POSTER 9

Bugs and Insectivorous Plants - A Current Review

Dirk Weickmann; LATRODECTA, - Biogene Gifte -, Jägerstr. 31A, 82041 Deisenhofen, Germany
Paul Debbert; München, Germany
Renate Burda; Sauerlach, Germany
Markus Fischer; München, Germany

Since the last century bugs living on insectivorous plants have been described. In the last years some new species were found. We know bugs on following plant genera:

- *Roridula*
- *Drosera*
- *Byblis*

Only carnivorous bugs live on these plants in a special kind of 3-dimensional symbiosis. During the last 3 years we have studied these bugs in nature, in cultivation and by literature research and we compared their biology with the biology of some Reduviidae.

The results showed us that the carnivorous plant bugs are highly specialized to the plants and they are not able to live without these plants.

The symbiosis enables the bugs to eat insects 100 times heavier than themselves.

POSTER 10

Secondary Metabolism of Nepenthales

Jan Schlauer, Heiko Rischer, Michael Wohlfarth, Markus Rückert, Matthias Wenzel,
Gerhard Bringmann; Institut für Organische Chemie, Am Hubland, 97074 Würzburg, Germany

The order Nepenthales has only recently been redefined on the basis of homology comparison studies of the rbcL (Fay & al., 1997) and 18S rDNA (Soltis & al., 1997) genes, which revealed a close phylogenetical relationship between families that have formerly been assigned to widely separate positions in the natural system. It comprises the families Polygonaceae, Plumbaginaceae, Simmondsiaceae, Nepenthaceae, Droseraceae, Drosophyllaceae, Dioncophyllaceae, Ancistrocladaceae, Frankeniaceae, and Tamaricaceae. Including more different carnivorous plant families than any other order of flowering plants, Nepenthales is a sister group to Caryophyllales. All carnivorous and some of the non-carnivorous Nepenthales have unique glands in which the secretory tissues are separated from the tissues beneath by one or few endodermoid cell layers. These glands are vascularized in the carnivorous members. While Caryophyllales are characterized phytochemically by the widespread presence of betalain pigments, which are not found in other flowering plants, Nepenthales are almost as distinct by the common possession of polyketide metabolites, which are found only in a few cases outside this order. Thus, studies of their secondary metabolism yield valuable information both on the physiology and the systematics of these plants.

The metabolites most widespread in Nepenthales are naphthoquinones like plumbagin, which are formally composed of six molecules of acetate (hexaketides). Other widespread compounds are isoshinanolone, droserone, and 7-methyljuglone. Naphthylisoquinoline alkaloids (Bringmann & Pokorny, 1995), unique biaryl componds sharing important structural properties with the naphthalene derivatives mentioned, probably originate from similar biosynthetic precursors. These alkaloids are only known from two small families of Nepenthales, *viz*. Dioncophyllaceae (three monotypic genera in W Africa, among which *Triphyophyllum* is carnivorous) and Ancistrocladaceae (only genus, *Ancistrocladus*, with 20 species from W Africa to Borneo), which confirms their close relationship.

Feeding experiments in which ^{13}C labelled alanine was applied to the insect-trapping organs of *Triphyophyllum peltatum*, the label has been detected in shoots and leaves after an incubation of three days

(Bringmann & al., 1998). This proved the uptake and the redistribution of the amino acid (a common digestion product of animal proteins), completing the carnivorous syndrome of this species.

The acetogenic nature of plumbagin and isoshinanolone has been established by feeding ^{13}C labelled acetate to callus cultures of *A. heyneanus* and NMR investigations of the formed metabolites (Bringmann & al., 1998). The folding pattern of the intermediate polyketide that has likewise been deduced from these studies suggests a hypothesis on the biosynthesis of isoquinoline derivatives and naphthylisoquinoline alkaloids.

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