

CONSTITUENTS OF THE MARKING-NUT : ' SEMECARPUS ANACARDIUM ' LINN.

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The marking-nut tree, *Semecarpus anacardium* Linn., occurs in the tropical outer Himalayas and in the hotter parts of India with the exception of the Eastern Peninsula. The tree itself grows to a height of 20-40 feet, with a girth of 4-6 feet and with bark 1 inch thick.¹ The fruit is described as a drupe 1 inch long and nearly as broad. The upper portion of the fruit is cup-shaped, smooth, fleshy, orange-red in colour and sweet and edible when ripe. It is formed of the thickened disc and accrescent calyx-base. The lower portion, which may be termed the nut, consists of a smooth, black, shining pericarp which is thick, containing between its outer and inner laminae oblong cells full of a corrosive resinous juice. This juice is white when the fruit is immature, but brownish or quite black when the fruit is ripe. The nut is approximately 1 inch \times 0.75 inch \times 0.33 inch and weighs on an average 3.5 grams. Inside the nut and protected by a hard shell is a white kernel which is as sweet and nutritious as the almond or cashew-nut kernel. It is stated to be highly esteemed by certain classes of confectioners.

The black, corrosive juice is largely used throughout India as an efficacious drug : internally in cases of dyspepsia, nervous debility, acute rheumatism, asthma and cough ; externally for swellings, piles and various cutaneous affections.² It is also largely used by dhobies as an indelible marking ink, and in certain parts of the country an aqueous extract of the crushed seeds is used in conjunction with iron salts for producing a jet-black dye on cloth.

Considerable care must be taken in working with the nuts as the juice is excessively corrosive, producing blisters and swellings on the skin, and even the fumes obtained on heating the nuts are said to have injurious effects on certain constitutions.

¹ For details of the tree, leaves, flowers and fruits and also of the medicinal uses to which the fruit is put, compare Kirtikar and Basu's *Indian Medicinal Plants*, 1918, p. 385.

The vernacular names are :—Hindustani, 'Bhelá'; Mahratta, 'Bhiba'; Tamil, 'Sheran Kottai'; Telugu, 'Nalla Jeedi' or 'Jidi-vittulu'.

² The therapeutics are discussed by Dr. Hem Chandra Sen in the *Indian Medical Gazette*, 1902.

The marking-nut tree and the cashew-nut tree belong to the same natural order, the *Anacardiaceae*, and resemble one another in many respects. This has led the United States Dispensatory¹ to make the following statement: 'The oriental cashew-nut or *Anacardium occidentale* is the fruit of *Semecarpus anacardium*, a tree common in Southern Asia. It contains principles similar to the West Indian cashew and is also said to contain an alkaloid chuchunine', according to which the two trees, the East Indian cashew-nut and the marking-nut are identical, whereas they are two distinct species. Several authorities appear to conclude that from a chemical point of view the black juices from the two fruits are very similar. Thus Dymock² states, 'The pericarp of the marking-nut contains 32 per cent. of a vesicating oil of specific gravity 0.991, readily soluble in ether and blackening on exposure to the air. It is similar to that of *Anacardium occidentale*'.

Städeler³ has examined the corrosive juice of the cashew-nut and shown the presence of a monobasic acid, anacardic acid, $C_{22}H_{32}O_3$ and a phenolic substance, cardol, $C_{32}H_{52}O_4$.

A preliminary study of the oil from the marking-nut according to Städeler's method gave no indication of the presence of anacardic acid; the products were dark resinous materials not easy to manipulate.

An examination of the acid, saponification and iodine values of the oil was made in order to compare with the similar values for the oil from cashew-nut husk, and finally a more detailed examination of the products obtained by extracting the nuts successively with light petroleum, alcohol and water was made.

The products isolated include (a) a fixed oil from the kernels, (b) catechol, (c) a new monohydroxy-compound, *anacardol*, $C_{18}H_{30}O$, (d) an acid, $C_{17}H_{16}O_5$, yielding an insoluble barium salt, (e) an acid, $C_{15}H_{14}O_5$, yielding a soluble barium salt and (f) the potassium salt of an acid with strong reducing properties.

EXPERIMENTAL.

Extraction of the juice from the pericarp.—Superficial incisions were made on a number of nuts, care being taken that the cut did not penetrate the hard shell of the kernel and the nuts were then extracted with ether in a soxhlet and gave 21 per cent. of a thick, dark oil; a

¹ Twentieth Edition, 1248.

