

## RESEARCH ARTICLE

## ***Unispermospinocarpon keriensis* gen. et sp. nov., a permineralized spiny fruit from the Deccan Intertrappean Beds of Keria, Madhya Pradesh, India**

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### ABSTRACT

A small, elliptical, unilocular single seeded, dehiscent, small stalked, spiny fruit is described from the Intertrappean rocks exposed at Keria of Chhindwara Dist., M.P., India. The fruit is compared with modern families like Rubiaceae, Ceratophyllaceae, Elaeocarpaceae, Caprifoliaceae, Asteraceae, Zygophyllaceae, Hamamelideaceae. The fruit could not assigned to any living family. Since it differs from the known fossil fruits, it is named as *Unispermospinocarpon keriensis* gen. et sp. nov.

**Key words:-** Dicotyledonous fruit, Deccan Intertrappean, Late Cretaceous, Keria, Madhya Pradesh, India.

### INTRODUCTION

The present paper deals with the detailed study of new petrified dicotyledonous spiny fruit from Keria (N 21° 59. 904' and E 079° 10. 418') of Chhindwara Dist., M.P., India. This locality lies in between villages Keria and Jhiria, where many dicot and monocot woods are found scattered mixed with black and brown cherts in the field. So far, one gymnosperm wood- *Araucarioxylon kerienne* (Trivedi & Shrivastava, 1989), few dicot woods -*Boswellioxylon indicum* (Dayal, 1964), *Sapindoxylon scheicheroides* (Dayal, 1965), *Mellatoxylon kerienne* (Lakhanpal & Dayal, 1964), *Paraphylanthoxylon kerienne* (Dayal, 1968); and a palm wood- *Palmoxylon kerienne* (Trivedi & Verma 1971), from Keria and *Oleoaxylon deccanensis* (Trivedi & Shrivastava, 1989), from Jhiria are reported. Regarding fruits, many fruits were reported from the Deccan Intertrappean beds of India. Among the reported dicots fruit there are some records of capsular fruits viz, *Enigmocarpon parijaii* (Sahni, 1943; Shukla, 1944; Dwivedi, 1956; Mahabale & Deshpande, 1957; Patil, 1972; Biradar & Mahabale, 1976); *Enigmocarpon sahnii* (Chitaley & Kate, 1977), *Indocarpa intertrappea* (Jain, 1964); *Harrisocarpon sahnii* (Chitaley & Nambudiri, 1973); *Sahnioocarpum harrisii* (Chitaley & Patil, 1973; Nambudiri et al., 1987; Karekar, 1989;

Bobade et.al., 2011); *Daberocarpon gerhardii* (Chitaley & Sheikh, 1973); *Deccanocarpon arnoldii* (Paradkar, 1975); *Euphorbiocarpon drypeteoides* (Mehrotra et al., 1983), *Wingospermocarpon mohgaoense* (Sheikh & Kapgate, 1984); *Phyllanthocarpon singhpurii* (Mistri & Kapgate, 1992); *Orygiocarpon jhargadi* (Yawle & Channe, 1998); *Duabangocarpon deccanii* (Kadoo & Kolhe, 2002); *Lytherocarpon mohgaoense* (Kapgate et. al., 2003); *Surangeocarpon mohgaoense* (Kapgate et. al., 2005); *Euphorbioecocarpon singhpurii* (Bhowal & Sheikh, 2006); *Chitaleyocarpon intertrappea* (Kapgate et. al., 2006); *Pantocarpon deccanii* (Kapgate et. al., 2007); *Bicarpelarocarpon singhpurii* (Bhowal & Sheikh, 2008); *Lymnophyllocarpon surangeii* (Kolhe et. al., 2009); *Tiliaceocarpon jamsavlii* (Meshram et. al., 2013); *Lagerstroemiocarpon harrisii* (Kokate et. al., 2013). One spiny capsule or utricle type of fruit described as *Spinocarpon mohgaoense* by Kapgate in 2013. The fruit described here is also a spiny. But the fruit described here is quite different from aforesaid fruits hence formed the matter for present investigation.

