Unusual triterpenoids from African medicinal plants

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Introduction

Investigations into the phytochemistry of many African plant species have led to the isolation of many unusual triterpenoids and triterpenoid-derived compounds. Examples of compounds isolated from the Gentianaceae, Rutaceae (Ptaeroxylaceae) and Meliaceae families are discussed.

The Phytochemistry of Anthocleista grandiflora (Gentianaceae)

Anthocleista grandiflora Gilg (syn. A. zambesiaca Bak.) is a large tree of moist forests in the eastern and southeastern African tropics, and the Comores. Anthocleista Aafzel. ex R.Br. is a small genus of only fourteen species, eleven of which occur on Continental Africa and three only on the island of Madagascar (Leeuwenberg, 1992). In southern Africa, bark decoctions are used traditionally to treat malaria (Palmer and Pitman, 1972). Regionally, preparations of the bark have also found use as an anthelmintic (specifically for roundworm) (Githens 1949), antidiarrhoeal (Watt and Breyer-Brandwijk 1962; Mabogo 1990), and to treat diabetes, high blood pressure and venereal diseases (Mabogo 1990). Further north on the continent, epilepsy is remedied with the aid of bark decoctions (Neuwinger 2000).

Anthocleista Aafzel. ex R.Br. is presently assigned to the Gentianaceae although its affinities were previously considered to be with the Loganiaceae (tribe Potaliace which at times has been recognised as the family Potaliaceae)(Leeuwenberg 1992). Phytochemical (iridoid glycoside presence), morphological and molecular data all support its transfer to the Gentianaceae (Backlund et al. 2000). A previous investigation of this species yielded two iridoid glucosides, grandifloroside and methyl grandifloroside and methyl grandifloroside, together with the coumarin, scopoletin (Chapelle, 1976). Our re-investigation of the stem bark has yielded four novel triterpenoids, bauerenol, 1, bauerenone, 2, 6-ketobauerenone, 3 and grandiflorol, 4, in addition to scopoletin 5 and (+)-de-O-methylasiodiplodin, 6. The root bark has yielded, in addition to the above compounds, lupenone, 7 and the iridoid sweroside, 8.

The skeleton of grandiflorol, 4, has not been reported previously and compounds 1-3 are the C-13β-methyl isomer of the bauerane class of triterpenoids. This type of skeleton has been reported once previously in a compound from Artemisia mongolica Fisch. ex Bess. (Asteraceae)(Hu et al., 2000).
3. The Chemotaxonomy of the Ptaeroxylaceae

The Ptaeroxylaceae J.Leroy has at various times been placed in the Sapindaceae, Meliaceae, Rutaceae and Simaroubaceae before being widely accepted as a small natural family (Pennington and Styles, 1975; White, 1986). Whereas the family was earlier considered to comprise only two genera (*Cedrelopsis* Baill. and *Ptaeroxylon* Ecklon & Zeyher, with eight and one species respectively), the monotypic *Bottegoa* Chiov. has more recently been transferred to the Ptaeroxylaceae from the Sapindaceae (Van der Ham et al., 1995). Subsequent *rbcL* sequence analyses (Savolainen et al., 2000) revealed *Ptaeroxylon* to nest within the Rutaceae and to be closely related to the genera *Cneorum* L., *Spathelia* L., *Dictyoloma* A.Juss. and *Harrisonia* R.Br. ex A.Juss. (a genus which had been included in the Simaroubaceae). A number of authors (The Angiosperm Phylogeny Group, 2003) have accordingly referred the Ptaeroxylaceae to the Rutaceae and on the basis of molecular analyses by Chase *et al.* (1999), to a recircumscribed subfamily Spathelioidae. For the purposes of this report we refer largely to taxa of the old Ptaeroxylaceae in relation to Spathelioidae representatives.
Ptaeroxylon obliquum (Thunb.) Radlk., the sneezewood tree, has been found to contain a range of prenylated coumarins and chromones (Dean et al., 1966, 1967a, 1967b, 1967c; McCabe et al., 1967). Of the eight known Cedrelopsis species, all endemic to Malagasy, the chemistry of four has been investigated – Cedrelopsis gracilis J.F.Leroy, C. longibracteata J.F.Leroy, C. microfoliata J.F.Leroy and C. grevei Baill. The bark and wood of C. grevei have yielded prenylated coumarins and prenylated chromones (Dean and Robinson, 1971; Koorbanally et al., 2003) as well as three limonoid derivatives, cedmiline, 9, cedashnine, 10, and cedmilinol, 11, and a quassinoid, cedphiline, 12 (Mulholland et al., 1999; Mulholland, et al., 2003a). The fruits have been shown to contain prenylated chalcones and prenylated flavanones (Koorbanally et al., 2003).

The stem bark of C. microfoliata has yielded prenylated coumarins and prenylated flavanones (Koorbanally et al., 2002), and the bark of C. longibracteata has yielded prenylated coumarins (Randrianarivelosia et al., 2005). The bark of C. gracilis has yielded prenylated chromones and two limonoid derivatives cedkathryn A, 13, and cedkathryn B (Mulholland et al., 2004). The limonoid derivatives isolated from Cedrelopsis are highly modified, and similar to those isolated from the Cneorum (Mondon and Epe, 1983) and Harrisonia (Khuong-Huu et al., 2001).

The presence of simple and prenylated coumarins and chromones in Ptaeroxylon, Cneorum, Dictyoloma and Spathelia and the presence of similar simple limonoids, such as obacunone, and highly oxidised limonoids in Ptaeroxylon, Cneorum, Spathelia and Harrisonia further supports the inclusion of these taxa within a recircumscribed Spathelioideae (Rutaceae) rather than the maintenance of a distinct family Ptaeroxylaceae or the placement of Harrisonia within the Simaroubaceae. However, Spathelia and Dictyoloma contain quinoline-derived alkaloids which have not been found in Ptaeroxylon, Cneorum or Harrisonia. Additionally, the isolation of a quassinoid from Cedrelopsis grevei is puzzling. Quassinoids are typically found in the Simaroubaceae, with which Harrisonia was previously grouped. The isolation of further quassinoids or quinoline alkaloids from these related genera would be of great interest.

The wide variety of possible complex triterpenoid structures can be illustrated by compounds 14-18, complex tetranortriterpenoids from members of the Meliaceae. Compound 14 has ring B opened to give a C-7 carbomethoxy group and a 8, 30-exocyclic methylene group, a contracted ring C and a ring D which has been oxidised to form a lactone. In compound 15, additionally, ring A has been expanded into a 7-membered oxygen-containing ring. Both these compounds are derived from the Madagascan species *Astrotrichilia voamata* (Mulholland *et al.*, 1999, 2000).

The Malagasy genus *Neobeguea* Leroy has yielded complex limonoids. In leandrianin B, 16, and C, 17, from *N. leandriana* J.F.Leroy, ring B gas been opened and recylised by bond formation between C-2 and C-30 to give phragmalin-type limonoids (Coombes *et al.*, 2003). In compounds 16 and 17, ring D has been oxidised to a lactone, but this is opened to give a...
keto group at C-17 in compound 18, isolated from *N. mahafalensis* J.F.Leroy (Mulholland *et al.*, 2003b). The presence of a C-1, 8, 9 - orthoester adds to the complexity of these compounds.

![Chemical Structures](image)

**Conclusion**

The large number of possible structures that can be achieved from folding the thirty carbon skeleton in different ways, cyclizations, migrations and other rearrangements, oxidations, ring cleavages and subsequent rearrangements and loss of carbon atoms, leads to an enormous variety of possible structures.

**REFERENCES**


