Contribution of Arrow and Ordeal Poisons to Medicine

by I. U. W. OSISIOGU

Department of Pharmacy University of Nigeria, Nsukka

Trial by ordeal is a system of justice which existed in certain parts of the world whereby poisonous potions were administered to suspected criminals. If the suspect died he was guilty of the alleged offence, but if he survived he was innocent. If on the one hand the potion was not strong enough or the suspect possessed a strong physique, death might not occur, even if the suspect was guilty. If on the other hand the potion was strong enough or the suspect possessed a weak constitution, death might occur irrespective of guilt or innocence. Thus justice by ordeal hardly discriminated between the guilty and the innocent, and "miscarriage of justice" was the rule rather than the exception.

Arrow poisons are used principally for hunting, and sometimes for fighting. In contrast to ordeal poisons which were always administered by mouth, arrow poisons pass into the body through the wound inflicted by the arrow. The effectiveness of the arrow poison depends, among other things on the depth of the wound and on the potency of the poison. Arrow poisons are usually prepared from a mixture of many plants some of which however, seem to be entirely valueless, but ordeal poisons are carefully chosen from well tested poisonous materials and seem not to be administered in admixture with different plant materials. It is not unusual to find the same plant being used both as an arrow poison and as an ordeal poison. The following genera of plants whose members have found a place in modern medicine will be considered: **Strophanthus, Acokanthera, Thevetia, Strychnos, Chondondedron** and **Physostigma.**

Strophanthus and Acokanthera

The seeds of **Strophanthus** species have been used as arrow and ordeal poisons. This genus was first discovered in Java in 1795 (Taylor, 1965), but some species are found in India, and many of them in tropical Africa. During his travels in Africa Dr. David Livingstone, in 1861 found the seeds of **S. Kombé** in use as arrow poison around the Shiré River near Mozambique. Frazer isolated the active principle strophanthin in Edinburgh and this was shown to have a digitalis-like effect on the heart. Strophanthus thus became introduced into modern medicine. Strophanthin, unlike digitalis is preferably administered by the intravenous route. The reason is that its absorption from the digestive tract is unreliable, and there is no way therefore of predicting the outcome of its administration. This was a fact not appreciated by the ordeal poisoners when they administered **S. Kombé** to their suspects some of whom therefore escaped death. Another **Strophanthus** species, **S. gratus** furnishes the cardiotonic drug ouabain. Whereas strophanthin from **S. Kombé** is a mixture of glycosides consisting of cymarin, K-strophanthin — B etc., ouabain is a pure crystalline substance and is nearly twice as toxic as strophanthin. Here again the oral use of ouabain is unsafe because of its slow and irregular absorption from the gastrointestinal tract. Therefore like strophanthin, it is preferably administered by the parentheral route. It is quick-acting, being faster than strophanthin and preferred by many cardiologists to strophanthin. Other important sources of ouabain are the woods of **Acokanthera schimperi** and **A. ouabaio,** both of which have often featured in arrow poisons.

Thevetia

Thevetia peruvian is listed among plants that are used as arrow or ordeal poisons (Watt& Breyer-Brandwijk, 1962). It is a native of tropical America, but now grows in many parts of the tropics. **T. peruviana (T. neriifolia)** yields thevetin which produces a typical digitalis action and is effective from four to six hours after being taken by mouth (Martindale, 1967). It has been used clinically particularly on the Continent, the best results having been obtained in mild or slight myocardial insufficiency.

