

# CHEMICAL CONSTITUENTS OF THE PITCHER LIQUOR OF THE SARRACENIACEÆ

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## HYDRION CONCENTRATION OF THE PITCHER LIQUOR

The hydrion concentration of the pitcher liquor was determined in the field by the colorimetric method devised by Wherry<sup>73, 74, 75, 76, 77, 78, 79</sup> for the study of soil reactions. Dr. Wherry had made certain determinations on the liquor of mature pitchers of *Sarracenia purpurea* prior to the inclusion of this phase of the biochemistry of the *Sarraceniaceæ* within the scope of our research. All values, whether determined by him or by ourselves, are expressed as *specific reactions, i.e., specific acidity or specific alkalinity*. We are indebted to him for the following results on liquor from open pitchers of various species of *Sarracenia*. Each test, unless otherwise stated, was made on liquor from a single pitcher.

### SARRACENIA PURPUREA

- May 8, 1919. Essick Heights, Pa., Bog water acid 300; pitcher liquor acid 300.  
May 13, 1919. Green Pond, N. J. Swamp water alkaline 30 to acid 30; sphagnum hummocks in which plants grew acid 300; pitcher liquor 5 tests, 1 alkaline 3, 1 neutral, 3 acid 3 to 30.  
May 14, 1919. Dover, N. J. Swamp water acid 300; pitcher liquor 3 tests, 3 acid 30 to 300.  
June 20, 1919. West Burke, Vt. Bog water acid 300; pitcher liquor acid 300.  
August 7, 1919. Nuangola, Pa. Bog water acid 300; pitcher liquor acid 300.  
January 1, 1921. Gary, Ind. Bog water alkaline 3; muck at base of plants neutral; pitcher liquor acid 3.  
June 28, 1922. Wilmington, N. C. Sandy soil acid 300; pitcher liquor acid 300.  
August 20, 1922. Laurel, Md. Swamp soil acid 300; pitcher liquor acid 300.  
August 3 to 18, 1923. Mount Desert Island, Me. New Mill Meadow. Stream water acid 3, peat soil acid 30, liquor from young pitcher alkaline 10, liquor from older pitcher of same plant acid 300.  
Witch Hole. Lake water acid 30, sphagnum soil acid 1,000,

liquor from young, just opened pitcher acid 1,000, old pitcher alkaline 10.

Great Cranberry Island. Peat soil acid 1,000, pitcher liquor 10 tests, acid 100 to 3,000.

September 9, 1923. Mineral Springs, Ind. Swamp water alkaline 3 to 10, soil hummocks neutral to acid 300, pitcher liquor several tests acid 10 to 1,000.

## OTHER SPECIES

- S. minor.* June 20, 1922. Cox, Ga. Mud soil acid 30, pitcher liquor acid 300. Peat soil acid 300, pitcher liquor acid 300.  
 June 24, 1922. Summerville, S. C. Woodland soil acid 300, pitcher liquor acid 300.  
 June 25, 1923. Buffton, S. C. Pitcher liquor acid 1,000.
- S. flava.* June 25, 1921. Flat Rock, N. C. Sandy meadow soil acid 300; pitcher liquor acid 300.  
 June 24, 1922. Summerville, S. C. Soil acid 300; pitcher liquor 6 tests, 6 acid 30 to 300.  
 June 29, 1922. Winter Park, N. C. Peaty meadow soil acid 300; pitcher liquor acid 300.  
 June 25, 1923. Near Statesville, Ga. Pitcher liquor acid 3,000.
- S. rubra.* June 29, 1922. Winter Park, N. C. Sandy soil acid 300; the pitchers contained no liquor, distilled water was introduced into them and attained a reaction of acid 300.  
 June 25, 1923. Near Statesville, Ga. The pitchers contained no liquor; distilled water, used as in the preceding experiment, attained a reaction of acid 300.
- S. psittacina.* June 25, 1923. Near Statesville, Ga. The pitchers contained no liquor; distilled water was introduced into them and attained a reaction of acid 300.

*Our tests on Sarracenia purpurea*, made at Whitings and Davenport, Ocean County, N. J., showed the following range in reaction. Unless otherwise stated, the pitcher liquor was obtained from large, well developed, open pitchers containing much liquor, and each test was made on liquor from a single pitcher.

November 15, 1919. Bog water acid 300; pitcher liquor 7 tests, 1 alkaline 3, 6 acid 3 to 300.

May 23, 1920. Bog water acid 300; pitcher liquor 10 tests, 10 acid 300 to 1,000.

May 29, 1920. Bog water acid 300; pitcher liquor 5 tests, 5 acid 10 to 1,000.

July 7, 1920. Bog water acid 300; pitcher liquor 6 tests, 2 alkaline 3, 4 acid 10 to 1,000.

September 15, 1920. Bog water acid 300; pitcher liquor 8 tests, 8 acid 300 to 1,000.

The tests in May were made on pitchers of the preceding season, the new pitchers not having yet opened.

