PRODUCTION OF QUININE AND QUINIDINE BY PLANT CELL CULTURES OF CINCHONA LEDGERIANA

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Quinine, which is used as an anti-malarial, as a bitter and for the treatment of night cramps, and quinidine, which is used as an anti-arrhythmic agent, are obtained commercially from the bark of a number of Cinchona species. In African plantations, it takes seven years of cultivation before the bark can be harvested, so plant tissue culture may offer a suitable alternative for alkaloid production. Quinine and quinidine have been reported to be present in leaf organ cultures of C. ledgeriana but not in root organ cultures and unorganised cell suspensions (Staba and Chung 1981). These results contrast with findings that root organ cultures and root cell suspensions of C. ledgeriana produce quinine and quinidine (Anderson et al 1982).

Young and old leaves of C. ledgeriana, Zapote-type plantation material, and plant tissue cultures from seeds of these plants have been evaluated for their alkaloid content. TLC and HPLC analyses of the young and old leaves indicated that the four major alkaloids were the isomeric cinchophylline-type indoles (Zeches et al 1980) and that other indole alkaloids, including quinamine, epi-3-quinamine and cinchonamine, were also present. Quinine and quinidine were detected only as minor alkaloids of both young and old leaves but, in contrast, plant tissue cultures produced mainly quinine and quinidine and not the cinchophyllines. Quantitative HPLC, using theophylline as internal standard, has been used to assay the plant material listed in Table 1 for quinine and quinidine.

Table 1. Alkaloid content (mg/g dry wt.) of leaves and tissue cultures of C. ledgeriana (Zapote-type plantation material)

Plant material	Young leaves	Old leaves	Leaf organ cultures	Root organ cultures	Root suspension cultures
Dry wt. extracted (g)	95.0	100.00	0.37	1.27	5.20
Quinine	0.010	0.041	0.080	0.010	0.056
Quinidine	<0.001	0.003	<0.001	0.011	0.076

The old leaves produced higher levels of quinine than the young leaves while the leaf organ cultures yielded even higher amounts (Table 1). The quinidine levels in whole leaves and leaf organ cultures were low. In root organ cultures, the quinine and quinidine contents were equivalent and when transferred to root cell suspensions increased to levels of 0.056 and 0.076 mg/g dry weight, respectively, after twenty weeks (Table 1). These results indicate the potential of plant cell cultures of C. ledgeriana for the production of quinine and quinidine.

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Staba, J.E. and Chung, A.C. (1981) Phytochemistry 20: 2495-2498
Zeches, M. et al (1981) Phytochemistry 19: 2451-2454

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