The Effect of Solanum Malacoxylon on Rachitic Bone Lesions in the Rat*

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Summary. The plant Solanum malacoxylon (S.M.) is known to cause severe soft tissue calcifications in cattle and sheep and has recently become of special interest since it exerts biological actions which resemble those of vitamin D. In order to investigate whether S.M. is capable to improve the rachitic bone changes in vitamin D and phosphate deficient rats, a watery extract of 50, 100 and 200 mg S.M. was fed daily to these animals over a period of 10 days. The width of epiphyseal plates was compared after that time with those of rats treated with 0, 0.225, 0.45, and 0.9 IU of vitamin D₃ daily. There was a dose related curative effect of S.M. on the epiphyseal lesions very similar to that of vitamin D₃. The hypercalcemic and hyperphosphatemic effect of S.M. was identical to that of vitamin D₃. The 25-hydroxyvitamin D serum levels remained almost undetectable in the S.M. treated rats as well as in the vitamin D₃ treated animals.

Key words: Solanum Malacoxylon — Line Test — Vitamin D — Rickets.

The plant Solanum malacoxylon is known to cause severe soft tissue calcifications in cattle and sheep (Worker and Carillo, 1967) and has recently become of special interest since it exerts biological actions which resemble those of vitamin D (Mautalen, 1972; O'Donnell and Smith, 1973; Uribe et al., 1974). In contrast to cholecalciferol, which, finally, gains its biological activity by renal conversion to 1,25-dihydroxycholecalciferol (review by Norman and Henry, 1974), Solanum malacoxylon is effective on intestinal calcium absorption even in nephrectomized rats and in patients with advanced chronic renal failure (Herrath et al., 1974). Therefore, it seemed to be of interest to investigate whether Solanum malacoxylon is also capable to improve the rachitic bone changes in vitamin D deficient and phosphate deficient growing rats.

Methods

The antirachitic activity of Solanum malacoxylon was tested in comparison to vitamin D₃ according to the Line-test as described by Bliss and György (Bliss and
György, 1951). The offsprings of seven female Wistar rats were fed a commercial vitamin D deficient diet (Altromin® C 1017, calcium-phosphorus ratio 1:1) during their first 28 days of life. After that time they were separated from their mothers and divided into 8 different groups of 7 animals according to a latin quarter while the vitamin D deficient diet was deprived also in phosphorus (calcium-phosphorus ratio 1:0.3). Over a period of 10 days 3 groups received via gastric tube a daily substitute of 0.225, 0.45, and 0.9 IU vitamin D₃ respectively dissolved in 0.1 ml peanut oil; a control group received plain peanut oil only. Another 3 groups were fed a watery extract of 50 mg, 100 mg, and 200 mg dried leaves of Solanum malacoxylon¹ respectively per day over the same period. For extraction 25 g dried and grinded leaves of Solanum malacoxylon were stirred with 125 ml distilled water for 1 hr at room temperature and afterwards strained by suction through a paper filter. The extract was adjusted to dosage by further dilution. The single applied volume of this watery extract was 1.0 ml per day and per animal. After 10 days all rats were killed by decapitation. Serum calcium concentration was estimated by atomic absorption spectrophotometry and serum inorganic phosphate concentration by Mercotest® (± SD).

Serum concentration of 25-hydroxyvitamin D was measured by competitive protein binding assay (Offermann and Dittmar, 1974). For calculating the antirachitic activity, both tibiae of all rats were fixed in 39% formaldehyde for 3 days and afterwards stained by 4% AgNO₃ and ultraviolet light. The width of the epiphyseal plates was estimated independently by 3 investigators experienced in this procedure, but not informed about treatment. The classification ranged between 1 unit for the smallest and 4 units for the widest epiphyseal line. These arbitrary units (AU) were added up per animal and further per group and a regression line was graphically constructed according to administered dose of vitamin D₃.

Results

From the data presented in Fig. 1 it is clearly evident that Solanum malacoxylon is capable of reducing the width of epiphyseal plates in ricketic rats, furthermore, it is obvious from our results that the effect of Solanum malacoxylon is dose related. We found the antirachitic activity of a watery extract from 50 mg Solanum malacoxylon resembling that of 0.35 IU vitamin D₃, that of 100 mg Solanum malacoxylon 0.69 IU vitamin D₃, and that of 200 mg Solanum malacoxylon 0.99 IU vitamin D₃ (Fig. 1).

The hypercalcemic and hyperphosphatemic effect of Solanum malacoxylon (mean range of serum calcium 3.33 ± 0.19 to 3.79 ± 0.77 mmol/l, of serum phosphate 1.52 ± 0.20 to 1.57 ± 0.20 mmol/l) was identical to that of vitamin D₃ (mean range of serum calcium 3.33 ± 0.34 to 3.54 mmol/l, of serum phosphate 1.53 ± 0.20 to 1.66 ± 0.17 mmol/l), while untreated controls showed distinctly lower calcium (2.80 ± 0.20 mmol/l) and phosphate (1.12 ± 0.10 mmol/l) serum levels (Table 1).

¹ Solanum malacoxylon was a friendly gift by Prof. Dr. Dirksen (Munich) and Dr. L. J. Döbereiner (Rio de Janeiro).