Blowpipe dart poison in Borneo and the secret of its production: the latex of Antiaris toxicaria; the poison-making procedure; the heat-sensitive main toxic chemical compound, and the lethal effect of the poison.

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Blowpipe dart poison in Borneo is generally produced from the latex of the Antiaris toxicaria tree (Moraceae). This latex contains a variety of toxic chemical compounds. The principal toxic agent is a steroid glycoside known as [beta]-Antiarin. A lethal dose (L50) is only about 0.1 mg. per kg. weight of a warm-blooded animal. To dehydrate the milky latex into a paste, a long, carefully implemented procedure is essential because the steroid glycoside compound is extremely heat-sensitive. Therefore, hunters perform the dehydration of the latex by using a young leaf from the small Licuala spinosa palm. The leaf is folded into a boat-shaped container to hold the latex at a carefully determined distance over a small flame for about one week. This is possible because the young Licuala leaf is astonishingly fireproof and durable. This is the secret of producing the lethal poison. If the latex were heated at too high a temperature, the glycoside compound would crack and its toxicity would be lost.

Introduction

The diverse indigenous Dayak tribes, as well as the formerly semi-settled hunters and gatherers of Borneo (Kalimantan) such as the Punan, Berusu, and Basap have traditionally hunted for wild animals with blowpipes and poison darts. The blowpipe, which is about two meters long, is made of ironwood (Eusideroxylon zwageri), generally known as ulin in Indonesia, or of another hardwood species. Among my collection are also some antique blowpipes cut from bamboo sections.

The 30 cm. long blowpipe darts weigh less than 1 g. The darts exit the blowpipe at a speed (V0) of at least 50 m/see, or about 180 km/h, as ascertained through trials by the author at the German Bundeskriminalarat (German Federal Bureau of Investigation) in the city of Wiesbaden in 1985 (Zahorka 1986:37). Because of minimal weight and high velocity, the darts' trajectory is flat up to a distance of 25 to 30 meters. Therefore, at this distance, the dart can hit an animal even if only a small part of it is visible or it is shielded by branches and leaves in the dense jungle cover. This would not be possible if using a bow because the flight path of a heavy arrow is not straight but takes on a ballistic curve. Another advantage of hunting with a blowpipe is the nearly soundless shooting.

The agent that brings about the demise of the animal is the poison, not the dart itself. Irrespective of which part of the animal's body the dart hits, the poison diffuses very rapidly throughout the whole body. A two-centimeter segment of the points of the darts used for hunting small animals, monkeys and large birds is treated with poison. The darts for hunting deer (Cervus unicolor), muntjak (Muntiacus muntjac) and wild boar (Sus barbatus) are treated with poison to five centimeters down from the point upon which is affixed a sharp head of bamboo, metal or a small animal's pointed tooth.

Because of the depletion of the forests in Kalimantan, the present indigenous hunters need a hunting weapon that can be shot over a much greater distance than the blowgun. Therefore, some Basap people living on the Mangkalihat Peninsula, Kalimantan Timur, have constructed sophisticated air guns powered by strings of elastic, which shoot these poison darts accurately at a distance of about 100 meters (Zahorka 2004a:10).

The Plant Species Needed to Produce the Dart Poison

The raw material that yields the poison is the latex of the tall tree Antiaris toxicaria (Pers.) Lesch., Moraceae. However, the poison processing is possible only with the use of a young leaf of the small Licuala spinosa Thunb. palm.

1. Antiaris toxicaria (Pers.) Lesch., Moraceae, can grow up to 50 meters in height and to a diameter of up to 1.5 meters or more. The tall branchless trunk is straight; the buttresses are relatively small, and the small treetop is nearly spherical. It is a rare tree that grows from the lowland up into the montane tropical forest. Generally, the lower parts of the trunks display numerous scars, which indicate former latex tapping over many decades.

Because of its powerful poison, this tree has been the subject of horror stories for 200 years. Thus, the seventeenth century German-Dutch natural scientist Rumphius wrote: "This tree grows on barren mountains. The soil below it is desolate and singed. Only a horned snake lives under the tree which cackles like a hen and has eyes that glow in the night" (cit. Beekmann 1981 in Zahorka 2000:19, translated by the author). Similarly, the Swedish Borneo explorer Eric Mjoberg reported in 1929: "To stay at a close distance to the tree is life-threatening and an embankment of bones surrounds it ..." (Mjoberg 1929:307, translated from German by the author). Fortunately, this all is pure fantasy. In a more recent book, we can read: "There is a fabulous legend that it is deadly merely to sleep in the shade of the upas tree" (Smith 1997:36).

In Java, Sumatra and Malaysia, the tree is widely known as pohon ipoh or pohon upas. However, the various traditional tribal communities in Kalimantan have their own vernacular names for it. Here are some examples which I collected in East and Central Kalimantan between 1976 and 2003:

2. Licuala spinosa Thunb., Palmae, is a small fan palm growing in the tropical forests of SE Asia along the equator (McCurrach 1960). The 3-to-5-meter-high stems grow in tufts. The 15 to 18 leaf segments, which are up to 40 centimeters long and up to 15 centimeters wide are widely used for thatching. The Indonesian and Malaysian name for it is sang.

For the dehydration process of the Antiaris latex, a very young sang leaf, that is still accordion-like folded and not yet spread out, is used. In this original condition, the leaf is absolutely fire resistant and durable. It is this property of the leaf that holds the secret of producing the dart poison over a fire. The young leaf keeps its shape and will not burn even if put into a hot gas flame. A boat-shaped container made with this leaf must be durable enough to hold the latex throughout the prolonged dehydration.

