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Research Article

Ethnobotanical study and safety assessment of medicinal plants from Guiriko region of Burkina Faso used for their doping properties

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Abstract

The use of medicinal plants remains an essential practice in sub-Saharan Africa, where they constitute a major therapeutic and socio-cultural resource objective of the study was to investigate medicinal plants used for doping in the city of Bobo-Dioulasso. Methods: To do this, a semi-structured ethnobotanical survey was first conducted among traditional practitioners. Phytochemical compositions of the plants were analyzed using spectrophotometry. Finally, the acute toxicity of the doping plants was studied by administering a single dose of 5000 mg/kg body weight to NRMI mice, which were observed for 14 days. Results: A total of 50 traditional practitioners and herbalists were interviewed and 25 plants species belonging to 17 botanical families were identified. Based on the frequency of citation, the species *Martynia annua* Lin (Martyniaceae), *Securidaca longepedunculata* Fresen (Polygalaceae), and *Leptadenia hastata* (Pesr.) Decne (Asclepiadaceae) were selected for further study. The leaves (55.13%) and root bark (21.79%) were the most used parts. The phytochemical study revealed the presence of phenolic compounds such as polyphenols, total flavonoids and tannins. The extracts exhibited antioxidant activity. The toxicity test of hydroethanolic extracts of *M. annua* and *L. hastata* species in mice established an LD_{50} indicates no toxicity. Conclusions: This study showed that, in addition to using medicinal plants for healing, the local population also uses them for other purposes.

Keywords: Ethnobotany, Performance-enhancing plants, Phytochemistry, Safety, Burkina Faso

1. INTRODUCTION

The use of medicinal plants remains an essential practice in sub-Saharan Africa, where they constitute a major therapeutic and socio-cultural resource. According to the World Health Organization, nearly 80% of rural populations still rely on traditional medicine for their primary healthcare [1]. Burkina Faso, with its remarkable biodiversity, is a privileged setting for ethnobotanical uses. Surveys conducted by several authors in the country have shown that local populations have a wealth of knowledge about plants used for therapeutic purposes [2, 3, 4, 5]. These medicinal plants are used not only against various diseases such as urinary tract infections, malaria, neuropsychiatric and human reproductive disorders, anti-inflammatory and bacterial diseases, etc [4, 5, 6, 7] In addition to using medicinal plants to treat diseases, they are also used as traditional stimulants or 'doping agents' to increase physical endurance and resistance to fatigue [8, 9]. Doping or doping practices involve taking certain substances to improve performance [10]. Nowadays, the desire to excel, to persevere, to win, to be inspired, to perform well drives certain individuals (amateur footballers, competitive athletes, street vendors, musicians) or a category of the population (young people) to engage in doping practices using local resources (due to the high cost or inaccessibility of imported drugs, addiction, etc.). However, the safety of these plants remains a key issue. Some species pose health risks related to their consumption and variability in dosage, or to the presence of potentially bioactive molecules [8] with low therapeutic indices. The aim of the

study was to compile an inventory of medicinal plants used for their doping properties in the city of Bobo-Dioulasso to assess their safety and the chemical composition of the most frequently cited species.

2. METHODOLOGY

2.1. Study Site:

The study was conducted in the Guiriko region, located in western Burkina Faso, specifically in the city of Bobo-Dioulasso, the country's economic capital. It is located between 11°10'59.999' "N latitude and 4°16'59.999"' W longitude, with an area of 136.78 km^2 and a population of 903,887 (RGPH, 2020). The climate is South Sudanese, with average rainfall of 900.8 mm and an average temperature of 27.7°C. The vegetation is dominated by wooded savannahs and open forests with all subtypes, from wooded savannah to grassy savannah (Figure1).



Figure 1: Data collection area

2.2. Ethnobotanical Data collection

The ethnobotanical survey took place between September and October 2020 in the city of Bobo-Dioulasso. It focused on traditional healers belonging to the 'Jigi Sémè Association of Traditional Healers of Houet'. The method used was a semi-structured interview with each therapist, using a survey form. Information was collected in the local languages (Moore and Dioula). Therapists were selected based on their knowledge of plants used as doping agents. The data collected covered socio-demographic profiles, plant names, families and parts.

2.3. Collect of plant material

The plant species were collected in the locality of Dendérésso (Bobo-Dioulasso) in October 2024. The species were previously identified and authenticated by a botanist. The plant material was washed and dried in the laboratory at room temperature and then ground into powder.

2.4. Experimental Animals

Adult male and female NMRI (Naval Medical and Research Institute) mice weighing between 31 and 42 grams (aged 8 to 10 weeks) from the animal facility at the International Centre for Research and Development on Sub-humid Zone Livestock Farming (CIRDES) in Bobo-Dioulasso were used in the study. For all tests, the mice were kept at a temperature of 25°C with alternating light and darkness every 12 hours and had free access to adequate water and food.

