

In case of belladonna root the rate of free flow decreases after a time, even though the pressure in the percolator decreases; with the other drugs there is a decreased pressure accompanied by an increased rate of flow as percolation proceeds. In general, the use of increasing quantities of moistening liquid decreases the pressure and increases the rate of free flow. Maceration after packing increases the pressure in the percolator. The greatest pressure was observed during the percolation of red cinchona, while the greatest decrease in pressure during percolation was observed with senna.

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A STUDY OF *LACINARIA* SPECIES.\*

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*Lacinaria* or *Laciniaria*<sup>2</sup> is the name generally used to-day by taxonomists for the genus formerly known as *Liatris*, although this latter name still persists on continental Europe. Under the name "Liatris," the corm of several species of the genus has been used in American medical practice for over a century, particularly by the Eclectics and Shakers.

In the present work, attention was confined chiefly to the species *L. spicata* (L.) Kuntze and *L. tenuifolia* (Nuttall) Kuntze, which grow commonly in the region of Gainesville, Florida. The former species was particularly valuable for study because it is the subterranean parts of this member of the genus which have been used most frequently as a drug.

## LACINARIA SPICATA.

*Lacinaria spicata* has been known by at least thirty-five common English names, of which the most important are (Blue) Blazing Star, (Ohio) Devil's Bite, Rattlesnake's Master, (Spike) Gayfeather, and (Spiked) Button Snakeroot. Some of these names indicate medicinal uses of the plant, and even the scientific name, *Liatris*, is said by some to be derived from a Greek word meaning "invulnerable," referring perhaps to its supposed value in treating (snake) wounds. The species differs from all but two or three others of the same genus in preferring a thinly wooded moist humid soil. It is said to grow throughout eastern North America in the area bounded by the Atlantic Ocean on the east, the Gulf of Mexico in the south, Arizona and Colorado in the west, and Minnesota and Ontario on the north. It is perhaps the most widely distributed *Lacinaria* species.

The underground portions used constitute the corm with attached fibrous roots. The corm is irregularly globoid, tapering to the stem above, often laterally lobed, and measuring 1.5 to 2.5 cm. in vertical diameter and 1.5 to 3 cm. in horizontal diameter. Externally, it is pale reddish brown to brownish gray, with roughly furrowed surface; the upper portion covered with adherent fibrous leaf bases, the lower bearing numerous small fibrous roots which originate largely at the tips of the corm protrusions. Fracture tough, woody, showing dirty yellowish internally; when cut, showing waxy sheen. In younger specimens one or two, in older several, woody rings

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<sup>2</sup> The authors consider *Laciniaria* to be somewhat less preferable by reason that the same name is given to a molluscan genus.

noted as distinct striations. The corm is protected externally with several layers of cork cells, while the great bulk of the organ consists of parenchyma tissue. Scattered sporadically through the cork and constituting a secondary cortex to protect the vascular bundles outside of which they lie are strands of sclerenchyma. Sclerenchymatic strands also extend radially through the phloem and xylem.

Odor strongly terebinthinate, aromatic, somewhat resembling that of elecampane. Taste strongly terebinthinate, acrid, unpleasant, burning.

The roots are small and fibrous; in cross section, the cortex is approximately equal in thickness to the wood from which it is easily separable.

#### LACINARIA TENUIFOLIA.

This species has been referred to in English by at least thirteen common names, of which the most characteristic is probably Slender-Leaved Blazing Star, or simply Blazing Star. In the region of Gainesville, it appears to have the common name of "Deer Bowl."

The plant has a more restricted geographical distribution than *L. spicata*, being found from North Carolina to southern Florida and west into Alabama.

The corm is sub-globose, in older specimens tending to become irregular in form; varying from 1.2 to 2 cm. in vertical diameter, and from 1.5 to 3 cm. in horizontal diameter. Externally, dark grayish brown, with smooth surface; upper portion showing traces of stem or stems; lower portion bearing root scars and fibrous roots, much less abundant than in *L. spicata*. Fracture of corm woody; internally, pale yellowish to faint brownish white. Otherwise similar to *L. spicata*.

Odor characteristic, aromatic, somewhat terebinthinate; taste rather sweetish and pungent.

#### CHEMISTRY.

General analysis by the Dragendorff scheme gave the following results in percentages of the bone-dry weight:

	<i>L. spicata</i> .	<i>L. tenuifolia</i> .
Moisture (corrected for vol. matter)	7.79	7.61
Ash, total	5.32	7.74
acid-insoluble	....	4.38
Petroleum ether extract, total	4.18 (hot)	4.58 (cold)
non-volatile	4.12	...
volatile	0.06	...
Ethyl ether <sup>1</sup> extract, total	3.46 (hot)	9.81 (hot)
non-volatile	2.91	7.86
volatile	0.55	1.95
Ethyl alcohol extract	2.08 (abs.)	6.81 (92%)
		14.69 (70%)
Distilled water and NaOH solution extract	67.74	56.02
Total extractive and moisture	85.25	84.83
Crude fibre, etc.	14.75	15.17
	100.00	100.00

<sup>1</sup> Used ordinary ether (97%).

The specific constituents found included the following:<sup>1</sup> volatile oil, 0.02% (0.06% in

<sup>1</sup> Qualitatively, the two species were found very similar; unless otherwise noted, the percentages refer to *L. tenuifolia*.

