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To cite this article: Drissa Diallo, Britt Hveem, Mohamed Ag Mahmoud, Gunnvor Berge, Berit Smestad Paulsen & Aboubacar Maiga (1999) An Ethnobotanical Survey of Herbal Drugs of Gourma District, Mali, *Pharmaceutical Biology*, 37:1, 80-91, DOI: [10.1076/phbi.37.1.80.6313](https://doi.org/10.1076/phbi.37.1.80.6313)

To link to this article: <https://doi.org/10.1076/phbi.37.1.80.6313>



Published online: 29 Sep 2008.



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AN ETHNOBOTANICAL SURVEY OF HERBAL DRUGS OF GOURMA DISTRICT, MALI

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ABSTRACT

The Gourma population has a vast knowledge of medicinal plants, as demonstrated in this survey carried out between 1989 to 1991 with herbalists, traditional healers and resource persons, as well as 424 households as informants. This investigation includes 42 species of major use in native medicine for rural health care in the Gourma region. These plants belong to 23 families and are used in the treatment of digestive disorders, malaria, skin diseases, cardiovascular and respiratory complaints. The plants identified are a potential source for new bioactive compounds of therapeutic value in Malian medicine.

INTRODUCTION

Plants have fed the world and cured illnesses from time immemorial. A vast knowledge of how to use the plants against different illnesses may be expected to have accumulated in areas where the use of plants still is of great importance. It has also been shown that screening of medicinal herbs for phytochemicals is important for finding potentially new compounds of therapeutic value.

A research program called SSE (Soudan Sahel Ethiopia) between the University of Oslo and several research institutes in Mali was divided into five parts: ecology, geography, water resources, nutrition and use

of wild plants for food, medicine and in craft industry. The collection of information took part in Gourma, Mali (Fig. 1) for all research areas, except for the nutrition team that, in addition, worked in Koutiala. The team dealing with the use of wild plants collected the information on the medical use of the plants described in the present paper. Part of the information collected on some of the medicinal plants was the subject for one of the reports related to the SSE report series (Diallo & Ag Mahmoud, 1992).

The Malian Gourma, a Sahelian zone located in northern Mali, is bordered by the bend of the river Niger in the north and east, the interior delta of the river in the west and with the boundaries of the Republics of Niger and Burkina Faso in the south. The Gourma district has a total land area of 46,000 km² (Ag Mahmoud, 1992). The annual rainfall is 100 mm in the north and 500 mm in the south. The culture and traditions of the Gourma district have been affected by a dry, variable climate. The area of investigation is dominated by people belonging to Tuareg (T), Sonrhais (S) and Fulani or Peulh (P) tribes with a population of approximately 84,600 in 1990 (Sarr, 1991). The predominant economic activities are animal husbandry, agriculture and fishing.

The purpose of this investigation was to explore the potential of medicinal plants in the Gourma region and also to evaluate possible new uses of the plants of the area not described previously in the scientific literature. This inventory presents briefly the information obtained during the exploration. Important objectives are also to contribute toward the maintenance of the rich traditions as well as to provide access to plants that can be important for the search for new natural products to be used in modern medicine. It is also of

Keywords: Gourma, Mali, medicinal plants.

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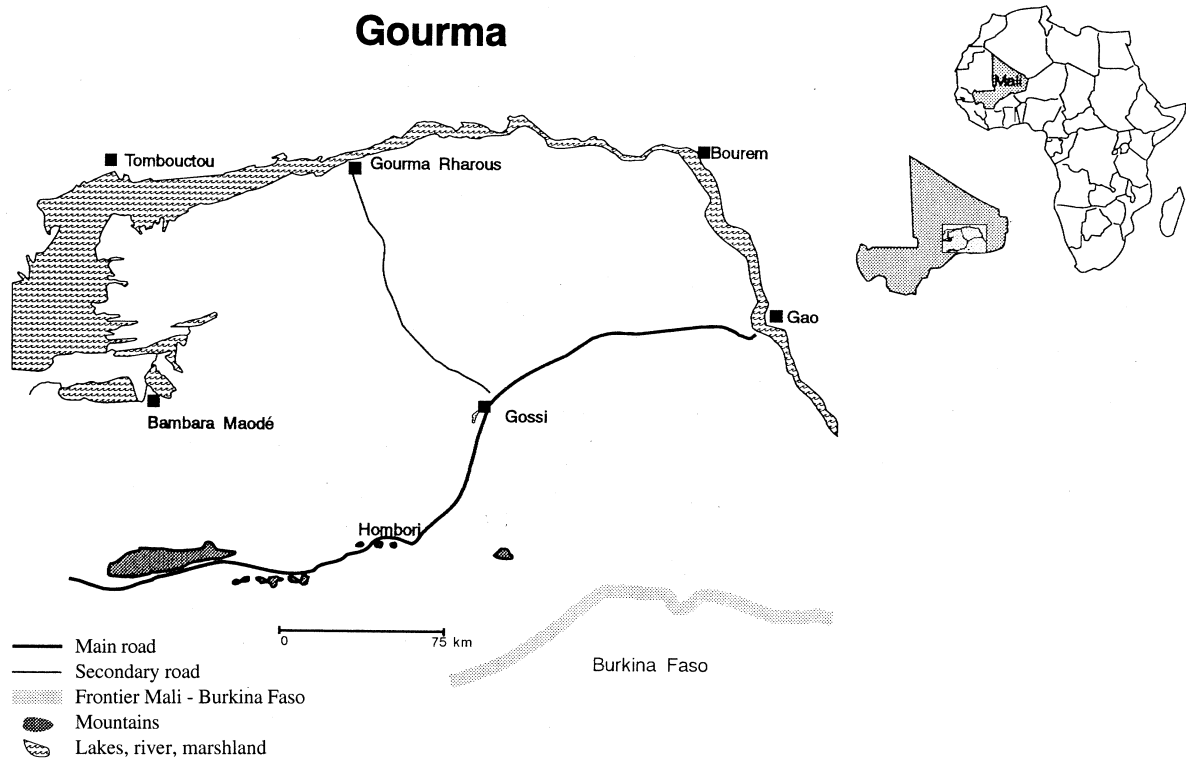


Fig. 1. Map of the Gourma region, Mali.

importance to verify traditional use of the plants by literature studies.

METHODOLOGY

The survey was carried out from 1989 to 1991 and covers the three main seasons in the Gourma area. The medicinal uses of the plants were collected from different localities of the area. Traditional uses were discussed with local healers and other resource persons like teachers and old persons in the villages and encampments. They were asked about the use of the plant, what parts used, for what disease, preparation of the remedy and if any secondary effects had been observed. Data were also collected by a survey including 424 households. Both the head of the household and the wife were interviewed. They were asked the following questions related to the plant: (1) local name, (2) medicinal uses, (3) preparation and administration, (4) part of the plant used, (5) how the plant was collected, (6) local classification in "cold" and "hot" plants, (7) how stored, and (8) local name of the illness and the symptoms to help correlation of local names

with western medicinal conceptions. All plants reported used by the households, the healers and other resource persons are included in this inventory. In some cases the plants could only be found locally. In other cases, the plants were readily available in the market.

Herbarium samples were prepared of most plants. They were preserved, authentically identified and deposited at the Center for Development and the Environment, University of Oslo, Norway. They have been labeled SUM-SSE followed by a number. The study has also involved a literature search in modern scientific databases.

