

***Hydrastis canadensis* L.**
Goldenseal Rhizome and Root
Hydrasti Rhizoma et Radix
Ranunculaceae

Goldenseal root is one of the most commonly used botanicals in Western herbal traditions for the treatment of mucosal infections. It is rich in the alkaloid berberine, which has strong antimicrobial activity. There are many plants that are used as adulterants of goldenseal including yellow dock root (*Rumex* spp.), Oregon grape root (*Mahonia* spp.), yellow root (*Xanthorhiza simplicissima*), and *Coptis* spp. Additionally, goldenseal leaf is often intentionally or unintentionally included in material denoted as root. Differentiations for these adulterations are easily discerned and are provided in this atlas.

A. Rhizome

Transverse section: Parenchyma tissue dominates the rhizome in this view. Cork thin, yellowish- or reddish-brown, of several thin-walled cell layers; secondary phloem of generally rounded or polygonal and thin-walled parenchyma that frequently contain yellowish-brown granular masses; walls may be somewhat thickened in outer region; semicircular regions of smaller cells close to the cambium indicate sieve tubes and companion cells; phloem bundles aligned radially with strands of vessels in secondary xylem; vessels often filled with yellow granular masses, and arranged in narrow cuneiform groups separated by broad medullary rays; pith cells thin-walled; crystals, sclereids, and fibers mostly absent. Although infrequent, when fibers are present they are usually associated with the vessels and are thin-walled with simple pits and are lignified.

Longitudinal section: Secondary phloem parenchyma cells elongated in this view; vessels small with numerous slit-shaped pits, bordered pits, scalariform, or helical secondary walls; the simple circular perforation plates of the vessels are conspicuous.

Starch: Abundant in parenchyma cells; grains simple or compound, more or less spheroidal, from 2-15 μm diameter, with round or slit-shaped hilum.

B. Root

Transverse section: Parenchyma tissue dominates the root in this view. Hypodermis one cell layer thick; secondary cortex parenchymatous, separated from vascular tissue by conspicuous endodermis composed of cells often having sinuous walls; vascular tissue of older root oligarch; crystals and sclereids absent. Fibers may be rarely present in the root.

Powder (rhizome and root): A dull yellow-ochre powder with a faint, unpleasant odor and a persistently bitter taste; when chewed it colors the saliva yellow. Fragments of fibers, mostly associated with starch-bearing parenchyma may be present; small vessels with pitted (simple and bordered), scalariform, or helical secondary walls and circular perforation plates; less frequent larger vessels with reticulate walls; infrequent short fibers with thin walls and simple pits; tabular cork cells with yellowish- or reddish-brown walls and occasional yellowish-brown granular masses attached to them. Numerous, mostly simple with or without spheroidal starch grains, free or in parenchyma cells; yellow to yellow-brown granular masses. The primary diagnostic characteristics of this species are the pervading yellow color, the minute starch granules, the absence of crystals and sclereids, and infrequent fibers.

Mixture of goldenseal root with leaf: Goldenseal leaf powder is dark green and lacks the persistent characteristic odor and taste of the root. If present, it will give the powder a greenish hue. Pure goldenseal leaf or admixtures of root and leaf can be microscopically identified by the occurrence of leaf fragments with unicellular, thick-walled, acute trichomes (up to 600 μm in length) and epidermal cells with wavy or sinuous walls. On fragments from the lower epidermis, anomocytic stomata are often found.

