

CONCLUSIONS.

1. It is ascertained that good French and Spanish Psyllium Seeds of the current American market are yielded by *Plantago psyllium* and *Plantago arenaria*.

2. *Plantago psyllium* seed is superior to *Plantago arenaria* seed in mucilage swelling capacity.

3. Most of the French Psyllium seed is now yielded by *Plantago arenaria*, less by *P. psyllium* while occasional lots contain mixtures of *P. arenaria*, *P. psyllium* and, rarely, *P. Cynops*.

REFERENCES.

- (1) Post, G. E., "Flora of Syria, Palestine and Sinai," pages 671-672 (1896).
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- (3) Youngken, H. W., *Jour. A. Ph. A.*, 21, 1272 (1932).
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- (5) François, L., "Différents Types de Graines du Genre *Plantago*," Dunod, Paris, 7-9 (1933).
- (6) Reichenbach, H. G. L., "Incones Floræ Germanicæ et Helveticæ," 17, Pl. 1135, 1136 (1855).

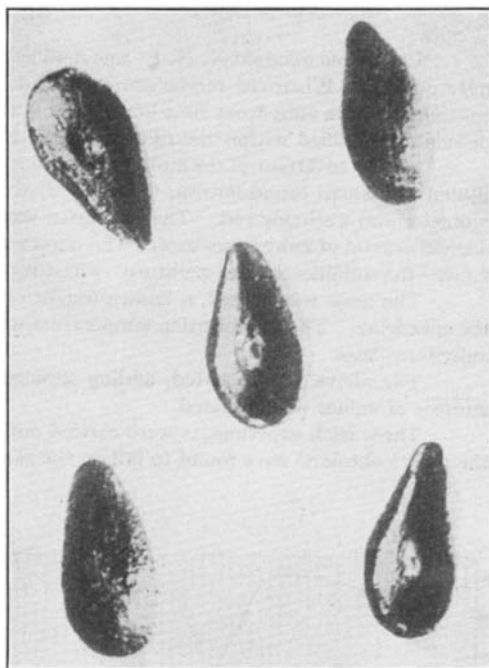


Fig. 7.—Seeds of *Plantago Cynops* L. \times 6.5.

CRYSTALLINE FORMS OF EPHEDRINE ALKALOID.*

BY E. E. MOORE AND D. L. TABERN.

Ephedrine alkaloid as it appears on the market was found to exist in two forms, one containing about 95 per cent of the alkaloid, and five per cent of water, while the other assays nearly 100 per cent. Although the former is crystalline, while the latter is usually an oil or a rock-like solid, assays of the latter indicated that the more nearly the composition approached the anhydrous, the higher the melting point.

Emde (1) reported an ephedrine hydrate containing about 10 per cent of water which would correspond to one mol. of water for each mol. of ephedrine. However, samples of hydrated ephedrine obtained from different manufacturers, or prepared by recrystallizing the alkaloid from water, were assayed in this laboratory and found always to contain about 5 per cent of water. This would correspond to a hemi-hydrate, rather than a hydrate.

The purpose of this work was to prove that the hemi-hydrate is the usual hydrate of ephedrine, to determine the melting point of anhydrous ephedrine, and to ascertain the effects of different amounts of water on this melting point.

* Abbott Laboratories, North Chicago, Ill.

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METHOD.

Ephedrine alkaloid N. N. R. was distilled at 25 mm. Any water which was present came over quickly. When the temperature reached 150°, the receiver was changed and distillation continued. The anhydrous base boiled over within the range, 151–153°. A number of different distillates solidified within the range, 38.0–38.1°.

Fifteen to 30 Gm. of the molten anhydrous alkaloid obtained above accurately weighed was placed in a small round-bottom flask, fitted with a stopper having holes for an Anschutz thermometer and a stirring rod. The apparatus was cooled to 30° C. and the ephedrine seeded with a small crystal of anhydrous base. The mass was stirred and the temperature rose to a constant value—the solidification temperature—where it remained for some time.

The mass was melted, a known weight of water added and incorporated thoroughly with the ephedrine. The solidification temperature was determined by the same procedure used for the anhydrous base.

The above was repeated, adding successive small quantities of water, until the desired number of values was obtained.

Three such experiments were carried out, using different samples of anhydrous base and the points obtained were found to fall on the same curve. (Table I), (Curve I), Fig. 1.