RESULTS

The plants are arranged alphabetically according to family. Under each family, the plants are arranged in alphabetical order. The information is arranged as follows:

botanical name, local name, preparation and medicinal uses of plant reported by local users, bibliographical information.

Aizoaceae

Glinus oppositifolius (L.) Aug. DC.: Balasa (T) Balasa (S)

SUM-SSE 564

Dried stems with leaves are ground into fine powder and put in food as a treatment for abdominal pain and jaundice. Fine powder is put in water, curdled milk or juice of stems of *Echinochloa stagnina* (Retz.) P. Beauv. (Poaceae) for a few minutes, and the liquid is taken as a remedy against malaria. Four handfuls of fresh leaves are crushed, a paste of the leaves is made, mixed with curdled milk or the juice of *E. stagnina*. One teaglass of this is taken once a day for treatment of dizziness or to stimulate the appetite.

In India, the warm juice of fresh leaves is used against earache and the cold juice is applied externally for the treatment of itches and other skin diseases (M'Badruzzaman & Wazahat, 1991). No chemical studies are available for *G. oppositifolius*, but triterpenoidal saponin glycosides have been identified in a relative, *G. lotoides* (Hamed et al., 1996).

Limeum pterocarpum (Gay) Heimerl: Balasa-Ejef (T) SUM-SSE 579

Leaves and stems are used for the same indications as that of *Cadaba glandulosa* Forsk (Capparidaceae). The whole plant is crushed and boiled in water until it changes colour. The solution is drunk for 3 days to cure malaria. Ikhiri et al. (1995) have isolated and determined the structure of a drimane-type sesquiterpene, limeolide, from this plant.

Apiaceae

Cuminum cyminum L.: Alkamun (T), Alkafun (S), Cubbe (P)

SUM-SSE 528

The fruits boiled with dry fish, common salt and the bulb of *Allium cepa* L. (Liliaceae) is used for the treatment of malaria, to gain a good appetite, against heart disease, cold and nausea. Two pinches of the entire plant of *C. cyminum* are powdered and mixed with ground millet. This mixture is used to treat dysentery. According to Ag Mahmoud (1992), fruits are added to several preparations used to treat stomachache and vomiting. Both seed extract and essential oil of *C. cyminum* has been shown to inhibit the growth of bacteria and fungi as well as poliomyelites and coxsackie viruses. Orally administered seed powder reduced blood glucose levels in hyperglycemic rabbits (Satish et al. 1992; Romanramos et al., 1995).

Arecaceae

Hyphaene thebaïca (L.) Mart.: Akof (T), Kongougna (S), Ball (P)

SUM-SSE 541

A paste of the root is regularly massaged on the chest to relieve chest-pain.

Asclepiadaceae

Calotropis procera (Ait.) Ait.f.: Torcha (T), Torza (S), Turza (P)

SUM-SSE 516

The branches are burnt to coal, powdered and mixed with fresh milk and applied on areas of inflammation twice a day. Powder of leaves is used to cure sinusitis. Leaves are also crushed and applied on wounds or used as a poultice on inflammation.

Bibliographic information show that *C. procera* flowers are used against asthma and mature yellow leaves to alleviate earache. Roots of the plant together with fruits of *Ziziphus mauritania* Lam. (Rhamnaceae) are used against common fever and eczema (Singh et al. 1989). Chloroform extract of the roots of *C. procera* caused significant reduction of elevated levels of serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), serum lactate dehydrogenase, serum alkaline phosphatase and also serum bilirubin in both acute and chronic liver damage (Basu et al. 1992). Singh et al. (1994) mention that in India, *C. procera* shrub, flower, buds and root bark are crushed, made into tablets and given against malaria fever. An extract of flowers of *C. procera* displayed cytotoxic activity when tested on COLO 320 tumour cells (Smit et al., 1995). Ursane triterpenoids from the bark of the plant (Gupta et al., 1996) and urcharin from the latex has potent molluscicidal activity (Hussein et al., 1994); antiinflammatory activity is also demonstrated for fractions of the latex (Kumar and Basu, 1994; Majumder and Kumar, 1997), antiulcer activity is reported from a chloroform extract of the root (Basu et al., 1997), and procera-genin is an antibacterial cardenolide having activity towards both Gram positive and Gram-negative bacteria (Akhtar et al., 1992). A review of uses, contents and pharmacological effects has been given by Samuelsson et al. (1991).

Caralluma edulis (L.): Ibalawan (T)

The stem, smeared with cow's butter, is warmed and put repeatedly on the affected parts (inflammation) before bed-time, regularly, to relieve pain. No studies

have been reported for this plant, but pregnane glycosides have recently been found in two closely related plants (Lin et al., 1994, Halim & Khalil, 1996).

Leptadenia hastata (Pers.) Vatke.: Tatola (T), Halum (S), Saboto (P)

SUM-SSE 544

Two handfuls of fresh leaves are boiled in about 500 ml of water until reduced to half. Three soup spoonfuls of this decoction is taken three times a day to treat nausea. Extract of boiled leaves and stem is drunk regularly to treat dyspepsia and haemorrhoids. Polyoxypregnane esters and esterified glycosides have recently been isolated from the plant. The structure has been elucidated and the compounds also tested for their antitumour activity on Raji cells (Aquino et al., 1995, 1996).

Leptadenia pyrotechnica (Forsk.) Vatke.: Ana (T), Saboy (S), Sabei (P)

SUM-SSE 545

The stem juice is administered twice a day for 4 or more days into the nostrils to cure cough, colds and running nose. The pentacyclic triterpenoid leptadenol has been isolated from the plant (Noor et al., 1993).

Balanitaceae

Balanites aegyptiaca (L.) Del.: Taborak (T), Garboy (S), Tane (P)

SUM-SSE 510

This plant is called "Pharmacy Tree" by one of the resource persons because all parts are used for medicinal purposes. Root bark maceration is drunk to treat constipation and malaria. Fresh leaves crushed with fruits of *Acacia nilotica* (L) Willd. Ex Del (Fabaceae) are mixed with cow's butter and water; this mixture is gargled to treat tonsillitis. It may also be applied locally to treat gum inflammation. Fruit maceration is used against conjunctivitis. Almonds of crushed fruits are dampened with water and laid on pimples; almonds are also used against wounds and scabies. Dry thorns are powered and used against suppurate wounds and boils.

Von Maydell (1990) has found that this plant is used for the cure of head diseases, sterility, sexual diseases, vermifuge and parasitics, malaria, fever and toothache. Senegal Kerharo and Adam (1974) indicated that this plant is used against syphilis, epilepsy, leprosy, worms and sterility. Various types of steroidal glycosides have been identified in the fruits of *B. aegyptiaca*, e.g., balantoside and 6-methyl-diosgenin (Hosny et al.,

1992) and pregnane glycosides (Kamel & Koskinen, 1995). Anthelmintic activity has been reported for an aqueous extract of the plant (Ibrahim, 1992). A review of the plant is given by Samuelsson et al. (1991).

Bombacaceae

Adansonia digitata (L.): Tudukust (T), Kowa (S), Mboki (P)

SUM-SSE 506

The leaves are boiled in water and drunk warm with sugar twice a day to relieve cough and serve as an expectorant. Its prolonged use is also claimed to relieve asthma. Few studies have been performed on the leaves from *A. digitata*; vitamin A precursors have been found (Smith et al., 1996). The nutritional value of the seeds is of interest due to the use as food (Eteshola & Oraedu, 1996, Salami & Okezie, 1994). Other traditional uses and a literature survey is given by Samuelsson et al. (1991).