Strychnos and Chondodendron

Strychnos is a genus which is widely distributed in tropical areas. Members of this genus are used as arrow poisons, both in Africa and South America. The species in use in Africa, around the Congo and Mozambique are **S. icaja, S. kipapa** and **S. spinosa** (Githens, 1948). They yield the convulsant poison strychnine. However, the seeds of the Indian species, **S. nux-vomica** provide the commercial supply of strychnine. The species being used in South America are **S. toxifera, S. castelnaei** and **S. crevauxii.** These along with **Chondodendron tomentosum** produce the material generally known as curare. It was a Spanish soldier who in 1540 found Indians in the lowlands of Peru, Ecuador, Columbia and Brazil shooting arrows tipped with curare poisons (Taylor, 1965). Curare varies in composition among the Indian tribes each modifying the formula in accordance with its tribal custom, and the preparations are named according to the type of container in which the drug was packed. e.g. calabash, tube (bamboo) or pot curare. The first curare to be thoroughly investigated was tube curare, and its active principle (+) -tubocurarine chloride has been isolated as a crystalline substance. Tubocurarine is also found in **Chondodendron tomentosum** which now serves as the usual source of the alkaloid. About 1844 the eminent French Physiologist, Claude Bernard, had demonstrated that curare has a blocking action on the impulses from the brain resulting in the loss of muscular control. The muscles that are essential for respiration are also affected, which explained why animals poisoned by the drug died by asphyxiation. Tubocurarine chloride has quite a few important uses, as for example, a skeletal muscle relaxant for securing muscle relaxation in surgery without deep anaesthesia. It is also used to control convulsions of strychnine poisoning and tetanus, is an adjunct to shock therapy in neuropsychiatry and a diagnostic aid in myasthenia gravis. Neostigmine is used as an antidote for curare poisoning. Curare itself is an antidote for strychnine poisoning and its use for this purpose is a rare example of principles from one plant acting as an antidote for principles of another plant of the same genus as the former. This difference in action is further magnified by the fact that the plants yielding these different principles are as it were, located at opposite ends of the world, that is, the Curare producing plants in South America and the strychnine-producing ones in India.

Physostigma:

The important plant in this genus is **Physostigma venenosum** from which the Calabar bean is obtained. The plant grows on the banks of streams in West Africa, particularly around Calabar. A British missionary, Dr. Daniell, having noted the use of the beans, called **esere** by the local inhabitants around Calabar, in ordeal trials, sent some of them to England, in 1840. (Taylor, 1965). Frazer in 1862 discovered that the constituents of the seeds have the effect of contracting the pupil of the eye. (Wallis, 1967). The chief active principle is physostigmine, the toxic effects of which results in death due either to pulmonary oedema or central respiratory paralysis. It is used in glaucoma, myasthenia gravis, and in the reduction of gas in a post-operative abdomen. A purely synthetic analogue to

physostigmine, namely neostigmine has been prepared, and is preferred by many doctors, especially in glaucoma and myasthenia gravis. As mentioned above this substance is also used as an antidote for curare poisoning.

ANTIDOTES TO ORDEAL AND ARROW POISONS

It is to be reasonably expected that antidotes used against ordeal or arrow poisons may themselves lead to the discovery of new pharmaceuticals. However, from its very nature ordeal poisoning would not permit of any antidotal treatment for the suspect has got to die if "guilty" or survie if "innocent", and his survival must not be aided. If the suspect was through some reflex able to vomit the poison soon after taking it, he might be saved. Writing about ordeal trials with a brew of tanghin in Madagascar, Taylor (1965), pointed out that if the suspect "was knowing, he swallowed it at a gulp and promptly vomitted. Such a person was accredited as "innocent'. If he was stupid and afraid, he sipped the brew slowly and would be dead almost immediately and, of course, 'guilty"'.

With regard to arrow poisoning, a variety of antidotes are available for treating wounded persons. The juice of some plants are applied topically to the wounds. Sometimes, plant extracts are taken internally, and the smoke produced from plant materials in a pipe has been directed against the wound. The application of most of these antidotes seems to be without basis, excepting perhaps in those cases where a tannin-containing plant, e.g. **Adansonia digitata** has been applied locally to a wound inflicted by an arrow which carried cardiac glycosides — the tannin being known to have a precipitant action on cardiac glycosides which are thereby rendered ineffective. So far it seems that no known antidote has contributed anything to modern medicine.