² *Pharmacographia Indica*, 1890, i, 392.

³ *Annalen*, 1847, 63, 137.

similar experiment made with cold light petroleum gave 20 per cent. of dark extract. These extracts when distilled under reduced pressure, viz., 5-7 mm. gave yields of 4.5 to 6.0 per cent. of a pale yellow oil boiling at 240-243° under a pressure of 7 mm. and turning dark coloured in contact with the air, especially in the presence of small amounts of alkali.

The same product was obtained by taking the whole seeds, pericarp and kernel, crushing between rollers, extracting the pasty mass with cold light petroleum, removing the solvent and shaking the residue several times with cold alcohol (90 per cent. by volume) in order to separate the fixed oil of the kernels which is practically insoluble in cold alcohol. After separating the alcoholic extract, removing the alcohol and shaking the dark residue three times with its own volume of water and distilling the residue under reduced pressure, a 4.5-6.0 percentage yield of pale yellow oil boiling at 247-250° under 9 mm. was obtained.

The object of shaking with water is to remove small amounts of catechol which are present and which tend to pass over with the oil. From 1 kilo. of seeds, light petroleum extracted 245 grams of a viscous black oil and the alcoholic extract of this after washing with water weighed 185 grams or 18.5 per cent. on the weight of the seeds. The distillate weighed 50 grams, and after redistillation, 42 grams of a pale yellow oil boiling at 240-243° under 7 mm. pressure were obtained. The residue left in the distilling flask after the first distillation is about 66 per cent. of the total extract and on cooling solidifies to a hard black resin.

Considerable difficulty was met with in carrying out the distillation, and success can only be ensured by working under the following conditions:—

1. As low a pressure as possible.
2. The fixed oil should be removed as far as possible, as otherwise its products of decomposition colour the distillate.
3. Water should be removed as completely as possible; otherwise the liquid foams excessively during the early stages of distillation.
4. It is advisable to remove the catechol; otherwise it passes over with the distillate and has to be removed afterwards.

If the pressure is higher, so that the temperature rises to 270° or above, much decomposition results and a complex mixture of substances boiling from 90° to 245° at 8 mm. pressure is obtained.

As the volatile product is very susceptible to atmospheric oxygen, an attempt was made to extract the pericarp, but not the kernel, with light petroleum as rapidly as possible and to distil immediately after extraction, taking care to minimise the time of contact with air. It was hoped in this way to increase the yield of volatile oil.

Five hundred grams of fresh, good quality nuts were incised superficially and dropped into the extraction chamber of a copper soxhlet apparatus containing light petroleum (b.p. 40-60°). The solvent covered the seeds and the whole was well corked and left overnight. Next day the extraction was started and continued for 10 hours, the extract dried carefully with anhydrous sodium sulphate and the solvent removed by heating in the same flask in which the distillation was to take place. The last traces of solvent were removed by warming gently under reduced pressure and the oil obtained by immediate distillation without first removing catechol. There was an appreciable amount of frothing and bumping which made the distillation tedious, but not nearly so prolonged as in the previous experiments. The yield of extract was 25 per cent. of the weight of the nuts and the yield of volatile oil 9.2. The results indicate that extraction of the pericarp and not of the whole seeds is preferable and that it is advisable to carry through the operations as rapidly as possible; for the 9.2 per cent. yield the time from making the incisions to the completion of the distillation was 3.5 days.

The quality of the seeds affects the percentage yield, as in one experiment old shrunken nuts gave only 16.5 per cent. of extract and 2.2 per cent. of volatile oil.

Comparison of the extract with the juice from the pericarp of *Anacardium occidentale* seeds:

The following table gives the constants of the two products:—

TABLE I.

—	Acid value	Saponification value	Iodine value
Oil from marking-nut rind ...	99.3	334.2	262
Oil from cashew-nut rind ¹ (1) ...	...	45.1	294
(2) ...	107.0	119.0	296

¹ (1) Crossley and Le Sueur, *Imp. Inst. Tech. Reports and Sci. Papers*, 1903, 128.
 (2) Joseph and Sudborough, *This Journal*, 1922, 5, 155.

It is clear that the extract from the marking-nut contains appreciable amounts of saponifiable matter, whereas that from the cashew rind contains very little.

A treatment of the marking-nut extract with alkalis, e.g., sodium carbonate or sodium hydroxide, to remove acids or phenol, produced black, sticky products from which nothing definite could be obtained.

