Chemical Examination of the Roots of *Aristolochia Indica*, Linn. Part II. The Essential Oil.

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This paper deals with the study of the essential oil (163 g.) obtained from the roots of *Aristolochia indica* during the systematic investigation described in the previous part. The pale yellow oil which separated from the aqueous layer in the steam distillate was dried over anhydrous magnesium sulphate and used for the determination of the physical and chemical constants.

$D_{25°}^{25°}$	0·9525	Acid value	2·0
$\eta_D^{25°}$	1·5023	Ester value	7·3
$\alpha_D^{25°}$	−33·11°	Ester value after acetylation	22·5

The oil possessed the characteristic aromatic odour of the roots. When cooled to −15° it became a viscous liquid strewn with a few crystals. The oil dissolved in 5 volumes of 95% alcohol and was found to be practically insoluble in 70% alcohol. A portion of the oil was subjected to fractional distillation under diminished pressure (1 mm.) ; only a small fraction came over below 100° and over half the quantity was collected between 100° and 116°. The higher fractions up to 150° were in small amounts.

The oil did not contain any substance possessing the phenolic or the lower alkoxy groups. The carbonyl compounds estimated according to the bisulphite method amounted to 3%

The total quantity of the essential oil (150 g.) was dissolved in water and extracted with 5% sodium bicarbonate solution. The amount of free acids thus extracted was found to be too small to permit of any investigation. The oil was recovered from the ether solution and shaken for 48 hours with excess of a saturated solution of sodium bisulphite. The bisulphite extract was separated and hydrolysed by boiling with sodium carbonate. The liberated compounds were extracted with ether and the ether extract, dried over anhydrous magnesium sulphate, gave a small quantity of an oil

possessing the odour of *iso*vaniliin. Attempts to prepare a semicarbazone proved unsuccessful.

The oil was then boiled under reflux with excess of 0·5 *N*-alcoholic potash to saponify the ester constituents. Alcohol was distilled off after one hour, and the alkaline solution was separated from the oil. On acidifying the former, a viscous oil was obtained. This was separated into solid and liquid constituents by Twitchell's method. The former on crystallisation from alcohol melted at 61° and was recognised as palmitic acid (M. W. 254, mixed m.p. with pure palmitic acid 61·5°). The liquid portion (M.W. 286) did not give any solid product when brominated according te Eibner and Muggenthaler and on oxidation with dilute permanganate was converted into dihydroxystearic acid (m.p. 136°; M.W. 316°). Thus the presence of oleic acid in it was established.

The oil (130 g.) was then subjected to fractional distillation under diminished pressure using a four pear Young column and the following fractions were collected:

Fraction.	Temperature	Wt. of fraction.
1	42-44°/5 mm.	2·6 g.
2	110-115°/1 mm.	10·7
3	118-130°	72·6
4	130-140°	16·0
5	140-150°	13·7
6	150-160°	8·3
	Residue and loss	6·1

A small amount of crystalline material separated from the first fraction. This substance also separated out from the second fraction on cooling in the refrigerator. When recrystallised from alcohol, it had the characteristic odour of camphor, m.p. 176°, and did not depress the m.p. of pure camphor. Further examination was not possible owing to the insufficiency of the material.

The fractions 2 to 6 were subjected to very careful and repeated fractional distillations under a pressure of 1 mm. In this manner two principal fractions were obtained, A (75 g.) boiling at 104-05° was colourless, and B (15 g.) boiling at 128-30° was pale green.

Isolation of a new Sesquiterpene—Ishwarene.

Several unsuccessful attempts were made to refractionate A by distilling it at different pressures. Finally it was repeatedly distilled over sodium till all the compounds containing oxygen were eliminated. The purified substance was a mobile colourless liquid and analysis showed that it was a new sesquiterpene, b.p. 130-132°/10 mm.; 104-105°/1 mm. D_{15}^{25} 0·9227 ; η_D^{25} 1·5035 ; α_D^{25} −42·37° and the name *Ishwarene* is proposed for it. [Found: C, 88·2; H, 12·0; M.W. (cryoscopic method in benzene), 204. $C_{15}H_{24}$ requires C, 88·2; H, 11·8 per cent. and M.W. 204].

The hydrocarbon gave a liquid monohydrochloride [b.p. 128-30°/1 mm.; $d_{30}^{30°}$ 1·0200; $\eta_D^{30°}$ 1·5107 ; $[\alpha]_D^{30°}$ in alcoholic solution −18·7°]. (Found: Cl, 14·8. $C_{15}H_{24}$, HCl requires Cl, 14·7 per cent). When attempts were made to prepare the nitrosite, nitrosate, nitrosochloride and the additive compound with bromine, oily products were obtained which could not be purified.

