TOXICOLOGICAL INVESTIGATIONS OF LASIOSIPHON KRAUSSIANUS (MEISN.)

BY

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Dedicated to the memory of my dearly
beloved father, Nwude Okeke, who died
during the civil war on 9th August 1969

TABLE OF CONTENTS

		Page
INTRODUCTION		1
SECTION 1:	A REVIEW OF NIGERIAN PLANTS WHICH MAY CAUSE POISONING IN LIVESTOCK	8
1.1.	Introduction	9
1.2.	Plants containing toxic glycosides	10
1.3.	Plants containing toxic alkaloids	17
1.4.	Plants containing fluoroacetate	24
1.5.	Plants containing oxalates	25
1.6.	Plants containing saponine	25
1.7.	Plants containing toxalbumin	26
1.8.	Plants containing miscellaneous and unknown toxic principles	29
1.9.	Plants causing photosensitization	37
1.10.	Plants causing mechanical injury	38
References		41
SECTION 2:	BOTANICAL CHARACTERISTICS OF LASIOSIPHON KRAUSSIANUS	47
2.1.	Habitat	48
2.2.	Morphological features	48
2.3.	Anatomical features	50

Page

Summary 51

References 52

Figures 54

SECTION 3: TOXICITY OF LASIOSIPHON KRAUSSIANUS TO LIVESTOCK 63

3.1. Introduction 64

3.2. Materials and Methods 66

3.3. Results 69

3.4. Discussion 72

Summary 74

References 76

Tables 79

Figures 80

SECTION 4: HAEMATOLOGICAL AND BIOCHEMICAL CHANGES IN LASIOSIPHON KRAUSSIANUS POISONING 87

4.1. Introduction 88

4.2. Materials and Methods 89

4.3. Results 91

4.4. Discussion 92

Summary 94

Page

References 95

Tables 96

SECTION 5: TOXICITY OF ETHER, CHLOROFORM, ETHANOL AND WATER EXTRACTS OF LASIOSIPHON KRAUSSIANUS IN MICE 100

5.1. Introduction 101

5.2. Materials and Methods 101

5.3. Results 102

5.4. Discussion 103

Summary 105

References 106

Tables 107

SECTION 6: ISOLATION AND IDENTIFICATION OF THE TOXIC PRINCIPLES OF LASIOSIPHON KRAUSSIANUS 108

6.1. Introduction 109

6.2. Materials and Methods 110

6.3. Results 112

6.4. Discussion 115

Summary 116

References 118

Page

Tables 121

CONCLUSIONS 125

ACKNOWLEDGEMENTS 126

APPENDIX 128

ABSTRACT

INTRODUCTION

Knowledge of poisonous plants dates as far back as history. The ancient man used poisons mainly of plant origin for hunting purposes. The ancient Egyptians had vast knowledge of poisonous plants and they used plants such as Hyoscyamus, Aconitum, Conium species and many others (Pammel 1911). The ancient Greeks and Romans disposed of criminals by killing them with Conium maculatum, Papaver somniferum or Hyoscyamus niger (Steyn 1934). Later in history, Datura stramonium, Atropa belladonna, Atropa mandragora, Ranunculus and Euphorbia spp were used for human poisoning (Steyn 1934).

Information on poisonous plants was recorded by Dioscorides (40-90 A.D.) in his manuscript of medicinal matters and such plants as Hyoscyamus, Conium, Aconitum and Colchicum were mentioned (Pammel 1911; Kingsbury 1965). During the eighteenth century compilations limited to poisonous plants appeared in Europe. Most of the information was based on chance observations of accidental cases of natural poisoning. Planned experimental work, however,

gradually replaced chance observations. Early in the nineteenth century Orfila who has been called the "father of toxicology" described some experiments with dogs using Daphne bark. Modern knowledge of poisonous plants advanced further through development of scientific agriculture and veterinary medicine and is based more on the concern for livestock health. Experimental investigations of poisonous plants have been extensive in South Africa, Australia, United States, and New Zealand.

In Nigeria, not much work has been done nor is there much information available on indigenous poisonous plants. The first report of plant poisoning in Nigeria was from the Department of Veterinary Research at Vom (Anon. 1929). Sporadic deaths occurred among animals grazing in the departmental paddocks, mainly during the dry season and plant poisoning was suspected, but the actual plants were not identified. In 1930, 15 cases of plant poisoning in cattle and one in sheep were reported from Vom (Anon. 1930). Several goats were reported lost at Katsina in 1934 from eating cassava leaves (Anon. 1934). Many deaths were reported annually among trade cattle and sheep during the dry season

on the cattle trade track between Bode Sadu and Ilorin as a result of eating Erythrophleum africanum (Anon. 1936). The first recorded experimental work in Nigeria was carried out by Mettam in 1941. He fed cattle with a number of plants growing in the vicinity of Vom and found the following to be poisonous: Crotalaria intermedia, Clematis hirsuta, Gloriosa superba, Kalanchoe lanceolata, Lasiosiphon kraussianus, Morea zambesica, Nerium oleander, Paullinia pinata, and Urginea nigritania.

Twenty-one pigs were reported dead in Vom in 1948 following a heavy rain which blew many leaves into the paddocks. Among the leaves were those of Cassia siamea and mahogany (Khaya spp. probably grandifolia). Cassia siamea was said to be non-poisonous while the toxicology of mahogany was unknown (Anon. 1948).

Three cases of suspected plant poisoning occurred at Shika in 1954 and four in 1956 (Anon. 1954, 1956a). In the same year several cattle were lost at Daudawa Agricultural farm due to poisoning by Lasiosiphon kraussianus which was prevalent in part of the grazing area (Anon. 1956b). The same plant was reported to have caused the loss of a number

of cattle at Shika and the Nigerian Tobacco Company's farm at Samaru (De Leeuw 1969). Na'Isa (1969) reported cattle losses along the trade cattle route, Maiduguri - Makurdi, due to Erythrophleum africanum. In 1974, Adaudi reported several goat deaths due to poisoning with Dichapetalum barteri.

The above reports stress the importance of poisonous plants to the Nigerian livestock industry. Apart from extensive livestock losses, human poisoning can also occur through consumption of products from animals eating poisonous plants (Schoental 1965). It is, therefore, important that information be provided and systematic studies be carried out on Nigerian poisonous or suspected poisonous plants.

As a result of inquiries among herdsmen in the Northern States of Nigeria, Lasiosiphon kraussianus, the plant most often incriminated in livestock poisoning was selected for this study. The objectives were to determine:

1. The botanical characteristics of L.kraussianus.

2. The toxicity of L.kraussianus to livestock.
3. Haematological and biochemical changes due to L.kraussianus poisoning.
4. Toxicity of L.kraussianus extracts in mice.
5. The toxic principles in L.kraussianus.

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SECTION 2

REVIEW OF NIGERIAN PLANTS WHICH MAY CAUSE POISONING IN LIVESTOCK

1.1. INTRODUCTION

Conditions which favour the occurrence of plant poisoning in livestock are prevalent in Nigeria. During the long annual dry season and particularly during the periodic droughts, animals may be forced to eat the poisonous species which are adapted to arid conditions. Much of the land is overgrazed, resulting in insufficient palatable forage even during the rainy season. Nomadism is still the dominant form of animal husbandry in Nigeria. In addition to movements to obtain grazing, every year over 200,000 cattle trek on hoof and about the same number are transported by rail or road to market over the 1,000 kilometres or more from the north to the south, changing from one environment to the other and therefore to surroundings with strange vegetation. Such cattle are unfamiliar with poisonous species in the new environment and are liable to be poisoned. The natural vegetation is still relatively undisturbed in many areas so that poisonous plants could still constitute a significant part of the flora.

With all these conditions favourable to poisoning, plant poisoning could constitute a serious problem to Nigerian livestock. However, little information is available on plant poisoning in Nigeria. This is partly due to the fact that the agriculture and veterinary services are not fully developed.

This review covers 60 species of plants which are potential sources of poisoning to livestock in Nigeria. Some have actually caused poisoning in Nigeria, but the majority have been included because they have been reported to be poisonous in other parts of the world. However, it does not necessarily follow that such plants would also be poisonous under Nigerian conditions as weather, soil and other environmental factors may influence the toxicity of a plant.

1.2. PLANTS CONTAINING TOXIC GLYCOSIDES

1.2.1. Cyanogenetic Glycosides

Probably the most common hazard to livestock in Nigeria are species of plants containing cyanogenetic glycosides, which are hydrolyzed after consumption to yield hydrocyanic acid, a potent cellular asphyxiant. Included in the cyanogenetic glycoside containing plants below, are number of crops, such

as sorghum, maize, millet, cassava and lima beans; certain grasses which may be planted to improve pastures, Cynodon spp. and Johnson grass (a sorghum); and other plants, Cassia siamea, Passiflora foetida being examples of those found in Nigeria (Clarke and Clarke 1967; Oakes and Butcher 1962; Dalziel 1955).

Signs observed when the dose of cyanide is large include instantaneous death with muscle spasms and respiratory paralysis. Smaller amounts cause a short period of stimulation with excitement and convulsions followed by depression and death. Respiration is first accelerated, becoming weak and irregular before finally ceasing. At necropsy the most characteristic finding is bright red venous blood.

Cassia siamea (Lam.)

The leaves, stems and seeds of Cassia siamea are known to contain an alkaloid that causes rapid death in pigs. Cattle and sheep are apparently not affected (Oakes and Butcher 1962). The leaves, stem and root contain hydrocyanic acid (Watt and Breyer-Brandwijk 1962). This plant was probably the cause of swine poisoning at Vom (Anon. 1948).

Cynodon species

(Hausa, K'irik'iri; Fulani, bogal boje; Yoruba, koko-igba)[1]

Cynodon species are also known to contain cyanides (Clarke and Clarke 1967) and are an important cause of poisoning in South Africa (Van der Walt and Steyn 1941). The grasses in this genus are less likely to cause poisoning in heavy rainfall areas.

Ipomea batatas (Lamm.)

The sweet potato belongs to a different family from the Irish potato. Both the vegetative and the reproductive organs of the plant have been found to contain hydrocyanic acid and the tops have caused death when eaten in large quantity (Watt and Breyer-Brandwijk 1962).

Manihot species

The concentration of cyanogenetic glycoside varies among varieties of cassava. "Sweet" cassava grown in the north contains less cyanide than the "bitter" variety grown in the south.

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(1) All vernacular names in this review were taken from Dalziel (1955); The useful plants of West Tropical Africa. Crown Agents, London.

Although the leaves contain less cyanide than the roots, they can still cause poisoning as is evident from a case reported from Katsina (Anon. 1934). Poisoning can occur when an animal eats the fresh leaves or roots or drinks water in which the roots have been soaked.

Passiflora foetida (Linn.)

(Passion flower or wild water lemon; Benin, ikokosin; Efik, ninge ninge; Ibo, ahu enyi)

The fruit is edible when ripe. Before maturity, however, the leaves and green fruits contain a cyanogenetic glycoside. If eaten in quantity it may be dangerous to animals (Dalziel 1955). Other species of Passiflora like P.alba are known to be poisonous to cattle and sheep (Hindmarsh 1941).

Pennisetum spicatum

One of the species of millet, Pennisetum spicatum is reported by Dalziel (1910) to be toxic to livestock. Of the two cultural varieties of P.spicatum ("gero" and "maiwa"), "maiwa" is reported to be more injurious than "gero". The plant has been shown to contain cyanide and is reported to cause poisoning when shooting before the rains (Watt and Breyer-Brandwijk 1962).

Phaseolus lunatus

Lima or Java beans are also known to contain cyanogenetic glycosides (Dalziel 1955). Fatal cases of poisoning were common in England when the beans were imported as animal feed (Clarke and Clarke 1967).

Sorghum species

Most species of sorghum (guinea corn) contain the cyanogenetic glycoside, dhurrine. Young plants may be dangerous to stock because the poison is present from germination, increasing to a certain stage of growth, then disappearing completely with the development of grain (Dalziel 1910, 1955). However, the grains have been shown to be toxic to chickens in Australia (Mc Clymont and Duncan 1952). Crops affected by drought are to be suspected and shoots growing after harvest are usually very poisonous (Dalziel 1955).

Zea mays (Linn.)

The green parts of maize are known to contain a cyanogenetic glycoside which increases in concentration up to the flowering stage, then decreases rapidly as soon as the cob begins to form; none is found in mature plants or seeds. Animals are said to be poisoned occasionally after eating the green plants (Watt and Breyer-Brandwijk 1962).

In the United States, a disease known as cornstalk disease occurs when cattle are allowed to eat maize stalks. Within a day or two of being turned into fields of standing maize stalks cattle suddenly sicken and die (Clarke and Clarke 1967). Zea mays is one of the plants which is capable, under suitable conditions, of absorbing sufficient nitrate to make it a potential danger to livestock (Clarke and Clarke 1967).

1.2.2. Cardiac Glycosides

Adenium honghel (A.DC.)

(Hausa, k'arya)

The Hausa name means "a lie" because it is said to flower freely but rarely bears fruits. The plant is generally regarded as poisonous and contains a cardiac glycoside called adeniine. The action is analogous to digitalin but complicated by an effect on the central nervous system (Dalziel 1955; Watt and Breyer-Brandwijk 1962).

Calotropis procera (Ait.)

(Hausa, tumfafiya; Yoruba, bomubomu)

The juice of Calotropis procera contains a glycoside, calotropin, which is extremely toxic. It is a potent, quick acting cardiac poison (Chen et al. 1937; Patel and Rowson 1964; Sharma 1934). The milky juice is caustic to mucous membranes and tender skin, the horse being quite susceptible (Dalziel 1955). Goats and sheep eat the flower and withered leaves but not the fresh leaves. In Sudan, occasional poisoning has been attributed to it (Dalziel 1955).

