



Determination of Wound Healing of the Solvent Extract of the Mixture of Dried Leaves of *Chromolaena odorata* L. and *Sida acuta* Burm. F. on Wounds in Albino Rats

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Abstract

Herbal medicines have made significant contributions to humankind's fight against illness and maintenance of health. It is estimated that 2.3 billion people, or 56% of the world's population, still depend on traditional healers and healing methods. Many plants contain antioxidants which are beneficial and are of therapeutic use in several ailments as well as wound healing. In most Ghanaian societies, when a person gets a fresh cut and bleeds profusely, the local people mash a leaf or more of *Chromolaena odorata* (Acheampong) or *Sida acuta* in their palms, squeeze and drop the liquid on the cut. The blood then clots a few seconds after the treatment. Random sampling was used to sort thirty albino rats into five groups. The extraction method of the herbal mixture adopted is maceration where four different solvents were used to do the extraction; 70% ethanol, 30% ethanol, 30% methanol and distill water. Penicillin ointment was used as a positive control. A circular wound of a specific diameter (2cm) was inflicted on the side of each rat by using a sterilized scalpel. The solvent extracts were applied on the wounds once a day for fifteen days. From the experiment, it was concluded that the four solvent extracts of the herbal mixture had a significant effect on healing wounds in the rats. Lastly, distil water and 30% methanol were most effective in the extraction of the herbal mixture. It is recommended that other parts of *Chromolaena odorata* L. and *Sida acuta* Burm. F. such as the roots or stems should be worked on to investigate their efficacy on wound healing.

Keywords: Wound Healing, Solvent Extract, *Chromolaena odorata* L., *Sida acuta* Burm. F., Albino Rat

Introduction

Herbal medicines have made significant contributions to humankind's fight against illness and maintenance of health. It is estimated that 2.3 billion people, or 56% of the world's population, still depend on traditional healers and healing methods for the treatment of a broad range of physical and mental ailments. Interest in the use of plant concoctions has grown in recent years (Mukherjee, 2002) ^[13]. Wound is damage to the integrity of biological tissue, including skin, mucous membranes and organ tissues (Kujath & Michelsen, 2008) ^[11]. Various types of traumata can cause these, and it is critical to ensure wounds are cleaned and appropriately dressed to limit the spread of infection and further injury (Wilkins & Unverdorben, 2013) ^[25].

There is no standard classification for wounds. On the other hand, wounds can be classified in several ways based on the nature of the injury, the timing whether acute or chronic and the depth of injury to the skin and the underlying tissues. These factors will have a significant effect on the ability of the wound to heal with or without surgical intervention (Percival, 2002) ^[18]. According to Velnar, Bailey and Smrkolj (2009) ^[23], the process of wound healing is continuous, and it is divided into four phases: coagulation and haemostasis, inflammation, proliferation and lastly, wound remodeling with scar tissue formation. It also involves generations of multiple cell populations, the extracellular matrix and the action

of soluble mediators such as growth factors and cytokines. Santos-Buelga, Mateus and De-Freitas (2014) ^[19] asserts that many plants have been used traditionally to treat wounds due to their high efficiency in healing process. The reason is that plant – based medicines are affordable and cause reduced side effects (Ekor, 2014) ^[5].

From Nagori *et al.* (2011) ^[14], extensive research has been done in the field of wound healing and wound management through plant-based medicines recently. Many plants contain antioxidants which are beneficial and are of therapeutic use in several ailments that are connected with potential pathologic actions of oxidants as well as wound healing (Yeoh, 2000) ^[26].

Since the introduction of *Chromolaena odorata* into Ghana since 1970 according to Ghanaweb (2020) ^[7], the herb has been used to stop bleeding, it is efficient in healing wounds, treatment of snake poison when it is immediately administered after a bite. The herb is also used to treat stomach aches, bilharzia and also to preserve dead bodies.

In a typical Ghanaian society, when a person gets a fresh cut with blood oozing non-stop, the local people just rub a leaf or more of *Chromolaena odorata* (Acheampong) in their palms, squeeze and drop the liquid on the cut. The blood then clots a few seconds after the treatment (Ghanaweb, 2020) ^[7]. Siam weed extract has been shown to stimulate haemostasis and wound healing management. The phytochemical substances in the leaf of *Chromolaena odorata* were used for antibacterial, antifungal, anti-inflammatory, anticancer, antidiabetic, antidiarrheal and hepatoprotective activities (Sirinthipaporn & Jiraungkoorskul, 2017) ^[21].

