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An ethnopharmacological survey of plants used for wound healing in Dogonland, Mali, West Africa

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Abstract

Traditional medicine, being a significant element in the cultural patrimony, still remains the main recourse for a large majority of people in Dogonland, Mali, for treating various diseases and ailments. This paper reports an ethnopharmacological study in Dogonland with the aim to identify medicinal plants used in the treatment of wounds. Information obtained from traditional healers revealed 73 plant species being used as wound healing remedies, according to the definitions of wounds given by the healers themselves. The plants, belonging to 34 plant families, are used as first aids, in the washing of wounds, extraction of pus, as coagulants, as well as for infected wounds. The most frequently used preparations are decoctions and powdered plant material.

Keywords: Wound healing; Mali; Dogonland; Medicinal plants

1. Introduction

In Mali, West Africa, the sanitary situation is characterised by a predominance of parasitic illnesses, infections and nutritional diseases together with an insufficiency of qualified health workers, medicines and equipment. To improve their state of health, people use both conventional and traditional medicines. Traditional medicine, being a significant element in the cultural patrimony, still remains the main recourse for a large majority of people for treating health problems, approximately 80% of the population use traditional medicine (Diallo et al., 1996). The traditional medicine encompasses the utilisation of substances (herbs, plants, animals and mineral elements), dosages and practices based on social-cultural norms and religious beliefs as well as witnessed experiences and observation of a specific group, mainly traditional healers and herbalists. This knowledge is handed down from generation to generation, in oral or written form.

The first research establishment for the study of medicinal plants in Mali was created in 1968. Today the establishment is called Department of Traditional Medicine (DMT), housed in the National Institute for Research in Public Health (INRSP). This department is a collaborating centre of WHO for research in traditional medicine and has as one of its main objectives to assure that traditional medicine is complementary to conventional medicine, assuming that medicines can be produced from local resources, in particular medicinal plants. The main activities of DMT are registration of traditional healers and medicinal plants, in addition to research and development of improved traditional medicines (ITMs) from local plants. In the period from 1989 to 1991 information on the medical use of medicinal plants was collected in the Gourma area, Mali. The purpose of the investigation was to explore the potential of medicinal plants and evaluate possible new uses of the plants (Diallo et al., 1999). So far DMT has developed seven ITMs, which are acknowledged as essential medicines in Mali (Diallo and Paulsen, 2000).

Traditional healers and herbalists are the main informants for DMT in the development of ITMs. A traditional healer is defined as a person with competence to practice traditional medicine. Competence is evaluated on the grounds of the person's achievements in the respective community. As a result of the collaboration between DMT and the tra-

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ditional healer, the healer is granted official recognition as a practitioner in traditional medicine and is provided with an identity card for traditional practitioners. The creation of drying centres, raw material storages and production of ITMs are some of the infrastructural improvements initiated through the collaboration. The collaboration has in addition resulted in the creation of associations for traditional healers. There are many separate organisations, and they can be founded either in an area, a village or in a part of a community or city. The essential goal of the associations is to assemble all individuals interested in the promotion of traditional medicine. Traditional medicine healers organised in healers associations may also play a role in plant conservation, as they are usually aware of the importance of plant diversity (Diallo and Paulsen, 2000).

Since 1996 the Department of Pharmacognosy, School of Pharmacy, University of Oslo, has had a research cooperation with DMT, and medicinal plants used in the treatment of wounds are a part of this research project. Wound is a collective term for conditions in which there is interruption or damage to the structural integrity of the skin or the underlying tissues. It includes abrasions, abscesses, bites, burns, blisters, boils, bruises (contusions), clean cuts (incisions), fractures, injuries, skin lesions, sores and ulcers (Onayade et al., 1996). Wound healing is a complex process involving hemostasis, inflammation, angiogenesis and regeneration of the skin (Majno and Joris, 1996).

Wounds are common in Mali and are a public health problem. Traffic accidents, rural activities, injuries, burns and fractures can be the cause. If the wounds are not well treated, they can be infected. Infected wounds heal more slowly, re-epithelialisation is more prolonged, and there is also the risk of systemic infection. The use of plants is often the first treatment for wound healing in Mali. Treating infected wounds with conventional medicines becomes too expensive for the majority of people living in Mali. Besides, these medicines are not easily accessible for the more than 70% living in rural areas.

The aim of this study was to identify what types of wounds that occur in the district of Bandiagara, Dogonland, Mali, how these wounds are treated and which plants are used in their treatment. Further studies on pharmacological effects and active compounds in the plants may substantiate the traditional uses of these plants. Medicinal plants have a vital role in the primary health care of the people in Dogonland. A study has shown that only 19.4% of current diseases has been cured by conventional medicine (Diallo et al., 1996).

The district of Bandiagara is situated within the latitudes 14–15° north and 3–3.5° west in the semi-desert Sahel. The Sahel is the part of West Africa between the Sahara Desert in the north and the forested zone of the south, a vast horizontal band stretching from the Atlantic coast into the countries of Chad and Sudan. The district of Bandiagara has a total land area of 400,000 ha and rainfall in the region varies from 400 to 600 mm per year. The largely agrarian population is dominated by people belonging to different Dogon tribes living on the plateau and cliffs of the Bandiagara Escarpment.

The plateau of Bandiagara where most of the interviews were conducted is covered in a typically Sudanian savannah flora. The landscape consists primarily of well-dispersed trees, the most common being various species of acacia, like *Acacia albida* and *Acacia nilotica*, in association with communities of *Daniellia oliveri*, *Butyrospermum parkii*, *Parkia biglobosa*, *Terminalia macroptera*, *Khaya senegalensis*, *Prosopis africana*, *Lannea microcarpa*, *Combretum glutinosum* and brush species such as *Combretum micranthum* and *Guiera senegalensis*. All these species are used in the traditional medicine (Keita and Coppo, 1993; Lonely Planet, 1999).

