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On the Complexity of Simples, Pharmacognosy, and Actaea Racemosa

W. John Hayden
University of Richmond, jhayden@richmond.edu

ON THE COMPLEXITY OF SIMPLES

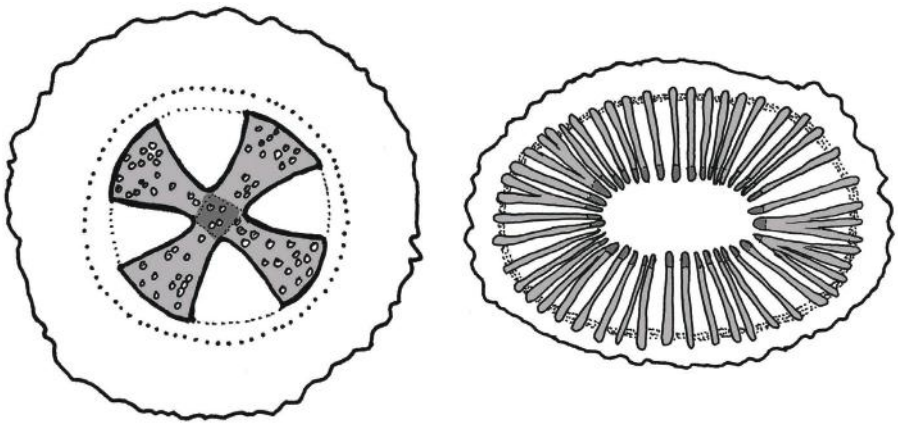
Pharmacognosy and *Actaea racemosa*

Article and illustrations by W. John Hayden, Botany Chair.

Pharmacognosy, a discipline at the intersection of botany and medicine, deals with knowledge about medicines derived from plants (Youngken 1950). A central goal of pharmacognosy is the accurate and consistent taxonomic identification of medicinal plants and medicinal plant products. Unlike drugstore pill bottles, medicinal plants in nature do not come with labels. One aspect of pharmacognosy, then, is the identification of whole plants found in nature. Much as in field botany and plant systematics, this aspect of pharmacognosy involves learning to recognize species by overall appearance (gestalt), or by dichotomous keys, or both.

Seldom, however, do entire plants possess desirable medical properties. Rather, depending on the species, useful compounds tend to be concentrated in just one or a few plant organs. In the case of *Actaea racemosa* (Black Cohosh), the Virginia Native Plant Society's 2017 Wildflower of the Year, medicinal properties are concentrated in the roots and rhizomes (see sidebar). For other medicinal plants, leaves, flowers, fruits, or seeds are prized.

Typically, once a medicinal plant is found, only the organs with medicinal properties are harvested, and these crude bits of plant matter are known as simples. Simples are usually dried for storage and subsequently may be shredded or pulverized. Obviously, it is just as important to be confident of the identity of one's stockpile of simples as it is to know their sources in the field. Consequently, pharmacognosy also strives to provide means for identifying isolated and dried plant organs, whether intact, sliced, diced, or powdered. Identification of simples is, thus, a particularly challenging aspect of pharmacognosy, which by necessity adopts the tools and techniques of comparative microscopic plant anatomy. This article explores anatomical aspects of Black Cohosh used in pharmacognosy to aid in identification of this significant medicinal plant. Much of the information discussed here was developed in the late 19th and early 20th centuries, but remains relevant today.



Figures 1 and 2. Root and rhizome of *Actaea racemosa* as seen in cross section. Dark-gray regions represent first-formed (primary) xylem, light gray represents later-formed (secondary) xylem. Figure 1. Root; central diamond-shaped area of primary xylem; the Maltese cross–like pattern develops as secondary xylem is added to the root. Figure 2. Rhizome; xylem in the form of radially elongate patches of cells; primary xylem is innermost. Figures 1 and 2 redrawn by W. John Hayden from *Wintermute* (1905).