Sida acuta has been shown to have wound healing potentials. The methanolic extract of *S. acuta* produced significant healing in wounds treated with it.

However, *Sida acuta* has been traditionally used for thousands of years and is used for treating various ailments, including malaria, bacterial infections, ulcers (Tcheghebe *et al.*, 2017). In the Ghanaian society, a decoction of the leaves of the wire weed is applied on wounds to stop bleeding (CSIR, 2023). Several studies have investigated the effect of *Chromolaena odorata* and *Sida acuta* on wound healing. For example, Ezeja, Anaga and Asuzu (2012), conducted a study to investigate the effect of *Chromolaena odorata* on wound healing in rats. The study showed that *Chromolaena odorata* extracts had a positive effect on wound healing by increasing the rate of wound closure, reducing inflammation, and promoting tissue regeneration. The study also showed that *Chromolaena odorata* extracts increased collagen deposition in the wound tissue, which is an important factor in the healing process.

Similarly, Akilandeswari, Senthamarai and Prema (2010) ^[1], investigated the effect of *Sida acuta* on wound healing in rats. The study showed that *Sida acuta* extracts had a positive effect on wound healing by increasing the rate of wound closure and reducing inflammation. The study also showed that methanolic extract of *Sida acuta* treated wounds were found to epithelialize faster and the wound contraction rate was higher when compared to the control wounds. However, other studies have shown no significant effect of these plants on wound healing. For example, a study conducted by Iwu, Duncan... and Janick (1990) ^[9] showed that *Chromolaena odorata* extracts had no significant effect on wound healing in rats. Similarly, a study conducted by Gbotolorun *et al.* (2006) ^[8] showed that *Sida acuta* extracts had no significant

effect on wound healing in rats. Example of local herbs that are efficacious in healing wounds include; *Arctium lappa*, *Astragalus propinquus*, *Rehmannia glutinosa*, *Ampelopsis japonica*, *Andrographis paniculata*, *Caesalpinia sappan*, *Aloe vera*, *Prosopis africana*, *Curcuma longa*, *Euphorbia hirta* etc.

This research work combined two herbs, *Sida acuta* Burm. F. and *Chromolaena odorata* L., to investigate their efficacy on wound healing in albino rats. There is confidence to explore new knowledge by drawing on the historical empirical experiences of herb-herb combinations as there is growing interest in switching from the one-drug, one-target paradigm to combination therapy or polypharmacy to obtain therapeutic benefits for a multitude of ailments (Che, Wang & Lam, 2013) ^[3]. From literature, wound healing in mammals has attracted the attention of many researchers and several herbs have been investigated to solve real life problem. This has led the researcher to gain interest in investigating the efficacy of *Chromolaena odorata* and *Sida acuta* leaves extracts on the wounds of albino rats.

Literature review

Common medicinal plants used for wound healing

Based on the factors that influence wound healing process, some medicinal plants contain microbial inhibiting factors, growth factors e.g., cytokines and promote blood circulation. Research by Shedoeva together with other scientists on wound healing and the use of medicinal plants, indicated that several plant medicines have been investigated and are capable of healing wounds. These herbs include; *Arctium lappa*, *Astragalus propinquus*, *Rehmannia glutinosa*, *Ampelopsis japonica*, *Andrographis paniculata*, *Caesalpinia sappan* and *Aloe vera* among others (Shedoeva *et al.*, 2019) ^[20]. Again, a review by Payghan *et al.* (2023) ^[20] reviewed twenty common medicinal plants for wound healing. These include; *Phyllanthus emblica*, *Aloe vera*, *Musa paradisiaca*, *Magnifera indica*, *Datura metal*, *Cinnamomum cassia*, *Curcuma longa*, *Cinnamomum zeylanicum*, *Allium sativum*, *Catharanthus roseus*, *Coriandrum sativum*, *Daucus carota*, *Ocimum sanctum*, *Syzygium aromaticum*, *Hibiscus rosa-sinensis*, *Camellia sinensis*, *Carthamus tinctorius*, *Eucalyptus deglupta*, *Cuminum cyminum* and *Lawsonia inermis*,

Herbal combination

Herbal combinations refer to the use of multiple herbs together in a single formula or treatment regimen to achieve a therapeutic effect. The use of herbal combinations is a common practice in traditional medicine systems, such as Ayurveda, Chinese Medicine, and Unani Medicine (Jangale, 2022). The combination of herbs has been shown to enhance the therapeutic efficacy of individual herbs by working synergistically to provide a broad range of therapeutic actions.

