BORNH Bulletin of Regional Natural History
Formerly Bollettino della Società dei Naturalisti in Napoli

Phytotherapy in the management of African healthcare: Our experience in Benin (West Africa)

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DOI https://doi.org/10.6093/2724-4393/11767

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Financial Disclosure Statement: the Authors declare that no specific funding was received for this work

Competing interests: The Authors declare that they have no competing interests for this work.

Submitted: 07 Februaryr 2025
Revised: 10 March 2025
Accepted: 18 March 2025
Published: 23 April 2025

Associate Editor:
Karl Duffy

Abstract

Africa, renowned for its vast plant biodiversity, remains the largest reservoir of infectious diseases globally, with high morbidity and mortality rates due to conditions like tuberculosis, malaria, and AIDS. Despite the limited availability of modern medical facilities, traditional medicine, particularly herbal remedies, is pivotal, serving approximately 90% of the population. The Republic of Benin, a small West African nation, exemplifies this reliance on phytotherapy. This review delves into how traditional medicine is integrated into Benin's healthcare system, emphasizing the extensive use of medicinal plants for various local diseases. Through our personal experience at Ziniviè "La Croix" Hospital, we recorded the use of 41 medicinal plants. Comparing these findings with other African countries reveals both unique and common phytotherapeutic practices. Despite the advantages, the unregulated use of herbal medicines presents safety risks, highlighting the need for careful regulation and standardization. The study emphasizes the importance of combining traditional knowledge with modern scientific research to ensure the safe and effective use of medicinal plants.

Keywords: Ethnobotany, Phytotherapy; Traditional medicine; Africa; Benin

Riassunto

L'Africa, nota per la sua ampia biodiversità vegetale, rimane il più grande serbatoio di malattie infettive a livello globale, con alti tassi di morbilità e mortalità dovuti a patologie come la tubercolosi, la malaria e l'AIDS. Nonostante la limitata disponibilità di strutture mediche moderne, la medicina tradizionale, in particolare i rimedi erboristici, è

fondamentale e serve circa il 90% della popolazione. La Repubblica del Benin, una piccola Nazione dell'Africa occidentale, è un esempio di questo affidamento alla fitoterapia. Questa rassegna analizza come la medicina tradizionale sia integrata nel sistema sanitario del Benin, sottolineando l'ampio uso di piante medicinali per varie malattie locali. Attraverso la nostra esperienza personale presso l'ospedale di Ziniviè "La Croix", abbiamo registrato l'uso di 41 piante medicinali. Il confronto con altri Paesi africani rivela pratiche fitoterapiche uniche e comuni. Nonostante i vantaggi, l'uso non regolamentato dei farmaci vegetali presenta rischi per la sicurezza, evidenziando la necessità di un'attenta regolamentazione e standardizzazione. Lo studio sottolinea l'importanza di combinare le conoscenze tradizionali con la moderna ricerca scientifica per garantire un uso sicuro ed efficace delle piante medicinali.

Parole chiave: Etnobotanica, Fitoterapia, Medicina tradizionale, Africa, Benin

1. Introduction

Africa is the largest reservoir of infectious diseases in the world. Indeed severe pathologies such as tuberculosis, malaria and AIDS, represent a substantial burden in African healthcare systems, leading to high morbidity and mortality rates across the continent (Mbele et al., 2017). It is estimated that 90% of the African population are still dependent on traditional medicine (Wachtel-Galor & Benzie, 2011). This reliance is often due to the limited availability of modern medical facilities and the high cost of conventional treatments, which many people cannot afford. As a result, traditional medicine, comprising insects (Ferrazzano et al., 2023) and medical herbs, remains an integral part of the healthcare landscape in Africa (Okaiyeto & Oguntibeju, 2021). Moreover, Africa is characterized by an impressive floristic richness and biodiversity. The continent's diverse ecosystems host a wide variety of plant species, many of which have been used for centuries in traditional medicine. Suffice it to say that more than 5400 African medical plants are documented, although only the 8% of the medical herbs used worldwide origin from Africa (Wink, 2011; Brendler & van Wyk 2008).