2. Methodology

An ethnopharmacological survey was carried out in the district of Bandiagara (212,300 inhabitants), Dogonland, Mali, from January 2000 to March 2002 (Fig. 1). The villages and healers to be interviewed were selected randomly and no appointments were made prior to the visits. A total of 37 healers from 22 different villages were interviewed during the 2-year period. Mature men dominate the practice of traditional medicine, 35 of the interviewed healers were men with an average age of 65 years.

Conversations with the healers were used to obtain information. The healers were asked to give their definitions and classification of wounds and describe how the different wound types are treated. Where the treatment included the use of plants, the information collected also included methods of preparation, details of administration, including the approximate amounts and number of doses per day or week. Local names of the plants and wound types were also recorded. The plant material described was identified by DMT, Bamako, Mali, and voucher specimens are deposited in the herbarium at DMT.

As there is a diversity of local dialects in the area (given in Table 1) the interviews were conducted through a local translator knowledgeable in both the local names and the Latin names of the plants, in addition to a local medical doctor that could correlate the description of the “wounds” with conventional medical terms. The translator and the medical doctor were both from the Centre of Traditional Medicine, Bandiagara.

The traditional healers who were not already a part of the Centre of Traditional Medicine in Bandiagara, were registered. Prior to the interviews the healers were given information about the project, participants and goals. In respect of tradition, gifts of cola nuts and money were bestowed upon the traditional healers. The conversations with the healers are built on trust with the common goal to improve the health situation in the country and increase the knowledge on medicinal plants.

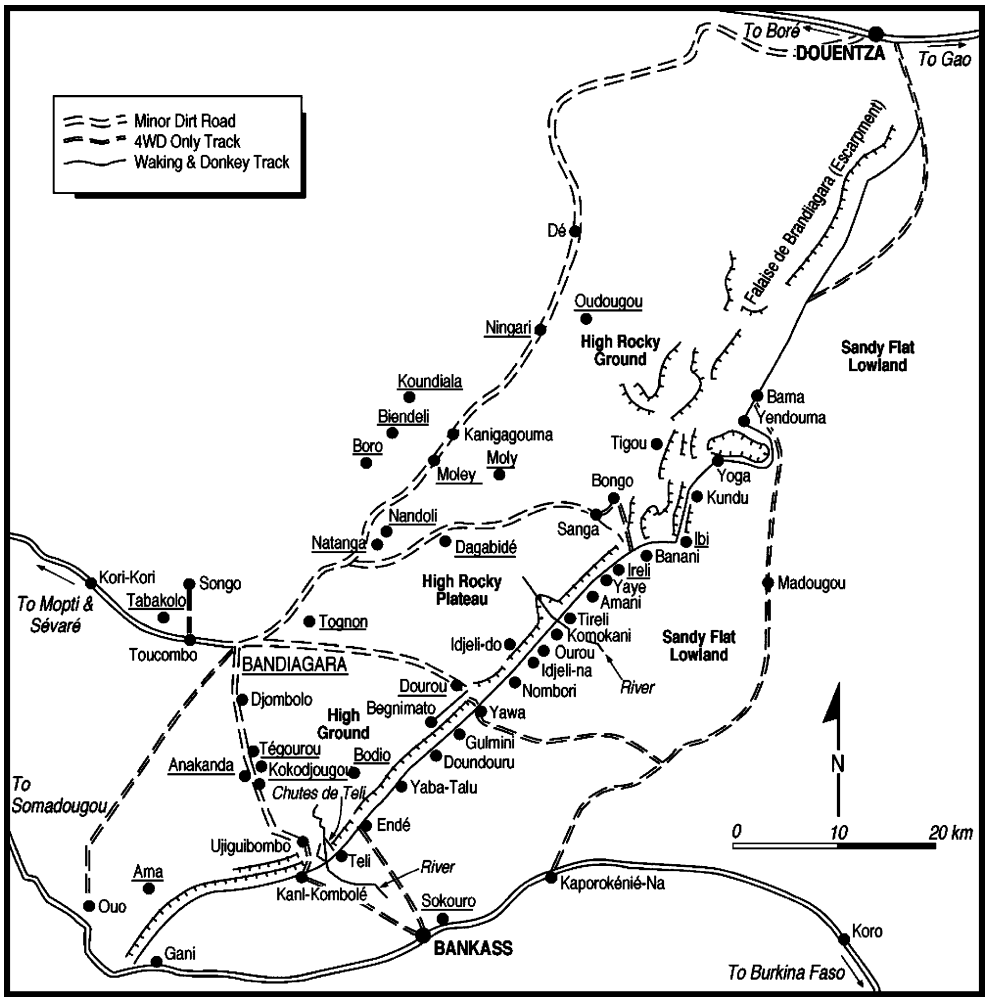

Fig. 1. Map of Dogonland. The villages visited are underlined.

3. Results and discussion

The results of the survey are presented in Table 1. The traditional healers classify the wounds according to the origin of the wound, the localisation, and whether the wound is new or old. The treatment can differ according to these conceptions. Wounds caused by injury with a sharp object, like a knife or a hatchet, is classified as a new wound at the moment of injury. Old wounds are more than 1-year-old, and the healers find them difficult to cure. They often say that these wounds are provoked by a curse. The healers also make a difference between wounds and burns and the localisation of the wounds. The healers pay special attention to wounds on the sexual organs, wounds in the mouth and internal wounds (Diallo, 2000). The healers in addition reported otitis, fractures, insect stings, snakebites, gastric ulcer and scabies.

While burns, snakebites and insect stings do not fall under the medical definition of a wound, they can result in deterioration of the skin, e.g. after scratching, and hence lead to wounds. According to this, the healers' definition of a wound includes, in addition to common wounds, ailments where blood is present and conditions, like insect stings that may lead to wounds. Blood in the urine or feces are taken as an indication of internal wounds. Internal wounds are often connected to internal worms or to schistosomiasis (bilharzia). The guinea worm (*Dracunculus medinensis*), a common human parasite, especially in Africa, leads to wounds as the larvae are discharged into environment through an ulcer in the skin of the leg caused by the worm.