Anacardol, $C_{18}H_{30}O$.—

This hydroxy-compound is obtained when the yellow oil is carefully fractionated. It is a mobile pale yellow oil when freshly distilled, but turns first brown and then black on exposure to the air. It has a strongly corrosive action on the skin. It has $d_{15.5}^{15.5} = 0.9693$ and $n_D^{25} = 1.5078$ as determined in a Pulfrich refractometer.

Analyses.

- i. 0.2096 gave 0.6372 of carbon dioxide and 0.2111 of water.
- ii. 0.2086 gave 0.6313 of carbon dioxide and 0.2138 of water.

				Calculated for	
	i.	ii.	mean	$C_{18}H_{30}O$	$C_{18}H_{28}O$
C	82.88	82.50	82.7	82.44	83.08
H	11.19	11.39	11.3	11.45	10.72
O	5.93	6.11	6.0	6.11	6.20

Molecular weight.—The method adopted for determining the molecular weight was that recommended by Fawsitt¹ using pure acetic acid as solvent in an atmosphere of dry nitrogen.

i. 0.3479 gram in 16.54 grams of acetic acid produced a depression of 0.273° .

ii. 0.5765 gram in 16.38 grams of acetic acid produced a depression of 0.432° .

$$M = \frac{K \times 100 \times w}{\Delta (W + bw)}$$

Where K = molecular constant of acetic acid = 39.

W = grams of solvent used.

w = grams of solute.

Δ = depression in freezing point.

b = a constant varying with solvent and solute.

If w_1, w_2 are the weights of solute and Δ_1, Δ_2 the depression in two

$$\text{particular cases, } M = \frac{100 K \left(\frac{1}{\Delta_1} - \frac{1}{\Delta_2} \right)}{W \left(\frac{1}{w_1} - \frac{1}{w_2} \right)} = 275 \text{ when the experimental}$$

values given above are substituted and w_1, w_2 calculated for equal weights of solvent. Calculated molecular weight for $C_{18}H_{30}O = 262$.

It is thus clear that the compound has the simple formula $C_{18}H_{30}O$ and is not a polymer.

Percentage of hydroxyl.—The method adopted was the one recommended by Hibbert and Sudborough¹ using magnesium methyl iodide in amyl ether solution and measuring the volume of methane evolved.

- i. 0.1574 gram gave 15.8 cc. of methane at 25.5° and 682 mm.
 ii. 0.1550 " " 15.6 " " 25.5° " 682 "

	Found		Calculated for
	i.	ii.	$C_{18}H_{30}O$
Per cent. OH	6.25	6.27	6.5.

A three per cent. solution of the compound in chloroform appears to be optically inactive.

The bromine absorption was examined by the method described by Clarke,² using bromine in carbon tetrachloride solution and estimating both the bromine used and the hydrogen bromide liberated. The latter is a measure of the bromine used for substituting and the difference between this and the total bromine used gives the bromine absorbed by olefine linkages. Two experiments gave the following results:—

		i	ii
No. of atoms of bromine substituted	....	5.8	5.7
" " added	....	0.16	0.20

From these results it appears that practically no bromine is absorbed by olefine linkages, but that six atoms of bromine react to produce substitution and three hydrogen atoms in the molecule $C_{18}H_{30}O$ are displaced by three bromine atoms. The non-formation of additive compound points to the absence of aliphatic ethylene linkages.

¹ *J. Chem. Soc.*, 1904, 85, 933.

² *Handbook of Organic Analysis*, 1920, p. 225.

The oily compound dissolves in all organic solvents including light petroleum, but is insoluble in water. Its alcoholic solution rapidly darkens, especially in the presence of alkali, and with ferric chloride gives a dark green coloration and finally a dark coloured precipitate. Its solution in dry ether or toluene in the presence of sodium gives a rapid evolution of hydrogen. It is not soluble in aqueous solutions of ammonia or sodium carbonate, but with the latter it gradually darkens. It dissolves in aqueous sodium or potassium hydroxide yielding dark coloured solutions which give a dark oily product when acidified. In an inert gas the alkaline solutions do not blacken, but the liquid deposits a pale green gelatinous solid, which rapidly darkens on exposure to the air.

Its alcoholic solution yields precipitates with salts of barium, aluminium, lead and zinc; these all show a tendency to turn dark-green, and when acidified liberate dark oily products.

Acetyl derivative.—When acetylated in the usual manner with acetic anhydride and anhydrous sodium acetate, it yields an oily product with $n_D^{25} = 1.4875$. It is more mobile than the original hydroxy compound, has a pleasing odour, is non-corrosive and does not darken on exposure to the air, but gradually turns dark coloured in contact with alkalis.

