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A survey of toxic plants on the market in the district of Bamako, Mali: traditional knowledge compared with a literature search of modern pharmacology and toxicology

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In Mali, the empirical knowledge on plant medicine is held by traditional practioners. Scientific studies have been carried on some plants and they have confirmed their local uses, but few data are available on the toxicity of Malian medicinal plants. In the present work, we record the toxic plants used as medicines in the Bamako district, Mali, with the aim to evaluate the knowledge of traditional healers and herbalists on the toxicity of the plant used. A survey was carried out on the market places in the Bamako district and 106 healers and herbalists were interviewed. A survey of the scientific literature was conducted to verify or sustain the claimed toxicological data. Nineteen plants are arranged according to their frequency of quotation based on the questionnaire. The information includes the botanical name, literature survey on the pharmacology of the plants, the healers' knowledge on plant toxicity and its prevention by some of the healers.

The survey was carried out in Mali on the market places of the Bamako district. The persons included are healers and herbalists that consented to participate. An individual interview was performed and the following questions were asked:

1. What plants do they consider that one should be aware of because of the risk on human health?
2. What diseases do they treat with the plants?
3. How do they prepare the medicine?
4. Which are the toxicity signs?
5. What type of use leads to harmful effect?
6. How can one prevent these risks?

A literature research was carried out for all the plants detected to be in use within the database of the library of the University of Oslo, Norway. These are ISI-Science Citation Index, BIBYS, OVID web, Biological abstracts/WebSPIRS and Scifinder.

Totally106 healers were interviewed. The plants are arranged according to the frequency that the healers reported toxic effect of the plant. The information includes the botanical name, literature survey on pharmacology and toxicology of the plant. The knowledge the healer had on plant toxicity, the plant part used, the number of healers using the plant and how to prevent the toxic effect and the names of the plants in Bambara (the main Malian language) are given in Table 1. Below we describe the result of the literature survey for each plant that shows toxic effects.

Toxic plants used on the markets in the Bamako districts, and plants used as antidot

Botanical name (family)	Local name in Bam bara	Plant part used	Number of healers reported toxic effect	Traditional uses against	Toxic signs reported by the healers	Remedies used against toxic effects
Swartzia madagascariensis Desv (Caesalpiniaceae) 12090	sama kara	Root s	39	Malaria, jaundice, gastric ulcer and as an insecticide	Diarrhoea, vomiting	Porridge of *Pennisetum typhoideum* Rich., Graminaceae
Cassia sieberiana DC. (Caesalpiniaceae) 02680	sinjan	Root s	23	Abdominal pains, malaria, jaundice headache, gonorrhoea	Diarrhoea, vomiting	Decoction of the leaves of *Lannea velutina* A.Rich., Anacardiaceae
Trichilia roka Chiov. (Meliaceae) 12570	sulafi nzan	Leav es, roots	21	Haemorrhoids, fever malaria, wounds	Diarrhoea, vomiting	Decoction of leaves of *Euphorbia hirta* L., Euphorbiaceae, and *Guiera senegalensis* J.F.Gmel, Combretceae
Securidaca longepedonculata Fresen. (Polygalaceae) 11290	djoro	Root s	20	Haemorrhoids, dermatitis, snake bite, abdominal pains headache	Diarrhoea, vomiting	Decoction of leaves of *Guiera senegalensis* J.F.Gmel, Combretaceae
Cassia alata L. (Cesalpiniaceae) 02560	konta ba	Fruits , leave s	17	Malaria, constipation	Diarrhoea	Decoction of leaves of *Afrormosia laxiflora* (Benth. Ex Baker) Harms, Fabaceae and *Euphorbia hirta* L., Euphorbiaceae,
Anogeissus leiocarpus DC. Guill. & Perr. (Combretaceae) 01290	N'gal ama	Leav es	13	Malaria, wound, constipation	salivation, nausea, vomiting	Decoction of leaves of *Guiera senegalensis* J.F.Gmel, Combretaceae
Entada africana Guill. & Perr. (Mimosaceae)	Sama nere	Root s	12	Malaria, jaundice	Vomiting	Decoction of leaves of *Afrormosia laxiflora* (Benth. Ex Baker) Harms, Fabaceae
Gardenia ternifolia, Schumach. & Thonn. (Rubiaceae) 06120	M'bo urétié	Root s	10	Malaria, jaundice	Diarrhoea, vomiting	decoction of leaves of *Euphorbia hirta* L., Euphorbiaceae and *Burkea Africana* Hook, Fabaceae
Acacia senegal L. (Mimosaceae) 00260	Patou kou	Root s	10	Sexual diseases, haemorrhoids	diarrhoea, abdominal pains, vomitng	decoction of leaves of *Guiera senegalensis* J.F.Gmel, Combretaceae
Opilia celtidifolia Guill. & Perr. Endl. (Opiliaceae) 09240	Korog ué	Leav es, roots	8	Malaria, abdominal pain, constipation	diarrhoea, trembling, vomiting	decoction of *Combretum micranthum* G.Don, Combretaceae
Ximenia america L. (Olacaceae) 13140	N'ton gue	leave s, roots	7	bilharzia, throat infection	Salivation	decoction of leaves of *Afrormosia laxiflora* (Benth. Ex Baker) Harms, Fabaceae
Pteleopsis suberosa Eng.& Diels (Combretaceae) 10570	N'tere ni	Fiber	7	Cough, wound, gastric ulcer	Nausea, vomiting	decoction of leaves of *Guiera senegalensis* J.F.Gmel, Combretaceae
Acacia nilotica L. Willd. Ex Del. var. nilotica (Mimosaceae) 00190	N'gun a	Stem bark	7	gastric ulcer	abdominal pains, salivation, nausea, vomiting,	*Pennisetum typhoideum* Rich, Graminaceae