The study was conducted in full compliance with international guidelines for the ethical use of animals in research, including Directive 86/609/EEC of the European Community and the U.S. Public Health Service Policy on Humane Care and Use of Laboratory Animals (OLAW Assurance A5926-01). The authors affirm that all protocols strictly adhered to the "Principles of Laboratory Animal Care" and institutional animal welfare regulations. Efforts were made to minimize animal suffering and reduce the number of animals used without compromising scientific validity.

2.5. Preparation of plant extract

Fifty grams (50 g) of powder from each plant species were macerated with ethanol-water (70 : 30) for 24 hours. The extract was then concentrated using a rotary evaporator, the aqueous phase was collected, frozen and freeze-dried. The extracts obtained were weighed and stored at 4°C until use.

2.6. Phytochemistry

2.6.1. Total Phenolic

Total phenolic content was measured according to the procedure described by Singleton *et al.* (1999) [11] using Folin-Ciocalteu reagent (FCR). Results are expressed in mg gallic acid equivalent per 100 mg extract (mg GAE/100 mg extract).

2.6.2. Total Flavonoids

The method used to estimate flavonoid levels in the plant extract is described by Dowd and adapted by Meda *et al.* (2010) [12] using aluminum chloride reagent. The results are expressed in milligrams of quercetin equivalent (EQ) per 100 milligrams of extract (mg EQ/100 mg).

2.6.3. Condensed tannins

The condensed tannin content was determined using the method described by Agbangnan *et al.* (2012) [13] with vanillin sulphate as the reagent. The results are expressed in milligrams of tannic acid equivalent (TAE) per 100 milligrams of extract (mg TAE/100 mg).

2.7. Biological activities

The antioxidant activity and acute toxicity test of the most frequently cited species were determined.

2.7.1. Antioxidant activity determination

Three methods were used:

Method DPPH

Antioxidant activity was assessed using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method described by Velázquez *et al.* (2003) [14] and adapted by Meda *et al.* (2010) [12]. This method is based on the reduction in absorbance at 517 nm due to the DPPH free radical H● in the presence of a radical donor H● [15] Stock solutions of the extracts were prepared at a concentration of 10 mg/mL, then diluted 1:10 or 1:100 in pure methanol. Thus, 375 µL of the diluted solution was added to three (03) samples, along with 750 µL of a DPPH solution (20 mg/L), and then incubated for 15 minutes in the dark. A blank was prepared using 375 µL of the sample and 750 µL of methanol. Absorbances and concentrations were measured using a spectrophotometer at 517 nm against a standard ($y=2.224\times10^{-2} + 0.348$; $R^2=0.9966$) obtained from ascorbic acid.

Method FRAP

The FRAP (Ferric Reducing Antioxidant Power) method is based on the ability of compounds to reduce ferric ions (Fe^{3+}) to ferrous ions (Fe^{2+}). This method assesses the reducing power of extracts described by Hinneburg *et al.,* (2006)[16] is adapted by Meda *et al.,* (2010)[12]. In a test tube, 0.25 mL of an extract solution was mixed with 0.625 mL of phosphate buffer (0.2 M; pH = 6.6) and 0.625 mL of potassium hexacyanoferrate [$K_3Fe(CN)_6$]. After incubation in a water bath for 30 minutes at 50°C, 0.625 mL of trichloroacetic acid (10%) was added. The mixture was then centrifuged at 3000 rpm for 10 minutes. 0.625 mL of the supernatant was then mixed with 0.625 mL of distilled water and 0.25 mL of freshly prepared aqueous $FeCl_3$ solution (0.1%). Absorbances were measured at 700 nm against a calibration curve ($y = 3.270 \times 10^{-3}$; $R^2 = 0.9990$) obtained from ascorbic acid (0–200 mg/L).

Method ABTS

The antioxidant activity was assessed using the ABTS method described by Meda *et al.* (2010) was used [12]. It is based on the decolorization of a stable radical cation, ABTS•+ (2,2'-azinobis-[3-ethylenesothiazoline-6-sulfonic acid]), to ABTS in the presence of antioxidant compounds at 734 nm. A methanolic solution (10 mg mL^{-1}) was diluted 1:100 in ethanol. Ten µL of the sample (diluted solution) and the reference substance (ascorbic acid) were mixed with 990 µL of fresh ABTS•+ solution. The mixture is kept in the dark for 15 minutes and the absorbances are measured at 734 nm using a spectrophotometer against a standard curve of ascorbic acid ($y = -7.874 \times 10^{-4} + 0.709$; $R^2 = 0.9993$). Concentration of compounds with a reducing effect on the radical cation

All results were expressed in µmol Ascorbic Acid Equivalent (AAE)/g of extract according to the following formula:

$$C = \frac{c \times D}{M \times ci}$$

C = concentration of antioxidant activity in µmol EAA/g of extract

c = concentration of the sample read from the standard curve

D = dilution factor of the sample being analysed

ci = initial concentration of the solution to be analysed

M = molar mass of ascorbic acid (176.1 g/mol).