The affordability and the ease of finding and preparing botanical extracts make phytotherapy attractive for developing countries and, in some cases, may be the only resource. African traditional medicine is in the hands of so-called healers, who pass down their knowledge from generation to generation. These healers are often highly respected members of their communities, serving as both medical practitioners and keepers of cultural heritage. However, healers wouldn't necessarily get appropriate training and education required to prescript and administer herbal products. This lack of formal education can lead to inconsistent practices and potential health risks. In fact, even though the beneficial role of plant extracts is acknowledged worldwide, the indiscriminate use of herbal medicines may cause adverse effects, like kidney failure, live damage, diarrhea, and so on (Gurib-Fakim, 2006). Such adverse effects highlight the need for careful regulation and standardization of herbal medicine practices. Eventually, incorrect dosages may turn out to be toxic, so safety issues must always be considered (Fennel et al., 2004).

The Republic of Benin, one of the smallest countries of West Africa, located in the tropical zone between the Equator and the Tropic of Cancer, has a rich cultural heritage and a diverse ecosystem that supports a wide variety of medicinal plants. Indeed, this country boasts a wide use of medical herbs, considered as the primary source of healthcare.

In this review we'll discuss the role of phytotherapy in Benin and the application of several plant species in the treatment of local pathologies, according to our personal

experience in Ziniviè "La Croix" Hospital. We will explore how these traditional practices are integrated into the local healthcare system and their effectiveness in treating various ailments. Eventually, we will compare the clinical application of medicinal plants in Benin, with other African countries. By drawing these comparisons, we aim to highlight both the commonalities and unique aspects of phytotherapy practices across the continent.

2. Benin Healthcare

Benin is one of the poorest countries in the world, with a critical health condition. The economic challenges faced by the country severely impact its healthcare system, creating numerous obstacles to providing adequate medical care for its citizens.

The demographic structure is comparable to the situation of backward sub-Saharan regions (May, 1989). According to the World Health Organization report of 2016, life expectancy is 60 years for men and 62 years for women. This relatively low life expectancy is a stark indicator of the health challenges faced by the population, reflecting widespread issues such as infectious diseases, malnutrition, and inadequate medical care. The probability of dying between birth and age 1 per 1000 live births is 62.04, although this value rises to 95.6 within 5 years old. These alarming statistics highlight the urgent need for improved maternal and child health services, as well as better prenatal and postnatal care. Moreover, it is estimated that about a third of children under 5 suffer from malnutrition. Malnutrition is a significant problem that affects physical and cognitive development in children, leading to long-term health issues and perpetuating the cycle of poverty.

The public health system in Benin is organized in a three-tiered pyramid structure. At the base, there are peripheral health facilities, such as medical dispensaries, which are the most decentralized and accessible. These facilities refer patients to area hospitals, which are designed to serve populations ranging from 100,000 to 200,000 people. At the top of the pyramid are the national hospitals, which are expected to offer specialized and advanced medical care. However, their accessibility is often limited to urban areas, resulting in a lack of services for rural populations.

The situation of public health infrastructure has certainly improved in recent years, but the availability of medicines, both public and private, remains inadequate and limited. This shortage of medicines leads to significant treatment gaps and forces patients to seek alternative, often less effective, remedies.

Moreover, there has been no fair distribution at the national level and therefore there are areas where it is difficult to have even basic assistance. Rural and remote areas are particularly disadvantaged, lacking the most fundamental healthcare services and infrastructure.

One of the major problems of the health system in Benin is the human resources available for health, in terms of quantity, quality and distribution. It has been estimated that per 10.000 inhabitants there are about 1.6 doctors, leading to long waiting times and inadequate care for many patients.

Another critical point of the socio-sanitary situation, in Benin, is the private health system. While private healthcare facilities may offer higher quality services, their costs are relatively high. For this reason, most treatments and surgical interventions are unaffordable for most of the population, forced to survive with incomes below the poverty line.

3. The relationship between patients and the traditional medicine in Benin

In the cultural context of the Beninese tradition, the state of disease is often considered as