According to Manilal *et al.* (2011) cited in Okaiyeto and Oguntibeju (2021), the concentration of phytochemicals differ from one plant to another. Again the geographical distribution and abiotic factors affect the distribution of these phytochemicals in the same plant species. In order to increase the efficacy of herbal medicine, it is necessary to combine different plants nonetheless, herbs used together with other herbs for therapeutic purposes will have complex effects.

Methodology

Sample and sampling techniques

With the sorting of the thirty albino rats into groups, simple random sampling techniques were employed to sort the rats into five groups. This sampling technique was necessary since the rats form a homogeneous group and no specific qualities in the rats are of interest to the researcher. A non-probability sampling technique, convenience sampling technique was used for adopting a maceration method of extraction. Again, convenience sampling was used for the research instrument used which was unstructured observation, which was used to determine the area where mature and healthy *C. odorata* and *S. acuta* are abundant. In convenience sampling, units are chosen for the sample based on how convenient they are for the researcher to access (Pace, 2021) ^[16].

Data Analysis

Data was analyzed using SPSS version 20. Line graphs were drawn to compare the average wound areas among the five groups of the albino rats after treatment with the herbal extracts and the penicillin ointment (control). Percentage reduction in the wound areas in the albino rats was also

calculated and represented on a line graph. One – way ANOVA was calculated to compare the means of the average wound area among the five groups of the albino rats at the level of significance 0.05.

The study area

Through unstructured observation by the researcher, the researcher found out that Assin Andoe is one of the many towns with largest *Chromolaena odorata* and *Sida acuta* infestation in the Assin South District. Assin Andoe is in the Southern part of Ghana, which lies in the rain forest belt along Cape Coast to Kumasi highway (Fig. 1).

The town is rich in biodiversity by different forms of plant species, ranging from perennating trees to annual crops and rich in biodiversity. Among the herbs in the town are *Sida acuta*, *Chromolaena odorata*, *Phyllanthus amarus*, *Tuja nana*, *Sporobolus pyramidalis* etc. The quality of the soil supports agriculture as well as weeds, hence the abundance of *Chromolaena odorata* L. and *Sida acuta* Burm. F. Assin Andoe was selected due to the abundance of the *Chromolaena odorata* L. and *Sida acuta* Burm. F. which provided easy access to the herbs and also a convenient place close to the place where the albino rats were caged.