2.7.2. Acute toxicity studies [16]

The acute toxicity test was conducted in accordance with OECD Guideline No. 425 [17]. The test was performed on 24 male and female mice divided into four (4) groups of three (3) according to their body weight (p. c), numbered from 1 to 4 (groups of males 3 and females 3) with a control for each group. After subjecting the animals to an 18-hour fast, the control groups were given distilled water (200 µL) and the test groups were given plant extract solutions (5000 mg/kg bw). The extracts were prepared in distilled water. The animals were first monitored for 72 hours for changes in coat condition and mortality. In the event of death, the animal was autopsied and a macroscopic examination of the internal organs was performed to detect any abnormalities. The animals were then kept under observation for 14 days, with weight measurements taken on days 0, 7 and 14. All animals were euthanised at the end of the 14 days.

2.8 Statistical analysis

Statistical analysis of the data was performed using Graph Pad Prism 8.0.2 software, and graphs were created using Microsoft Excel version 2024. Results were expressed as mean ± standard deviation for quantitative variables. To compare groups, an ANOVA test was used with a significance threshold of $p < 0.05$.

3. RESULTS

3.1. Ethnobotanical survey

3.1.1. Socio-demographic profile of respondents

A total of fifty (50) traditional practitioners were surveyed in the city of Bobo-Dioulasso. The study revealed that both sexes practiced traditional medicine, with 66% (33/50) being men and 34% (17/50) being women. The survey showed that the youngest traditional practitioner was 24 years old and the oldest was 83 years old. The average age was 50.82 years. The number of years of experience varied between 3 and 40 years. The majority (60%) of those surveyed inherited their knowledge from a family initiation.

3.1.2 Ethnobotanical profile

3.1.2.1 Plant species used

Twenty-five (25) plant species used as doping agents were identified (table 1). They belong to 17 botanical families, the most represented being Combretaceae (4 species) and Anacadiaceae (3 species) (Figure 2). The frequency with which species were cited ranged from 2% to 36.76%. *Martynia annua* (36.76%), *Securidaca longipedunculata* (8.82%) and *Leptadenia hastata* (8.82%) were the species most frequently cited by traditional practitioners (Figure 3). Other plants were used alone or in combination with other plants.

