X Dioscorea: In Vitro Culture and the Micropropagation of Diosgenin-Containing Species

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1 Introduction

Dioscorea belongs to the monocotyledons, family Dioscoreaceae, subfamily Dioscoreoideae. It comprises ca. 600 species and is divisible into numerous sections according to stem twining, leaf morphology, inflorescences, seed wings, bulbil formation, tuber morphology and chemical content (Dahlgren et al. 1985). Bulbils occur in the leaf axis of numerous species of Dioscorea and contribute greatly to vegetative propagation. Flowers are dioecious and seeds often winged. The plants are usually climbers, with tubers or rhizomes at the base. Underground tubers, vary in shape and are rich in starch. They also contain the poisonous alkaloid dioscorine, and therefore may be eaten only when boiled or roasted. The tubers are given the name yams. The term, however, should not be confused with the sweet potato, Ipomoea batatas (Convolvulaceae), which is also known as yam in the USA. Food tuber yams include D. alata, D. bulbifera, D. rotundata, D. cayenensis, D. esculenta and D. trifida. The plants are propagated vegetatively from tubers. Many species have a low rate of flowering and fruit setting and poor seed germination. Many species of Dioscorea are native to the Old World tropics and warm-temperature regions, some to tropical America. In Europe D. caucasia and D. pyrenaica are found (Engler 1964; Coursey 1967; Willis 1973; Brouk 1975; Dahlgren et al. 1985).

In recent years great advances in research on the Dioscorea species have been observed. The species have been the object of numerous studies by botanists, chemists and pharmacists. Some Dioscorea species play an important role in pharmacy. The steroidal sapogenins, mostly diosgenin (Fig. 1), present in the tubers and roots are one of the most valuable commercial sources for synthesis of corticosteroidal drugs (cortisone) and sexual hormones such as progesteron.

The consumption of steroid drugs increases every year. According to Fowler (1984), the steroids derived from diosgenin are among the ten most often prescribed medicines of plant origin. Other authors have described the biological properties of diosgenin. Dhawan et al. (1977) found that D. bulbifera has diuretic and anti-inflammatory activity. Sarma (1980) studied the influence of diosgenin, isolated from D. prazeri, on chromosomes of Allium cepa.

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Diosgenin was first isolated by Tsukamoto and Ueno (1936) from the Japanese species *D. tokoro* with a yield of 1%. Later, Marker et al. (1943) studied many other wild yams from Central America, such as *D. composita*, *D. testudinatia* and *D. lobata*, with high levels of steroidal sapogenin. The greatest development in sapogenin utilization has taken place in Mexico. One of the first plants to be investigated there were *D. mexicana*, *D. floribunda* and *D. composita*. New sources for important sapogenins have been indicated.

Hegnauer (1963) mentioned many *Dioscorea* species containing diosgenin, but as is known from other authors, only certain *Dioscorea* have so far been found to contain sufficient diosgenin of economic importance.

Akahori (1965) found an interesting correlation between morphological features and sapogenin content. He analyzed the Japanese *Dioscorea* species, three of which did not contain sapogenins. He discovered that species with alternative leaves, stems twining to the left and no bulbils contained diosgenin, whereas in species with opposite leaves, stems twining to the right and edible roots sapogenins were not present. The only exception is *D. bulbifera*, which, although if has stems twining to the left and globose tuber and forms bulbils, was not found to contain sapogenins. Other authors (Hegnauer 1963; Kaul and Staba 1968; Quigley 1978) found traces of diosgenin in *D. bulbifera*.

Coursey (1967) mentioned 53 *Dioscorea* species containing sapogenin, and a high percentage of diosgenin content (more than 2%) was found in 23 species in-