misfortune, divine punishment, or curse. As a result, the cultural interpretation of sickness significantly influences the healthcare-seeking behavior of the population. Patients prefer to rely on traditional healers, rather than go to hospitals. Healers are often the first point of contact for individuals seeking medical help and are believed to possess spiritual and medicinal knowledge, that is passed down through generations. It is a fact that the first reference health for the Beninese population is that of traditional care: first as self-medication and then benefiting from therapists related to the so-called "folk health care system". With the term "traditional medicine" or "folk health care system", the World Health Organization (WHO) indicated in 1976: "the collection of all knowledge, the use of substances, measures and practices that can be explained or not, based on the socio-cultural and religious foundations of a specific community, which rely exclusively on experiences and observations transmitted from generation to generation, orally and in writing, and used to diagnose, prevent or eliminate an imbalance in physical, mental and social well-being". This definition underscores the holistic nature of traditional medicine, integrating physical, mental, and social aspects of health. In 2000, the WHO further clarified the definition of traditional medicine: "the sum of knowledge, skills and practices based on indigenous theories, beliefs, and experiences of different cultures, whether or not they can be explained, used in maintaining health, as well as in prevention, diagnosis, improvement or treatment of physical and mental diseases. In some countries, the terms complementary/alternative/unconventional medicine are used interchangeably with "traditional medicine". Eventually, in Benin, the therapeutic form of self-medication is extremely widespread: traditional medicines or modern drugs are sold at low cost on the streets or in markets, and this situation, of course, demonstrates a total lack of control over the prescription and use of drugs.

4. Source of data

All the plants described in this review and their clinical applications derive from our personal experience in the hospital "La Croix", in the region of Ziniviè. This hospital was founded in 1980 by priests belonging to the Camillian Order, who still manage it. The integrative approach combining modern medicine with phytotherapy offers patients a choice of different treatment options, that can help improve their overall well-being and customize the treatment to their needs and preferences. Our 6 months experience in "La Croix" hospital and the interaction with patients allowed us to collect information about 41 medicinal plants and their application in the treatment of different diseases.

As mentioned above, Africa is characterized by an impressive biodiversity, that supports a wide variety of plant species, many of which have unique medicinal properties.

In the following paragraphs, we'll report the most frequently employed plants in in the hospital "La Croix", of Benin, detailing their specific use, compared with the use of these plants in other African regions (Table 1).

4.1. Plants used in the management of microbial diseases

Africa has always been one of the largest reservoirs of viral infections, and this explains the wide use of medicinal plants to face these diseases (Ndhlala et al., 2013). Based on the data we collected, most plants are used in Benin local medicine to treat hepatitis B (HBV). The natural history of this pathology in Africa is poorly understood, although approximately 80 million people struggle with HBV (Riches et al., 2023). Despite the significant impact of HBV, there is still a lack of comprehensive

epidemiological data and a need for more research to understand the progression and management of the disease in the African context. Leaves and roots of *Annona muricata*, a tropical plant of the Annonaceae Family, is widely used in Benin to treat HBV, while

Table 1. Plants used in the traditional medicine of Benin, compared with their use in other African Sates (N/A: Not Available)

Name	Family	Medical use in Benin	Part(s) used	Medical use in Africa	Part(s) used	Reference
Abrus precatorius L.	Leguminosae	Asthenia, cough, asthma, jaundice	Leaves	Antimicrobial and cytotoxic activity; Tuberculosis; bronchitis; whooping cough; chest complaints; asthma.	Leaves, stem, seeds, roots, fruits	Madikizela et al., 2013; Jiofack et al., 2010
Aframomum melegueta K. Schum.	Zingiberaceae	Kidney pain	Seeds	Antimicrobial and antiviral activity; Typhus; Amoebiasis; Skin diseases.	Seeds, leaves, rhizome, fruit, roots	Doherty & Olaniran, 2010; Alo et al., 2012; Oladunmoy, 2011; Egharevba & Ikhatua, 2008.
Allium cepa L.		Hernia	Bulb	N/A	N/A	N/A
Amorphophallus dracontioides (Engl.) N.E.Br.	Araceae	Hernia	Roots	N/A	N/A	N/A
Anacardium occidentale L.	Anacardiaceae	hyperglycemia, hypertension	Leaves, bark	Antiviral and antimicrobial; Skin diseases; Diabetes; Dental Caries; Peptic ulcer.	Seeds, leaves, stem, bark extract	Onawunmi et al., 1984; Shah et al., 2011; Jeruto et al., 2011; Lawal et al., 2010; Akinjogunla et al., 2012
Annona senegalensis Pers.	Annonaceae	Anorexia	Leaves	Stomach problems; Infertility; improved sexual performance; Diarrhea; Antimalarial; Antibacterial; Antioxidant; Anti-inflammatory, Anticonvulsant; Antinociceptive; Analgesic.	Bark; root; leaves	Mahwasane et al., 2013; Suleiman et al., 2008; Ajaiyeoba et al., 2006; Lino & Deogracious, 2006; Okhale et al., 2016.
Annona muricata L.	Annonaceae	Hepatitis B	Leaves, seeds	Hypoglycemic effects; Anti-hypertensive; Antitumoral; Antimicrobial; antioxidant.	Leaves, bark root seed, fruit, bark, stem	Adewole & Caxton, 2009; Zubaidi et al. 2023; Gavamukulya et al. 2014; Nwokocha et al., 2012
Anthocleista vogelii Planch.	Loganiaceae	Hernia	Roots	Antidiabetic; Antibacterial; Urinary tract infections; typhus; diarrhea; skin diseases and food poisoning; antimalarial; anti-inflammatory; venereal diseases.	Stem bark, leaves, root bark, root	Jiofack et al., 2010; Anyanwu et al., 2015; Eta Okon et al., 2014.
Boerhaavia diffusa L.	Nyctaginaceae	Threat of abortion	Leaves	Anticonvulsant; antioxidant; Antibacterial; Anti-tumor; anti-inflammatory; immunomodulatory.	Leaves, roots	Kaur & Goel, 2011; Kouakou-Siransy et al., 2010; Girish &, Satish 2007; Patil KS, Bhalsing, 2016