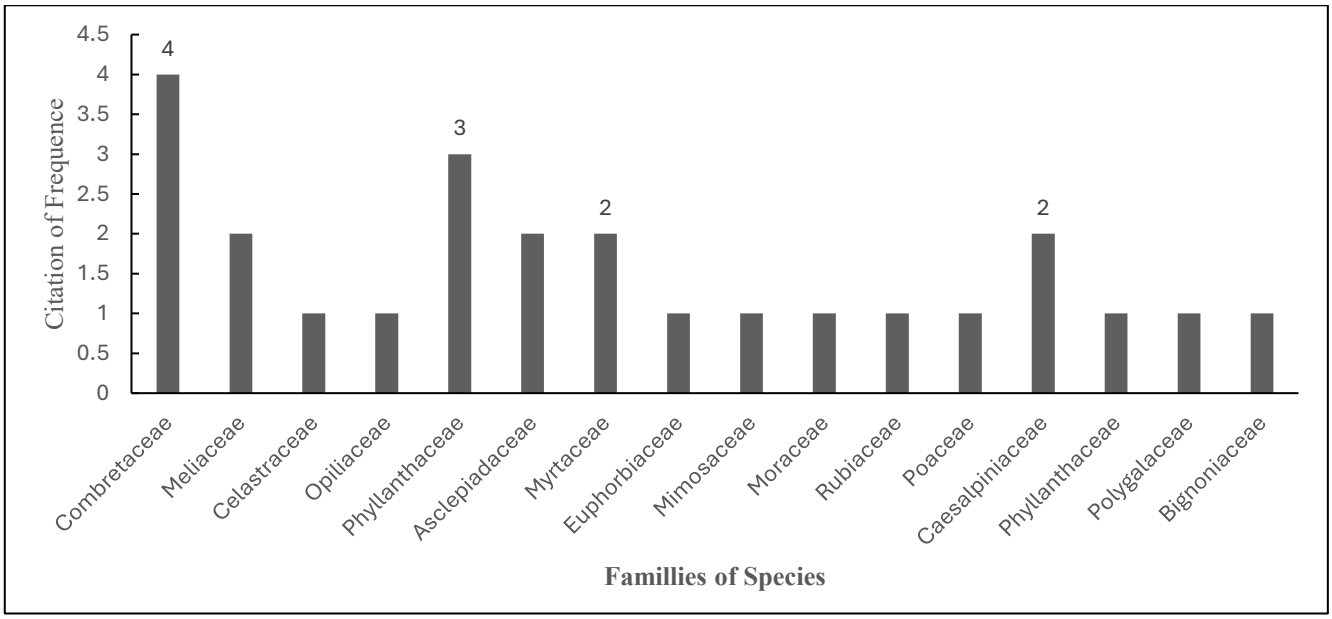


Figure 2. Doping plant species families

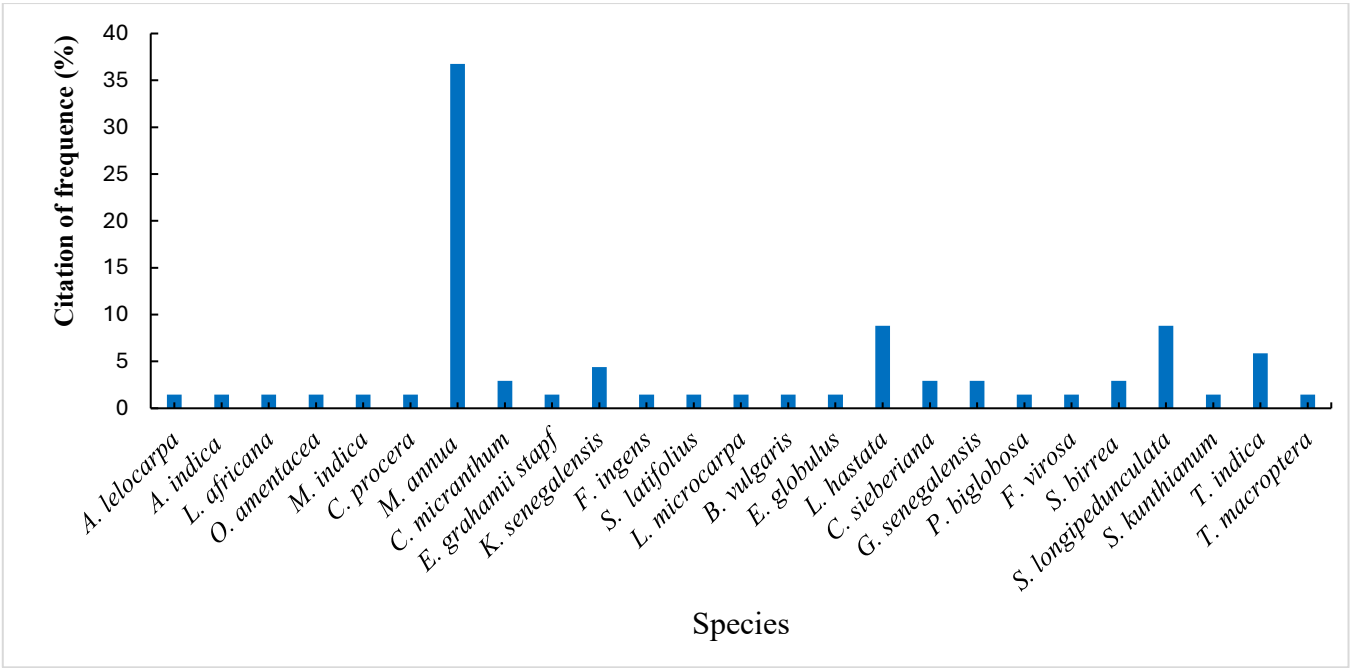


Figure 3. Frequency of doping species

Table 1: Different species recorded

Scientific Names (Species)	Family	Local Name (Mooré)	Local Name (Dioula)	Parts Used	Biological activities	Phytochemistry
Anogeissus leiocarpa (DC.) Guill. & Perr.	Combretaceae	Siiga	-	Leaves	Skin infections, diarrhoea; antioxidant; antibacterial; antifungal; antidermatophytic; depressant [18,19]	Phenolic acids; coumarins; tannins ; flavonoids [19]
Azadirachta indica A. Juss	Meliaceae	Niim	Nîmyiri	Bark	Alkaloids, free alkaloids, triterpenic saponins, triterpenes, quercetin, azadichthine, sitosterols, melialin, diacetylnimbine, vitamin C, carotene, coumarin, nimbosterine, flavones, nonacosane [9]	diuretic, diabetes, hepatitis, antiseptic, anti-infective, yellow fever, gastric ulcer, analgesic, emetic, spasm, diabetes, urogenital infection [9]
Bambusa vulgaris Schard. Ex J.C. Wendl.	Poaceae	-	Bambou	Leaves	Allelopathic, stimulant aphrodisiaque. Affaiblissement sexuel [20,9]	Tannins, phenols, flavonoids, flavones, flavonols, xanthones and catechins alkaloids, steroids, amino acids, saponins [20]
Calotropis procera (Ait.) R. Br	Asclepiadaceae	Putrepuuga	Fogofog	Leaves; bark	Antiseptic, insecticide, antimicrobial, fever, diarrhoea, rheumatism, antihyperglycaemic, stimulant.[9,21]	Alkaloids, triterpenes, tannins, saponins, flavonoids, sterols, cardénolides, coumarins [21]
Cassia sieberiana DC.	Caesalpiniaceae	Kumbresaka	Siguian	Leaves	anti-inflammatory, antibacterial, antispasmodic, diuretic, tonic, anthelmintic, astringent, antimalarial, antidysmenorrheic, antiparasitic, anti-schistosomal, aphrodisiac [23]	Mucilage, sterols, tannins, anthraquinones, ß sitosterol, polyphenolic derivatives, anthracenes [9]
Combretum micranthum G. Don	Combretaceae	Randgo	K-inkéliba	Leaves	Antiseptic, wound-healing, antibacterial, antispasmodic [9]	Polyphenols, flavonoids, tannins, quinones, coumarins, alkaloids, gallic and catechic acids, saponins, mucilages [24]