Khaya senegalensis, A.Juss (Meliaceae) 07650	Diala	stem bark, root bark	6	Malaria, abdominal pains	diarrhoea, nausea, vomiting	decoction of leaves of *Combretum micranthum*
Nauclea latifolia Sm. (Rubiaceae)	Baro	Roots	6	Malaria, abdominal pains	Vomiting	Stem bark of *Sclerocarya birrea* (A.Rich.) Hochst., Anacardiaceae
Vernonia colorata Willd. Drake (Compositeae)	Kosafunè	Leaves	6	Malaria, wound healing	Vomiting	Macerate of fruit of *Gardenia ternifolia* Schumacher & Thonn., Rubiaceae
Daniella oliveri (Rolfe) Hutch. & Dalz. (Cesalpiniaceae)	Sana	Leaves	5	Headache, fever, abdominal, pains		
Mitragyna inermis (De Willd.) O Kuntze (Rubiaceae)	Djou	Leaves	5	Malaria	Vomiting	decoction of leaves of *Vitex doniana* Sweet, Verbenaceae
Vernonia kotschyana Sch. Bip ex Walp. (Asterceae)	Bouaye	Tuber	5	Gastric ulcer	Abdominal pains, nausea	Decoction of leaves of *Cassia siberiana* D.C., Fabaceae

3.1. *Swartzia madagascariensis* Desvaux (Caesalpiniaceae)

3.1.1. Traditional use as a toxic plant

The fruits and seeds are the classic additives to larva arrow poison in some African countries (Namibia, Botswana and Ivory Coast) and outside Africa, *Swartzia servicea*, *Swartzia schultesii*, *Swartzia pendula* and *Swartzia auriculata* are also used for fish poisoning (Columbia and Brazil (Neuwinger, 1996).

3.1.2. Biological activities and toxicity

Molluscidal properties have been found in extracts of root (Hostettman, 1995, Hostettman and Wolfender, 1997, Neuwinger, 1996 and Suter et al., 1986). Anti-microbial diterpenes have been isolated from the root; they are active against *Candida*, *Aspergillus* and *Staphylococcus* and are especially useful against *Onychomycosis* (Hostettman and Schaller, 1999). The crude extract of the fruit pod is highly toxic against the mosquito larva *Anopheles gambia*, vector of falciparum malaria and *Bancroft filaris* (*Wucherreria bancrofti*).
Both the root and fruit are said to be toxic for the fish *Carassius auratus*. The seeds are strongly haemolytic and the petroleum extract of root is strongly cytotoxic.
Medicarpine, an isoflavonoid isolated from *Swartzia madagascariensis* is toxic for animal systems. It causes rapid haemolysis of human and animal red blood cells (Neuwinger, 1996).

3.2. *Cassia sieberiana* DC. (Caesalpiniaceae)

Synonym: *Cassia kotchyana* Oliv.

3.2.1. Traditional use as a toxic plant

The roots are used as part of the arrow poison used in the south-west Niger; the fruit are used as fishing poison in Nigeria and Ivory Coast. *Cassia mimosoïdes* and *Cassia italitica* are also widely used as fishing poison (Neuwinger, 1996).

3.2.2. Biological activity and toxicology

The aerial have virucidal activity against a clinical strain of *Herpes simplex* virus type I (SHV-1) and African swine fever virus (ASFV) (Silva et al., 1997). The leaves and the roots have a purgative effect attributed to their content of anthraquinones. Neuwinger (1996) reports that "because of their large amount of flavonoids they (the roots author's addition) are diuretic, anti-inflammatory, anti-bacterial and anti-diarrhoeal". Quercitrin in particular was reported to be responsible for anti-diarrhoeic activity. Flavonoids from *Cassia sieberiana* increased the bile secretion in the liver and showed marked spasmolytic effects in animal experiments. Ripe fruit shows weak insecticidal activity and the aqueous root extract shows mild anti-bacterial effect (Neuwinger, 1996). A heterogeneous tannin extract inhibits tumour promoter-stimulated ornithine decarboxylase activity, DNA synthesis, hydro peroxide production and oedema formation (Perchellet et al., 1996).
The root is said to be toxic in larger doses. *Cassia* species proved to exhibit acute toxicity. Sheep that are fed with Cassia leaves died between 8 h and several days. The autopsy showed haemorrhagic gastroenteritis; the lungs, kidneys and the liver were congested. The ethanol extract of leafy twigs of Indian *Cassia* species, *Cassia fistula* and *Cassia emarginata*, caused in mice after intraperitoneal administration, ataxia, tremor and clonic convulsions (Neuwinger, 1996).

