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# Wound Care: Traditional African Medicine Approach

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## Abstract

Wound care represents a major health burden in Africa. The types and causes of wounds in Africa are numerous; however, the interventions to these injuries are easily accessed in hospitals in the urban cities, while in most rural communities, the primary source of interventions is traditional medicine (TM). In recent times, there are incidences of preferences to the use of TM in the management of especially challenging wounds even when conventional interventions are available. In some African communities, there are incidences of quasi integration of conventional and traditional African medicine (TAM) in wound care. In the typical traditional African approach to wound care, diverse practices such as the use of herbal medicine, divination, and other physical interventions are common. There appears to be a favorable future for wound management using TAM with the increasing popularity due to various affirmative reasons other than poverty. The recognition, patronage, and uses of TAM for wound care as an alternative or complimentary to the conventional approach is expected to continue, hence, the need for the different regional governments in consonance with the WHO to promote the standardization, regulation, and other factors that will assure the safety and efficacy of the various practices and products of TAM.

**Keywords:** wounds, African traditional medicine, wound care, herbal medicine

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## 1. Introduction

Wounds constitute among the major causes of visits to hospitals in Africa, accounting for about 30–42% of hospital attendance and 9% death every year [1, 2]. It is also among the most underreported health challenges in many parts of Africa, probably because of the poor access to hospitals among other reasons. In Africa as in other parts of the world, the causes of wounds are numerous varying markedly between age groups, environment, and occupation. Generally, the prevalent wounds in most parts of Africa are caused by assaults, road crashes, occupation-

related injuries (in construction sites, farms, and domestic accidents in homes), animal bites, burns, surgery, and diseases (resulting in acute or chronic soft tissue damages). The primary source of interventions to wounds is the hospitals where health professionals are available to manage the different types of conditions as may be presented by the patients. An estimated 27–82% of the people in the different countries in Africa live in rural areas where hospitals and conventional healthcare services are either poor or nonexistent. Usually, the main option available to the majority of these rural communities is the indigenous traditional medicine [3]. The Africa traditional medicine has an intimate and long history of use and constitutes an important part of the culture and life of the people.

The various approaches to wound care in the different African cultures as shown by the knowledge, skills, and practices vary widely, and sometimes, with similarities that cross match in both far and near communities; nevertheless, the outcomes remain the same, which is, that the patients have quick healing and return to normal lifestyle [4]. In recent times, there has been an upsurge in incidences of preferences to the use of indigenous to traditional medicine for wound care even when conventional interventions are available. These arise due to certain experiences and prejudices that include perceived failure of the conventional therapy to meet the expectations of the patients especially as regards the management outcomes of such wound conditions as compound bone fractures, chronic ulcers, side effect of drugs, high cost of the conventional therapy, etc. [4, 5].

In the typical traditional African approach to wound care, diverse practices such as the use of herbal medicines, divination, and ritual performances are common [6]. The approach to the intervention often depends on the society, type, and severity of the wound. Generally, the use of herbal materials for wound management cuts across most cultures and wound types [7]. Though, much remain unknown about many of the traditional practices, techniques, and products used in wound care as regards scientific proofs that convincingly demonstrate the efficacy and safety of the practices, these traditional approaches will continue to play important roles in the healthcare needs of the people.

Sometimes, there is crude integration of the conventional and some traditional wound care practices. Some areas where integration is commonly used include in the treatment of bone fractures, burn wounds, and chronic ulcers due to certain diseases. In Nigeria, some traditional bonesetters enjoy high patronage. Some of the reasons adduced for this include claims of better treatment outcomes compared with the conventional approach, low cost, intimate interaction between patients and practitioners, among others. Many traditional medical practitioners (TMPs) integrate aspects of conventional healthcare practices such as use of antibiotics, anti-inflammatory drugs, and X-rays with their traditional methods in the management of certain wounds. Serious wounds such as burns, pressure, and chronic wound ulcers have continued to be the cause of morbidity and change in lifestyle of patients. Many of the difficulties have been tracked to the emergence of multiresistant strains of organisms to conventional antibiotics and the absence of effective conventional remedies. Recent scientific evidences and clinical trials conducted using certain herbal materials for wound treatment has shown good promise [8]. Some herbal materials including products containing *Hibiscus sabdariffa*, *Aloe vera*, and honey have been used extensively for wound care with excellent results [9–11]. The objective

of this chapter is to have a comprehensive cache of information on the traditional approach to wound care in Africa. There appears to be a favorable future for wound management using the TAM approach. The recognition, patronage, and success of TAM in wound care as an alternative or complimentary to the conventional approach is expected to continue, hence, the need for the different indigenous governments in consonance with the WHO to safeguard the life of the people by standardizing and improving the regulation of the various practices and products used by the TMPs, design basic training (especially in areas of patient handling and hygiene), research and clinical trials to show proof of efficacy and safety of their practices, products, and techniques. This will ensure that only genuine practitioners are allowed to practice as well as ensure that only safe and effective techniques and products are used as a precursor to integrating this system into the mainstream healthcare system. In this chapter, the general concept of wound care, types, and efficacy of traditional interventions and indigenous African medicinal plants used for wound care are discussed.

