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CHEMICAL EXAMINATION OF THE BARKS OF BRUCEA ANTIDYSENTERICA, LAM., AND BRUCEA SUMATRANA, ROXB.

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1.—EXAMINATION OF THE BARK OF BRUCEA ANTIDYSENTERICA. *By Arthur H. Salway, Ph.D.*

A small quantity of this bark was obtained through the kindness of H.B.M. Minister, Lieut-Colonel Sir J. L. Harrington, K.C.V.O., C.B., at Adis Ababa, Abyssinia, and it was deemed of interest to compare its constituents with those of the fruit of the same species of *Brucea*, more especially with reference to the bitter principle contained in the latter, since both parts of the plant are stated to be used with success in Abyssinia in the treatment of diarrhœa and fever (compare Engler, "Die natürlichen Pflanzenfamilien," Theil III., Abtheil. 4, p. 220, Leipzig, 1896).

The bark was in small fragments of a light brown colour, and possessed a slightly bitter taste. As a preliminary experiment a portion of the finely ground material was extracted successively in a Soxhlet apparatus with various solvents, when the following amounts of extract, dried at 100°C., were obtained :—

Petroleum (b.p. 35–50°C.)	extracted	1·22	per cent.
Ether	,,	0·96	,,
Chloroform	,,	0·78	,,
Alcohol	,,	8·48	,,
Water	,,	7·22	,,
	Total	18·66	per cent.

For the purpose of a complete examination of the constituents of the bark, a quantity (675 Gm.) of the finely ground material was extracted with hot alcohol. After the removal of the greater portion of the alcohol, the thick, dark-coloured extract was brought into a distilling flask, water added, and steam passed through the mixture in order to separate any volatile substances. The distillate, which contained a few oily drops and had an acid reaction, was extracted with ether. This removed a very small quantity (about 0·2 Gm.) of a yellowish-brown *essential oil*, which, on standing, partially solidified. The acids which remained in the aqueous portion of the distillate were converted into a barium salt, and, although the amount of this was also very small, it afforded reactions which indicated the presence of *formic* and *butyric acids*, with apparently traces of *acetic acid*.

After the steam distillation, the contents of the distilling flask consisted of an aqueous liquid (A) and a quantity of resin (B) which were separated by filtration.

(*A*) *The Aqueous Liquid.*

This liquid was concentrated under diminished pressure to a small bulk. It then possessed a deep red colour and a very bitter taste, was coloured brown with ferric chloride, yellow with alkalies, readily reduced Fehling's solution on heating, and gave a copious precipitate with tannic acid.

With the endeavour to isolate the bitter principle, the liquid was repeatedly extracted with chloroform, as described in connexion with the examination of the fruit of *Brucea sumatrana* (compare Power and Lees, "Year-Book of Pharmacy," 1903 p. 503, and *Pharm, Journ,* 1903, 71, p. 183). The combined chloroformic liquids were washed with a little water, dried with calcium chloride, and the chloroform removed, when 1·6 Gm. of a dark brown, amorphous product was obtained, which possessed a bitter taste. For the purpose of its purification it was dissolved in a little alcohol, mixed with prepared sawdust, and the thoroughly dried mixture then extracted in a Soxhlet apparatus with perfectly dry ether. This yielded about 1 Gm. of a viscid, dark-brown product, similar in appearance and properties to the chloroform extract from which it had been obtained.

The aqueous liquid which had been extracted with chloroform, as above described, was treated with a slight excess of basic lead acetate. This produced a voluminous, deep yellow precipitate, which was separated by filtration with the aid of a pump, and washed with a little water.

Basic Lead Acetate Precipitate.—This was suspended in water, decomposed by hydrogen sulphide, and the mixture filtered. On concentrating the filtrate under diminished pressure, a reddish-brown liquid was obtained, which, on long standing, deposited a brown, amorphous solid, but nothing crystalline could be isolated from it. The liquid gave with ferric chloride a green coloration, indicating the presence of *tannin*.

Filtrate from Basic Lead Acetate Precipitate.—This was treated with hydrogen sulphide for the removal of the lead, the mixture filtered, and the filtrate concentrated under diminished pressure. The light-brown syrupy liquid thus obtained still possessed a very bitter taste, and readily reduced Fehling's solution on heating, but gave no precipitate with tannic acid, and only a faint brown coloration with ferric chloride. With phenylhydrazine acetate it yielded a crystalline osazone, which melted at 216°C., and therefore evidently contained a considerable amount of *glucose*.

