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Original Article

WOUND HEALING AND ANTIFUNGAL EVALUATIONS OF SOME SURVEYED PLANTS OF GWADABAWA/ILLELA COMMUNITIES OF SOKOTO STATE-NIGERIA

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ABSTRACT

Objective: This study aimed to evaluate the wound healing and antifungal properties of five earlier surveyed plants of Gwadabawa and Illela communities of Sokoto State-Nigeria cited for their acclaimed therapeutic purpose.

Methods: Air-dried plant parts species for each plant were extracted by maceration using methanol. These were concentrated *in vacuo* to obtain crude methanolic extract (CME). The CME was partly defatted and partitioned with n-butanol to solubilize bioactive compounds in the organic phase, leaving sugars, amino acids, and salty compounds in the aqueous phase. The resulting concentrated n-butanol extracts were then screened by subjecting each extract to *in vitro* antifungal assay for the determination of the minimum inhibitory concentration (MIC) on *Aspergillus niger* in a 96-well flat bottom polystyrene microtiter plate using the broth microdilution method as outlined in the 2021 Clinical and Labora tory Standard Institute guideline; while the CME above for each plant, was subjected to wound healing assay using the wound excision model.

Results: Our findings showed all five plant extracts were active with variable antifungal properties of MIC values ranging from 250 to 3.9 (mg/ml). The lowest activity was recorded for *Waltheria indica*, (with a MIC of 125 mg/ml), while the highest activity was indicated for *Faidherbia albida* (with a MIC of 3.90625 mg/ml). The other three extracts exhibited moderate activity at test concentration with a MIC of 7.8125 mg/ml. Similarly, the CME showed a comparable wound healing effect for all the plant extracts concerning the control groups (5 mg/ml povidone Iodine, PI as positive control and distilled water, DW as negative control). Increased tissue contraction of lesions on the excised skin of rats was observed to significantly differ accordingly based on the applied treatment with the graded doses of the test sample concentrations used (1.25, 2, and 5) mg/ml. Epithelial closure in all the rats occurred after 14 d, and more so, on the 16th 16th-day wounding, the wounds were almost scarless, while those of blank control (DW) had obvious scars.

Conclusion: The wound healing and antifungal potentials of the crude extracts of the selected plants were confirmed. Thus, the five screened plant extracts may possibly be further investigated and developed into drugs for topical treatment of fungal-infected wounds, in line with their earlier folklore documentation.

Keywords: Antifungal screening, Ethnomedicinal plants, Wound healing, Wounds

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INTRODUCTION

The scientific study of plants and their therapeutic significance is most often carried out as survey research into the use of such plants in unlettered societies. The use of medicinal plants in the management of acute and chronic wounds is common in most traditional medical practices in the world. Based on this, many plants in the tropical and subtropical regions of the world have been screened for their wound-healing activity [1, 2]. There are a lot of medicinal plants to be screened in the search for newer, efficacious, and cost-effective wound-healing agents [3]. In most of the developing world, plants or herbal products play an important role in the treatment of wounds [4, 5]. The choice of herbal products for the treatment of wounds varies between regions and cultures [6].

Wounds represent a major global health challenge, which puts much economic, financial, and social stress on health institutions, caregivers, patients, and their families [7]. Wounds are defined as physical, chemical, or thermal injuries or insults that result in an opening or breaking in the integrity of the skin or the disruption of the anatomical and functional integrity of living tissues [8]. Medicinal plants heal the wound healing process by promoting blood clotting, fighting against infection, and accelerating wound healing. It can be stated that plants and chemical agents obtained from plants improve treatment and manage wound healing [9]. Medicinal plants show wound healing effects by different mechanisms, such as modulation in wound healing, decreasing bacterial count, improving collagen deposition, increasing fibroblasts and fibrocytes, etc.