Burseraceae

Commiphora africana (A.Rich.) Engl.: Adaras (T), Kabarkantegna (S), Mbadadi (P).

SUM-SSE 526

Powder of gum is mixed with water and applied in poultice to treat inflammation. Gum is burnt as incense (in connection with diseases, delivery, marriage, new site) to divert evil forces like devils and sorcery. The plant has little tradition in Mali as a medicinal plant, but the resin from other species has recently been shown to exhibit antiinflammatory activity (Dowiejua et al., 1993), anticarcinogenic (AlHarbi et al., 1994), protection against gastric ulcer and cytoprotective effect (AlHarbi et al., 1997). The use in Somalia and literature studies on other *Commiphora* spp. are given by Samuelsson et al. (1991).

Capparaceae

Boscia angustifolia A. Rich.: Ajardahan (T), Danarehi (P)

SUM-SSE 512

The bark of the trunk is used for headache. The dried bark is burnt and the smoke is used to fumigate the head.

In Senegal, leaves are considered as a cholagogue, and the bark is used in poultice against a swollen foot (Kerharo and Adam, 1974). Recently, the protoalkaloids stachydrine and 4-hydroxystachydrine have been identified in the plant (Chini et al., 1992).

Boscia senegalensis (Pers.) Lam ex Poir: Tadhant (T), Horgey (S), Gigili (P)

SUM-SSE 513

The decoction of dry roots is used to expel round worms in children. Two handfuls of fresh leaves are collected, ground and macerated with water. The first macerate is not taken; the second is used against cough. Leaves are pounded, mixed with water and applied to treat scabies; this process is performed early in the morning and at bed time for a week. To treat heart pain, two handfuls of green leaves are crushed and mixed with water and the solution is drunk. In Sudan roots are used against jaundice. The roots contain sterol and triterpenes (El-Kleir & Salim, 1980).

Seck et al. (1993) have shown that leaves, fruits and extracts of the shrub contain compounds being lethal towards different types of grain insects, and attribute this activity to methylisothiocyanate being liberated from a glycosinolate precursor, glucoapparin, present in fruits and leaves of the plant.

Cadaba glandulosa Forsk.: Tahahist (T), Heggara (S), Wadagore (P)

SUM-SSE 515

Leaves are dried, ground and made into a fine powder. This powder is mixed with curdled milk and used to treat malaria fever. About 200 g powder of dried leaves are macerated in water overnight. The macerate is drunk against malaria fever. Decoction of the dried leaves is taken orally against stomachache, normally one soup spoon for two or three days. Decoction (225 ml) made of one handful dried leaves in 500 ml of water is drunk with 75 ml of fish fat against loss of weight.

Few studies have been reported for components of *Cadaba* species; one of the few describes the presence of quaternary ammonium compounds like prolinebetaine and/or 3-hydroxyprolinebetaine in *Cadaba* (McLean et al., 1996).

Podandroyne brachycarpa (DC.) Woodson Almakhy-naz (T)

SUM - SSE 524

The whole plant is cut, dried and finely powdered. Three pinches of dried powdered entire plant (pinch with three fingers) is macerated with 6 teaglasses (450 ml) of water; the macerate is mixed with arabic gum and taken to cure stomachache ("Adu": wind in the stomach).

Studies on various *Cleome* species have revealed the presence of dammarane triterpenes (Tsichritzis et al.,

1993; Harraz et al., 1995), sesquiterpenes (Hussein et al., 1994) and essential oil, and the effect of these as repellents towards tick and maize weevil (Ndungu et al., 1995). Flavonoids and possible effects on inflammation (Sharaf et al., 1992, 1997, Selloum et al., 1995), coumarino-lignoids (Chatterjee et al., 1994), and the presence of quaternary ammonium compounds (McLean et al., 1996), have also been found.

Maerua crassifolia Forssk.: Ajarr (T), Hassu (S), Tirhohiy (P)

SUM - SSE 546

One handful of fresh leaves is crushed and paste made after addition of water. The first macerate with water is discarded and the second mixed with butter and given once a day for eight days against diarrhoea. The dried leaves are burnt to ashes. This ash is mixed with salt, fruits of *Capsicum annum* var *frutescens* (L.) Kuntze, Solanaceae, *Cuminum cyminum* and curdled milk. This mixture is used to cure abdominal pain, malaria fever and appetite loss. The decoction of dried leaves is used against malaria fever, jaundice and constipation. Decoction is made of a 1/2 coffee glass of powdered dried leaves with 1/2 litre of water taken once a day on an empty stomach. Powder of dried leaves (about three pinches once a day), is given for about 3 days to treat heart disease. The juice of fresh leaves is taken to cure constipation. Juice of fresh leaves mixed with water is used to make porridge which is eaten against cold. The bark of the trunk is crushed, put into water and the liquid is either drunk or administered as enema to cure abdominal pain. Maceration of leaves with those of *Hibiscus sabdariffa* (L.) (Malvaceae) is used against malaria.

As in other members of the *Capparaceae*, quaternary ammonium compounds have been identified in *Maerua* sp. (Samuelsson et al., 1985, McLean, et al., 1996)

Celastraceae

Maytenus senegalensis (Lam.) Exell.: Asanna (T), Ngyeel-ngoto (P)

SUM-SSE 570

Decoction of the leaves is drunk to treat diarrhoea. A paste of leaves is used to cure toothache.

Nozaki et al. (1990) have identified various triterpenes, like maytenfolic acid and maytenfoliol, being antileukemic principles, and others, e.g., polpunonic acid as antitumor agents from *M. diversifolia* (Gray) Hou. De Sousa et al. (1994) have done a study on constituents of *Maytenus* species. *Maytenus* species are

used against rheumatism, tumor inflammation and the alcohol extract is used as an aphrodisiac. Gessler et al. (1994, 1995) have shown that extracts from various parts of *M. senegalensis* exhibit both *in vivo* antimalarial and *in vitro* cytotoxic effects.

Combretaceae

Anogeissus leiocarpus (DC.) Guill & Perr.: Akarkara (T), Wiya (S) Kojole (P)
SUM-SSE 509

Decoction of branches with leaves is taken against fevers including malarial fever once a day for 3 days. Powder of dried leaves mixed with salt and milk is used to cure diarrhoea. Decoction of leaves is used to wash wounds as an antiseptic.

It is interesting to note that anolignans A and B present in *A. acuminata* are active HIV-1 reverse transcriptase inhibitory compounds (Rimando et al., 1994).

Combretum glutinosum Perr. ex DC.: Kadogo (T), Kokorba (S), Dooki (P)
SUM-SSE 525

Decoction of branches with leaves is taken orally to cure oedema.

Extracts of *C. glutinosum* are active against hepatitis B virus antigen *in vitro*, extracts containing gallic tannins were said to be responsible for the effect on the angiotensin-converting enzyme, ACE (Pousset et al., 1993). Combretastatin-A4 phosphate from *C. caffrum* is a tubulin inhibitor (Dorr et al., 1996).

Guiera senegalensis Gmel.: Tangaloki (T), Sabara (S), Geloki (P)
SUM-SSE 539

About 3 to 4 handfuls of dried leaves are boiled in water. A dose of 2 or 3 teaglasses (150–225 ml) is drunk for the treatment of malaria. The coal of wood is ground into fine powder, mixed with butter and applied on spots and pimples. Leaves are macerated for 12 h and taken against abdominal pain. It is also recorded that the plant is used against pernicious access, bronchio-pneumonia, diarrhoea and haemorrhoids (Adjanohoun et al. 1979). In Sudan, roots are used as laxative (El-Kleir, 1980).