3.3. *Trichilia roka* Chiov. (Meliaceae)

Synononym: *Trichilia emetica* Vahl.

3.3.1. Traditional use as a toxic plant

According to Burkill (1985–2000) the residue after extraction of oil from the seed is an emetic and probably poisonous, but the latter effect is doubted. In Ghana, it is reported to be taken as an antidote to poisoning to cause emesis.

3.3.2. Biological activity and toxicology

The root decoction showed a significant protective action on carbon tetrachloride-induced liver damage in rats (Germano et al., 2001) and a significant reduction of body temperature on yeast-induced hyperthermia in rats (Sanogo et al., 2001). Gunatilaka et al. (1998) showed that some constituents of the stem bark had selective toxicity towards DNA repair-deficient yeast. The aqueous extract of the bark was lethal at 6.25 mg/ml to schistosomula of the species *Schistosoma haematobium* (Sparg et al., 2000).
The seeds are both emetic and purgative and were stated to be toxic to stock. Cake made from the whole seed is extremely toxic (Watt and Breyer-Brandwijk, 1962).

3.4. *Securidaca longepedonculata* Fresen. (Polygalaceae)

3.4.1. Traditional uses as a toxic plant

The stem bark of *Securidaca longepedonculata* is an ingredient in some African arrow poisons (northern Nigeria, south Zambia and Zimbabwe). The roots are used as a fishing poison in Angola. In south Zaire, Angola and Zambia, the peeled root or the root pulp is a wide spread suicide poison used by the women. *Securidaca longepedonculata* is also an ordeal poison in the Central African Republic, in Cameroon and Nigeria. The root is used to commit suicide (Neuwinger, 1996).

3.4.2. Biological activity and toxicology

The methanol extract of the root produced an inhibition of the carrageenan-induced rat paw oedema, an inhibition of writhings induced by acetic acid in mice, a complete protection against leptazol-induced convulsion and a potentialisation of the phenobarbitone sleeping time in mice (Olajide et al., 1998). It showed spasmodic actions on the gastrointestinal tract of laboratory animals. An increase of the propulsive movements of the intestinal contents as well as a reduction in gastric emptying time was also produced. The number of wet faeces was increased in rats after the oral administration. On isolated guinea-pig ileum the extract evoked

contractions, which were blocked by atropine. At high dose, the extract produced ulcerations on gastric mucosa and small intestine (Olajide et al., 1998).
The crude ethanol extract of the stem bark has a fatal dose for rats of 50 mg/kg. The animals died after 24 h (Neuwinger, 1996).
Several compounds with biological activities have been isolated
Securidine (a securinega alkaloid) had a stimulating effect on the spinal cord. It influenced the function of the autonomic nervous system using a non-toxic dose, raised muscle tonus, stimulated respiration, strengthened cardiac contracture and raised the blood pressure. In the range 5–30 g/kg, it acted like strychnine, causing spasms and death by respiratory arrest. It acts upon the spinal cord causing an enhancement of the reflex activity and an increase in the muscular tone in animals; it also influences the function of the autonomic nervous system. In toxic doses, it induces powerful tonic convulsions. The toxic dosage-causing convulsion is very close to that causing death. Most of the animals died during the convulsions due to respiratory arrest (Neuwinger, 1996). Securinine, another alkaloid, was found to possess anti-malarial activity in vitro against the malaria parasite *Plasmodium falciparum* with IC_{50} = 5.35 µg/ml.
There is in the roots a protein, which is similar to but less toxic than snake venom and prevents its effect on the receptors (Neuwinger, 1996).
Elymoclavine, isolated from the roots, belongs to the central “excitor group” of the ergot alkaloids and is the most active stimulant in this group, which causes central stimulation. It will also cause central stimulatory syndromes consisting of sympathetic excitation. In various animal species, it produces characteristic symptoms like hyperpnoea, mydriasis, increased spontaneous activity and anxiety similar to those produced by lysergic acid diethylamide (LSD). Dihydroelymoclavine generally converts excitation to depression and belongs to the “inhibitor group”.
3,4,5-tri-*O*-caffeoylquinic and 4,5-di-*O*-caffeeoylquinic acids are selective inhibitors of HIV (human immunodeficiency virus) and SIV (simian immunodeficiency virus) infection of T_4 lymphocyte in culture.