Seventy-three species belonging to 34 plant families were reported being used as wound healing remedies by the traditional healers in Dogonland, the most common plant families being Fabaceae (17 plants) and Combretaceae (6 plants) (Table 1). The plants are used as first aids, in the washing of wounds, extraction of pus, as coagulants, as well as for infected wounds. Leaves and roots are the most frequent plant parts used, constituting about 22 and 24% of the preparations, respectively, followed by stem bark and fruits (12% of each). The plants used by the healers are listed under their respective families, which are arranged alphabetically together with their Latin and vernacular names. Plant parts used, preparations, wound types and locality of the interviews are also included in Table 1.

Table 1
Medicinal plants used in the treatment of wounds in Dogonland, Mali, West Africa

Plant family/scientific name/local name (dialect)	Plant part used and preparation of the remedy	Wound types (local name of the wound)
Acanthaceae		
Blepharis linariaefolia Pers.		
Yaanso (tèngu kaan)[1]	Aerial parts. A decoction is used as a wash and powder of dried plant material is applied	All kinds of wounds
Yawotanjomolo (tonmo soo)[2]	Seeds. A powder mixed with oil from the seeds of *Lannea microcarpa* or *Sesamum indicum* applied	Otitis (“Sugulujim”)
Anacardiaceae		
Lannea microcarpa Engl. & Krause		
Saa (donno soo)[3]	Leaves (fresh). Heated in oil from the seeds, applied	Internal wounds caused by worms (“Yoro”)
Saa (donno soo)[7]	Fruits. A decoction mixed with dried stem and leaves from *Cissus quadrangularis* is drunk	Internal wounds caused by Bilharzia
Saa (tengi soo)[4]	Fruit. Dried fruit is carbonised, mixed with oil from the fruits and applied	Wounds associated with lips and mouth (“Kan-mei”)
Kuree (dogulo soo)[5]	Seeds. Hot ash in a cloth dipped in oil from the seeds and applied	Big boils, severely inflammated (“Dindin mina”)
Saa (tèngu soo)[6]	Seeds. Oil from the seeds mixed with a powder of seeds from beans and applied	Circular wounds (“Nenuwemei”)
Saa (toro soo)[2]	Gum. A decoction is used as a wash	Chronic wounds
Spondias mombin L.		
Enin (dogulo soo)[5]	Stem bark. A powder is applied	Big boils (“Gomoogu”)
Annonaceae		
Annona senegalensis Pers.		
Jankoonno (tomoso)[7]	Roots and leaves. A decoction is drunk and used as a bath	Gastric ulcer and gastritis (“Binisugu butu”)
Hexalobus monopetalus Engl. & Diels		
Gonjo (tonmo soo)[2]	Roots. A decoction is used as a wash	Snake bites (“Yireeminu”)
Apocynaceae		
Saba senegalensis (A.DC.) Pichon		
Kambè (tonmo soo)[2]	Fruit (green). A decoction is used as a wash	Small boils (“Kunju”)
Kaamu (dogulo soo)[8]	Fruit (green). Hot seeds are used in order to stop the inflammation	Boils (“Anjuminu”)
Kambee (dogulo soo)[9]	Seeds. Oil from the seeds is applied	Wounds/cracks on the feet (“Nakiri”)
Kambee (dogulo soo)[9]	Roots. A decoction is drunk and used as a bath	Scabies
Asclepiadaceae		
Calotropis procera (Aiton) W.T. Aiton		
Anranpobo (tonmo soo)[2]	Fruit (dried). A powder is applied	Inflammation of the breast (“Irujim”)
Poobu (toro soo)[2]	Latex. Applied as a wound closure	New wounds (“Banrun”)
Pumpum (teng soo)[10]	Latex. Applied and left to dry	New wounds (“Baarum”)
Anranpobo (tonmo soo)[2]	Roots (dried). A powder mixed with butter from oil of the seeds of *Butyrospermum parkii* applied	Inflammation on legs, arms and back (“Gaama anran”)
Poobu (donno soo)[11]	Roots (dried internal bark). A powder applied	New wounds (“Barma”)
Caralluma dalzielii Br.		
Sukulaga (tomoso)[7]	Stem. Liquid obtained by heating the trunk applied	Otitis (“Sukunenè”)
Caralluma retrospiciens N.E. Br.		
Omolobakadma (tommo soo)[12]	The upper part of the plant. A powder is applied	Boils (“Anja mirun”)
Dululu (dogulo soo)[8]	Juice from a plant without leaves. Coagulant	Open wounds (“Nadongu”)
Dululu (dogulo soo)[9]	Latex from the stem	New wounds
Bignoniaceae		
Stereospermum kunthianum Cham.		
Popolo (toro soo)[2]	Roots. A decoction is used as a wash and a powder is applied	Chronic wounds
Bombacaceae		
Adansonia digitata L.		
Oro (teng soo)[10]	Stem bark. A decoction is used as a wash	Old wounds (>3 years) (“Miin pin hu”)
Oro (tommo soo)[12]	Stem bark. A powder is applied	Small boils (“Taltal”)
Oro (teng soo)[13]	Stem bark. Juice from fresh bark or powder of dried bark is applied	Many small inflammated boils (“Yaanga-yang”)
Oro (tommo soo)[14]	Moss or lichen (“Nyengegi”). A powder mixed with oil from seeds of *Lannea microcarpa* (“Saa”) applied	Deep boils (“Taltal”)

Table 1 (*Continued*)