Eucalyptus globulus Dehn.	Myrtaceae	-	Flao	Leaves, bark	Analgesic, antipyretic, anti-inflammatory, antispasmodic, antirheumatic, stimulant [25]	Terpenes, monoterpenes, sesquiterpenes, flavonoids, phenolic acids, tannins. Eucalyptol or 1,8-cineole [25]
Excoecaria grahamii Stapf & Hutch.	Euphorbiaceae	Kionnem	Lèfaba	Whole plant	Skin conditions, oedema, leprosy, hallucinations, constipation, insecticide, insecticide, dysentery, muscarinic activity, antihypertensives, Relaxant effects [23, 24]	anthocyanosides, tanins, s,gallic tannins, flavanoïds, saponins terpenoids [23, 25]
Ficus ingens (Miq.) Miq.	Moraceae	-	Djatiguifaga	Leaves	Anti-inflammatory, analgesic, hypotensive, laxative, anti-rheumatic activities [29]	Tannins, Saponins ; Flavonoids ; Phenols ; Glycosides [29]
Flueggea virosa	Phyllanthaceae	-	Balan balan	Leaves	Analgesic; anti-inflammatory, aphrodisiac ; sedative, ant-arrhythmic ; antidiabetic ; antimalarial ; anti-HIV ; anti-hepatitis C ; anti-diarrheal, cytotoxic, anti-microbial ; antifungal, antioxydant, laxative properties [30]	Alkaloids, triterpenoids, tannins ; flavonoids ; resins ; steroids ; cardiac glycosides ; anthraquinones [30]
Guiera senegalensis J. F. Gmel.	Combretaceae	Wilin-wiiga	Koungouè, Kungouè	Bark	Anti-inflammatory ; anti-microbial ; antioxydant ; cytotoxic, antiparasitic; antitussive, antiviral, anti-diarrheal [31]	Steroids; saponins; flavonoids, alkaloids, tannins, saponins, cardiac glycosides, coumarins, anthraquinones, ascorbic acid, cardiotonic glycosides, cyanogenic compounds and terpenoids [31]
Khaya senegalensis (Desr.) A. Juss.	Meliaceae	Kuka	Djalan	Bark	Anti-inflammatory, antimicrobial, anticancer, skin diseases, diarrhoea, immunostimulants, anti-hyperglycemic, antioxidant, diabetes [32]	Saponins, phenolic compounds, flavonoids, phytosteroids, triterpenoids, cardiac glycosides, anthraquinones, tannins and alkaloids [32]