Three additional tests were made using newly opened pitchers containing few captures and a small volume of liquor. In all three pitchers, the liquor was alkaline 3 in reaction. A composite sample of liquor from 50 such pitchers was also tested, and found to be neutral (alkaline 1, acid 1). These additional tests seem to indicate that the alkaline reaction is more prevalent in the liquor of newly opened active pitchers, while the reaction is more frequently acid in the liquor of older pitchers.

In *our work* on the southern species, tests were made on the liquor from open pitchers of *Sarracenia Sledgei*, *S. flava*, and *S. Drummondii*. The experiments on *S. Sledgei* were made at Biloxi, Miss., May 10, 1921. Using individual pitchers, the reaction of the liquor was neutral in 2 pitchers, alkaline 3 in 1 pitcher, and ranged from acid 3 to acid 10 in 2 pitchers. A composite sample of liquor from 40 pitchers was neutral in reaction. At the time these tests were made, the volume of liquor in each pitcher was very small, and the liquor was diluted with neutral distilled water in the experiments on individual pitchers.

The experiments on *S. flava* were made at De Funiak Springs, Florida, May 19, 1921. The liquor from 5 pitchers, tested separately, was invariably acid; the reaction ranged from acid 100 to acid 3,000.

The experiments on *S. Drummondii* were made at Freeport, Florida, May 22, 1921. Five individual pitchers were tested; the liquor in 3 pitchers had a reaction of acid 3, that in 2 pitchers a reaction of alkaline 3.

#### CONSTITUENTS OF THE PITCHER LIQUOR

The *nitrogen content* of the liquor has been determined for various types of pitchers of *Darlingtonia californica* and *Sarracenia flava*. Liquor from

open pitchers was filtered prior to analysis. The determination was made by the Gunning modification of the Kjeldahl method. The sample was mixed in a Kjeldahl flask with 10 grams potassium sulphate, a tiny fragment of cupric sulphate, and 25 cc. concentrated sulphuric acid. Heat was applied until the water had been driven off; and the determination was then carried out in the usual manner. The samples were preserved for analysis by addition of trikresol immediately after their collection in the field. The results are reported in Table X.

TABLE X.—TOTAL NITROGEN CONTENT OF PITCHER LIQUOR

Sample Number	Genus and Species.	Type of Pitcher	Actual Volume of Pitcher Liquor in Sample cc.	Weight of Nitrogen in Sample mg.	Weight of Nitrogen in 1 cc. of Pitcher Liquor, mg.
1.	<i>Darlingtonia californica</i> . . . . .	Closed	45.45	1.26	0.027
2.	<i>Darlingtonia californica</i> . . . . .	Plugged	22.75	0.35	0.015
3.	<i>Darlingtonia californica</i> . . . . .	Plugged	45.45	0.42	0.009
4.	<i>Darlingtonia californica</i> . . . . .	Open	45.45	1.54	0.034
5.	<i>Darlingtonia californica</i> . . . . .	Open	45.45	2.24	0.049
6.	<i>Sarracenia flava</i> . . . . .	Closed	25.00	0.91	0.036
7.	<i>Sarracenia flava</i> . . . . .	Open	50.00	3.01	0.060
8.	<i>Sarracenia flava</i> . . . . .	Open	25.00	1.26	0.050

*Gross Composition.*—A composite sample of liquor from closed pitchers of *Darlingtonia californica* had a specific gravity of 1.003 at 15° C. It contained 0.213% total solids, 0.104% ash, and 0.046% calcium oxide (lime). The lime formed 44.23% of the ash. The total solids were determined by drying a known mass (approximately 15 grams) of the pitcher liquor, free from preservatives, in a platinum dish at the temperature of boiling water until the weight became constant. The ash was determined by incinerating the total solids in a muffle furnace at a dull red heat. The calcium was precipitated as the oxalate and weighed as the sulphate. Chlorides were present in the liquor, for it yielded a white curdy precipitate with an aqueous solution of silver nitrate; this precipitate dissolved in ammonia water, and was reprecipitated from the resulting solution by nitric acid.

*Tests for Reducing Sugar.*—Composite samples of liquor from closed pitchers of *Darlingtonia californica* and *Sarracenia Sledgei*, and from open pitchers of *D. californica*, *S. Sledgei* and *S. Drummondii*—5 samples in all were tested with respect to their action on Benedict qualitative alkaline copper solution. This reagent was not reduced by any of the samples; therefore, reducing sugar was not present in the pitcher liquor examined. It is, however, possible that the liquor may at times be contaminated by sugar derived from the nectar.

PRESENCE OF HYDROGEN SULPHIDE IN THE PITCHER LIQUOR UNDER CERTAIN CONDITIONS

In certain experiments (page 60) on *Darlingtonia californica*, cubes of coagulated egg white were introduced into open pitchers, and examined 144 hours later. The contents of one of the pitchers then had an odor of hydrogen sulphide.

In other experiments on this species, raw egg white was diluted with nine-fold its volume of water and introduced into 10 plugged pitchers. Five days later, the contents of these pitchers were collected. A composite sample of the contents was placed in a test tube, acidified with hydrochloric acid, and heated. A piece of filter paper, which had been moistened with an aqueous solution of lead acetate, was held at the mouth of the tube. The evolved gas blackened the paper. Therefore, hydrogen sulphide was present in the contents of these pitchers.

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