. 1.6). Each seed has a small stalk attached to the central axis, showing axile placentation (Fig. 1.5).

Central axis—Central axis is well preserved. It is pentangular and consists of outer compact limiting layer, loosely arranged 5 to 6 layered cortical zone and central broad pith having large air spaces at places (Pl. 1.1, 2; Pl. 2.1, 3; Fig. 1.7, 8). Five vascular bundles are present at the base of each septum. Each vascular bundle is conjoint, collateral and endarch, and consists of 3 to 4 metaxylem and 2 to 3 protoxylem elements (Fig. 1.7, 8, 11, 12).

DISCUSSION

The fossil fruit described above is characterized by pentalocular, pentangular, pentaribbed, semicircular fruit. Pericarp is smooth, spongy and multilayered, dehiscence loculicidal, single seed in each locule showing axile placentation. Seeds are endospermous. Embryo curved with two cotyledons, plumule and radical. Central axis pentangular with broad pith. The reported capsular fruit *Enigmocarpum parijai* (Sahni, 1943; Mahabale & Deshpande, 1957; Patil, 1972; Biradar & Mahabale, 1976) and *E. Sahnii* (Chitale & Kate, 1977) differ from the present one by having 6 to 12 locular capsule with thick spongy wall and larger in size. Each locule contains a row of seed showing loculicidal dehiscence. It is apparently developed from *Sahnianthus* flower showing Sonneratiaceae affinities. Present fruit differs from *Indocarpa intertrappea* (Jain, 1964) and *I. mahabalei* (Nambudiri, 1969) which are tetralocular, many seeded, septicidal capsule with columella and fleshy testa showing affinity with Guttiferae. *Harrisocarpum sahnii* (Chitale & Nambudiri, 1973) is pentalocular, pentaribbed, septicidal malvaceous capsule similar to *Abutilon*. *Sahnioarpum harrisii* (Chitale & Patil, 1973; Patil & Karekar, 1986; Tidwell & Chitale, 1987) is a pentalocular, septicidal capsule having an elongated triangular, large seed showing affinity with Linaceae. *Daberocarpum gerhardii* (Chitale & Sheikh, 1973) is ten locular, septicidal schizocarpic ribbed capsule with a single seed in each locule. *Deccanocarpum arnoldii* (Paradkar, 1975) is eight locular capsule with one seed in each locule. Two Euphorbiaceae capsules *Euphorbiocarpum drypeticides* (Mehrotra, Prakash & Bande, 1984) is a trilocular capsule with single seed in each locule where as *Phyllanthocarpum singhpurii* (Mistri & Kapgate, 1992) has two seeds in each locule. *Duabungocarpum deccanii* (Kadoo & Kolhe, 2002) is multilocular, multiseeded loculicidal capsule which resembles with that of *Duabanga*