Strophanthus species

(Hausa, kwankwani; Yoruba, isha; Ibo, ota)

Species of Strophanthus; S.gratus, S.hispidus, S.preussi and S.sarmentosus, contain the cardiac glycoside, strophanthin, which is of therapeutic value. They are poisonous when eaten in large quantities (Dalziel 1955; Everard 1966).

Thevetia neriifolia (Juss. ex Steud)

(Yoruba, olomiojo)

The milky juice and roots are very poisonous. The kernels, bark, root and stem contain the bitter glycoside, thevetin, which is a powerful cardiac poison (Dalziel 1955). Human poisoning caused by the kernels of Thevetia peruviana has been reported (Watt and Breyer-Brandwijk 1962).

1.3. PLANTS CONTAINING TOXIC ALKALOIDS

Argemone mexicana (Linn.)

(Hausa, kwarko; Yoruba, ekan ekun)

The seeds contain two poisonous alkaloids, beberine and protopine (Santos and Adkilen 1932). They have been found to be toxic to fowls (Hart 1941). The leaves and roots are also poisonous but because of its unpleasant taste and prickles animals seldom eat the plant (Oakes and Butchers 1962). It can cause mechanical injury to animals.

Crotalaria retusa (Linn.)

The stems, leaves and roots of Crotalaria retusa contain the toxic alkaloid, monocrotaline (Adams and Rogers 1939). The plant is toxic to animals (Oakes and Butcher 1962). In acute cases signs include loss of apetite, bloody diarrhoea, nasal discharge and yellow mucous membranes. Liver lesions are observed in chronic poisoning. Similar toxic effects have been reported for C.spectabilis, C.intemedia, C.giant striata, C.laburnifolia and C.recta (Emmel 1937; Harms et al. 1963; Kelly et al. 1961; Mettam 1941; Schoental and Coady 1968).

Datura metel (Linn.)

(Hairy thorn apple; Hausa, zakami, haukata yaro; Yoruba, apikan)

A drink made from the seeds of this plant is given to Fulani youths to incite them in the Sharo Contest or Ordeal of Manhood. The leaves and seed contain the alkaloids, scopolamine, hyoscyamine and atropine. All parts of the plant are poisonous, especially the seeds and young leaves. Poisoning occurs in man through mistaking it for certain chewsticks (Dalziel 1955) and children are sometimes poisoned by chewing the flowers (Oakes and Butcher 1962). Animals avoid eating

the plant because of its repugnant odour and unpleasant taste and eat it only when pressed for food or when it is accidentally included in hay. In cattle, rapid pulse and respiration, diarrhoea, pupil dilation, and stiffness are observed (Oakes and Butcher 1962). D.stramonium is also known to be poisonous and to contain the same alkaloids as D.metel (Hansen 1927).

Erythrophleum africanum (Harms).

Two reports on poisoning by Erythrophleum africanum have been recorded in Nigeria (Anon. 1936; Na'Isa 1969). The vernacular names for this tree are samberu in Hausa and sungwoi in Fulani.

It contains an alkaloid erythrophleine, which has an action similar to that of digitalis. Hausa and Fulani herders consider the plant to be very poisonous to livestock and cattle are carefully prevented from grazing or travelling by routes where the trees of this species are known to occur (Dalziel 1955). In some areas the tree is controlled by burning every two years. Signs observed in poisoning include dyspnoea, distended stomach, salivation, nasal discharge and sunken eyes. In acute cases, death occurs within minutes. In subacute cases blood-stained watery diarrhoea is observed (Na'Isa 1969). The

plant is also known to be highly toxic to livestock in East Africa (Watt and Breyer-Brandwijk 1962).

Another plant of the same genus is E.guineense (G. Don). It is also known as ordeal or red water tree. The vernacular names are: Hausa, gwaska; Yoruba, erun; Ibo, inyi; Efik, akpa.

It contains the alkaloid, erythrophleine. The bark and seeds of the plant were used by certain tribes as an ordeal brew for those suspected of witchcraft or serious crimes. The leaves are poisonous to horses and to cattle (Dalziel 1955).

Gloriosa superba (Linn.)

(Climbing lily; Hausa, baurere; Yoruba, mora, Ibo, ugu ele)

Gloriosa superba is said to contain the alkaloid colchicin, which is highly toxic to animals and man. The root-stock, leaf and stem are all poisonous to grazing stock. Signs in cattle include uneasiness, salivation, abdominal pain, and violent purgation with passage of green-black faeces (Dalziel 1955; Mettam 1941; Watt and Breyer-Brandwijk 1962).

Mirabilis jalapa (Linn.)

(Four o'clock; Yoruba, itana pa osho)

The large tuberous roots of Mirabilis jalapa produce the alkaloid, trigonelline, which has laxative properties. In Hawaii, the seeds and roots of the plant are reported toxic. Livestock are not likely to be poisoned but pigs are capable of uprooting and consuming harmful amounts of the tuber (Oakes and Butcher 1962).

Nicotiana species

The species of tobacco, Nicotiana rustica (Linn.) and N.tabacum (Linn.) contain the alkaloid nicotine, which is highly toxic and has a powerful insecticidal activity which is mainly utilized in horticulture.

The plant is not palatable but livestock can acquire a taste for it and poisoning has been reported (Kingsbury 1958; Watt and Breyer-Brandwijk 1962). Signs in cattle include salivation, sweating, marked dyspnoea, clonic spasms, muscular incordination and coma (Watt and Breyer-Brandwijk 1962).

Physostigma venosum (Balf.)

(Ordeal or calabar bean; Efik, esere; Yoruba, isho)

It is called the Calabar bean because it was first taken to England in 1840 by a British medical officer stationed in Calabar. It was used locally as an ordeal poison to determine the guilt of suspected criminals. It contains the alkaloid physostigmine, also known as eserine. Physostigmine is used mainly in ophthalmic medicine for constricting the pupils.

The poisonous effect of eating the beans is caused by the alkaloid. Signs observed include marked muscular weakness, nausea, vomiting, colic, diarrhoea, dyspnoea, and bradycardia. Convulsions may be observed and respiratory paralysis is the usual cause of death.

Senecio species

(Yoruba, amunimuye, bologi; Ibo, obompa onini)

Senecio species contain hepatotoxic alkaloids (Ostertag and Kulenkampff 1941; Schoental 1960, 1963; Schoental and Coady 1968). Various species of the genus Senecio are of considerable toxicological importance in South Africa, causing

disease in man and animal (Steyn 1933; De waal 1940). The disease is called Molteno cattle sickness or straining disease in cattle and dunsiekte, stomach staggers, senecio cirrhosis disease or Molteno disease in horses (Watt and Breyer-Brandwijk 1962).

Solanum incanum (Linn.)

(Hausa, gautan kura; Yoruba, igba aja; Ibo, afufa)

The vernacular names do not distinguish between the cultivated and wild varieties even though the wild fruit, especially when unripe, are thought to be poisonous (Dalziel 1955). They contain the alkaloid solanine, which is irritant to the alimentary canal and after absorption, causes haemolysis, and stimulation followed by depression of the central nervous system. Death is due to cardiac arrest (Watt and Breyer-Brandwijk 1962).

Solanum tuberosum (Linn.)

Irish potatoes also contains solanine. The tuber is the commonest source of poisoning for farm animals. Pigs are mostly commonly poisoned, but horses, cattle and poultry can also be affected. When exposed to light, potatoes become

green and large quantities of solanine are formed. Unripe and old, rotten or sprouting tubers which have been kept for a long time can also be dangerous. The alkaloid is in greatest concentration in the "eye", skin and young sprout (Clarke and Clarke 1967; Hansen 1927). Cooking inactivates the solanine. Apart from the effects of solanine already mentioned, exanthematous lesions are also found in pigs and cattle. They include ulcerative stomatitis, conjunctivitis, and dermatitis (Clarke and Clarke 1967).

1.4. PLANTS CONTAINING FLUOROACETATE

Dichapetalum barteri (Engl.)
(Ibo, akwuosa, ngbuewi, "goat killer")

This plant was reported to have caused the death of goats after being fed in transit from Sokoto to Enugu (Adaudi 1975). Experimental work confirmed that the plant was highly toxic to rabbits and goats. Death occurs within one to four hours after consumption of the plant. This and other species of Dichapetalum are toxic because they contain monofluoroacetate (Marais 1943; Nwude et al. 1976; Remington 1935; Vickery and Vickery 1973; Watt and Breyer-Brandwijk 1962).

1.5. PLANTS CONTAINING OXALATES

Trianthema species

The Hausa names for T.pentandra (Linn.) and T.portulacastrum (Linn.) are the same, gadon machiji.

T.pentandra is a half succulent plant which forms a close growth over waste places and is supposed to harbour snakes. The plant is poisonous and death is caused by acute nephritis.

Both species are reported to have poisonous effects, producing diarrhoea and paralysis (Dalziel 1955). Trianthema species are known to contain oxalates (Clarke and Clarke 1967).

1.6. PLANTS CONTAINING SAPONINE

Balanites aegyptiaca (Dal.)

(Called soapberry tree or desert date and aduwa in Hausa)

This plant contains saponine and is used as fish poison. The fruit and bark are lethal to the fresh water snails, which are intermediate hosts for bilharzia. The unripe fruit have purgative effects which have been observed in horses (Dalziel 1955; Watt and Breyer-Brandwijk 1962). The plant also has sharp thorns which can cause mechanical injury.

Clematis hirsuta (Guill.)

(Hausa, yamanza; Yoruba, adapopo)

According to information gathered from local herdsmen, Clematis hirsuta is very poisonous to livestock. The juice of the plant is a vesicant. Saponine is widespread in the genus Clematis (Dalziel 1955), and the leaf of almost every species of Clematis is suspected as being poisonous (Watt and Breyer-Brandwijk 1962). Mettam (1941) reported experimental poisoning in cattle with this plant at Vom.

1.7. PLANTS CONTAINING TOXALBUMIN

Abrus precatorius (Linn.)

The bright red seeds with a black end are known as prayer beads or cat's eyes (Hausa, idon zakara; Yoruba, oju ologbo; Ibo, anya nwono; Efik, enyinmukpo).

The seed contains a toxalbumin, abrin, which is very toxic. Abrin is known to be haemolytic and neurotoxic (Dalziel 1955). If thoroughly chewed before swallowing, one seed is said to be able to kill an adult man. Horses are very susceptible while cattle and goats are more resistant. Farm

animals suffer severe stomach upset. Symptoms in man are nausea, vomiting, severe diarrhoea, weakness, cold perspiration, and trembly hand (Oakes and Butcher 1962).

Cassia absus (Linn.)

(Hausa, fidili)

This plant contains a toxalbumin, absin, which is similar to abrin (Dalziel 1955).

Jatropha curcas (Linn.)

(Hausa, bini da zugu; Yoruba, botuje; Ibo, olulu udu)

It is a common hedge plant. The seeds contain a toxalbumin, curcin, which is highly irritant (Dalziel 1955). It resembles ricin and abrin but is milder in action. The leaves, roots and stems are poisonous (Oakes and Butcher 1962). Poisoning has occurred in man using the seeds as a purge and in children consuming them out of curiosity (Oakes and Butcher 1962). The symptoms caused in man are burning sensation in the mouth and throat, nausea, abdominal pain, vomiting, diarrhoea, depression, and collapse. Livestock ordinarily do not brouse on this plant but may eat it when other forage is not available. The cake left after extraction of the oil may produce purgation when fed.

Jatropha gossypiifolia (Linn.)

(Yoruba, botuje pupa; Ibo, akinbogho)

The viscid sap is said to be poisonous (Dalziel 1955). It possesses the same toxic properties as J.curcas but is less potent in its action (Oakes and Butcher 1962).

Ricinus communis (Linn.)

(Castor oil bean plant; Hausa, zurma; Yoruba, lara; Ibo, ugba)

Ricinis communis is cultivated or grows wild over most of Nigeria. All parts of the plant are poisonous but the castor beans contain the highest concentration of the toxalbumin, ricin, which is the toxic principle. Ricin is inactivated by fermentation in the preparation of human food and by cooking. All classes of livestock and man may be poisoned with symptoms which include nausea, vomiting, gastric pain, bloody diarrhoea, thirst, rapid pulse, sweating, convulsions, exhaustion, and death (Oakes and Butcher 1962; Woodcock 1928). Animals have been poisoned by eating the cake left after extraction of castor oil. Goats have been poisoned after eating the beans being prepared for fermentation (Nwude 1976).

1.8. PLANTS CONTAINING MISCELLANEOUS AND UNKNOWN TOXIC PRINCIPLES

Acacia nilotica (Del.)

(Thorn tree; Hausa, bugaruwa namiji)

The seeds of Acacia nilotica have been reported to have caused the death of many goats in South Africa (Terblanche et al. 1967).

Agelae oblique (Baill.)

(Yoruba, esura; Ibo, akunken)

This plant was shown by Vickery and Vickery (1973) to be poisonous to rabbits.

Anacardium occidentale (Linn.)

The cashew nut contains, in its pericarp, a dark coloured oily juice containing cardol, which is caustic and vesicant to the skin. It produces inflammation, irritation, blisters, itching, burning and open sores. Animals should be prevented from eating the fruit (Oakes and Butcher 1962).

Blighia sapida (Koenig.)

(Hausa, fisa, gwanja kusa; Yoruba, ishin; Ibo, okpu ocha)

The akee apple is known to be the cause of "vomiting sickness" in Jamaica (Dalziel 1955). Larson et al. (1953)

estimated that more than 5,000 people in Jamaica have been fatally poisoned after eating the immature, green fruit. The ripe fruit is not toxic.

Byrsocarpus coccineus (Schum and Thonn.)

(Hausa, kimbar mahalba)

The plant has proved to be poisonous (Dalziel 1955; Vickery and Vickery 1973).

Capparis tomentosa (Lamm.)