## MATERIAL AND METHODS

Material of this fruit was collected from the Deccan Intertrappean beds of Keria, M.P., India. While breaking the cherts the fruit was exposed in longitudinal plane. The petrified fruit was observed on one of the parts of the rock piece during cutting, both part and counterpart obtained. After etching the specimens with hydrofluoric acid (HF), serial peel sections were taken with Cellulose Acetate peel Technique (Darrah, 1936; Joy et al., 1956; Stewart and Tylor, 1965; Holmes and Lopez, 1986; Kapgate et al., 2011) through its part and counterpart. The peels were mounted in DPX mountant and photographed. The camera lucida sketches of the slides were drawn for detailed study of fruit cut in longitudinal plane. Preservation is good, serial peel sections were taken to study anatomical details. The description of the fruit is based on the study of both part and counterpart of specimen

## RESULTS AND DISCUSSION

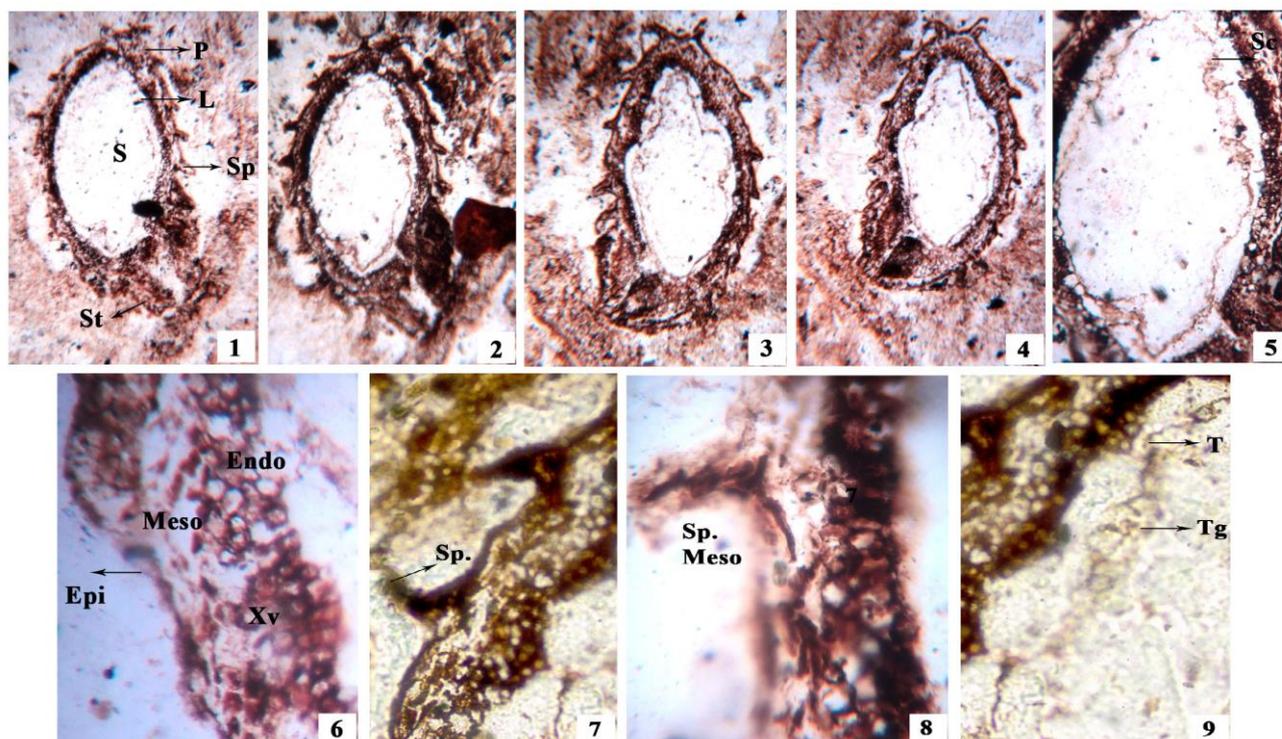
The present petrified fruit cut in longitudinal plane is oblong to elliptical in shape. It is unilocular single seeded, dehiscent, small stalked, having a spiny

