

THE DISTRIBUTION OF STEROLS, ALKALOIDS AND FATTY ACIDS IN SENITA CACTUS, *LOPHOCEREUS SCHOTTII*, OVER ITS RANGE IN SONORA, MEXICO

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Abstract—Young and old stems of senita cactus have been examined for their sterol, alkaloid and fatty acid content. No systematic cline was observed when these phytochemical characteristics were compared with the location in Sonora where the plants were gathered. Instead, there were significant differences between young and mature stems of a single plant and between the epidermis and cortex of a single stem. These differences did not correlate with plant morphology or with a chromosomal inversion in *Drosophila pachea*, an insect that uses senita as its sole breeding site.

INTRODUCTION

SENITA, *Lophocereus schottii* (Engelmann) Britton and Rose, is a large columnar cactus abundant in the states of Sonora and Baja California, Mexico. Three varieties of senita have been described, two of which, *L. schottii* var. *schottii* and *L. schottii* var. *tenuis*, grow in Sonora.¹ Felger and Lowe reported a clinal variation in the surface-volume ratio and number of stem ribs in senita.² Larger, thicker (13–18 cm dia.) stems with fewer ribs are observed in northern Sonora (var. *schottii*). Shorter, thinner stems (7–12 cm dia.), with a larger surface-volume ratio (var. *tenuis*), occur in southern Sonora where there is more rainfall. In both areas, the green epidermis covers a pale green cortex in young stems, a color which changes to a golden yellow as the stems mature. On very old stems the epidermis turns grey and the cortex orange. A tubular woody skeleton filled with pith develops within the stems as they age.

Senita is an unusual plant. It contains at least five sterols, of which only two have been described, lophenol (4- α -methyl- Δ^7 -cholesten-3 β -ol) and schottenol (Δ^7 -stigmaster-3 β -ol).³ Schottenol appears to be the main reason why a particular species of fruit fly, *Drosophila pachea*, uses senita as its sole breeding site.⁴ The cactus is also rich in alkaloids. Djerassi and co-workers^{5–7} isolated small quantities of lophocereine (1-isobutyl-2-methyl-6-methoxy-7-hydroxy-1,2,3,4-tetrahydroisoquinoline) and larger amounts of two lophocereine trimers, pilocereine and piloceredine. The latter two are structurally the largest cactus alkaloids

¹ G. LINDSAY, *Cactus Succ. J.* 35, 176 (1963).

² R. S. FELGER and C. H. LOWE, *Ecology* 48, 530 (1967).

³ C. DJERASSI, G. W. KRAKOWER, A. J. LEMIN, H. H. LIU, J. S. MILLS and R. VILLOTTI, *J. Am. Chem. Soc.* 80, 6284 (1958).

⁴ W. B. HEED and H. W. KIRCHER, *Science* 149, 758 (1965).

⁵ C. DJERASSI, N. FRICK and L. E. GELLER, *J. Am. Chem. Soc.* 75, 3632 (1953).

⁶ C. DJERASSI, T. NAKANO and J. M. BOBBITT, *Tetrahedron* 2, 58 (1958).

⁷ C. DJERASSI, H. W. BREWER, C. CLARK and L. J. DURHAM, *J. Am. Chem. Soc.* 84, 3210 (1962).

known. These compounds are toxic to Sonoran species of *Drosophila* other than *D. pachea*, and prevent them from using rotting senita cactus as a breeding site.⁸

An added impetus for the initiation of this work was the discovery of an inversion in the salivary chromosomes of *D. pachea*.⁹ Populations of this fly in northern Sonora had a much higher incidence of this genetic marker than those in the south. The purpose of this study was therefore threefold: (1) to correlate differences in the lipid content of senita with morphological differences, (2) to correlate differences in the lipid content with chromosomal variations in *D. pachea*, and (3) to determine which plants or parts of plants are the best sources of the three unknown sterols.

RESULTS

Senita was collected from October 1967 to February 1968 in the places indicated on Fig. 1, dried *in vacuo*, and extracted with 2:1 CHCl_3 -MeOH. The extracts of young stems varied from 9 to 25 per cent and of mature stems from 15 to 21 per cent of the dry plant material. Except for a few cases, between 45 and 65 per cent of the extracts were recovered in three

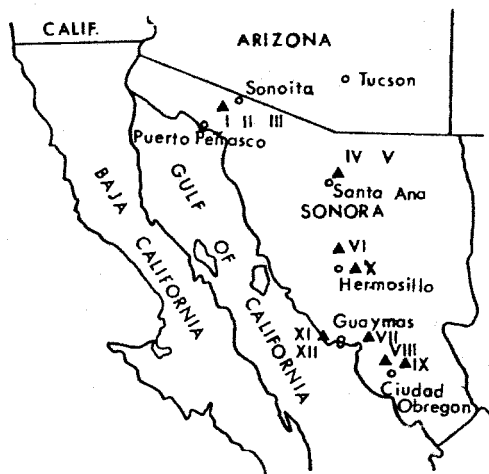


FIG. 1. MAP OF SONORA, MEXICO, SHOWING SENITA COLLECTION SITES. Triangles and Roman numerals represent individual cacti that were sampled and that are represented in subsequent figures.

crude fractions: non-saponifiables, fatty acids (plus chlorophytin), and alkaloids; the remainder of the CHCl_3 -MeOH extracts was water-soluble material. The contents of the three fractions in whole stems of nine plants collected from Sonora to Ciudad Obregon is shown in Fig. 2. The contents of the epidermis and cortex (and of the wood and pith in one case) of young and mature stems of three plants collected near Hermosillo and Guaymas is shown in Fig. 3. The crude extracts of the epidermi (15-44 per cent) varied more than those of the cortices (8.5-23 per cent of the dry plant material).

The fatty acid fractions from all plants had as their main constituents palmitic, oleic, linoleic, and linolenic acids (Fig. 4a-h). Greatest differences were observed between young and mature stems of a single plant (4a,b) and between mature stems in northern plants vs.

⁸ H. W. KIRCHER, W. B. HEED, J. S. RUSSELL and J. GROVE, *J. Insect Physiol.* **13**, 1869 (1967).

⁹ B. L. WARD, W. B. HEED and J. S. RUSSELL, *Genetics* **60**, 235 (1968).