Lannea microcarpa Engl. & K. Krause	Anacardiaceae	Sambga	Pekoûn	Fruit	Antibacterial ; anti-Inflammatory ; antifungal ; antihypertensive; antioxidant; antiprotozoal and antitrypanosomal activities ; hypertension ; Respiratory problems [32]	Myricetin glycosides ; flavonoids ; trihydroxybenzoic acid ; flavone ; anthocyanin [32]
Leptadenia hastata (Pers.) Decne.	Asclepiadaceae	Lelongo	Kosafla	Roots	Anti-androgénique ; anti-diabetic ; antibacterial and antimicrobialAnti-androgénique ; anti-diabetic ; antibacterial and antimicrobial [33]	phenolic glycosides, tannins, flavonoids, proanthocyanidins, alkaloids and saponins phenolic glycosides, tannins, flavonoids, proanthocyanidins, alkaloids and saponins [33]
Loeseneriella africana	Celastraceae	-	Kogotigui	Leaves	Anti-inflammatory, antioxidant [34]	Alkaloids, triterpenoids, phytosterols, flavonoids, tannins, coumarins [34]
Mangifera indica L.	Anacardiaceae	Mangue-tiga	Mangoro	Leaves	antioxidant, gastro-protective, anti-inflammatory, analgesic, immunomodulatory, anti-microbial, [35]	Polyphenols ; phenolic acids ; flavonoids ; Vitamin-C, Vitamin-E, Carbohydrates, Amino acids, Organic acids [35]
Martynia annua L.	Myrtaceae	-	Soubaga-won	Whole plant	epilepsy, inflammatory, sore throat, burns, itching, skin affections and tuberculosis. anthelmintic, analgesic, antipyretic, antibacterial, anti-convulsant, antifertility, antinociceptive, antioxidant, depressant, antidiabetic [36]	alkaloids, tannins, saponins, glycosides, flavonoids, anthocyanins, amino acid, steroids, phenol [36]
Opilia amentacea	Opiliaceae	Wagsaiga	Korogouein	Leaves	anti-inflammatory, antimicrobial, antioxidant, wound healing, and anticancer activities., dermatoses, malaria, wounds, abdominal pain, internal worms, jaundice, headache [37]	Triterpenes, and flavonoids, tannins polyphenol [38]

Parkia biglobosa (Jacq.) R. Br. ex G. Don	Mimosaceae	Roanga	Nèrè	Roots	Antibacterial ; Antibacterial ; Antimicrobial Antivira [39]	tannins, flavonoids, anthraquinones, coumarins, mucilages ; saponosides [39]
Sarcocephalus latifolius (J.M. Smith.) Bruc	Rubiaceae	Winga	-	Leaves	Gonorrhea, cough, fever, hemorrhoid, dysentery, malaria, bilharzia, headache, constipation, syphilic chancre antiradical, antimicrobial [40]	Catechic, tannins, saponosides, flavonoids, leuco an-thocyanins, coumarins, mucilages, sterols, terpenes [40]
Sclerocarya birrea (A. Rich.) Hochst.	Anacardiaceae	Noabga	Douda	Fruit	Antidiabetic, anti-inflammatory, antimicrobial, antioxidant [41]	Tannins, flavonoids amino acids, including leucine, lysine [41]
Securidaca longipedunculata Fres.	Polygalaceae	Pèlga	Djoro, Diouro	Roots	Pain-relieving, anti-inflammatory, antioxidant [42]	Saponins, tannins, anthraquinones, alkaloïds, terpenes, stéroids, sugars, caffeic acid [42]
Sterospermum kunthianum Cham.	Bignoniaceae	Ninyilinga	-	Leaves	ulcer, rheumatic arthritis and dysenteria, diabetes, diarrhoea, antibacteria, anti-inflammatory, anticonvulsant, antihelmintic, nalgesic, antioxidant, diuretic [43]	Gallic, catechic, tannins, flavonoids, saponosides, alkaloids, sterols, polyterpenes, affeic and chlorogenic acids [43]
Tamarindus indica L.	Caesalpiniaceae	Pusga	Ntomi, Toni	Fruit	Ulcers, inflammation, diarrhea, dysentery, vertigo, diabetes, analgesic, Fungicidal, antioxydant, Anti-inflammatory [44]	Phenolic, tannins, fatty acids, flavonoids, saponins, alkaloids, glycosides, amino acids [44]
Terminalia macroptera Guill. & Perr.	Combretaceae	Kodpooko	Woloba	Leaves, bark	Diarrhea, pain, fever anti-inflammatory, antipyretic, analgesic , hepatoprotective o antibacterial, antifungal, antiplas modial, antitrypanosomal, and antiviral [45]	Tannins, flavonoids, saponins, anthracene, sterols, triterpenes and sugars [45]

3.1.2.2. Parts of organs used

Leaves were the most used part of the plant (55.13%), followed by roots (21.79%) (Figure 4).

