One is the direct cyclization of 2-methyl-4,6,2′,4′,6′-pentahydroxybenzophenone which has been postulated as the first aromatic product in the biosynthesis of griseofulvin [4]. Alternatively, if, as has been suggested by Harris *et al.* [5], a polyketide precursor is methylated before it is cyclized into aromatic products, then it may be that norlichexanthone is formed by demethylation of griseoxanthone C.

EXPERIMENTAL

Production and isolation of the metabolites. A mutant strain of *Penicillium patulum* was grown on a glucose–corn-steep liquor medium under conditions specified in British Patent 784618. Filtered broth (600 l.) was acidified (pH 2) by the addition of mineral acid and extracted with EtOAc (1 × 200 l; 1 × 120 l). The EtOAc was evaporated to a thick, brown residue, part of which (188 g) was redissolved in MeOH (1:2 l) and evaporated onto Si gel (1 kg). This was packed as a dry column [6] on top of a further 1·5 kg of silica gel. The column was washed initially with toluene (5 l.), then $CHCl_3$ (20 l.) followed by $CHCl_3$–EtOAc (17:3) 4 l. and finally $CHCl_3$–EtOAc–EtOH (17:3:1) 10 l.

The first $CHCl_3$ fractions (6 l) were concentrated (200 ml) and the pptd crystals (5 g) identified as griseoxanthone C mp 253–255° (lit.[2] 253–255°); τ-3·5 and 0·2 (O<u>H</u>), 3·35 (AB *qu*, Ar<u>H</u>), 3·78 (AB *qu* Ar<u>H</u>), 6·2 (C<u>H</u>$_3$-O), 7·23 (C<u>H</u>$_3$-Ar). The mother liquors were diluted with EtOAc to a density < 1, washed with 2 N NaOH, and evaporated to yield griseofulvin, identified by direct comparison with a standard sample. The caustic washings were acidified (pH 5) and extracted with EtOAc. Evaporation of this extract gave an oil (32·8 g) which crystallized on standing. Recrystallization from toluene gave griseophenone C mp 175–178° (lit. [3] 183–185°); τ-1·2 (O<u>H</u>), 3·71 (2H, *s*, Ar<u>H</u>), 4·11 (2H, *s*, Ar<u>H</u>), 6·24 (OC<u>H</u>$_3$)., 6·34 (OC<u>H</u>$_3$), 7·90 (ArC<u>H</u>$_3$). Following these fractions the next 34 l. of eluate, on evapn, pptd norlichexanthone (42 g), which crystallized from aq Me_2CO mp 272–274° (lit. [7] 272–275°); blue-green with $FeCl_3$; positive Dimroth reaction [8]; *m/e* 258·0531; λ_{max}(EtOH), 241 nm (ε 36500), 311 nm (ε 22500); ν_{max} 3500, 3050, 1650, 1620, 1500, 830, 812, 760 cm^{-1}; τ-3·4 (O<u>H</u>) 3·4 (2H, *m*, Ar<u>H</u>), 3·85 (AB *q*, *J* 2Hz, Ar<u>H</u>), 7·24 (Ar–C<u>H</u>$_3$).

Methylation of norlichexanthone and griseoxanthone C. Methylation of both norlichexanthone and griseoxanthone C with diazomethane gave lichexanthone mp 185–187° (lit. 185–187°) [2].

Acknowledgements—We would like to thank Mr. Alan H. Davies for the fermentation and large scale extraction work.

REFERENCES

1. McMaster, W. J., Scott, A. I. and Trippett, S. (1960) *J. Chem. Soc.* 4628.
2. Rhodes, A., Boothroyd, B., McGonagle, P. and Somerfield, G. A. (1961) Biochem. J. **81,** 28.
3. Santesson, J. (1968) *Acta. Chem. Scand.* **22,** 1698; Santesson. J. and Sundholm, G. (1969) *Arkiv. Für Kem.* **30,** 426.
4. Scott, A. I. (1965) *Quart. Rev.* 19.
5. Harris, T. M., Howarth, T. Trefor and Carney, R. L. (1971) *J. Am. Chem. Soc.* **93,** 2511.
6. Loev, B. (1967) *Chem. Ind.* 2026.
7. Santesson, J. and Sundholm, G. (1969) *Arkiv. Für Kemi.* **30,** 427.
8. Dimroth, D. and Fanst, T. (1921) *Chem. Ber.* **54,** 3020.

Phytochemistry, 1975, Vol. 14, pp. 2083–2084. Pergamon Press. Printed in England.

LIPIDS AND PHENOLICS OF HEALTHY AND MALFORMED PANICLES OF *MANGIFERA INDICA**

MOHAN L. MAHESHWARI and SUNIL K. MUKERJEE

Division of Agricultural Chemicals, Indian Agricultural Research Institute, New Delhi-110012, India

(*Revised received* 17 *March* 1975)

Key Word Index—*Mangifera indica* L.; Anacardiaceae; healthy and malformed panicles; fats; sitosterol; phenolic acids; inositol; galactose.

Plant. Mangifera indica L (Var. Langra). *Uses.* Principal fruit crop of Indian subcontinent. Fruit is laxative, diuretic, diaphoretic, astringent and refrigerant, bark and kernel are astringent and tonic, leaves and dried flowers are useful in diarrhoea and chronic dysentry.