Plant family/scientific name/local name (dialect)	Plant part used and preparation of the remedy	Wound types (local name of the wound)
Oro (toro soo)[2]	Roots. A decoction is used as a wash	Chronic wounds
Bombax costatum Pellegrin & Vuillet		
Togole (tomoso)[7]	Bark (external). A powder is applied	Wounds
Togee (tommo soo)[2]	Roots or stem bark. A decoction is used as a steam bath and drunk	Inflammation
Burseraceae		
Commiphora africana (A. Rich.) Engl.		
Manjara mabin (toro soo)[15]	A mixture of *Commiphora africana*, *Balanites aegyptica*, sulfur and potash applied	Old, infected wounds (“Gaana”)
Capparidaceae		
Boscia senegalensis (Pers.) Lam. ex Poir.		
Èlè (tomoso)[7]	Roots. A decoction is used as a steam bath and drunk	Internal wounds caused by Bilharzia (“Ngirkisé”)
Combretaceae		
Anogeissus leiocarpa Guill. & Perr.		
Sigilu (toro soo)[2]	Leaves (dried). A powder mixed with water is applied	Burns (“Yaanhu”)
Combretum ghasalense Engl. & Diels		
Gujapilu (dogulo soo)[9]	Leaves (fresh). A decoction is used as a wash. A powder of young, dried leaves is applied	New wounds
Combretum glutinosum Perr. ex DC.		
Bannakile (tonmo soo)[2]	Leaves or roots. A powder is applied	Wounds
Dujopilu (dogulo soo)[16]	Leaves. A powder is mixed with water and applied	New wounds
Ghjopilu (donno soo)[17]	Leaves (dried, young, red). A powder is applied	New wounds (“Barmu”)
Combretum micranthum G. Don		
Kéké (donno soo)[11]	Leaves (young) and roots. A decoction of leaves is used as a wash. A powder of internal root bark applied	Old wounds (“Minu pei”)
Kéké (toro soo)[2]	Seeds (dried) and stem bark (inner part, dried). A powder is used as a coagulant	New wounds (“Banrun”)
Kuyo (tonmo soo)[2]	Stem bark. Mixed with inner root bark of *Waltheria americana* + butter from *Butyrospermum parkii* and applied	Insect stings (“Onguyèngèlè mimuminu”)
Kéké (donno soo)[2]	Roots (bark). A powder is applied	New wounds (“Baannu”)
Kuyo (tonmo soo)[14]	Roots. Juice of the exterior parts is applied	Burns (“Yang”)
Guiera senegalensis J.F. Gmel.		
Gorugo (tèngu soo)[2]	Leaves (fresh). The juice is applied	New wounds (“Baarmu”/“Baanhi”)
Goorugo (teng soo)[2]	Leaves (fresh). The juice is applied	New wounds (“Baarum”)
Toniburu (dogulo soo)[5]	Leaves. The leaves or juice from the leaves applied	New wounds (“Mina banrun”)
Gorugo (tèngu soo)[6]	Leaves (fresh). The juice is applied	New wounds (“Banhi”)
Goorugo (teng soo)[10]	Leaves. The juice is applied	New wounds (“Miin kaana”)
Toniburu (dogulo soo)[18]	Stem with leaves. Burnt with roots of *Securidaca longepedunculata*. The smoke is inhaled	Wounds due to satan (“Ogulubelem”)
Toniburu (dogulo soo)[8]	Fruit (dried). A powder mixed with butter from oil of the seeds of *Butyrospermum parkii* (“Mina”), *Lannea microcarpa*(“Puree”) or *Arachis hypogea* (“Elgele”) applied	Itching, small boils on head (“Kuu kenhu”)
Toniburu (dogulo soo)[16]	Fruit. A powder mixed with milk or coffee is drunk	Internal wounds
Goburu (toro soo)[19]	Roots (bark). The juice is applied	New wounds (“Banru”)
Gorubu (donno soo)[20]	Roots. A powder mixed with butter from the oil of the seeds of *Butyrospermum parkii* (“Munjo”) to a paste is applied	Small boils containing liquid (“Modokudu”)
Terminalia macroptera Guill & Perr.		
Gaduba (tonmo soo)[2]	Fruit. Mixed with fruit of *Ficus sur* + inner root bark of *Balanites aegypticaiaca* and applied	Snake bites (“Yireeminu”)
Bodokubo (tommo soo)[14]	Stem bark (internal). Carbonised, powdered and mixed with oil from *Lannea microcarpa* (“Saa”) to a paste	Boils appearing spontaneously (“Jorogoii”)
Compositae		
Centaurea perrottetii DC.		
Injeinjeju (tommo soo)[14]	Upper part. Carbonised, powdered, mixed with oil from *Lannea microcarpa* (“Saa”) and applied	Deep boils (“Taltal”)
Gaana keeru (tonmo soo)[2]	Whole plant (dried). A decoction is used as a wash and a powder is applied	Inflammation (having lasted for a long time) (“Gaana”)

Table 1 (*Continued*)