## **2. Wounds**

Wounds may be defined as a circumscribed damage that may be caused by physical, chemical, disease, or combinations of these factors often involving tissue or organ resulting in the disruption of the continuity of the epithelial lining of the skin or other tissues so that the integrity and/or protective functions of the tissue is compromised [12–14].

### **2.1. Causes of wounds**

Physical factors capable of causing wounds are many. In ancient times, the primary physical factors that may generate wounds include battles, animal bites, farming, hunting, and culture-religious activities (such as circumcision, tribal marks, and body piercing), among others. In contemporary times, the common and prevalent physical factors causing wounds include assaults, road crashes, surgery, burns, freezing, corrosive chemicals (acids, basis, and so forth), radiations, animal bites, gunshots, occupational, and domestic accidents resulting in unspecified soft tissue damage due to cuts, abrasions, fractures, and so forth. In general, certain diseases including microbial, fungal, and viral infections as well as immunological defects have caused wounds. It is estimated that about 34% of all the diseases encountered worldwide are diseases with potential to cause wounds [15]. Common wound-causing diseases include diabetes, tumors, boils, athlete's foot, necrotizing ascitis, sporotrichosis, and chicken pox [16].

### **2.2. Types of wounds**

Even in ancient times, people in Africa have differentiated their wounds based on their experiences from injuries incurred in their various day to day activities. The ancient Egyptians have differentiated their wounds simply into fresh and nonhealing wounds, which correspond closely to acute and chronic wounds, respectively, as classified in this contemporary times [17]. In contemporary times, however, the classification of wounds has become more complex so as to meet certain functional objectives.

Many wound classifications are based on such factors as etiology that relates to causes such as wounds due to mechanical injury (bites, cuts, abrasion, crush, muscle tear, incisions, and others), wounds due to chemicals (acid, basis, and other corrosive substances), radiations wounds, wounds from thermal factors (burns and freezing). Classification based on severity related to physical presentation based on depth of the wound (superficial, partial thickness, full thickness, and deep wounds). Classification based on wound contamination (clean wound, clean-contaminated wound, contaminated wound, and heavily contaminated wound). There are other classifications that include surgical or traumatic; mild, severe, or lethal; simple or compound; acute or chronic [18].

In typical African communities, people sustain different types of wounds with varying severity in their daily life activities. Assuming the simple conventional classification of chronic and acute wounds, the common wounds encountered include incision wounds (e.g., circumcision), animal bites, cuts (sharp objects), abrasion, crush, muscle tears, diabetic ulcers, among others.

### **2.3. Circumcision wounds**

Circumcision is a simple surgical procedure that results in an acute predetermined wound. In African communities, where circumcision is part of the culture there are always TMPs who are dedicated to this practice. They carry out the surgery and manage the wounds using traditional methods. In many parts of Africa, the traditional methods rely heavily on herbal materials and herbal products to prevent infection, ameliorate pains, and swelling, and accelerate wound healing [19]. Currently, conventional medical circumcision is popular in most urban African cities [20]. However, the traditional providers will continue to be an important approach to circumcision in especially rural area for various reasons [21].

## **3. Pains**

Pain is an unpleasant sensation that is felt as a result of the brain's response to damage in the body [22]. It is an important feature of wounds. Pains due to wounds are usually localized, intense, and persistent, and may be exacerbated by physical and psychological factors. Most persistent wound pains may be related to conditions such as ischemia, hypoxia, venous insufficiency, vasculitis, or pressure. Conditions such as inflammation, hypersensitivities, and local infection can also result in persistent pains [23–25]. Pains due to physical factors are often related to movement, poor dressing techniques, and the use of inappropriate dressings, among others [26]. Psychological factors include factors such as anxiety, stress, fear, depression, and sleep disturbances [27–30]. Pains can greatly affect the quality of life of the patient as well as those taking care of the patient. Although it may not be feasible to completely eliminate the pain, however, an effective wound care system must make the pains tolerable [26, 31, 32].