*L. spicata*); fixed oil, 4.56%; unsaponifiable matter, 0.02%; resin acids, 3.59%; resenes, etc., 4.29%; tannin; a sterol; caoutchouc-like substance; phlobaphene; bitter principle; reducing sugars, including ketohexoses; inulin; phytomelane; suberin; lignin; cellulose; mineral matter.

The sclerenchyma cells of the rhizome and also of the pericarps of both species and also of *L. pauciflora* (Pursh) Kuntze were embedded in phytomelane. This material has been found in the flower head of *L. scariosa* by Hanausek (1), and it has been discovered in the flower heads of many other *Compositæ*, but this is apparently one of the few times in which it has been reported from the underground parts.

The sterol resembled that one found by Rümpler (2) in the beet and named by him "Betasterin." This sterol had a melting point of 116°, was practically insoluble in cold water, and boiling water dissolved only one part in 1750 of solvent. It was only slightly soluble in 92% alcohol, petroleum ether (1:700); somewhat more soluble in cold absolute alcohol (1:200) and chloroform (1:90), and most soluble in ether (1:24). The sterol occurred in the form of rhombic or acicular crystals. With ferric chloride solution, strong hydrochloric acid, and chloroform, a dark blue coloration was produced. When treated with diluted sulphuric acid (1:5 of water), a greenish coloration was produced, and on the addition of iodine solution, several successive coloration reactions occurred through yellow and red to red-brown.

Coumarin has frequently been reported from the dried leaves of *L. spicata* (3), (4) and related species; while Sanford (5) found that the inflorescence rather than the leaves gave out the greater fragrance. In the present work, dried plants were placed in a chamber saturated with ether vapor. After a time, the plants of both species had the distinct hay odor characteristic of coumarin.

#### USES.

Members of genus *Lacinaria* have been used as foods (*L. punctata* Hook by the Tewa Indians (6)), for ornamentation, in perfumery and as insect repellent (*L. spicata*), as medical agents, and as adulterants for other crude drugs.

As a drug adulterant, the subterranean parts of *Lacinaria* species have been used to adulterate Helonias (7), and possibly to substitute for *Glycine apios* L. (*Apios tuberosa* Moench), known as Indian Potato (8). *L. spicata*, in particular, has been used as a substitute for *Eryngium aquaticum* L. (Water Eryngo Root), while various species of *Lacinaria* have been substituted for the more desirable *L. spicata* (8).

A great deal has been written in regard to the medicinal value and uses of "Liatris." In the past, it has been referred to as alexiteric (especially in rattlesnake bite), diuretic, astringent, tonic, stimulant, alterative, diaphoretic,<sup>1</sup> febrifuge, antispasmodic, anodyne, emmenagogue, expectorant, carminative and anti-syphilitic. It has been recommended for use in a great many conditions and diseases; in general, it has been looked upon as most valuable in genito-urinary disorders, in addition to its systemic uses.

To determine as clearly as possible the effects of the drug, preparations of *Lacinari tenuifolia* were administered first to a guinea pig, in relatively enormous doses, and later to a healthy human subject, in more moderate amounts.

The soft extract prepared by evaporation of the fluidextract was administered orally to a guinea pig weighing 450 Gm. in a dose equivalent to 7.14 Gm. of the crude drug. This represented the equivalent of over 110 Gm. of the crude drug to

<sup>1</sup> Cf. "Diaphoretic or Sweating Powder," patent awarded H. Howard in 1832 (9).

a man weighing 150 pounds. By checking urinary output, this was found to remain practically unaffected, although there was a considerable purgative action. After the lapse of some time, an amount of the sterol equivalent to 62.4 Gm. (of sterol) for a 150-pound organism was administered orally to the same animal: no effects were noted.

Three experiments were carried on with the human subject; in the first, 28.4 Gm. of the drug, in the form of extract and fluidextract, was administered. In the second test, 6 cc. of the fluidextract, representing the average dose, was administered. In the final test, approximately 10 Gm. of the crude drug in the form of decoction was given.

The effects noted include a local stimulation of the mucous surfaces of the mouth and throat, nausea and revulsion from the extreme bitterness, and slight expectorant action. Following absorption, the effects were a pronounced general stimulant and tonic action which manifested itself in insomnia, increased activity, rise in temperature and diaphoresis (the latter two not pronounced, however), and, of particular interest, a reduction in heart rate, with the missing of beats. Even a therapeutic dose reduced the pulse from 67 to 53 beats per minute in the course of four hours, while the largest dose given lowered it to 48 beats. Contrary to the common opinion, and even to the experimental results of Neal (10), *L. tenuifolia* was not found to have a distinct diuretic effect.

#### SUMMARY.

A pharmacognostic examination of the corm and roots of the species *Lacinaria spicata* (L.) Kuntze and *L. tenuifolia* (Nutt.) Kuntze has been made. A preliminary chemical examination disclosed the presence of volatile oil, fixed oil, resins, tannin, a sterol similar to Betasterin, and bitter principle, among other constituents. Phytomelane was found in both the rhizome and pericarp of the two species and also of *L. pauciflora* (Pursh) Kuntze.

The drug gives evidence of value as a tonic, stimulant and cardiac drug; but in the doses in which used, it probably is of little value as diuretic or diaphoretic, properties which have generally been ascribed to it.

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The University of Texas, in cooperation with the Commission of Control for Texas Centennial Celebrations, is planning a University Centennial Exposition on the campus at Austin from June 1st to November 30th, of this year.