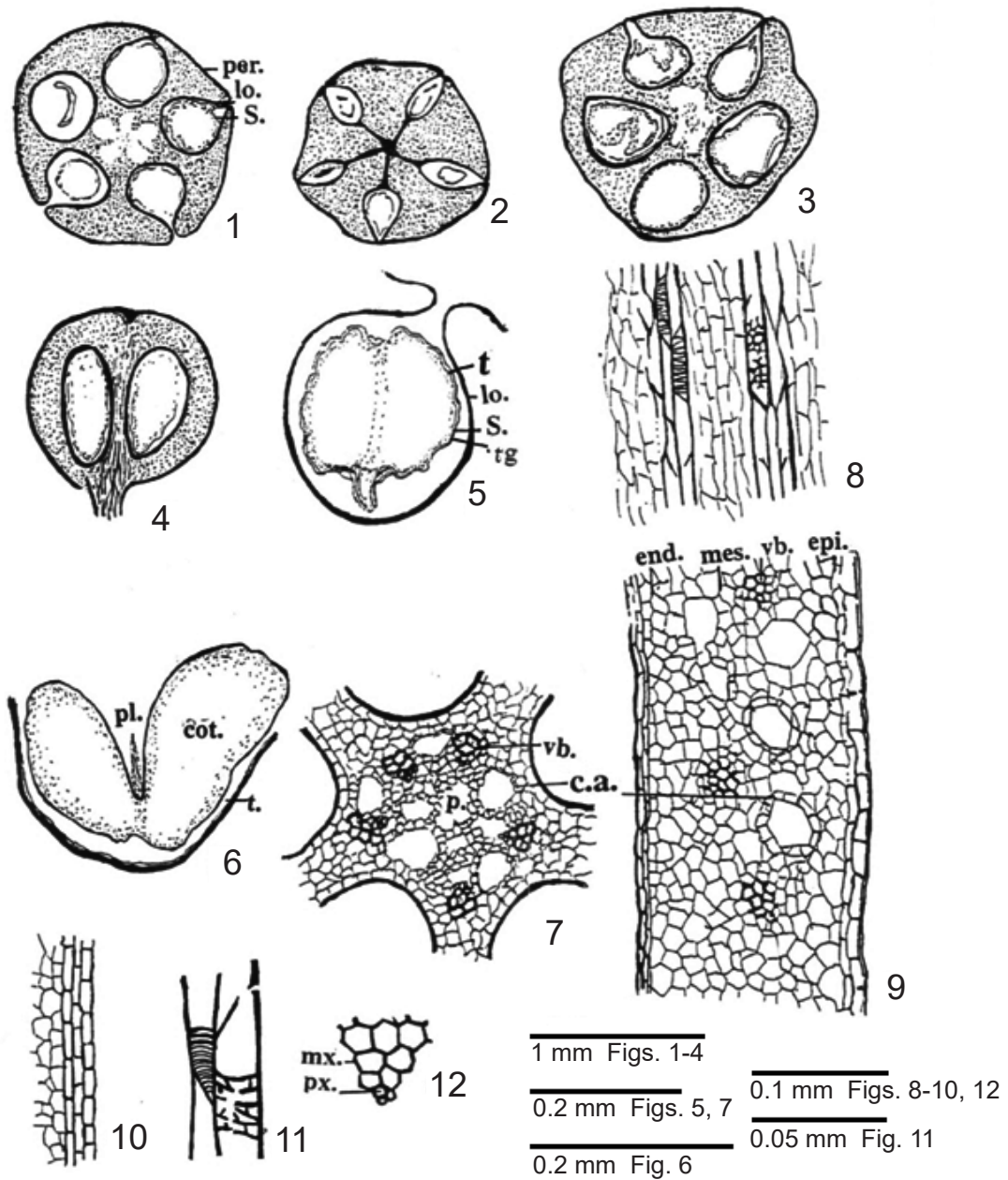


Fig. 1—*Hibiscocarpon mohgaonensis* gen. et sp. nov.

1. Specimen No. 1, exposed oblique transversely on the chert showing pericarp (per.), five locules (lo.) and single seed in each locule (S.). Slide No. 20.
2. Fruit at disappearing stage. Slide No. 98.
3. Specimen No. 2 exposed transversely on the chert. Slide No. 16.
4. Specimen No. 3 exposed longitudinally on chert. Slide No. 08.
5. A single locule with a seed attached on central placenta showing testa (t.), tegmen (teg.) and endosperm tissue (end.). Slide No. 28.
6. Lower part of the seed showing dicotyledonous (cot.) embryo with radical (r.) & plumule (pl.). Slide No. 66.
7. Central axis cut in T.S. showing it's pentangular nature, 5 vascular bundles and air spaces. Slide No. 50.
8. Central axis exposed longitudinally showing central parenchymatous pith, xylem elements with reticulate and spiral thickening and outer parenchymatous cortex bounded on both the side. Slide No. 52.
9. Wall of the fruit (pericarp) showing thin, 1-2 layered epicarp (epi.) with outer most epidermis. Multilayered (mes.) with lacunar parenchyma, air spaces (a. c.) and few vascular bundles (vb.); inner thin endocarp (end.) with 1-2 layered thick walled parenchyma. Slide No. 23.
10. Seed coat with testa and tegmen and few endosperm tissue. Slide No. 68.
11. Xylem elements with reticulate and spiral thickening. Slide No. 57.
12. Xylem in T. S. with metaxylem (mx.) and protoxylem (px.) elements. Slide No. 27.