Bosquiea angolensis Ficalho	Moraceae	Dysentery	Leaves	N/A	N/A	N/A
Citrus aurantium L.	Rutaceae	Hepatitis B, sickle cell anemia	Leaves and fruits	Anticancer, antianxiety, antiobesity, antibacterial, antioxidant, pesticidal, and antidiabetic.	Fruits, seeds, leaves, flowers	Suryawanshi, 2011; Suntar et al., 2018
Citrus limon L.	Rutaceae	Rheumatisms	Fruits	Antibacterial; antioxidant; Cough; Influence; Analgesic; Protector of the intestinal mucosa.	Fruits	Otang &, Afolayan, 2016; Maroyi, 2013
Clausena anisata (Willd.) Hook.f. ex Benth.	Rutaceae	Sinusitis	Whole plant	Hypoglycemic effects; Antioxidant; Anti-inflammatory.	Whole plant	Ojewole, 2002; Amoo et al., 2012; Adebayo et al., 2015
Crateva religiosa G. Forst.	Capparaceae	Migraine, antibiotic	Leaves	Antibacterial properties; anti-inflammatory; antifungal.	Whole plant	Patil, 2012; Sharma et al., 2013
Cymbopogon citratus (DC ex Ness) Stapf.	Gramineae	Hepatitis B	Leaves	Antibacterial; anti-amoebic; antibacterial; antidiarrheal; antifilarial; antifungal; anti-inflammatory; antimalarial; antimutagenicity; antimycobacterial; antioxidants; hypoglycemic; neurobehavioral.	Leaves and whole plant	Onawunmi et al., 1984; Sha et al., 2011
Diospyros mespiliformis Hochst.	Ebenaceae	Hernia	Roots	Stomach disorders; Vomiting; Diarrhea; Abdominal pain; Antimicrobial effects.	Bark, roots	Mahwasane et al., 2013; Maroyi, 2013; Mabona et al., 2013
Ehretia cymosa Thonn.	Boraginaceae	Sickle cell anemia	Whole plant	Venereal diseases, pneumonia, epilepsy, dry cough, malaria, ECF, tonsils, mental problems, asthma, typhoid, wounds, aphrodisiac Venereal illnesses; Pneumonia; Epilepsy; Dry cough; Malaria;Tonsils; Mental Problems; Asthma; Typhus; Wounds; Aphrodisiac.	Leaves, roots	Jeruto et al., 2011
Elaeis guineensis Jacq.	Arecaceae	Kidney pain, Licken Plaw	Oil	Menstrual cramps	Dry leaves	Lawal et al., 2010
Euphorbia hirta L.	Euphorbiaceae	Asthma	Whole plant	Diarrhoea; Gastritis; diabetes; dysentery; rheumatisms; amoebiasis; antibacterial.	Whole plant	Jiofack, 2010
Gardenia spellis J. Ellis	Rubiaceae	Hypertension	Leaves, stem	N/A	N/A	N/A
Jatropha gossypiifolia L.	Euphorbiaceae	Anemia	Roots, leaves	Antimalarial; antimicrobial, anti-inflammatory, antidiarrheal, antihypertensive; anticancer.	leaves	Gbeassor et al., 1989; Félix-Silva, 2014
Momordica charantia L.	Cucurbitaceae	Licken Plaw	Fruits	Peptic Ulcer; Yellow Fever; Jaundice; Diabetes; Infertility; Dysmenorrhea	Fruits, whole plant	Jiofack, 2010; Oladunmoye, 2011; Tsabang et al, 2017; Sharaibi et al., 2017