There are two types of pains: nociceptive and neuropathic pain. Wound patients may experience both nociceptive and neuropathic pains. Nociceptive and neuropathic pains can either be acute or chronic; however, neuropathic pains are the major contributors to most chronic

pains. Nociceptive pains arise from damaged tissues and wounds such as compound fracture, burns, bruises, and inflammatory disorders are typically nociceptive.

Plant	Botanical part used	Common/ vernacular name	Type of wounds	Geographical/ country of origin
<i>Acacia Senegal</i>	Root	Gum Arabic	New wounds	Nigeria, South Africa
<i>Aloe ferox</i>	Bark	Bitter aloe	Burn wound	South Africa, Nigeria
<i>Agathosma betulina</i>	Leaves	Buchu	Open wound	South Africa
<i>Aspalathus linearis</i>	Root	Rooibos	All wounds	South Africa, Nigeria
<i>Azardica indica</i>	Seed	Dogonyaro	New wounds	Nigeria, West Africa
<i>Bauhinia rufescens</i>	Stem-bark	Danya	New and chronic wounds [33]	South Africa
<i>Camellia sinensis</i>	Leaves	Tea plant	New wound [33]	South Africa
<i>Centella asiatica</i>	Leaves	Gotu kola	New wound [34]	South Africa
<i>Cyclopia genistoides</i>	Leaves	Honey bush	New wound [34]	South Africa, Nigeria
<i>Euphorbia hirta</i>	Leaves	Buje	New and old wound [33]	West Africa, Nigeria
<i>Hibiscus sabdariffa</i>	Calyx	Zobo	Surgical wound [9]	Nigeria
<i>Hypoxis hemerocallidea</i>	Leaves	African potato	Wound heal	Mozambique
<i>Merwillan atalensis</i>	Bulb	Inguduza	Burn wound [8]	Swaziland, Lesotho
<i>Moringa oleifera</i>	Leaves	Miracle tree	New and old wounds [33]	Nigeria, West Africa
<i>Musa sapientum</i>	Leaves	Ayaba	New and old wounds [35]	Nigeria
<i>Parkia biglobosa</i>	Leaves	Iru	Chronic wounds [36]	Nigeria, Mali,
<i>Pelargonium sidoides</i>	Leaves	Umckaloabo	All wound	Senegal
<i>Sclerocarrya birrea</i>	Bark	Marula	New and old wound	Senegal
<i>Siphonochilus aethiopicus</i>	Rhizome	Wild ginger	New wounds [37]	Mozambique
<i>Sutherlandia frutescens</i>	Leaves	Petola	Wound heal [37]	Nigeria, Namibia, Malawi Botswana, Namibia

**Table 1.** Some indigenous African plants used for wound healing in TAM.

### 3.1. Nociceptive pains

Nociceptive pains arise from damaged tissues. Signals are picked up by sensory receptors in nerve endings of the damaged tissue. These nerves transmit the signals to the spinal cord and then to the brain, where the signals are interpreted as pain. The pains are typically well localized and constant. They are often described as aching or throbbing pain. Visceral (involve internal organs) and somatic (involve the body surface or musculoskeletal tissues) pains are nociceptive in origin. Wounds such as compound fracture, burns, bruises, and inflammatory disorders are typically nociceptive.

### 3.2. Neuropathic pains

Neuropathic pains are caused by either damage or dysfunction in the (peripheral and central) nervous system. The pain is frequently chronic and tends to respond poorly to treatment with opioids and nonsteroidal anti-inflammatory drugs. The pains are often described by patients as burning, tingling, shooting, stinging, piercing, stabbing, etc. [23, 24, 26].

### 3.3. TAM and wound pains

Herbal materials are the mainstay of the TAM approach to wound care. The holistic nature of TAM makes for a sensitive patient-centered care, whose goal is patient's comfort and accelerated wound healing. Most TMPs control wound pains by administering herbal materials or herbal products. Many of the herbal products used for wound treatment have combined immune-boosting, anti-anxiety, antibacterial, anti-inflammatory, and analgesic properties. The products may be administered orally or applied directly on the wounds [9] (Table 1).

## 4. Wound management with TAM

Some common paraphernalia used for wound care using the TAM approach includes divination, animal products, minerals, and herbal medicine. In TAM approach to wound care, the type of care and attention given to patients differ among the different people and cultures; however, factors such as perceived severity and cause of the wound are among the paramount considerations.

In especially chronic or serious wounds, TMPs employ their experience or use divination as a means of diagnosis to gain insight to the cause of the wound and also the probable remedy [38]. The healing agents may be applied directly on the wounds and/or taken orally or in a manner that the healer sees fit. The wounded patients are treated either in their homes or in traditional therapy clinics. In contemporary times, in the typical African rural community, wounds are managed by the TMPs with a salient area of specialization. For example, traditional midwives are experienced in taking deliveries and handling wounds arising from cuts and tears during childbirth, also TMPs specialized in circumcision, manage circumcision wounds. In most cases, the pedigree of the TMPs is well known by their communities and their client often repose a lot of trust in them.