It is a common situation, especially in unlettered society to find wounds with complications due to delay in healing resulting from microbial infections. Thus, Jakucs, [10] established that a major culprit to consider when dealing with delayed wound healing is the presence of fungi that lead to fungal wound infection. Wound infections caused by fungi occur when wounds are contaminated with spores [11]. It was further revealed by the sags that, overall, the incidence of fungal infections is much lower than those caused by bacteria and often occurs later in the infection course than a bacterial infection. If the fungus has developed an infection, it can complicate the healing of a wound that began as bacterial [11]. Some of the more common fungi that cause wound infections include yeast (Candida spp.), Fusarium spp., Mucorales (e. g., Rhizopus, Mucor, or Rhizomucor), and Aspergillus spp. [11].

Our earlier ethnobotanical survey of the communities of the Gwadabawathe/Illela region afforded a record of 40 medicinal remedies prepared from over 40 plants to treat various wounds [12]. The interesting nature of the data obtained in the documentation of these rural communities showed that some plant species were used to treat common injuries of bleeding, cut and burns wounds; boils, whitlow, menstrual pains, and eye injuries. Thus, preparations of medicinal plants are used in folkloric medicine in diverse cultures of the world to treat infections caused by pathogens [13]. The

Gwadabawa/Illela people are predominantly Hausa-Fulani situated in Sokoto State-Nigeria. They are communities that lie within the coordinates 13°43'57" N (Latitude) and 5°18'1" E (Longitude) in DMS (Degrees Minutes Seconds) or 13.7325 and 5.30028 (in decimal degrees), Northwest of the Sahel Savannah region of Nigeria. The inhabitants of this place are people who are largely rural with a population of about 17,461 that pursue an agrarian trader/nomadic herder economy. Hence, the present study investigates some selected surveyed plants commonly employed by the Gwadabawa/Illela inhabitants in Sokoto state, cited for their wound-healing and antifungal properties using the 96 well microtiter plate-based model and the excision wound model *in vitro* assays.

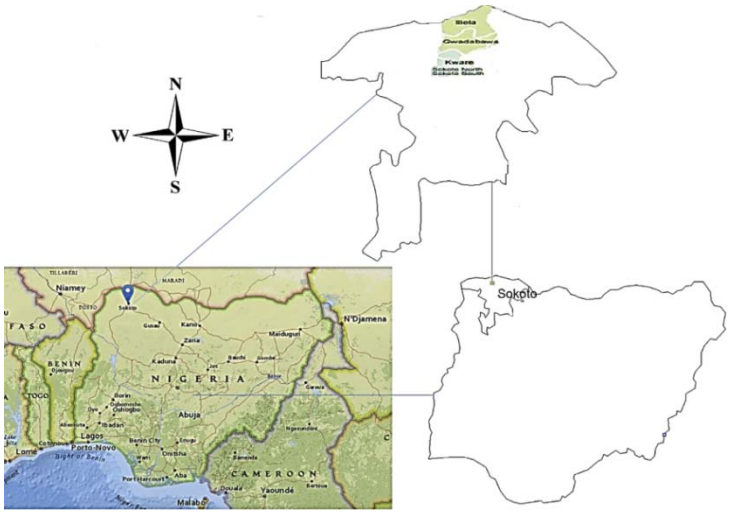

Fig. 1: A map of Nigeria (bottom left corner) located along the Gulf of Guinea: retrieved from Mapmaker Interactive (https://mapmaker.nationalgeographic.org/); map of Nigeria (bottom right corner) showing especially, Gwadabawa/ Illela Local Government Areas where our earlier study was performed. The maps were adopted from our earlier published study of different areas in the same State [14] with slight modifications; designed using the academic version of Map Maker 4 software obtainable from www.mapmaker.com

MATERIALS AND METHODS

Plant identification, collection, and preparation

Our earlier ethnobotanical studies afforded the identification, collection, and preparation of 40 medicinal plants used as antifungal and wound healing agents in Gwadabawa/Illela Local Government Areas of Sokoto State [12]. The informants, through a focal TMP, guided us to the field where the cited medicinal plants were seen and the plant specimens in question were procured, most especially in cases where it was not found around their homes. Photographs images of the collected plant species were made to facilitate their identification processes. Final identification (both colloquially and scientifically) was made at the herbarium unit of the Department of Pharmacognosy and Ethnopharmacy, Usmanu Danfodiyo University, Sokoto-Nigeria, following compilations of Hausa plant names [15]; Vernacular names of Nigerian plants [16] and other books of regional floras [17]. The specimens were labeled with voucher numbers and deposited (where it was not initially available) in the same department for reference. Thus, five selected plants cited as a remedy for both fresh, infected and old wounds were air-dried and investigated for biological activity.