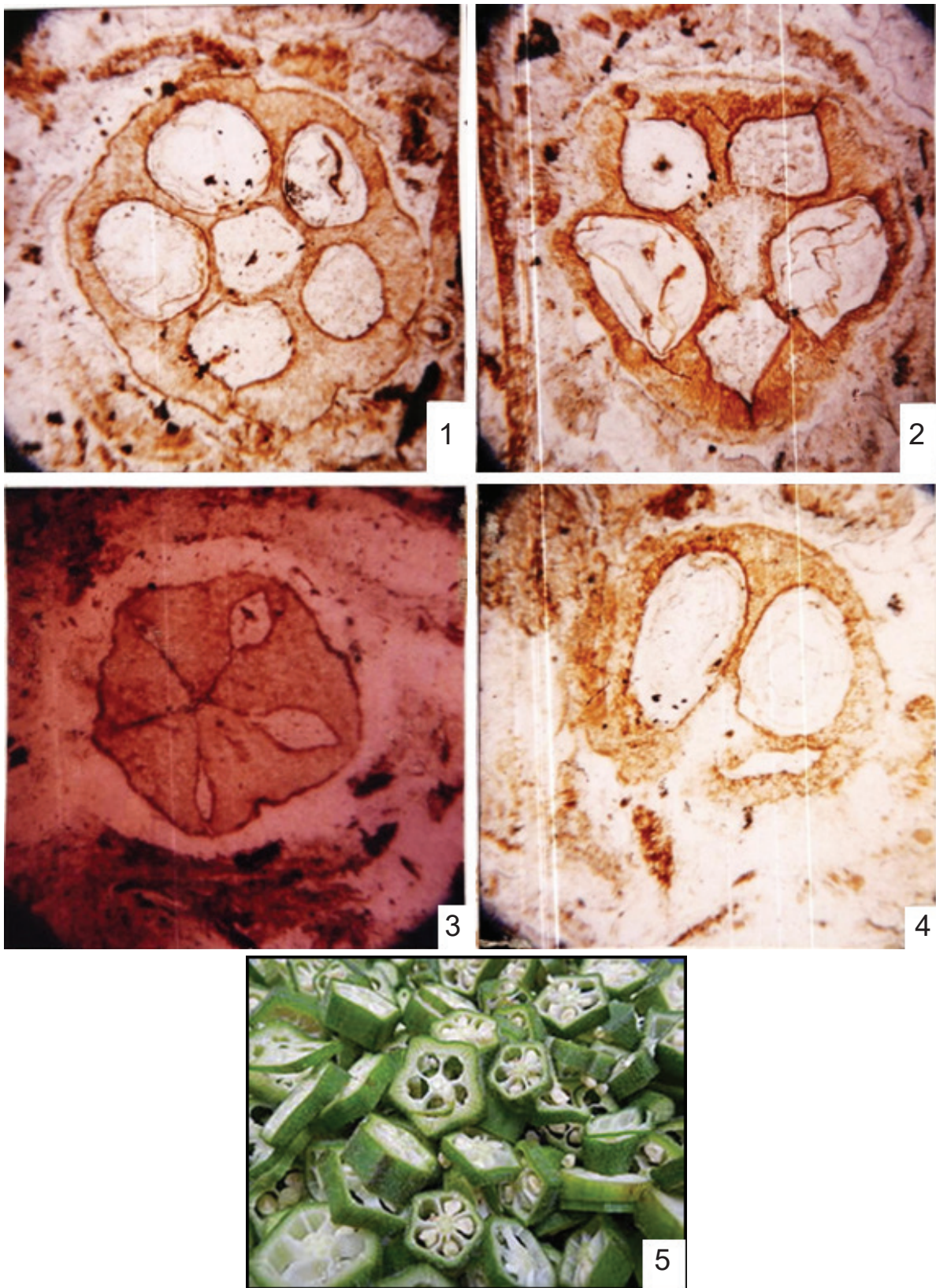
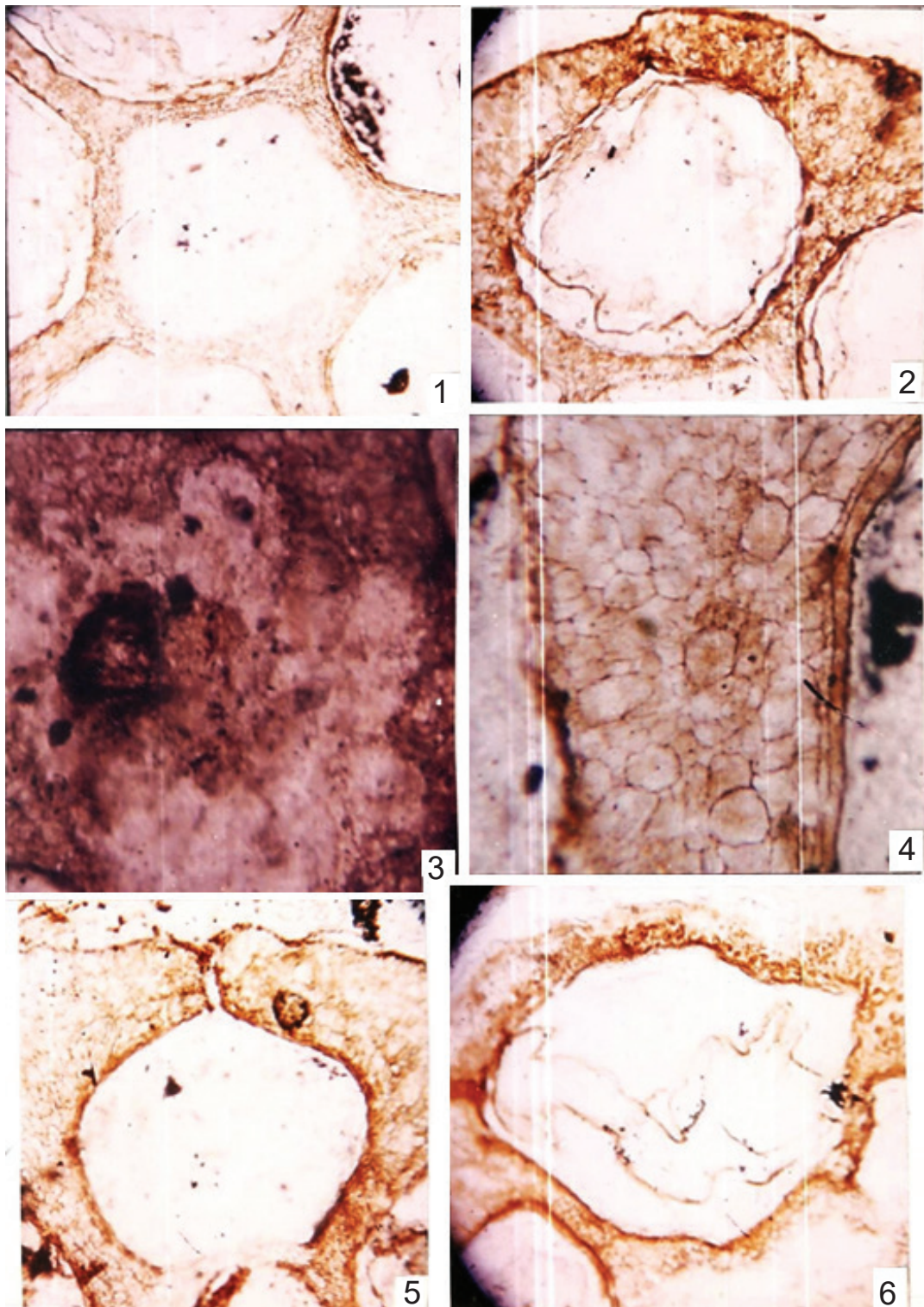