Plant family/scientific name/local name (dialect)	Plant part used and preparation of the remedy	Wound types (local name of the wound)
Crassulaceae		
Bryophyllum pinnatum (Lam.) Oken		
Sugulujiinloo (donno soo)[2]	Leaves. The juice is applied	Otitis (“Sugulujin”)
Cucurbitaceae		
Citrullus vulgaris Schrad. ex Eckl. & Zeyh.		
Gamu (teng soo)[13]	The peduncles (stalk of fruits). Mixed with butter from the oil of the seeds of *Butyrospermum parkii* (“Miyu ningu”) to a paste and applied	Boils (“Agnaran mii”)
Cucurbita pepo Linn.		
Gonron (tengi soo)[4]	The peduncles (stalk of fruits). Calcinated, mixed with butter from the oil of the seeds of *Butyrospermum parkii* to a paste and applied	Boils (“Ayaanra -meï”)
Euphorbiaceae		
Chamaesyce hirta (L.) Millsp		
Peelegreeiir (donno soo)[2]	The whole plant (fresh). A decoction is drunk	Internal wounds caused by Bilharzia (jari Tintin)
Euphorbia balsamifera Ait.		
Gommuju (toro soo)[2]	Roots (bark). A decoction is used as a wash	Chronic wounds
Euphorbia sudanica A. Chev		
Teenju (toro soo)[2]	Stem. A powder is applied	Leaking wounds (“Poro”)
Tègnu (dogulo soo)[16]	Latex.	New wounds
Teegnu (tonmo soo)[2]	Roots. A decoction of roots is used as a wash	Small boils on the body (“Poro”)
Securinega virosa Baill.		
Segedere (donno soo)[2]	Leaves (dry). A powder is applied.	Boils
Ségélé (tonmo soo)[2]	Leaves (young). A decoction is used as a wash and drunk	Small boils all over the body (“Toogo”)
Sèsègèrè (teng soo)[10]	Stem and leaves. A decoction is used as a wash and a powder is applied	Boils on head and neck (“Baara nan miin”)
Sèsègèrè (teng soo)[10]	Roots and leaves. A decoction is used as a wash and drunk. A powder of the leaves is applied	Big, old infected wounds (“Danran waaga”)
Fabaceae		
Acacia nilotica (L.) Willd. ex Delile var. *adansonii* (Guill & Perr.) Kuntze		
Baala (dogulo soo)[8]	Leaves or fruits. Juice from the leaves or a powder of dried fruits is applied	New wounds (“Baarum”)
Bara (tengi soo)[4]	Fruit (dried) A powder is applied	Old wounds (“Danna-wagaa” or “Mii-pein”)
Baala (dogulo soo)[8]	Fruit (dried). A powder is applied	Open wounds (“Nadonyu”)
Baala (tommo soo)[14]	Fruit. A powder mixed with water is used as a wash. A powder is applied	New wounds (“Baanrun”)
Baala (dogulo soo)[16]	Stem bark. A decoction is used as a wash	All kinds of wounds
Baara (toro soo)[19]	Root bark. A decoction is drunk and used as a bath	Genetial wounds (“Sopise”)
Baara (toro soo)[19]	Roots. A powder is applied	Boils (“Agnumiirun”)
Bauhinia reticulata DC.		
Koibo (donno soo)[2]	Roots (fresh). The juice is applied	New wounds (“Barmu”)
Koiboii (toro soo)[19]	A decoction of root/stem bark is used as a wash. A powder of dried, green fruit peel is applied	Chronic wounds (“Miirunpei”)
Bauhinia rufescens Lam.		
Séségéré (teng soo)[13]	Leaves and fruit (dried). A powder is applied	Mycosis on the head of children (“Aramakaja”)
Cassia italica (Mill.) Lam. Ex F.W. Andrews		
Anrangun gangalu (tommo soo)[2]	Stem with leaves (dried). A decoction is used as a wash and a powder is applied	Small boils (“Taltal”)
Cassia podocarpa Guill. & Perr.		
Anranwee (teng soo)[13]	Leaves and stem bark. A decoction is used as a wash. A powder of stem bark is applied	Itching leading to wounds (“Moronpoudjo”)
Cassia sieberiana DC.		
Pèlpèlmun’gu (toro soo)[2]	Fruit (dried). A powder is applied	Chronic wounds

Table 1 (*Continued*)

Plant family/scientific name/local name (dialect)	Plant part used and preparation of the remedy	Wound types (local name of the wound)
Detarium senegalense J.F. Gmel.		
Ponnu-Konkon (tomoso)[7]	Leaves of the gui. A decoction is used as a steam bath and drunk	Boils (“Hogufugula”)
Poondu (tommo soo)[2]	Stem bark. A decoction is used as a wash. A powder mixed with sesame oil is applied	Burns caused by hot oil or water (“Yaangu”)
Pondu (dogulo soo)[5]	Trunk bark. A fine powder is applied	Old infected wounds (“Mina dioo”)
Dichrostachys cinerea (L.) Wright & Arn.		
Pogo (donno soo)[2]	Roots. A powder of ash + water is applied and drunk	Internal wounds caused by worms (“Yoro”)
Entada africana Guill. & Perr		
Balayolo (tomoso)[7]	Leaves and roots. Mixed with *Gardenia sokotensis* leaves and butter of the oil from the seeds of *Butyrospermum parkii*. A decoction is used as a bath, steam bath and drunk	Internal wounds (“Kélénunron”)
Aala aala (donno soo)[2]	Fruit. A powder is applied	Breast inflammation
Aala aala (dogulo soo)[16]	Trunk bark (dry). A powder mixed with butter from *Butyrospermum parkii* applied	Inflammation
Faidherbia albida (Delile) A. Chev.		
Sènginii (donno soo)[2]	Fruit (1-year-old). The seeds are eaten	Prevents Guinea worm (“Yoro”)
Parkia biglobosa (Jacq.) R. Br. ex G. Don		
Porgu (dogulo soo)[9]	Leaves or pods[BP1] (dried). A powder of both or one of the parts is applied	New and old wounds
Yulo (tonmo soo)[2]	Stem bark. A decoction is used as a wash	New wounds (“Too-coupuu”)
Yulo (tomoso)[7]	Bark. A decoction	Mouth sores
Phaseolus vulgaris L.		
Nii (tèngu soo)[2]	Seeds. A powder of carbonised seeds is applied	Wounds caused by ants (“Manga mii”)
Phaseolus sp.		
Nun (toro soo)[15]	Leaves. Mixed with a powder of peas and applied	Boils on the fingers (“Kékéré”)
Prosopis africana(Guill. et al.) Taub.		
Kilè (dogulo soo)[16]	Stem bark (dried). A powder is applied	New wounds
Senna occidentalis (L.) Link		
Guinjimognu (teng soo)[21]	Leaves. A decoction is used as a wash and a powder is applied	All kinds of wounds
Kangalaguno (donoso)[2]	Fruit. The seeds from the fruit are eaten	Prevents Guinea worm (“Yoro”)
Tamarindus indica Linn.		
Somee (dogulo soo)[9]	Leaves. A decoction is used as a wash	Insect- and snake bites
Omolo (teng soo)[10]	Leaves. A decoction is used as a wash	New wounds (“Miin kaana”)
Omolo (teng soo)[21]	Leaves. A decoction is used as a wash and a powder is applied	All kinds of wounds (except fractures)
Omulu (donno soo)[22]	Leaves. A decoction is applied while hot	New wounds (“Banrun”)
Somee (dogulo soo)[9]	Leaves or stem bark (dried). Applied	Internal wounds caused by worms (“Yoro”)
Omogon (tomoso)[7]	Gum. A powder is applied	Odontitis
Somee (dogulo soo)[18]	Bark. A powder mixed with a powder of fruit from *Hibiscus sabdariffa* is applied	Old wounds
Vigna unguiculata (L.) Walp.		
Nimu (teng soo)[2]	Seeds. Carbonised, powdered and applied	Insect stings (“Magamei”)
Gramineae		
Pennisetum typhoides Trin.		
Yooro (toro soo)[2]	Seeds. The shell of the seeds are boiled and applied to prevent tetanus	Deep wounds (a type of new wound) (“Banrun”)
Hernandiaceae		
Gyrocarpus americanus Jacq. spp. *Pinnatilobus* Kubitziki		
Polon polon (donno soo)[3]	Leaves (fresh). Crushed and applied	Scabies (“Kunju”)
Labiatae		
Hyptis spicigera Lam.		
Dunumajinjin (tèngu kaan)[1]	Aerial parts. A decoction is used as a wash and a powder is applied	New and old wounds (“Koin-kèjè”)