Plant extraction

Air-dried plant samples were ground into powder and extracted by maceration in methanol to obtain crude methanolic extracts (CME). These were concentrated *in vacuo* to obtain CME residue. The CME was divided into two portions and the latter was further extracted in hexane to give a defatted CME residue before being suspended in water and partitioned with n-butanol to solubilize antifungal compounds in the organic phase, leaving sugars, amino acids, and salty compounds in the water phase. The n-butanol extract (NBE) was vacuum dried and the resultant residue was used for antifungal susceptibility tests.

Determination of minimum inhibitory concentrations

The minimum inhibitory concentration (MIC) of the extracts was determined in a 96-well flat bottom polystyrene microtiter plate using the broth microdilution method as outlined in the 2021 Clinical and Laboratory Standard Institute guideline (CLSI) [18]. Briefly, a stock concentration (500 mg/ml) of the extracts was prepared in 10 % DMSO. Into 100 µl of double-strength Sabroud Dextrose broth in the wells of the polystyrene plate, an aliquot (100 µl) of the extract was dispensed into the first wells of the first rows and serially two-fold-diluted aseptically into 10 different concentrations (250 to 0.49 mg/ml). Thereafter, 10 µl of the standardized 0.5 McFarland turbidity suspension of the test fungi strain, *Aspergillus niger*, (obtained from the Department of Pharmaceutical Microbiology, Usmanu Danfodiyo University, Sokoto), diluted at 1:100 to obtain a final inoculum density of 1 x 10^5CFU/ml was inoculated into the wells. Negative (broth and DMSO) and growth (broth and fungi inoculum, without extract) controls were maintained for each test. The plates were thereafter covered and incubated aerobically at 35 °C for 48h. After incubation, the end-point was determined as the lowest concentration of the extracts in the wells that showed no visible growth.

Wound healing activity determination

The CME obtained above for each of the 5 surveyed plants was subjected to a wound-healing assay using the wound excision model.

Animal model and wound healing

Eight-week-old male and female albino rats (weighting 180–200 g) were supplied by the department of pharmacology, UDUS animal house. All rats were maintained under constant conditions (temperature 25±1 °C) and had free access to a standard diet and drinking water. All animals were treated in accordance with the "Principle of Laboratory Animal Care" (NIH publication no.85-23, revised 1985)'. Ethical approval was duly sought from the Health Research Ethics Committee (HREC) of the Usmanu Danfodiyo University, Sokoto-Nigeria, and a UDUS HREC reference was issued as PTAC/ES/CAF/OT/44-22; dated 10/09/2021. After one week of acclimatization, a total of 25 rats (for each plant extract) were anesthetized and the hair on the back was clipped; all rats were wounded on their dorsum and treated according to their groups. Their health status was closely monitored by regular assessment of their weight and stress indicators according to guidelines established in the literature [19]. Thereafter wounding, the rats were treated as shown in table 1 and observed for 14 d during which all the wounds completely healed.

Table 1: Wound healing assay experimental groups design

Group	Number	Treatment
A	5	Control (negative)
B	5	Povidone Iodine ointment (5%)
C	5	Extract X paste (at 1.25%) for 14 d
D	5	Extract X paste (at 2.5%) for 14 d
E	5	Extract X paste (at 5%) for 14 d

Wound creation

The surgical procedure during wound creation was under a high aseptic technique. All surgical instruments were sterilized by autoclaving at 138 °C. Throughout the wounding process, the rats were under anaesthesia with ketamine hydrochloride (120 mg/kg b.w. i. p.). An electric clipper (model number GM-3005) was used to shave their dorsum. After cleaning the shaved with an antiseptic and methylated spirit, a 1.5x1.5 cm^2 was marked off as the wounding site using methylene blue, and the surgical site was draped. A full-thickness oval-circular wound was excised from the target area using a surgical blade, scissors, and forceps, and haemostasis was attained by applying pressure on the wound using sterile gauze.