To gain some insight into the structure of this sesquiterpene, attempts were made to dehydrogenate it by heating with selenium for 48 hours at 260-270°. A dark blue liquid was formed. This was distilled over sodium and the distillate carefully fractionated. Most of the original material was recovered unchanged. The smaller fractions and residue did not give any derivatives with picric or styphnic acids.

Isolation of a New Sesquiterpene Ketone—Ishwarone.

The pale green fraction B was obtained in large quantity (60 g.) from the unsaponifiable matter extracted by petroleum ether, from the residues left after the steam distillation of the total alcoholic extract of the roots (*vide* Part I). The oil was highly viscous and the green colour partially disappeared on keeping it exposed for a few days. Unsuccessful attempts were made to fractionate it further by redistilling it at various pressures.

Preliminary tests indicated the presence of a ketone. Fraction B was then dissolved in excess of 95% alcohol and excess of semicarbazide hydrochloride and sodium acetate were added and the mixture refluxed for 2 hours. The semicarbazone separated as a solid (50 g.).

This was filtered off and recrystallised from alcohol in silky white needles, m. p. 240°. (Found: C, 69·7; H, 9·1 ; N, 15·5. $C_{16}H_{25}ON_3$ requires C, 69·8; H, 9·1; N, 15·5 per cent).

The semicarbazone was decomposed by refluxing it with 10% oxalic acid and the liberated ketone was purified by steam distillation. The product was dried and distilled when almost the entire quantity passed over at 118-20°/1 mm. as a fairly mobile colourless liquid. The substance had the following constants: $d_{30°}^{30°}$, 1·0290 ; $\eta_D^{30°}$, 1·5122. $\alpha_D^{30°}$,—46·47°.

Analysis showed that it was a sesquiterpene ketone of the formula $C_{15}H_{22}O$ and the name *Ishwarone* is proposed for it. [Found: C, 82·5 ; H, 10·0 ; M. W. (cryoscopic in bromoform), 214. $C_{15}H_{22}O_4$ requires C, 82·6 ; H, 10·1 per cent and M. W. 218]. Its semicarbazone was identical with the one prepared from the fraction B. The p-*nitrophenylhydrazone* crystallised from alcohol in yellow plates, m. p. 186·5°. (Found: N, 11·8. $C_{21}H_{27}O_2N_3$ requires N, 11·9 per cent). The 2:4-*dinitrophenylhydrazone* crystallised from alcohol in long yellow silky needles, m. p. 167·5°. (Found: N, 14·1. $C_{21}H_{26}O_4N_4$ requires N, 14·1 per cent).

When it was attempted to prepare the oxime by the usual methods a white crystalline compound was obtained which was insoluble in alkalies. On crystallising it from methyl alcohol it was obtained pure and melted sharply at 133°. (Found: C, 77·3; H, 9·9; N, 6·1. $C_{15}H_{23}O$ N requires C, 77·3; H, 9 9; N, 6·0 per cent). The substance was found to contain 1 active hydrogen atom (Zerewitinoff method) and is probably an iso*oxime*.

Isolation of a Sesquiterpene Alcohol—Ishwarol.

The residues from the fraction B (30 g.) after the complete removal of the semicarbazone of Ishwarone were distilled under diminished pressure ; 15 g. of the distillate were collected, the rest having resinified. This was carefully fractionated under a pressure of 1 mm.

Fraction.	Temperature.	Quantity.	$\eta_D^{25°}$.
1	up to 126°/1 mm.	4 g.	1·5114
2	126—28°	7	1·5126
3	128—30°	3	1·5148

The middle fraction on redistillation gave a pale yellow viscous oil which was found to be a new sesquiterpene alcohol *Ishwarol*, of the formula $C_{15}H_{23}.OH$, $d_{30°}^{30°}$, 0·9926; $\eta_D^{30°}$, 1·5098 ; $\alpha_D^{30°}$ (in alcohol) −7·29°. [Found: C, 81·9; H, 11·1; M. W. (cryoscopic in bromoform), 219 ; one active hydrogen atom (Zerewitinoff method). $C_{15}H_{23}OH$ requires C, 81·8; H, 11·0 per cent. M. W., 220].

The alcohol did not react with phenyl *iso*cyanate and resinified when heated with phthalic anhydride. However, it was partially acetylated on boiling with acetic anhydride and sodium acetate for a period of 3 hours.

Summary.

The essential oil obtained from the roots of *Aristolochia indica* has been found to consist mainly of new sesquiterpenoid compounds. A small quantity of camphor was also found to occur in it. A sesquiterpene *Ishwarene*, a sesquiterpene ketone *Ishwarone*, and a sesquiterpene alcohol *Ishwarol*, have been isolated and described. The names are derived from the Kannada name of the roots, *Ishwari beru*

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