Koumaré et al. (1968) have identified some of the constituents of *Guiera senegalensis*.

Benoit et al. (1996) have shown weak antimalarial activity for extracts obtained from *G. senegalensis*, while certain galloylquinic acids from the galls of the plant have shown weak anti-HIV activity (Mahmood et al., 1993).

Cucurbitaceae

Citrillus lanatus (Thunb.) Matsumura+Nakai:Tajillit (T), Kaney-horto (S), Dende (P)
SUM-SSE 523

Parts of the fruit with butter are used as a drink against headache and flatulence.

Cyperaceae

Cyperus rotundus L.: Aghichi (T), Azi (S)
SUM-SSE 553

Dried rhizomes are used as incense. In the local tradition, no medicinal use was reported.

Fabaceae

Acacia ehrenbergiana Hayne.: Tamat (T), Bissaw (S), Bisam (P)
SUM-SSE 502

The decoction of dried leaves is used as a remedy against diarrhoea and dysentery.

Acacia nilotica (L.) Willd. ex Del. var. *nilotica* or *Acacia nilotica* (L.) Willd. ex Del var. *tomentosa* (Benth) A.F.Hill: Tahajart (T), Baani (S), Gawde (P)
SUM-SSE 503

Juice of fruits is taken against chest pain or applied locally in the mouth against gingivitis. Two handfuls of dried fruits are ground to fine powder and mixed with one teaglass of curdled milk. This mixture is drunk once a day to cure fever with vomiting, constipation and flatulence. Fruits are burnt and applied as an antiinflammatory agent. Gum is ground and mixed with sugar and the fruits of *C. annuum* var *frutescens* and is used for treatment of cold. The seeds are pounded and mixed with water and used for healing of cuts and wounds. The fruits are boiled in water. The liquid obtained is used against diarrhea, intestinal worms and haemorrhoids. Decoction of dried leaves (one handful in half litre of water) is used in the eyes for healing. Bashir et al. (1987) and Hussein Ayoub and Yankov (1987) have studied the molluscicidal properties of this plant.

Gums from various *Acacia* species have been extensively studied and structurally they are highly branched polysaccharides with a galactose 1,3 linked backbone, to which several sidechains are attached consisting of galactose, arabinose, rhamnose and glucuronic acid (Stephen et al., 1990.) Aqueous extracts from *A. nilotica* have an inhibitory effect on carrageenan-induced rat paw edema, yeast induced pyrexia in rats and also produced a significant increase in the hot plate reaction time in mice (Dafallah & AlMustafa, 1996). Various

uses, contents and pharmacological effects of *A. nilotica* is given by Samuelsen et al. (1992).

Acacia senegal (L.) Willd.: Ewarwar (T), Deligna (S), Patuki (P) SUM-SSE 505

Gum and leaves are used against pneumomia, boils and sprain. As mentioned above, the gums produced by *Acacia* species have been extensively studied, basically due the commercial value of the gums being used as thickeners and emulsifiers in food production. Little is known of their possible biological effects.

Adenolobus rufescens (Lam.) Schmitz.: Tedeyne (T), Namary (S), Nammadi (P) SUM-SSE 511

A decoction of the leaves is drunk against fever and body pain. Fresh leaves are crushed and fresh water is added. The juice is used to cure stomachache. A decoction is made of the bark of the trunk and of leaves and drunk to treat fever and pain. Glele et al. (1982) found that the aqueous extract of leaves was inactive on *Trichomonas vaginalis*. Studies on other *Adenolobus* species have shown antiinflammatory, liver-protective and radical scavenging effects (Lin et al., 1992, 1995) in addition to anti-ulcerogenic effect (Akhtar & Ahmad, 1995).

Piliostigma reticulatum (DC.) Hochst.: Tafaraghraghat (T), Kassora (S), Barklhi (P) SUM-SSE 551

The decoction of dried leaves is taken against fevers, including malarial fever. No studies have been found to substantiate the repeated use of this plant.

Prosopis juliflora (I.C.) DC.: Makabani (T), Makkabaani (S), Sahel-ber (P) SUM-SSE 572

The fresh leaves are crushed and water is added. The macerate is taken to cure diarrhoea and dysentery, or put on the eye as a remedy for conjunctivitis. Dried leaves are powdered and the fine powder is put on wounds. Caceres et al. (1995) have shown that a water extract of the leaves from *P. juliflora* inhibited the growth of five different strains of *Neisseria gonorrhoeae*.

Senna italica P.Mill.: Aharjijim (T), Hirjijim (S), Balbalehy (P) SUM-SSE 518

The plant is known for its laxative properties. The leaves are used to make a decoction and can be mixed with milk, food, salt or butter. Two handfuls of dry

leaves are boiled in water (half litre). One pinch of salt (pinch with two fingers) and one pinch of sugar (pinch with four fingers) are added. This solution is used to cure constipation. Fresh leaves are ground and used as a macerate against stomachache and flatulence. The macerate of dry leaves with fruits of *Tamarindus indica* (L.) Fabaceae and of *Capsicum frutescens* (L.) Solanaceae, is drunk to treat malaria. *Senna* species are well known for their content of anthraquinone derivatives being responsible for the laxative effect both of leaves and fruits of the plants. Recently Kazmi et al. (1994) found a new anthraquinone from *S. italica* possessing antimicrobial and antitumour activity. A new flavonoid, tamarixetin, has also been identified (El Sayed et al., 1992).

Senna obtusifolia (L.) Irwin + Barneby: Barafigma (T), Houlo (S), Huulo (P) SUM - SSE 520

Powder of dry leaves is mixed with curdled milk and drunken to cure constipation. In Mocni Hills (Haryana), India, seeds are used against rheumatism, taken with milk, tea or coffee; decoction of the young plants is given to patients with acute backache and rheumatic pain (Virendra, 1995). *Senna tora* (L.) Roxb. which is a synonym of *S. obtusifolia*, is used against skin diseases (Rai, 1994). A mild hepatoprotective effect has also been demonstrated for water extracts of *S. obtusifolia* (Hase et al., 1996) and toxicological and hematological effects have been demonstrated after feeding the seeds to rats (Voss & Brennecke, 1991).

Malvaceae

Hibiscus sabdariffa L.: Jisma (T), Jisma (S) SUM-SSE 566

One or two handful of dried flowers are put in water until the liquid becomes red. This liquid is boiled with butter and salt. Three teaglasses a day of the decoction is used against fever including malaria fever.

According to Di Stasi et al. (1994), in Brazil, *Hibiscus sabdariffa* is an antipyretic, emollient and used against eating disorders and the plant is hallucinogenic. Ali et al. (1989) have shown that the aqueous extract of *Hibiscus sabdariffa* calyces induced an estrogenic activity in immature female rats when injected intraperitoneal at a dose of 500 mg/kg.

Hibiscus protocatechuic acid has been shown to protect against oxidative damage induced by tert-butylhydroperoxide in rat hepatocytes (Tseng et al., 1996). Extracts of *H. sabdariffa* have an inhibitory effect on yeast-induced pyrexia in rat and also signifi-

cant effect on the hot plate reaction time. The presence of flavonoids, polysaccharides and organic acids were proposed to be responsible for these effects (Dafallah and AlMustafa, 1996). Structure and immunomodulating activity of polysaccharides from flowerbuds have been investigated. Some activity was found, but this was marginal (Muller & Franz, 1992).