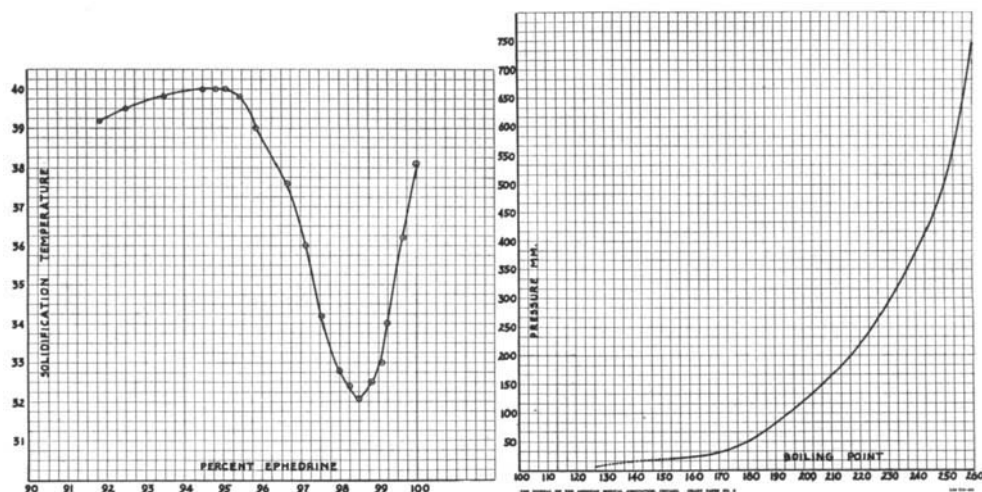


Fig. 1.—Solidification temperature.

Fig. 2.

The values for the anhydrous base and for the base with a half mol. of water were checked by melting point determinations.

The solidification temperature can be determined with as little as 2 Gm. of ephedrine, if a small insulated test-tube is employed as the container. This modified technique has been found to be very useful as a rapid method of determining the purity of the alkaloid.

Anhydrous ephedrine melts at 38.1°. The addition of water lowers the melting point until with 1.5 per cent a eutectic mixture, ephedrine-ephedrine hydrate melting at 32.1° is obtained. Further addition of water raises the melting point until with five per cent a maximum of 40° occurs. The composition of this last substance corresponds closely to that of a hemi-hydrate.

Incidental to the purification of anhydrous ephedrine base by distillation, the boiling point was determined at various pressures in the range of 65 and 760 mm. (Table II), (Curve 2), Fig. 2. This supplements the data between 7 and 25 mm. reported in the A. D. M. A. proceedings for 1933. (2) Above 250° slow decomposition seemed to ensue.

TABLE I.—SOLIDIFICATION TEMPERATURES. SYSTEM, EPHEDRINE-WATER.

Per Cent.		Solidification Temperature.	Per Cent.		Solidification Temperature.
Ephedrine.	Water.		Ephedrine.	Water.	
100.00	0.00	38.1	97.15	2.85	36.0
99.65	0.35	36.2	96.65	3.35	37.6
99.25	0.75	34.0	95.85	4.15	39.1
99.10	0.90	33.0	95.45	4.55	39.8
98.80	1.20	32.5	95.10	4.90	40.0
98.50	1.50	32.1	94.85	5.15	40.0
98.45	1.55	32.1	94.50	5.50	40.0
98.25	1.75	32.4	93.50	6.50	39.8
98.00	2.00	32.8	92.50	7.50	39.5
97.55	2.45	34.2	91.85	8.15	39.2

TABLE II.

Press. Mm.	B. Pt.	Press. Mm.	B. Pt.
745	260	65	185
645	257	32	172
545	253	A. D. M. A. Proc. 1933 (2)	
445	246	25	152-153
345	237	20	146-148
245	224	10	132-133
145	205	7	127-128

When the distilled anhydrous base was crystallized from an anhydrous medium, such as dry ether, crystals were obtained which analyzed 100 per cent ephedrine. When crystallized from water or dilute alcohol, the crystals analyzed 95 per cent.

The anhydrous crystals were very hygroscopic, while the hydrated material did not tend to take up or give off water.

Dr. George L. Clark has kindly studied the crystalline forms of the anhydrous and hydrated bases and found them to be different.

SUMMARY.

Crystalline anhydrous ephedrine was prepared and its melting point determined.

The existence of a hemi-hydrate of ephedrine containing 95 per cent of the base was proved. The anhydrous and hydrated alkaloids differ in crystalline form, melting point, stability and solubility in oil.

The effects of different amounts of water on the melting point of ephedrine were determined.

REFERENCES.

- (1) Emde, H., *Helv. Chim. Acta*, 12, 365 (1929).
- (2) Am. Drug. Mfrs. Assoc., *Proc.*, 235 (1933).

DISPENSARY SERVICE.

Dispensary service owes its existence to the great London fire in 1666. The Pennsylvania Hospital established the first dispensary in this country (1751).