STRUCTURAL DESIGN OF THE ENDOSPERM OF CARROT (*DAUCUS CAROTA* L. VAR. *SATIVA*)

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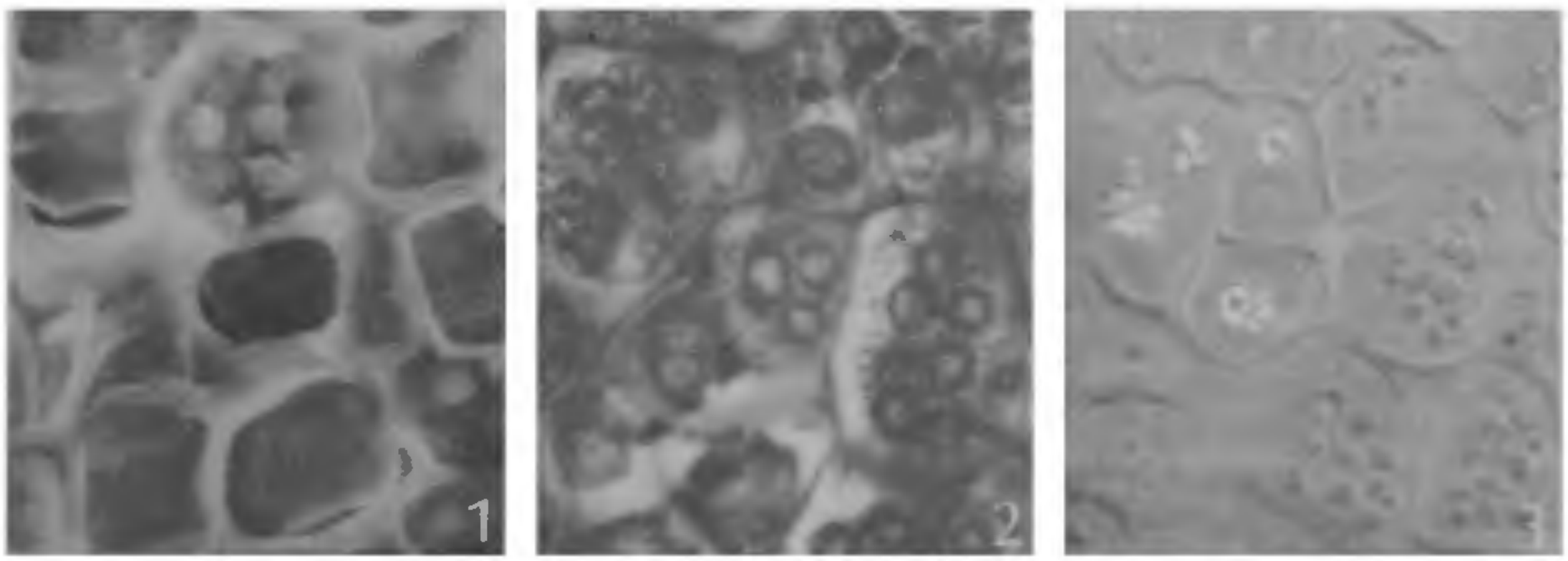
INVESTIGATIONS on seed structure are restricted to only a few agriculturally important seeds. Anatomical variations have been examined[1] in regions of the endosperm and the structure and composition of protein bodies of ungerminated celery seeds have been studied followed by a detailed investigation of 10 umbelliferous species[2–4]. Most of the seed storage protein and mineral reserves were contained in the protein bodies. In view of the importance of protein bodies, the endosperm of carrot (*Daucus carota* L. var. *sativa*) has now been studied.

Fully matured seeds of carrot, collected from local gardens, were processed for microtomy using conventional techniques. Stained or unstained trans-sections were used for observation. (Following Lott[5], protein-rich particles located in seed tissues are termed 'protein bodies' rather than 'aleurone grains').

In carrot, the major volume of the seed is occupied by the endosperm which is limited externally by the seed coat. A tiny embryo usually occupies the centre position surrounded by a group of endospermous cells under various stages of degradation.

The angular or irregularly-shaped cells of the endosperm have thick walls (figures 1 and 2). Among the endospermous tissue, two cell types were distinguishable. One contained a number of protein bodies with small, circular inclusions, believed to be globoids, while the other contained one or a few large transparent crystalline inclusions (figures 2 and 3). However, it is not clear, if these



Figures 1–6. 1–3. Endospermous cells. **1.** SE micrograph (× 280); **2.** Bright field micrograph (× 300); **3.** Nomarsky interference micrograph (× 280). **4–6.** Polarization micrographs. **4.** Mericarp trans-section to show the distribution of crystals (× 40); **5.** A few endospermous cells to show crystals (× 230); **6.** Crystal druse and single tetrahedron crystal (× 1400).

crystals were always the inclusions of protein bodies. Under polarized light the crystals were highly birefringent while the globoid inclusions were not birefringent (figures 4–6). Figures 4 and 5 are trans-sections of the mericarp viewed with fully crossed polarizers to see the crystals. The crystals show themselves in Nomarsky Interference Microscopy also (figure 3). Figure 4 depicts the crystal distribution in the endosperm. The central cells were devoid of any such crystals.