outgrowth from mesocarp. The spines may be for the dispersal mechanism and the seed occupying the complete lumen. The size of the fruit in the middle with spine measures 1.65 to 1.85 mm in length and 1.0 to 1.15 mm in width and without spine 1.45 to 1.55 in length and 0.85 to 0.95 mm in width. It is well preserved to reveal anatomical details of pericarp.

**Pericarp (Fruit Wall):** The tissue of the pericarp is well preserved. It is dry, shows spiny outgrowth, multilayered, thick walled and measures about 0.120 to 0.125 mm thick and differentiated into three zones. Outer zone is epicarp, middle zone is mesocarp shows spiny outgrowth and inner zone is endocarp (Plate Fig.6). The outermost zone (Epicarp) showing pointed bulging of spiny outgrowths originated from mesocarp measures 22 to 26  $\mu\text{m}$  in thickness, made up of 2-3 layered thick walled parenchymatous cells. (Plate Fig.6). The middle zone (Mesocarp) shows spiny outgrowths measures 35 to 40  $\mu\text{m}$ , made up of 3-6 layers of compactly arranged thick walled parenchymatous cells (Plate Fig.6). The spines are multilayered, thick-walled cells. The spines may be protective devices of the fruit and help in the dispersal of the fruit by any agency. The size of the spine measures 125 to 135  $\mu\text{m}$  in length, pointed at the apex and broad at the base measures 70 to 75  $\mu\text{m}$  wide (Plate Fig.7). The innermost layer ( Endocarp) measures 50 to 60  $\mu\text{m}$  in thickness made up of thick walled parenchymatous 5-7 layered cells, each cell measures 15 to 20  $\mu\text{m}$  in size (Plate fig.6). Vascular supply is present in the inner layer of endocarp. This layer consists of vascular cells in the form xylem elements. Xylem elements measures 12 to 16  $\mu\text{m}$  in diameter (Plate Fig.6).

**Locules :** The locule is single and measures 1.0 to 1.10 X 0.55 to 0.65 mm in size containing single large prominent seed occupying maximum portion of the locule with basal placentation. The single locule determines the unilocular nature of the fruit (Plate-Figs. 4&5).

**Seed :** A single prominent oval or elliptical shaped seed is present in the complete lumen of the fruit measures 0.95 to 1.0 X 0.45 to 0.50 mm in size (Plate Figs.1to5). Seed is free from fruit wall (Plate Fig.5). At few places, it seems to fuse with endocarp. Seed coat is bitegmic, 2-3 layered, differentiated into testa and tegmen measuring 20 to 30  $\mu\text{m}$  in thickness (Plate Fig.9). Outer testa is double layered consisting of thick



**EXPLANATION OF PLATE FIGURES 1 to 9**

**Figs.1-4:** Complete fruit in L. S. at various stages appeared on fossiliferous chert showing pericarp (P); locule (L) with single seed (S), spiny outgrowth on pericarp (Sp), small stalk of fruit (St) and dehiscence split (Dspl.). **Fig.5:** A single seed occupying complete lumen of locule. Thin bitegmic seed coat (Sc) seen free from the endocarp at some places. **Fig.6:** Spiny pericarp (Fruit wall) magnified showing three zones- outer bulging of spine of epicarp (Epi), middle mesocarp (Meso.) with outgrowth of spine and inner zone Endocarp (Endo). **Fig.7:** Magnified outgrowth of spine. **Fig.8:** Magnified spine (Sp). **Fig.9:** Magnified Seed coat showing bitegmic layer outer testa (T) and inner tegmen (Tg)

walled parenchymatous cells measures 12 to 15 µm in thickness (Plate Fig.9). While inner tegmen is prominent, single layered, made up of thin walled parenchymatous cells and measures 8 to 10 µm in thickness (Plate Fig.9). The lumen of the seed shows an empty space but at few places it consists of thin walled parenchymatous cells are preserved as an endospermic cells (Plate Fig.9). The embryo is ill preserved. Seed is attached to the basal portion of the fruit indicating its basal placentation (Plate Fig.4).

