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ANTIMICROBIAL ACTIVITIES OF SKINCARE PREPARATIONS FROM PLANT EXTRACTS

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Abstract

In this study, *Tithonia diversifolia* Helms. (A Gray), *Aloe secundiflora* (Miller) and *Azadirachta indica* (A. Juss) plant extracts were used to make herbal soaps while *Thevetia peruviana* (Schum) seed oil was used to make a herbal lotion for skincare. The soaps were tested for the growth inhibition of *Escherichia coli*, and *Candida albicans*. The lotion was evaluated against *Staphylococcus aureus* and *E.coli*. Although *Tithonia diversifolia* soap exhibited the highest inhibitory effect on the test bacterial strains, it had the least inhibition against *C. albicans*. Results from this study indicated that the '*Tithonia diversifolia*' soap would have superior skin protection against the tested bacteria but would offer the least skin protection against *C. albicans*. The herbal lotion inhibited *S. aureus* and *E. coli* in a concentration dependent manner, however, the inhibitory effect was more pronounced on *S. aureus*.

Key words: Yellow oleander, *Tithonia diversifolia*, lotion, soap, antimicrobial

Introduction

Herbal remedies for skin care with antibacterial and antifungal activities are prepared from a variety of plant parts such as leaves, stem, root, bark or fruit. These medicines are administered topically and may be applied in the form of cream, lotion, gel, soap, sap, solvent extract or ointment, and have been established to possess antimicrobial properties (Millogo-Kone et al., 2000; Holetz et al., 2002; Gata-Goncalves et al., 2003; Moses et al., 2006; Mathabe et al., 2006; Melendez et al., 2006; Kareru et al., 2008; Wagate et al., 2009; Simon et al., 2009). Gels, creams and soap formulations containing a variety of plant extracts have been used to treat various skin disorders caused by microbial infections (Mukherjee et al., 2000; Semkina, 2005; Esimone et al., 2008; Nebedum et al., 2009).

Most skin infections are caused by fungi, *Staphylococcus aureus* and *Streptococcus* species (Millogo-Kone et al., 2000). Treatment of bacterial infections is achieved by use of antibiotics, while fungal infections require antifungal pharmaceutical preparations such as clotrimazole solution (Buck et al., 1994). However, alternative treatment can be achieved by topical application of herbal extracts and herbal preparations in form of soaps, gels, creams and lotions.

Tea-tree oil, an essential oil extract from *Melaleuca alternifolia* in gel form, was reported to reduce skin acne (Bassett et al., 1990). The tea-tree oil gel preparation was found to be as effective as benzoyl peroxide lotion, but with fewer side effects. In another experiment, tea-tree oil was reported to be as effective as clotrimazole solution in treating fungal infections (Buck et al., 1994). An ointment containing tea leaf extract has also been reported to be effective against skin bacterial infections (Karen et al., 2003). Further, a lotion and ointment formulation containing the bark extract of *Terminalia arjuna* were successfully evaluated and found to possess wound healing activity (Pulok et al., 2003). There is need, therefore, to explore plants used in folklore medicine as potential sources of antibacterial and antifungal infections.

Tithonia diversifolia Helms. (A Gray) aqueous extract has been traditionally used for skin infections (Maundu et al., 2005). Extracts from the leaf and oils from the seed kernels of *Azadirachta indica* A. Juss (Neem) were first used in India to treat fungal infections, wide spectrum bacterial skin conditions, as well as ringworm, eczema and scabies (Biswas et al., 2002). The succulent gel from the Aloe species has been used for centuries in the treatment of skin disorders such as psoriasis (Khan et al., 1987). Antibacterial (Ravikumar et al., 2007) and activity against the fungus *Cladosporium cucumerinum* (Gata-Goncalves et al., 2003) have been reported for *Thevetia peruviana* Schum (Yellow oleander) extracts.

In this study plant extracts from *Tithonia diversifolia* Helms. (A Gray), *Aloe secundiflora* (Miller), *Azadirachta indica* (A Juss) and *Thevetia peruviana* (Schum) were used to make soaps and a lotion for personal skincare. The herbal skincare products were evaluated for their antimicrobial properties. The formulation of skincare products using the yellow oleander and *Tithonia diversifolia* extracts is reported for the first time.