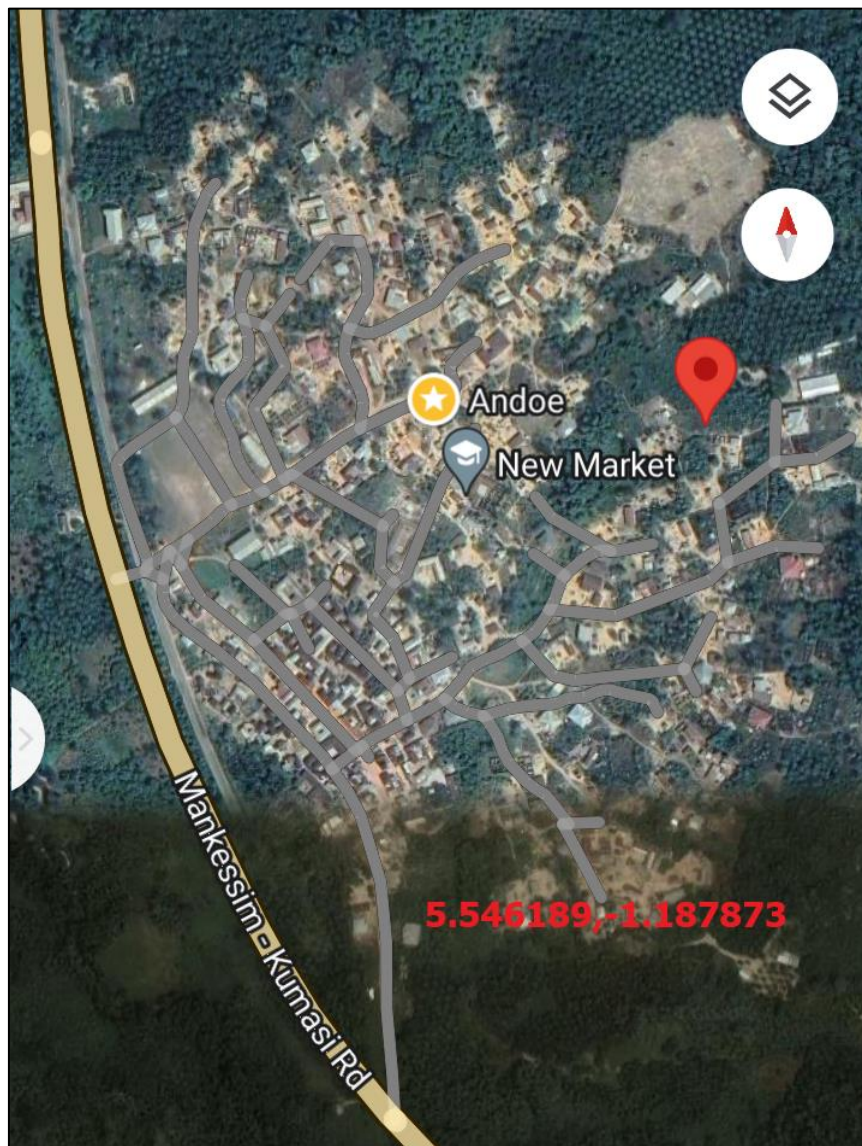


Fig 1: A map to Assin Andoe

Plant materials collection and processing

Fully mature dark green leaves of *C. odorata* and *S. acuta* were collected in Assin Andoe near the vicinity of the Andoe new market. The plant materials were collected in the morning. The plant species were identified by verifying the pictures of the species on google lens as well as by following the description and characters of the species by eye inspection.

Two large black polythene bags were used to collect the leaves of *C. odorata* and *S. acuta* separately. This was to prevent direct effect of the harmful rays from the sun on the leaves in order not to alter the chemical compositions of the leaves. The leaves were thoroughly washed with water. The leaves were dried under shade separately for four weeks and the temperature of the room was approximately 25 °C. The dried leaves were powdered by using an electric blender. A sieve with size 1.0 mm was used to sieve the pulverized leaves. The sieved leaves were kept in two plastic containers separately.

Extraction procedure

The extraction method adopted was maceration. The researcher picked 15g each of the powdered leaves of *C. odorata* and *S. acuta* making 30g and mixed them in a beaker. The mixture was introduced into one plastic container. Using the measuring cylinder, 500mL of distil water was added to the mixture. The mixture was then stirred followed by vigorous shaking to form a uniform solution. 70% ethanol was prepared by picking 350mL of absolute ethanol and diluted with 150mL of distilled water. 15g powdered leaves of *S. acuta* and 15g powdered leaves of *C. odorata* leaves were dissolved in the 70% ethanol in another plastic container. The same procedure was repeated for 30% ethanol and 30% methanol.

The four solutions were left for three days with intermittent agitation to aid in the extraction procedure. What man no. 1 filter paper was used to filter the solution after three days. On the other hand, the aqueous extract was filtered after two days and was kept in a freezer to prevent it from going bad. The ethanolic and methanolic extracts were concentrated by using a vaporizer followed by heating the water bath. The aqueous extract was concentrated by heating it over the water bath.

Treatment of the albino rats, wound excision and treatment of the wounds

Thirty albino rats were used for the study. These albino rats were procured from the University of Cape Coast animal farm. The rats were fed the same food for a week to ensure they were all provided with the same nutrients. The meals provided for the albino rats include milled corn and wheat, dried fish, bread crumbs and vegetables i.e., cabbage. Maintenance of hygiene and proper care of the rats were taken to ensure the rats are healthy. Guide for the care and use of lab animals, 8th edition, was duly followed. The eating behaviour of the rats were sternly observed and noted.

The rats were randomly divided into five groups. A circular wound of a specific diameter (2cm) was inflicted on the side of each rat by using a sterilized scalpel.

Rats in group 1 were treated with penicillin ointment

(synthetic ointment) and this group was used as the control group. Rats in group 2 were treated with 70% ethanolic extract, group 3 with 30% ethanolic extract, group 4 with 30% methanol extract and group 5 with aqueous extract once a day for fifteen days. The groups of the rats were labelled PO, SC1, SC2, SC3 and SC4 for groups 1,2,3,4 and 5 respectively. The areas of the topical wound inflicted on the sides of the albino rats were calculated by multiplying the longest vertical dimension by the longest horizontal dimension i.e. length x breadth. The surfaces of the wounds of the rats were observed to monitor scar formation at three days interval until the fifteenth day. The results were tabulated.

Results

Observation of the wound surface

The following observations were made about the wound surface after the wounds were inflicted on the sides of the albino rats (Plate 1).