3.5. *Cassia alata* Linn. (Caesalpiniaceae)

No traditional use as a toxic plant is reported in the literature.

3.5.1. Biologcal activity and toxicology

Villasenor et al. (2002) studied bioactivity of the leaf extract and found that a hexane extract showed analgesic activity. It reduced the number of squirms induced by acetic acid. Both hexane and EtOAc extracts exhibited anti-inflammatory activity in carrageenan-induced inflammation. The chloroform extract was anti-mutagenic at a dosage of 2 mg/20 g mouse with 65.8% inhibition in the mutagenicity of tetracycline. It was also the most active against the pathogenic fungus *Trichophyton mentagrophytes*, at a concentration of 50 mg/ml. The hexane and EtOAc showed anti-microbial activity against both *Candida albicans* and *Trichophyton mentagrophytes* (Ibrahim and Osman, 1995). It was also hypoglycaemic at a dose of 5 mg/20 g mouse. All the extracts of the leaves caused a decrease in motoric activity, nophthalmus, hyperaemia, micturition and diarrhoea. At the dose of 150 mg/20 g mouse, the EtOAc extract caused paralysis, screen grip loss and enophthalmus accompanied by dropping and closure of the eyelids.
The effect of an aqueous leaf extract on haematological indices in albino rat was studied by Sodipo et al. (1998). Significant dose-dependance decreases in the levels of haemoglobin (Hb) and erythrocyte count ($P < 0.05$) were observed. In addition, increased packed cell volume (PCV), mean corpuscular volume (HCV) and mean corpuscular haemoglobin concentration (MCHC) were also observed.
Ethanol/water extract of the aerial part when administrated to mice intraperitoneally showed a LD_{50} of l gm/kg (Ross, 1999). The ethanol extract and compounds isolated from *Senna alata* caused subtle hepatorenal toxicity in rata (Yagi et al., 1998).

3.6. *Anogeissus leiocarpus* (DC.) Guill. & Perr. (Combretaceae)

No traditional use as a toxic plant is reported in the literature.

3.6.1. Biologcal activity and toxicology

The aqueous extract from wooden chewing sticks showed potent anti-bacterial activities against a wide spectrum of bacteria including methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococcus* and multidrug-resistant *Burkholderia cepacia* and *Pseudomonas aeruginosa* (Oluronke et al., 1999).
The methanol extracts produced an inhibitory action against the clinically isolated bacterial strains *Haemophilus influenzae, Streptococcus pyogenes, Staphylococcus aureus,*

Staphylococcus pneumoniae and *Moraxella catarrhalis*, all responsible for respiratory infections (Sanogo et al., 1998a).

3.7. *Entada africana* Guill. & Perr. (Mimosaceae)

Synonym: *Entada sudanica* Schweinf.

3.7.1. Traditional use as a toxic plant

The seeds have been used as a fish poison in South Africa, in the Philippines, in Indochina and in India and has also been used as an emetic (Watt and Breyer-Brandwijk, 1962).
The leaves are used as an emetic, administrated as an antidote in food poisoning and as an abortifacient (Burkill, 1985–2000).

3.7.2. Biological activity and toxicology

According to Burkill (1985–2000), the plant contains toxic substances. The leaves contain rotenone and tannins, whose presence explains their piscicidal property. The toxicity, however, does not appear to be quick acting, causing a slowing down of swimming, leading to paralysis and then death. The seeds in quantity is also said to be poisonous. An alkaloid called paucin is also present and this has abortive properties.
The 40% ethanol extract showed anti-microbial activity against *Vibrio cholerae* (Akinsinde and Olukoya, 1995 and Silva et al., 1996). The methanol extract of the root showed anti-oxidant and radical scavenger activities (Diallo, 2000).
The root decoction significantly reduced bronchoconstriction induced by histamine and provoked a bronchodilatation response (Occhiuto et al., 1999). Certain fractions also showed anti-hepatotoxic properties (Sanogo et al., 1998a and Sanogo et al., 1998b). The bark presents a strong inhibition of tyrosinase (Baurin et al., 2002).

3.8. *Gardenia ternifolia* Schumach. & Thonn. (Rubiaceae)

3.8.1. Traditional use as a toxic plant

The leaves are associated with the arrow poison used in Senegal and the root associated to those of *Pennisetum glaucum* is a criminal poison. In Ivory Coast, the leaves are put in baths and lotions against arrow-poisoning. The leaves are put into arrow-poison formulations used in Senegal (Burkill, 1985–2000). Other species of *Gardenia* are used as fishing poison (Neuwinger, 1996).