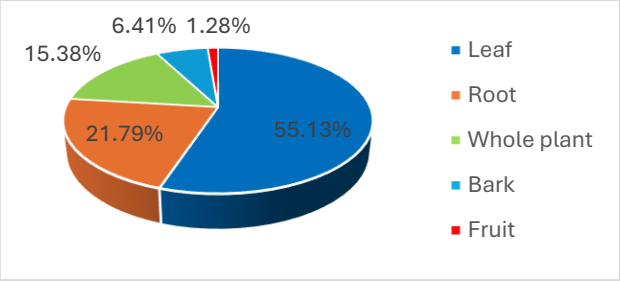


Figure 4: organs used

3.3. Phytochemistry analysis

Total phenolic content of the extracts significantly varied and ranged from 7.57 ± 0.24 to 11.9 ± 0.43 mg EAG/100 mg extract (P 0.05; Table 1). The highest content was obtained from the whole plant of *M. annua*, with a value of 11.9 ± 0.43 mg EAG/100 mg extract. The total flavonoid content ranged from 0.34 ± 0.04 to 4.05 ± 0.56 mg EQ/100 mg of extract. The best result was obtained with *M. annua* at 4.81 ± 0.64 mg EQ/100 mg of extract. Condensed tannin content ranged from 0.4 ± 0.04 to 3.32 ± 0.09 mg CAT/100 mg, with the highest content obtained from the roots of *L. hastata* at 3.32 ± 0.09 mg CAT/100 mg. (Table 2).

Table 2. Phenolic compounds content

Extract	Part used	Total phenolic mg EAG/100mg	Total flavonoids mg EQ/100mg	Condensed tannins mg EAT/100mg
SL	Root	8,64 ±0,49^{ab}	0,34 ±0,04^{a}	0.4 ± 0,04^{a}
LH	Root	7,57 ±0,24^{a}	0,9 ±0,05^{a}	3,32 ± 0,09^{c}
MA	Plant	11,9 ±0,43^{b}	4,05 ±0,56^{b}	1,35 ± 0,16^{b}

(a-c) are significantly different at P < 0.05; SL: Securidaca longipedunculata, LH: Leptadenia hastata, MA: Martynia annua

3.4. Biological properties

3.4.1. Antioxidant capacities

Compared to quercetin and trolox, which are reference compounds with antioxidant activity of 646.85 µmol EAA/g and 785.99 µmol EAA/g respectively, the antioxidant activity of the plant species was lower. The species *S. longepedunculata* had the best antioxidant activity among the three (03) species using the DPPH (315.77 ± 0.14 EAA/100mg) and ABTS (1929.77 ± 1.38 EAA/100mg) methods. Using the FRAP method, the species *Martinia annua* showed the best antioxidant activity (833.03 ± 0.90 EAA/100mg) (Table 3).

Table 3. Antioxidant activity

Extrait	Part used	DPPH µmol EAA/100mg	FRAP µmol EAA/100mg	ABTS µmol EAA/100mg
SL	Root	315.77 ±0.14^{c}	347.32 ±0.53^{b}	1929.77 ± 1.38^{c}
LH	Root	135.32 ±0.47^{a}	155.86 ±0.52^{a}	117.79 ± 3.67^{a}
MA	Plant	156,61 ±0.05^{ab}	833.03 ±0.90^{c}	865.42 ± 1.27^{b}
Trolox	Reference molecules	765.98±0.31^{e}	5991.29±1.33^{e}	8137.61±0.24^{d}
Quercetin		646.8±0.02^{d}	2211.24±0.63^{d}	14664.01±0.24^{e}

(a-e) are significantly different at P < 0.05; SL: Securidaca longipedunculata, LH: Leptadenia hastata, MA: Martynia annua

3.4.2. Plants acute toxicities

The toxicological evaluation of plant extracts showed no mortality after oral administration of plant extracts from *L. hastata* and *M. annua* at a dose of 5000 mg/kg. Autopsy of the animals revealed no changes in the general appearance of internal organs such as the liver, spleen, kidneys, and lungs. The relative weight of the organs was unchanged in the treated groups compared to the control group. In the toxicity test on the species *S. longepedunculata*, mortality was observed, with five (5) (Table 4).

Table 4. Weekly body weight and relative organ weights after two weeks

Parameter	Control		Extract of *L. hastata* roots		*M. annua* plant extract		Extract of *S. longepedunculata* roots	
	200 µL of distilled water		5,000 mg/kg (body weight)					
Mice	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
Number of mice per extract	**03**	**03**	**03**	**03**	**03**	**03**	**03**	**03**
Poids corporel (g)								
Day 0	**39.00**±0.00	**36.63**±0.25	**36.20**±0.46	**31.06**±0.37	**42.07**±1.03	**42.66**±0.25	**39.33**±0.30	**40.16**±0.97
Day 7	**36.52**±1.18	**36.22**±0.82	**40.69**±2.23	**34.39**±2.21	**40.28**±5.35	**42.31**±1.90	-	-
Day 14	**42.16**±1.66	**37.79**±1.59	**42.18**±2.30	**35.17**±1.87	**40.30**±5.53	**42.**17±1.57	-	-
Weight gain								
Day 14	**3.16**	**1.16**	**5.98**	**4.10**	**-1.77**	**-0.49**	-	-
Mortality	**0**	**0**	**0**	**0**	**0**	**0**	**03**	**02**
Animal organs	**Weight of organs**							
Heart	**0.38**±0.01	**0.38**±0.08	**0.42**±0.02	**0,34**±0.00	**0.41**±0.07	**0.39**±0.03	-	-
Lungs	**0.46**±0.10	**0.51**±0.09	**0.57**±0.00	**0.54**±0.05	**0.58**±0.08	**0.59**±0.02	-	-
Liver	**3.32**±0.14	**2.74**±0.28	**3.24**±0.11	**2.95**±0.45	**3.20**±0.27	**3.36**±0.08	-	-
Kidneys	**0.91**±0.05	**0.72**±0.10	**0.92**±0.05	**0.75**±0.07	**0.81**±0.12	**0.86**±0.13	-	-
Spleen	**0.43**±0.04	**0.40**±0.12	**0.58**±0.28	**0.34**±0.05	**0.45**±0.12	**0.40**±0.08	-	-