Other poisons:

It will be worthwhile mentioning certain plants which have been used as poisons, but have failed to find a place in medicine. These plants are **Strophanthus sarmentosus, Erythrophleum guineense, Tanghinia venenifera (Cerbera tanghinia)** and **Antiaris toxicaria.**

Strophanthus sarmentosus occurs mainly in Senegambia, Sierra Leone and the lower Congo. The seeds of this plant yield the cardiac glycoside sarmentocymarin whose aglycone is sarmentogenin. Sarmentogenin is a trihydroxygenin and its possession of a hydroxyl group at carbon atom number eleven in the steroid nucleus makes it particularly useful as a chemical precursor for cortisone — a drug that is highly valued for the treatment of rheumatoid arthritis and rheumatic fever. The special value of **S. sarmentosus** as a source of cortisone lies in the fact that the other natural (animal) source is very expensive. For example, cortisone can be derived from bile acids obtained from ox-bile, and one day's treatment for one patient is estimated at requiring about forty heads of slaughtered cattle. With strophanthus, however, the seed can be grown quite extensively and it is estimated that one ton of seed could yield as much cortisone as about 12,000 tons of cattle (Kreig 1965). Moreover the plant precursor is nearer by several chemical steps to cortisone than the animal precursor. For some reasons this plant failed to achieve these high hopes. For example, the main problem attendant upon the procurement of this plant is that of botanical identity. The plant forms a large number of varieties which are morphologically indistinguishable, and these varieties in their turn show considerable chemical variation. Cultivation of the plants in open fields is beset with the problem of there being no insects to pollinate the flowers, the reason probably being that the insects which normally pollinate them do not leave the forests for the open fields.

Erythrophleum guineense is said to be the chief ordeal poison of most of tropical Africa (Githens, 1948). Its chief constituent is erythrophleine, an amorphous alkaloid with a powerful digitalis-like action on the heart. Unlike the digitalis glycosides, this substance neither possesses the steroid nucleus nor a lactone ring (Watts & Breyer-Brandwijk, 1962). The erythrophleum alkaloids are also said to have a powerful analgesic action on mucosae, this action being slow in onset, of high intensity and of long duration. These alkaloids are also considered to be more potent than cocaine.

Tanghinia venenifera (Cerbera tanghin) is found in Madagascar where the seeds were used as an ordeal or homicidal poison. These seeds are said to be violently poisonous. Although they have a digitalis-like action on the heart, and two active principles, tanghinin and cerberin have been isolated, they have never been employed as a substitute for digitalis, since they possess no obvious advantages over the latter.

Antiaris toxicaria grows in Java, Burma, India and Ceylon. Its latex is said to be one of the most deadly of all plant poisons, and has been used as a homicidal and arrow poison in Java (Taylor, 1965). The active principle, antiarin, which has been extracted from the plant gum has a strong digitalis-like tanghinia, antiaris has not been employed as a substitute for digitalis.

Conclusion:

Local uses of herbs have in the past provided leads for new drugs, and will perhaps continue to do so in the future. At a time when many Nigerians are crying out for a massive research into and exploitation of Nigerian medicinal plants, the successes of the past should provide the necessary stimulus and encouragement for further work.

REFERENCES

Githens, T. S. (1948: Drug Plants of Africa. University of Pennsylvania Press.

Kreig, M. B. (1965): Green Medicine; George G. Harrap & Co. Ltd. London.

Martindale, Extra Pharmacopoeia (1967): 25th Edn. The Pharmaceutical Press, London.

Taylor, N., (1965): Plant Drugs that Changed The World; George Allen & Unwin Ltd. London.

Wallis, T. E. (1967); Textbook of Pharmacognosy 5th Edn. J. & A. Churchill Ltd. London.

Watt, J. M., and Greyer-Brandwijk, M. G. (1962). Medicinal and Poisonous Plants of Southern and Eastern Africa. E. & S. Livingstone, Edinburgh and London.

REFERENCES:

1. Drug Ther. Bull, 1972, 10 3
2. Klein, J. O. & Finland, M. Amer. J. Med. Sci. 1963 **245** 544
3. Knudsen, E. T. et all Lancet 1962 632
4. Sutherland, R. et all British Med. J. 1970 4 455
5. McCarthy, G. G. & Finland, M. New Engl. J. Med. 1960 **263** 315
6. Manufacturers recommendation.
7. Johnson, A. G. Brit. Med. J. 1971 2 25.