The Lethal Arrow Poison in the Traditional Tribal Community of Siberut Island, Indonesia

(The concoction of *Tabernaemontana peduncularis*, *Derris elliptica* and *Capsicum species* ; the active chemical compounds; the extraction procedure, and the toxic effects)

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ABSTRACT

The indigenous tribal community on the island of Siberut in the Mentawai island group of Indonesia has retained an early Neolithic culture. Hunting is still performed with a bow and poison arrows. The poison is extracted from three plants: *Tabernaemontana (Ervatamia) peduncularis*, *Derris elliptica*, and *Capsicum sp.* The combined poisons result in a chemical composition of bisindole alkaloids, isopropenyl-benzopyrane and benzylamid acids, as well as, most probably also, steroid glycosides. Death results mainly from cardiac and respiratory failure. The meat of the game killed with this poison is edible.

Key words: Arrow poison, *Capsicum, Derris elliptica, Tabernaemontana peduncularis (Ervatamia peduncularis)*, hunting, indole alkaloids, Indonesia, Mentawai, Neolithicum, Siberut, steroid glycosides.

INTRODUCTION

The people indigenous to the Mentawai Islands of Indonesia still inhabit the hilly hinterland of the island Siberut. They adhere to a traditional culture believed to have originated in the early Neolithic period (Loeb, 1928, Schefold, 1980: 5, 1988: 81). Their ritual hunting activities are still executed with a strong reflex action bow cut off from the extremely hard and tough *Arenga obtusifolia* Martius (*A. westerhoutii* Griff.) wood, Arecaceae, or a local variety of that species. The vernacular name of that palm is *poula* (Zahorka, 1998a: 4/21). The arrows are treated with poison from the point to ten centimeters down. The game hunted consists of local stags, wild boars and monkeys. All four species of monkeys existing there are endemic (Whitten, 1982), as is the case with 67% of all 31 mammal species and subspecies explored there until now. The endemics among the plant life existing on Siberut are assessed at between 5 and 15% (WWF, 1980:38). The reason of this high rate of endemics is the geological separation of at least a 500,000 years of the Mentawai Islands from the wealth of other Asian forms.

BOTANICAL DESCRIPTION OF THE PLANT SPECIES USED

The poisons for the lethal concoctions are extracted only by the sanctioned Mentawai *kerey* (shamans) from selective parts of the following three distinguished plant species:

1. *Tabernaemontana peduncularis* Wallich (*Ervatamia peduncularis* King and Gamble), Apocynaceae

The leaves, the stem bark or the wood is used. The use of leaves is predominant presumably by their abundance. However, if available, the bark and the rasped wood are preferred. This is presumably because of a higher lethal effectiveness of the agents found in them.

T. peduncularis is a bush some two meters high. Botanic descriptions are rare and short (v.a. Ridley, 1930 reprint 1967: 343; Burkill, 1925: 943; Prosea, 2001 12(2): 537). The five white petals of the rare blossoms of the plant are twisted like the arms of a propeller, and are open during the day. The vernacular name of that plant on Siberut is *daggi*. Together with *Herbarium Bogoriense* experts, we could finally identify the *daggi* herbar twigs in 1998. Previously, all researchers on Siberut over the period of the last 80 years had described *daggi* as being the (tall) Moraceae tree *Antiaris toxicaria* Lesch. The leaves of that big tree, however, contain no poison. It is the latex of that tree which is mainly used by the hunters and gatherers in Borneo to extract the poison for their blowpipe darts. The result of this poison consists chiefly of cardiac failure causing steroid glycosides like α- and β-Antiarin (Zahorka, 1986: 58f, 1987: 26ff). The occurrence of *Antiaris toxicaria* on Siberut is not confirmed.

2. *Derris elliptica* Benth., Fabaceae

Only the poisonous roots of this plant, a climber that most commonly grows close to small rivers, are used. The inflorescence is a raceme consisting of small inconspicuous dirty white blossoms. On other islands of Southeast Asia, extractions from the roots are applied as an insecticide, and used as an abortive, as well as a traditional medicine for oxyuriasis (Hagers Handbuch, 1979: 493). It is well-known for its effectiveness as fish poison. The active substance destroys the gill epithelia preventing the absorption of oxygen. The vernacular name of Derris in Siberut is *langgit*.

3. *Capsicum species*, Solanaceae

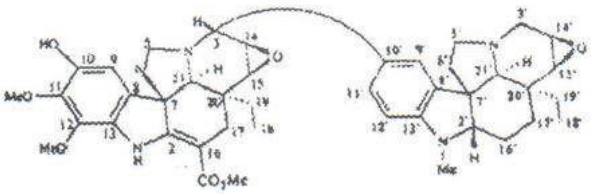
This third element of the composition is type of spice, rather a medicinal plant, albeit a non toxic one. It is an extremely hot and very small red chili pod (Cayenne pepper). The vernacular name among the Mentawais, who do not eat it as a spice, is *daro*.