Application of substances

In group A, the wound was left to heal naturally by the application of distilled water only. Group B rats were treated with some 0.2 ml of Povidone iodine ointment (Jawa International Nigeria Limited) at 5%w/w concentration for 14 d. The test extracts samples were made by mixing the appropriate amount of each plant extract with soft paraffin wax to obtain a paste substance. Hence, some 0.2 ml paste was used for the treatment of groups C, D, and E wounds in the rain. The treatment was daily for 14 d (table 3.1).

Healing parameters

The weight of the animals was observed and taken every 3 d. The wound closure percentage was measured and scar formation was observed and photographed every 3 d. The area of the wound was outlined by copying the wounds with transparent paper, and the wound closure percentage was calculated according to the following formula:

Data analysis

Data collected from the different groups of animals were expressed in mean±standard deviation. They were analyzed with SPSS (version 20), using ANOVA with Tukey's and Dunnett's post hoc tests with the level of significance taken at $p<0.05$.

RESULTS AND DISCUSSION

Ethnomedicinal plants for wound healing

Five medicinal plants were sampled out of forty from our earlier documented survey study [12] and are screened for antifungal and wound healing properties; as shown in table 2 below.

Table 2: Some surveyed ethnomedicinal plants of Gwadabawa/Illela used for wound healing

Family/Scientific name	Source community	Local name	Ailment uses	Plant part use	Habit	Mode of preparation (Therapeutic indications)
[Anonaceae] *Annona senegalensis* pers.	Gaido Illela Tungan-Kwangi Gatti, Galadi	Gwanda Daji	Bleeding, wounds	roots	shrub	Powdered drug is sprayed on the wound; can as well be soaked and drink; also stops bleeding.
[Fabaceae] *Faidherbia albida* (Delile) A. Chev.	Chimmola	Gawo	Wounds, bleeding	stem bark	tree	Spray powdered herb on the wound;
[Malvaceae] *Sterculia setigera* Delile	Bakin Dutsi, Tudun doki	Kukkuukii	Wounds, bleeding	Stem bark	tree	Dried and powdered herb is sprayed on the wound, heals within a week; also stops bleeding.
[Combretaceae] *Uraria picta* (Jacq.) Desv. ex DC.	Gaido	Daakushee	Wounds, bleeding	whole plant	herb	The powdered plant is sprayed on the wound and effect healing within 30 d; stops bleeding; can as well be infused and bath in for healing
[Malvaceae] *Waltheria indica* L.	Lakoda, Bakin Dutsi, Galadi	Gobir Hausa Yankufa	Wounds, bleeding	Flowers whole plant roots	herb	Powdered mixed herb is sprayed on the wound; stops bleeding, especially during circumcision; 10 d to heal

Table 3: The minimum inhibitory concentration of five screened plant extracts against *Aspergillus niger*

Concentration (mg/ml)	Plants samples evaluated/Responds				
	Sterculia setigera (Kukkuki)	*Faidherbia albida* (Gawo)	*Annona senegalensis* (Gwanda daji)	*Waltheria indica* (Yankufa)	*Uraria picta* (Dakushee)
250	-	-	-	-	-
125	-	-	-	-	-
62.5	-	-	-	-	-
31.25	-	-	-	-	-
15.625	-	-	-	-	-
7.8125	-	-	-	+	-
3.90625	+	-	++	++	+
1.95313	+	+	++	++	++
0.97656	++	++	+++	+++	+++
0.48828	+++	+++	+++	+++	+++

-implies no growth observed; +implies little growth; **++**implies more growth; **+++**implies highest growth