(*B*) *The Resins.*

The resinous substances, which had been separated from the aqueous liquid, as above described, formed a brittle, black, amorphous solid. This was dissolved in a little alcohol, mixed with prepared sawdust, and the thoroughly dried mixture then extracted successively in a Soxhlet apparatus, with the following solvents :—

Petroleum (b.p. 35–50°C.)	extracted	9·90	Gm.
Ether	,,	4·40	,,
Chloroform	,,	3·00	,,
Ethyl Acetate	,,	0·45	,,
Alcohol	,,	4·80	,,
Total		22·55	Gm.

The portion of resin extracted by the light petroleum was a soft, dark-coloured, wax-like mass. It was heated with an alcoholic solution of potassium hydroxide, the alcohol then removed, water added, and the mixture extracted with ether. The ethereal liquid yielded about 1 Gm. of a solid substance, which, after one crystallization from ethyl acetate containing a little dilute alcohol, separated in large flat plates, melting at 133°C. This substance, when dissolved in chloroform, gave on the addition of a little acetic anhydride and a drop of concentrated sulphuric acid the colour reaction characteristic of the phytosterols. It was analysed, with the following result :—

0·5161, when heated at 110°C., lost 0·0269 H_2O. $H_2O = 5·2$.
0·1503 of anhydrous substance gave 0·4555 CO_2 and 0·1614H_2O.

$$C = 82·7, \quad H = 11·9$$

$C_{20}H_{34}O,H_2O$ requires $H_2O = 5·8$ per cent.
$C_{20}H_{34}O$ requires $C = 82·8$, $H = 11·7$ per cent.

The substance was thus identified as a *phytosterol*, and it appears to be identical with that isolated from the fatty oil from the fruit of both *Brucea antidysenterica* and *B. sumatrana* (*loc. cit.*).

The alkaline liquid from which the phytosterol had been extracted, as above described, was acidified with sulphuric acid and again extracted with ether. About 2 Gm. of solid fatty acids were thus obtained, which were crystallized from alcohol, but it was found impossible to separate them in a state of sufficient purity to permit of their identification.

The portions of resin extracted by the other above-mentioned solvents were, as indicated, small in amount, and no crystalline substances could be isolated from them.

This investigation of the bark of *Brucea antidysenterica* has shown that, like the fruit of the same species, it contains some bitter substances, but in neither case could these be obtained in the form of definite products.

II.—Examination of the Bark of Brucea Sumatrana.

By Walter Thomas.

A quantity of the bark of this species of *Brucea* was obtained through the kindness of Mr. H. N. Ridley, Director of the Botanic Gardens of the Straits Settlements, Singapore. Its collection was attended with considerable difficulty, for, as stated in a communication from Mr. Ridley to Messrs. Burroughs, Wellcome and Co., of London, the plant is a tender shrub, the stems of which are barely an inch in diameter, and the bark not easily removed. It was also noted that, although the bark is distinctly bitter, it is much less so than the fruit, and therefore probably contains less of the bitter principle.

The bark was in thin strips, of a light brown colour externally, and paler on the inner surface. A portion of the finely ground material was extracted successively in a Soxhlet apparatus with various solvents, when the following amounts of extract, dried at 100°C., were obtained :—

Petroleum (b.p. 35–50°C.) . .	extracted	0·42	per cent.
Ether	,,	0·68	,,
Chloroform	,,	0·86	,,
Alcohol	,,	2·40	,
Water		5·62	
	Total	9·98	per cent.

For the more complete examination of the constituents of the bark, a quantity (3833 Gm.) of it, in moderately fine powder, was extracted by percolation, first with cold alcohol and subsequently with hot alcohol, as it was found that the latter removed a considerable quantity of a substance which was practically insoluble in cold alcohol, and separated from the hot alcoholic extract on cooling in the form of a light brown gelatinous mass. The two extracts were, therefore, separately examined.

Extract Obtained with Cold Alcohol.—This extract, after the removal of the greater part of the alcohol, was very dark in colour. It was brought into a distilling flask, mixed with a little water, and steam passed through the mixture in order to separate any volatile substances. The distillate, which had a strongly acid reaction, was extracted with ether. This removed a small quantity (2·5 Gm.) of a light greenish-yellow *essential oil*, having a rather unpleasant odour, but the amount was much too small to permit of its further examination. The acids remaining in the aqueous distillate were converted into their barium salts, which formed a yellowish-brown syrup, and gave reactions indicating the presence of *formic*, *acetic*, and *butyric acids*.