Meliaceae

Khaya senegalensis (Desr.) A.Juss.: Kahi (T, S, P)
SUM - SSE 543

Juice of bark is given 2 times a day against abdominal pain.

Adjanohoun et al. (1979) have, in Mali, identified the use of this plant against diarrhoea, dysentery and urticaria in dermatology. Cardiovascular effects have been found from ethanol extracts of the stem bark of *K. senegalensis*. The effects may be related to stimulation of beta-receptors and alpha-adrenoceptors (Olayinka et al., 1992). Liminoid triterpenes are present in the stem of the tree, and these are thought to be responsible for the insecticide activity observed (Isman et al., 1997).

Nymphaeaceae

Nymphaea lotus (L.): Alata (T), Boyegna (S), Bululu (P)
SUM - SSE 547

The tuber of *Nymphaea lotus* and fruits of *Acacia nilotica* are crushed. The paste obtained is applied externally to cure wounds and cuts. Geraniin, a hydrolysable tannin with antimicrobial activity, is found in *N. tetragona* (Kurihara et al., 1993). In France, the rhizome of yellow water lily is used in a phytopharmaceutical, and traditionally used as an itch-relieving agent for skin disorders, and also as a protective agent in the treatment of bruises, insect bites, sunburns and other type of burns and for different types of rashes (Bruneton, 1995).

Poaceae

Cymbopogon schoenanthus (L.) Spreng. subsp. *proximus* (Hochst. ex A. Rich.) Maire+Weiller: Teberemt (T), Wulunda (S), Walunde (P)
SUM-SSE 529

Decoction of one handful of dried flowers in half a litre of water is made and the liquid is taken against flatulence, constipation, dizziness and indigestion. Essential oils from six different *Cymbopogon* strains have been shown to have antibacterial activity (Pattnaik et al., 1995). Similar oil from *C. citratus* has shown antifungal activity towards clinical isolates of *Dermatophytes* (Lima et al., 1992, 1993; Kishore et al., 1993)

Echinochloa stagnina (Retz.) P. Beauv.: Burju (T), Bur-gou (S), Burgu (P)

SUM-SSE 532

A macerate of the stems in water gives a sweet solution. This solution is used as an energetic and against intoxication of *Fugosia digitata* (Cav.) Pers. (Malvaceae). The sweet solution can be concentrated and conserved.

Various species of *Echinochloa* are used in food; in some countries, they are used in the same way as millet.

Vetiveria nigriflora (Berth.) Stapf.: Abarom (T), Diri (S), Daje (P)

SUM - SSE 557

Roots are used as an aromatic in drinking water.

Rhamnaceae

Ziziphus mauritiana Lam.: Tabakat (T), Dareygnan (S), Daje (P)

SUM-SSE 558

Fresh leaves are crushed and mixed with clay from an ant hill. The paste obtained is made into a poultice to treat inflammation.

Other species of *Ziziphus* have been shown to contain triterpenoid sweetness inhibitors (Suttisri et al., 1995; Kurihara, 1992) and cyclopeptide alkaloids (Barboni et al., 1994; Abuzarga et al. 1995), and Han et al. (1992) have isolated sedative alkaloids from *Ziziphus* plants.

Rubiaceae

Mitragyna inermis (Willd.) Kuntze: Tajalat (T), Kabe (S)
SUM-SSE 592

Decoction of leaves (fresh or dried) is used against malaria. Women use flowers as a cosmetic. Dried flowers are pounded and added to powder of the bark of *Acacia seyal* Del. (Mimosaceae). Women spray this powder on their bodies.

Adjanohoun et al. (1979) found different uses of *M. inermis* in Mali, e.g., kidney diseases, hepatitis, analeptic and malaria. Possible hepatic activity of the alkaloid speciophylline isolated from *M. inermis* has been tested, and an increase in biliary flow was observed with an increase in bilirubin content. No hepatotoxic activity was found (Toure et al., 1996). Mitragynine is an analgesic corynanthene-type indole alkaloid isolated from *M. speciosa*. It is apparently 10-fold as active as morphine. Some studies have been performed to understand the mechanism responsible for the activity (Matsumoto et al., 1996; Tohda et al., 1997; Watanabe et al., 1997).

Salvadoraceae

Salvadora persica L.: Tchaq (T), Hiraw (S), Hirohi (P)
SUM-SSE 552

Decoction of fresh leaves is drunk as a remedy against influenza. Fresh leaves are crushed, and the paste is squeezed to get juice which is used to make porridge. The porridge is taken to cure cold and cough. Pieces of thin branches are used as tooth cleaners.

Two new lignan glycosides were isolated from stems of *S. persica* by Kamel et al. (1992). Knowledge available on the plant up to 1993 has been published by Samuelsson et al. (1993).

Sterculiaceae

Waltheria indica L.: Amatraq (T), N'gorfu (S)
SUM-SSE 552

Juice of stem bark is put in the eyes to treat conjunctivitis. Decoction of the entire plant is used against diarrhoea.

Tiliaceae

Corchorus tridens L.: Hoy (T), Fakahoy (S), Orosalka (P)
SUM-SSE 527

Macerate of leaves is used as shampoo.

Certain *Corchorus* species are used for production of jute. Corchoionoides A and B from *C. olitorus* inhibit the release of histamine (Yoshikawa et al., 1997). Polysaccharides from leaves of the same plant show proliferative activity towards the murine splenocyte (Ohtani et al., 1995).

Grewia bicolor Juss.: Deje (T), Tchelli (S), Kele (P)
SUM-SSE 535

Macerate of bark is used as shampoo.

The roots of *G. bicolor* probably contain a peptide, exerting serotonin-like effects on rat uterus, fundus and rabbit jejunum. A transient serotonin-like rise in cat blood pressure was produced by the same active fractions (Mohamed et al., 1990)

DISCUSSION AND CONCLUSIONS

In the Gourma area of Mali, medicinal plants are the main source of medicine. The traditional knowledge on the use of medicinal plants among healers, resource persons and ordinary households have been recorded by different types of interviews. All information obtained for each plant is found in the results section.

Some plants were used more or less throughout Gourma, while others were used in only one or two places. In certain areas the plants were collected by the users themselves, in other areas they had to buy them on the market as they could not be grown locally due to special conditions required for growth of the specific plant. Since the information given was based on oral communication, not practical use of the plants, the authors saw no reason for discriminating between the information obtained.

Various species are used as anti-infectives and anti-parasitics; use against digestive problems, malaria, skin diseases, cardiovascular and respiratory complaints were also prevalent.

In the Gourma region of investigation, it was observed that 42 plants belonging to 36 genera and 23 plant families were used for medicinal purposes. Eleven plants were used for treatment of malaria, 7 against stomach-ache, 7 against diarrhoea, and 5 for curing wounds.

Malaria and ulcer are major causes of illnesses and deaths in Mali, and among those plants recorded in this study, it may be possible to find new remedies for reducing these problems. This could be of great medical and economic value for Mali.

Approximately 15 plants have been partly studied with respect to chemical compounds and biological activities, and the biological activities recorded may possibly verify the traditional use of the plants. However, for most of these plants, unrecorded uses have been found, and for known ways of using the plants, various biological studies are still lacking.

Seventeen plants have hardly been studied and are thus potentially subjects for new phytochemicals with pharmacological activities that can lead to important medicines in the future. It is also of importance for the medical doctors and healers in Mali to get the new scientific information on the plants they are using in order to be able to produce more standardized preparations of the medicinal plants they use for treating people.

