

IPOMOEA—AN ANATOMICAL STUDY

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A detailed anatomical investigation has been made of the dried sliced tubercles of *Ipomoea orizabensis* (Pelletan) Ledanois which constitutes the drug known in commerce as Ipomoea. A list of the characteristic features of the powdered drug is given.

IPOMOEA was imported into Europe early in the nineteenth century probably as a substitute or adulterant for Vera Cruz jalap. It occurred as irregular pieces which were sometimes sliced and sometimes roughly hacked from a very large tuberous root. In Germany it was called stipites jalap, jalap stalk and jalap tops and in France, fusiform jalap and woody jalap. In this country it has long been known as male, light and woody jalap.

The botanical name of the plant yielding the drug is *Ipomoea orizabensis* (Pelletan), Ledanois, (Fam. Convolvulaceae). The plant grows in Mexico near to Orizaba and this has led to the drug being known as Orizaba jalap.

Following the work of Power and Rogerson (1912) who declared the resins obtained from Ipomoea and scammony root to be almost identical, Ipomoea was used in place of scammony root as the source of scammony resin. The drug was included in the British Pharmacopoeia 1914 and given the synonym "Mexican Scammony." It has subsequently been included in the British Pharmacopoeias 1932 and 1948 and in the British Pharmaceutical Codices 1934–1959. However, apart from a brief note by Ballard (1911) when he compared its structure with that of scammony, Ipomoea does not appear to have been the subject of an original publication. Thus the descriptions given in the text-books are all brief and are either not illustrated or the drawings are not satisfactory. For this reason it was decided to make a careful anatomical study of the drug.

MATERIALS

Commercial samples were obtained from drug brokers, merchants and wholesalers and identified by comparison with specimens in the Museum of the Pharmaceutical Society of Great Britain.

MACROSCOPICAL CHARACTERS

Most of the samples consist of dried, transverse slices of large tubercles, measuring from 5 to 10 cm. across and 1 to 3 cm. thick though slices less than 1 cm. thick may also occur. Some samples are almost entirely irregularly shaped pieces which may be wedge-shaped or even halves of smaller tubercles cut obliquely while occasionally portions of the narrow part of the root are also present.

The cork is greyish-brown to brown and coarsely wrinkled. Lenticels are not present. The transverse surface is grey or dark brown and

exhibits coarse fibrous protruding strands arranged in 3 to 8 irregular concentric zones. On some pieces of drug masses of dried latex which glisten in reflected light are visible in concentric zones which alternate with the zones of fibres. The drug is light and fibrous and the thinner pieces can be broken easily giving a short fracture. The larger pieces, however, are very difficult to break. It has only a very slight odour and a faintly acrid taste.

The smoothed transverse surface shows a small circular secondary cambium in the centre of the root and concentrically arranged around this are 2 to 7 roughly circular tertiary cambia. These are closer to each other the nearer they are to the periphery. Numerous black dots may be seen in the phloem on the outside of each cambium and on the inside of the cambia scattered xylem groups are readily visible (Fig. 1, A).

MICROSCOPICAL CHARACTERS

The cork consists of about 15 to 25 rows of cells, which in transverse and longitudinal sections appear brick-shaped and arranged in regular tangential, radial and longitudinal rows. In surface view they appear square or rectangular or polygonal or irregular in shape (Figs. 2, A). The individual cells measure 30 to 85 μ long, 20 to 45 μ wide and 5 to 15 μ high. The cell walls are thin, suberised and very slightly lignified.

The phellogen is not readily discernible but there is a distinct phellogen. The outermost three or four layers of cells are arranged in a regular radial, tangential and longitudinal pattern but the inner phellogen consists of irregularly shaped cells often elongated tangentially. Isodiametric sclereids and elongated sclereids are frequently present. The isodiametric sclereids occur either singly or in groups of two or three. They measure 80 to 175 μ long, 50 to 150 μ wide and the same in depth. They have lignified cell walls, 10 to 25 μ thick which show stratification and simple branched pits. The elongated sclereids occur either singly or in groups of two to six. They measure R* and T = 20 to 80 μ and L = 50 to 120 μ . The cell walls are from 8 to 25 μ thick and are lignified with simple pits (Figs. 1, B; 2, D).

The most characteristic feature of the phellogen, however, is the large number of latex cells, the walls of which are thin, brown and suberised. The cells occur in longitudinal rows of 2 to 8 or even 10 cells. The dimensions of the cells are R and T = 60 to 240 μ and L = 100 to 180 μ . Frequently the radial and tangential are greater than the longitudinal dimensions (Fig. 2, E). The latex is granular and is soluble in ethanol, solution of sodium or potassium hydroxide, solution of chloral hydrate and partially soluble in ether. It is stained bright lemon yellow with solution of iodine. Cluster crystals of calcium oxalate measuring 8 to 48 μ in diameter are present in some cells and often appear to be concentrated in the outermost cells of the phellogen. In the innermost cells

* In recording the measurements, the system adopted by Moll and Janssonius (i.e. the dimensions in the radial (R), tangential (T) and longitudinal (L) directions of growth) is used in the majority of cases for the sizes of cells. Where, however, this system might be confusing or ambiguous, the ordinary method of recording the longest and shortest axes irrespective of direction of growth, is given.