Previous work. Stembark [1], heartwood [1], leaves [1–3]. blossoms (essential oil [4], tannin [5], flavonoids [5] and ethyl gallate [6]), seed [7] and resin [8]. Malformation is a serious disease in *M. Indica* and a variety of reasons are ascribed [9,10]. This investigation was under-

* Contribution No. 79 from Division of Agricultural Chemicals, Indian Agricultural Research Institute.

† Percentage in malformed particles.

taken to see whether there were chemical differences between healthy and diseased. *Panicles.* Healthy and malformed panicles were plucked from the same tree and each was extracted in light petrol.(40–60°), Me_2CO and MeOH. Yields of the extracts were same in both the cases except for the acetone extract, which was double in the case of malformed panicles. However, the constituents of both types of panicles were found to be same. Light petrol extract; *Octadecane* (0·28%, 25%†, bp, *m/e* 254); *Bis-2-ethylhexanyl phthallate* (1·40%, 1·28%*, bp, TLC, IR, NMR; hydrolysis-phthallic acid; mp, mmp, IR; 2-ethyl hexanol-IR, NMR, GLC, mixed GLC, *m/e* 130); n-*Octacosanol* (0·16%, 0·12%*, *mp, IR, m/e* 410); *Sitosterol* (0·28%, 0·18%*, mp, mmp; TLC, IR); *Palmitic acid* (0·22%, 0·30%*, mp, methyl ester bp, IR, GLC, mixed GLC, *m/e* 270). Acetone extract; *Gallic acid* (Major, 4·20%, 8·68%*, mp, mmp, IR, UV; methyl gallate (mp; mmp, IR, UV, TLC); *Dimethylellagic acid* (0·56%, 1·50%*, mp, mmp, IR, UV, negative Griessmayer test [11]. Methanol extract; *Methyl gallate* (3·00%, 3·20%*, formed during extraction in contradiction to the observations of Singh and Bose [6], mp, mmp, IR, UV, TLC); *Gallic acid* (4·86%, 5·60%*); *Ellagic acid* (1·12%, 0·88%*; IR, UV, positive Griessmayer test); Meso-*Inositol* (1·00%, 0·58%*; mp, mmp, IR, Hexacetate—mp, mmp, IR); *Galactose* (Major carbohydrate, 1·02%, 0·88%*; R_f on ppc.).

Acknowledgements—Authors thanks are due to Dr. M. R. Parthasarthy (Delhi University, Delhi) for the authentic samples of ellagic and dimethyl ellagic acids, Dr. R. L. Bhasin, (Hindustan Lever Research Centre, Bombay) for GLC and Dr. (Miss) S. Bhanu (Commonwealth Scholar, University of Salford, U.K. for mass spectra.

REFERENCES

1. Bhatia, V. K., Ramanathan, J. D. and Seshadri, T. R. (1967) *Tetrahedron* **23**, 1363.
2. Nigam, I. C., Nigam, M. C. and Dhingra, D. R. (1961) *Indian Perfumer* **V (II)**, 136.
3. Younes, K. El-Garby, Osman, A. M. and Sheta, A. E. (1973) *Ind. J. Chem.* **11**, 405.
4. Baslas, K. K. (1970) *Flavour Industry* **1**, 473.
5. Bose, J. L. and Siddiqui, S. (1948) *J. Sci. Ind. Res.* **7B**, 100.
6. Singh, L. B. and Bose, J. L. (1961) *J. Sci. Ind. Res.* **20B**, 296.
7. Pathak, S. P. and Vashishta, A. K. (1961) *J. Sci. Res. (Banaras Hindu Univ.)* **12**, 41.
8. Corsano, S. and Mincione, E. (1967) *Ann. Chim. (Rome)* **57**, 508.
9. Srivastava, R. P. and Bhutani, Dhano K. (1973) *Fruits* **28**, 389.
10. Varma, Anupam, Lele, V. C. and Goswami, B. K. (1974) *(Current Trends in Plant Pathology, Botany Dept. Lucknow Univ.)* 196.
11. Srivastava, S. N., Bhakuni, D. S., Sharma, V. N. and Kaul, K. N. (1962) *J. Sci. Ind. Res.* **21B** 549.

Phytochemistry, 1975. Vol. 14. pp. 2084–2085. Pergamon Press. Printed in England.

SESQUITERPENE LACTONES OF *ARTEMISIA TRIDENTATA* SSP. *VASEYANA*

NAGESHUAR R. BHADANE,* RICK G. KELSEY and FRED SHAFIZADEH

Wood Chemistry Laboratory, Department of Chemistry and School of Forestry, University of Montana, Missoula, Montana 59801, U.S.A.

(*Received* 21 *January* 1975)

Key Word Index—*Artemisia tridentata* ssp. *vaseyana*; Compositae; sesquiterpene lactones; artevasin; dehydroleucodin.

Plant. Artemisia tridentata Nutt. ssp. *vaseyana* (Rydb.) Beetle. *Plant part.* Leaves. *Source.* Sage Creek, Montana, T2S, R17W, Section 17, Elevation 1951 m. (Voucher Nos. 8/21/72—1–4, kept in the University of Montana).

Compounds. Column chromatography of the $CHCl_3$ extract resulted in the isolation of two sesquiterpene lactones, artevasin (**1**) and dehydroleu-

* Present address: Department of Chemistry, S.S.V.P.S. Science College, Dhulia, Maharashtra, India.