3.8.2. Biological activities and toxicology

The methanolic leaf extract is active against malaria (Neuwinger, 1996).
Gardenia fruit is reported to have an inhibitory effect on platelet aggregation.
The root decoction has anti-microbial activity against *Staphylococcus aureus, Streptococcus faecalis, Vibrio cholerae* and *Shigella dysenteriae*. Saponins of *Gardenia jovis-tonantis* exhibited sedative, analgesic, mild diuretic and transient hypotensive activities. *Gardenia erubescent* and a species from Nigeria, *Gardenia lutea*, show molluscidal activities (Ahmed et al., 1985).
Geniposide, an iroid glycoside, and another iridoid glycoside of the fruit of *Gardenia spp* were found to cause diarrhoea in mice through oral administration. This glycoside causes a propulsive action in the large intestine. Genipin, a hydrolysate of geniposide, act as a propulsive agent in the large intestine (Yamaushi et al., 1976).
The fruit is used as fish poison. Tests for lethal action on fresh water snails *Bulinus* and *Biomphalaria* gave 100% mortality at a concentration of 100 ppm.

3.9. *Acacia senegal* L. (Mimosaceae)

No traditional use as a toxic plant is reported in the literature
Acacia senegal has been mainly studied for the commercial value of the gums the plant produces. The gums are used as thickener and emulsifier in food production. Literature lacks information on their biological activities. The gum is used as a dysentery remedy in Senegal and it is used against nodular leprosy inflammations in Nigeria (Watt and Breyer-Brandwijk, 1962).

3.10. *Opilia celtidifolia* (Guill. & Perr.) Endl. ex Walp (Opiliaceae)

No traditional use as a toxic plant is reported in the literature.

3.10.1. Biological activity and toxicology

A saponin fraction of a methanol extracts of the stem bark was studied by Shihata et al. (1977). It seems to possess the following properties: intestinal anti-spasmodic, uterine stimulant, hypotensive and depression of the coronary outflow, but has no effect on renal outflow. It activated to a great extent the activities of certain dog parasites (*Taenia pisiformis* and *Toxoscaris leonani*). It produced a fall in the blood pressure and an increase in respiratory rate. The drug also inhibited the cardiac contraction. Its effect on the uterine musculature differs; it stimulated the non-pregnant uterus to a great extent, while the pregnant uterus was affected only slightly.

3.11. *Ximenia americana* L. (Olacaceae)

No traditional use as a toxic plant is reported in the literature.

3.11.1.1. Biologcal acitity and toxicology

The crude extract of the root showed an anti-bacterial activity against *Staphylococcus aureus*. Polymeric proanthocyanidin, gallic acid and 3-*O*-galloylepicatechin are present in the stem and leaf decoction (Mwangi et al., 1994). Extracts prepared as infusion and decoction exhibit anti-malarial activity both on chloroquine-sensitive strain and chloroquinine-resistant strain of *Plasmodium falciparum* (Benoit-Viscal et al., 1996).
In Tanganyika, the plant has figured in homicidal cases. The leaf is thought to be strongly cyanogenic. The kernel is thought to be rich in hydrocyanic acid, but toxicity has not been proven (Watt and Breyer-Brandwijk, 1962).

3.12. *Ptelopsis suberosa* Eng. & Diels (Combretaceae)

No traditional use as a toxic plant is reported in the literature.

3.12.1. Biological activity and toxicology

The aqueous extract of the stem bark and shoots showed fungicidal and fungistatic effects on certain dermatophytes and *Candida albicans* (Baba-Moussa et al., 1999). The aqueous extract of the bark decoction protected gastric mucosa against ethanol and indomethacin-induced gastric lesion (De Pasquale et al., 1995). On citric acid-induced cough in guinea-pig, the same extract significantly decreased the number of coughs at the dose of 250 mg/kg similar to codeine of 10 mg/kg (Olajide et al., 1999).

3.13. *Acacia nilotica* L. Willd. Ex Del. var. nilotica (Mimosaceae)

No traditional use as a toxic plant is reported in the literature.

3.13.1. Biological activity and toxicology

The acetone, alcohol and aqueous extracts of fruits showed molluscicidal activity against *Billinus truncates* and *Biomphalaria pfeifferi* (Hussein Ayoub, 1982). The water extracts of the dried powdered fruit showed anti-microbial activity against Gram-positive and Gram-negative bacteria and *Candida albicans* (Abd el Nabi et al., 1992). The water, ethanol, chloroform and *n*-hexane extracts of the dried powdered fruit have anti-microbial activity. The extracts were more effective against Gram-positive cocci than Gram-negative bacilli. The anti-fungal activity of the fruit extract against *Candida albicans* was found in the *n*-hexane extract (Mustafa et al., 1999). The methanol extracts of bark and pods and the aqueous extracts of pods showed considerable inhibitory effect against HIV-1 protease (Hussein et al., 1999). The aqueous extract of *Acacia nilotica* has an inhibitory effect on carrageen-induced paw oedema and yeast-induced pyrexia in rat. It also produced a significant increase in the hot plate reaction time in mice (Dafallah and al-Mustafa, 1996). Methanol extract of pods exhibits anti-hypertensive and anti-spasmodic actions (Gilani et al., 1999).
The methanol extract of the seed exerted high activity on the malaria parasite *Plasmodium falciparum*. The ethyl acetate extract possessed the highest anti-plasmodial activity. The effect of the plant extract on lymphocyte proliferation showed low toxicity to the human cells (El-Tahir et al., 1999).
The intravenous administration of the aqueous extract of the seeds produced dose-related elevation of arterial blood pressure of anaesthetized normotensive cats (Amos et al., 1999).