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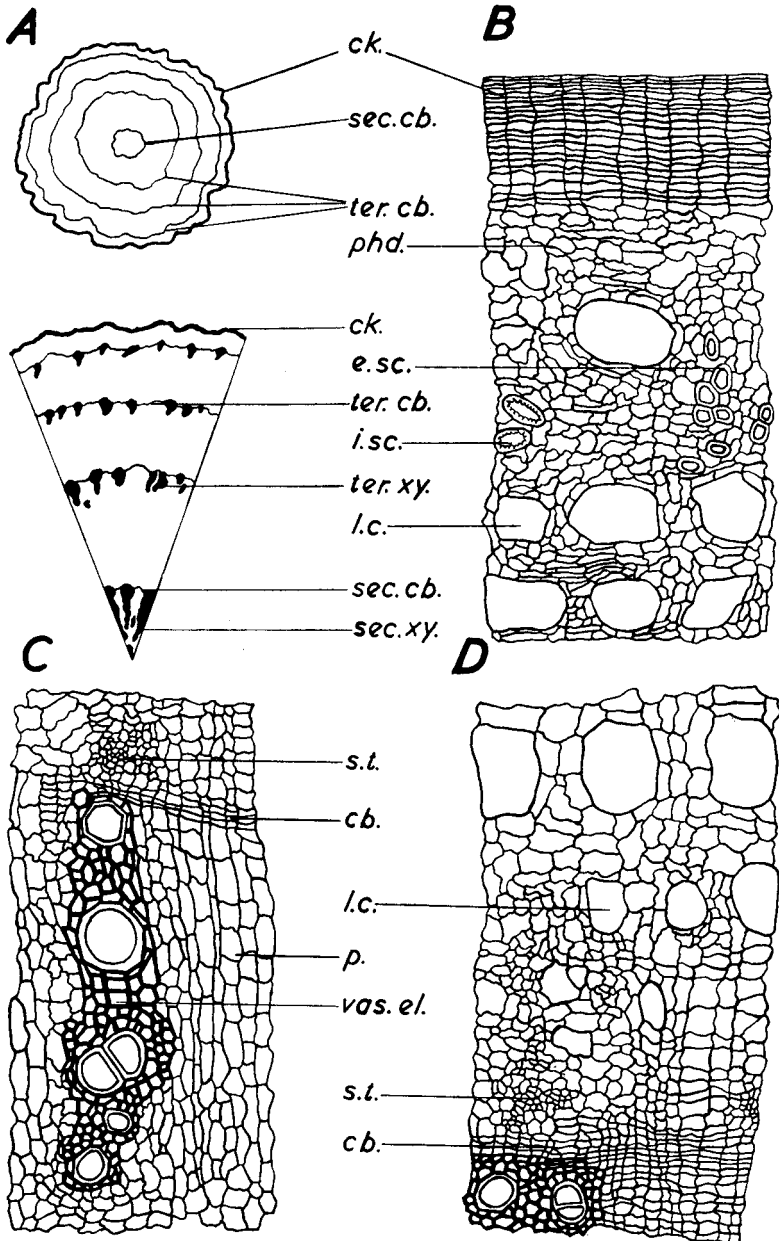


FIG. 1. *Ipomoea*. A. Transverse surface $\times 1/3-1$ and segment of transverse surface $\times 1-3$; B, transverse section showing cork and phelloderm $\times 90$; C, transverse section showing tertiary xylem $\times 90$; D, transverse section showing tertiary phloem $\times 90$. cb., cambium; sec. cb., secondary cambium; tert. cb., tertiary cambium; sec. xy., secondary xylem; tert. xy., tertiary xylem; ck., cork; phd., phelloderm; e.sc., elongated sclereids; i.sc., isodiametric sclereids; l.c., latex cells; p., parenchyma; s.t., sieve tissue; vas. el., vascular elements.

they are arranged in longitudinal files of up to 30 crystals (Fig. 2, E). Prismatic crystals measuring from 10 to 20 μ are also present (Fig. 2, B).