ACKNOWLEDGEMENTS

The authors are grateful to the Soudan Sahel Ethiope (SSE) program for necessary facilities for performing the present work, and to Alida Boye for all the support given throughout the program period. We are also grateful to all the people giving us the information on which this work is founded.

REFERENCES

- Abuzarga M, Sabri S, Alaboudi A, Ajaz MS, Sultana N, Attatur-Rahman (1995): New cyclopeptide alkaloids from *Ziziphus lotus*. *J Nat Prod* 58: 504–511.
- Adjanohoun EJ, Ake Assi L, Floret JJ, Guinko S et al. (1979): Les plantes medicinales du Mali. *Médecine traditionnelle et pharmacopée: contribution aux études ethnobotaniques et floristiques au Mali*, pp. 25–146, A.C.C.T., Paris.
- Ag Mahmoud M (1992): Médecine traditionnelle Tamacheq, *Le Gourma Central; VIè région de la République du Mali. Présentation générale*. Eds Imprimerie de Recherche, Université Paul Valéry, pp. 105–108, Aide de l'Eglise Norvégienne, Oslo.
- Akhtar AH, Ahmad KU (1995): Anti-ulcerogenic evaluation of the methanolic extracts of some indigenous medicinal plants of Pakistan in aspirin-ulcerated rats. *J Ethnopharmacol* 46: 1–6.
- Akhtar N, Malik A, Ali SN, Kazmi SU (1992): Proceragenin, an antibacterial cardenolide from *Calotropis procera*. *Phytochemistry* 31: 2821–2824.
- AlHarbi MM, Qureshi S, Raza M, Ahmed MM, Afzal M, Shah AH (1997): Gastric ulcer, cytoprotective effect of *Commiphora molmol* in rats. *J Ethnopharmacol* 55: 141–150.
- AlHarbi MM, Qureshi S, Raza M, Ahmed MM, Giangreco AB, Shah AH (1994): Anticarcinogenic effect of *Commiphora molmol* on solid tumors induced by Ehrlich carcinoma-cells in mice. *Chemotherapy* 40: 337–347.
- Ali MB, Salih WM, Humida AM (1989): An oestrogen-like activity of *Hibiscus sabdariffa*. *Fitoterapia* 60: 547–548.
- Aquino R, Peluso G, DeTommasi N, DeSimone F, Pizza C (1996): New polyoxypregnane ester derivatives from *Leptadenia hastata*. *J Nat Prod* 59: 555–564.
- Aquino R, Pizza C, DeTommasi N, DeSimone F (1995): New polypregnane ester derivatives from *Leptadenia hastata*. *J Nat Prod* 58: 672–679.
- Badruzzaman SM, Wahazat H (1992): Some aquatic, marshy land medicinal plants from Hardoi district of Uttar Pradesh. *Fitoterapia* 63: 245–248.
- Barboni L, Gariboldi P, Torregiani E, Verotta L (1994): Cyclopeptide alkaloids from *Ziziphus mucronata*. *Phytochemistry* 35: 1579–1582.
- Bashir AK, Sulaiman SM, Sheikh SH, El Kheir YM (1987): Molluscicidal, cercaricidal, miracidicidal activities of *Acacia nilotica* ssp. and *Adansonii*. *Fitoterapia* 58: 51–55.
- Basu A, Sen T, Pal S, Mascolo N, Capasso F, Chaudhuri AKN (1997): Studies on the antilceractivity of the chloroform fraction of *Calotropis procera* root extract. *Phytother Res* 11: 163–165.
- Basu A, Sen T, Ray RN, Nag Chaudhuri AK (1992): Hepatoprotective effects of *Calotropis procera* root extract on experimental liver damage in animals. *Fitoterapia* 63: 507–514.
- Benoit F, Valentin A, Pelissier Y, Diafouka F, Marion C, KoneBamba D, Kone M, Mallie M, Yapo A, Bastide JM (1996): *In vitro* antimalarial activity of vegetal extracts used in West African traditional medicine. *Amer J Trop Med Hyg* 54: 67–71.
- Bruneton, J (1995): *Pharmacognosy, Phytochemistry, Medicinal Plants*. p. 864, Intercept Ltd. Andover, Hampshire, England.
- Caceres A, Menendez H, Mendez E, Cohobon E, Samayoa BE, Jauregui E, Peralta E, Carrilla G (1995): Antigonorrhoeal activity of plants used in Guatemala for the treatment of sexually transmitted diseases. *J Ethnopharmacol* 48: 85–88.
- Chatterjee A, Das PC, Joshi PC, Manda S (1994): Naturally occurring coumarino-lignoids. *J Ind Chem Soc* 71: 475–482.
- Chini C, Bilia AR, Keita A, Morelli I (1992): Protoalkaloids from *Boscia angustifolia*. *Planta Med* 58: 476.
- Dafallah AA, Mustafa ZA (1996): Investigation of anti-inflammatory activity of *Acacia nilotica*, and *Hibiscus sabdariffa*. *Amer J Chinese Med* 24: 263–269.
- De Sousa JR, Das Graças Da Silva, M, Del Carmen G, Salazar M et al. (1994): Constituents of two *Maytenus* species. *Fitoterapia* 65: 553.
- Diallo D, Ag Mahmoud M (1992): Quelques méthodes d'utilisation de Plantes Médicinales dans le Gourma Malien Annexe No. 20 du Rapport d'Etape Plantes Sauvage, Programme de Recherche SSE, Mali-Norvege.
- Di Stasi LC, Hiruma CA, Guimaraes EM, Santos CM (1994): Medicinal plants popularly used in Brazilian amazon. *Fitoterapia* 65: 529–540.
- Dorr RT, Dvorakova K, Snead K, Alberts DS, Salmon SE, Pettit GR (1996): Antitumor activity of ombretatatin-A4 phosphate, a natural tubulin inhibitor. *Investigational New Drugs* 14: 131–137.
- Duwiejua M, Zeitlin IJ, Waterman PG, Chapman J, Mhango GJ, Provan GJ (1993): Antiinflammatory activity of resins from some species of the plant family *Burseraceae*. *Planta Med* 59: 12–16.
- El-Kheir YM, Salih MH (1980): Investigation of certain plants used in Sudanese folk medicine. *Fitoterapia* 3: 143–147.
- Elsayed NH, Abudooh AM, Elkhisy EAM, Mabry TJ (1992): Flavonoids of *Cassia italica*. *Phytochemistry* 31: 2187.
- Eteshola E, Oraedu ACI (1996): Fatty acid compositions of tigernuts tubers (*Cyperus esculentus* L), baobab seeds (*Adansonia digitata* L), and their mixture. *J Amer Oil Chem Soc* 73: 255–257.
- Gessler MC, Nkunya MHH, Mwasumbi LB, Heinrich M, Tanner M (1994): Screening Tanzanian medicinal plants for antimalarial activity. *Acta Trop* 56: 65–77.
- Gessler MC, Tanner M, Chollet J, Nkunya MHH, Heinrich M (1995): Tanzanian medicinal plants used traditionally for the treatment of malaria - *in vivo* antimalarial, and *in vitro* cytotoxic activities. *Phytother Res* 9: 504–508.
- Glele-Coefe J, Senet JM (1982): Etude de l'influence d'extraits aqueux de végétaux supérieurs sur la multiplication de *Trichomonas vaginalis* en culture axénique *in vitro*. *Plantes Médicinales et Phytothérapie Journal de Pharmacognosie* 16: 39–45.
- Gupta DK, Ali M, Bhutani KK (1996): Triterpenoids from *Calotropis procera* root bark. *Indian J Chem, Section B* 35: 1079–1084.