Antifungal screening of five (5) surveyed plants

Minimum inhibitory concentration

The antifungal assay was performed by screening the five (5) surveyed plants against *A. niger* using the 96 well microtiter plate-based method. The result of the assay showed that all five plant extracts screened possessed antifungal activity in varying degrees. The lowest extreme showed that while *Waltheria indica* extract indicated a slight antifungal activity at tested concentrations with a MIC of 15.625 mg/ml, *Faidherbia albida* extract exhibited the highest activity at a concentration with a MIC of 3.90625 mg/ml. The other three extracts (*Annona senegalensis, Sterculia setigera,* and *Uraria*

picta) exhibited a somewhat moderate antifungal activity at the same concentration of MICs (7.8125 mg/ml). These are shown in table 3 below. Hence, the plant extracts effectively inhibited the growth of *A. niger.* Thus, the screened extracts possessed moderate to high antifungal activity with MICs ranging from 62.5-3.90 mg/ml. This could be said to demonstrate the potential of the plant extracts as antifungal agents.

The observed activity of *Faidherbia albida* extract in this study correlates with the results of the results studies on the plant. For example, [20] the effect of *F. albida* has been previously reported to have an inhibitory effect on the growth of pathogenic bacterial and fungi species. Similarly, *S. setigera* [21] was reported to be bioactive antifungal in nature in a typical evaluation study, showcasing it as a potent antifungal agent. The activity recorded for *Annona senegalensis* also supports the previous evaluation of its stembark as an antimicrobial agent on several fungi and bacterial strands [22-24]. Similarly, in a recent study, Mishra and Kumavat, [25] findings supported ours on *Uraria picta* leaves, where it was related that its extract can be effectively used for the green synthesis of AgNPs. The MIC tests experimentally showed that silver nanoparticles exhibited antimicrobial and antifungal properties of *Uraria picta* and hence, a better understanding of the development of new antimicrobial and antifungal activities towards the lead production of an antifungal agent is possible. Overall, results from this study agree strongly with those from the reported literature and thereby support the antifungal potentials of *Faidherbia albida, Sterculiaia setigera, Annona senegalensis, and Uraria picta* plant species. Hence, these data can be exploited for their further evaluations as antimicrobial drug leads of nature. Their use by the locals of Gwadabawa/Illela LGAs has, thus, been validated for their folklore and therapeutic indications.

Wound healing evaluation of five (5) surveyed plants

Wound healing assay

Wound healing of the skin incision was determined by the percentage of wound surface covered by regenerating epidermis. The appearance of the repaired wound sites is shown in fig. 2 (a). The CME of each plant significantly contributed to wound healing compared to the blank control (fig. 2. (b-f)). There was no obvious decrease in the weight of animals observed during the healing period but appeared to be a dose-dependent occurrence, it was observed that there was a significant difference in the contraction of the lesion areas treated with different extracts based on the application of the graded doses of test samples concentrations (1.25, 2, and 5) mg/ml, compared to the control groups. This was most notable, especially in the early stage of wound healing (on the 7th day of post-wounding); hence, the healing rate was increased by 1.24 times and 1.23 times, respectively in the low dose group and the middle dose group compared with the blank group (table 3). Thus, epithelial closure in all rats (with the exception of the negative control, DW) occurred within 14 d. More so, on the 16th day post-wounding, all the wounds (after CME treatment) were scar-less, while the wounds in the DW (distilled water group) had obvious scars. These are thus, an indication that the CME of each plant extract investigated could promote wound healing.

The variability of wound healing all through the stages observed was such that, as the respective treatments were administered topically on the animals in each respective group, lesions without treatment (DW group) took a long time to heal, while for those in both the positive control group (povidone-iodine, PI) and the recipient group with the highest test sample concentration (5 mg/ml), there was a significant respond towards complete epithelialization, starting from the onset of operation in all the cases. Hence, the percentage of wound contraction and period of epithelialization parameters informed the scarless or no lesions seen on the 14-16th day post wounding after CME treatment. Worth noting is the fact that wound healing is a complex and orderly pathological process, and its outcome comprises the interaction of a variety of repair cells (epidermal cells, fibroblasts, endothelial cells, etc.) [26]. Thus, an indication that the screened plant extracts may have some wound healing potential is imminent; even though as earlier noted, wound healing is a physiological process and does not normally require much help, however, still wounds cause discomfort and are prone to infection and other complications [27]. Therefore, the use of agents to expedite healing is required. Successes in the use of natural products from plant sources with wound healing potential aided by a synergistic antimicrobial property have also been recorded in *Procera africana, Phyllanthus muellerianus* [28, 29], and several others where an *in vitro* wound healing assay was conducted on 36 ethnophamacological surveyed plants yielded interesting results [30].