- On day 1(Plate 1), when the wounds were inflicted, the researcher used cotton to clean blood from the wound site and applied the various extracts as well as the penicillin ointment on the wounds. In a few minutes time, there was blood clotting. This characterizes the first and second stages of wound healing thus haemostasis and inflammation (Wikipedia, 2023) ^[24]. A day after the infliction of the wounds on the sides of the rats and application of the extracts, it was observed that the surfaces of the wounds were dried and hardened, besides, there was no significant decrease in the wound area among the albino rats. On the subsequent days, it was observed that some of the rats licked the extract applied on the wounds. This made some groups of rats having wound surfaces to be wet, as a result, healing was delayed in these groups of the rats.
- On the third day, most rats had hardened wound surface thus re-epithelialization with the epithelial tissue being light pink in colour as well as a significant decrease in the wound area. Angiogenesis (formation of new vascular tissues), granulation and re-epithelialization characterizes the third stage of wound healing which is proliferative stage (Wikipedia, 2023) ^[24].
- By the end of the first week, specifically on the sixth day, there was formation of scar tissue and the disappearance of the light pink colour from the wound area and a significant decrease in the wound area. The tissue remodeling and scar formation continued into the second week of the experiment. According to Wikipedia (2023) ^[24] on wound healing, tissue remodelling is the last phase of wound healing and can last for a short time or long time depending on the type and depth of the wound.
- On day 9, the wound area continued to decrease across the five groups of the rats and by day 12, there was significant reduction in the wound areas as compared to the previous days (Plate 2). The wound area in PO, SC2, SC3 and SC4 were closed except in SC1.
- By day 15, the wound area was closed in all the groups including SC1. The wounds were replaced by linear scar tissue.

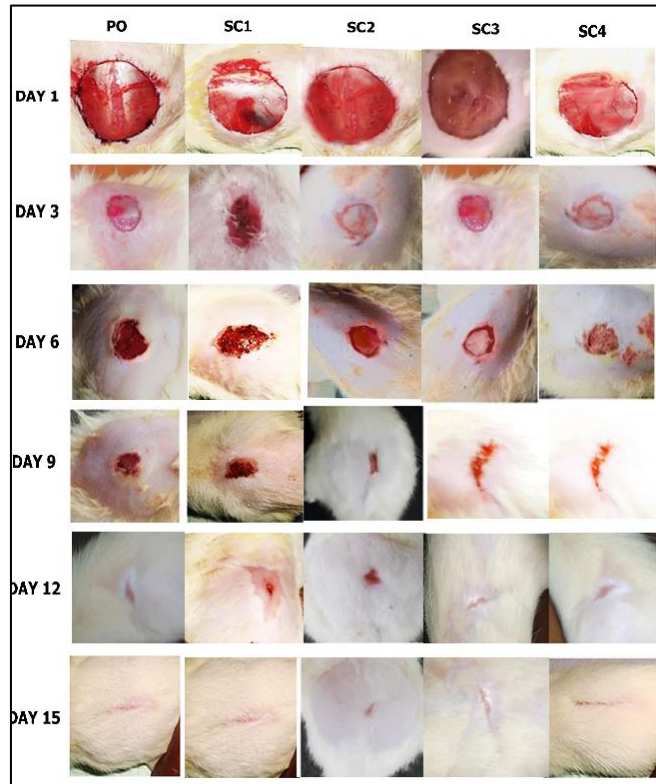


Plate 1: Images of the wounds of the five groups of the albino rats

Percentage reduction of wound areas

The percentage reduction of the wound areas was calculated for the five groups of albino rats. Percentage reduction is the percent change in the wound area compared to the initial

wound area. Comparison of the percentage reduction of the wound areas after the treatment of the extracts on the wounds of albino is summarized in Fig. 2

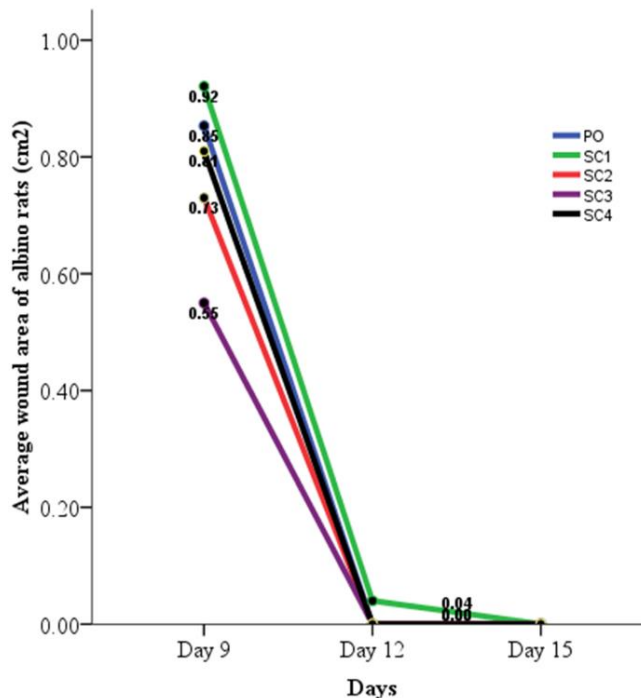


Fig.2: Percentage reduction (%) of the wound area of the five groups of the albino rat