Monodora myristica (Gaertn.) Dunal	Annonaceae	Rheumatisms	Seeds	Hypercholesterolemia; Antimicrobial; Skin diseases; Anti-inflammatory; Anthelmintic; Antioxidant	Seeds, bark	Egharebva et al., 2008 Lino & Deogracious, 2006; Adewole et al., 2013; Akinwunmi K & Oyedapo, 2015; Ekeanyanwu, 2012; Moukette et al., 2015; Onyenibe et al., 2015
Moringa oleifera Lam.	Moringaceae	Hepatitis B	Leaves	Cardiac and circulatory stimulant; Antitumor; antipyretic; antiepileptic; anti-inflammatory; antiulcer; antispasmodic; diuretic; antihypertensive; cholesterol lowering; antioxidant; antidiabetic; hepatoprotective; antibacterial; antifungal; Vitamin supplement; Acute rheumatism	Leaves, roots, seeds, bark, fruit, flowers and immature pods	Lawal et al., 2010; Anwar et al., 2007; Moyo et al., 2012
Newbouldia laevis (P.Bea.) Seen. Ex Bureau	Bignoniaceae	rheumatism, jaundice	roots	Antibacterial activity; Diarrhea; Dysentery; Sexually transmitted diseases, Jaundice; Antifungal; Anti-inflammatory; Antioxidant; Anti-arthritic; Menstrual disorders; Infertility	Leaves, roots, stem	Sharaibi et al., 2017; Akinpelu et al., 2009; Hoffman et al., 2004; Chukwujekwu et al., 2005; Woode et al., 2008
Ocimum gratissimum L.	Lamiaceae	Sinusitis, antibacterial effects	Leaves	Peptic Ulcer; Skin diseases; Antimicrobial	;	Egharevba & Ikhatua, 2008; Alebiosu et al., 2012; Ngassoum et al., 2003
Ocimum americanum L.	Lamiaceae	Sickle cell anemia	Leaves	N/A	N/A	N/A
Phyllanthus amarus Schum. Et Thonn.	Euphorbiaceae	Hepatoprotective effects	Leaves	Antidiabetic	Whole plant	Tsabang et al., 2017
Piper guineense Schumach.	Piperaceae	Rheumatism	Fruits	Hypertension	Seeds, leaves	Mensah et al., 2009
Remirea maritima Aubl.	Cyperaceae	Hypocalcemia	Leaves	N/A	N/A	N/A
Rhaphiostylis beninensis (H. ex P.) Pl. Ex. Ben.	Icacinaceae	Sickle cell anemia	Leaves	Anti-inflammatory; antimicrobial; antitumoral	Roots, leaves	Ofeimun et al. 2014; Ofeimun & Mbionwu, 2014; Adebayo-Tayo et al., 2011
Securinega virosa Roxb. Ex Willd.	Euphorbiaceae	Fever	Leaves	Antiviral; Antidiarrheal; antioxidant	Leaves, root bark extracts	Oladunmoye, 2011; Uzama et al., 2013; Magaji et al., 2007
Senna occidentalis (L.) Link.	Fabaceae	Hepatitis B	Leaves	Diabetes; Jaundice	Leaves, seeds	Etuk & Mohammed, 2008; Musa et al., 2011