## **5. Reason for the continuous sustenance of TAM**

The status and practices of TAM in various parts of Africa vary widely due to differences in geographical, economic, and sociocultural orientation, among others. Indeed TAM generally occupies an important position in the healthcare needs of many Africans especially people in the rural communities. Sometimes the sociocultural and religious factors often have overwhelmingly influence on the system of healthcare. Many reasons have been tracked why many people in Africa continue to use TAM for their various healthcare needs. Some of the reasons include the following:

### **5.1. Personal preferences for TAM**

TAM is an age-long system of healthcare that is deeply enshrined in the culture of the people. In time past, the people have relied on it as the primary healthcare system with much success. Despite modernization and the proliferation of the conventional healthcare system, some people still show personal preferences for TAM. This group of people will always prefer for their healthcare needs TAM whenever possible, and the choice exists irrespective of their financial, educational, and social status even though there are opportunities for prompt and easy accessibility to conventional healthcare services. The most popular aspect of TAM that is commonly used is the herbal medicine. Many people believe and use herbs, herbal materials, and herbal products as medicines for wound care and other ailments. The use of herbal medicine will continue to grow for many reasons: some people believe that herbal medicines are generally safe and carry no risk or side effect. This belief may be erroneous as many herbal medicines are comparatively more tolerable than orthodox drugs; however, they are not totally devoid of side effects, adverse reactions, and interactions with other products [39, 40].

### **5.2. Easy accessibility**

In many African communities, there are inadequate conventional medical centers and healthcare practitioners as compared to easy and quick access to the TMPs. In many African communities, the TMPs generally outnumber the conventional health practitioners especially in the rural communities [41]. Many TMPs provide personalized, culturally appropriate, holistic, client-centered healthcare. In some cases, the autocracy observed in the attitudes of doctors and nurses may force clients to swing to the use of traditional methods. Also because of the high relative ratio of patients to conventional physicians, a lot of pressure is placed on medical personnel resulting in perceived or quasi-incompetence as many patients are often not satisfied with the attention given to them by health workers. The patients have insufficient time to interact and discuss their problems with their physicians and other health workers in matters regarding their health condition [42].

### **5.3. Low cost of treatment**

The cost required to secure the services of TMPs in many rural African communities is often low when compared to that for the medical doctors. The TMPs are usually community



members and are often within walking distance of their clients' and patients' homes, as against the long distances to be traversed to reach the conventional medical centers. The modalities of payment for services are often more flexible with TMPs, who may accept part payments or payment in kind (they may accept chickens, goats, etc.) as against in conventional medical centers where the patients are often required pay before or immediately after treatment [43].

#### **5.4. Efficacy of treatments**

In recent times, there has been an increase in regulation and research activities into various aspects of indigenous traditional healthcare practices and products. The safety and efficacy of some products and practices have been scientifically evaluated and results collaborated with folk claims. The scientific proof of safety and efficacy has contributed to the increasing confidence and popularity of many herbal medicines and other products of TAM. There are also certain endemic diseases where patients have indicated preferences for TAM approach for the management instead of the conventional medicines [44].

#### **5.5. As last resort**

Some TAM practices and products are used as a last resort in the management of certain health challenges especially when the conventional approach has failed to yield the desired results. Some of such health challenges include chronic wounds, ulcers, and complex bone fractures. Indeed, sometimes the TAMs have proven to be better [45].

### **6. Factors affecting wound healing**

Wound healing can be enhanced or impeded by several factors. The factors that can affect the healing of wounds can be grouped into systemic and local. The local factors include infections, slough and necrotic tissues, low oxygen tension, inadequate perfusion, foreign bodies, poor wound hygiene, and pressure, while the systemic factors include cardiovascular disorders, nephropathy, metabolic disorders (diabetes), high age, medication (e.g., steroidal anti-inflammatory drugs), poor nutrition, smoking, and immune suppression. Wounds under favorable healing factors will heal fast even with minimum intervention. In the holistic approach of TAM, some of the interventions are capable of addressing both the local and systemic factors at the same time [46].