Table 3: Effect of CME of five surveyed plants on excision wounds in rats (Dunnett t, 2-sided)[a]

Treatment	Dose (mg/ml)	Wound contraction (%)													
		Day 2		Day 4		Day 6		Day 8		Day 10		Day 12		Day 14	
		mean± SD	*P-Value*	*mean± SD*	*P-Value*	*mean± SD*	*P-Value*	*mean± SD*	*P-Value*	*mean± SD*	*P-Value*	*mean± SD*	*P-Value*	*mean± SD*	*P-Value*
Annona senegalensis															
DW	0	2.68±1.64	0.00*	5.34±2.49	0.00*	6.66±2.97	0.00*	18.66±2.49	0.00*	21.33±3.27	0.00*	29.33±3.34	0.00*	33.33±4.71	0.00*
CME	1.25	56.74±2.12	0.00*	58.50±2.26	0.01*	63.60±2.53	0.12	76.22±2.37	0.01*	84.16±0.51	0.03*	88.76±1.68	0.88	97.42±1.15	0.94
CME	2.5	57.82±2.66	0.88	62.50±1.81	0.73	66.68±2.07	0.89	78.64±1.98	0.70	84.38±1.11	0.69	92.70±0.50	0.56	98.96±0.64	0.94
CME	5	64.62±1.14	0.68	66.80±2.07	1.00	69.66±1.71	0.42	81.36±1.26	0.58	86.44±1.51	0.51	92.12±1.19	1.00	98.68±0.54	1.00
PI	5	62.34±1.05		65.80±0.58		65.88±0.59		80.98±1.37		87.52±1.11		95.56±0.83		97.08±1.15	
Faidherbia albida															
DW	0	2.68±1.64	0.00*	5.34±2.49	0.00*	6.66±2.97	0.00*	18.66±2.49	0.00*	21.33±3.27	0.00*	29.33±3.40	0.00*	33.33±4.71	0.00*
CME	1.25	54.98±2.65	0.02*	58.26±2.78	0.06	63.58±2.65	0.89	76.92±3.27	0.51	78.74±2.45	0.04*	85.58±3.92	0.03*	94.02±3.31	0.84
CME	2.5	66.26±1.47	0.30	70.20±2.57	0.42	69.68±1.51	0.61	82.84±1.15	0.93	84.54±1.38	0.75	90.50±1.07	0.42	97.62±1.24	1.00
CME	5	62.06±0.87	1.00	64.16±1.05	0.94	68.90±2.88	0.77	79.08±1.99	0.93	84.46±2.25	0.73	90.38±1.22	0.40	98.58±0.58	0.98
PI-	5	62.34±1.04		65.88±0.59		65.88±0.59		80.98±1.37		87.52±1.12		95.56±0.83		97.08±1.15	
Sterculia setigera															
DW	0	2.68±1.64	0.00*	5.34±2.49	0.00*	6.66±2.97	0.00*	18.66±2.49	0.00*	21.33±3.27	0.00*	29.33±3.40	0.00*	33.33±4.71	0.00*
CME	1.25	47.72±3.21	0.00*	49.24±3.81	0.00*	58.68±3.12	0.12	71.52±2.75	0.01	77.70±3.19	0.03	93.80±1.08	0.88	98.96±0.64	0.94
CME	2.5	60.26±1.27	0.88	69.36±1.68	0.73	68.22±1.59	0.89	78.26±1.11	0.70	84.04±1.68	0.69	92.54±1.07	0.56	98.96±0.64	0.94
CME	5	59.28±2.30	0.68	65.74±2.77	1.00	70.64±2.34	0.42	77.78±0.94	0.58	83.12±1.86	0.51	95.68±0.63	1.00	97.30±1.52	1.00
PI	5	62.34±2.34		65.88±0.59		65.88±0.59		80.98±1.37		87.52±1.12		95.56±0.83		97.08±1.15	
Uraria picta															

