

lected as that concentration killing at least three of five animals within three hours. It is recognized that different values for the M. L. D. might be obtained by using a different period of survival. The M. L. D. of this series of oils is given in Table II. Values of ethyl alcohol are given for comparison.

It is evident that these toxicity figures fail to agree among themselves. No lethal doses have been found to agree with chemical analyses for the ascaridol content. Further work is under way in an effort to develop a biological assay which will bear some relationship to ascaridol content. In a similar investigation Knaffl-Lenz has also failed to obtain consistent results upon worms, fish or mice which bore any relation to results of chemical assay.

CONCLUSIONS.

1. The Pharmacopœial assay confirms the greater ascaridol content and higher specific gravity reported for "high-test" oil of chenopodium, as compared with "normal" oil.

2. No method of biological assay has been found which agrees with the chemical determination of ascaridol in either normal or high-test oil of chenopodium.

3. Goldfish, earthworms, bloodworms and porcine ascarides differed in susceptibility to different samples of oil of chenopodium of the same ascaridol content.

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THE VOLATILE OIL OF *PYCNANTHEMUM MITICANS*.*¹

BY HAROLD W. WERNER.

The plant *Pycnanthemum miticans* (Michx.) Pers. (*Koellia mutica* (Michx.) Britton) is a member of a genus represented in the United States by eighteen species, all of which, excepting *P. californicum* (1), are found east of the Mississippi River ranging from Canada down into Florida.

Like the other members of the genus, *P. miticans* is a perennial herb with opposite leaves and square stems. This species grows to be about 1 meter tall, and is more or less branched. The leaf blades are lanceolate, the floral ones whitened, thus giving the plant an attractive and distinctive appearance. The small white flowers, dotted with magenta, are terminally arranged in dense, conspicuously bracted corymbs.

Although oils produced in two consecutive years were investigated, results were parallel; therefore only the work on the oil of 1928 will be reported here.

The herb from which the oil was produced represents two cuttings made while the plants were in full bloom. The material was dried and the oil extracted by

* From thesis presented in partial fulfilment of the requirements for the Degree of Master of Science in Pharmacy, University of Florida, May 1929.

¹ Scientific Section, A. P. H. A., Rapid City, 1929.

steam distillation. 70.41 kilos of dried plant yielded 1102.0 Gm. or 1.57% of dry oil.

The oil was golden-yellow with a somewhat mint-like odor and taste. Its general constants were: 1 cc. soluble in 1.82 cc. of 70% alcohol; d_{20}^{20} 0.9250; a_D^{23} +16.49; n_D^{26} 1.4807; acid value negligible; ester value 12.64 (corresponding to 4.47% of $C_{10}H_{19}OH$ calculated as acetate); ester value after acetylation 61.29 (corresponding to 17.90% of $C_{10}H_{19}OH$ in the original oil); per cent ketone with Na_2SO_3 method 71.75.¹

It should be noted that the ester values are high due, most likely, to the enolization of ketones present in the oil. Under identical conditions pulegone was found to give an ester value of 10.95 which corresponds to 3.87% of an alcohol, $C_{10}H_{20}O$, calculated as acetate. Pulegone after acetylation gave an ester value of 21.0 corresponding to 5.94% of an alcohol, $C_{10}H_{20}O$.

Pulegone.—The presence of pulegone was established by first extracting the ketone from the oil as the sulphite addition compound, using a modification of the normal sulphite assay technique. The ketone was regenerated by treatment with KOH followed by steam distillation. The identity of this material as pulegone is established by a comparison of its properties with those of pulegone (2).

TABLE I.—COMPARISON OF PROPERTIES.

Property.	Regenerated sulphite addition compound.	Pulegone.
Color.....	Colorless, turning yellowish with age	Colorless, darkening on standing
Odor.....	Peppermint-like	Peppermint-like
B. p.....	223–224°	221–224°
d_{15}^{15}	0.9405	0.9405
a_D^{23}	+23.73°	+20° to +23°
n_D^{26}	1.4860	At 20°—1.484 to 1.488
M. p. of semicarbazone.	168°	167.5–168°

TABLE II.—DATA FOR FRACTIONS.

No.	Boiling temperature.	d_{20}^{19} .	a_D^{23} .	n_D^{23} .	Soly. by vol. in 70 per cent alc.	Per cent by vol. of total oil.
1	Below 56°	0.8863	Too small	1.4529	Mostly soluble	0.25
					1:25	
2	56–72°	0.8890	+ 4.20°	1.4512	1:2.1	0.84
3	72–75°	0.8967	+13.02°	1.4514	1:2.3	2.33
4	75–80°	0.9027	+18.12°	1.4554	1:2.3	6.39
	77°					
5	78–81°	0.9117	+21.47°	1.4632	1:2.3	0.98
6	81–89°	0.9204	+18.46°	1.4693	1:2.3	0.75
7	89–110°	0.9265	Too small	1.4813	Mostly soluble	0.13
					1:60	
8	Residue					0.16

The binitroso compound prepared according to Baeyer and Henrich (3) melted at 84–85°. According to the above authors this compound melts at 81°; however, Miller (1) gives 83–84° while Gordon (4) records 85° (uncorr.)