### **7. Efficacy of TAM in wound management**

Chronic wounds take a longer time to heal and may sometimes reoccur after healing due to overwhelming underlying unfavorable healing factors, hence, the need to identify such factors and treat them accordingly. Considering conventional healthcare approach to wound care, patients with chronic wounds often experience significant financial burden due to prolonged periods of treatment requiring dressings. There are claims of significant success when TAM

was used as an alternative or complimentary to the conventional system of wound care. Some of the successes achieved by traditional bonesetters with various serious cases of compound fractures, diabetic ulcers, and burns in Nigeria highlight some of the achievement of TAM over the conventional [47]. Such feats have resulted in the popularity and trust in TAM interventions in the management of especially challenging wounds.

The concept of moist wound healing has been used to achieve effective accelerated wound healing with an added benefit of reducing scar. This approach to wound treatment has been recognized and practiced by many TMPs as shown by the use of various honey-based herbal products [48]. It is important to be continually conscious that TAM is a wide array of practices that differs in concept and efficacy along different cultural and geographical locations. The type of intervention and outcomes any TAM-based wound care system will achieve often varies depending on the effectiveness of the intervention [48].

Since ancient times, the importance of effective wound care and the benefits of maintaining wound-site moisture to ensure successful closure of the wound have long been known, as documented in the annals of the ancient Egyptians [49]. The target of an efficient TAM intervention to wounds is expected to have the following features: prevent and control of wound infections, accelerate healing, minimize pain, discomfort, odour, scaring, and protect surrounding tissues. This is achieved through the use of various traditional products that provide appropriate and effective physiological environment conducive for tissue repair and regeneration [50].

## **8. TAM approach to wound care**

In the TAM approach to wound care especially as it pertains to severe and chronic wounds, certain practices and products such as divination, herbal medicine, and honey are commonly used in most parts of Africa.

### **8.1. Divination**

In many parts of Africa, divination is widely practiced [51]. It is used as a means to understand the complexities of life and avoid catastrophe. It takes into consideration both the cause/source of the problems and remedies in relation to the physical as well as spiritual levels of existence to offer solutions to problems. In the management of perceived serious wounds such as severe burns and nonhealing wounds, some TMPs have employed divination as a means seeking information or direction for interventions or treatments from realms beyond the physical [52]. Thus, divination is a metaphysical practice used as a diagnostic tool in some traditional medicine practices.

### **8.2. Herbal medicines in wound care**

Generally, herbal medicine is at the center of various interventions used in TAM approach to healthcare. Herbal medicines have been used as intervention in wounds by enhancing blood clotting, disinfect wounds, and accelerate tissue regeneration.

Herbal medicines include herbs, herbal materials, herbal preparations, and finished herbal products that contain as active ingredients, parts of plants, other plant materials, or combinations. Herbal materials include herbs and other substances such as juices, gums, and oils. Herbal medicines may contain plant materials other than the active ingredients and may also contain nonplant organic and inorganic substance as a component of the active ingredients [53]. The pharmacological activities of the herbs used in herbal medicines are due to the presence of bioactive chemical entities present as secondary metabolites. Some of these substances are capable of eliciting wound-healing activities among other pharmacological activities [9].

Africa has a wide botanical resource, and many have medicinal uses. Plants such as garlic, opium, castor oil, coriander, mint, and indigo were popular as medicines in ancient Africa. The African traditional herbal medicine is perhaps one of the oldest in human history. Many herbal recipes used in TAM contain herbal materials with alleged wound-healing properties. Empirical pharmacological evaluations has collaborated the folk claims of many of these herbs. The wound-healing activities of some herbs have been tracked to the anti-inflammatory, antibacterial, and skin-regenerative properties of their secondary metabolites. Some herbal products developed from traditional herbal recipes from various parts of Africa have shown to be effective in managing some challenging wounds such as pressure sores, burns, and leg ulcers that are often sources of intense pains and morbidity. These have proved to be extremely helpful in patients showing undesirable side effects or intolerance to certain conventional medicines. One probable important contributory reason accounting for the success of many herbal products used for wound care is their user-specific nature as most products are extemporaneously prepared to meet specific needs of patients. The extemporaneous products often do not contain any artificial additives or synthetic components such as preservatives, stabilizers, colours, or perfumes that may interfere with the activities of the active components.

### **8.3. Reason for the wound-healing potential of herbal medicines**

Most of the herbal materials with wound-healing activities are known to contain biochemical substances such as vitamins, amino acids, fats, hydrocolloids, and some inorganic substances such as minerals salts.

The mechanism of the wound healing and other health benefits of the herbal materials have been tracked to their antioxidant properties [54]. The antioxidant properties of the herbs have been linked to their content of polyphenol and carotenoids. Antioxidants are classified into two major categories depending upon the nature of their chemical constituents namely carotenoids and polyphenols. Carotenoids are structurally related to vitamin A and constitute the various retinols like compounds. Polyphenols are antioxidant compounds that also include flavonoids. Flavonoids in addition to their antioxidant action also impart protection against ultra violet light and have metal chelating properties [55].

