E2-36: The solubility of calcium oxalate, magnesium oxalate and magnesium phosphate in aqueous extracts of *Bryophyllum pinnatum leaves*

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Aqueous leaf extracts of *Bryophyllum pinnatum* are used in the non-surgical treatment of urinary calculi by the practitioners of indigenous medicine in Sri Lanka. Analysis of urinary calculi has revealed that 70-90% of these contain insoluble forms of calcium, magnesium, oxalate and phosphate ions in varying amounts. In this study the solubility of calcium oxalate, magnesium oxalate and trimagnesium diorthophosphate in the aqueous extracts of *Bryophyllum* leaves *in vitro* were measured with a view to determining the ability of the extract to solubilize calcium and magnesium from their insoluble forms and the possible mechanism of solubilization.

Mature *Bryophyllum* leaves were picked from plants about 0.75 m in height. Aqueous extracts used in the study were prepared, as required, using the following procedure: 200 g of washed and dried leaves

were ground with about 200 cm^3 of distilled water and left to stand for about 3 h. After the foam was broken the total volume of the system was adjusted to 1.00 dm^3 with distilled water and centrifuged at 2000 rpm for 20 min to obtain a clear pale yellow extract which was stored in a refrigerator.

Laboratory reagent grade calcium oxalate (Park Scientific), magnesium oxalate (BDH) and trimagnesium diorthophosphate (BDH) were used for magnesium solubility studies without further purification. The solubilities of these in the leaf extracts were determined using the following general procedure: 0.100 g of each of the above compounds was added to 100 cm^3 aliquots of the leaf extract and the mixture was magnetically stirred for 15 min. The mixture was then centrifuged and the supernatant thus separated was analysed for the species of interest using atomic absorption spectrophotometry and chemical methods.

All determinations were made at 25°C. Control experiments were carried out where necessary by replacing the leaf extract with an equivalent volume of distilled water. Calcium, magnesium and phosphate content of the fresh leaf extracts and the total calcium and magnesium in the leaves were also determined. Similar analysis of the leaf extracts and leaves of Gotukola (*Centella asiatica*) and Sarana (*Boerhavia diffusa*) were also carried out for comparison purposes.

The calcium content in the *Bryophyllum* extract did not change significantly after stirring with solid calcium oxalate showing that the fresh leaf extract was unable to solubilize any calcium from its oxalate form. However the fresh extract solubulized the equivalent of 10.77 mg of Mg of magnesium oxalate and 26.87 mg of Mg of trimganesium diorthophosphate per 100 cm^3 of leaf extract.

The total Ca and Mg content /g fresh leaves was found to be 47.9 mg and 5.83 mg, respectively,. These are significantly higher values when compared to those determined, for example, for Gotukola and Sarana. Gotukola contained 1.34 mg Ca and 0.43 mg Mg whereas Sarana contained 1.73 mg Ca and 1.29 mg Mg. The aqueous extract of *Bryophylum* leaves was found to contain 58.0 mg Ca and 12.4 mg Mg/100 cm^3 leaf extract. In comparison the aqueous extract of Gotukola leaves (prepared similarly) contained 8.4 mg

Ca and 0.26 mg Mg, whereas the squeous extract of Sarana leaves contained 0.1 mg Ca and 8.4 mg Mg. These data point to a special ability of *Bryophylum* to uptake and store large amounts of calcium and magnesium from their habitats when compared to most other plants.

Fresh leaf extracts of *Bryophylum* are found to be capable of solubilizing Mg from its insoluble forms, magnesium oxalate and trimagnesium diorthophosphate. The solubility of Mg in the extract is 17 times as high as that in water for magnesium oxalate and 36 times as high as that in water for trimagnesium diorthophosphate. This result indicates that leaf extracts of *Bryophylum* may be effective in the treatment of urinary calculi containing magnesium whether in oxalate or phosphate form.