4. DISCUSSION

The ethnobotanical study aimed to catalogue medicinal plants used for doping in the Guiriko region, specifically in the city of Bobo-Dioulasso. During the survey, the average age was around 50. Other studies conducted in Togo also found that the average age of traditional practitioners was 53 and 51, respectively. This shows that traditional medicine is more commonly practised by older people [43, 44]. Many traditional practitioners were men (66%). This could be explained by the fact that traditional medicine is often more reserved for men [5, 45].

The ethnobotanical study identified 25 species divided into 17 families. This result demonstrates traditional practitioners' knowledge of the diversity of medicinal plants and their properties. Studies have shown that local populations in Burkina Faso are better known for benefiting from the best of biodiversity in traditional medicine [49]. The study shows that the species *M. annua* (36.76%), *S. longipedunculata* (8.82%) and *L. hastata* (8.82%) were most frequently cited. According to some authors, the species *S. longipedunculata* and *L. hastata* are used for their anticonvulsant, anxiolytic, antidepressant and sedative properties [8, 46, 47, 48]. Previous studies have shown that these species are used in the treatment of neuropsychiatric disorders such as epilepsy and psychosis [8].

This study shows that traditional practitioners mainly use leaves and roots, which could be explained by the availability of these plant parts throughout the year, but their effectiveness is linked to the significant accumulation of chemical compounds in these organs [6]. However, the use of roots poses a threat to biodiversity. In 2019, Tiendrébéogo *et al.* [52] also found that roots and bark were used in 41% of cases in eight villages in the province of Soum, compared to 43% for leaves.

The analysis of polyphenolic compounds showed different levels between the hydroethanolic extracts of *S. longepedunculata*, *L. hastata* and *M. annua*. These results show that polyphenolic compounds vary from one species to another. This variation in content may be due to the influence of biotic and abiotic factors on the synthesis of secondary metabolites. This content could be attributed in part to the nature of the extraction solvent used [53]. Several studies in the literature have shown that phenolic compounds have multiple biological properties. Studies have shown that the species *S. longepedunculata*, *M. annua* and *L. hastata* have anti-inflammatory, analgesic, depressive and convulsive

properties. These properties could be due to the presence of these phenolic compounds [49, 51, 52, 53 54]. This could justify the use of these plants to treat pain, fatigue, stress and depression. According to Kinda *et al.* (2017) [6], certain flavonoids have anxiolytic effects and neuroprotective activities; the high flavonoid content of the species *M. annua* could be responsible for the traditional use of this plant.

The results of the acute toxicity assessment in this study show that extracts from the roots of L. hastata and the whole plant of *M. annua* have LD_{50} values greater than 5000 mg/kg (b.w.). According to OECD guidelines, any drug or pharmaceutical compound with an oral LD50 greater than 2000 mg/kg could be considered safe or low in toxicity [18]. This result suggests that hydroethanolic extracts of *L. hastata* and *M. annua* are virtually non-toxic at a single dose of up to 5000 mg/kg (b.w) administered orally. Previous studies have shown signs of toxicity at a dose of 5000 mg/kg (b.w) of the methanolic extract of *L. hastata* roots, which differ from our findings. This could explain that the degree of toxicity of the species is due to the route of administration and the type of solvent used for extraction [58]. The change in body weight could be due to fat accumulation or a physiological adaptation response such as decreased appetite rather than the toxic effects of the drugs [49].

CONCLUSION

This study identified 50 plant species, the most cited of which were *M. annua*, *L. hastata* and *S. longepedunculata*. Laboratory analyses showed the presence of phenolic compounds and antioxidant activity in these plant extracts. The acute toxicity study showed that the species *S. longepedunculata* was toxic at a dose of 5000 mg/kg b.w. The study identified several medicinal plants used as performance-enhancing substances

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