Materials and methods

Coconut oil and *Aloe secundiflora* dried gel were purchased from a dealer in Mombasa. *Thevetia peruviana* seeds collected from Jomo Kenyatta University farm were pressed to obtain crude oil which was used in this study. Technical grade sodium hydroxide and sodium silicate were purchased from Kobian Ltd, Nairobi. *Tithonia diversifolia* leaves (Voucher specimen number TD/JKU/06) were collected from Mbeere district, Eastern province of Kenya and authenticated by a taxonomist from the National Museums of Kenya. The specimen was kept at the Botany department of Jomo Kenyatta University. Dry powdered leaves were extracted with water and the aqueous extract used to make herbal soaps.

Herbal soaps

One gram of NaOH was dissolved in 5 ml of distilled water, to which one gram of sodium silicate was added and the mixture cooled to room temperature. Into eight separate batches of the latter mixture, varying amounts of the aloe extract were sequentially added ranging from 0.0 to 15.0 % (w/w). Seven grams (7 g) of coconut oil was then added to each batch. Stirring was started immediately until a thick paste of homogenous soap resulted. The soap samples were left to solidify. The above procedure for making herbal soaps was repeated using varying amounts of neem oil and aqueous *Tithonia diversifolia* extracts (0.0 - 15.0% (w/w)).

Herbal lotion

The lotion was made using a process described elsewhere (Williams et al., 1992). Seven lotion samples were made, into which varying amounts of yellow oleander oil were added (0.0 – 11.67 % (w/w)).

Antibacterial and antifungal assays

The procedure followed was as described by Cheesbrough (1984). Inhibition zone diameters for soaps were determined against *E. coli* and *C. albicans*. The yellow oleander lotions were tested for their growth inhibitions against *E. coli* and *S. aureus*.

Results

Figure 1 shows the variation of the antibacterial activities of the herbal soaps against *Escherichia coli*. The antibacterial activities of the herbal soaps were concentration dependent. However, these results indicated that *Tithonia*-based soap had the highest activity. The non-herbal soap (control) did not inhibit growth of *E. coli*. All the herbal soaps inhibited growth of *C. albicans* in a concentration dependent manner. However, *Tithonia*-based soap had the least activity against the test fungus and did not inhibit *C. albicans* at plant extract concentration levels below 9.0% w/w. Neem soap had the highest activity against *C. albicans* when compared to the other two soap types. The activities of the yellow oleander-based herbal lotion against *S. aureus* and *E. coli* generally increased with the concentration of oil in the lotions. In general, the herbal lotions were more effective against *S. aureus*. The activities of the lotions against *S. aureus* and *E. coli* were significantly different ($p < 0.05$)

