Phytochemistry, 1980, Vol. 19, pp. 485–486. © Pergamon Press Ltd. Printed in England. 0031-9422/80/0301-0485 $02.00/0

THE *R, S* NOMENCLATURE OF PTEROCARPAN STEREOCHEMISTRY

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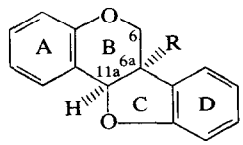
(*Revised received* 14 *May* 1979)

Key Word Index—*R, S* nomenclature; isoflavonoids; pterocarpans; glyceollin; inermin; pisatin.

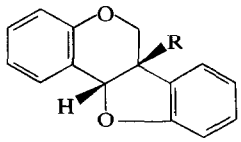
The majority of known natural pterocarpans have negative $[\alpha]_D$ values and are considered to have the same absolute stereochemistry [1–4], which is consistent with results from ORD curves [5, 6]. Formula **1** shows the absolute configuration established for these compounds [2, 3] which is currently indicated as 6a*R*, 11a*R*. According to the *R, S* system [7], this designation is correct only if both C-6a and C-11a as well as C-6 bear only hydrogen atoms: the presence of a substituent on any one of these carbon atoms can cause a change in priorities [7, 8], often resulting in a change of *R* to *S* or vice versa. Especially if the substituent of lowest priority (here, hydrogen) is replaced by a substituent of highest priority (here, a hydroxyl group) the *R, S* designation is reversed.



1

(−)-pterocarpan
1a R = H; 6a*R*, 11a*R*
1b R = OH; 6a*S*, 11a*S*

Consequently, the configuration of (−)-6a-hydroxypterocarpans (**1b**) such as glyceollin [6], should be indicated as 6a*S*, 11a*S*. Similarly, if the configuration assigned to the few known (+)-6a-hydroxypterocarpans, such as pisatin [9], prove to be correct, it should be designated 6a*R*, 11a*R*. Thus the *R, S* nomenclature has been often applied incorrectly for 6a-hydroxypterocarpans (e.g. refs. [2–4, 6, 10]).



2

(+)-pterocarpan
2a R = H; 6a*S*, 11a*S*
2b R = OH; 6a*R*, 11a*R*

The necessity of designating the absolute configuration correctly is demonstrated in the biogenetically interesting case of 6a-hydroxyinermin, which is produced in both fungus-infected red clover [11] and peas [12, 13] from inermin and pisatin, respectively. Since inermin ((−)-6aH-pterocarpan, **1a**) and pisatin ((+)-6aOH-pterocarpan, **2b**) are *considered* to have opposite absolute configurations (though both should be indicated as 6a*R*, 11a*R*), their respective metabolites might be enantiomers. If so, the first metabolite should be indicated as 6a*S*, 11a*S* and the other as 6a*R*, 11a*R*.

The case of 6a-hydroxyinermin also serves to illustrate that chemically similar series and biogenetic families are not necessarily correlated in *R, S* nomenclature, as pointed out by Cahn [14], because *any* alteration in structure or substitution, particularly on or near the chiral centre(s) may change the *R,S* designation [8]. As a result the proper use of the *R, S* nomenclature can cause confusion in naming isoflavonoids. In discussing the family relationships of the isoflavonoids, one might adopt an α, β type nomenclature [15], analogous to that long used in steroid chemistry [8]. However, this system must be coupled to an international agreement on the convention for drawing pterocarpan formulae (preferably with the A-ring top-left). For the moment, however, we support the *R, S* system, because if correctly used, it provides the only unambiguous description of the absolute configuration of the specific compound considered. Nevertheless, it is important that it is properly used and its vagaries understood.

Acknowledgements—The authors are indebted to Dr. A. Fuchs, Laboratory of Phytopathology, and Dr. Ae. de Groot, Laboratory of Organic Chemistry, for advice in preparing the manuscript.

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Phytochemistry, 1980, Vol. 19, pp. 486–487. © Pergamon Press Ltd. Printed in England. 0031-9422/80/0301-0486 $02.00/0

CODEINE FROM CELL SUSPENSION CULTURES OF *PAPAVER SOMNIFERUM**

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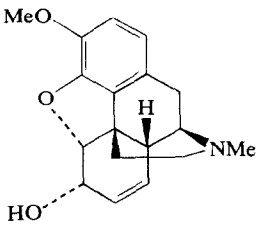
(*Received* 3 *April* 1979)

Key Word Index—*Papaver somniferum*; Papaveraceae; cell suspension culture; synthesis; morphinan alkaloids; codeine.

Presence of alkaloids in callus tissues of opium poppy has been reported [1–3] but no isolation and identification have been attempted. There have also been reports on the presence of phthalic acid ester in poppy tissues [4, 5]. Furuya *et al.* [6] and Ikuta *et al.* [7] reported the presence of benzophenanthridine, protopine, and aporphine type alkaloids but could not detect any synthesis of morphinan alkaloids in the callus tissues of *Papaver somniferum*. In their biotransformation experiments, Furuya *et al.* [8] indicate that the cell cultures of *Papaver somniferum* lack the ability to metabolize (*RS*)-reticuline to thebaine, codeine and morphine, but are able to metabolize (−)-codeinone to (−)-codeine. The present paper describes the synthesis of codeine **1** by cell suspension cultures of *Papaver somniferum* L. cv Marianne.



1 Codeine

The cell suspension cultures of *Papaver somniferum* cv Marianne, after incubation in 1-B5C medium for 3 weeks, were harvested and extracted for alkaloids by the procedure described below. The crude product showed presence of codeine **1** when compared with the authentic codeine on TLC. Purification of the crude product by preparative TLC yielded a compound (1.2 mg) having the same R_f (0.22) as the authentic codeine when co-chromatographed on TLC, mp 146–148° (lit. 154–155°). The MS displays a molecular ion at *m/e* 299, corresponding to $C_{18}H_{21}NO_3$, the molecular formula for codeine **1** and is identical with that of the authentic codeine. This indicates that the compound is codeine, the yield being 0.15%. Examination of the other seven fractions from preparative TLC purification by GLC with authentic morphine and thebaine as references showed neither of these alkaloids to be present. Comparison of these fractions with authentic protopine, norcodeine and papaverine on TLC showed absence of these alkaloids.

EXPERIMENTAL

Mps are uncorr. MS were recorded, using a direct insertion probe. GLC was performed on equipment with a FID using a glass column (180 × 0.2 cm) packed with 3% OV-17 on Gas-Chrom Q (80–100 mesh). Solutions of the fractions to be examined were subjected to GLC isothermally at a column temp. of 245° with He at 40 ml/min as the carrier gas. The injector and detector were at 230 and 250°, respectively.

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