

ART. V.—*Berberin in Hydrastis Canadensis*; by F. MAHLA, Ph.D.,
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HYDRASTIS canadensis L., commonly termed Orange-root, or Yellow Puccoon grows in rich woods from New York to Wisconsin and southward. It is a low perennial herb, which belongs to the natural family of the Ranunculaceæ. The root of this plant contains a large quantity of a yellow coloring matter and its juice has indeed been used by the Indians to color their clothing yellow. It has been asserted also, that the Cherokees used to employ it for the cure of cancers and other diseases. In regular medical practice the root itself was but little used, until the so-called eclectic and botanic physicians began to employ it largely in their prescriptions. Of late even our regular physicians have begun to use an article, which was introduced by several parties under the false name of *hydrastin*. This so-called hydrastin is, as some experiments lead me to believe, not an isolated organic principle, but merely a dissicated alcoholic extract of the Orange-root and must accordingly be so denominated.

Hydrastis, however, contains an alkaloid and there are several methods mentioned by which it may be most conveniently ex-

tracted. The eclectic Dispensatory gives one of those methods, according to which the powdered root should be extracted with alcohol. The tincture thus obtained is then evaporated, the residue mixed with water, the whole filtered and a quantity of hydrochloric acid added to the watery liquid, when a beautiful crystalline precipitate makes its appearance, which was *assumed to be the pure hydrastin*.

The circumstance, that this substance is precipitated from its solutions by a mineral acid, at the first glance makes its basic nature a little improbable. This circumstance combined with the fact, that an organic elementary analysis of this substance does not exist, seemed to make it desirable to have its properties a little better investigated.

In preparing the body in question, I followed in general the above given directions. I modified the process merely by effecting the extraction in a hot-water percolator so that the alcohol was always in boiling condition. I found, that by this modification, the process was finished in a much shorter time and that less quantities of alcohol were necessary. The crystalline body, formed by the addition of hydrochloric acid, was collected on a calico filter, pressed and redissolved in boiling alcohol. The hot filtered solution readily deposits on cooling such an amount of crystals, that the whole seems to form one solid mass. These crystals were again pressed and once more crystallized from alcohol, after which they were considered pure.

This substance forms, when dry, a light yellow powder, which presents under the microscope the appearance of prismatic crystals. It has a bright yellow color and a very intense bitter taste. It is inodorous and little soluble in cold water, to which it imparts, however, a deep yellow color. Cold alcohol dissolves also very little but it is readily soluble and in large proportions both in boiling water and in alcohol. These hot solutions exhibit a brown-yellow tint, while the cold diluted solutions are purely yellow. Neither litmus nor curcuma paper is affected by them.

Concentrated sulphuric acid dissolves it with olive green color and disengages hydrochloric acid.

Concentrated nitric acid produces a deep red solution under disengagement of nitrous acid vapors.

It does not emit any trace of ammonia, when boiled with a diluted solution of caustic potassa, but clots together and is transformed into a brown resinous substance, which adheres strongly to the sides of the vessel. This resinous body is insoluble in water but soluble in alcohol, to which it imparts a bitter taste.

Heated with soda-lime it emits ammonia.

Dry chlorine gas transforms it into a red body, which is readily soluble in water.

Polysulphid of ammonium, when mixed with a hot solution of this so-called hydrastin produces immediately a red brown precipitate.

Sulphate of copper is precipitated with a yellowish green; nitrate of silver, chlorid of zinc, corrosive sublimate, chlorate of potassa, and chlorid of platinum with a yellow color. A solution of bichromate of potassa when mixed with a solution of this body throws down an orange-yellow, cyanid of potassium an ochre-yellow and ferrocyanid of potassium a greenish-yellow precipitate.

When moderately heated it exhibits a deeper yellow tint; the original bright yellow color is, however, restored on cooling; if heated to a higher temperature it melts like a resin and leaves finally a light coaly residue.

All these reactions coincide so completely with the reactions of muriate of Berberin, that I should not have hesitated a moment on this evidence alone to declare its identity with that alkaloid.

(The fact that berberin is precipitated from its solutions by hydrochloric acid explains the peculiar method of preparation of hydrastin.)

To quiet, however, all doubts, I undertook an elementary analysis of it, which lead to the following results:

1. The nitrogen was determined by Will and Varrentrapp's method. Before commencing the experiment, I dried the substance for 10 hours at a temperature of 100° C. The quantity of material employed amounted to 0.416 grammes. It yielded 0.236 ammonia-chlorid of platinum. This corresponds to 3.563 per cent of nitrogen. Muriate of berberin dried at 100° C. requires 3.57 per cent.

2. The combustion for the determination of carbon and hydrogen was made with bichromate of lead.

0.440 substance dried at 100° C. yielded:—

Carbonic acid	= 1.0450	which corresponds to carbon	= 64.77 per ct.
Water	= 0.2035	“ “ hydrogen	= 5.138 per ct.

Muriate of berberin dried at 100° C. requires in 100 parts 64.20 carbon and 4.841 hydrogen.

3. The quantity of chlorine was found by precipitating the boiling solution of the substance with nitrate of silver. This mixture was filtered, when still quite hot, and washed on the filter with boiling water.

The material also in this instance was dried at a temperature of 100° C.

0.497 substance yielded 0.1725 chlorid of silver; this corresponds to 8.579 per cent of chlorine.

Muriate of Berberin requires 9.03 per cent chlorine.

Berberin has been discovered thus far in different species of

the Berberideæ and in one or two speics of the Menispermeæ. This occurrence was one of the principal arguments, with which the union of these two families in one under the name of Cocculineæ was justified.

It is, as far as I am aware, the first instance that this interesting body has been found in a plant, which belongs to the Ranunculaceæ. This circumstance is, therefore, a proof, that even true alkaloids may occur in *several* plants which belong to *different* families.

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