From Fig. 2, on day 1, there is a 0.00% reduction in the wound area for all the groups of albino rats. This means there was no significant decrease in the wound areas. On day 3, the control (PO) had the least percentage reduction in the wound area as compared to the other groups of albino

rats. There was a 10.00% reduction in the wound area of PO (group 1 rats), 18.00%, 23.33%, 43.75% and 38.13% wound area reduction in SC1, SC2, SC3 and SC4 respectively. On day 6, SC3 had the highest reduction of 61.00% of wound area reduction, while PO, SC1, SC2 and SC4 had 47.75%,

42.58%, 46.42% and 41.88% respectively. On day 9, while the control (PO) had a reduction of 78.67%, SC3, SC2 and SC4 had a reduction of 86.25%, 81.75% and 79.75% respectively. But SC1 had the least percentage reduction of 76.98%. On day 12, there was a 100.00% wound area reduction in PO, SC2, SC3 and SC4 while in SC1 there was 99.00% reduction of the wound area. The wound areas were completely closed

in all the groups except for SC1. By day 15, there was 100.00% wound closure in all the groups of the albino rats.

The average wound areas for the five groups of rats

Figs 3 and 4 are the summary of the average wound areas in the rats for the first and second weeks of the experiment respectively.

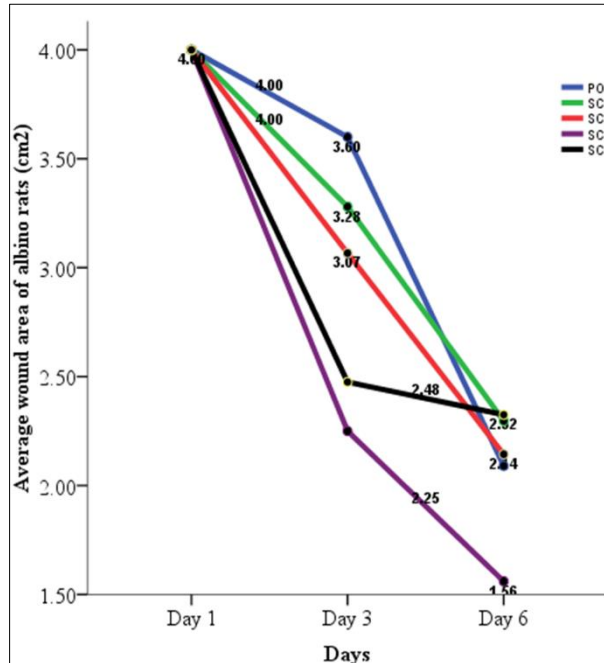


Fig. 3: Average wound area in Albino rats for the first week of the experiment

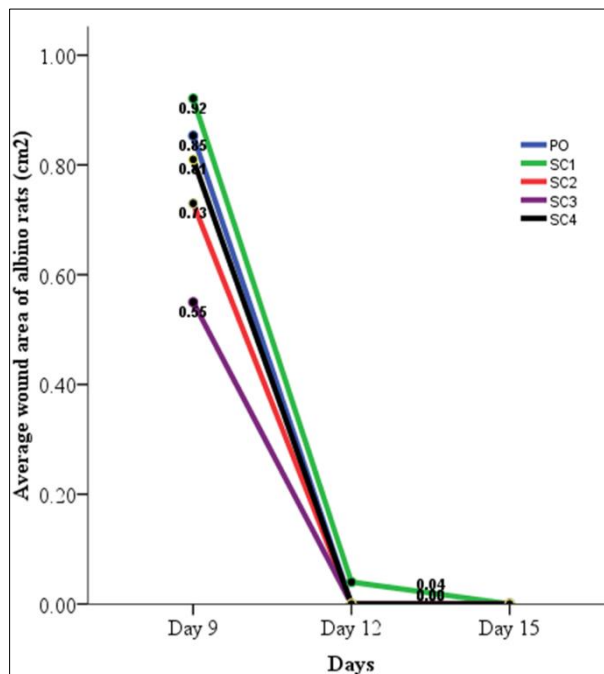


Fig. 4: Average wound area in Albino rats for the second week of the experiment

From Fig. 3, it can be deduced that all groups, including the control group (PO) and the experimental groups (SC1, SC2, SC3, SC4), had similar wound areas of 4.00 cm² on the first day.