Treatment	Dose (mg/ml)	Wound contraction (%)													
		Day 2		Day 4		Day 6		Day 8		Day 10		Day 12		Day 14	
		mean± SD	*P-Value*	*mean± SD*	*P-Value*	*mean± SD*	*P-Value*	*mean± SD*	*P-Value*	*mean± SD*	*P-Value*	*mean± SD*	*P-Value*	*mean± SD*	*P-Value*
DW	0	2.68±1.64	0.00*	5.34±2.49	0.00*	6.66±2.97	0.00*	18.67±2.49	0.00*	21.33±3.27	0.00*	29.33±3.40	0.00*	33.33±4.71	0.00*
CME	1.25	52.80±3.70	0.02	52.52±5.11	0.02*	60.74±2.65	0.29	71.44±6.94	0.19	82.76±2.39	0.26	93.26±0.93	0.75	96.76±1.88	1.00
CME	2.5	62.12±1.56	1.00	67.96±1.47	0.97	73.44±2.41	0.07	81.64±1.92	1.00	87.86±0.45	1.00	95.08±1.15	1.00	98.04±0.49	1.00
CME	5	63.58±2.34	0.99	67.10±3.34	1.00	75.02±0.92	0.02*	80.72±0.34	1.00	88.00±0.43	1.00	94.24±0.42	0.95	98.10±1.36	0.99
PI	5	62.34±1.05		65.88±059		65.88±0.59		80.98±1.37		87.52±1.12		95.56±0.83		97.08±1.15	
Waltheria indica															
DW	0	2.68±1.64	0.00*	5.34±2.49	0.00*	6.66±2.97	0.00*	18.67±2.49	0.00*	21.33±3.27	0.00*	29.33±3.40	0.00*	33.33±4.71	0.00*
CME	1.25	58.16±2.12	0.21	61.22±1.66	0.20	69.38±1.63	0.43	82.64±2.23	0.90	85.70±1.77	0.88	93.88±0.65	0.88	100.00±0.00	0.78
CME	2.5	62.80±1.34	1.00	69.14±0.99	0.48	66.50±0.35	1.00	81.38±0.39	1.00	81.44±0.57	0.08	95.68±0.70	1.00	97.22±1.57	1.00
CME	5	65.02±1.48	0.57	69.70±2.05	0.35	72.86±1.68	0.03*	80.10±1.44	0.99	86.94±0.26	1.00	94.76±0.11	0.99	99.50±0.50	0.87
PI	5	62.34±1.05		65.88±0.59		65.88±0.59		80.98±1.37		87.52±1.12		95.56±0.83		97.08±1.15	

*The mean difference is significant at the 0.05 level. [a]Dunnett t-tests treat one group as a control and compare all other groups against it.