PLATE 1

Hibiscocarpon mohgaonensis gen. et sp. nov.

- 1, 2. Photograph of Specimen No. 1 & 2 exposed in T. S. x 45.
 3. Photograph of Specimen No. 3 in disappearing stage. x 45.
 4. Photograph of Specimen No. 4 in L. S. x 45.
 5. Photograph of living genus *Hibiscus esculentus* L. ver. Moench / okra (OH-Kruh).

**PLATE 2***Hibiscocarpon mohgaonensis* gen. et sp. nov.

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| 1. | Photograph showing central axis in T. S. x 180. Slide No. 29. | 5. | Photograph showing loculicidal dehiscence of fruit. x 250. Slide No. 18. |
| 2. | Photograph of single seed in the locule. x 180. Slide No. 42. | 6. | Photograph of the locule showing details of seed & embryo. x 250. Slide No. 53 |
| 3. | Photograph of pentangular central axis. x 250. Slide No. 35. | | |
| 4. | Photograph of pericarp showing thin epicarp and endocarp and broad multilayered Mesocarp. x 250. Slide No. 16. | | |

of Lythraceae. *Chitaleocarpon intertrappea* (Kapgata *et al.*, 2006) is a seven locular multiseeded capsule with loculicidal dehiscence. *Lagerstroemiocarpon harrisii* (Kokate *et al.*, 2013a) is a hexalocular capsule having six prominent ridges resembling fruits of the family Lythraceae. *Loganiocarpon deccanensis* (Kokate *et al.*, 2013b) is a bilocular, septicidal capsule with single seed and shows similarity with the fruits of Loganiaceae.

The present fruit does not show any affinity with the reported fossil fruits. The comparison of fossil fruit with those of extant family is also carried out. The overall characters shows that the fossil fruit is closely comparable with those of family Malvaceae (Cook, 1967; Saldanha & Nicolson, 1978; Mathew, 1998; Eames & Mac Daniel, 1947; Esau, 1953; Hooker, 1883; Hutchinson, 1967). The extant species *Hibiscus esculentus* L. var. Moench / okra (OH–Kruh) / *Abelmoschus esculentus* (Pl. 1.5) is pentalocular, pentangular fruit with broad fleshy wall and ribbed fuzzy pod. It has pentangular central axis, single seed in each locule with axile placentation and loculicidal dehiscence. Present fossil fruit is also pentalocular, pentangular and has loculicidal capsule with broad spongy fruit wall, broad pentangular central axis and has single seed in each locule showing axile placentation. The comparative study shows that except diameter, other morphological character of the fossil and extant fruits are similar. Hence, the name *Hibiscocarpon mohgaonsis* is proposed for the fruit described herein. Generic epithet is after extant genus *Hibiscus* and the specific epithet is after the locality from where the fossil fruit is collected.

Holotype—VDK/ Ang–6/ Botany Department, Institute of Science, Nagpur.

Horizon—Deccan Intertraps.

Locality—Mohgaonkalan, M.P. India.

Age—Early Tertiary.

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