THE ACTIVE CHEMICAL COMPOUNDS

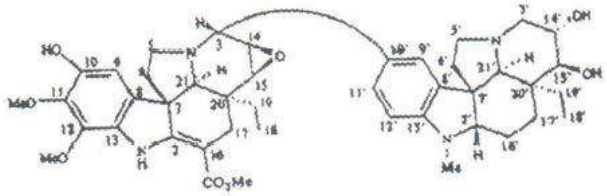
1. *Tabernaemontana peduncularis* Wal., *(Ervatamia peduncularis* King and Gamble), Apocynaceae.

Phytochemical analyses on alkaloids was done on stem bark and leaves only not before 1995 (Zeches-Hanrot *et al.*, 1995). It is unfortunate that the woody substance was not included into the testing. The investigation also neglected analyses of possible cardiac effective steroid glycosides, which are recorded of other closely related *Tabernaemontana species.*

From the crude alkaloid mixture (AM) of the leaves three alkaloids were obtained: The already known N(1)-methyl aspidospermidine (2% AM), and two novel bisindole alkaloids, which were named pedunculine (17.9% AM) and peduncularidine (15% AM). Both are bis-tabersonine derivatives. The biological effectiveness of these alkaloids has not been evaluated. The Neolithic hunters on Siberut Island can prove, however, that the components act in an absolutely lethal manner, if applied parenteralic; causing cardiac arrest and probably respiratory failure.



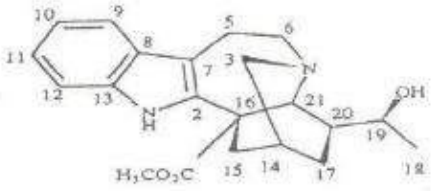
Pedunculine



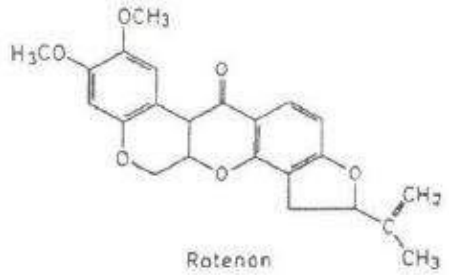
Peduncularidine

From the stem bark, six known alkaloids were isolated. In increasing polarity they were coronaridine (10% AM), coronaridine hydroxyindolenine (0.3% AM), eglandine (2% AM), heyneanine (44% AM), eglandulosine (0.5% AM) and heyneanine hydroxyindolenine (0.5% AM). Among them are powerful heart poisons with paralyzing effects comparable to strophantine, also sorotonin antagonists, with some having antimicrobic properties and even anticancer activity. Other groups of phytochemists (Kamesh *et.al.*, 1980 and Perera *et.al.*, 1985) have also been able to isolate v.a. the cardiac active coronaridine from closely related *Tabernaemontana divaricata* R.Br. (*T.coronaria* Willd.) and from *T. dichotoma* Roxb. et Wall.

The presumed presence of additional heart effecting steroid glycosides in leaves and/or in stem bark and/or in woody substance cannot be excluded. For example, glycosides were confirmed in the leaves and stems of related *Tabernaemontana pandacaqui* Poir. (Handbook on Philippine Med. Plants, 1977 : 19) and in the roots of *T. pachysiphon* (cit. Bisset, 1991 : 87).



Heyneanine



Rotenon

In addition, a recent source mentioned that "bark and leaves" of *Tabernaemontana rostrata* Roxb. ex Wallich are ingredients of the dart poison in Siberut (Prosea, 2001, 12 (2): 537). It was noted in this reference that the flowers of that species are open only during the night. However, the specimens I observed had the flowers open during the day.

2. *Derris elliptica Benth.*, Fabaceae

The sap extracted from the roots includes a number of polycyclic toxins (Hager, 1979 : 177 and 490-493). Most abundant is the benzopyrane rotenon (tubatoxine, rotenone). The others are ellipton, malaccol, deguelin, dehydrodeguelin, DL- and L-toxicarol, dehydrotoxicarol and tephrosin. Rotenon is supposed to be the main agent.

Rotenon acts as a neurotoxin and as a haematotoxin. It severely interrupts the contact spots of the somatomotoric nerves to the muscles, creating convulsions, which are finally followed by paralysis. This can be lethal even to major animals (Römpp Lexicon, 1989). The effectiveness is increased twenty fold with the presence of lipoid substances. Capsicum pods contain it!