0.2462 gave 0.7043 of carbon dioxide and 0.2208 of water. $C = 78.02$ and $H = 9.96$; $C_{20}H_{32}O_2$ requires $C = 78.90$ and $H = 10.52$ per cent. The product appeared to contain a little free acetic acid. A viscous, yellow benzoyl derivative is obtained by benzoylating in pyridine solution, but when kept this deposits crystals of benzoic acid.

Although it reacts readily with bromine in carbon tetrachloride solution evolving hydrogen bromide, and with a mixture of nitric and sulphuric acids, it has not been found possible to isolate definite crystalline bromo- or nitro-derivatives. It is also readily oxidised by chromic acid in glacial acetic acid or by acidified permanganate, but so far it has been found impossible to isolate definite products.

Distillation with zinc dust.—10 grams of the corrosive liquid were well mixed with 100 grams of zinc dust and placed in a hard glass tube a further 100 grams of zinc dust added and the whole heated in a furnace beginning with the open end. 3.8 grams of a mobile liquid were obtained. Several lots of the liquid were collected and fractionated under a pressure of 12 mm., when nearly 40 per cent. was obtained as a mobile oil boiling at $110-120^\circ$, mainly 115° , under 12 mm. pressure. This product had $n_D^{25} = 1.4918$, but still contained oxygen, as the carbon content was 87.7 and the hydrogen 10.75 per cent.

A picrate was obtained by boiling the liquid with picric acid in alcoholic solution, evaporating to dryness and digesting the residue with water until all excess of picric acid was removed. The resulting brown solid was recrystallised from dilute alcohol and gave white needles melting at 100–101°.

Structure.—With the data available it is not possible to assign a definite structure to the compound. It belongs, however, to the general type, $C_nH_{2n-6}O$, and may be a homologue of phenol or a reduced substituted anthranol.

CATECHOL.

This was isolated by repeatedly shaking the oil extracted from the pericarp with water. On evaporating the water a solid residue was left, which was extracted with ether and finally crystallised from benzene. The yield was 0.1 per cent. of the weight of the nuts and the melting point 103–104°. Its identity with catechol was proved by its mixed melting point and by conversion into the diacetyl derivative ¹ melting at 62–63° and the tetrabromo-derivative ² melting at 192–193°.

ACIDS $C_{17}H_{16}O_5$ AND $C_{15}H_{14}O_5$.

After the nuts had been crushed and extracted with light petroleum (40–60°) they were extracted in a reflux apparatus with boiling 95 per cent. alcohol (by weight) and the operation repeated four times, each extract being worked up separately according to the following process. The residue left after removal of the alcohol was warmed with water, giving a red solution and leaving undissolved appreciable amounts of a dirty yellow solid and a dark viscid oil. The water was removed by filtration and the residue well washed with light petroleum and then extracted with ether when only a small amount of a dark sticky material remained undissolved. The ethereal solution was shaken with a 10 per cent. aqueous solution of sodium carbonate and on removing the ether only a small amount of a dark viscid oil was left. The sodium carbonate extract when acidified with hydrochloric acid gave a pale yellow precipitate which dissolved readily in ether, alcohol, ethyl acetate or acetone, but only sparingly in chloroform or benzene and was practically insoluble in light petroleum. Attempts were made to crystallise the product from chloroform, but no definite crystalline compounds could be isolated and the melting points of the various products ranged from 187 to 250°.

¹ Nachbauer, *Annalen*, 1858, 107, 245.

² Zincke, *Ber.*, 1887, 20, 1777.

As it was found that part of the barium salts derived from these acids was insoluble and part soluble in cold water, the following procedure was followed. The precipitated acids were dissolved in ammonia solution, the excess of ammonia removed by heating and barium chloride solution added gradually to the hot solution until no more precipitate was formed. This precipitate was removed on cooling and washed with barium chloride solution and the free acids precipitated from both the soluble and insoluble salts and extracted separately with ether. The whole of the acid derived from the insoluble salt did not dissolve in ether, but the residue insoluble in ether dissolved in sodium carbonate solution, and mineral acid produced a brown precipitate, 60 per cent. of which dissolved in ether.

It was found that when the five alcoholic extracts were treated separately in this manner, the acids from the insoluble barium salts appeared to be identical and the properties of the acids from the soluble barium salts were the same in all five cases as shown by the data given in Table II.