- Halim AF, Khalil AT (1996): Pregnane glycosides from *Caralluma retropiciens*. *Phytochemistry* 42: 1135–1139.
- Hamed AI, Springuel I, ElEmary NA, Mitome H, Miyaoka H, Yamada Y (1996): Triterpenoidal saponin glycosides from *Glinus lotoides* var. *dictamnoides*. *Phytochemistry* 43: 183–188.
- Han BH, Park MK, Han YN, Park MH, Park JH, Kim YC (1992): Chemical, biochemical studies on sedative alkaloids from *Ziziphus* plants. *J Amer Chem Soc* 203: 484.
- Harraz FM, Ulubelen A, Oksuz S, Tan N (1995): Dammarane triterpenes from *Cleome amblyocarpa*. *Phytochemistry* 39: 175–178.
- Hase K, Kadota S, Basnet P, Namba T, Takashi T (1996): Hepatoprotective effects of traditional medicines. Isolation of the active constituent from seeds of *Celosia argenta*. *Phytother Res* 10: 387–392.
- Hosny M, Khalifa T, Calis I, Wright AD, Sticher O (1992): Balanitoside, a furostanol glycoside, and 6-methyl-diosgenin from *Balanites aegyptica*. *Phytochemistry* 31: 3565–3569.
- Hussein HI, Kamel A, Abouzeid M, Elsebae AKH, Saleh MA (1994): Uscharin, the most potent molluscicidal compound tested against land snails. *J Chem Ecol* 20: 135–140.
- Hussein Ayoub SM, Yankov LK (1987): Molluscicidal properties of the Sudan *Acacias*. *Fitoterapia* 58: 363–366.
- Hussein NS, Ahmed AA, Darwish FMK (1994): Sesquiterpenes from *Cleome droserifolia*. *Pharmazie* 49: 76–77.
- Ibrahim AM (1992): Anthelmintic activity of some Sudanese medicinal plants. *Phytother Res* 6: 155–157.
- Ikhiri K, Mahaman I, Ahond A, Chiaroni A, Poupat C, Riche C, Potier P (1995): Limeolode, an new drimane-type sesquiterpene isolated from *Limeum pterocarpum*. *J Nat Prod* 58: 1136–1138.
- Isman MB, Gunning PJ, Spollen, KM (1997): Tropical timber species as sources of botanical insecticides. *ACS Symposium series* 658: 27–37.
- Kamel MS, Kosknen A (1995): Pregnane glycosides from fruits of *Balanites aegyptiaca*. *Phytochemistry* 40: 1773–1775.
- Kamel MS, Ohtani K, Assaf MH, Kasai R, Elshanawani MA, Yamasaki K, Ali AA, Tanaka, O (1992): Lignan glycosides from stems of *Salvadora persica*. *Phytochemistry* 31: 2469–2471.
- Kazmi MH, Malik A, Hameed S, Akhtar N, Ali SN (1994): An anthraquinone derivative from *Cassia italica*. *Phytochemistry* 36: 761–763.
- Kerharo J, Adam JG (1974): *La pharmacopée sénégalaise traditionnelle, plantes médicinales et toxiques*. Eds. Vigot Frères, Paris.
- Kishore N, Mishra AK, Chansouria JPN (1993): Fungitoxicity of essential oils against *Dermatophytes*. *Mycoses* 36: 211–215.
- Koumaré M, Cros J, Pitet G (1968): Recherches sur les constituants chimiques du *Guiera senegalensis* (Combretacées). *Plantes Méd et Phytothér* 2: 204–209.
- Kumar VL, Basu N (1994): Antiinflammatory activity of the latex of *Calotropis procera*. *J Ethnopharmacol* 44: 123–125.
- Kurihara Y (1992): Characteristics of antisweet substances, sweet proteins, and sweetness-inducing proteins. *Crit Rev Food Sci Nutr* 32: 231–252.
- Lima EO, Gompertz OF, Giesbrecht AM, Paolo MQ (1993): *In vitro* fungal activity of essential oils from officinal plants against *Dermatophytes*. *Mycoses* 36: 333–336.
- Lima EO, Gompertz, OF, Paolo MQ, Giesbrecht AM (1992): *In vitro* antifungal activity of essential oils against clinical isolates of *Dermatophytes*. *Rev Microbiol* 23: 235–238.
- Lin CC, Lin JM, Chiu HF (1992): Studies of folk medicine Thang-kau-tin from Taiwan. I. The antiinflammatory, liver-protective effect. *Amer J Chinese Med* 20: 37–50.
- Lin LJ, Lin LZ, Gil RR, Cordell GA, Ramesh M, Srilatha B, Reddy B, Rao A (1994): Pregnane glycosides from *Caralluma umbellata*. *Phytochemistry* 35: 1549–1553.
- Lin JM, Lin CC, Hen MF, Ujiie T, Takad, A (1995): Studies on Taiwan folk medicine, Thang-kau-tin. II. Measurement of active oxygen scavenging activity using an ESR technique. *Amer J Chinese Med*: 43–51.
- Mahmood N, Moore PS, Detommasi N, Desimone F, Colman S, Hay AJ, Pizza C (1993): Inhibition of HIV-infection by caffeoylquinic acid derivatives. *Antiviral Chem Chemother* 4: 235–240.
- Majumder PK, Kumar VL (1997): Antiinflammatory activity of fractions of latex of *Calotropis procera*. *Phytotherapy Res* 11: 166–167.
- Matsumoto K, Mizowaki M, Suhitra T, Murakami Y, Takayama H, Sakai S, Aimi N, Watanabe H (1996): Central antinociceptive effects of mitragynine in mice. Contribution of descending noradrenergic, serotonergic systems. *Eur J Pharmacol* 317: 75–81.
- McLean WHF, Blunden G, Jewers K (1996): Quaternary ammonium compounds in the Capparaeae. *Bioch Syst Ecol* 24: 427–434.
- Mohamed AEH, Karrar MA, Salih AEM, Bashir AK, Ali MB, Khalid SA (1990): Pharmacological activities of *Grewia bicolor* roots. *J Ethnopharmacol* 28: 285–292.
- Muller BM, Franz G (1992): Chemical structure, biological activity of polysaccharides from *Hibiscus sabdariffa*. *Planta Med* 58: 60–67.
- Ndungu M, Lwande W, Hassanali A, Moreka L, Chabra SC (1995): *Cleome monophylla* essential oil and its constituents as tick (*Rhipicephalus appendiculatus*): and maize weevil (*Sitophilus zeamais*) repellents. *Entomologia Experimentalis et Applicata* 76: 217–222.
- Noor F, Ahmed, Imtiazuddin SM, Khan B (1993): A triterpenoid from *Leptadenia pyrotechnica*. *Phytochemistry* 32: 211–212.
- Nozaki H, Matsuura Y, Hirono S, Kasai R, Chang J-J, Lee K-H (1990): Antitumor agents, 116. Cytotoxic triterpenes from *Maytenus diversifolia*. *J Nat Prod* 53: 1039–1041.
- Olayinka AO, Onoruvwe O, Lot TY (1992): Cardiovascular effects in rodents of the methanolic extract of the stem bark of *Khaya senegalensis* Juss. A. *Phytotherapy Res* 6: 282–284.
- Ohtani K, Okai K, Yamashita U, Yuasa I, Misaki A (1995): Characterization of an acidic polysaccharide isolated from