The aqueous liquid remaining in the distilling flask was separated from a quantity of black, amorphous resin by filtration, and the filtrate clarified by shaking out once with ether. It was then extracted with chloroform until nothing further was removed. After distilling off the chloroform there remained a small amount (1·8 Gm.) of a dark red, viscid product. This was dissolved in alcohol, and the solution poured into a quantity of boiling water, which caused the separation of a very small amount of resin. The filtered aqueous liquid was then concentrated, mixed with prepared sawdust, and the mixture, after thorough drying, extracted in a Soxhlet apparatus with dry ether. During the process of extraction a small amount of an amorphous, scarlet-coloured solid separated on the side of the flask, and finally, after the removal of the ether, a deep-red syrupy liquid was also obtained. The whole of this ether extract was then dissolved in alcohol, the solution filtered, and allowed to stand for several weeks, but nothing crystalline separated. Although this deep red extract possessed a strongly and persistently bitter taste, it was evidently different from the bitter principle isolated by a similar method from the fruit of this species of *Brucea* (compare Power and Lees, "Year-Book of Pharmacy," 1903, p. 503, and *Pharm. Journ.*, 1903, 71, p. 183).

Inasmuch as the last-mentioned bitter principle had only been obtained in the form of an amorphous powder, it was deemed of interest to ascertain whether any simple derivative of it could be obtained in a crystalline state. Attempts were, therefore, made to prepare acetyl and benzoyl derivatives, respectively, but in both cases the substance was recovered in an apparently unchanged condition.

The aqueous liquid which had been extracted with chloroform, as above described, was treated with basic lead acetate, which produced a voluminous yellow precipitate. This was collected, washed, suspended in water, and decomposed by hydrogen sulphide, but it finally afforded only a dark brown uncrystallizable syrup, which gave no colouration with ferric chloride.

The filtrate from the basic lead acetate precipitate was treated with hydrogen sulphide for the removal of the lead, filtered, and concentrated under diminished pressure. It then formed a dark brown syrup, from which a small amount of a crystalline substance separated; this was found to consist of a mixture of potassium chloride and nitrate. The syrup, even after heating with hydrochloric acid, did not reduce Fehling's solution. When heated with caustic alkali it evolved ammonia, and therefore probably contained protein substances.

Extract obtained with Hot Alcohol.—This product was re-dissolved in hot alcohol, and the solution filtered. On cooling, a quantity of a light brown, amorphous, resinous substance separated. This was collected on a filter, then mixed with prepared sawdust, the mixture dried, and extracted successively in a Soxhlet apparatus with petroleum, chloroform and alcohol.

(*a*) *Petroleum Extract.*—This was a light green, fatty solid, amounting to 5 Gm.

(*b*) *Chloroform Extract.*—This was a dark brown, friable resin, amounting to 12 Gm.

(*c*) *Alcohol Extract.*—This was also a dark brown resin, amounting to only 1·2 Gm.

The petroleum extract (*a*) was hydrolyzed with an alcoholic solution of potassium hydroxide. The product, after the removal of the alcohol, was mixed with water, and the alkaline liquid extracted with ether. This removed a very small amount of a substance which, after recrystallization from alcohol, and finally from ethyl acetate, was obtained in colourless crystals, melting at 75° C. The melting point of this substance agrees with that of the hydrocarbon *pentatriacontane*, $C_{35}H_{72}$, but the amount was insufficient for analysis.

The alkaline liquid, after extraction with ether, was acidified with sulphuric acid and distilled in steam. The distillate, which contained a few oily drops, was extracted with ether, and on removing the latter a very small amount of a liquid was obtained having the characters of *butyric acid.* The acid remaining in the aqueous distillate was converted into a barium salt, and found to consist chiefly of *formic acid*, with apparently a little acetic acid. After the above-mentioned steam distillation there remained on the surface of the liquid in the distilling flask a light green fatty solid. The whole was extracted several times with ether, and, after the removal of the latter, a residue was obtained which was crystallized several times from light petroleum, then from ethyl acetate, and finally again from light petroleum. The acid so obtained melted at 66–67° C., and on analysis gave the following result :—

0·1128 gave 0·3200 CO_2 and 0·1362 H_2O. C=77·3, H=13·4
$C_{22}H_{44}O_2$ requires C=77·6, H=13·0 per cent.

It would thus appear probable that this substance was *behenic acid*, the melting point of which has been variously stated to be 73° C. (Völcker) 75° C. (Meyer and Jacobsen), and 80–82° C. (Lewkowitsch), and that the exceptionally low melting point observed in this instance was due to a slight impurity.

The chloroform extract (*b*) and the alcohol extract (*c*) of the resins obtained by extracting the bark with hot alcohol, as above described, did not appear to contain anything of chemical interest.

In view of the difficulty of obtaining any quantity of the bark of *Brucea sumatrana*, and the fact that it contains a much smaller proportion of bitter principles than the fruit, it would appear that the latter is to be preferred for medicinal use.

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