Apart from the sclereids and latex cells, all the cells of the phelloderm are packed with starch. The individual grains are round, oval or semi-faceted. The round and oval grains are single and the muller-shaped ones are compound, the compounds consisting of 2, 3, 4, 5 or occasionally

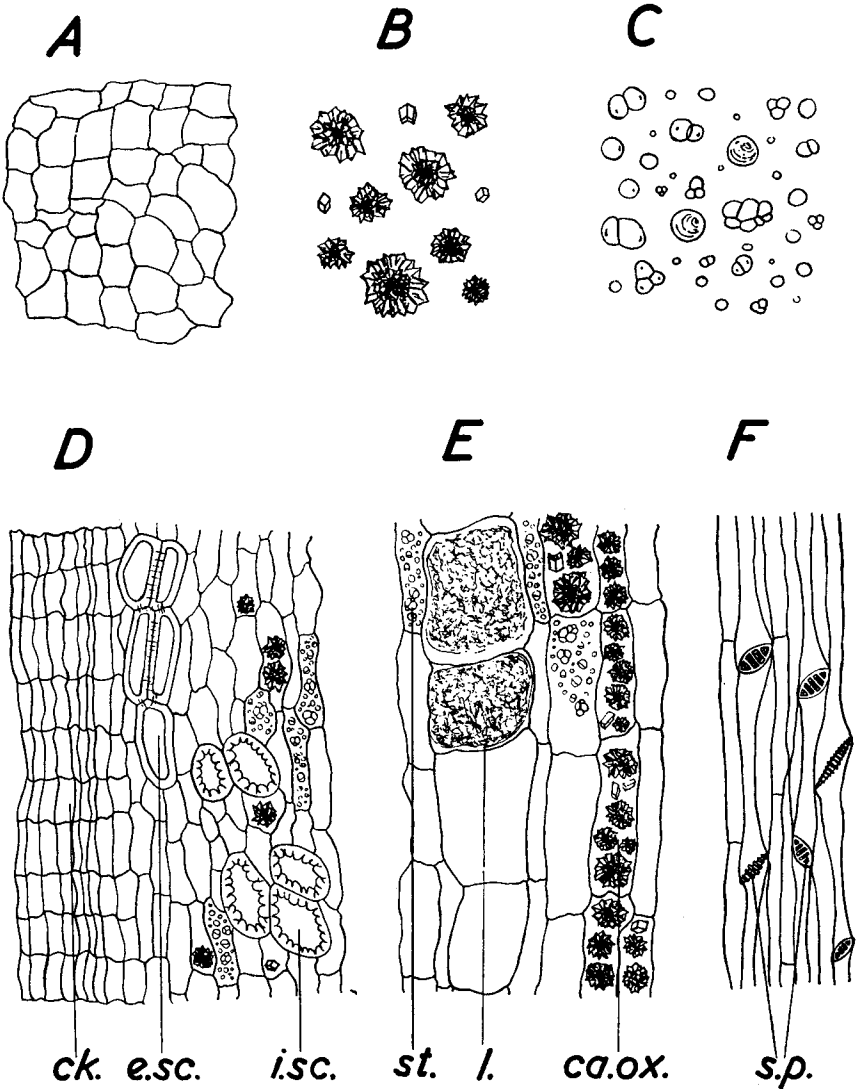


FIG. 2. *Ipomoea*. A, Cork, surface view $\times 120$; B, crystals of calcium oxalate $\times 180$; C, starch $\times 180$; D, cork and phelloderm R.L.S. $\times 120$; E, latex cells $\times 120$; F, Sieve tissue $\times 120$. ck., cork; ca. ox., files of calcium oxalate crystals; e. sc., elongated sclereids; i. sc., isodiametric sclereids; l., latex; s.p., sieve plates; st., starch.

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up to 8 individual grains. The grains measure 2-4.8-14.8-33 μ in diameter but with some grains occasionally up to 40 μ . The hilum is slightly eccentric and often appears as a slit or radiate cleft. Striations are faintly visible on the larger grains. No gelatinised grains appear to be present (Fig. 2, C).

No primary cortex is present so that the tissue abutting on to the phelloderm is tertiary phloem. This is formed from a tertiary cambium which arises in the previously formed tertiary tissue. The tertiary cambium also gives rise to some tertiary xylem. There may be up to 7 such tertiary zones of tissue, the first tertiary cambium to have been formed having arisen in the secondary phloem. The tertiary phloem is quite extensive.