On day 3, the control group (PO) showed a slight reduction in wound area to 3.60 cm². Among the experimental groups,

SC1 had the highest reduction to 3.28 cm², followed by SC2 (3.07 cm²), SC3 (2.25 cm²), and SC4 (2.48 cm²). On day 6, the control group (PO) experienced a further decrease in wound area to 2.09 cm². SC2 showed the highest reduction in wound area among the experimental groups with a value of 2.14 cm². The other

experimental groups had slightly higher values: SC1 (2.30 cm²), SC3 (1.56 cm²), and SC4 (2.33 cm²).

In the second week, from Fig. 4, on day 9, the control group (PO) continued to exhibit a decrease in wound area, reaching 0.85 cm². Among the experimental groups, SC3 had the lowest wound area (0.55 cm²), followed by SC2 (0.73 cm²), SC4 (0.81 cm²), and SC1 (0.92 cm²).

On day 12 and day 15, both the control group (PO) and the experimental groups (SC1, SC2, SC3, SC4) achieved complete reduction in the wound area by reaching a wound area of 0.00 cm². It can be judged from the graphs (Figs. 3 and 4) that, the extracts of the mixture of *Chromolaena odorata* L. and *Sida acuta* Burm. F. leaves had potential wound-healing effects on the wounds of albino rats. The groups treated with the extracts consistently showed smaller wound areas compared to the control group, indicating their

efficacy in promoting wound closure. Again, the groups treated with the extracts showed faster wound closure compared to the control group treated with penicillin ointment and the group treated with 30% methanol extract (SC3) showed the most pronounced effects in reducing wound area.

Determination of the significance difference among the means of the wound areas of the five groups of the rats

Statistical H₀: there is no significant difference among the means of the wound areas of the five groups of the rats

The means of the wound areas of the experimental groups were compared to the control group. The five groups include: PO (penicillin extract ointment), SC1, SC2, SC3 and SC4. The results are illustrated in Table 1.

Table 1: One - way ANOVA Table on the wound area among the five groups of the rats

Source of variation	Sum of Squares	df	Mean Square	F-ratio
Extracts	.538	4	.134	.049
Error	68.915	25	2.757	
Total	69.452	29		

From Table 1, the calculated F-value is 0.049. from the ANOVA Table, using the degree of freedom of the various extracts = 4 and the degree of freedom of error = 25, at the level of significance = 0.05, the critical value is 2.76. Since the calculated F-value is less than the critical F-value, there is no significant difference therefore I fail to reject the null hypothesis. Thus, there is no significant difference among the means of the wound areas of the five groups of the rats. This means that the different solvent extracts of the mixture of the dried leaves of *C. odorata* and *S. acuta* were effective in closing the wound areas in the albino rats in the same way as the penicillin ointment which was used as the control.

Discussion of observation of the wound surface and the wound area

Webster dictionary (2022) posits that wound breaks the surface membrane of the skin and causes damage to the integrity of skin as well as damage to the underlying tissues. Wound healing is important to prevent invasion of microorganisms into the skin therefore the body produces Platelets, neutrophils, macrophages and fibroblasts at the wound site which produce cytokines and growth factors to restore the integrity of the skin(Mohd, *et al.*, 2012) [12].

Some of the phytochemicals present in the mixture of *Chromolaena odorata* L. and *Sida acuta* Burm. F. leaves contribute and enhance the production of the cells and chemicals that aid in the wound healing process.

On day 1, after the treatment of the extracts, there was blood clotting in all the groups of the rats (Plate 1). Haemostasis is initiated whereby Platelets become activated and produce Platelet-derived growth factor (PDGF), transforming growth factors (TGFs), fibroblast growth factors (FGFs) and vascular endothelial growth factors (VEGFs) to help in blood clotting. Haemostasis overlaps with inflammation phase whereby enzymes are produced by inflammatory cells to aid in healing (Mohd, *et al.*, 2012; Wikipedia, 2023) [12, 24].

On day 3(Plate 1), the wound area was reduced in all the groups and the wound appeared light pink in colour. From observation of the wound surface there was re-epithelialization, thus, formation of new epithelial tissue.