The Active Chemical Compounds

Phytochemical analyses reveal that the latex of the Antiaris toxicaria includes a differing blend (individually and provincially) of at least 30 complex cardenolides, i.e., strong heart poisons (Hegnauer 1973, Neumuller 1979). Alkaloids are extremely rare. The chemical structure is clarified with [alpha]-Antiarin, [beta]-Antiarin, [alpha]-Antiosid, Antiosid, Malayosid, Convallatoxin (which is a Strophantin Rhamnosid), Desglucocheirotoxin and other compounds, most of which include Strophantin (Bisset 1962:143-51; Dolder et al. 1955:1364-96). The bark, the wood, the roots, and the seed include the same toxic compounds. However, the leaves, the male inflorescence, and the flesh of the fruit are flee of them.

The principal toxic agent of the dart poison is the glycoside [beta]-Antiarin; 1.5 to 2 percentage of the total weight of the original latex consists of this glycoside. The molecule of [beta]-Antiarin consists of two components. One is the complex Sterin Antiarigenin, which is the toxic component. The other is the glycoside [alpha] L-Rhamnose, which is a sugar compound. This sugar component is connected to the Antiarigenin by a heat-sensitive oxygen bridge (glycoside connection). This sugar makes the whole molecule rapidly and readily soluble in water and in blood. However, if the latex or the final poison is heated to too high a temperature during the dehydrating process or later, during boiling the meat while cooking it, the glycoside connection cracks and the sugar component becomes free. In that way, the toxicity of the latex is lost.

[ILLUSTRATION OMITTED]

The Poison-Producing Procedure

With a bushknife, the latex collector cuts a deep notch into the bark. Instantly, a yellowish latex pours out. If a considerable mass is wanted, the latex is collected in a bamboo container. When small amounts are needed, the latex is collected directly into the boat-shaped Licuala leaf container.

A small fire is lit and a simple construction of several small branches is set about 70 centimeters high above it. For at least several days, the top of this trestle serves as the resting place above the fire for the Licuala container with the latex inside. In case of rain, the container may be temporarily placed above the fireplace in the house. The process of dehydration requires great patience and care. A medium quantity of latex takes a week's work. During the process, the latex darkens to a deep brown color. As the processing continues, the viscosity becomes more and more glutinous and the final color is a metallic black. Temperature control requires the most attention. If the latex gets too hot, the glycoside connection of the [beta]-Antiarin cracks and the sugar component becomes free. If this happens, the glutinous mass will taste sweet and the toxicity will be lost. This fact is well known to indigenous hunters. Therefore, during the dehydration process, they repeatedly taste the mass carefully with the tongue. It has to taste extremely bitter. If it tastes sweet, all the efforts will have been in vain. Although published accounts of this procedure have appeared in books and magazines (v.a. Zahorka 1976:57f; 1987:26; 2000: 22), incorrect information, such as "The mixture is boiled over a fire ..." (Boer et al. 1999:128) is still widespread. Boiling would cause the toxicity to entirely dissipate.

To poison the darts, the tips are simply dipped and turned round in the thick toxic paste. This poison is very durable and effective for years if not heated. Old poisoned darts in museums are dangerous even after decades of display (Needham 1988). The comment "... it cannot be stored and must be used fresh." (Boer et al. 1999:128) is incorrect. The traditional hunters prepare new poison about once a year. If stored poison gets too hard, it is made glutinous again by adding the sap of pressed Derris elliptica roots, which contain a neurotoxin and a haematotoxin. Some authors claim that other poisons are added, such as snake poison, strychnos or the like (Potsch-Schneider 1982). None of the tribes I have spent time with in Kalimantan since 1976 have ever confirmed this. No other ingredients can enhance the lethal effectiveness of [beta]-Antiarin.

The Physiological Effects on Game

Like omai, the arrow poison of the Mentawaians (Zahorka 2004b:34), the ipoh or upas poison acts in a lethal manner only if applied in a parenteralic manner. Death results from cardiac failure. Intestinal absorbance rarely occurs. Therefore, the meat of bagged game is edible. For safety reasons, a small piece of meat is cut off at the spot where the poison dart hit the animal. Boiling and frying the meat also destroys the poison.

Animals hit by a poison dart, irrespective of the part of the body that is pierced, start to twitch after a few seconds. This state lasts several minutes as the animal's condition worsens and convulsions occur. The animals lose consciousness at an accelerating rate. The throes of death last longer with large animals like wild boar or deer. Death is ultimately due to cardiac failure. The cardiac glycoside affects the Na+K+ATPase activity of the heart muscle membrane (Boer et al. 1999: 127).

Reports on dosage specify that 0.3 mg would be lethal for a rabbit. One mg. causes death in dogs (Boer et al. 1999:127), while 0.1mg. is the lethal dosage (L50) per kg. weight for cats (Zahorka 1986:58). The toxicity of [beta]-Antiarin is much higher than that of curare.

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TRIBAL COMMUNITY NAME OF TREE NAME OF
 DART POISON

 Punan Aput dajuk upun
 Punan Menalui puntajem moshu tajum
 Basap Balui boon biru ipoh
 Ot Danum Dayak sadiron konyong
 Bahau Dayak tasam ipu
Kenyah Lepo Ma'ut Dayak salok salok
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Kenyah Lepo Badgn Dayak saluh saluh
 Tumon Dayak ketatai ipoh
 Lun Dayeh Dayak lawar farir farir
 Benuaa Davak poutnn ipu ipu
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