Chemistry. — *"The essential oil from the fruits of Morinda citrifolia L."* By Prof. P. van Romburgh.

(Communicated in the meeting of April 23, 1909).

Morinda citrifolia L, a plant from the family of the *Rubiaceae* (Malay: Bengkudu, Sundanese: Tjangkudu) occurs in the wild state in Java and is also cultivated for the sake of the red dye, which can be obtained from the root bark. The over ripe fruits of this shrub have a very disagreeable odour, reminding of rancid fat. Some years ago, when at Buitenzorg, I prepared from it an essential oil by distillation in water vapour, which was subjected in 1896 to a preliminary investigation by my then assistant C. J. E. Lohmann [1]), which showed it to contain a higher volatile fatty acid, accompanied by an ester.

During my stay at Buitenzorg, last summer, I found back an old specimen of the oil and Dr. A. W. K. de Jong had the great kindness to prepare for me the essential oil from 1000 Kilos of Bengkudu fruits, for which I wish to express my gratitude, so that I had sufficient material for an investigation.

A portion of the essential oil was separated by decantation from the aqueous distillate, but in other cases the oil was obtained by shaking the aqueous distillate with benzene.

The. oil separated by decantation had a brownish-yellow colour and was turbid owing to minute, glittering, crystals floating therein. The specific gravity was 0.927 at 13°. The sp.gr. of another sample, of which only a small quantity was at my disposal, was 0.961 at 14°.

The crystals were filtered off and the filtered oil treated with a dilute sodium hydroxide solution, in which it is almost entirely soluble, while a turbid liquid is formed from which a thin oily layer separates after a very long time. Shaking with ether or benzene readily causes emulsions, which separate with difficulty. The least troublesome way to effect the separation of the volatile neutral components from the substances dissolved in the alkali was found to be a careful distillation of the dilute solution.

With the aqueous vapours a liquid, the odour of which is not disagreeable, passes over, which floats on water. The alkaline liquid, which was heated in a basin on the waterbath, in order to remove the last traces of volatile admixtures, was strongly acidified with sulphuric acid and a yellow layer of liquid acids collected on the surface. When these had been removed the liquid was distilled to

[1]) Report Gov. Botanical Gardens, Buitenzorg 1896 p. 59.

recover any dissolved acids. A few drops of slightly soluble fatty acids were recovered.

The separated acids, after having been dried over anhydrous sodium sulphate were subjected to a careful fractional distillation, which yielded two fractions boiling constant within a few degrees, one at about 205° and another at 238°. Of acids having a higher boiling point only traces are present.

The liquid boiling at 205° solidified when cooled in liquefied ammonia. The melting point was situated at —5°.2, $D_{15} = 0.932$. These constants agree with those of n. capronic acid [1].

The acid boiling at 238° solidified to a beautiful crystalline mass at a temperature below 15°. The melting point was 15°.2, $D_{14} = 0.913$. n. Caprylic acid [2]) has the same constants; addition of caprylic acid m. p. 15° from the specimen collection of the laboratory did not cause any melting point depression.

The amount of caprylic acid in the oil investigated was about eight times that of the capronic acid.

The content in neutral volatile constituents amounts to a few per cent only and consequently I had at my disposal such a small quantity that a separation by fractional distillation gave no sharp results. Fractions were obtained boiling at about 170°, 196° and 208°.

These were again united and heated with strong aqueous potassium hydroxide. After dilution with water a very slight quantity of an oily liquid separated which resisted a further treatment with the alkali. The alkaline liquid was heated in a flask to obtain the alcohols formed. The distillate gave, on addition of potassium carbonate, a separation of about 0.5 $cM.^3$ of a mixture of alcohols, which commenced to boil at about 70° and in which the presence of ethyl alcohol could be demonstrated with certainty (iodoform reaction) whilst the presence of methyl alcohol [3]) is very probable. Moreover, an odour of fusel oil is noticed in the fraction having the higher b.p.

The acid mixture formed in the saponification contains mainly caprylic acid, which was isolated in a pure condition, and to judge from the b.p. also a slight quantity of capronic acid.

The oil of the fruits from *Morinda citrifolia* therefore contains

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1) GEORG W A. KAHLBAUM, Zeitschr. phys. Ch. XIII, 40 [1894], gives the m.p. as —5°.2, the b.p. as 205°.7 (corr.).

2) For n. caprylic acid GEORG. W. A. KAHLBAUM (loc. cit p. 62) gives the m.p. as 15°.1, the b.p. as 237°.5. SCHEY, Rec. **18**, 185 [1899] found the m.p. = 16°, and $D_{20} = 0.910$.

3) Methyl alcohol occurs in abundant quantity in the *durian* fruits (from *Durio zibethinus* Murr.).

ethyl caprylate and capronate in small quantities and to judge from the b.p. also a little of the methyl esters of the same acids.

The crystals separated from the oil were recrystallised from boiling alcohol in which they are but sparingly soluble. The m.p. is 60°.

The elementary analysis gave a result showing that this substance is a saturated hydrocarbon (found C 85.2 H 15.2).

Sulphuric acid has no action, even on being heated; its solution in chloroform does not decolorise a bromine solution, whilst potassium permanganate in acetone does not react.

Parraffins, m.p. 55°—65°, not unfrequently occur in essential oils, on the other hand n. capronic- and n. caprylic acid but rarely occur in the free state in such oils and then only in minute quantities. The essential oil from the fruits of *Morinda citrifolia* which consists of more than 90 % of these acids is, therefore, very remarkable in that respect.

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Mathematics. — *"On pentaspheric geometry."* By Dr. S. L. VAN OSS. (Communicated by Prof. P. H. SCHOUTE.)

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1. Referred to a rectangular simplex of coordinates $OX_1X_2X_3X_4$ and to an imaginary unity point whose cartesian coordinates are: $x_1 = x_2 = x_3 = x_4 = i$, the equation

$$x^2_1 + x^2_2 + x^2_3 + x^2_4 + x^2_5 = 0 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

represents a real hypersphere H in fourdimensional space S_4.

Let X be a point of H, X' the stereographic projection of X on $x_4 = 0$, then, if x, y, z, be the non homogeneous coordinates of X' referred to the axes OX, OY, OZ, coinciding respectively with OX_1, OX_2, OX_3, we have the following relations:

$$x_1 : x_2 : x_3 : x_4 : x_5 = 2x : 2y : 2z : x^2 + y^2 + z^2 - 1 : \frac{x^2+y^2+z^2+1}{i}$$

Putting

$$2x = x'_1 \ , \ 2y = x'_2 \ , \ 2z = x'_3 \ , \ x^2+y^2+z^2-1 = x'_4 \ , \ x^2+y^2+z^2+1 = ix'_5,$$

we have identically

$$x'^2_1 + x'^2_2 + x'^2_3 + x'^2_4 + x'^2_5 = 0 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

These x'_i are known to represent a set of pentaspheric coordinates referring X' to the five orthogonal spheres:

$$x = 0 \ , \ y = 0 \ , \ z = 0 \ , \ x^2 + y^2 + z^2 - 1 = 0 \ , \ x^2 + y^2 + z^2 + 1 = 0.$$

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