Mohd *et al.* (2012) [12] reiterates that epithelialization, fibroplasia and granulation constitutes the proliferation phase which is the third phase of the wound healing process. Fibroblasts produce collagen at the wound site as well as formation of blood vessels to replace damaged blood vessels. Re-epithelialization is initiated after the proliferative phase where epithelial cells interact with keratinocyte growth factors and transforming growth factors (TGF- α) to aid in the reduction of the wound area (Mohd, *et al.*, 2012; Wikipedia, 2023) [12].

On day 6(Plate 1), scar tissue was prominent and a significant reduction in the wound area. Formation of scar tissue and disappearance of the pink colour of the wound site indicate the on-set of phase IV of the wound healing process. Tissue remodeling (phase IV) can last for a long time depending on the type of wound (Wikipedia, 2023) [24].

After the sixth day till the fifteenth day, tissue remodeling continued until the wound was closed. At this stage, cells involved in the production of growth factors are reduced at the site as well as the inflammatory cells. Although fibroblasts also decrease in number, they continue to produce collagen (Mohd, *et al.*, 2012) [12]. Collagen interact with each other to form scar during the remodeling phase.

On day 12(Plate 1), the wound areas for all the groups of the rats were reduced and replaced with a linear scar except for group 2 rats(SC1).

On the fifteenth day, it was observed that the wound area was reduced and replaced with a linear scar (Plate 1).

Percentage reduction of wound areas in the rat groups

The efficacy of the solvent extract of the mixture of dried leaves of *Chromolaena odorata* L. and *Sida acuta* Burm. F. was assessed by measuring the percentage reduction of wound area in the five groups of the rats.

On day 1, there was no significant reduction in the wound area observed across all groups. This indicated that the wounds were in the early stages of healing.

By day 3, a discernible difference in the percentage reduction of the wound area emerged between the control group (PO) and the treated groups. The control group had the least

reduction, with only a 10.00% decrease in wound area, while the treated groups, SC1, SC2, SC3, and SC4 displayed higher percentage reductions of 18.00%, 23.33%, 43.75% and 38.13% respectively.

On day 6, SC3 had a remarkable reduction of 61.00% in wound area, exhibiting the highest progress among all the groups. The control group (PO) and the other treated groups showed moderate reductions ranging from 41.88% to 47.75%. These findings suggest that 30% of the methanolic extract of the dried leaves (SC3) contributes to accelerated wound healing compared to the control group on the sixth day.

On day 9, an increment in percentage reduction of the wound areas was observed. While the control group showed a reduction of 78.67%, the treated groups, SC3, SC2 and SC4 demonstrated higher reductions of 86.25%, 81.75% and 79.75% respectively. On the other hand, SC1 had the least percentage reduction of 76.98%.

On day 12, notable progress was observed, with most groups, PO, SC2, SC3, and SC4 achieving 100.00% wound area reduction, signifying a complete wound closure. SC1 closely follows with a 99.00% reduction, indicating almost complete closure but with a slight difference compared to the other groups.

By day 15, all groups achieved complete wound closure, demonstrating 100.00% wound closure in each case. This further supports the effectiveness of the solvent extracts of the dried leaves of the mixture of *Chromolaena odorata* L. and *Sida acuta* Burm. F. as the wounds successfully healed in all the groups. The groups treated with the solvent extracts of the dried leaves of the mixture of *Chromolaena odorata* L. and *Sida acuta* Burm. F. consistently outperformed the control group in terms of wound area reduction.

Limitation

The rate of wound healing might have been affected by the feeding habits of the rats since they were caged away from their natural habitat.

Implication of the study

The study investigated the effectiveness of *Chromolaena odorata* and *Sida acuta* leaves extracts on the wounds of albino rat which is a mammalian, and the findings revealed a positive effect of the extractions. This indicates that proper proportion of a solvent mixture of dried leaves of *Chromolaena odorata* L. and *Sida acuta* Burm. F. leaves have a healing ability on wounds among albino rats and thus would have positive impact of wounds on other mammals.

Conclusions

From the study, it is concluded that:

- The four solvent extracts of the mixture of the dried leaves of *Chromolaena odorata* L. and *Sida acuta* Burm. F. leaves had significant effect in healing wounds in albino rats.
- Distil water and 30% methanol were most effective in the extraction of the mixture of *Chromolaena odorata* L. and *Sida acuta* Burm. F. leaves.

Recommendation

Other parts of *Chromolaena odorata* L. and *Sida acuta* Burm. F. such as the roots or stems should be worked on to investigate their efficacy on wound healing.

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