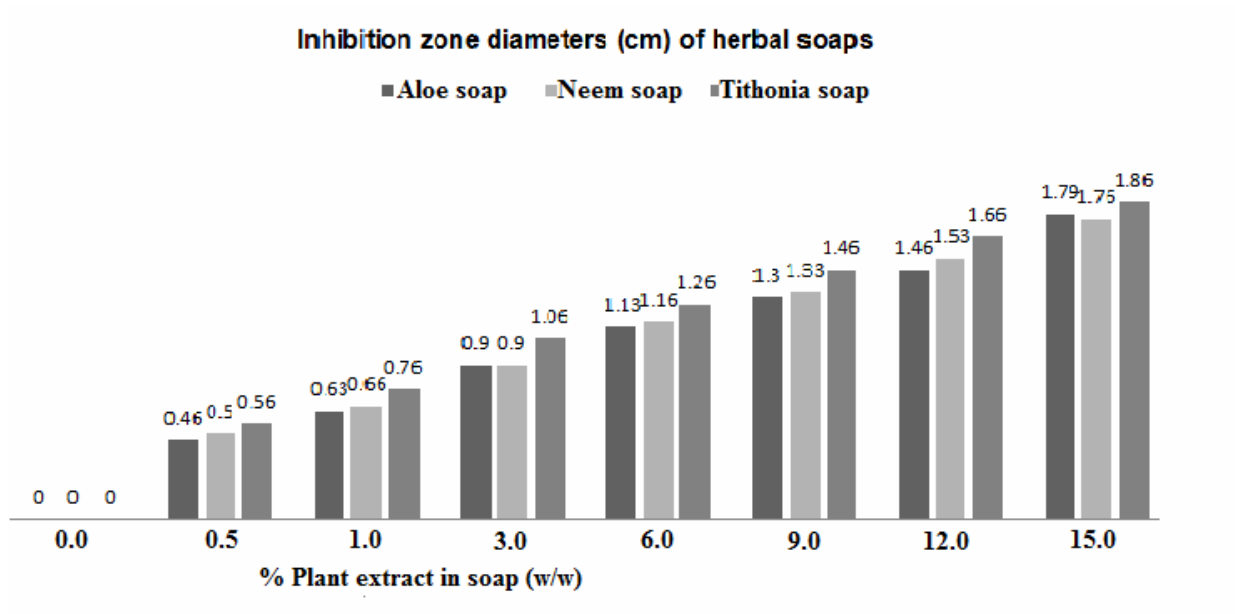


Figure 1: Antibacterial activities of herbal soaps against *E. coli*

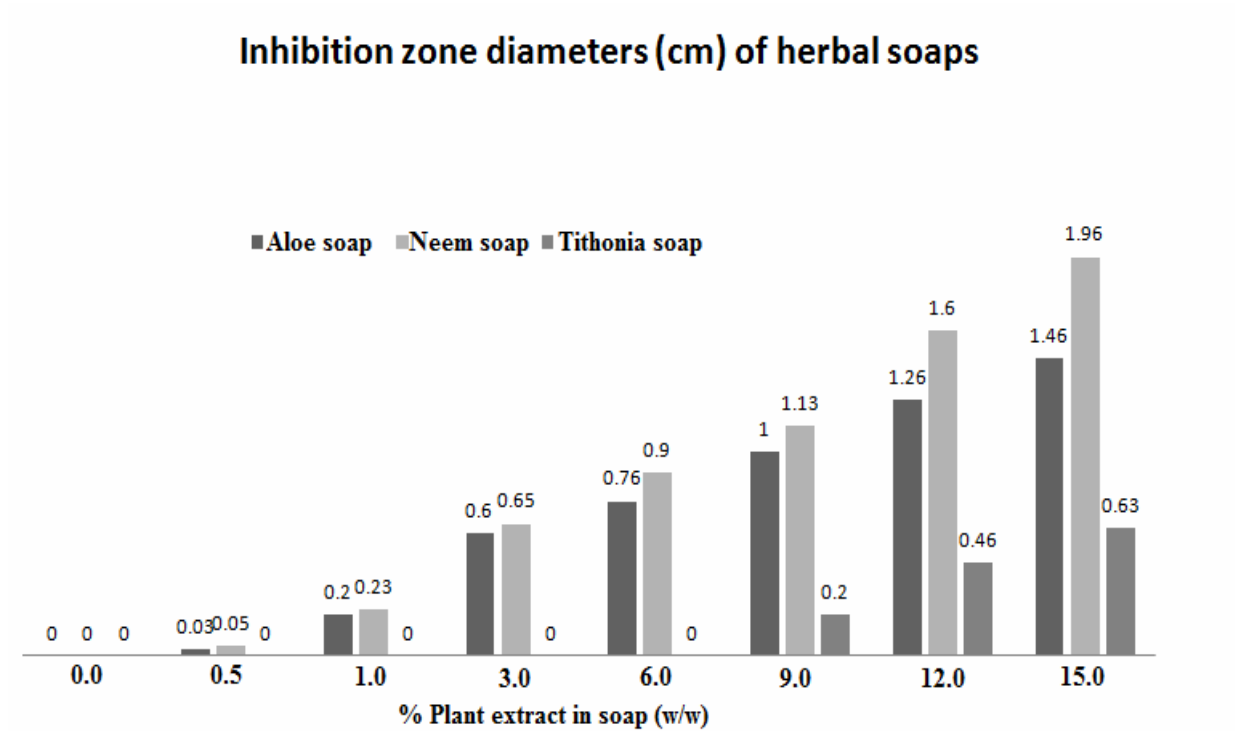


Figure 2: Antifungal activities of herbal soaps against *Candida albicans*.

