SCIENTIFIC SECTION

PHYTOCHEMICAL NOTES.*

NO. 1. CHEMISTRY OF MONARDA MENTHÆFOLIA.[1]

BY R. S. JUSTICE.

In the course of investigations on the Monardas, a species growing on the eastern slope of the Rockies in Wyoming and Colorado was collected in June and July 1931. The material collected in southeastern Wyoming and the adjacent part of Colorado was identified by Dr. Aven Nelson, botanist, U. of Wyoming, as *Monarda menthæfolia*, R. Grah.

As a preliminary the plants were divided into flower heads (8.76%), leaves (40.76%), stems (45.55%) and roots (4.93%). The ash was determined in each case, as also were some of the more common elements, some of the fundamental structural units of plant tissues and the Dragendorf type selective solvent extractives. The results obtained were as follows.

TABLE I.—ASH AND MISCELLANEOUS DETERMINATIONS, PERCENTAGE RESULTS.*

Determination.	Flower Heads.	Leaves.	Stems.	Roots.
Moisture	10.57	10.24	9.09	8.94
Total ash	9.66	9.47	4.61	10.63
Water-insoluble ash	7.42	6.04	2.53	9.34
Water-soluble ash	2.28	3.44	2.08	1.29
Acid-insoluble ash	3.16	1.54	0.16	6.59
Ash constituents				
Calcium (Ca)	0.73	0.98	0.31	0.50
Magnesium (Mg)	0.13	0.28	0.09	0.017
Iron (Fe)	0.24	0.45	0.12	0.49
Aluminum (Al)	0.91	0.59	0.50	0.35
Chlorine (Cl)	0.014	0.044	0.04	0.023
Sulphate $(SO_4)''$	0.28	0.24	0.07	0.11
Silicate $(SiO_3)''$	3.98	2.32	0.53	8.54
Phosphate $(PO_4)'''$	0.26	0.28	0.19	Trace
Alkalinity of ash $(CO_3)''$	2.92	2.78	2.22	1.76
Pentosan	10.09	8.59	17.42	16.44
Crude fibre, U. S. P. X	12.65	10.62	42.32	35.74
Crude fibre, Dutch method	10.43	9.20	28.69	23.52
Tannin	2.90	4.85	3.98	6.30
Volatile oil	0.31	0.31	0.05	Trace

NOTES: * Each result represents the average of two or three determinations.

Methods:

Moisture (1), water-insoluble ash (8), total ash (2), acid-insouble ash (2), calcium (3), magnesium (4), iron (6), aluminum (6), chlorine (7), sulphate (5), silicate (9), phosphate (10),

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pentosan (11), tannin (12), crude fibre (U. S. P. X), Dutch Method crude fibre (13), volatile oil for apparatus (14) and carbonate by titration using standard acid and methyl orange as indicator.

TABLE II.—SELECTIVE SOLVENT DETERMINATIONS, PERCENTAGE RESULTS.

Solvent.	Flower Head.	Leaves.	Stems.
Petroleum ether	4.27	5.68	2.70
Ether	2.11	2.22	0.55
Chloroform	0.43	1.09	1.11
Alcohol	24.76	16.17	11.26
Water	9.63	12.37	3.00
Aqueous KOH (2 per cent)	26.59	30.36	35.73
Aqueous HCl (1 per cent)	5.55	8.66	10.44
Dregs	16.65	13.16	25.05
Moisture	10.57	10.21	9.11
Total	100.56	99.92	98.95

NOTES:

(*a*) The results are the average of two determinations.
(*b*) The Dragendorf procedure was followed.

The combined flower heads and leaves weighing 24.1 Kg. were extracted with 95 per cent alcohol in a Lloyd extractor. The yield of extractive was 16.77 per cent. This extractive was fractionated by subsequent extraction with petroleum ether, water, steam distillation, carbon tetrachloride and ethyl ether. During the investigation the following isolations were made.

(*1*) *A Volatile Oil.*

- (*a*) Thymol.
- (*b*) Carvacrol.
- (*c*) Acetic Acid.
- (*d*) Cymene.
- (*e*) Probably linaloöl (quantity was not sufficient for absolute identification).
- (*f*) Probably geraniol (see note above).
- (*g*) A red resin after the distillation of the phenols.

(*2*) *Non-Saponifiable Matter.*
(*3*) *Fatty Acids.*

- (*a*) Linolenic acid as the hexabromide.
- (*b*) Linoleic acid as the tetrabromide.
- (*c*) Oleic acid as the dibromide.
- (*d*) An unknown fatty acid bromide melting at 95° to 95.5° C. with a bromine content of 46.33 and 46.94 per cent, respectively, for two determinations.
- (*e*) Solid fatty acids.

(*4*) *Hydrothymoquinone.*
(*5*) *A yellow pigment melting at 216° to 218° C.*
(*6*) *A yellow pigment melting at 204° to 205° C.*

NOTE: The ratio of thymol to carvacrol is about 1 to 1.

SUMMARY.

Monarda menthæfolia growing in Wyoming and Colorado was examined chemically. The quantitative determinations include the ash, elements of the

ash, structural elements of the plant, selective solvent extractives and volatile oil. The alcoholic extractive was examined and several isolations were made.

REFERENCES.

(1) *U. S. Forest Service Circular* No. 134.
(2) *Guide for Chemistry 40*, for Pharmacy Students, *University of Wisconsin Bull.*, page 13.
(3) Treadwell and Hall, *Analytical Chemistry*, 2, page 86 (1928).
(4) *Ibid.*, page 78.
(5) *Ibid.*, page 603.
(6) *A. O. A. C. Methods*, page 41 (1920).
(7) *Ibid.*, page 43.
(8) *Ibid.*, page 180.
(9) *Ibid.*, page 39.
(10) *Ibid.*, page 45.
(11) *Ibid.*, page 96.
(12) *Ibid.*, page 259.
(13) Wallis and Goldberg, *Quart. J. Pharm. Pharmacol.*, 4, 28 (1931).
(14) Clevenger, *Am. Perf. Ess. Oil. Rev.*, 25, 467 (1928).

A CONTRIBUTION TO THE PHARMACOLOGY OF PINACOLONE.*

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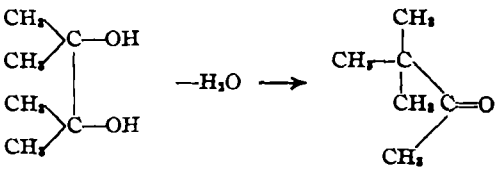
The replacement of the hydrogen atoms in the glycols by alkyl groups confer upon them hypnotic activity. This activity in general increases with the molecular weight of substituent groups. These compounds, known as pinacones, have been investigated pharmacologically. By dehydration of tetramethylethylene glycol, pinacolone is obtained as shown by the following equation:



Thus pinacolone is unsymmetrical trimethyl acetone. No record of a study of the pharmacology of pinacolone was found in the literature (1).

Owing to the structural relationship of pinacolone to the useful hypnotics, the pinacones, the authors decided to investigate its pharmacology.

PREPARATION AND PROPERTIES.

Pinacolone was prepared for us by Dr. Wilton C. Harden of the firm of Hynson, Wescott and Dunning. The method (2) consists of dehydrating pinacol hydrate by means of concentrated sulfuric acid. Pinacolone is a colorless, oily liquid with a strong camphoraceous odor. It boils at 106° C. and is very soluble in alcohol and ethereal solvents, but is sparingly soluble in water.

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* Scientific Section, A. PH. A., Dallas meeting, 1936.

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