- the leaves of *Corchorus olitorus* (Moroheiya). *Biosci Biotech Biochem* 59: 378–381.
- Pattanaik S, Subramanyam V, R, Kole CR, Sahoo S (1995): Antibacterial activity of essential oils from *Cymbopogon*: Inter-and intra-species differences. *Microbios* 84: 239–245.
- Pousset JL, Rey JP, Levesque J, Coursaget P, Galen FX (1993): Hepatitis-B surface antigen (HBSAG): inactivation, angiotensin-converting enzyme (ACE): inhibition *in vitro* by *Combretum glutinosum* Perr (Combretaceae): extract. *Phytother Res* 7: 101–102.
- Rai MK (1994): Herbal medicines in India: retrospect and prospect. *Fitoterapia* 65: 483–491.
- Rimando AM, Pezzuto JM, Farnsworth NR, Santisuk T, Reutrakul V, Kawanishi K (1994): New lignans from *Anogeissus acuminata* with HIV-1 reverse transcriptase inhibitory activity. *J Nat Prod* 57: 896–904.
- Romanramos R, Floressaenz JL, Alarconaguilar FJ (1995): Anti-hyperglycemic effect of some edible plants. *J Ethnopharmacol* 48: 25–32.
- Salami LI, Okezie UN (1994): The nutritional composition, storage stability of millet (*Pennisetum americanum*) supplemented with varying levels of baobab (*Adansonia digitata*) flours. *Ecol Food Nutr* 3: 211–218.
- Samuelsson G, Kyrematen G, Fara MH (1985): Preliminary chemical characterisation of pharmacologically active aqueous extracts from plants used in traditional medicine. *J Ethnopharmacol* 14: 193–201.
- Samuelsson G, Farah MH, Claeson P, Hagos M, Thulin M, Heeberg O, Warfa AM, Hassan AO, Elmi AH, Abdurrahman AD, Elmi AS, Abdi YA, Alin MH (1991): Inventory of plants used in traditional medicine in Somalia. I. Plants of the families Acanthaceae-Chenopodiaceae. *J Ethnopharmacol* 35: 25–63.
- Samulesson G, Farah MH, Claeson P, Hagos M, Thulin M, Hedberg O, Warfa AM, Hassan AO, Elmi AH, Abdurrahman AD, Elmi AS, Abdi YA, Alin MH (1992): Inventory of plants used in traditional medicine in Somalia. III. Plants of the families Lauraceae-Papilionaceae. *J Ethnopharmacol* 37: 93–112.
- Samulesson G, Farah MH, Claeson P, Hagos M, Thulin M, Hedberg O, Warfa AM, Hassan AO, Elmi AH, Abdurrahman AD, Elmi AS, Abdi YA, Alin MH (1993): Inventory of plants used in traditional medicine in Somalia. IV. Plants of the families Passiflorae-Zygophyllae. *J Ethnopharmacol* 38: 1–29.
- Sarr M, Diakité MY (1991): La population en 1990. *La population du cercle de Gourma-Rharous*, Vol. 2, pp. 75–96, SSE, Bamako.
- Satish CJ, Purohit M, Jain R (1992): Pharmacological evaluation of *Cuminum cyminum*. *Fitoterapia* 63: 291–294.
- Seck D, Lognay G, Haubruge E, Wathelet JP, Marlier M, Gaspar C, Severin M (1993): Biological activity of the shrub *Boscia senegalensis* (Pers): Lam ex-Poir (Capparaceae) on stored grain insects. *J Chem Ecol* 19: 377–389.
- Selloum L, Arrar L, Medani B, Khenchouche A, Bisker H (1995): Effect of *Cleome arabica* leaves extract on inflammatory cells response in rat. *Biochem Soc Trans* 23: S609.
- Sharaf M, Mansour RMA, Saleh, NAM (1992): Exudate flavonoids from aerial parts of four *Cleome* species. *Biochem Syst Ecol* 20: 443–448.
- Sharaf M, ElAnsari MA, Saleh NAM (1997): Flavonoids of four *Cleome* and three *Capparis* species. *Biochem Syst Ecol* 25: 161–166.
- Singh VK, Zaheer Anwar A (1989): Folk medicines of Aligarh (Uttar Pradesh), India. *Fitoterapia* 60: 483–490.
- Singh VK, Zaheer Anwar A (1994): Folk medicines in primary health care: common plants used for the treatment of fevers in India. *Fitoterapia* 65: 68–74.
- Suttisri R, Lee IS, Kingshorn AD (1995): Plant derived triterpenoid sweetness inhibitors. *J Ethnopharm* 47: 9–26.
- Smit HF, Woerdenbag HJ, Singh RH, Meulenbeld GJ, Labueker SR, Clifford AJ, Grivetti LE (1996): Carotenoid values of selected plant foods common to southern Burkina Faso, West Africa. *Ecol Food Nutr* 35: 43–58.
- Stephen AM, Churms SC, Vogt DC (1990): Exudate gums, in “*Methods in Plant Biochemistry*”. 2: Carbohydrates (Dey, PM, ed), p. 483–522, Academic Press.
- Tohda M, Thongpraditchote S, Matsumoto K, Murakami Y, Sakai S, Aimi N, Takayama H, Tongroch P, Watanabe H (1997): Effects of mitragynine on cAMP formation mediated by delta opiate receptors in NG108–15 cells. *Biol Pharm Bull* 20: 338–340.
- Toure H, Balansard G, Pauli AM, Scotto AM (1996): Pharmacological investigation of alkaloids from leaves of *Mitragyna inermis* (Rubiaceae). *J Ethnopharm* 54: 59–62.
- Tseng TH, Wang J, Kao ES, Chu HY (1996): Hibiscus protocatechuic acid protects against oxidative damage induced by tert-butylhydroperoxide in rat primary hepatocytes. *Chem Biol Interact* 101: 17–148.
- Tsichritzis F, Abdelmogib M, Jakupovic J (1993): Dammarane triterpenes from *Cleome africana*. *Phytochemistry* 33: 423–425.
- Virendra S, (1995): Herbal folk remedies of Morni hills (Haryana), India. *Fitoterapia* 66: 425.
- Von Maydell HJ (1990): Arbres et arbustes médicinaux, répulsifs et toxiques. *Arbres et arbustes du sahel*. pp. 56–63, Weikersheim - Margraf GTZ.
- Voss KA, Brennecke LH (1991): Toxicological, hematological effects of siclepod (*Cassia obtusifolia*) seeds in Sprague-Dawley rats - a subchronic feeding study. *Toxicol* 29: 1329–1336.
- Watanabe K, Yano S, Horie S, Yamamoto LT (1997): Inhibitory effect of mitragynine, an alkaloid with analgesic effect from Thai medicinal plant *Mitragyna speciosa*, on electrically stimulated contraction of guinea-pig ileum through the opioid receptor. *Life Sci* 60: 933–942.
- Yoshikawa M, Shimada H, Saka M, Yoshizumi S, Yamahara J, Matsuda H (1997): Medicinal foodstuffs. 5. Moroheya. 1. Absolute stereostructures of corchoionosides A, B, C, histamine release inhibitors from leaves of Vietnamese *Corchorus olitorus* L. (Tiliaceae): *Chem Pharm Bull* 45: 464–469.