Table 1 (*Continued*)

Plant family/scientific name/local name (dialect)	Plant part used and preparation of the remedy	Wound types (local name of the wound)
Hyptis suaveolens Poit.		
Does not have a Dogon-name[2]	Leaves. The juice is applied	New wounds
Loganiaceae		
Strychnos spinosa Lam.		
Does not have a Dogon-name	Seeds. A powder mixed with soup is eaten	Internal wounds caused by worms ("Béré susu")
Grows further south[19]	Seeds. A powder of the seed capsules are applied	All kinds of wounds
Malvaceae		
Ceiba pentandra Gaerth.		
Genhu (donno soo)[2]	Leaves. A decoction is used as eye drops	Wounds in the eyes ("Girukuunu")
Gossypium barbandense L.		
Kèmènè (donno soo)[2]	Leaves (fresh). Juice + water used as eye drops	Conjunctivitis ("Girukuunu")
Hibiscus sabdariffa L.		
Anjukooro (teng soo)[2]	Flowers (dry). A macerate and a powder are applied	Wounds in the nostrils ("Jindongo")
Anje (dogulo soo)[18]	Fruit. A powder mixed with a powder of bark from *Tamarindus indica* is applied	Old wounds
Meliaceae		
Khaya senegalensis (Desr.) A. Juss.		
Pèlu (tonmo soo)[2]	Stem bark with leaves. Mixed with the trunk of *Cissus quadrangularis*. A decoction is drunk	Boils caused by supernatural spirits ("Goommu")
Pèlu (tonmo soo)[2]	Stem bark (dried). A powder is applied	Boils caused by supernatural spirits ("Goommu")
Peeu (teng soo)[10]	Stem bark. A decoction is used as a wash and a powder is applied	Boils, mainly with children ("Toogo")
Pèlu (donno soo)[1]	Bark (trunk, dried). A powder mixed with butter from *Butyrospermum parkii* to a paste is applied	Cracks on the feet ("Monno-koju")
Pèlu (donno soo)[1]	Bark. Mixed with the aerial parts of *Hyptis spicigera*. A decoction is used as a wash	New and old wounds
Pèlèn (dogulo soo)[9]	Bark (inner trunk). A powder is applied	Insect- and snakebites
Pèlèn (dogulo soo)[9]	Bark (external trunk, dried). A decoction is used as a wash and a powder is applied	Wounds all over the body and chronic wounds
Azadirachta indica A. Juss.		
Gonji (teng soo)[21]	Leaves (dried or fresh). A decoction is used as a wash and a powder is applied	All kinds of wounds
Moraceae		
Ficus sur Forssk.		
Gaa (tonmo soo)[2]	Fruit. Mixed with fruit from *Terminalia macroptera*, root bark from *Balanites aegyptica* and applied	Snakebites ("Yireeminu")
Kumupiiru (teng soo)[21]	The peduncles (stalks of flower/fruit). Mixed with oil of seeds from *Butyrospermum parkii* and applied	Boils
Gaa (tèngu soo)[2]	Stem bark. The latex is applied	Boils caused by earthworms ("Yaanga-yang")
Gaa (tèngu soo)[2]	Bark. The latex is applied	Leaking wounds ("Yaangayin")
Kumupiiru (teng soo)[21]	Bark (dried). A powder is applied	Mouth sores
Olacaceae		
Ximenia americana L.		
Onombani (donno soo)[11]	Roots (dried). A powder of internal bark is applied	Insect sting leading to boils, a curse ("Yaanga-kein")
Opiliaceae		
Opilia celtidifolia (Guill. & Perr.) Endl. ex Walp.		
Ciso (tomoso)[7]	Leaves and roots. A decoction is applied	Scabies ("Kunju")
Pedaliaceae		
Sesamum indicum L.		
Poli (tonmo soo)[2]	Oil. Mixed with a decoction of any kind of plant and applied	Haemorrhoids ("Dumogoi")
Polygalaceae		
Securidaca longepedunculata Fresen.		
Toro (teng soo)[10]	Roots. A powder is applied	Wounds in the nostrils ("Jindingon")

Table 1 (*Continued*)