It is evident that carrot endosperm possessed two structural types of protein bodies — one with proteinaceous matrix and a number of globoid inclusions and the other of proteinaceous matrix and calcium-rich inclusions[4]. Both types were however not present in the same cell suggesting cell wall formation before the formation of protein body inclusions[2]. The use of polarization microscopy established whether calcium-rich crystals were present and their location in a given section, since such crystals were highly birefringent. On the contrary, the crystals may be either a solitary tetrahedron or an aggregated group of small crystals forming a druse (figure 6). The solitary crystals are few in number.

Besides protein bodies, the other major inclusions of the endospermous cells are some lipid droplets and starch grains (figure 2).

Much of the seed reserves of vital minerals occur as phytin which is mainly localized within the protein bodies as globoid inclusions[6], whereas the role of calcium oxalate crystals in seeds is clear. Formation of calcium oxalate crystals may prevent oxalic acid from accumulating in toxic quantities in the cytoplasm[1]. Alternatively the crystal may protect the plant against grazing animals or play a role in long-term calcium storage[7].

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OCCURRENCE OF *HEPATIARIUS BENDAWESI* SP. NOV., FROM *ANAS POECILORHYNCHA* (FORSTER) FROM INDIA

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Two specimens of *Hepatiarius bendawesi* were collected from the liver of a single bird from Meerut. The following are the details:

Body (figure 1) cylindrically narrow, measuring 4.98×0 63 mm. Oral sucker well-developed 0.15 ×0.14 mm., ventral sucker poorly developed at anterior third of the body, 0.16×0.14 mm. Prepharynx absent. Pharynx well-developed 0.10×0.06 mm. Oesophagus 0.31 mm long and intestinal caeca extend up to the posterior end of the body. Testes tandem, lobed close to posterior

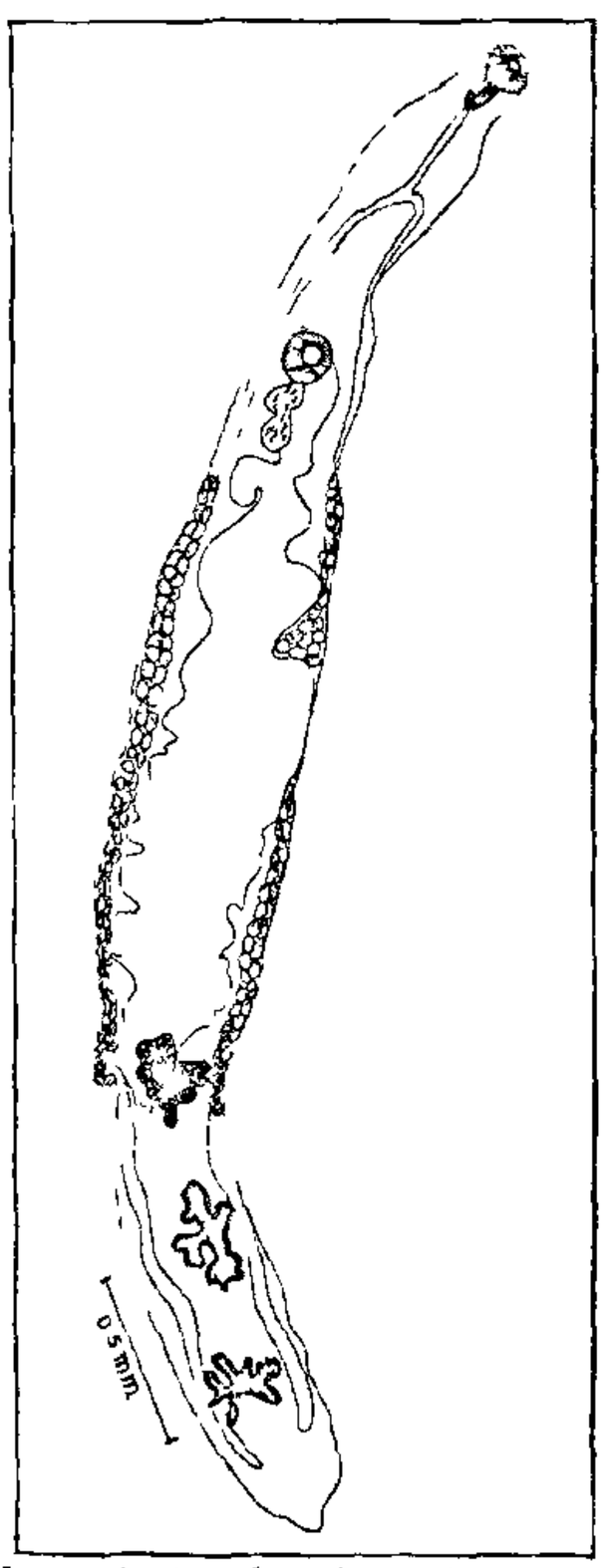

Figure 1. *Hepatiarius bendawesi* sp. nov., Ventral view.