3.14. *Khaya senegalensis* A.Juss (Meliaceae)

3.14.1. Traditional use as a toxic plant

The stem bark of *Khaya senegalensis* is one of the ingredients of the arrow poison in the Banfora region of Burkina Faso. The stem bark together with that of *Securidaca longepedonculata* is an ordeal poison in the north-west of Nigeria. The stem bark is used as a fishing poison in Ivory Coast (Neuwinger, 1996).

3.14.2. Biological activity and toxicology

The alcoholic extract of the stem bark of *Khaya* species (2 g/kg) caused depression, sedation and reduced locomotor activity in mice, and also protected 70% of mice against leptazol-induced convulsion (Adesina, 1983).
The methanol extract of stem bark exhibited a significant anti-bacterial activity against *Pseudomonas aeruginosa* and leishmanicidal activity against *Leishmania donovani* (Abreu et al., 1999). The methanol extract of the stem bark also showed a dual agonist action on smooth muscle of rat bladder. At concentrations lower than 1×10^{-5} g/ml the extract produced a dose-dependant relaxation of the rat bladder while greater concentrations produced a dose-dependant contraction. The relaxation was mediated by stimulation of adrenergic receptors and also by depression of the bladder by a direct action (Olayinka et al., 1994). The methanolic stem bark extracts increase the rate and force of contraction of isolated rabbit atria. The vasoconstrictor effect observed with isolated spiral strips of rabbits is dose dependant (Olayinka et al., 1992). The petroleum ether and chloroform extracts of stem bark showed dose dependent inhibitory effects on croton oil-induced mice ear oedema (Lompo et al., 1998). The aqueous extracts of the barks and leaves exhibited a strong anti-sickling activity.

3.15. Nauclea latifolia Sm. (Rubiaceae)

3.15.1. Traditional use a toxic plant

Root and/or stem bark as ingredients of the senufo arrow poison in the north of Ivory Coast and the south-west part of Burkina Faso. In Nigeria and Guinea, the plant is used as arrow poison (Neuwinger, 1996).

3.15.2. Biologcal activity and toxicology

The phenolic fraction of the decoction of the leaves inhibited the growth of *Entamoeba histolitica*, and the root bark extract showed a spasmolytic activity (Tona et al., 1999). The alkaloid rich extract showed anti-proliferative activity on human monocytes (Traore-Keita et al., 2000). The bark has proved to be effective in experimental bird malaria but is toxic (Watt and Breyer-Brandwijk, 1962).

3.16. *Vernonia colorata* (Willd.) Drake (Asteracaea)

3.16.1. Traditonal use as a toxic plant

The *Vernonia species* are used as arrow poison by the ndorobo hunters of the western part of the foot of Mont Kilimanyaro in Tanzania and as fish poison in Gabon and Mozambique (Neuwinger, 1996).

3.16.2. Biological activity and toxicology

The sesquiterpene isolated from the leaves have shown anti-bacterial activity against Gram-positive bacteria (Kelmanson et al., 2000 and Rabe et al., 2002).
Aqueous extracts of *Vernonia colorata* were found to be inhibitory for *Toxoplasma* growth at concentrations up 10 mg/l and organic extracts were inhibitory at concentration as low as 1 mg/l (Benoit-Vical et al., 2000). The methanol extract of the fruit showed an inhibitory concentration of 250 µg/ml.
Both the crude alkaloid preparation and the alcoholic extract of the original arrow-poison plant (aerial parts) of *Vernonia* showed toxicity in frogs, rabbits and pigeons. Two classes of symptoms were observed: effect on the heart and motor incoordination. The effect on the heart is not digitalis-like. A continuous decrease in cardiac contraction was observed, also a central toxic vagal stimulation. The movement disorder was parallel to the cardiac effect. Frogs rapidly became lethargic; the head sank to the table, very similar to a curarised animal. Forelegs, and then hind legs, were spread; finally, complete motor paralysis occurred (Neuwinger, 1996).

3.17. *Daniella oliveri* (Rolfe) Hutch. & Dalz. (Caesalpiniaceae)

No traditional use as a toxic plant is reported in literature.