(Hausa, haujeri)

The fruit and leaves contain a sulphur oil poisonous to camels and cattle (Dalziel 1955; Watt and Breyer-Brandwijk 1962).

Cassia occidentalis (Linn.)

(Hausa, rai 'dore; Yoruba rere; Ibo, ogbunmo)

The seeds of Cassia occidentalis contain the toxic material, chrysarobin, which is destroyed by roasting (Bruere 1942). The roots, leaves and stems are toxic in large amounts and are capable of producing losses in cattle (Hensen et al. 1965; Mercer et el. 1967). However, livestock rarely eat the plant because of its unpleasant odour and taste.

Euphorbia poisonii (Pax.)

(Hausa, tinyal; Yoruba; oro adete)

The latex is a powerful irritant to mucous membranes and the juice has been added to food, drinking water, kola nut, etc. with criminal intent. The latex is part of poisonous preparation called "gunguma" in Hausa and used for catching guinea fowls, etc. (Dalziel 1955). Some species of Euphorbia have been suspected of causing death in sheep (Watt and Breyer-Brandwijk 1962).

Gossypium herbaceum (L.)

(Cotton; Hausa, abduga; Yoruba, owu; Ibo, owulu)

Cotton seed cake as well as raw seeds are used in feeding animals and are a source of occasional illness or death in fattening calves and pigs (Clarke and Clarke 1967; Golberg and Maynard 1923; Roberts 1916).

Cotton seed contains about 25% indigestible fibre which can cause trouble through impaction or obstruction of the gastrointestinal tract. Cotton seed contains a toxic principle, gossypol, in the pigment glands. Mature cows and sheep can

tolerate more gossypol than other farm animals. The acute toxic effects include gastroenteritis, dyspnoea, convulsions, and death. In chronic poisoning there is loss of condition, diarrhoea, prostration, and death. Cattle should not receive more than 3kg of the cake and pigs not more than 500g per day (Clarke and Clarke 1967). Gossypol can be inactivated by heating for one hour at 100°C.

Kalanchoe lanceolata

(Hausa, gadalin kura)

Feeding the plant to cattle resulted in acute gastro-enteritis (Mettam 1941). Other species of Kalanchoe have been shown to produce the same effect (Watt and Breyer-Brandwijk 1962).

Lasiosiphon kraussianus (Meisn.)

(Hausa, tururubi; Fulani, sungoje; Gbari, pmatiniya)

The leaves and root of this plant are said to be used criminally in food. Herdsmen in Northern Nigeria and East Africa recognize it as dangerous to livestock (Dalziel 1910, 1955; Watt and Breyer-Brandwijk 1962). In Nigeria this plant

caused loss of several cattle at Daudawa Agricultural Farm and at Shika Agricultural Research Station (Anon. 1956; De Leeuw 1969).

Leonotis nepetaefolia (R. Br.)

(Hausa; jam barawo)

The leaves have short hairs which are irritating to the skin of susceptible individuals, causing a burning rash. Feeding trials showed the leaves to be toxic to chicks and the plant is considered potentially harmful to poultry (Oakes and Butcher 1962).

Melia azedarach (Linn.)

(Hausa, kurnan masar; Yoruba, afororo oyibo)

The tree is regarded as dangerous to stock in Australia (Dalziel 1955). The berries are the most toxic but flowers, leaves and bark are also poisonous. Pigs are poisoned from eating either green or ripe berries (Oakes and Butcher 1962).

Morae zambesiaca (Bab.)

(Hausa, alubasa kwadi)

Mettam (1941) fed the plant to cattle at Vom, Nigeria and found that it caused gastroenteritis. M.zambesiaca was proven poisonous in Rhodesia and was thought to cause many deaths in times of drought (Watt and Breyer-Brandwijk 1962).

Nerium oleander (L.)

Nerium oleander is cultivated as an ornamental shrub. Poisoning in livestock and humans have been reported since ancient times. All parts of the plant contain oleandrin, a potent digitalis-like toxin. Livestock have been poisoned by eating the leaves and flowers and by drinking water in which they have fallen. Signs of poisoning include vomiting, diarrhoea trembling, convulsions, paralysis and stupor (Watt and Breyer-Brandwijk 1962).

Paullinia pinnata (Linn.)

(Hausa, hannu biyar; Yoruba, kakashenla; Benin, aza)

This plant is regarded in Tropical Africa as a "terrible" poison with slow but fatal effects (Dalziel 1955). The seeds

and roots are highly toxic (Watt and Breyer-Brandwijk 1962). The leaves are regarded in the Cameroons to be particularly poisonous to pigs (Dalziel 1955). Mettam (1941) found it toxic to cattle in Nigeria.

Portulaca oleracea (Linn.)

(Hausa, fasa k'aba; Yoruba, papa san; Efik, efere makara)

The plant is used for topical application to swellings, bruises, withlow, etc. It is known to contain oxalic acid (Clarke and Clarke 1967). It is suspected to cause poisoning in cattle and sheep in Australia (Watt and Breyer-Brandwijk 1962).

Spigelia anthelmia (Linn.)

(Yoruba, ewe aran)

The fresh plant is said to be poisonous to livestock, causing death within two to three hours. It has anthelmintic properties and is used in man. Symptoms caused by overdosing are dimness of vision, dilated pupils, giddiness, muscle spasms of the eyes and face, convulsions, and death (Dalziel 1955). The seeds proved toxic to rabbits (Johnson 1963).

Spondianthus ugandensis(Hutch.)

(Yoruba: owe, obo ekute (destroy rat), Efik, ibok-eku (=rat medicine)

The bark of this tree is used as a rat poison and is said to be potent enough to kill a man. The leaves are known to be poisonous to cattle, goats and dogs (Dalziel 1955; Everard 1966). Other species like S.preussi are also reported to be toxic (Quarre and Mols 1945).

Urginea species

(Hausa, albasar kura)

The vernacular name covers several species: U.altissima (Baker), U.nigritana (Baker) and U.indica (Dalziel 1955). In South Africa various species of Urginea including U.altissima are known to be fatal to livestock (Ostertag and Kulenkampff 1941; Watt and Breyer-Brandwijk 1962).

1.9. PLANTS CAUSING PHOTOSENSITIZATION

Lantana camara (Linn.)

(Yoruba, ewon agogo)

The leaves of Lantana camara are capable of causing photosensitization (Louw 1943; Oakes and Butcher 1962). Cattle and sheep are most frequently affected. Acute poisoning occurs only when large quantities of the plant are consumed. Common signs include extreme weakness, soft bloody faeces and occasionally, partial paralysis of the legs. Cattle which have become familiar with the plant by long association do not usually eat it (Sanders 1946).

Tribulus terrestris (Linn.)

(Hausa, tisido; Yoruba, da ogun duro)

The fruit is a kind of caltrop rendering it a pest on foot paths and waste places both to men and cattle and may cause mechanical injury internally as well (Dalziel 1955). The plant causes photosensitization which is hepatogenous in origin. Signs observed in animals include subcutaneous oedema, erythema, necrosis and sloughing of the skin. Secondary bacterial

infection of necrotic areas is common (Clarke and Clarke 1967). The photosensitive reaction occurs only in unpigmented or lightly pigmented areas of the skin, particularly about the head in sheep and the udder in cattle (Kingsbury 1958). The plant is most dangerous when it is wilting or immature and not bearing fruit (Watt and Breyer-Brandwijk 1962).

1.10. PLANTS CAUSING MECHANICAL INJURY

A number of plants may inflict external or internal injury to animals in a purely mechanical manner. They possess sharp awns, burrs, spines or thorns which may tear the skin around the eyes and mouth, penetrate the feet or hooves and cause crippling or cause ulcers or hair balls in the digestive tract. Secondary infections may occur in the injured tissues. There are many spiny plants in drier regions but they also occur in tropical rain forest and swampy areas. Only a few will be mentioned here. Argenome mexicana, Balanites aegyptiaca and Tribulus terrestris were listed above.

Acanthospermum hispidium

(Hausa, kashin yawo)

Acanthospermum hispidium is a troublesome weed. The burrs can puncture the skin causing lesions which take a long time to heal (Watt and Breyer-Brandwijk 1962).

Aristida adscensionis (Linn.) and Sporobolus species

Both plants are known to cause impaction by forming hair balls by the massing of plant hairs or fibres in the stomach or intestines of animals. Such impactions may lead eventually to death (Oakes and Butcher 1962). Aristida species are also known to contain cyanogenetic glycosides (Ostertag and Kulenkampff 1941).

Cnestis corniculata (Lani.) and C.ferruginea (DC.)

The fruits of both plants are covered with bristles which are irritating to the skin (Dalziel 1955). Both plants are toxic to rabbits (Vickery and Vickery 1973).

Mucuna pruriens (DC.)

(Hausa, karara; Yoruba, werepe; Ibo, agbala)

The hairs on the fruit (trichomes) penetrate the skin causing intense irritation. The trichomes contain serotonine, a histamine releaser. The histamine causes wheals and irritation (Watt and Breyer-Brandwijk 1962).

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SECTION 2

BOTANICAL CHARACTERISTICS OF

LASIOSIPHON KRAUSSIANUS (MEISN.)

2.1. HABITAT

Lasiosiphon kraussianus belongs to the family Thymelaeaceae which includes trees, shrubs and some herbs. The family comprises about 40 genera and 400 to 500 species. They are widely distributed in South Africa, Australia and the Mediterranean area (Hutchinson and Dalziel 1966). L.kraussianus is widespread in tropical and South Africa in Savannah and neighbouring forest areas (Hutchinson 1946). In Nigeria, it is found in Savannah woodland of the Northern States and is abundant in many localities including Sokoto, Katagun, Zaria and Bauchi Plateau (Hutchinson and Dalziel 1966).

2.2. MORPHOLOGICAL FEATURES

The morphology of the family Thymelaeaceae and L.kraussianus has been described by several authors (Brain 1939; Chopra et al. 1965; Collins and Wild 1950; Domke 1934; Hutchinson and Dalziel 1966; Leandri 1930; Marloth 1925; Quarre and Mols 1945; Riley 1963; Verdcourt and Trump 1969; Wood 1902). Figs 1-4 show the morphological characteristics of L.kraussianus. It is a herbaceous perennial 25-35cm high with yellow flowers. The root

is a thick woody rhizome (Fig.4). Numerous close erect stems arise from each root (Fig.2). They are yellow-green and covered with long white hairs especially towards the apex. Leaves vary from densely hairy to quite hairless. They are alternate, oblong or lanceolate, obtuse or subacute, 3-6cm long and 0.5 to 1.2cm wide. Inflorescence is in terminal bracteate heads. Involucreal bracts are 8 to 12 in number, lanceolate, about 1.5cm long and enclose 40 to 80 flowers. The receptacle is pitted; the pits are margined with long white hairs. Perianth is tubular, jointed above the ovary and a little inflated towards the apex. It is densely pilose with long white hairs and has five lobes. There are five petals which alternate with the lobes and are ovate, obtuse or minutely toothed at the apex. Stamens are ten and arranged in two rows. Anthers are sessile, oblong and two-celled. The ovary is free and enclosed in the base of the perianth tube. It is one celled and one ovuled. The style is filiform and the stigma captate, hairy and reaching about half way up the perianth tube. The seed is small, dry and enclosed in the base of the perianth tube.

2.3. ANATOMICAL FEATURES

Anatomical features of L.kraussianus correspond to those described by Metcalfe and Chalk (1950) and Leandri (1930) for the family Thymelaeaceae. The most prominent features are shown in Figs. 5-9. They include the presence of irregular sclerenchymatous fibres in the mesophyll (Figs. 5, 7). The vascular bundles of the vein are accompanied by these sclerenchymatous elements which extend into and support the entire leaf margin. Triangular phloem fibre strands contain variously arranged fibres which appear as silken threads in transverse sections (Fig. 6). In the stem, fibres are also very common in the phloem. The fibres are provided with lignified and unlignified walls of varying thickness. Pith is also composed of lignified and unlignified cells (Figs. 8, 9).

SUMMARY

Lasiosiphon kraussianus is a herbaceous perennial 25-35cm high with alternate, lanceolate leaves, 40-80 yellow flowers in terminal bracteate heads and a thick woody rhizome. It is found in Savannah and neighbouring forest areas of Nigeria. The vascular bundles of the vein are accompanied by sclerenchymatous elements which extend into and support the leaf margins. Phloem fibres have silken thread appearance in transverse section. The pith of the stem is composed of lignified and unlignified cells.