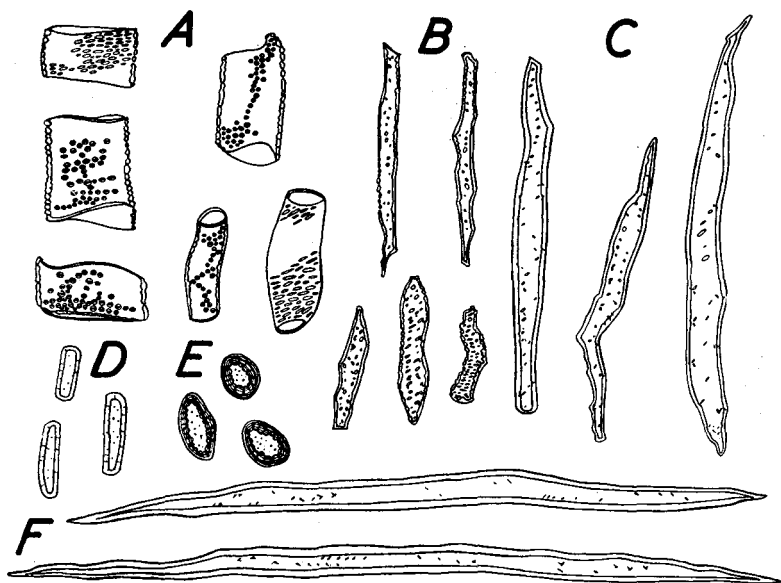


FIG. 3. *Ipomoea*. Isolated lignified elements all $\times 90$. A, vessels; B, tracheids; C, fibre tracheids; D, elongated sclereids; E, isodiametric sclereids; F, fibres.

Although most of the cells are arranged in regular radial rows the tissue is characterised by the longitudinal rows of latex cells. Near to the cambium these are quite small but in the outer regions of the phloem they are large and similar to those in the phelloderm. Hemi-cylindrical groups of sieve tubes are present in the phloem opposite to the xylem element groups. The sieve tubes seen in longitudinal section have oblique end walls which are divided into several sieve areas (Fig. 2, F). Some of the parenchymatous cells of the phloem are slightly elongated tangentially while others are elongated radially. It is not possible to discern in the longitudinal sections any definite medullary rays though in the transverse sections some of the radial rows of cells give the appearance of being uniseriate rays. All the parenchymatous cells are full of starch and some contain crystals of calcium oxalate (Figs. 1, B, D).

The tertiary xylem is a band of tissue on the inside of each of the tertiary cambia. It is composed chiefly of thin-walled parenchymatous cells which are cut off from the cambium in regular radial rows and which are continuous with the radial rows of cells in the inner phloem.

The cells vary considerably in width between one radial row and another and many of them are elongated tangentially. As in the phloem it is not possible to discern any medullary rays in the longitudinal sections. The parenchymatous cells are packed with starch but only an occasional cluster crystal of calcium oxalate is present.

The xylem groups contain vessels, tracheids, fibre-tracheids and true fibres. No tracheidal vessels are present. The vessels have thick walls which are strongly lignified. The pits are usually round or oval bordered. The vessel elements may be long and narrow or they may be short and wide. The dimensions are R and T = 45 to 150 μ , L = 70 to 210 μ . The tracheids have thickened, lignified walls with elongated bordered pits. and measure R and T = 20 to 50 μ , L = 140 to 400 μ . The fibre-tracheids also have thickened, lignified walls with elongated, often slit-like pits. They measure R and T = 15 to 50 μ , L = 250 to 650 μ . The true fibres measure R and T = 15 to 50 μ , L = 300 to 1500 μ and they have lignified walls up to 10 μ thick and with small slit-like pits. There are no latex cells in the xylem (Figs. 1, C; 3).

The secondary phloem and central secondary xylem consist of elements similar to those in the tertiary tissues.

CHARACTERS OF POWDERED IPOMOEA

1. Abundant starch, chiefly 2-4.8-14.8-33 μ in diameter, but with some grains occasionally up to 40 μ . The smaller grains are rounded or oval and occur singly; the larger grains are muller-shaped and occur chiefly in groups of up to 8 components.
2. Portions of parenchymatous tissue packed with starch.
3. Numerous cluster crystals of calcium oxalate 8-11.4-24.8-48 μ in diameter. Some prismatic crystals of calcium oxalate 10-20 μ long.
4. Portions of parenchymatous tissue containing files of cluster crystals of calcium oxalate.
5. Masses of brownish granular latex which stains bright lemon yellow with dilute solution of iodine.
6. Brown cork in surface view, some cells of which have slightly lignified walls. The cells measure 30-85 μ long and 20-45 μ wide.
7. Fragments of lignified, thick walled vessels with round or oval bordered pits.
8. Tracheids, often entire, measuring 140-400 μ long by 20-50 μ wide and having elongated bordered pits.
9. Fibre-tracheids, often entire, measuring 250-600 μ long by 15-50 μ wide, and having oblique slit-like pits.
10. Fragments of fibres, 15-20 μ diameter with lignified walls up to 10 μ thick and having small slit-like pits.

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11. Isodiametric sclereids, 80–175 μ long, 50–150 μ wide, with lignified walls, 10–25 μ thick and having simple branched pits.
12. Elongated sclereids, 50–120 μ long, 20–80 μ wide, with lignified walls 8–25 μ thick and having simple pits.

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