Plant family/scientific name/local name (dialect)	Plant part used and preparation of the remedy	Wound types (local name of the wound)
Toro (teng soo)[10]	Roots (internal bark, dried). A powder is applied	Scabies (“Kuyun”)
Toro (donno soo)[11]	Roots (internal bark, dried). A powder is applied	Insect sting leading to boils, curse (“Yaanga-kein”)
Tooroo (dogulo soo)[18]	Roots. Burnt with stem and leaves from *Guiera senegalensis*. The smoke is inhaled	Wounds due to satan (“Ogulubelem”)
Rhamnaceae		
Ziziphus mauritiana Lam.		
Oruwo (toro soo)[15]	Leaves. Fresh leaves are applied	Boils on the fingers (“Kékéré”)
Rubiaceae		
Feretia apodanthera Delile		
Gigiree (tommo soo)[14]	Roots (bark, dried). A powder is mixed with water and used as a wash. A powder is applied	Old, infective wounds (“Gaana”)
Gardenia sokotensis Hutchinson		
Tongologala (tomoso)[7]	Leaves. Mixed with *Entada africana* roots, leaves and butter of *Butyrospermum parkii*. A decoction is used as a bath, steam bath and drunk	Internal wounds (“Kélénunron”)
Mitragyna inermis Kuntze		
Sadeene (donno soo)[2]	Leaves (fresh or dry). The vapour of a decoction is inhaled.	Boils
Sadeene (donno soo)[2]	Roots or stem with leaves. A decoction applied	Small boils (“Satègèlè”)
Sapotaceae		
Butyrospermum parkii Kotschy		
Miyun nii (toro soo)[2]	Seeds. Hot oil from the seeds is applied	Deep wounds, a type of new wounds (“Banrun”)
Minjugu (dogulo soo)[8]	Seeds. Oil from the seeds is applied	Burns (“Googo”)
Minjugu (dogulo soo)[9]	Seeds. Butter from the seeds are mixed with cotton from *Ceiba pentandra* and applied	Old wounds (“Mirun pei”)
Minju (tonmo soo)[2]	Stem bark and leaves. The vapour from a decoction is inhaled. A powder mixed with butter from oil of the seeds of sesame oil, *Lannea microcarpa* or *Butyrospermum parkii* applied	Inflammation (“Kiru”)
Simaroubaceae		
Balanites aegyptica Wall.		
Monron (toro soo)[19]	Protuberance. Carbonised with *Solanum incanum* stem, mixed with water or butter of *Butyrospermum parkii* and applied	Boils (“Taa”)
Moolo (tonmo soo)[2]	Roots (internal bark). Mixed with fruit of *Ficus sur*, fruit of *Terminalia macroptera* and applied	Snake bites (“Yireeminu”)
Monron (toro soo)[15]	A mixture of *Balanites aegyptica*, *Commiphora africana*, sulfur and potash is applied	Old, infected wounds (“Gaana”)
Solanaceae		
Capsicum annuum L.		
Keepel (tengi soo)[4]	Fruit. Carbonised, mixed with butter from *Butyrospermum parkii* and applied	Small, itching boils all over the body (“Kuu-kenhu”)
Solanum incanum Linn.		
Sonhugrèèpujoro (toro soo)[19]	Stem. Carbonised with *Balanites aegyptica* protuberance, [A2] mixed with water or butter of *Butyrospermum parkii* and applied	Boils (“Taa”)
Inrimbudu (toro soo)[2]	Stem with leaves. A decoction is used as a bath	Wounds on the head or in the groin “Bolokogno”)
Sterculiaceae		
Waltheria americana L.		
Kaanbeelu (tonmo soo)[2]	Roots (inner bark). Mixed with butter of *Butyrospermum parkii* and applied	Insect stings (“Onguyèngèlè mimuminu”)
Yin onwan (teng soo)[10]	Roots. A decoction is used as a wash	Small boils containing liquid (“Jojoro”)
Yang anwan (toro soo)[15]	Roots (external bark). A decoction is used as a wash and a powder applied	Old, infected wounds (“Gaana”)
Yang anwan (toro soo)[15]	Roots. A decoction is used as a wash and a powder is applied	Boils (“Anju mirun”)

Table 1 (*Continued*)

Plant family/scientific name/local name (dialect)	Plant part used and preparation of the remedy	Wound types (local name of the wound)
Yang anwan (toro soo)[19]	Roots (bark). The juice is applied	New wounds (“Banru”)
Yang anwan (toro soo)[19]	Roots. A powder is applied	Boils (“Agnumiirun”)
Tiliaceae		
Grewia bicolor Juss.		
Yooro (donno soo)[2]	Roots (inner bark). The juice is applied or a decoction is made if water is available	New wounds (“Barmu”)
Vitaceae		
Ampelocissus grantii (Baker) Planch.		
Enèginnu-omulu (donno soo)[1]	Leaves (dry). A powder is applied	Old wounds (up to 2–3 years old)
Omolosaa (donno soo)[20]	Roots. A powder of the tubercles is applied	Chronic wounds (“Menunpei”)
Cissus populnea Guill. & Perr.		
Jumbo (donno soo)[1]	Roots (dry). A powder is applied against external wounds. A powder mixed with water is drunk against internal wounds	New wounds, external and internal (“Kidè kèju”)
Cissus quadrangularis L.		
Ogonujaala (toro soo)[2]	Aerial parts (except leaves). Heated, the liquid is applied. Prevents tetanus and acts as a coagulant	Deep wounds, a type of new wounds (“Banrun”)
Zarnazaru (donno soo)[1]	Stem with leaves (dry). A powder is mixed with a decoction of fruit from *Lannea microcarpa* and drunk	Internal wounds caused by Bilharzia
Ogonujaala (toro soo)[2]	Stem. Mixed with butter from *Butyrospermum parkii, Lannea microcarpa* or sesame oil, boiled, cooled and applied	New wounds (“Bannu”)
Oongoonujaara (dogulo soo)[9]	Stem bark. The juice is applied	New wounds
Ongonzala (tonmo soo)[2]	Trunk. Mixed with *Khaya senegalensis* stem bark and lesves. A decoction is drunk	Boils caused by supernatural spirits (“Goommu”)

The superscript numbers are referring to the villages where the information was collected: [1]Bodio, [2]Bandiagara, [3]Dagabidé, [4]Kokodjougou, [5]Nandoli, [6]Dourou, [7]Ama, [8]Natanga, [9]Koundiala, [10]Sokouro, [11]Tégourou, [12]Oudougou, [13]Tabakolo, [14]Ningari, [15]Ireli, [16]Boro, [17]Moly, [18]Bendieli, [19]Ibi, [20]Tognon, [21]Anakanda, [22]Moley (Fig. 1).