3.17.1. Biologcal activity and toxicology

The hexane extract of the stem bark exhibit a dose-related analgesic activity in the acetic acid induced pain on mice. The methanol extract showed anti-inflammatory activity. Ethanol extract of the bark caused significant decreases in body weight, food intake, urine and stool out put of rats. This extract also exhibited a competitive antagonism on histamine-induced contractions of guinea-pig ileum and a non-competitive inhibition of acetyl choline-induced contraction of the frog rectum abdominal muscle (Onwukaeme, 1995). The methanol extracts of bark and leaf have neuromuscular blocking properties. The leaf extract appeared to act by inhibiting the influx of extra cellular Ca^{2+} principally by inhibiting K^{+} channels (Onwukaeme et al., 1999a and Onwukaeme et al., 1999b). The cardiac glycoside component of the methanol extract showed a non-competitive antagonist effect for muscarinic receptors on rat bladder smooth muscles (Onwukaeme et al., 1999a and Onwukaeme et al., 1999b).

3.18. Mitragyna inermis (De Willd.) O. Kuntze (Rubiaceae)

No traditional use as a toxic plant is reported in the literature.

3.18.1. Biological activity and toxicology

The pharmacological investigations showed that the alkaloid extract from the leaves of *Mitragyna inermis* and especially speciophylline (major alkaloid) increase bile flow of the rats. The alkaloids induced hepatic cellular activity without cellular necrosis. No hepatotoxicity was found (Toure et al., 1996). In vitro anti-malarial activity studies showed that the alkaloids present in the chloroform extracts, and also ursolic acid purified from hydro-methanol extract, induced a decrease of parasite proliferation. Aqueous extracts, traditionally used for medication against malaria did not show a high anti-malarial activity. No toxicity on peritoneal macrophages was founded (Traore-Keita et al., 2000). Methanol extract of stem bark showed larvicidal activity on *Anopheles gambiae* larva (Diallo et al., 2000).

3.19. *Vernonia kostchyana* Sch. Bip ex Walp. (Asteraceae)

Synonym: *Baccharoides adoensis var. kotschyana* (Sch. Bip. ex Walp.) M.A. Isawumi, G.El-Ghazaly and B. Nordenstam).
No traditional use as a toxic plant is reported in the literature.

3.19.1. Biological activity and toxicology

Pharmacological studies of the extract of the drug showed a gastroprotective effect of the *n*-butanol soluble part of the aqueous extract in different experimentally induced gastric ulcers in rats (Germano et al., 1996). It was concluded that saponins were the active principles for the protective effect seen (Sanogo et al., 1996 and Sanogo et al., 1997). Anti-bacterial activity has also been reported for the plant (Deeni and Hussain, 1994).

4. Discussion and conclusion

Swartzia madagascariensis, *Cassia siberiana*, *Trichilia roka*, *Securidaca longepedonculata* and *Cassia alata* are mentioned as toxic plants by traditional practitioners in the Bamako district. Some of these plants (*Swartzia*, *Cassia* and *Securidaca*) have been used as arrow poisons, fish poisons, or ordeal poison other places in Africa and in a few cases in other continents. Toxic substances have been found in some of the plants and some of these have been isolated. The saponins of *Swartzia madagascariensis* were found to be strongly haemolytic. *Cassia* species yield hydrocyanic acid. This acid is a well known as toxic substance. The seeds of *Securidaca longepedonculata* are known to be toxic; Watt and Breyer-Brandwijk (1962) reported that a cold infusion, given orally to cat produces irritation of the gastrointestinal tract which sometimes proves fatal. Vomiting and diarrhoea can occur. *Trichilia roka* and *Ximenia americana* were also found to be toxic in the literature (Watt and Breyer-Brandwijk, 1962). The plants are used orally and in the bath for treatment of variety of ailments such as malaria, stomach pains, constipation, jaundice and gastric ulcers. According to the traditional practitioners, diarrhoea and vomiting were the signs of intoxication. Seventy percent of the plants (Table 1) are used in malaria treatment. In this case vomiting, nausea, and fever can be due to malaria and not signs of toxicity. Plants are sold in the market generally by herbalists who are not specialists in toxicology. They have only general knowledge about toxic signs. The knowledge of traditional

healers is essentially the clinical knowledge they get through their practice and their interpretation of toxicity is on the basis of observations only, not on mechanism of intoxication. The three plants most frequently used for the treatment of toxic signs recorded on the basis of the interviews are *Guiera senegalensis* J.F.Gmel. (Combretaceae), *Euphorbia hirta* L. (Euphorbiaceae) and *Afrormosia laxiflora* (Benth. Ex. Baker) Harms (Fabaceae). Properties and uses for these plants are described in the following section.