TABLE II.

Alcoholic Extracts.

Extract No.			Crude extract	Mixed acids	Acids from insoluble barium salts	Acids from soluble barium salts
I.	Grams ...	...	3.25	2.46	0.94	0.31
	M. P. ¹ ...	...	198-202	195-200	196-200	210-215
	Neut. equivalent. ² ...	...	...	...	299	281
II.	Grams ...	...	4.70	3.50	0.82	0.31
	M. P. ...	...	195-200	195-198	196-200	210-215
	Neut. equivalent ...	...	...	...	...	...
III.	Grams ...	...	2.60	2.05	0.83	0.20
	M. P. ...	...	185-188	186-188	196-200	210-215
	Neut. equivalent ...	...	...	...	296	...
IV.	Grams ...	...	2.00	1.25	0.54	0.20
	M. P. ...	...	181-185	176-180	196-200	210-215
	Neut. equivalent ...	...	...	...	297	281
V.	Grams ...	...	1.70	1.50	0.40	0.12
	M. P. ...	...	170-175	150-155	196-200	210-215
	Neut. equivalent ...	...	...	...	299	282

¹ The melting points are not sharp as the substance swells during the time of heating. All melting points were determined with short thermometers and the substance was introduced into the cold bath.

The equivalents were determined by titration in alcoholic solution using phenolphthalein as indicator. Although the solutions tend to darken during titration the end point can be determined fairly accurately.

From these data it appears probable that two definite acids are present, the one yielding a soluble barium salt and the other a barium salt insoluble in barium chloride solution.¹ Each of the two acids was separately examined.

Acid C₁₇H₁₆O₅.—

The acid separates from its ethereal solution in minute yellow crystals melting and decomposing at 196–200°, and yielding an insoluble barium salt.

Analyses.

- i 0.2063 gave 0.5137 of carbon dioxide and 0.1091 of water.
- ii 0.2015 " 0.4985 " " " " 0.1027 of water.
- iii 0.2011 gram required 5.75 cc. of 0.1181 N. sodium hydroxide.
- iv 0.1869 " " 5.30 " " " " " "

	Found				Calculated for
	i.	ii.	iii.	iv.	C ₁₆ H ₁₅ O ₃ ·CO ₂ H.
Carbon	67.90	67.45	....	....	68.00
Hydrogen	5.88	5.66	....	....	5.33
Neutralisation } equivalent .... }	....	....	299	299	300

The acid dissolves readily in ether, alcohol, ethyl acetate or acetone, only sparingly in hot chloroform or benzene and is almost insoluble in boiling water or light petroleum. It dissolves in alkalis, forming yellowish-red or orange-red solutions and is precipitated by passing carbon dioxide into such solutions. Its alcoholic solution gives a violet coloration with ferric chloride. Its ammoniacal solution reduces silver nitrate when gently warmed and is readily attacked by permanganate. It forms insoluble calcium, barium, copper, lead and silver salts, but the last readily decomposes. When fused with phthalic anhydride and the product made alkaline, it yields a carmine-red phthalein derivative. It also couples with diazotised aniline or sulphanilic acid and possesses most of the characteristics of a phenolic acid.

Treatment with acetic anhydride and sodium acetate yields a product which crystallises from dilute alcohol as an almost colourless powder melting at 126–127°. On combustion the values C=63.5 H=4.3 are obtained, but these do not agree with the figures for any of the acetyl derivatives of the acid. The substance is not soluble in sodium carbonate.

¹ If the insoluble barium salt is washed with water, minute quantities dissolve and the addition of barium chloride produces a slight turbidity.

Treatment with benzoyl chloride and alkali yields a product crystallising from dilute alcohol in colourless crystals melting at 142–143°.

By nitrating the solution in sulphuric acid with a mixture of nitric and sulphuric acids, a product melting at 110–112° is obtained, and on the addition of bromine to an alcoholic solution of the acid a *bromo*-derivative melting at 160–161° is formed. 0.1747 gave 0.2358 of silver bromide. Br = 57.44. $C_{17}H_{11}Br_5O_5$ requires Br = 57.55 per cent.

Treatment with methyl sulphate in presence of 40 per cent. potassium hydroxide solution yields a neutral substance, probably an ether-ester melting at 120–121° and an acid, probably an ether-acid, melting at 161–163° and readily soluble in chloroform or benzene.