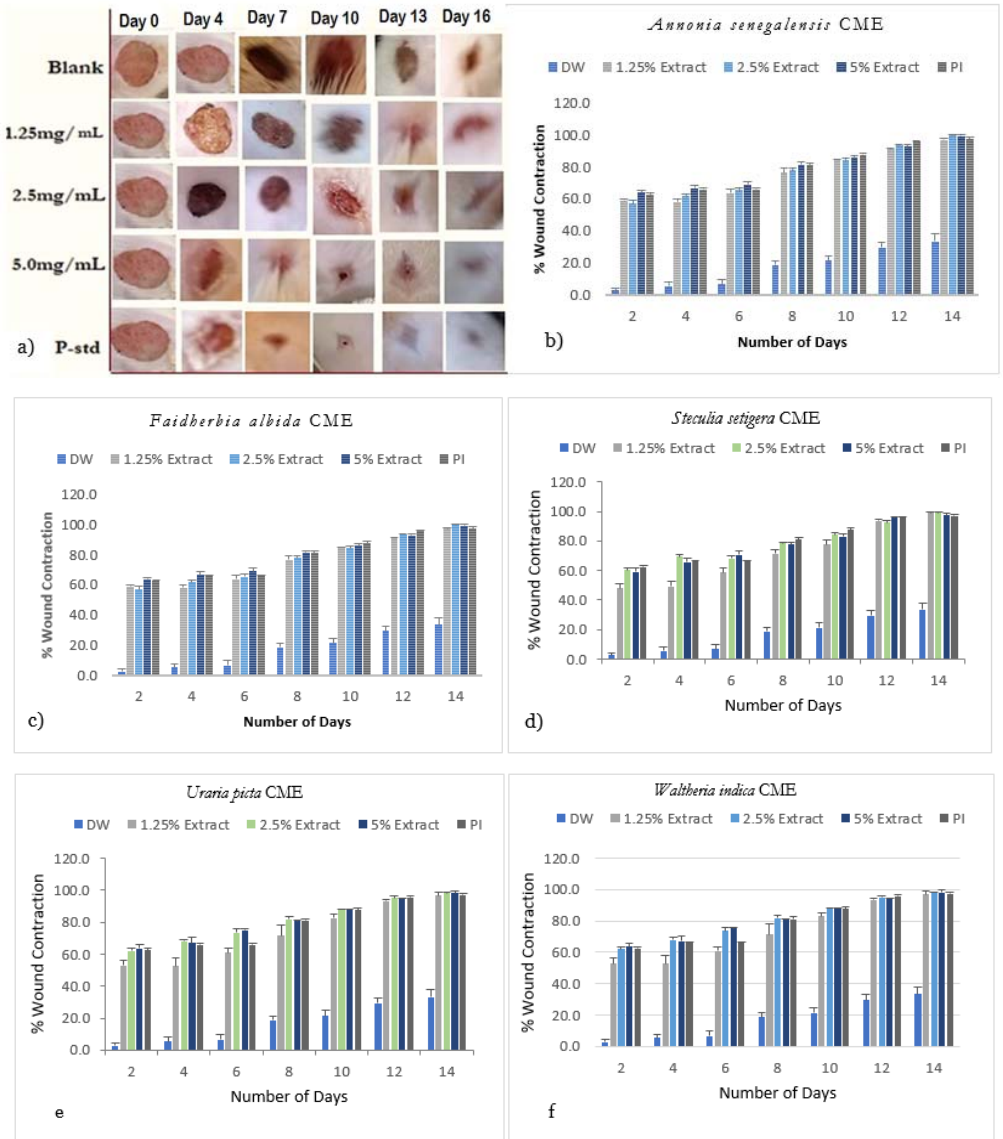

Fig. 2: Efficacy of CME in wound healing of five (5) surveyed plants compared with that of control.
a) Representative images of wounds on 4th, 7th, 10th 13th and 16th day are shown.
b-f) Wound closure at different time points were determined by one-way ANOVA followed by Dunnett's Students t-test. *P<0.05 significantly different from the control group

CONCLUSION

In this study, our findings have shown that the five (5) surveyed screened plants exhibited both wound healing and antifungal activity as acclaimed by the people of Gwadabawa/Illela communities. Thus, these findings may offer scientific validation for these claims. It would significantly go to suggest the rightful approach to adopt for further exploration and investigation of these plants' potential to establish their pharmaceutical end-use.

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DATA AVAILABILITY

Not applicable

ETHICS APPROVAL

All participants gave full oral consent for the study, including the presentation of data in a formal publication. This study received a prior-full consent approval from the Health Research Ethics Committee (HREC) of the Usmanu Danfodiyo University, Sokoto-Nigeria, in line with the laws and rights, mainly as stated in the Declaration of the OAU Model Law, Algeria, 2000 — *Rights of Communities, Farmers, Breeders, and Access to Biological Resources.* An UDUS HREC reference was issued as: PTAC/ES/CAF/OT/44-22; dated 10/09/2021.

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AUTHORS CONTRIBUTIONS

The study design and manuscript write up by Mathias SN; Ethnobotanical survey and data analysis by Mshelia HE and Mathias SN; Wound healing protocol and assay, Manuscript proof read by Giaze RJ and Mathias SN; Antifungal assay and as well as coordination of the overall project by Mathais SN.

CONFLICTS OF INTERESTS

Declared none

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