### 8.3.1. Polyphenols

Polyphenols are a large class of chemical compounds that are synthesized in many plants and are commonly stored in such botanical organs as fruits, seeds, leaves, and flowers of medicinal herbs, fruits, and vegetables. They are responsible for the colour, flavor, and healing qualities of many plants. They will inhibit the oxidation of other molecules. Polyphenols will terminate any chain reaction due to free radicals produced by oxidative processes. In many biological systems, such oxidative reactions often result in cell damage and other harmful processes such as abnormal platelet aggregation, which is a precursor to inflammatory responses. Flavonoids are the largest family of polyphenol compounds. Indeed, all flavonoids are polyphenols but not all polyphenols are flavonoids. The different classes of flavonoids include anthocyanins, flavanols, flavanones, flavonols, flavones, and isoflavones.

### 8.3.2. Health benefits of polyphenols

Polyphenols generally offer numerous health benefits [56]. As wound-healing agents, polyphenols will block the action of harmful enzymes that damage tissues due to UV radiations, wound ulcerations, and cell mutations by protecting tissue cells and body fluids from free radicals generated by oxidative processes. Some polyphenols have the ability to slow the growth of certain virulent viruses and microorganisms such as *Staphylococcus aureus* and *Escherichia coli*. Herbs containing polyphenols often elicit their wound-healing activities by such mechanisms as antibacterial, anti-inflammatory, and proregenerative activities. The antibacterial and anti-inflammatory properties of polyphenols will also prevent swelling and itching of the wounds by inhibiting the release and activities of allergic mediators such as histamine and serotonin [57, 58].

### 8.3.3 Sources of polyphenols

Many foodstuffs contain different types of flavonoids. Anthocyanins are common in many plants and are responsible for the characteristic purple and blue colours of many plants. Examples of foods rich in anthocyanins are blueberries, raspberries, cherries, blackberries, plums, purple grapes, and pomegranate. Cocoa and cocoa products that are abundant in West Africa as well as green and black teas are rich in various catechins that belong to a group of flavanols. All citrus fruits and juices are also good sources of flavanones [59, 60].

## 8.4. Honey

Honey is the sweet, yellow- or amber-coloured, viscous fluid produced from nectar of flowers by bees and certain other insects such as honey ants and honey wasps. [36]. The taste and colour of honey may vary depending on what the bees are eating, geographical, and seasonal conditions. Honey contains high quantities of sugars and small amounts of amino acids, lipids, vitamins, and minerals. It also has good antimicrobial properties; hence, it can be stored without risk of spoilage [36, 61]. The wound-healing and other medicinal benefits of honey have been known for centuries in Africa and in many parts of the world. The medicinal use of honey by ancient Egyptians is well documented. Various empirical results have also shown

the wound-healing potential of raw honey. The wound-healing activities of honey have been tracked to its antibacterial, immunomodulatory, and moisture-retention properties that enable it to disinfect, maintain a moist condition, and enhance tissue repair. The antimicrobial property of honey has been linked to the enzymatic production of hydrogen peroxide. The hydrogen peroxide disinfects and cleanses wounds. However, another kind of honey, called nonperoxide honey, displays significant antibacterial effects even when the hydrogen peroxide activity is blocked [62]. The antibacterial property of nonperoxide honey is related to low pH and high sugar content that imposes high osmolarity that hinder the growth of microbes [63, 64]. Surface skin wounds have been treated successfully with honey plasters with such benefits as reduction of pain and swelling.

### 8.5. Nutrition in wound care

Nutrition is among the critical factors that influence the outcome of wound care [64–66]. When injured, the body's metabolic process changes in attempts to repair itself. Such catabolic consequences often go unnoticed with good nutrition, and the wounds heal quickly. Poor and inappropriate diets can turn a normal superficial wound into a chronic wound since several processes including the body's immune capacity will be affected. Generally, nutrition has been shown to affect wound recovery time, tissue strength, and ability to resist infections. The consideration of proper nutrition in wound care has contributed significantly to enhance the healing of superficial wounds even with minimal direct attention. The practice of proper nutrition during wound care will make minor cuts to heal fast even without direct intervention as well as decrease the challenges, morbidity, and mortality often associated with serious and chronic wounds by reducing the impact, cost, and duration of management.