3. *Capsicum species*, Solanaceae

The small pods of the hot chili contain a high amount of capsazinoids, which are a blend of five chemically related amid acids. The principal component is capsaizine, a benzylamide. Other essentials of the pods are lipoids, flavonoids and ascorbine acid (BI-Lexicon, 1990:249,250).

The capsazinoides effect the contacts of the nerves connected to the skin. That leads to an expansion of the capillaries, which accelerates the blood circulation, and hence, also accelerates the distribution of the arrow poisons within the body.

THE ARROW POISON EXTRACTION PROCEDURE

One of the important properties of any arrow poison is that it has to be rapidly and readily soluble in water or in blood. Some experts, therefore, supposed that the poisonous ingredients of the plants used for arrow poisons are extracted by washing or

even by boiling. This is incorrect. The procedure on Siberut executed by the entitled *kerey* (shamans) only is as follows:

From *Tabernaemontana peduncularis* the stem bark and/or the moist stem wood is rasped and grated with a bush knife.

The roots of *Derris elliptica* and, - if used - the fresh latex-including leaves of *Tabernaemontana peduncularis*, are also grated into very fine pieces. The combined components are again thoroughly chaffed with the bush knife on a hard wood plate.

Then the pods of *Capsicum* are strewed over the mixture, and powerful crushed, squashed and mashed with a pestle into the other ingredients. This blend is then ground even more finely with the pestle with a technique like that still used by housewives combining spices for a good curry on the adjoining island of Sumatra.

This mixture is then stuffed into a small basket-like rattan container that appears very similar to the rings Boy Scouts use with the scarves. This small container filled with the mixture is placed into a pair of wooden pair pliers with long arms, which act as a powerful press. This container is squeezed hard until a blackish brown fluid oozes from it drip by drip. This liquid concoction is the final product of the arrow poison, which is called *omai* on Siberut.

Collected in a small coconut shell, the poison mixture is directly applied to the arrows by means of a broom-like device made of a piece of fibrous wood. The poisoned arrows are dried by carefully holding, moving and turning them in the smoke at the distance of about 20 centimeters from a small fire. Once the arrows are dry, they are ready for hunting.

Former analyses of various arrow poisons collected from three continents have shown the predominance of heart effective steroid glycosides (Pötsch-Scheider, 1982 : 5), while *omai*, is rich in indole alkaloids.

THE PHYSIOLOGICAL EFFECTS ON HUNTING GAME

Hunting is a ritual supervised by the *kerey* (shamans). Game animals, like monkeys, who are hit by an arrow, regardless of which part of the body is wounded, emit a guttural scream, and appear to become paralyzed immediately. The faces of such creatures, become contorted with pain, and their bodies start to twitch. This state lasts one minute or more, while the condition worsens. The animals then lose consciousness in an accelerating rate (Zahorka, 1998b : 107). Death results mainly from cardiac failure accompanied most probably by respiratory arrest. The throes of death last a few minutes longer with larger animals. The boiled or fried flesh of animals killed with the poison is edible.

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Figure 1. The bow is made from *Arenga obtusifolia* wood

Figure 2. *Ervatamia penduncularis* (*Tabernaenmontana*) inflorescence

Figure 3. *Derris elliptica* inflorescence

Figure 4. The parts of the three plants for poison production

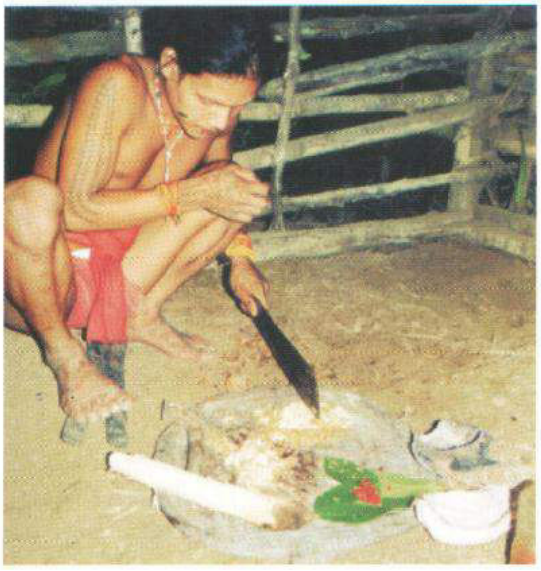

Figure 5. The three components are chaffed and grated

Figure 6. All is crushed, squashed, mashed into mass

Figure 7. Hard squeezing makes drip down the poison

Figure 8. The poison is applied to the arrows