Spondias mombin L.	Anacardiaceae	Hepatitis B	Leaves	Antiviral; Antibacterial; child birth aid; cough; sore throat; antimalarial; stomachache	leaves, fruits, root, bark, flowers	Okigbo et al., 2009; Adedokun et al., 2010; Aromolaran & Badejo, 2014
Triplochiton scleroxylon K. Schum.	Sterculiaceae	Threats of abortion	Leaves	Backache	N/A	Lawal et al., 2010
Verbena officinalis L.	Verbenaceae	Nervous tension, stress, gastritis, antitussives, rheumatism	Leaves	Antimicrobial; anti-inflammatory; analgesic; neuroprotective; hypnotic/ sedative; gastroprotective; hepatoprotective; anticancer; wound healing; antioxidant	stem, shoots	Lai et al., 2006; Turker et al., 2010
Vernonia amygdalina Delila	Asteraceae	Hemorroids, Licken Plaw	Leaves	Digestive; Poisoning; Diabetes; Laxative; Malaria; Wounds; Antispasmodic; Antibacterial; Whooping cough; Hemorrhoids, Measles, Jaundice, Chickenpox, antihypertensive	Leaves, juice	Jiofack et al., 2010; Oladunmoye, 2011; Lawal et al., 2010; Mensah et al., 2009
Vitellaria paradoxa C. F. Gaertn	Sapotaceae	Ulcer, cough	Seeds	Worms; Ulcers; Diarrhea	Bark, whole plant, seeds	Jiofack et al., 2010
Vitex doniana Sweet	Lamiaceae	Asthenia	Leaves	Gastroenteritis; HIV	Leaves, bark, root bark	Tietjen et al., 2016; Agunu et al., 2005
Xylopia aethiopica (Dunal) A. Rich	Anonaceae	Diabetes, hernia, cough	Seeds	Anthelmintic; Analgesic; Lactation inducer	Leaves, fruits, seeds, bark	Oladunmoye, 2011; Lawal et al., 2010; Sharaibi et al., 2017; Ekeanyanwu, 2012
Zanthoxylum zanthoxyloides Zepern. et Timler	Rutaceae	Toothache, ulcer	Fresh root bark	Antimicrobial; asthma	Dried fruits, bark, roots and leaves	Lawal et al., 2010; Ngassoum et al., 2003

in the rest of Africa, this plant is employed in a plethora of different illnesses, showing hypoglycemic, anti-hypertensive, antitumoral, antimicrobic and antioxidant effects (Adewole & Caxton-Martins, 2009; Zubaidi et al., 2023). The versatility of *Annona muricata* is remarkable, as it has been traditionally used to combat a wide range of health issues, reflecting its broad spectrum of biological activities. In Benin, the use of this plant for HBV treatment is particularly significant given the high prevalence of the disease. The traditional knowledge surrounding *A. muricata* highlights the potential for discovering new therapeutic agents from this plant, warranting further scientific investigation.

Citrus aurantium (Rutaceae), commonly called bitter orange, is also employed in the treatment of HBV. In particular, leaves extracts and fruits are helpful in HBV cases and are also administered to patients with sickle cell anemia. Conversely, evidence shows a different use of this plant in Africa, where is considered healing because of its antitumor, antimicrobic and antidiabetic properties (Suryawanshi, 2011). This wide range of applications illustrates the plant's diverse pharmacological properties and its importance in traditional African medicine. The use of *C. aurantium* in treating such a broad array of ailments signifies the plant's potential as a source of multiple therapeutic agents. Among other plants used against HBV in "La Croix" Hospital, we appoint: *Cymbopogon citratus* (Gramineae), *Moringa oleifera* (Moringaceae), *Senna occidentalis* (Fabaceae) and *Spondias mombin* (Anacardiaceae). Each of these plants has unique medicinal properties that contribute to their use in African traditional

medicine in various diseases. For instance, *Cymbopogon citratus*, commonly known as lemongrass, is renowned for its antipyretic effects and potential antibacterial properties), while *Spondias mombin*, commonly known as hog plum, is used for its anti-inflammatory and antimicrobial effects (Okigbo et al. 2009; Adedokun et al., 2010; Aromolaran & Badejo, 2014).

Dysentery is another widespread burden in Africa, primarily caused to Shigella dysenteriae infection. This condition is characterized by a state of infection of the intestine, especially the colon, which is manifested by abundant diarrheal discharges, presence of blood, mucus and/or pus in the stool. Moreover, loss of fluids and minerals can lead to dehydration and electrolyte imbalances. Interestingly, dysentery, regardless of bacterial or amebic etiology, is treated with leaves of *Bosquiea angolensis* (Moraceae).