The nutrients that play important roles in the healing of wounds include protein, carbohydrate, fats and oils, certain vitamins, and trace metals. Protein is the nutrient that is responsible for the maintenance and repair of body tissues. Adequate protein levels in wound conditions will enhance collagen production and accelerate the wound-healing process. The amino acid L-arginine that is a block component of protein when taken as a supplement enhances wound healing [67, 68]. Proteins constitute an important aspect of the diet of most Africans and are derived from such sources as meat obtained from various domestic animals, *bush-meat*, and fish as well as various plant sources. Carbohydrates, fats, and oil are the classical sources of energy for the human body. These are obtained from various starchy, whole grain, and nutty foodstuffs. Energy is required during the anabolic processes in wound conditions for the synthesis of collagen. Higher carbohydrate and low fats heal wounds faster. However, the diet must be balanced as excess carbohydrates may also impede wound healing due to hyperglycemia [69]. The vitamins C, E, and A also play an exceptionally important role in wound healing. Their roles are linked to the synthesis and cross-linking of collagen as well as the formation of new blood vessels (angiogenesis). Apart from these organic compounds, certain metals such as zinc, copper, and manganese occurring in trace quantities have also been linked to important roles in wound healing [9, 70–72]. Iron is also important and its role is linked to the perfusion of tissues with blood carrying enough oxygen to wound sites. Deficiency in these

metals can impair wounds healing by impairing collagen production and strength of the wound [73].

The importance of these metals in the healing of wound could be the reason for the application of the ashes of the root, bark, and pods of certain plants on wounds in some folk medicine [2, 74]. Vitamins and trace metals are derived essentially from the various vegetables, fruits, and nuts that abound in most African communities. In debilitating wounds such as wound ulcers, diabetic wounds, extended burns, and amputation wounds, among others, diet control constitutes a vital aspect of the management regimen just as chemotherapy and dressing. Such wounds that affect especially the elderly, chronically ill, and accident victims constitute a large social, economic, and healthcare burden in many parts of rural and urban Africa.

Water is another component of nutrition and its functions includes hydration of the body to ensure efficient blood circulation that ensures that oxygen and nutrients are carried to every part of the body where the water is especially required for the optimal hydration to enhance wound tissue elasticity and strength.

## **9. Evaluation and authentication of claims of efficacy of wound care using TAM**

Africa has a wide diversity of flora that is used for wound care. Various survey and review reports have established a bank of Ethnomedical information on the medicinal plants used for wound care in various African communities. Many of these reports focus on the ethnogeographical surveys of plant species and recipes used for wound care as well as reports on empirical research evaluations using appropriate models to prove the efficacy, mechanism of action, and safety of the herbs so as to corroborate the folkloric claims. Grierson and Afolayan, and De Wet et al . in their survey of medicinal plants used for traditional wound care in South African documented 38 species belonging to 26 families in Eastern Cape and 47 plant species from 35 families in Muputa land, respectively [75, 76]. Also, several surveys carried out in other parts of Africa including Cameroon, Egypt, Ethiopia, Ghana, Mali, and Nigeria have documented over 160 species from over 70 plant families that are used in traditional wound care [34, 35, 77–81]. These plants are prepared either as a mono-herbal or a poly-herbal some times in combinations with other substances plants. The herbs are prepared and used as decoction, infusions for drinking, or washing the wounds or are pulverized into powders to be applied directly on the open wounds, combined with other herbal materials such as palm oil, kernel oil, shear butter, etc., or made into poultices.

Due to the increasing attention in natural product research, a lot of work has been carried out to authenticate the various claims on the benefits of some of these plants for wound care. Empirical results have tracked the action of the wound-healing activities of some of the indigenous herbs to one or combination of the following pharmacological mechanisms: anti-inflammatory, antimicrobial, and cell-regeneration [82–85]. Many of these tests were carried out by simulating acute and chronic wounds using various simple animal models in rodents. The results have provided vital insights into the safety, efficacy, and mechanism of action of

these herbs in wound care in relation to the type of herb and wound in a reproducible, controlled environment to corroborate or refute claims. The references to the authentications of claims of the wound-healing potential of some herbs commonly used in TAM are presented in **Table 2**.