0.249 gram of the neutral substance gave 0.211 gram of AgI using Perkin's modification of Zeisel's method for the determination of methoxyl. Percentage of methoxyl = 11.3. The mono-methoxyl derivative of the acid contains 9.9 per cent. of methoxyl so that the substance appears to be a mixture. The quantity available was too small for further investigation.

Definite products have not been obtained by treatment with the ordinary reagents for the ketonic group.

Acid $C_{15}H_{14}O_5$.—

This closely resembles the acid from the insoluble barium salt as regards solubility and chemical reactions.

Analyses.

- i. 0.1893 gave 0.4581 of carbon dioxide and 0.1893 of water.
- ii. 0.1956 ,, 0.4688 ,, ,, ,, ,, 0.1956 ,, ,,
- iii. 0.2254 gram neutralised 6.80 cc. of 0.1181 N. sodium hydroxide.
- iv. 0.1429 gram neutralised 4.30 cc. of 0.1181 N. sodium hydroxide.

	Found				Calculated for $C_{14}H_{13}O_3 \cdot CO_2H$.
	i.	ii.	iii.	iv.	
Carbon	66.00	65.40	....	....	65.69
Hydrogen	5.45	5.44	....	....	5.11
Neutralisation } equivalent .... }	....	....	281	281	274

Its alcoholic solution gives a reddish brown coloration with ferric chloride.

AQUEOUS EXTRACT.

When the nuts were extracted with water after successive extraction with light petroleum and alcohol, they gave a red solution which was concentrated and mixed with 69 per cent. alcohol, when a flocculent precipitate was obtained equal to 4.5 per cent. of the weight of the nuts. It contains the potassium salt of an acid which so far has not been isolated.

The red aqueous extract¹ when evaporated gives a dark-red gummy residue equal to 1.3 per cent. of the weight of the nuts taken. It is acidic in properties, has a sugary odour, reduces Fehling's solution, is insoluble in ether and gives a black coloration with ferric chloride. The acids were removed as lead salts and the aqueous solution then gave a phenylosazone melting at 211–212° after crystallisation from alcohol.

FIXED OIL.

After the corrosive liquid has been removed with light petroleum² the nuts are broken open and the kernels removed, crushed and extracted in a soxhlet apparatus with ether. The kernels, which have a pleasant taste resembling cashew-nuts, constitute 15 per cent. of the weight of the nuts and yield 29.2 per cent. of a reddish coloured oil. Table III gives the analytical data for the oil and also for the oil from cashew-kernels.³

TABLE III.
Analytical Data.

	Oil from Marking-nut kernels	Oil from cashew-nut kernels
Sp. gravity 15.5/15.5	0.9277	0.918
Refractive index at 60°	1.4574	1.4556
Acid value	23.9	6.8
Saponification value	216.5	190.6
Iodine value	101.4	84-89
<i>Fatty acids</i>		
Hehner value... ..	87.5	89
Refractive index at 60°	1.4473	1.4461
Titre test	12.2	29.9
Mean molecular weight	293	278-292
Saturated acids (per cent.)	13.3	18.2
Saturated acids (m. p.)	51.1-51.5	...
Unsaponifiable matter * (per cent.)	0.82	0.41

¹ Cf. p. 136.

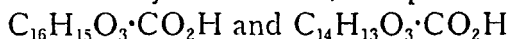
² page 132.

³ *This Journal*, 1923, 6, 114.

* Of the unsaponifiable matter 30 per cent. is precipitated by digitonin and hence is a sterol.

SUMMARY.

1. The corrosive juice from the pericarp of the marking-nut (*Semecarpus anacardium* Linn.) contains compounds quite different from those isolated from the juice of the cashew-nut. The constituents isolated are catechol, a new phenol, *anacardol*, $C_{18}H_{30}O$ to which the corrosive properties of the juice are due, two phenolic acids,



which can be separated by means of their barium salts, and an acid and a sugar, both soluble in water.

2. The amounts of these constituents are :—

		Per cent. in nut.	Per cent. in juice.	Per cent. in kernel.
Catechol	....	0·1	0·4	....
Anacardol $C_{18}H_{30}O$	....	9·0	37·3	....
Acid $C_{17}H_{16}O_5$	.... } .	1·1	4·4	....
Acid $C_{15}H_{14}O_5$	....		
Fixed oil	....	4·4	....	29·2

3. The fixed oil from the kernels of the nut resembles cashew-kernel oil.

In conclusion I have much pleasure in thanking Dr. J. J. Sudborough and Dr. H. E. Watson for guidance and assistance during the course of the work.

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