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Fig. 1: Flowering shoots of Lasiosiphon kraussianus



Fig. 2: Lasiosiphon kraussianus: Many stems
arising from one root



Fig. 3: Lasiosiphon kraussianus:

Part of stem and flower head



Fig. 4: Root of Lasiosiphon kraussianus

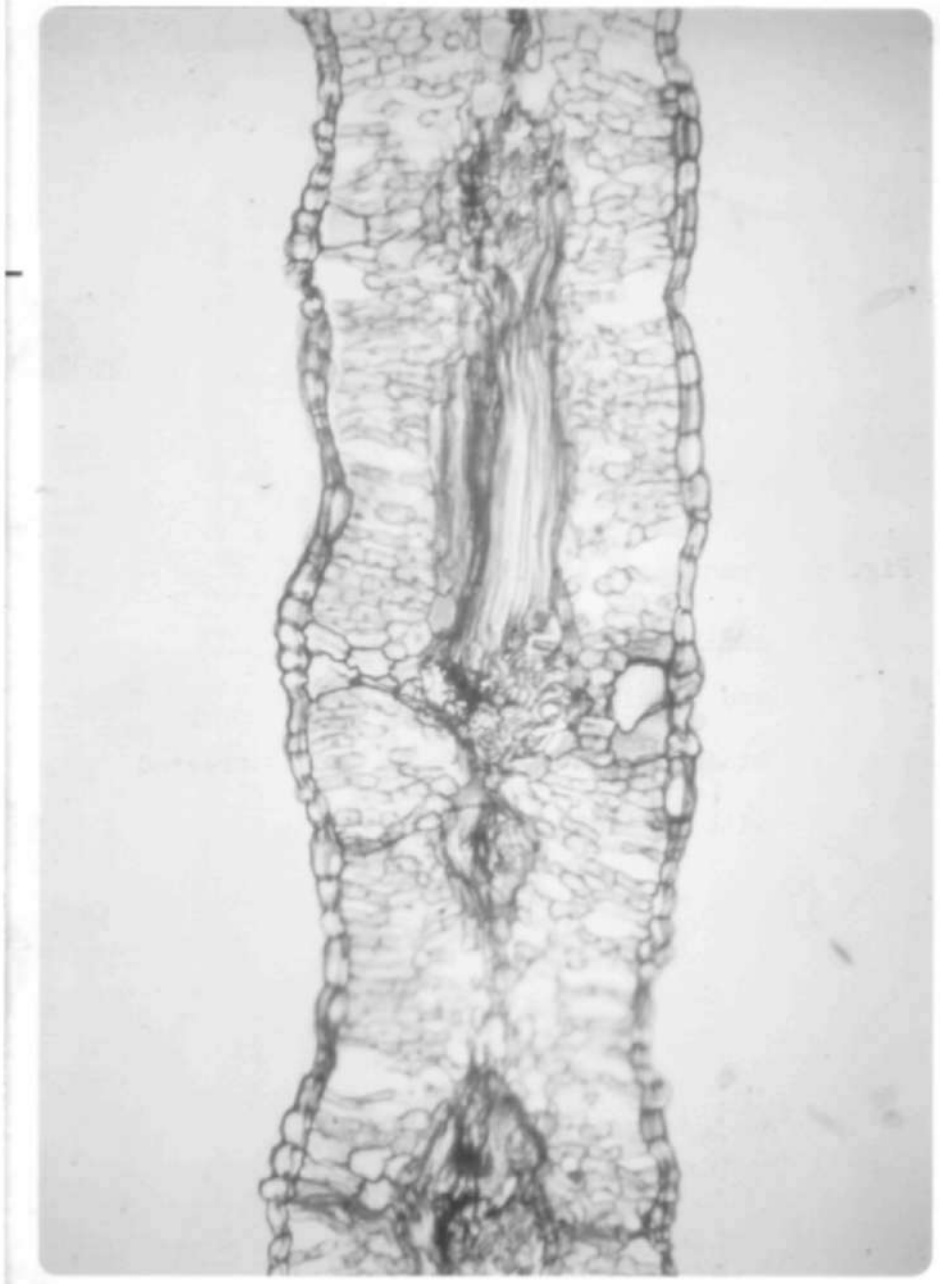


Fig. 5: Transverse section of the leaf of
Lasiosiphon kraussianus
red = sclerenchymatous fibres
stained with alcian blue and contrasted
with safranine. 160X



Fig. 6: T.S. of the leaf of Lasiosiphon kraussianus showing silken thread-like phloem fibres (blue) accompanied by sclerenchymatous fibres (red). 400X

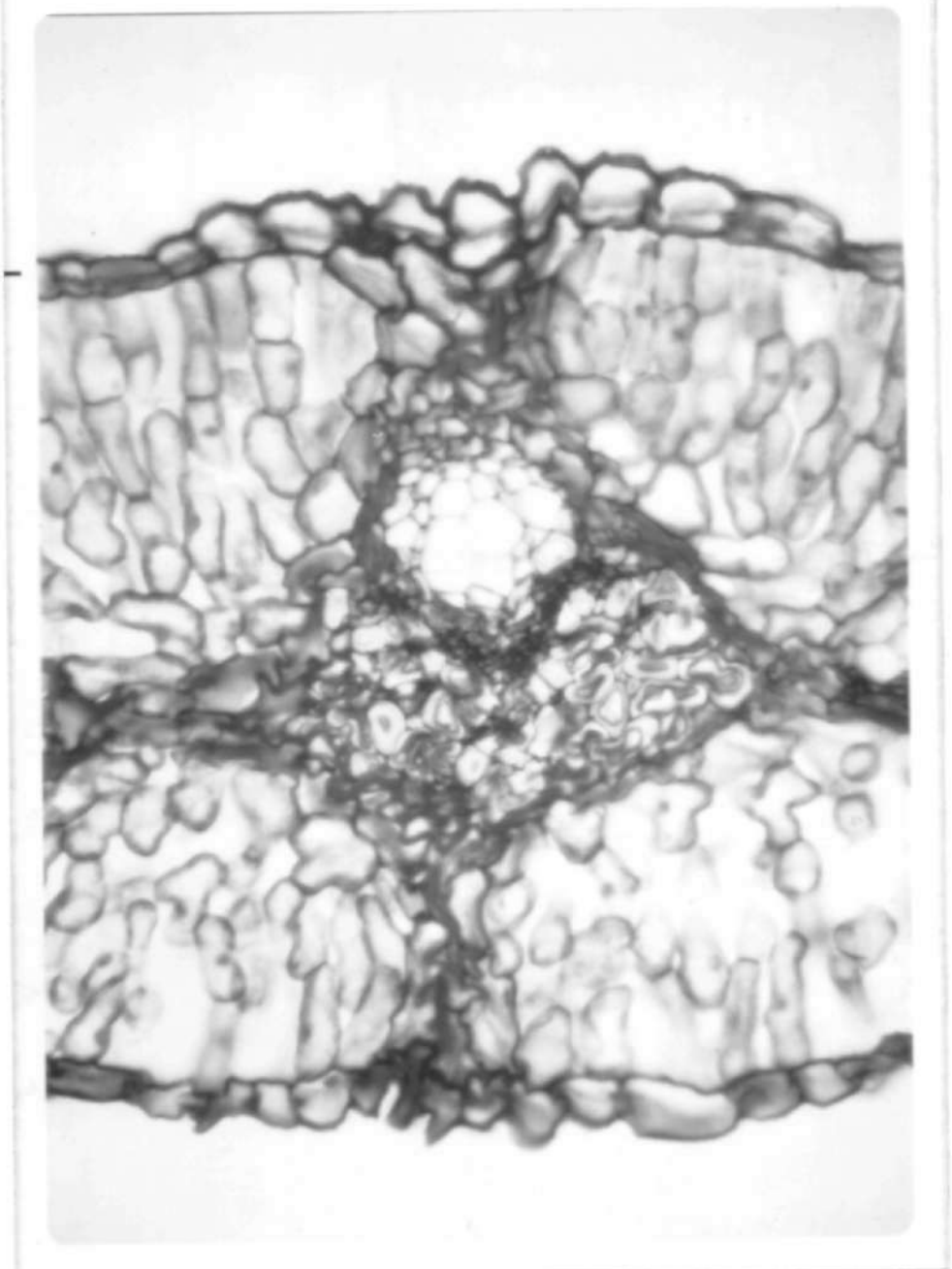


Fig. 7: T.S. of the leaf of Lasiosiphon kraussianus showing sclerenchymatous elements (red) surrounding the vein and extending into the leaf margin. Phloem fibres are blue. 400X

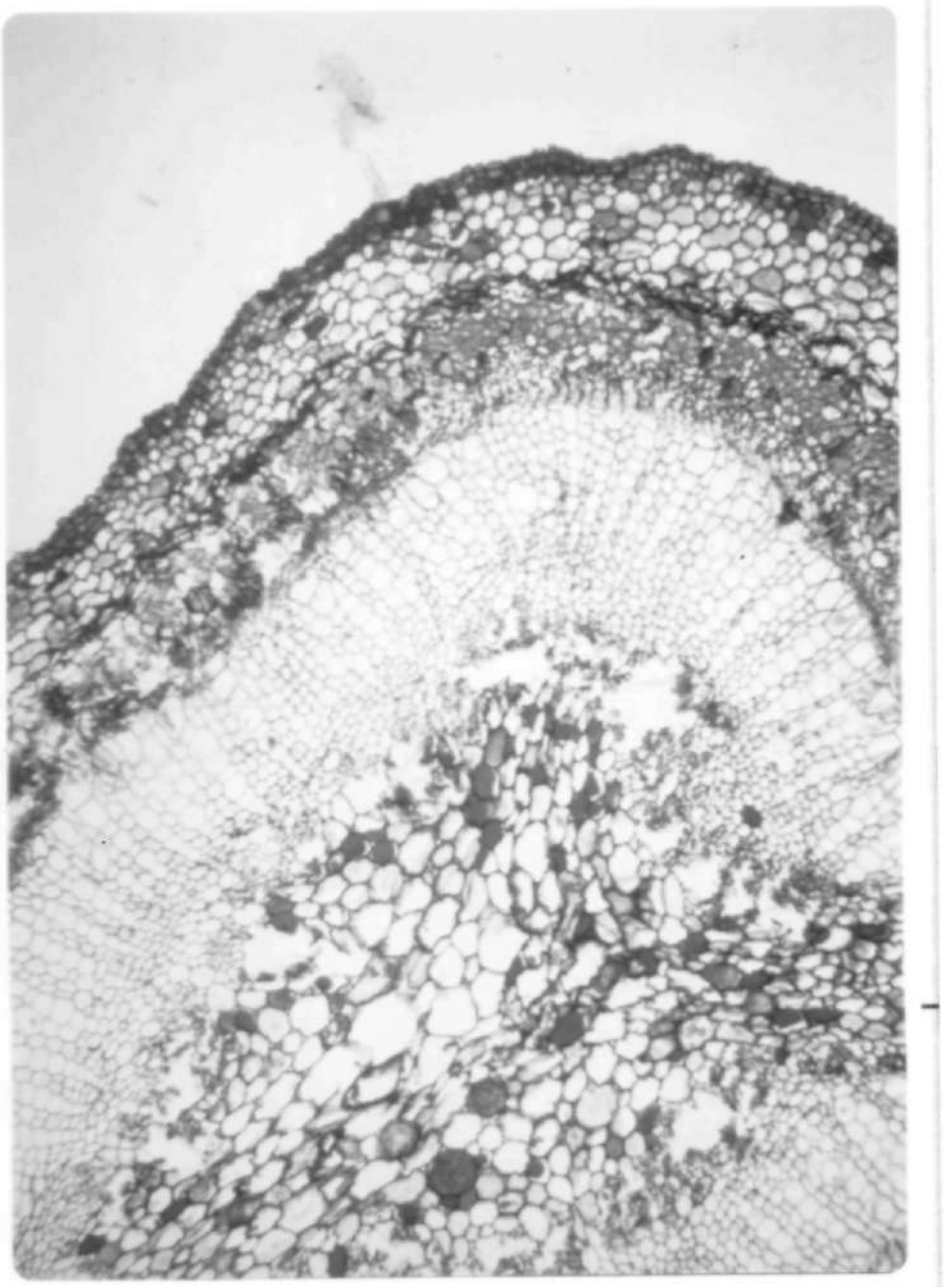


Fig. 8: T.S. of the stem of Lasiosiphon kraussianus showing lignified cells (red) in the pith and cortex. 160X

SECTION 3

TOXICITY OF *LASIOSIPHON KRAUSSIANUS* (MEISN.) TO LIVESTOCK

Fig. 9: T.S. of the stem of Lasiosiphon kraussianus showing lignified cells (red) in the cortex and among the phloem fibres (blue). Sclerenchymatous fibres (red) run along the outermost cells of the cortex. 400X

3.1. INTRODUCTION

A few plants in the family Thymelaeaceae, to which Lasiosiphon kraussianus belongs, are used as drugs while quite a number are reported to be poisonous. Species of Daphne (D.mezereum, D.laureola, D.oleoides, D.papyracea) are poisonous to man and animals (Clarke and Clarke 1967; Kingsbury 1964; Chopra et al. 1965). D.mezereum produces blisters and its bark is sometimes used externally as a stimulant and vesicant. Edgeworthia gardneri, Linostoma decandrum, and Wikstroemia indica are all used in India as fish poisons (Chopra et al. 1965). Arthrosolen polycephalus, Englerodaphne ovalifolia, and Gnidia chrysantha are poisonous to livestock producing acute fatal gastritis (Watt and Breyer-Brandwijk 1962; Steyn 1929). Pimelea prostata has caused poisoning in Australia and New Zealand (Clarke and Clarke 1967). Many species of Lasiosiphon (L.anthylloides, L.burchelli, L.meisnerianus, L.eriocephalus and L.kraussianus)are poisonous to livestock producing acute haemorrhagic gastroenteritis (Watt and Breyer-Brandwijk 1962; Chopra et al. 1965; Steyn 1932, 1934; Alexander 1928; Phillips 1919). L.kraussianus was reported as exceedingly poisonous and rapidly fatal to

livestock (Dalziel 1910, 1916; Verdcourt and Trump 1969). According to Holland (1913) the thick woody root of L.kraussianus was considered one of the most virulent poisons in Kontagora district of Nigeria. Quarre and Mols (1945) reported that 350g of the leaves and flowering tips of L.kraussianus killed a cow or horse so rapidly that no lesions were observed. Hutchinson (1946) listed L.kraussianus as one of the poisonous plants in Savannah and neighbouring forest regions of the tropics. Brain (1939) reported that the Zulus of Rhodesia used L.kraussianus in the treatment of snake bite and a decoction of the leaves as a gargle for sore throat. According to him, no evidence has been found that it is eaten by stock in Rhodesia. Collins and Wild (1950) reported that the root of L.kraussianus contains violent poison. However, grazing of the foliage did not prove harmful under Rhodesian conditions, while a case of human poisoning due to eating the roots was reported. Some tribes in East Africa use a decoction of the plant to bathe wounds and bruises, though it is stated to be poisonous (Alexander 1928). According to Verdcourt and Trump (1969), the young leaf and the flowering tip have proved extremely toxic, reaching full toxicity with complete opening

of the flower. The leaves and roots act as a drastic purgative and are said to be used criminally in food. They are also employed as fish poisons (Dalziel 1955; Verdcourt and Trump 1969; Watt and Breyer-Brandwijk 1962). In 1956 several cattle were reported lost at Daudawa Agricultural farm in Kaduna state of Nigeria, due to poisoning by L.kraussianus which was prevalent in the grazing area (Anon. 1956). A number of cattle deaths attributed to L.kraussianus occurred on Shika Agricultural Research station and the Nigerian Tobacco Company farm, both in Samaru, Nigeria (De Leeuw 1969). Discussions with Fulani herdsmen in the northern part of Nigeria indicated that they recognized the plant as dangerous to livestock.