From the above description following important features confirmed its identification:

- Small sized dicot, spiny fruit.
- Fruit is unilocular, dehiscent, small stalked and single seeded, spiny capsule.
- Pericarp is multilayered and differentiated into epicarp, mesocarp and endocarp
- The mesocarp forming spiny outgrowth for dispersal mechanism.

- A single seed occupying the complete lumen of the fruit.
- Seed is oval to elliptical in shape, but endospermic and embryonic cells ill preserved.
- Seed coat is thick, bitegmic differentiated into testa and tegmen.
- The fruit show basal placentation.
- Vascular supply is present at the stalk and continued in pericarp.

**IDENTIFICATION**

The present specimen is compared with reported capsular fruits and with fruits of modern taxa :

**Comparison with reported capsular fruits :**

The present specimen is compared with fossil capsular fruits such as - *Enigmocarpon parijaii* (Sahni, 1943; Shukla, 1944; Dwivedi, 1956; Mahabale & Deshpande, 1957; Patil, 1972; Biradar & Mahabale, 1976); *Enigmocarpon sahnii* (Chitale & Kate, 1977);

*Indocarpa intertrappea* (Jain, 1964); *Harrisocarpon sahnii* (Chitale & Nambudiri, 1973), *Sahnioacarpon harrisii* (Chitale & Patil, 1973; Nambudiri et al., 1987; Karekar, 1989; Bobade et al., 2011), *Daberocarpon gerhardii* (Chitale & Sheikh, 1973), *Deccanocarpon arnoldii* (Paradkar, 1975) *Euphorbiocarpon drypeteoides* (Mehrotra et al., 1983), *Phyllanthocarpon singhpurii* (Mistri et al., 1992), *Orygiocarpon jhargadi* (Yawle & Channe, 1998); *Duabangocarpon deccanii* (Kadoo & Kolhe, 2002); *Lytherocarpon mohgaoense* (Kapgate et al., 2003); *Surangeocarpon mohgaoense* (Kapgate et al., 2005); *Euphorbiaceocarpon singhpurii* (Bhowal & Sheikh, 2006); *Chitaleycarpon intertrappea* (Kapgate et al., 2006); *Pantacarpon deccanii* (Kapgate et al., 2007); *Bicarpelocarpon singhpurii* (Bhowal & Sheikh, 2008); *Lymnophyllocarpon surangeii* (Kolhe et al., 2009); *Lagerstroemiocarpon harrisii* (Kolhe et al., 2013); all are multilocular (2 to 10 locular) and many seeded capsules while the present fruit is unilocular. Hence the present fruit does not show exact similarity with any of the above reported fossil fruit. It is also different from unilocular *Wingspermocarpon mohgaoense* (Sheikh & Kapgate, 1984) the later fruit is multiseeded winged while present fruit is single seeded spiny fruit & *Tiliaceaceocarpon jamsavlii* (Meshram et al., 2013) showing hard & woody projections on fruit wall while present fruit shows spiny outgrowth on fruit wall. While considering the similarities of the studied fossil with reported fossil spiny fruit like *Spinocarpon mohgaoense* (Kapgate, 2013) are both spiny fruit but the later fruit is bilocular, while the present fruit is unilocular. So, no comparison could be made.

Thus the fossil fruit under consideration does not correlate with any fossil fruits described so far from these beds.