Eventually, *Securinega virosa* (Euphorbiaceae) is commonly used in Africa to treat various diseases, i.e. diarrhea and viral diseases. Indeed, a study of Uzama et al. (2013), showed that leaf extracts of this plant display very good antioxidant activities, which may be due to the presence of phenols and flavonoids. However, in Benin traditional medicine, *Securinega virosa* is exclusively used in cases of flu. Moreover, leaves of *Crateva religiosa* (Capparaceae) are considered powerful antibiotics, and are mostly employed in "La Croix" Hospital to cure different diseases with microbial etiology. Furthermore, this plant is also administered to patients with migraine, and herbal teas made from this plant are curative in cases of Lichen planus, an autoimmune disease affecting the skin, nails, hair, and mucous membranes (Mansouri, 2022).

The diverse applications of these plants underscore their significance in traditional medicine and the potential benefits of integrating traditional knowledge with modern scientific research to discover new treatments for various diseases.

4.2. Plants used in the management of diseases with other etiologies

In Benin, the utilization of medicinal herbs is not only used in the treatment of pathologies with microbial etiology. Rheumatism, a multifaceted condition encompassing a spectrum of discomforts or pains associated with the locomotor system, is not often precisely diagnosed, due to its diverse manifestations. However, despite the diagnostic challenge, several herbs are used to alleviate joint pain. Healers generally use massages on the part of the body affected by pain with a mixture of extracts from different plants. Among the most common plants used in these treatments, notable mentions include *Citrus limon* (Rutaceae), *Monodora myristica* (Annonaceae), *Newbouldia laevis* (Bignoniaceae) and *Piper guineense* (Piperaceae). *Citrus limon* is well known for its antimicrobial and antioxidant efficacy and stands out as a particularly versatile remedy. While it is commonly employed across Africa for alleviating symptoms of fever and sore throat, its extracts have also been found to offer relief in cases of arthritis, showing the adaptability of this plant in a broad spectrum of diseases (Otang & Afolayan 2016; Maroyi, 2013).

Another pathological condition that is normally treated with the help of medicinal herbs is hernia. This condition finds remedies in extracts derived from the roots of *Amorphophallus dracontioides* (Araceae) and *Anthocleista vogelii* (Loganiaceae). While the use of *Amorphophallus dracontioides* is quite unpopular in the rest of Africa, the beneficial effects of *Anthocleista vogelii* are well recognized, due to its richness in phytochemicals. Indeed, the plant is rich in secoiridoids and alkaloids, making it a potential remedy in a variety of clinical conditions, such as diabetes, malaria and other microbial infections, hypertension and inflammation (Anyanwu et al., 2015, Eta Okon et al., 2014).

Additionally, *Diospyros mespiliformis* ~~Hochst~~. belonging to the Ebenaceae Family, emerges as another noteworthy ally in the treatment of hernia. Despite its limited usage compared to other South African regions, *Diospyros mespiliformis* finds application not only as a pain reliever, but also as an antimicrobial agent and in digestive disorders (Mahwasane et al., 2013; Maroyi, 2013; Mabona et al., 2013).

Hematological diseases, particularly sickle cell anemia (SCA), represent a burden in Benin, affecting predominantly children. SCA is a life-threatening or chronically debilitating disease. 75% of children with sickle cell disease worldwide were born in sub-Saharan Africa, and 50-90% of affected children die before five years old (Esoh et al., 2021). Transfusion is an essential component in the management of patients with SCA, but the transfusion system is far from adequate (Diop & Pirenne 2021). For this reason, it is local opinion that medical herbs may be supportive for this disease. Leaves and fruits of *Citrus aurantium* are used in cases of anemia, as well as HBV as previously described. To give further examples, *Ehretia cymosa* (Boraginaceae) and leaves of *Ocimum americanum* (Lamiaceae) and *Rhaphiostylis beninensis* (Icacinaceae) are also thought curative for SCA.