Herb	Type of preparation	Type of test/mechanisms of action	References
<i>Acalypha wilkesiana</i>	Ethanol extract	<i>In vitro</i> antimicrobial, antioxidant assay, human fibroblast cell proliferation assay	[84]
<i>Bridelia ferruginea</i>	Ethanol extract	<i>In vitro</i> antimicrobial, antioxidant assay, human fibroblast cell proliferation assay	[84]
<i>Dodonea viscosa</i>	Ethanol extract	<i>In vitro</i> antimicrobial, antioxidant assay, human fibroblast cell proliferation assay	[86]
<i>Ficus asperifolia</i>	Aqueous	<i>In vitro</i> antioxidant assay, human fibroblast cell proliferation assay	[87]
<i>Kigelia africana</i>	Methanol	<i>In vitro</i> antimicrobial, antioxidant assay, human fibroblast cell proliferation assay	[83]
<i>Lawsonia inermis</i>	Methanol	<i>In vitro</i> antimicrobial, antioxidant assay, human fibroblast cell proliferation assay	[88]
<i>Nauclea latifolia</i>	Ethanol	<i>In vitro</i> antioxidant assay	[89]
<i>Ocimum gratissimum</i>	Ethanol	<i>In vitro</i> antimicrobial, antioxidant assay, human fibroblast cell proliferation assay	[84] [84]
<i>Parkia biglobosa</i>	Ethanol	<i>In vitro</i> antimicrobial, antioxidant assay, human fibroblast cell proliferation assay	[84]
<i>Tridax procumbens</i>	Ethanol	<i>In vitro</i> antimicrobial, antioxidant assay, human fibroblast cell proliferation assay	[84]
<i>Urena lobata</i>	Methanol	<i>In vitro</i> antimicrobial, antioxidant assay, human fibroblast cell proliferation assay	[90]
<i>Vernonia amygdaline</i>	Ethanol	<i>In vitro</i> antimicrobial, antioxidant assays	[84]
<i>Ximenia americana</i>	Methanol	<i>In vitro</i> antimicrobial, antioxidant assays	[91]
<i>Zingiber officinale</i>	Ethanol	<i>In vitro</i> antimicrobial, antioxidant assays	[92]

**Table 2.** References on the authentication of the wound-healing activities of some medicinal plants used in TAM.

## 10. Future of TAM in wound care

Wounds will continue to be an important health challenge in Africa as well as other parts of the world because of the contemporary complex lifestyles that predisposes people to physical injuries and diseases that cause wounds.

The orthodox health practice is the conventional intervention to wound care that has shown many successes; however; some treatment failures especially for chronic wounds have been experienced, which have been linked to factors such as high cost in treatment, severe pains,

anxiety, and side effect of medications that have promoted poor compliance to treatment and resistance to antibiotics. The success in the management of challenging wounds using the TAM approach has been linked to the holistic patient care that centers on a flexible combination of potent herbal medicines, nutrition, good interpersonal interaction, and communication between the patient and the TMP and other desirable practices. Thus, the increasing popularity of the traditional approach to wound and general healthcare is fast shifting from the old reason of poverty to a conscious acceptance of the system even the eye of easy accessibility to conventional healthcare.

Increased regulation activities by the government of many African countries have resulted in increased standardization of various practices and products, proof of safety and efficacy, training of TMPs especially in hygiene, patient handling, and access to conventional health professional when necessary. The confidence reposed in TAM by users, the successful management of some challenges that the conventional approach has proved less successful, and the increasing resistance of many wound bacteria to conventional antibiotics have shown the potential of TAM as a health system for the future. However, there are still numerous important challenges about TAM that will need to be addressed before many useful practices and products of TAM can be used or integrated into mainstream health care system. Herbal medicines constitute a major component of TAM used in wound management, numerous herbal materials and products with promising wound-healing activities and folkloric claims are available; however, poor research and development and regulation activities of these products are not enough to assure safety and efficacy for its widespread use. In order to adequately harness these potentially useful products and probably integrate them into the mainstream healthcare system, various gaps will need to be filled and this includes adequate documentation on proof of efficacy and general safety including important adverse effects such as mutagenic properties and presence of heavy metal contamination, pharmacokinetic interactions with common conventional medicines, and robust clinical studies are necessary. There is also an important need for the promotion of research and development of simple, effective, and fast quality control techniques to standardize and to assure quality of the crude herbal materials and products, as well as formulating the products into simple, stable conventional pharmaceutical dosage forms. The availability of a large cache of potentially effective wound-healing herbs with evidence of antibacterial, anti-inflammatory, antipains, and antianxiety properties will serve as leads to the discovery of new compounds for the management of challenging conditions.

## 11. Conclusion

The population of the African continent is increasing rapidly, hence, the need to strengthen its healthcare system. One important way to do this is to facilitate standardization and strict regulation of indigenous practices and products that are potentially effective and safe. Indeed, the popularity of TAM in wound care as in other healthcare needs will continue to grow for various reasons other than poverty. Thus, there is an urgent need for the various African governments and WHO to encourage research and development of safe and effective products,



introduce simple and effective quality control techniques that can be used to assure the quality of the various practices and products used in traditional medicine for wounds as well as for general healthcare so as to safeguard the health and lives of the people as a precursor to integrating the system into the mainstream healthcare.

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