Reported here is an investigation of the toxicity of L.kraussianus collected from Zaria area.

3.2. MATERIALS AND METHODS

3.2.1. Experimental animals

Five groups of animals were used for this study.

Group 1: Five female Yankasa sheep, two to three years old, weighing 20-25kg.

Group 2: Five female Red Sokoto goats, two to three years old, weighing 15 to 20kg.

Group 3: Four female donkeys, four to five years old, weighing 100 to 150kg.

Groups 4 and 5: Four and three Bunaji (White Fulani) cows, respectively, three to four years old, weighing 160 to 250kg.

All animals were purchased locally and housed in pens at the Faculty of Veterinary Medicine. Animals were examined clinically and treated for any internal or external parasites. They were observed for two to three weeks prior to use. Only clinically healthy animals were used.

3.2.2. Feeding Experiments

Initially each animal was offered fresh leaves and dried ground leaves of L.kraussianus mixed with its feed to determine the palatability before being force fed by stomach tube or via ruminal fistula.

Four test sheep (group 1) were drenched via a stomach tube with ground dried leaves of L.kraussianus at the rate of 3.3g/kg/day for nine days. One control sheep received 3.3g/kg/day of ground grass hay suspended in water for nine days.

Four goats (group 2) and three donkeys (group 3) were given 4.0g/kg/day of ground dried leaves of L.kraussianus via a stomach tube. One goat and one donkey served as controls and received each 4.0g/kg/day ground grass hay suspended in water for the same period as the test animals.

In cattle, ground fresh leaves and stem tips were fed through a ruminal fistula 14 days after rumenotomy. Three cows (group 4) were fed 8.0g/kg/day of fresh leaves and stem tips of L.kraussianus (equivalent of 2.8g/kg/day of dried plant material) collected during the dry season (December to January) for nine days. Three cows (group 5) received 8.0g/kg/day of fresh leaves and stem tips collected at the beginning of rainy season (April to May). One cow (group 4) served as the control. It received 8.0g/kg/day of ground grass hay fed via the ruminal fistula for nine days.

3.2.3. Postmortem Examination

All animals were subjected to standardized postmortem examination as soon as possible after death. Surviving animals were killed the day after feeding was discontinued.

For histopathological examination, the following specimens were collected: lungs, liver, heart, kidney, spleen and brain. Tissues were fixed in 10 percent buffered neutral formalin, trimmed and processed in a Tissuematon*, embedded in paraffin, cut at six microns and mounted and stained with haematoxylin and eosin.

3.3. RESULTS

3.3.1. Feeding Experiments

Most animals would not feed voluntarily on fresh leaves of L.kraussianus, even after starving for a day or two. Only two cows ate some fresh plant material after they were starved for one day. One took 200g (1.4g/kg) and the other 385g (2.0g/kg) but no effects were observed.

Feed was withheld for another day but the cows did not eat any more of the plant. Ground dried leaves of L.kraussianus alone or mixed with the feed was non-palatable to the animal species tested.

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* Fisher Scientific Company, Chicago, Illinois

3.3.2. Clinical Signs

All test animals had clinical signs of intoxication as described in cattle (vide infra). Clinical signs were not observed in any of the controls.

No deaths occurred among the sheep.

Two of the four test goats died on the final day of the nine day feeding period.

The resulting dysentery was more severe in donkeys than in cattle. One donkey died after one day's feeding while two died after being fed for two days.

Clinical signs were observed in cattle within 24 to 48 hours of feeding. The signs included depression, anorexia, grinding of teeth, nasal and ocular discharges, dysentery, coma, convulsions, torticollis and death. Cows (group 4) which received the plant material collected during the dry season, died after eight to nine days of feeding while cows fed the plant material collected at the beginning of rainy season (group 5) died after four to five days.

3.3.3. Postmortem findings

The test sheep and the two surviving test goats had small abomasal ulcers (0.5 to 1cm diameter), oedema of the

mesenteric lymph nodes and petechial haemorrhages in the lungs and spleen. Lesions as described below in cattle were found in the two goats which died and the test donkeys.

Necropsy findings in the cows were extensive ulceration and haemorrhage in the omasum, abomasum and intestines, ecchymotic and petechial haemorrhages on epicardium and endocardium, congestion of the brain, subcapsular haemorrhage in the spleen, and hepatomegaly (Figs. 1 - 4). There were no lesions in the control animals.

Histopathological findings in the gastrointestinal tract of the test cows were: mucosal haemorrhage, fibroplasia, submucosal oedema, massive infiltration of mononuclear cells (mainly lymphocytes) and eosinophils in the lamina propria, and congestion of subserosa (Figs. 5 - 7). There was congestion, oedema and serous exudate in the lungs, oedema and congestion of the brain, kidney and liver, and myocardial oedema.

The test sheep, goats and donkeys had histological lesions similar to those observed in cattle. No lesions were found in the control animals.

3.4. DISCUSSION

The results of the feeding experiment confirmed that Lasiosiphon kraussianus is poisonous. All the animals tested had clinical signs of intoxication. None of the sheep died after nine days of feeding. Terblanche et al. (1966), however, reported that Merino sheep fed the leaves of L.burchelli at the same rate died in six days. The difference in the results may be due to the difference in the plant species and breed of sheep used. While some goats died, clinical signs only were seen in others. The amount of the dried plant material (4.0g/kg) was the maximum that could be physically given to the goats.

Donkeys were more susceptible to L.kraussianus toxicity than the ruminants. Fed at the same rate as the goats, they died in one to two days. The difference in susceptibility may be due to some inactivation of the toxic principle(s) of L.kraussianus in the rumen.

Cattle were fed fresh leaves and stem tips because herdsmen reported cattle deaths after eating the fresh plants. Plant material collected during the dry season and at the beginning of rainy season were toxic to cattle, the latter

being more so. This may be why some East African tribes use the root of L.kraussianus collected during early rains for poisoning animals (Watt and Breyer-Brandwijk 1962). The low palatability of L.kraussianus suggests that it would be eaten in sufficient amounts to cause intoxication and death only under severe lack of forage for grazing. The experience of Nigerian herdsmen that L.kraussianus was rapidly fatal when consumed by cattle could not be confirmed by this study.

Three laboratory animals (two mice and one rabbit) which died suddenly on exposure to ground leaves of L.kraussianus (Nwude 1976) might have suffocated as a result of strong irritation of the respiratory tract. Several workers (Chopra et al. 1965; Oliver 1908; Rogerson 1911; Steyn 1934), using other Lasiosiphon species reported a strong burning sensation in the nasal and respiratory passages during the process of grinding the plant material. Similar irritation was experienced when grinding the dried leaves of L.kraussianus used for the present study. The irritation persisted for over 24 hours. The nasal and ocular discharges in test animals were probably due to irritation caused by the toxin(s) reaching the nose and eye via the blood.

The lesions in the gastrointestinal tract suggest that the plant contains a corrosive fraction(s). Haemorrhages in the various organs were probably due to hypoxia as a result of congestion which in turn may be the result of impaired cardiac function by L.kraussianus toxin(s). Oedema resulted from congestion and hypoxia. The lymphatic infiltration and other histological findings in the gastro-intestinal tract are typical signs of acute gastroenteritis caused by toxic substances (Smith et al. 1972).

SUMMARY

An investigation was carried out on the toxicity of Lasiosiphon kraussianus to sheep, goats, donkeys, and cattle. Four sheep, four goats and three donkeys were fed ground dried leaves of L.kraussianus via stomach tube. Sheep were fed 3.3g/kg/day for nine days, goats and donkeys received 4.0g/kg/day for nine and two days, respectively. Six cows were fed 8.0g/kg/day (equivalent of 2.8g/kg/day of dried plant material) of fresh leaves and stem tips of L.kraussianus via ruminal fistula for nine days.

Clinical signs of intoxication were observed in all test animals. These included depression, anorexia, nasal and ocular discharges, and dysentery. None of the sheep died, while two goats, and all the donkeys and cows died.

Necropsy findings included severe haemorrhagic enteritis, extensive ulceration and haemorrhages in the gastrointestinal tract, petechial and ecchymotic haemorrhages on epicardium and endocardium, and congestion of the brain.

Histological findings included massive infiltration of lymphocytes into the lamina propria of the gastrointestinal mucosa, oedema and congestion of the gastrointestinal tract, brain, liver, and myocardium.

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Table 1: Results of feeding the leaves of Lasiosiphon kraussianus to livestock

Group	Species	Fresh leaves in g/kg/day	Dried leaves in g/kg/day	No. days fed	No. animals	Morbidity (%)	Mortality (%)
1	Sheep	-	3.3	9	4	100	0
	Control	-	-		1	0	0
2	Goats	-	4.0	9	4	100	50
	Control	-	-		1	0	0
3	Donkeys	-	4.0	1-2	3	100	100
	Control	-	-		1	0	0
4	Cattle	8.0*	-	8-9	3	100	100
	Control	-	-		1	0	0
5	Cattle	8.0**	-	4-5	3	100	100

* Collected during dry season

** Collected at beginning of rainy season

Fig. 1: Intestines of a cow poisoned with the leaves of Lasiosiphon kraussianus. The intestines are filled with mucoid fluid containing blood



Fig. 2: Extensive ulceration and haemorrhage of part of the abomasum of a cow fed the leaves of L.kraussianus



Fig. 3: Duodenum of a cow fed Lasiosiphon kraussianus showing marked congestion, ulceration and haemorrhage



Fig. 4: Congestion and haemorrhage in the brain of a cow which died of Lasiosiphon kraussianus poisoning

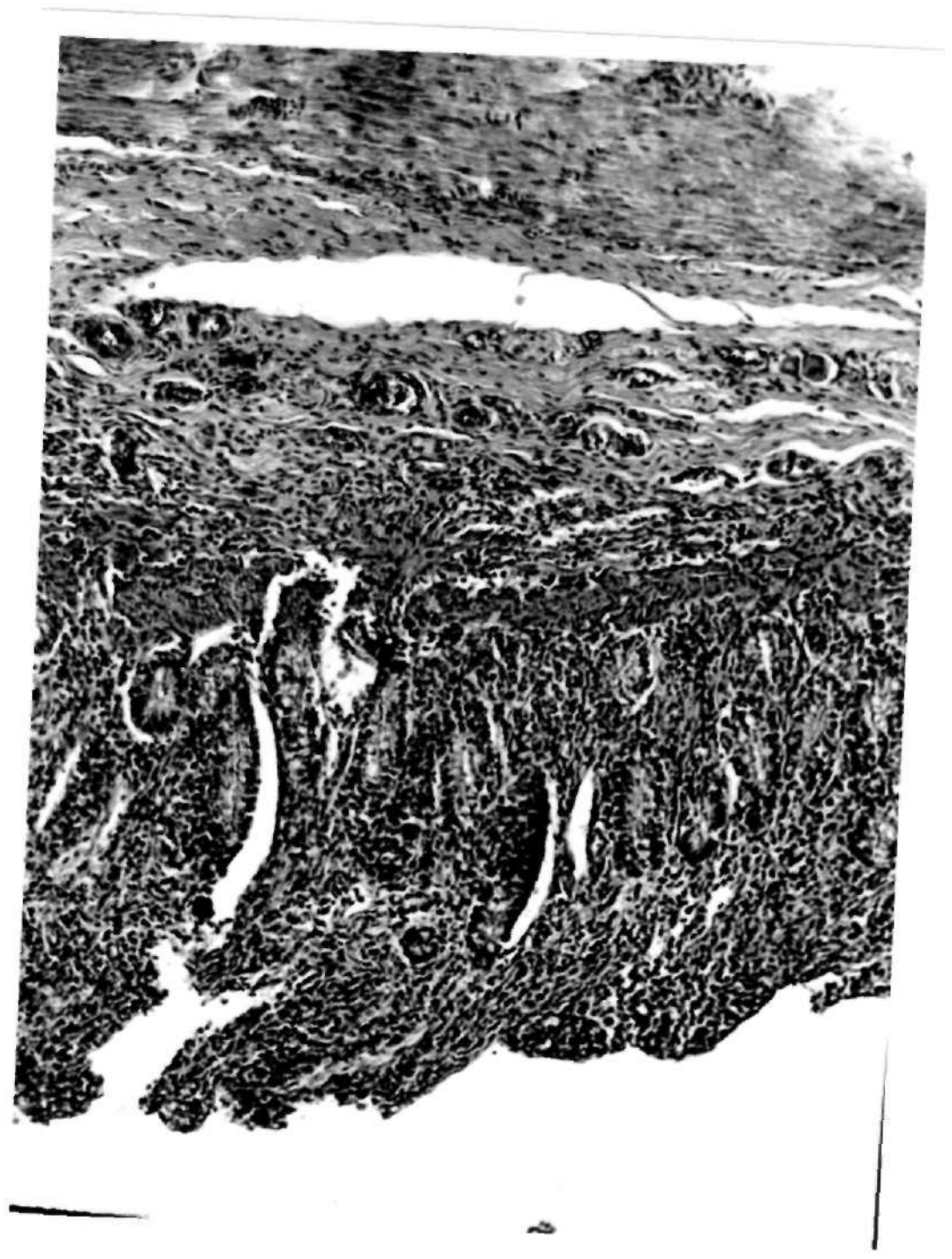


Fig. 5: Photomicrograph of jejunum of a cow fed leaves of Lasiosiphon kraussianus. Note the diffuse mononuclear cell infiltration in lamina propria and submucosa. 160X



Fig. 6: Higher magnification of Fig. 5. Note the extensive lymphocytic infiltration in the lamina propria.