#### Comparison with modern taxa :-

For assigning the fossil fruit to proper family, it was also compared with living genera of modern dicot families. Such a fruit is compared with the modern families having spiny (Gamble, 1957; Cooke, 1958; Hooker, 1961; Saldanha & Nicolson, 1978; Mathew, 1981). Presence of unilocular, single seeded, spiny fruit made it easier to trace its affinities with nearest living families like Rubiaceae, Ceratophyllaceae, Elaeocarpaceae, Caprifoliaceae, Asteraceae, Zygophyllaceae, Hamamelideaceae.

In family Rubiaceae (*G-Cephalanthus occidentals*) and family Ceratophyllaceae (*G-Ceratophyllum*); is differs in having moderately long spine and so many in number while present fruit shows small sized spine and few in number. Comparison also made with family Elaeocarpaceae (*G-Sloanea*) it is differs in having many seeded spiny fruit while present fruit shows single seed. Family Caprifoliaceae (*G-Kolkwitzia*) is differs in having fruit with persistent calyx and spines are long and many in number while present fruit shows fruit without persistent calyx, small small sized spine and few in number. Family Asteraceae (*G-Lagenophora*) is compared in having spiny fruit, pappus absent ; the fruit is differs in having unequal size of spines while present fruit shows equal size of spines. It is compare with family Zygophyllaceae (*G-Seetzenia*) is differs in having the seeds testa thick, with three skins, the outer membranous, the middle one cellular and mucous, the inner coriaceous while such structures are absent in present fruit. In (*G-Tribulus cistoides*) differs in having the spines are long and hairs are present on the pericarp while in present fruit the spines are small in size and hairs are absent on the pericarp. Family Hamamelideaceae (*G-Parrothia, Distylium, Corylopsis, Loropetalum, Maingaya*) is compared in having single seeded, ellipsoidal spiny fruit but differs in having horny endocarp separating from the exocarp such structure is absent in present fruit. Thus, from above comparisons it is clear that the present fruit does not show exact similarity with any of the modern families.

A comparison with known fossil dicot reported fruit and fruits of modern dicotyledonous taxa indicates that the present specimen is not resembles to any other previously described fossil fruits described so far and also it could not assigned to any known family or taxon. Hence, it is placed under an artificial genus

***Unispermospinocarpon keriensis*** gen. et sp. nov. Generic name being after the single seeded and spiny nature of fruit and specific name is after the locality of present fruit.

#### DIAGNOSIS

***Unispermospinocarpon*** gen. nov.

Fruit small, unilocular, single seeded, small stalked, having a spiny outgrowth from mesocarp, dry dehiscent fruit with basal placentation.

***Unispermospinocarpon keriensis*** gen. et sp. nov.

The longitudinal fruit is oblong to elliptical in shape, unilocular single seeded, dehiscent, small stalked, having a spiny outgrowth from mesocarp. The size of the fruit in the middle with spine measures 1.65 to 1.85 mm in length and 1.0 to 1.15 mm in width and without spine 1.45 to 1.55 in length and 0.85 to 0.95 mm in width. The fruit shows single locule containing single prominent oval or elliptical shaped seed is present in the complete lumen of the fruit. The pericarp (fruit wall) is spiny measures 0.120 to 0.125 mm thick, multilayered, and differentiated into three zones. The seed is single and 0.95 to 1.0 X 0.45 to 0.50 mm in size. The seed coat is bitegmic in nature measures 20 to 30 µm in thickness. The embryo is dicot type and ill preserved. Placentation is basal type. Some vascular cells are observed at endocarp and at stalk portion.

**Holotype:** PAP/ Ang / Dfr4/ Deposited at Botany Dept. J.M. Patel College, Bhandara, M.S. India.

**Horizon :** Deccan Intertrappean Series of India.

**Locality :** Keria (M. P.), India

**Age :** Late Cretaceous ( Maastrichtian )

**Conflicts of interest:** The authors stated that no conflicts of interest.

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