Before delving into the details of Black Cohosh's microscopic structure, it is worth noting that the diversity of plant form (sometimes referred to as disparity) is pervasive at all levels of biological organization. From whole plant architecture to the microscopic bumps on pollen grains, the plant kingdom encompasses a staggering array of forms. It is disparity of form that allows allergists to identify pollen grains caught floating in air or investigators to identify fragments of leaves or stems found at crime scenes. Pharmacognosy similarly exploits this fundamental disparity of plant form. The whole point, of course, is to guarantee correct identity of natural medicine ingredients and to guard against adulteration.

A noteworthy aspect of the roots and rhizomes of *Actaea racemosa* is that their internal tissues are yellow, a somewhat unusual feature that certainly helps in identification when confronting an apothecary's simple. But other plants in the Buttercup Family (Ranunculaceae) and the closely related Barberry Family (Berberidaceae) have similar yellow pigments in their roots and rhizomes. Consequently, additional anatomical details of each organ are required to assure correct identification.

Black Cohosh in the Wild: Let It Be!

Black Cohosh is in demand as a medicinal plant because it produces a number of biologically active compounds. In addition to antioxidant caffeic acids, multiple steroidlike triterpenes, and a number of different alkaloids and amines, are present. In short, there are many different molecules that interact with the nervous system and hormonal regulation. In fact, so many biologically active compounds are present that scientific deciphering of their collective modes of action is a complex and ongoing endeavor. Nevertheless, Black Cohosh remains a popular herbal medicine, widely available in health food stores as a dietary supplement. While the Virginia Native Plant Society takes no position on the efficacy of Black Cohosh in treating any of the several conditions for which it has been and continues to be promoted, VNPS is vigorously opposed to the collection of Black Cohosh, or any other wild plant, from the wild for medicinal purposes. Black Cohosh is amenable to cultivation; therefore, demand for herbal Black Cohosh should be met without depletion of its native populations. ❖

ROOTS

Roots of vascular plants always have a central core of water-conducting xylem tissue, flanked by patches of sugar-transporting phloem. The pattern of xylem and phloem, as viewed in root cross sections, may take the form of a simple narrow ellipse, a triangle, a diamond, or a polygon of five or more sides. Most often, young roots of Black Cohosh have a central diamond-shaped patch of xylem cells, but many other plants also have essentially the same pattern. The pharmacognocist must then turn to older roots. In *Actaea*, additional (secondary) xylem cells form along the sides, but not the tips, of the young root's initial, diamond-shaped, patch of xylem, resulting in a distinctive Maltese cross pattern in older roots (Figure 1); this is unique to *Actaea*. In contrast, most dicot roots add secondary xylem in a pattern that quickly assumes a circular outline. The distinction between older roots of *Actaea* and just about everything else is clear-cut.

STEMS.

Unlike roots, xylem and phloem tissue in stems of flowering plants form distinct clusters called vascular bundles, usually with xylem cells occupying the inner portion of the bundle and phloem present in the outer portion. In young stems of eudicots these vascular bundles are disposed in a ring near the stem surface. Sections of young rhizomes (horizontal basal stems) of *Actaea racemosa* reveal a notably large number of vascular bundles, a salient detail, but not definitive for identification. However, the pattern of accumulating additional (secondary) xylem cells marks *Actaea* rhizomes as unique among medicinal plants. Via secondary growth, over time, new xylem cells are added to individual vascular bundles, resulting in elongate radial strands of xylem tissue (Figure 2). In contrast, most dicots produce secondary xylem in the form of concentric rings—the same pattern seen in growth rings on tree stumps.

In summary, yellow roots with a Maltese cross pattern of xylem and yellow rhizomes with multiple, radially elongate, patches of xylem will confirm unknown samples as Black Cohosh. Now, imagine the documentation of anatomical details such as these for all plants with important medicinal properties, and you have a glimpse of the discipline of pharmacognosy. Knowing one's simples is no simple matter! ❖

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VIRGINIA NATIVE PLANT SOCIETY

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