400X

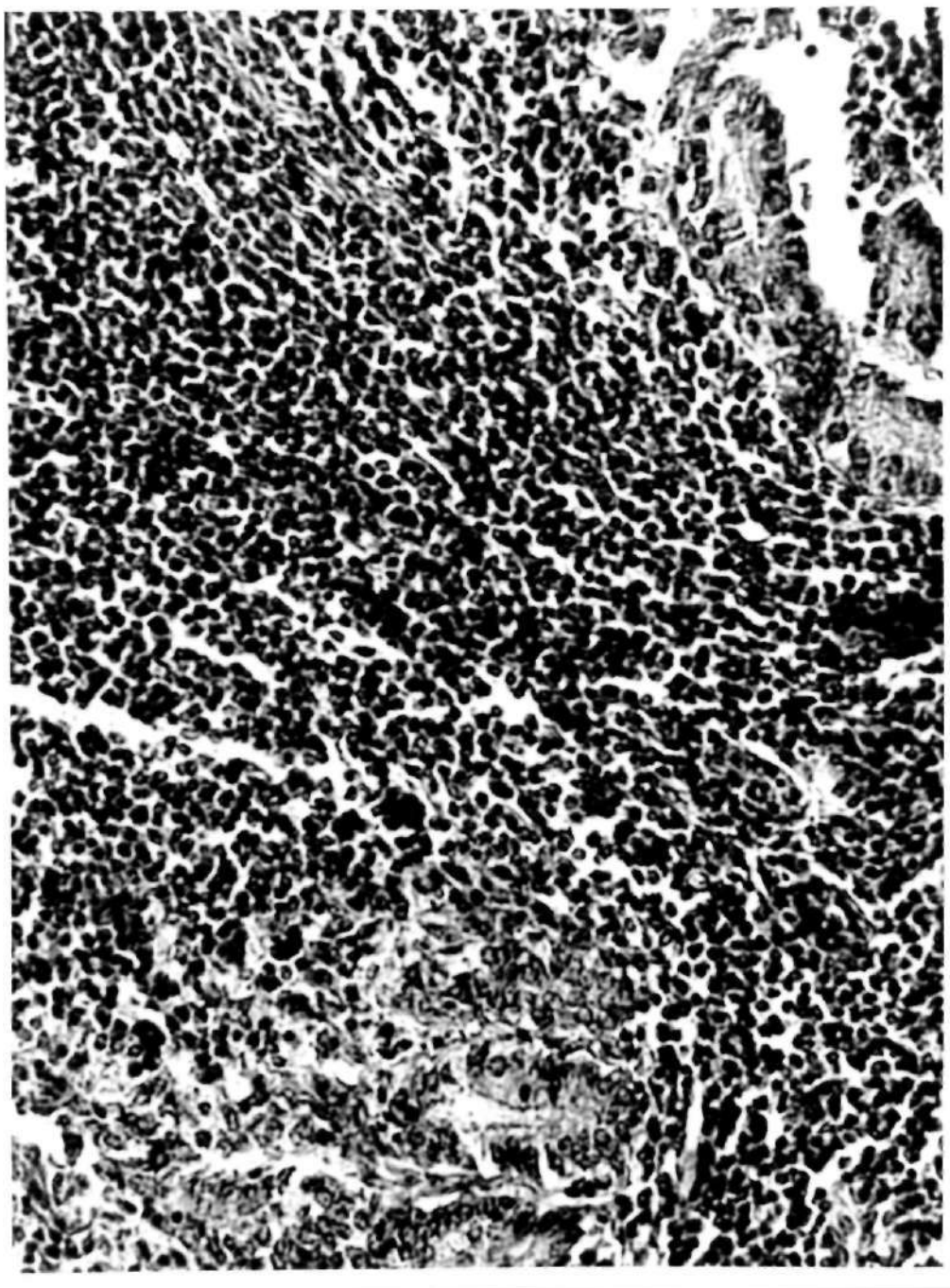




Fig. 7: Photomicrograph of jejunum of a cow fed leaves of Lasiosiphon kraussianus. Note the massive infiltration with lymphocytes and plasma cells in the lamina propria. 400X

SECTION 4

HAEMATOLOGICAL AND BIOCHEMICAL CHANGES IN *LASIOSIPHON KRAUSSIANUS* (MEISN.) POISONING IN THE BOVINE

4.1. INTRODUCTION

Feeding experiments reported in the previous section showed that Lasiosiphon kraussianus causes severe haemorrhagic gastroenteritis. However, no gross or microscopic changes were observed in the kidney and liver apart from congestion and oedema. Camp and Dollahite (1967) reported increases in serum glutamic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT) values in rabbits fed with oak tanin which has clinical signs similar to L.kraussianus poisoning. Buck et al. (1961) found that feeding of sheep with various toxic plants resulted in elevated SGPT activity. The Lasiosiphon spp. are reported to be esteemed for their blood purifying properties (Oliver 1908).

In the present study, determination of haematological and biochemical values were undertaken to see if any changes occur or if there are any indications of changes in kidney and liver functions during poisoning with L.kraussianus.

4.2. MATERIALS AND METHODS

4.2.1. Experimental animals

Four Rahaji (Red Bororo) cows, four to five years old, weighing 160 to 250kg were used for the experiments. They were purchased locally and housed in pens at Ahmadu Bello University. They were examined clinically and treated for any external or internal parasites. They were observed for two to three weeks before rumenotomy was performed on them. Feeding experiments started two weeks after rumenotomy.

4.2.2. Feeding experiments

Three cows were each fed 8.0g/kg/day of the fresh leaves and stem tips of L.kraussianus via ruminal fistula for four days. One cow served as the control and received ground grass hay at the rate of 8.0g/kg/day for four days. The ground grass hay was mixed with water and fed through ruminal fistula.

4.2.3. Blood sampling

A blood sample was taken from each cow four days before feeding L.kraussianus. Feeding started on day zero (0) after a blood sample was collected. Subsequent blood sampling was

done daily until the cow died. Blood samples for haematological evaluation was collected into tubes containing heparin as an anticoagulant.

Blood samples for biochemical tests were allowed to clot at room temperature and centrifuged for 15 minutes at 3500 rpm*. Serum was decanted into plastic tubes and kept frozen until analysed.

4.2.4. Haematological Examination

Haematological investigations were performed according to standard methods: haemoglobin (Hb) was determined by cyanmethaemoglobin procedure, packed cell volume (PCV) by the microhaemocrit method and red and white blood cells were enumerated using a haemocytometer. Blood smears were stained with Giemsa's stain and differential counts were based on 100 cells (Coles 1974; Medway and Prier 1969).

4.2.5. Biochemical Examination

Biochemical tests were carried out using commercially prepared reagents** Blood urea nitrogen (BUN), serum

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* I.E.C. Centrifuge Cat. No.748. International Equipment Co. Boston, Mass. U.S.A.

** Sigma Chemical Co., St Louis, Missouri, U.S.A.

glutamic oxalacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), alkaline phosphatase, and total protein were determined as described in Sigma technical bulletins*.

4.3. RESULTS

4.3.1. Clinical signs

All test animals had clinical signs of dysentery and nasal and ocular discharges and died after four to five days.

4.3.2. Haematological changes

The results of the haematological examinations are shown in Table 1. There were no changes in PCV, Hb concentration, red blood cell counts but there were decreases in total white blood cell counts, absolute and percentage lymphocyte and eosinophil values and a relative increase in neutrophils. There were no changes in the haematological values of the control cow (Table 2).

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* Sigma Chemical Co., St Louis, Missouri, U.S.A. Technical bulletins 604, 605, 104 and 504, respectively

4.3.3. Biochemical changes

The results of biochemical examination are given in Table 3. There was a progressive increase in BUN but the other values were unchanged. The values for the control cow were unaffected (Table 4).

4.4. DISCUSSION

The lymphopenia and eosinopenia observed with Lasiosiphon kraussianus poisoning in cattle may have been due to stress. Animals with L.kraussianus toxicity usually are anorexic and become cachectic and debilitated before they die. These conditions may lead to lymphopenia (Coles 1974). On the other hand, it is possible that L.kraussianus contains a toxin which causes dissolution of lymphocytes or causes release of adrenocorticotropic substances which then dissolve the lymphocytes. It is of interest that Tubery (1971) reported that alcohol extracts of the roots of L.kraussianus have lymphocytic activity which is the basis for its reported use in the treatment of leprosy. However, it is not clear from the abstract, if it causes lymphopenia or lymphocytosis.

The present study showed an increase in BUN over the prefeeding values and much higher values than those reported for Zebu cattle in Nigeria (Saror and Coles 1973). This increase is probably due to the congestion observed in the kidney. Decreased renal flow tends to increase BUN values (Medway and Prier 1969; Coles 1974). The increase in BUN may also be partly due to haemorrhage into the gastrointestinal tract (Coles 1974) which is a prominent sign in L.kraussianus poisoning. There was no indication that the liver function was affected in L.kraussianus poisoning as the SGOT and SGPT values were within normal values (Saror and Coles 1973). There was also no elevation of alkaline phosphatase. The biochemical results with L.kraussianus poisoning were similar to the findings of Terblanche et al. (1966). They found increases in BUN but no changes on SGOT and alkaline phosphatase in sheep and pigs poisoned with L.burchelli.

SUMMARY

Haematological and biochemical examinations were carried out on three Rahaji cattle fed the fresh leaves of Lasiosiphon kraussianus. This resulted in lymphopenia, eosinopenia, a relative neutrophilia, and an increase in BUN but no change in SGOT, SGPT and alkaline phosphatase values.

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Table 1: The means and standard deviations of haematological values from three cattle fed *Lasiosiphon kraussianus*

Day of Experiment	RBC $X10^6$/cu.mm	Hb g/100ml	PCV %	WBC Total Count $X10^3$/cu.mm	Band %	Segment %	Lymph %	Mono %	Eosino %
-4*	7.68±1.72	10.9±1.7	29.3±5.9	12.6±2.6	2.0±2.0	23.0±5.8	71.0±10.2	1.0±0.1	3.0±1.2
0	7.35±0.55	11.4±1.0	32.0±3.0	11.1±1.0	1.0±1.2	21.0±2.3	72.0±4.8	2.0±1.6	4.0±1.6
1	7.42±1.53	11.6±1.6	31.7±4.5	10.4±2.4	1.0±1.2	33.0±11.1	61.0±5.7	4.0±2.1	1.0±1.6
2	6.41±0.78	10.8±0.3	30.5±0.9	6.9±2.9	1.0±1.7	51.0±15.7	46.0±22.8	2.0±1.6	0.3±0.9
3	6.84±0.59	12.0±0.1	33.0±1.7	6.1±3.1	0.0±0.0	57.0±17.6	41.0±19.1	1.0±1.0	1.0±0.1
4	6.27±1.09	10.8±1.0	28.7±2.3	5.6±2.9	0.0±0.0	67.0±17.7	31.0±16.5	0.0±0.0	2.0±1.7

*-4 Four days before feeding *L.kraussianus*

± Standard deviation

Table 2: Haematological values in the control fed ground grass hay

Day of Experiment	RBC 10^6/cu.mm	Hb g/100ml	PCV %	WBC Total Count 10^3/cu.mm	Band %	Segment %	Lympho-cytes %	Mono-cytes %	Eosino-phils %
-4*	5.80	9.0	27	9.5	0	18	79	2	1
0	6.71	9.8	28	10.9	0	16	82	2	0
1	6.20	9.4	28	8.8	0	31	66	2	1
2	5.70	8.7	25	8.4	0	26	70	1	3
3	5.39	9.6	26	9.5	0	18	81	0	1
4	5.72	9.0	25	9.6	0	16	83	1	0

-4* Four days before feeding ground grass hay

Table 3: The means and standard deviations of biochemical values from three cattle fed Lasiosiphon kraussianus

Day of Experiment	BUN mg/100ml	SGOT SF Units/ml	SGPT SF Units/ml	Alkaline Phosphatase Sigma Units/ml	Alkaline Phosphatase I.U./L	Total Protein g/100ml
-4*	9.1±1.6	44.7±29.0	14.7±3.5	2.0±0.1	33.1±16.3	7.8±1.0
0	8.0±4.5	35.3±33.7	14.7±4.7	2.0±1.3	33.7±22.6	6.9±1.4
1	9.2±2.3	47.3±31.4	17.0±5.1	2.0±0.8	33.7±13.3	7.5±0.8
2	14.3±6.0	32.6±18.1	15.3±2.5	1.2±0.4	19.7±7.0	7.8±1.4
3	21.4±7.9	40.0±6.1	14.3±4.7	1.3±0.5	20.9±7.4	5.6±1.6
4	22.3±5.5	48.7±32.9	15.0±5.0	2.0±0.2	33.1±2.9	8.5±1.1

-4* Four days before feeding L.kraussianus

Table 4: Biochemical values from a cow (control) fed ground grass hay

Day of Experiment	BUN mg/100ml	SGOT SF Units/ml	SGPT SF Units/ml	Alkaline Phosphatase Sigma Units/ml	Alkaline Phosphatase I.U./L	Total Protein g/100ml
-4*	8.0	58.0	16.0	1.2	20.0	6.5
0	9.4	62.0	17.0	0.9	15.0	7.5
1	9.0	100.0	18.0	0.8	13.4	8.8
2	5.8	52.0	20.0	1.1	18.4	6.6
3	6.7	44.0	15.0	1.8	30.1	6.4
4	8.6	56.0	21.0	1.0	16.7	6.7

-4* Four days before feeding ground grass hay

SECTION 5

TOXICITY OF ETHER, CHLOROFORM, ETHANOL AND WATER EXTRACTS OF *LASIOSIPHON KRAUSSIANUS* (MEISN.) IN MICE

5.1. INTRODUCTION

A decoction of the plant Lasiosiphon kraussianus is reported to be used in bathing wounds and bruises (Alexander 1928, Phillips 1917) and as a gargle for sore throat (Brain 1939). Recently alcohol extracts of the roots have been used in the treatment of leprosy (Tubery 1971). Feeding experiments reported in the previous sections, however, showed the plant to be toxic.