To conclude, it is necessary to mention the management of diabetes in Benin, since this chronic disease has increased rapidly over the last years in sub-Saharan Africa. Despite the alarming trend, patients rarely self-monitor their glucose levels and not often adhere to medical recommendations, posing significant challenges to effective diabetes management. In response to these challenges, healthcare practitioners at "La Croix" Hospital have integrated various medicinal plants into diabetes management protocols, leveraging the therapeutic properties inherent in these botanical resources. *Anacardium occidentale* (Anacardiaceae) renowned for its antimicrobial and hypoglycemic properties, is employed in the treatment of diabetes both in Benin and other Southern states of Africa (Oyedemi et al. 2017). Similarly, *Xylopia aethiopica* (Anonaceae) is typically used for the preparation of herbal teas and has found favor among healthcare practitioners as a therapy for diabetes or cough. Interestingly, despite the well documented hypoglycemic effects of certain plants in other African regions, their utilization in Benin refers to a range of pathologies different from diabetes. For instance, *Clausena anisata* (Rutaceae), acknowledged for its hypoglycemic effects (Ojewole, 2002), finds application in Benin primarily in the treatment of sinusitis through nasal insufflation along with other plant extracts. Similarly, *Senna occidentalis* (Fabaceae) is one of the best characterized plants in Nigeria to treat diabetes (Etuk & Mohammed, 2008) nonetheless the same plant assumes a different therapeutic role in Benin, mostly serving as a treatment for HBV.

5. Safety of traditional herbal drugs

The safety of medicinal plants in Africa is a topic of significant importance due to the widespread reliance on traditional medicine across the continent. While many plants harbor proven therapeutic benefits, concerns regarding their consistency, purity, and potential toxicity remain. The absence of stringent regulatory frameworks in many African countries means that the quality control of these medicinal plants can be inadequate, leading to risks such as contamination, incorrect dosage, and interactions with conventional drugs.

The potential hazards associated with the consumption of herbal medicines are often underestimated, with contaminations posing one of the most significant risks. These contaminations include microorganisms, i.e. *Staphylococcus aureus*, *Escherichia coli*,

Salmonella spp., *Shigella* spp., *Pseudomonas aeruginosa*, as well as toxins (Aflatoxin, bacterial endotoxins). Moreover, the presence of pesticides (Chlorinated pesticides, Organic phosphates, Carbamate insecticides and herbicides, Dithiocarbamate fungicide, Triazin herbicides) and toxic metals (Lead, Cadmium, Mercury, Arsenic), further increase the risk associated to herbal plants administration (Parle & Bansap 2006).

Another important aspect is ensuring the correct dosage of herbal plants. Understanding the pharmacokinetic profile of phytochemicals is mandatory to ensure their safe and effective prescription, thereby minimizing the potential for adverse interactions with other drugs and herbs (Barnes et al., 2003). However, there is a lack of knowledge about pharmacokinetics linked to poor scientific studies and inadequate reporting, exacerbating the challenge of ensuring safe herbs usage (Muhammad & Awaisu, 2008).

Therefore, considering these complexities and risks, it is crucial to establish comprehensive safety assessments. This necessitates conducting rigorous toxicological studies to ascertain the safety profiles of medicinal plants and developing standardized guidelines for their cultivation, harvesting, processing, and administration. By instituting robust regulatory mechanisms and fostering scientific research endeavors, African nations can safeguard public health while harnessing the therapeutic potential of their rich botanical heritage.

6. Conclusions

In this review, we described the health conditions of Benin and the use of medicinal plants in the treatment of various diseases, according to data collected in the hospital "La Croix". Certainly, Benin fully represents the socio-health condition of Africa and has allowed us to investigate the concept of phytotherapy in depth. The use of medicinal plants in Africa is a deeply rooted tradition, integral to the continent's cultural and healthcare practices. Traditional healers, often referred to as herbalists, play a crucial role in this practice, possessing extensive knowledge of the medicinal properties of local flora. These natural remedies are not only accessible and affordable but also provide a sustainable alternative to conventional pharmaceuticals. Considering the local use of medicinal plants, it appears that there is a more restricted and limited use of herbs, which are used more extensively in the rest of Africa, probably due to lesser knowledge of their potential. However, the major concerns regarding the safety of medicinal plants are common with other African states. The use of African medicinal plants also requires that investors and researchers establish the cytotoxicity of these compounds to ensure their safety and efficacy. Eventually, as interest in natural and holistic medicine grows globally, African medicinal plants are gaining recognition for their potential in contributing to global health and wellness.

Author contributions

Conceptualization, Si.C., R.G., G.F.F., V.G. and A.P.; writing – original draft preparation, Si.C., F.D., Sa.C. and N.P.; writing – review and editing, Si.C., F.D., Sa.C. and N.P.; visualization, Si.C., R.G., G.F.F., V.G. and A.P.; supervision, Si.C., R.G., G.F.F. and A.P. All authors have read and agreed to the published version of the manuscript.

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