Acids.—After saponification of the pulegone-free oil, the alkaline hydro-alcoholic portion of the reaction mixture was distilled to free it of most of the alcohol. The still-residue was then made acid with dilute phosphoric acid and

¹ The 1927 oil assayed 62.0% ketone.

steam distilled, the distillate being collected in four fractions. These were treated with BaCO_3 and evaporated to a small volume. All four fractions were very low in acid content; however, Fraction 1 reduced AgNO_3 as well as HgCl_2 . This indicates the presence of formic acid. Fraction 2 gave a good ethyl acetate test establishing the presence of acetic acid.

An attempt to identify non-volatile acids in the still-residue was unsuccessful.

Fractionation.—The saponified pulegone-free oil was washed free of alkali, dried with anhydrous Na_2SO_4 and fractionated three times under a pressure of about 1.5 mm.

Menthone.—The odor and properties of Fraction 4 are suggestive of menthone. Its presence in this fraction was established by the preparation of a semicarbazone which melted at $184\text{--}185^\circ$ after recrystallization from alcohol. Wallach (5) gives the melting point of menthone semicarbazone as 184° . Fractions 2 and 3 yielded in smaller amounts semicarbazone melting at 184° and $183\text{--}184^\circ$, respectively.

Menthone was further characterized by the preparation of a thiosemicarbazone, melting at $158\text{--}159^\circ$, from Fraction 4. The melting point of menthone thiosemicarbazone is given as $155\text{--}157^\circ$ by Neuberg and Neimann (6).

Beta-Thujone.—From Fraction 5 a small amount of semicarbazone was obtained which melted at $174\text{--}175^\circ$ after recrystallization from alcohol. Gildemeister and Hoffmann (Kremers) (7) record the melting point of beta-thujone semicarbazone as $174\text{--}175^\circ$. Although this is not believed to be sufficient evidence to definitely establish the presence of thujone, it does show the presence of another ketone which may prove to be beta-thujone.

Alcohols.—From Fraction 5, and in smaller amount from Fraction 6, a phenyl urethane was obtained which after repeated recrystallization from a hydro-alcoholic solvent melted at 108.5° . This and the properties of Fraction 5 indicate the presence of *d*-neo-menthol, the phenyl urethane of which melts at 108° (8). However, the melting point of this compound would also indicate menthol according to the work of Gordon (4) who records the melting point of menthyl phenyl urethane as 108° , and Kremers (9) who gives $108\text{--}109^\circ$ as the melting point of a compound which he states was apparently a menthyl phenyl urethane.

An alpha naphthyl urethane prepared from Fraction 5 melted at $121\text{--}122^\circ$. The melting point of menthyl alpha naphthyl urethane is given as 119° by Bickel and French (10), as 120° by Gordon (4) and as $124\text{--}128^\circ$ by Neuberg and Hirschberg (11). Zeitschel and Schmidt record the melting point of *d*-neo-menthyl alpha naphthyl urethane as 126° (8). Amount of material precluded further investigation.

Additional Compounds.—In addition to the compounds identified, it is evident from the physical properties of the lower boiling fractions that this oil contains a terpene hydrocarbon; however, the amount of material at hand was too small to attempt its re-resolution at this time. The solubility, faint odor, light yellow color, as well as the other physical properties of Fraction 7, also strongly indicate the presence of sesquiterpenes.

SUMMARY.

The dried-above-ground portion of *Pycnanthemum miticans* yields 1.57% of volatile oil containing menthone, 60 to 75.75% pulegone, menthol or *d*-neo-menthol

and another ketone possibly beta-thujone. Acetic and formic acids are present and the presence of terpenes and sesquiterpenes is indicated.

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THE HYPOGLYCEMIC PROPERTIES OF WHITE SNAKEROOT.
(*EUPATORIUM URTICAEFOLIUM*.)

BY G. F. CARTLAND, F. W. HEYL AND E. F. NEUPERT.

It is now well established that the ingestion of white snakeroot by cattle leads to a condition known as trembles and that the use of milk from such cattle may cause milk sickness in man. A historical review of this subject is given in an article by Couch (1) who, as a result of animal experiments, has concluded that the toxic constituent of white snakeroot responsible for trembles is an unsaturated alcohol, tremetol.

That white snakeroot may contain one or more principles which affect the blood sugar is indicated by the fact that both a hyperglycemia and hypoglycemia have been reported in cases of poisoning with this plant. Couch (1) observed that in sheep poisoned with tremetol the blood sugar was markedly increased. On the other hand, Bulger, Smith and Steinmeyer (2) observed the development of hypoglycemia, even to the extent of convulsions and death in rabbits poisoned with white snakeroot. The experiments of these authors indicate a close relationship between the hypoglycemia and the toxic factor inasmuch as a lowered blood sugar was observed only in those animals which were obviously sick. The oral administration of dextrose produced marked improvement in most cases. Bulger, Smith and Steinmeyer regard hypoglycemia as an important symptom of white snakeroot poisoning and suggest the use of a high carbohydrate diet for treatment. These authors interpret the results of their preliminary experiments as indicating that such studies present a new field for the investigation of ketosis and of carbohydrate and fat metabolism. A tea prepared from white snakeroot has been used in some parts of the country for the treatment of diabetes under the belief that this plant contains an "insulin-like" substance.

The experiments here reported were conducted to investigate the "insulin-like" properties of white snakeroot with the object of finding out whether the changes in blood sugar following the oral administration of this plant are due to