This section reports the toxicity of extracts of L.kraussianus obtained by various solvents.

5.2. MATERIALS AND METHODS

5.2.1. Extraction

Ether, chloroform, ethanol and water extracts of the leaves of L.kraussianus were prepared by extracting one part (by weight) of the ground dried leaves in 10 parts (by volume) of the respective solvent for 24 hours at 25°C. The extracts were filtered and the filtrate evaporated in vacuo in a rotatory evaporator.* The solid ethanol and water extracts were dissolved in distilled water while the ether and chloroform extracts were dissolved in dimethlsuphoxide (DMSO).

*BUCHI Laboratoriums - Technik A.G. Flawil/Switzerland

5.2.2. Administration of extracts to mice

The extracts were injected into mice intraperitoneally. Ten female Swiss white mice three to four weeks old, weighing 10–20g, were used for each dose level of the various extracts (Table 1). Ten control mice each received DMSO 7g/kg and 10 mice each received 0.3ml distilled water (the largest volume used in the test mice).

5.2.3. Calculation of LD_{50}

LD_{50} was calculated according to the method of Reed and Muench (1938).

5.3. RESULTS

5.3.1. Extraction

Fifty grammes L.kraussianus leaves each yielded 0.76g, 1.02g, 3.86g of solid extract with ether, chloroform, and ethanol, respectively, and 8.7g of thick brown viscous substance with water.

5.3.2. Toxicity of extracts

The results of the toxicity tests are given in Table 1. The LD_{50} in mg/kg body weight was 6.2, 9.6, 37.4 and 468.0 for ether, chloroform, ethanol and water extracts, respectively.

Intraperitoneal injection of ether and chloroform extracts produced death within 1 to 12 hours while ethanol and water killed the mice in 6 to 24 hours.

The clinical signs observed were depression, tachypnoea, and convulsions. These signs were more marked with ether and chloroform extracts than with ethanol and water extracts.

At necropsy, haemorrhages were found mainly in the upper part of the small intestine in mice which received ether and chloroform extracts. In some cases, the lumen of the intestine was full of blood. The same lesions were also found in mice injected with ethanol extract but they were less severe. The water extract produced signs of enteritis but no haemorrhages were found in the intestinal lumen.

No effects were observed in the control mice.

5.4. DISCUSSION

Ether extracted the least amount of material but the extract proved to be the most toxic, followed by the chloroform, ethanol, and then water extracts. The typical lesions of haemorrhagic enteritis observed in domestic animals fed with leaves of L.kraussianus were also observed with the

ether, chloroform and ethanol extracts, while non-haemorrhagic enteritis was observed with the water extract.

Although the extracts were given intraperitoneally, the main effects were found in the intestines. The toxic principle and/or its metabolite are probably excreted in the bile to cause irritation in the intestine. Coetzer and Pieterse (1971, 1972) found that the toxic principles of L.burchelli hydrolysed to a third compound which had toxic effects comparable to the parent compounds.

The fact that it causes haemorrhagic gastroenteritis even when given parenterally the toxic principle resembles arsenic in its action. It is of interest that it was suggested that minute doses of Lasiosiphon roots could be substituted with advantage for arsenic (Fowlers' solution) or for a lotion for the throat in place of lunar caustic (Alexander 1928; Wood 1902). It is also of interest that ethanol extracts the toxic principle. This raises the question whether it is the toxic principle which is of value in the treatment of leprosy (Tubery 1971) and how safe it is to use the ethanol extract for this purpose.

SUMMARY

The toxicity of ether, chloroform, ethanol and water extracts of Lasiosiphon kraussianus were examined by intraperitoneal injection in mice. All the extracts were toxic. The LD_{50} for mice in mg/kg was 6.2, 9.5, 37.4 and 468.0 for ether, chloroform, ethanol and water extracts, respectively. The typical lesions of haemorrhagic enteritis observed in the feeding experiments in domestic animals with L.kraussianus leaves were also observed with ether, chloroform and ethanol extracts while water extract caused non-haemorrhagic enteritis. The main lesions were found in the intestinal lumen, even though the extracts were given intraperitoneally.

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Table 1: Results of the toxicity test on mice with ether, chloroform, ethanol and water extracts of Lasiosiphon kraussianus (Meisn.)

Extract	Group	Dose mg/kg	Dead	Survived	LD_{50} mg/kg
Ether	1	10.2	10	0	
	2	6.4	7	3	
	3	5.2	5	5	6.2
	4	4.0	0	10	
Control	5	DMSO 7g/kg	0	10	
Chloroform	1	16.2	10	0	
	2	10.2	9	1	9.5
	3	6.4	7	3	
	4	5.2	4	6	
	5	4.0	0	10	
Control	6	DMSO 7g/kg	0	10	
Ethanol	1	51.2	10	0	
	2	46.1	7	3	
	3	38.4	7	3	37.4
	4	35.2	5	5	
	5	32.0	1	9	
	6	16.0	0	10	
Control	7	0.3ml H_2O	0	10	
Water	1	800	10	0	
	2	500	5	5	
	3	312.5	2	8	468.0
	4	200	0	10	
Control	5	0.3ml H_2O	0	10	

SECTION 6

ISOLATION AND IDENTIFICATION OF THE TOXIC PRINCIPLES OF *LASIOSIPHON KRAUSSIANUS* (MEISN.)

6.1. INTRODUCTION

Although the plant Lasiosiphon kraussianus has been reported to be highly toxic to livestock (Dalziel 1910, 1955; Phillips 1917; Watt and Breyer-Brandwijk 1962), no investigation has been reported on the toxic principles. It is, however, known to contain an irritant poison. Other poisonous species of Thymelaeaceae are also reported to contain irritant toxins and some chemical studies have been done on them. In 1911 Rogerson examined the roots of L.meisnerianus. He isolated a tanin, sugar, a phytosterol and an amorphous resin to which its acrid properties were attributed. The toxic principle of L.kraussianus has been suspected of being the same compound as mezerein, one of the toxic principles found in Daphne mezereum (Quarre and Mols 1945). Recently the structure of mezerein ($C_{38}H_{38}O_{10}$) and daphnetoxin (a second toxic principle of Daphne mezereum, $C_{27}H_{30}O_8$) were determined (Roland and Wickberg 1970; Stout et al. 1970). Coetzer and Pieterse (1971, 1972) and Pieterse (1970) reported isolating from L.burchelli two toxic principles ($C_{34}H_{34}O_{10}$ and $C_{36}H_{36}O_{10}$) both of which hydrolysed to a common residue, 12-hydroxy-daphnetoxin ($C_{27}H_{30}O_9$). Coumarin compounds have also been isolated from Daphne, Lasiosiphon and Edgeworthia species of the Thymelaeaceae (Bhattacharya and Das 1971; Tschesche et al. 1963; Majunder et al. 1974).

The present study was undertaken to isolate and identify the toxic principles of Lasiosiphon kraussianus.

6.2. MATERIALS AND METHODS

6.2.1. Extraction

Four hundred and fifty grammes of dried ground leaves of Lasiosiphon kraussianus were extracted continuously with ether in a soxhlet extractor for 24 hours. The ether was evaporated in vacuo in a rotary evaporator. The extract was redissolved in ether and extracted successively with 5% HCl and 5% NaOH. The acid and the base extracts were neutralized with $NaHCO_3$ and HCl, respectively, and extracted with ether. The residue after acid and base extraction constituted the neutral fraction. The fractions were tested for toxicity in adult white mice.

6.2.2. Column Chromatography

One gramme of the neutral fraction was dissolved in hexane and chromatographed on a column of silica gel. It was eluted successively with hexane mixed with increasing concentrations (0%, 1%, 3%, 5%, 10%, 50% and 100%) of ethyl acetate and hexane mixed with 10% absolute ethanol. Fractions of 20ml each were

collected. The fractions were grouped into five according to their thin layer chromatography (TLC) characteristics and were tested for toxicity in adult white mice.

6.2.3. Thin Layer Chromatography

Thin layer chromatography of the neutral fraction was done on silica gel with fluorescent indicator. Development was with hexane-ethylacetate (1:1) and detection with ultraviolet (UV) light and fuming with iodine vapour. The toxic fractions from the column chromatography were combined and chromatographed on silica gel preparative layer plates. Chloroform was used as developing solvent. After development, the plates were air dried and developed again. This was repeated three times. When the neutral fraction was applied directly, the plates were developed four to five times for complete separation. The bands were scraped, ground and extracted with ether.

6.2.4. Toxicity Tests

The neutral and the base fractions were dissolved in dimethylsulfoxide (DMSO) and tested for toxicity in adult white mice of 20-30g bodyweight. Two mice were given 0.1g/kg of each extract intraperitoneally. Two control mice received the largest volume of DMSO used

(about 10g/kg) i.p. Toxicity tests on different fractions and bands separated from chromatography followed the same pattern. The amounts given were proportionate to the amounts extracted.

6.2.5. Spectral Measurements

Nuclear magnetic resonance (NMR) was measured with a nuclear resonance spectrophotometer.* About 3mg of sample dissolved in $CDCl_3$ was scanned 69 times. For UV-spectrum, the sample was dissolved in ethanol and measured with an ultraviolet-visible spectrophotometer.**

6.3. RESULTS

6.3.1. Extraction

Ether extraction of 450g L.kraussianus leaves yielded 20.28g of solid extract. No fraction could be extracted with acid while base extraction yielded 6.8g of soft black material. The neutral fraction amounted to 12.1g of yellowish green solid. Part of the neutral fraction precipitated out and was no longer soluble in ether. It constituted a grayish green substance amounting to 1g.

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* Varian XL-100-15 nuclear resonance spectrophotometer
Varian Aerograph, California, U.S.A.

** Perkin Elmer 202 Ultraviolet-visible spectrophotometer
Perkin Elmer, Norwalk, Connecticut, U.S.A.

6.3.2. Toxicity of Base and Neutral Fractions

The two mice which received 0.1g/kg of the neutral fraction had clinical signs of restlessness followed by depression and later convulsions and death within one hour. The two mice which received the base fraction had similar clinical signs but died after 12 hours. Necropsy revealed the typical lesions found in L.kraussianus poisoning: haemorrhages in the upper part of the intestines. The control mice had no signs and no deaths occurred.

Further work was done with the neutral fraction since it proved the more toxic of the two.

6.3.3. Column Chromatography of the Neutral Fraction

Many bands were visible on the column (Table 1). A white substance remained at the top of the column and was not soluble in any of the eluting solvents used. Two hundred and fifty fractions were collected. The results of the toxicity test in mice with the different fractions are given in Table 1. Fractions 71-205 were toxic; 146-185 were the most toxic; 186-250 caused no visible lesions. Fractions 116-185 were combined and extracted from DMSO into ether yielding 0.28g. This was chromatographed on preparative layer plates.

6.3.4. Thin Layer Chromatography

Thin layer chromatography of the neutral fraction showed seven spots. The R_f values and colours are listed in Table 2. When the neutral fraction was developed 4 to 5 times, 10 bands were visible. Preparative layer chromatography of the combined fractions 116 to 185 had 8 bands visible in UV light (Table 3).

Toxicity tests carried out on the bands revealed 6 and 7 as the most toxic (Table 4). Band 6 produced the same effects but was less potent. When the amounts were doubled, mice given bands 6 and 7 died within one hour and after 6 hours with band 8.

The amount extracted from band 7 was about 3mg of light green noncrystalline substance.

6.3.5. Spectral Measurements

NMR measurements of band 7 showed significant signals at 2.28, 2.64, 2.90, 3.68, 4.16, 5.00, 5.36, 5.64, 7.26(?), 7.52 p.p.m.

UV Spectrum: λ_{max}^{EtOH} 231 nm.

6.4. DISCUSSION

It was reported in the previous section that the toxic principle of L.kraussianus could be extracted in ether or chloroform. The results of the present study revealed that the major toxic principle is found in the neutral fraction. The base fraction was also toxic but less potent. The toxicity of the base fraction may be due to alkaline hydrolysis, during extraction, of the same toxic principles found in the neutral fraction. Coetzer and Pieterse (1972) and Pieterse (1970) showed that mild alkaline hydrolysis of either of the two toxic principles of L.burchelli led to a common residue, 12-hydroxy-daphnetoxin, which had toxic effects comparable to those of the parent compounds. Separation of the components of the neutral fraction of the extracts from L.kraussianus was achieved by a combination of column and preparative layer chromatography. However, satisfactory separation can also be obtained with preparative layer chromatography alone, if the plates are developed four to five times in chloroform. Comparison of the NMR spectrum of the most toxic component isolated from L.kraussianus with the spectrum of mezerein, daphnetoxin and 12-hydroxy-daphnetoxin (Rolan and Wickberg 1970; Coetzer and Pieterse 1971) shows it may have a similar structure.

L.kraussianus obviously contains two main toxic principles with similar effects. These are probably the same compounds isolated from L.burchelli (Coetzer and Pieterse 1971). The clinical signs and lesions found closely resembled those described for L.burchelli (Terblanche et al. 1966). Personal experience working with the plant confirmed the irritancy of the toxins as reported also for L.burchelli (Coetzer and Pieterse 1971) and other poisonous species of Thymelaeaceae (Marloth 1925; Kingsbury 1964). Even though most of the work was carried out in a fume cupboard, strong burning sensation of the lips and mouth and congestion of the nose was experienced that lasted for several hours.