The most common ways of treatment seems to either be using a decoction as a wash followed by application of a powder of plants or applying a plant powder directly on the wound. The plant material is often carbonised before pounding. A maceration of a powder from a plant and oil from the seeds of *Lannea microcarpa* (Anacardiaceae), or butter from oil the seeds of *Butyrospermum parkii* (Sapotaceae) is also a frequently used preparation, as well as juice obtained from leaves or roots by squeezing or heating. The treatments are usually repeated every day until the wounds are healed. Bandages most often consist of whole, fresh leaves or a cloth of cotton.

A literature search on biological activity and medicinal uses on most of the plants in Table 1 has been carried out (Aasberg, 2001). According to the literature search there is limited information on many of the plants, especially regarding wound healing effects. This includes both common wounds and wounds as described by the traditional healers interviewed. *Cissus quadrangularis* (Vitaceae), *Guiera senegalensis* (Combretaceae) and *Butyrospermum parkii* (Sapotaceae) are three plants frequently used by the healers in Dogonland. *Cissus quadrangularis* was reported by five of the interviewed healers, three of them in the treatment of new wounds. According to the literature search, *Cissus quadrangularis* is used in Niger and the Ivory Coast to treat skin disorders and fresh leaves are applied to burns in Guinea and Senegal (Neuwinger, 1996). An acetone extract of stem and leaves has shown to exhibit significant anti-inflammatory activity (Vetrichelvan et al., 1999). A methanolic extract of the stem of *Cissus quadrangularis* has been demonstrated to possess fracture-healing activity. The extract revealed faster initiation of healing process than the control animals (Deka et al., 1994).

Guiera senegalensis is reported being used for wound healing by 10 of the healers interviewed, 6 of them for treating new wounds, 5 of these using the leaves. In Senegal leaves of *Guiera senegalensis* are applied to wounds and sores in the mouth, in Nigeria the leaves are used to treat skin infections and inflammatory swelling and in the Soudanian region against skin diseases (Burkhill, 1985). A decoction and methanolic extract of the leaves have shown mild antibacterial activity against Gram-positive bacteria, antiradical effect and inhibition of elastase. Wound healing is a multifactor process where microbial infections and the formation of free radicals may contribute to retard or inhibit the resolution. Free radicals can oxidise the endogenous inhibitors of proteases, thus reducing their ability to inhibit elastase and the other proteases responsible for the deterioration of the extra-cellular matrix (Bosisio et al., 1997; Kudi et al., 1999).

Butyrospermum parkii is frequently used by the traditional healers, both alone and in macerations with other

plants. *Butyrospermum parkii* is used for treating wounds in many African countries (Cameroon, Ghana, Ivory Coast, Benin, Senegal, Nigeria, Mali), usually the bark, latex or oil. Antibacterial activities against Gram-positive and Gram-negative bacteria have been demonstrated by leaf and bark extracts from the plant (Kudi et al., 1999).

An ethnopharmacological study conducted in the Bamako Region, Mali, in the period 1998–1999 led to the identification of 123 plant species, belonging to 50 plant families, being used in the treatment of wounds in this region (Diallo et al., 2002). Thirty-four of the 73 plant species identified and used in the treatment of wounds in Dogonland were also reported by traditional healers in the Bamako Region for being used as wound healing remedies. The traditional healers in the two regions have the same classification of wounds and use the same modes of preparations. The wounds are usually first washed with a decoction of the plant, followed by application of a powder of the plant material.

The Bamako Region differs from Dogonland in both geographic and ethnographic characteristics. While Dogonland is situated in the semidesert Sahel, the Bamako Region lies in the more well watered south, and is the most densely populated area in Mali. The most prominent ethnic group in the Bamako Region is the Bambara, the largest ethnic group in Mali. The fact that the traditional healers in the two distinct regions of the country seems to be using many of the same plants in the treatment of wounds, and use the same modes of preparation, further supports the traditional use of these plants.

4. Conclusion

In the present study 73 species belonging to 34 plant families have been identified being used as wound healing remedies by healers in Dogonland, Mali. Plants used for the treatment of wounds can have different properties like, anti-inflammatory, anti-microbial, healing, analgesic, haemostatic and immuno-modulating activities. The immune system is an important factor in the process of healing a wound, and several papers have reported effects of plant polysaccharides on the immune system (Yamada and Kiyohara, 1999; da Silva and Parente, 2001; Diallo et al., 2002). Polysaccharides from several of the plants used in the treatment of wounds as described by the healers in Dogonland are now being screened for possible immune stimulating activities.

So far polysaccharides isolated from water extracts of the root bark, stem bark and leaves of *Annona senegalensis* (Annonaceae), stem bark and leaves of *Stereospermum kunthianum* (Bignoniaceae), root bark, stem bark and leaves of *Ximenia americana* (Olaceae) and roots from *Entada africana* (Fabaceae), all used as wound healing remedies in Dogonland, have shown potent complement fixating activity (Diallo et al., 2001, 2002). Complement activation appears to be intrinsically associated with several immune reactions such as the activation of macrophages and lymphocytes, cellular co-operation, immunopotentiation and regulation of cyclical antibody production, and causes several immunomodulation effects including an anti-inflammatory effect.

Further phytochemical, pharmacological and toxicological studies of the plants identified during the ethnobotanical survey in Dogonland will be carried out. The ultimate goal is providing efficient and non-toxic medicines to the population in Mali, where medicinal plants play a vital role in the primary health care of the people. The demonstration of bioactivity by plant extracts, which corresponds to its traditional application, can support the traditional medical use of the plant. An example of this is *Vernonia kotschyana* Sch. Bip. ex Walp. (Asteraceae), that has been accepted as an improved traditional medicine against ulcers and gastritis. The preparation is called Gastrosedal and is sold in pharmacies like conventional medicine. The plant has undergone preliminary phytochemical, pharmacological and clinical tests (Germano et al., 1996).

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