2. These studies were made many times upon commercial and laboratory samples. A commercial sample which was more than two years old continued to form a sediment after being filtered.

From these observations, we are led to believe that precipitation in fluidextract of senna is due to a slow chemical change, the cause of which is undetermined.

SUMMARY.

1. The literature upon precipitation in senna preparations has been briefly reviewed.

2. A comparative study of sedimentation in the official fluidextracts of senna has been reported.

3. It has been shown that fluidextract of senna continues to precipitate over long periods of time. The practice of allowing fluidextracts to stand for thirty days before being filtered and bottled for the trade is inadequate for fluidextract of senna.

REFERENCES.

(1) Maisch, J. M., *Am. J. Pharm.*, 31, 113 (1859).
(2) Thayer, H., *Ibid.*, 31, 216 (1859).
(3) Groves, T. B., "Proc. Brit. Pharm. Conf.," page 40 (1868).
(4) Lloyd, J. U., PROC. A. PH. A., 29, 408 (1881), *et seq.*
(5) Tschirch, A., and Hiepe, F., *Pharm. Ztg.*, page 117 (Feb. 9, 1901); through PROC. A. PH. A., 49, 735 (1901).
(6) Plenderlieth, J. W., *Pharm. J.*, 87, 884 (1911).
(7) Tutin, F., *Trans. Chem. Soc.*, 103, 2006 (1913).
(8) Wallis, T. E., *Pharm. J.*, 89, 644 (1913).
(9) Broeksmit, T. C., *N. Pharm. Weekblad*, 53, 1600 (1916); through YEAR BOOK A. PH. A., 5, 70 (1916).
(10) Scoville, W. L., JOUR. A. PH. A., 16, 1136 (1927).
(11) Zanotti, V., *L'Officina*, 81 (1929).

TASTE TESTS. IV. RELATIVE BITTERNESS.*

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Previous taste studies have led to the development of a standard method of taste evaluation (1, 2, 3, 4) which has been used in studies on strychnine (5). Tastes, for the purpose of our investigation, have been (arbitrarily) sub-divided into four groups: bitter, sour, sweet and salt. This report deals with the results obtained in studies of relative bitterness. After rinsing the mouth with distilled water, one or two cc. of test solution was placed in the mouth and held there for exactly one minute. The solution was then ejected, and the mouth rinsed with distilled water. An interval of 15 to 30 minutes elapsed between each test. In general, solutions were tasted which were obviously more bitter than the threshold, then the successive dilutions tried until a dilution had been reached which did not appear to have a bitter taste. In successive tests on subsequent days, solutions

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were prepared and tasted starting with the previously ineffective concentrations, until the bitterness threshold concentration had been reached. In some of these examinations the solutions were prepared by one member of the group, and given code designations, so that the subjects would not know what was being tasted. Efforts were made to determine the threshold within a range of plus or minus 10%.

The results obtained have been recorded in mg./litre in Table I. Arbitrarily assigning a value of 100 to Quinine Alkaloid, the relative bitternesses have been calculated.

TABLE I.

Product.	Bitterness Threshold Mg./Liter.	Relative Bitterness.
Brucine	0.2–0.25	1000–1250
Strychnine	0.8	320.0
Quinine	2.5	100.0
Aloin	7.5	33.0
Theobromine	47.6	5.0
Quassia—F. E.	11.0	2.3
Quassia—Infusion	13.0	1.9
Condurango—F. E.	40.0	0.6
Cascara—F. E.	133.0	0.2
Elix. I. Q. & S.*	140.0	0.18
Sucrose Octoacetate	5.0	50.0

* Cc. per liter.

Brucine was three to four times bitterer than Strychnine, and Strychnine about three times as bitter as Quinine. In some preliminary studies, the quantities of Fluidextract of Eriodictyon required to mask these bitter tastes were in the same proportions.

Some difficulty was experienced in determining the threshold for N. F. Elixir of Iron, Quinine and Strychnine. Upon dilution the orange taste tended to persist more forcefully than the bitter taste of the alkaloids. The results obtained in tasting several samples of this product showed only fair agreement with the threshold values calculated from the known alkaloidal content.

Sucrose Octoacetate gave a persistent bitter taste which was somewhat more difficult to remove from the mouth and tongue than the bitter response for the alkaloids.

CONCLUSION.

Using a standardized technique, the threshold bitterness values have been determined for a number of substances.

BIBLIOGRAPHY.

(1) Munch, James C., "Bioassays: A Handbook of Quantitative Pharmacology," Willams & Wilkins, 1931, 140–153.

(2) Munch, James C., "Bioassays of Capsicums and Chillies," JOUR. A. PH. A., 18, 1236–1246 (1929).

(3) Munch, James C., "The Bioassay of Capsicum U. S. P. X," *J. A. O. A. C.*, 13, 383–385 (1930).

(4) Munch, James C., Byers, George E., and Pratt, Harry J., "Organoleptic Bioassays," JOUR. A. PH. A., 23, 24–25 (1934).

(5) Ward, Justice C., Munch, James C., Spencer, H. J., and Garlough, F. E., "Studies on Strychnine. III. The Effectiveness of Sucrose, Saccharin and Dulcin in Masking the Bitterness of Strychnine," JOUR. A. PH. A., 23, 1984 (1934).

STRYCHNINE VIII. THE RELATIONSHIP OF BORAX AND CERTAIN OTHER CHEMICALS TO TOXICITY.*

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Earlier papers in this series presented findings in the Control Methods Research Laboratories of the United States Biological Survey relating to the effects of certain chemicals in modifying the bitter taste of strychnine, (1, 2, 3). The present study grew out of the fact that it was known that certain procedures affecting the bitterness of this alkaloid greatly modifies its toxicity. One case in point is that the addition of a methyl group to the strychnine molecule to form methyl strychnine causes a great reduction in the bitterness and at the same time lowers the toxicity decidedly (4).

Several other theories regarding strychnine action were given more attention in the present study than the taste-toxicity relationship, however. We used chemically unrelated substances in this work, and as a consequence will be forced to report our findings in a rather haphazard manner.

The matter of variation in physiological action of chemically pure strychnine alkaloid might conceivably be mentioned in any study reporting variation in strychnine action presumably due to incorporation with the alkaloid of a foreign chemical. Until the discovery that supposedly identical strychnines would vary decidedly in their killing efficiencies, a tremendous amount of work was done which cannot be compared critically with any later findings, because no reference standard for all tests had been deemed necessary. Within the past year, however, and since the report of our variation findings (5) we have adopted the policy of using a reference standard, so we have a reasonable relationship between various tests.

To emphasize the importance of this factor of variation further, we are presenting a brief summary of the detailed bioassays run at the laboratory during the past year as an introduction to the modification studies.

The system of testing used for all the tests reported in the body of this paper was a minor modification of that reported (5) last year. The rats used were of the same strain and were kept in the laboratory long enough to become acclimated and to have a uniform dietary history. The night before the test the animals were weighed and put into separate cages. They were given water, but no food. The next morning, the strychnine mixture to be tested was made into a suspension by means of 0.2% acacia in water. The animals were then stomach-tubed with the computed quantities in exactly the manner described before (5).

Readings were taken of the time of treatment, the time the animal went down in the first spasm (T/S), the duration of spasm period (T/T), and the time until

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