The decoction of the leaves of *Guiera senegalensis* is the most used by the healers for the treatment of the intoxication by other medicinal plants (Table 1). The leaves are often used in the traditional medicine in West Africa (Senegal, Guinea and Mali) in an aqueous decoction for the treatment of all types of pneumonia, bronchitis and coughs. (Koumare, 1968). All parts of the plant are also used for the treatment of diarrhoea and dysentery (Kerharo and Adam, 1974). The tannins have been shown to have radical scavenging and anti-oxidant properties (Bouchet et al., 1998). The Fulani herdmen and peasant farmers of the northern Nigeria usually apply the dried powdered leaves to incisions at sites of snakebites, presumably to remove venom from the bite site and subsequently reduce the absorption into the systemic circulation. The in vitro venom snake detoxifying action of the leaf extract of *Guiera senegalensis* was ascertained by Abubacar et al. (2000). The extracts have a high content of tannins that are known to unspecifically inactivate and bind enzymes/proteins (Abubacar et al., 2000; Bouchet et al., 1998), being the major constituents of snake venoms (Warrell, 1987). Pharmacological investigation on this taxon also showed a depressive action on CNS, as well as anti-inflammatory and anti-diarrhoeic activities (Oliver-Bever, 1986). Based on these results from the literature, it appears that extracts of *Guiera senegalensis* will stop diarrhoea caused by the toxic plants used and that the tannins are possibly the active ingredients responsible for this effect.

Euphorbia hirta has a long history of folkloristic use in the treatment of various ailments in almost every part of the world, particularly in rural Africa (Khan et al., 1980). In the East, and in the East and West Africa, the decoction of the flowering and fruiting plants are used in the treatment of asthma and respiratory tract infections, as well as against cough, chronic bronchitis and pulmonary disorders. *Euphorbia hirta* is also applied onto eczematous skin. In East Africa, the plant is used as a diuretic agent (Watt and Breyer-Brandwijk, 1962; Burkill, 1985–2000). In Mali, an Improved Traditional medicine, Dysenteral^{R}, is made against diarrhoea and dysentery based on this plant.

Ethanol and chloroform extracts of the whole plant exhibit more that 60% inhibition of *Plasmodium falciparum* growth in vitro at a test concentration of 6 µg/ml. Extracts of *Euphorbia hirta* have also been shown to have analgesic, anti-pyretic, anti-inflammatory and sedative effects in laboratory animals (Lanhers et al., 1990 and Lanhers et al., 1991). Increased urine output has also been shown for ethanol and water extracts of the plant (Johnson et al., 1999). Since *Euphorbia hirta* in Mali is used as a registered remedy against diarrhoea and dysentery, the same properties may be those responsible for the use of this plant against toxic signs as described by the healers.

The leaves of *Afrormosia laxiflora* is used in different parts of West Africa for the treatment of pain, rheumatism, cough, tooth ache and diarrhoea in children. The leaves and bark, combined with the bark of *Securidaca longepedonculata* are used against poisoning caused by animals (snake bite, dog and poisonous fish bites). The plant contains cathechin tannins in the stem bark (Neuwinger, 1996). The lyophilized root decoction showed depressant and anti-convulsant properties (Haruna, 2000). The content of tannins and the presence of anti-convulsant properties may explain the use of this plant against the toxic effects observed by the use of other plants.

The other plants used for the treatment of toxic signs reported by the healers in this investigation are: *Sclerocarya birrea* (A.Rich) Hocht, Anacardiaceae, *Combretum micranthum* G.Don, Combretaceae, *Burkea africana* Hook, Caesalpinaceae, *Gardenia ternifolia* Schumacher, Rubiaceae, *Pennisetum typhoideum* Rich., Graminaceae and *Lannea velutina* A.Rich, Anacardiaceae. The leaves of *Combretum micranthum* are used in traditional medicine as a diuretic and are also given against colic and nausea to prevent vomiting. The other plants are also associated with other drugs or plants against infantile and adult diarrhoea. A decoction of the powdered root of *Lannea velutina* is considered a good remedy against diarrhoea; a decoction of the bark of *Sclerocarya birrea* is taken internally as a purge and a macerate of the twig-bark against snake bite (Burkill, 1985–2000). In Mali, a 5 h macerate of the leaves of *Gardenia ternifolia* is drunk for persistent vomiting. All these plants are known to contain tannins or belong to families containing tannins (Aganga and Mosae, 2001, Ferrea et al., 1993, Regerat et al., 1982, Saleh and El Sherbeiny, 1971, Spiegel et al., 1962 and Towo et al., 2003) Tannins in food may act as digestion inhibitors with the resulting suppression of intake (Aganga and Mosae, 2001). The use of these plants for the treatment of toxic signs is by the healers based

on their traditional knowledge, and the presence of tannins will, to a certain extent, support the claimed effects.

Total 19 plants are used by the healers in the Bamako region, which they reckon to be toxic. The plants have to a great extent, based on the scientific literature, been shown to have a certain degree of toxic properties; thus, the healers should be advised to be careful with the use of these plants. A few of the healers do acknowledge the possible toxicity and treat the patients with other plants as well, in order to avoid the toxic effects otherwise seen. The treatment of the toxic signs is in many instances, performed with plants containing tannins, and to a certain extent, these compounds may explain the positive effects seen by the healers.