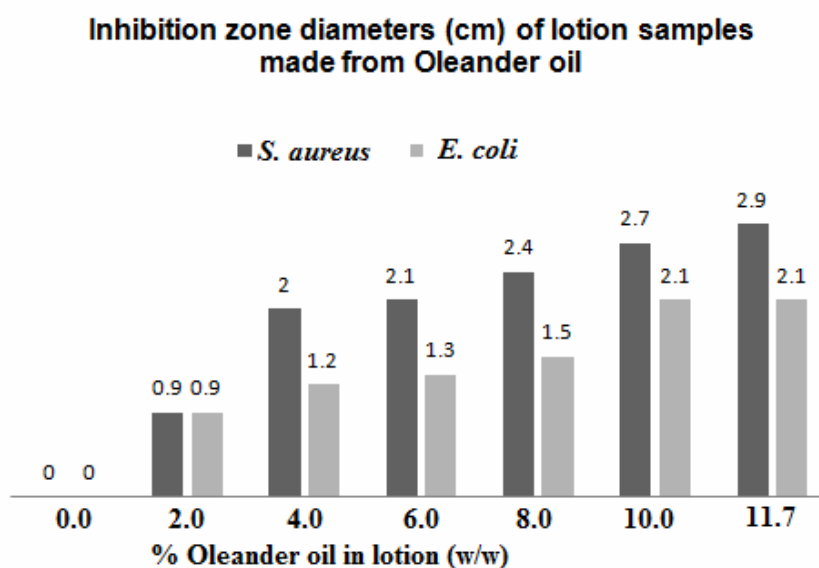


Figure 3: Antibacterial activity of lotions containing yellow oleander oil

Discussion and conclusions

Among the herbal soap preparations *T. diversifolia* soap exhibited the highest activity against *E. coli*. This was demonstrated by the increased inhibition of *E. coli* at all the *T. diversifolia* extract concentrations in the herbal soaps. The Aloe and Neem soaps had comparable activities against *E. coli*. Inhibition of *C. albicans* by the *T. diversifolia* soap was ineffective below 9% concentration of *Tithonia* extract in the soaps, and had the least effect against the test fungus when compared to the other soaps. These results justified the traditional use of *T. diversifolia* plant extract in the treatment of skin infections (Maundu et al., 2005). The *A. secundiflora* and Neem extracts were earlier reported to be used for skin conditions (Khan et al., 1987; Biswas et al., 2002). The reported antimicrobial properties of the Neem and *A. secundiflora* plant extracts were confirmed in this investigation. However, the activities of the herbal soaps on the test microorganisms were significantly different ($p < 0.05$) and depended on the extract concentration.

Yellow oleander-based lotion inhibited *S. aureus* more than *E. coli* and in a concentration dependent manner. These results indicated that the yellow oleander lotion had appreciable antibacterial activity and would protect the skin against bacterial infection. The antibacterial and antifungal activities of yellow oleander plant extracts have been established (Gata-Goncalves et al., 2003; Ravikumar et al., 2007).

Results from this study indicated that plant phytoconstituents had inhibitory effects against microorganisms. This is in agreement with other reported investigations (MacLaughlin et al., 1980; Millogo-Kone et al., 2000; Holetz et al., 2002; Gata-Goncalves et al., 2003; Moses et al., 2006; Mathabe et al., 2006; Melendez et al., 2006; Kareru et al., 2008; Wagate et al., 2009; Simon et al., 2009). Furthermore, incorporation of medicinal plant extracts into skincare preparations such as soaps, gels, creams and lotions have the advantages of aesthetic appeal with proven activity against skin infections (Basset et al., 1990; Mukherjee et al., 2000; Karen et al., 2003; Semkina, 2005; Esimone et al., 2008; Nebedum et al., 2009).

It was established that skincare products formulated from plant extracts (*Thevetia peruviana*, *Tithonia diversifolia*, *Azadirachta indica*, *Aloe secundiflora*) had antimicrobial properties. Soap made from *Tithonia diversifolia* plant extract was the most effective against *E. coli* while *Azadirachta indica* soap was the most effective against *C. albicans*. The lotion made from *Thevetia peruviana* oil extract had higher activity against *S. aureus* than on *E. coli*.

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