Further work is required to determine the exact structure of the toxic principles of L.kraussianus.

SUMMARY

An investigation was carried out on the toxic principles of Lasiosiphon kraussianus. The main toxic principles were extracted in ether and found in the neutral fraction.

Column and preparative layer chromatography on silica gel with chloroform as the solvent were used to separate the fractions. Nuclear magnetic resonance spectrum of the most toxic component indicated that it may have a structure similar to the tricyclic diterpenes, mezerein, daphnetoxin and 12-hydroxy-daphnetoxin.

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Table 1: Toxicity test in mice of fractions collected from column chromatography of 1 g of the neutral fraction from ether extract of the leaves of Lasiosiphon kraussianus

Fraction	Colour	Amount extracted in g	Amount given in g/kg	Effect	Remarks
1-70	colourless	0.09	0.09	no effect	
71-115	yellow	0.24	0.24	died in 4 hours	typical lesions; haemorrhagic enteritis
116-145	dark green	0.32	0.32	died after 12 hours	typical lesions; haemorrhagic enteritis
146-185	yellow	0.06	0.06	died in 1 hour	typical lesions; haemorrhagic enteritis
186-250	yellow	0.14	0.14	died in 6 hours	no visible lesions
white substance	white	0.10	0.10	no effect	

Table 2: Thin layer chromatography of the neutral fraction from ether extracts of the leaves of the Lasiosiphon kraussianus: solvent Hexane-ethylacetate (1:1)

Spot	R_f(x100)	Colour
1	75	yellow
2	64	blue fluorescence
3	36	blue fluorescence
4	25	blue fluorescence
5	13	blue fluorescence
6	4	yellow
7	0	yellow

Table 3: Preparative layer chromatography of fractions 116-185 (combined) from ether extract of the leaves of Lasiosiphon kraussianus: solvent chloroform

Band	Visible colour	Fluorescence in UV light
1	colourless	blue
2	light yellow	blue
3	light yellow	blue
4	yellow	blue
5	yellow	blue
6	dark yellow	dark
7	dark yellow	dark
8	dark yellow	dark

Table 4: Toxicity test in mice of the bands separated from fractions 116-185 from ether extract of the leaves of Lasiosiphon kraussianus.

Band	Amount extracted in g	Amount given in g/kg	Effect	Remarks
1	0.05	0.05	none	
2	0.01	0.01	none	
3	0.08	0.08	none	
4	0.02	0.02	none	
5	0.02	0.02	none	
6	0.04	0.04	died after 12 hours	typical lesions; haemorrhagic enteritis
7	0.04	0.04	died in 4 hours	typical lesions; haemorrhagic enteritis
8	0.01	0.01	no effect	

CONCLUSIONS

1. Lasiosiphon kraussianus is a herbaceous perennial with yellow flowers and massive root system. It has irregular sclerenchymatous elements in the mesophyll. These accompany the veins and extend into and support the leaf margin.

2. The plant is poisonous to sheep, goats, donkeys and cattle, with the donkey being the most susceptible. It causes severe haemorrhagic gastroenteritis and haemorrhages and oedema of the gastrointestinal tract, brain, liver and myocardium. It also causes lymphopenia, eosinopenia and increase in blood urea nitrogen.

3. The toxic principles can be extracted in ether, chloroform and ethanol and can be separated by column and preparative layer chromatography. They are probably tricyclic diterpenes. Further work is required to determine the exact structures.

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APPENDIX

HAEMATOLOGICAL AND BIOCHEMICAL VALUES IN CATTLE FED THE LEAVES OF *LASIOSIPHON KRAUSSIANUS*

Table 1: Haematological values from a test cow (C1) fed the leaves of Lasiosiphon kraussianus

Test Cow	Day of Experiment	RBC 10^6/cu.mm	Hb g/100ml	PCV %	WBC Total Count $X10^3$/cu.mm	Band %	Segment %	Lymph %	Mono %	Eisono %
C1	-4	5.72	9.0	25.0	9.6	0.0	16.0	83.0	1.0	0.0
	0	6.81	10.8	29.0	10.2	2.0	20.0	73.0	1.0	4.0
	1	8.66	11.5	32.0	9.5	0.0	31.0	63.0	5.0	1.0
	2	6.22	11.3	31.5	4.1	3.0	71.0	23.0	2.0	0.0
	3	6.34	12.1	34.0	3.3	0.0	68.0	29.0	1.0	2.0
	4	5.20	10.1	26.0	3.3	0.0	58.0	41.0	0.0	1.0

Table 2: Haematological values from a test cow (C2) fed the leaves of Lasiosiphon kraussianus

Test Cow	Day of Experiment	RBC 10^6/cu.mm	Hb g/100ml	PCV %	WBC Total Count $X10^3$/cu.mm	Band %	Segment %	Lymph %	Mono %	Eisono %
C2	-4	8.36	11.2	27.0	14.2	1.0	25.0	70.0	1.0	3.0
	0	7.31	10.8	32.0	12.3	0.0	20.0	75.0	2.0	3.0
	1	7.89	10.0	27.0	13.2	0.0	43.0	55.0	2.0	0.0
	2	5.73	10.4	30.0	9.9	0.0	48.0	51.0	1.0	0.0
	3	6.69	11.9	31.0	9.5	0.0	70.0	28.0	2.0	0.0
	4	6.22	10.3	30.0	8.9	0.0	81.0	18.0	0.0	1.0

Table 3: Haematological values from a test cow (C3) fed leaves of Lasiosiphon kraussianus

Test Cow	Day of Experiment	RBC 10^6/cu.mm	Hb g/100ml	PCV %	WBC Total Count $X10^3$/cu.mm	Band %	Segment %	Lymph %	Mono %	Eisono %
C3	-4	8.95	12.4	36.0	13.9	4.0	27.0	63.0	2.0	4.0
	0	7.92	12.5	35.0	10.8	0.0	24.0	66.0	4.0	6.0
	1	5.72	13.2	36.0	8.6	2.0	21.0	68.0	6.0	3.0
	2	7.27	10.7	30.0	6.8	0.0	42.0	53.0	4.0	1.0
	3	7.50	12.0	34.0	5.6	0.0	43.0	56.0	0.0	1.0
	4	7.38	12.0	30.0	4.7	0.0	46.0	50.0	0.0	4.0

Table 4: Haematological values in the control cow fed ground grass hay

Day of Experiment	RBC 10^6/cu.mm	Hb g/100ml	PCV %	WBC Total Count 10^3/cu.mm	Band %	Segment %	Lympho-cytes %	Mono-cytes %	Eosino-phils %
-4*	5.80	9.0	27	9.5	0	18	79	2	1
0	6.71	9.8	28	10.9	0	16	82	2	0
1	6.20	9.4	28	8.8	0	31	66	2	1
2	5.70	8.7	25	8.4	0	26	70	1	3
3	5.39	9.6	26	9.5	0	18	81	0	1
4	5.72	9.0	25	9.6	0	16	83	1	0

Table 5: Biochemical values from a test cow (C1) fed the leaves of Lasiosiphon kraussianus

Test Cow	Day of Experiment	BUN mg/100ml	SGOT SF Units/ml	SGPT SF Units/ml	Alkaline Phosphatase Sigma Units/ml	Alkaline Phosphatase I.U./L	Total Protein g/100ml
C1	-4	8.7	16.0	11.0	1.0	16.7	6.7
	0	4.3	20.0	11.0	1.6	26.7	5.3
	1	7.8	62.0	18.0	2.5	40.9	8.2
	2	8.2	58.0	13.0	0.8	13.9	9.6
	3	30.4	40.0	9.0	0.7	11.7	8.5
	4	25.7	24.0	10.0	2.0	33.4	8.4

Table 6: Biochemical values from a test cow (C2) fed the leaves of Lasiosiphon kraussianus

Test Cow	Day of Experiment	BUN mg/100ml	SGOT SF Units/ml	SGPT SF Units/ml	Alkaline Phosphatase Sigma Units/ml	Alkaline Phosphatase I.U./L	Total Protein g/100ml
C2	-4	10.8	44.0	15.0	2.0	33.4	8.2
	0	13.0	12.0	13.0	1.0	15.9	7.5
	1	8.0	62.0	13.0	1.1	18.4	8.0
	2	20.3	32.0	18.0	1.1	18.4	6.9
	3	15.2	28.0	16.0	1.6	25.9	6.0
	4	25.3	86.0	20.0	2.2	35.9	9.6

Table 7: Biochemical values from a test cow (C3) fed the leaves of Lasiosiphon kraussianus

Test Cow	Day of Experiment	BUN mg/100ml	SGOT SF Units/ml	SGPT SF Units/ml	Alkaline Phosphatase Sigma Units/ml	Alkaline Phosphatase I.U./L	Total Protein g/100ml
C3	-4	7.8	74.0	18.0	3.0	49.3	8.6
	0	6.7	74.0	20.0	3.5	58.5	7.9
	1	11.9	18.0	20.0	2.5	41.8	6.4
	2	14.5	8.0	15.0	1.7	27.6	7.0
	3	18.7	36.0	18.0	1.5	20.1	5.4
	4	16.0	36.0	15.0	1.8	30.1	7.4

Table 8: Biochemical values from the control cow fed ground grass hay

Day of Experiment	BUN mg/100ml	SGOT SF Units/ml	SGPT SF Units/ml	Alkaline Phosphatase Sigma Units/ml	Alkaline Phosphatase I.U./L	Total Protein g/100ml
-4	8.0	58.0	16.0	1.2	20.0	6.5
0	9.4	62.0	17.0	0.9	15.0	7.5
1	9.0	100.0	18.0	0.8	13.4	8.8
2	5.8	52.0	20.0	1.1	18.4	6.6
3	6.7	44.0	15.0	1.8	30.1	6.4
4	8.6	56.0	21.0	1.0	16.7	6.7

TOXICOLOGICAL INVESTIGATIONS OF *LASIOSIPHON KRAUSSIANUS* (MEISN.)

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Only few cases of plant poisoning in livestock have been reported in Nigeria even though conditions which favour poisoning are prevalent. Information on indigenous poisonous plants are also lacking. As a result of inquiries among herdsmen, Lasiosiphon kraussianus, the plant most often incriminated in livestock poisoning was selected for this study. The objectives were to determine: the botanical characteristics; the toxicity; and toxic principles of L.kraussianus.

A review of 60 species of poisonous or suspected poisonous plants in Nigeria was included.

L.kraussianus, a herbaceous perennial, 25-35cm high with alternate, lanceolate leaves, 40-80 yellow flowers in terminal bracteate heads and a thick woody rhizome, is found in savannah and neighbouring forest areas of Nigeria. The vascular bundles of the vein are accompanied by sclerenchymatous elements which extend into and support the leaf margins. Phloem fibres have silken thread appearance in transverse section. The pith of the stem is composed of lignified and unlignified cells.

An investigation was carried out on the toxicity of L.kraussianus in sheep, goats, donkeys, and cattle. Four sheep, four goats and three donkeys were fed ground dried leaves of

L.kraussianus via stomach tube. Sheep were fed 3.3g/kg/day for nine days, goats and donkeys received 4.0g/kg/day for nine and two days, respectively; six cows were fed 8.0g/kg/day (equivalent of 2.8g/kg/day of dried plant material) of fresh leaves and stem tips of L.kraussianus via ruminal fistula for nine days. All test animals had clinical signs of intoxication which included depression, anorexia, nasal and ocular discharges, and dysentery. None of the sheep died while two goats and all the donkeys and cows died. Necropsy findings included severe haemorrhagic enteritis, extensive ulceration and haemorrhages in the gastrointestinal tract, petechial and ecchymotic haemorrhages on the epicardium and endocardium, and congestion of the brain. Histological findings included massive infiltration of lymphocytes in the lamina propria of the gastrointestinal mucosa, oedema and congestion of the gastrointestinal tract, brain, liver and myocardium.

Haematological and biochemical examinations were carried out on three cows fed fresh leaves of L.kraussianus. This resulted in lymphopenia, a relative neutrophilia, and an increase in blood urea nitrogen but no changes in serum glutamic oxalacetic transaminase, serum glutamic pyruvic transaminase or alkaline phosphatase values.

The toxicity of ether, chloroform, ethanol and water extracts of L.kraussianus were examined by intraperitoneal injection in mice. All the extracts were toxic. The LD_{50} for mice in mg/kg was 6.2, 9.4, 37.4 and 468.0 for ether, chloroform, ethanol and water extracts, respectively. The typical lesions of haemorrhagic enteritis observed in the feeding experiments in domestic animals with L.kraussianus leaves were also observed with ether, chloroform and ethanol extracts while water extract caused non-haemorrhagic enteritis. The main lesions were found in the intestinal lumen even though the extracts were given intraperitoneally.

An investigation on the toxic principle of L.kraussianus revealed that the main toxic principles were extracted in ether and found in the neutral fraction. Column and preparative layer chromatography on silica gel with chloroform as the solvent were used to separate the fractions. Nuclear magnetic resonance spectrum of the most toxic component indicated that it may have a similar structure as the tricyclic diterpenes, mezereine, daphnetoxin and 12-hydroxydaphnetoxin.

It was concluded that:

1. L.kraussianus has in its mesophyll irregular sclerenchymatous elements which accompany the veins and extend into and support the leaf margin.

2. L.kraussianus is poisonous to sheep, goats, donkeys and cattle, with the donkey being the most susceptible. It causes severe haemorrhagic gastroenteritis and haemorrhages, congestion and oedema of the gastrointestinal tract, brain, liver and myocardium. It also causes lymphopenia, eosinopenia and increase in blood urea nitrogen. L.kraussianus is more toxic at the beginning of the rainy season than during the dry season.

3. The toxic principles can be extracted in ether, chloroform and ethanol and can be separated by column and preparative layer chromatography. They are probably tricyclic diterpenes. Further work is required to determine the exact structures.