Development of bio-bandages using herbal plants for human applications

Publication History
Received: 10 March 2015
Accepted: 14 April 2015
Published: 22 April 2015

Citation
DEVELOPMENT OF BIO-BANDAGES USING HERBAL PLANTS FOR HUMAN APPLICATIONS

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ABSTRACT

An adhesive bio-bandage is used personally to cover a minor injury on a human body, especially on a finger or a toe. Bio-bandages are made from herbal compounds that impart host compatible therapeutic properties. Bio-bandages are prepared from the herbals such as, *Azadirachta indica* (Neem), *Ocimum tenuiflorum* (Holy basil), *Vitex negundo* (Five-leaved chaste tree) and *Curcuma longa* (Turmeric). A bandages prepared with an adhesive inside, to which a pad is fixed to a central portion of inside of the bandage containing herbal composition and a protective paper having opposed end portions removable attached to inside of the bandage. The formulated quantity of herbal composition was loaded in the nonwoven fabric pad. Natural adhesive glue from neem tree was used as an adhesive to make the bandage. The antimicrobial assay was performed for the four herbal plants towards Gram negative bacterium (*Escherichia coli*) and Gram positive bacterium (*Bacillus subtilis*). The results showed effective zone of inhibition against the test organisms. Bio-bandages made of herbals posses antimicrobial properties that are chemical free, non-toxic and ecofriendly.

Keywords: Bio-bandages, herbals, antimicrobial properties, nonwoven fabric, natural adhesive glue.
INTRODUCTION

Plants are the richest resource of drugs in traditional systems of medicine, modern medicines, nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drugs (Hammer et al., 1999). The use of plants and plant products as medicines could be traced as far back as the beginning of human civilization. The earliest mention of medicinal use of plants in Hindu culture is found in “Rig-Veda”, which is said to have been written between 4500 - 1600 B.C. and is supposed to be the oldest repository of human knowledge. Plants have been considered as sources of medicine since age and successfully in curing a range of diseases. With the advancement in extraction, purification and assessment techniques, the field of herbal medicine is growing fast and finds its application in many interdisciplinary sectors. Herbal extracts and plant products are coated on textile surfaces and used in medical and protective textiles. Such products will have the functionality of textiles as well as the curative ability of the herbal compounds. Use of herbal medicines in the developed world continue to rise because they are rich source of novel drugs and their bioactive principles form the basis in medicine, nutraceuticals, pharmaceutical intermediates and lead compounds in synthetic drugs (Ncube N S et al 2008). Plant based products extracts are cheaper alternatives to the development of synthetic drugs.

MATERIALS AND METHODS

MATERIALS (HERBS)

Azadirachta indica (Neem)
A fast-growing tree, can reach a height of about 15 to 20 meters. The trunk is short, straight and has a diameter of 1.2 m, wherein the branches spread out widely. Young leaves are reddish to purple in colour and turn into dark green pinnate leaves on maturity. The white and fragrant flowers are arranged auxiliary in drooping panicles, about 25 cm in length. The smooth olive-like drupe fruit is elongated-oval to nearly roundish in shape.
**Properties:** Antibacterial, Antifungal, Antiviral, Anticancer, Antioxidant and Antimalarial activities

**Antibacterial** Oil from the leaves, seed and bark possesses a wide spectrum of antibacterial action against Gram-negative and Gram-positive microorganisms, including M. tuberculosis and streptomycin resistant strains.

**Antifungal** Extracts of neem leaf, neem oil seed kernels are effective against certain fungi including Trichophyton, Epidermophyton, Microspor Trichosporon, Geotricum and Candida.

**Antiviral** Aqueous leaf extract offers antiviral activity against Vaccinia virus, Chikungunya and measles virus.

**Ocimum tenuiflorum (Holy basil)**

Holy basil is a plant. It is originally from India and is used in Ayurvedic medicine as an “adaptogen” to counter life’s stresses. It is considered a sacred plant by the Hindus and is often planted around Hindu shrines. The Hindu name for holy basil, Tulsi, means "the incomparable one." Medicine is made from the leaves, stems, and seeds.

**Properties:** Adaptogen, antibacterial, antidepressant, antioxidant, antiviral, carminative, diuretic, expectorant, galactagogue (promotes the flow of mother's milk), and immunomodulator

Holy basil is used for the common cold, influenza ("the flu"), H1N1 (swine) flu, diabetes, asthma, bronchitis, earache, headache, stomach upset, heart disease, fever, viral hepatitis, malaria, stress, and tuberculosis. It is also used for mercury poisoning, to promote longevity, as a mosquito repellent, and to counteract snake and scorpion bites.

**Vitex negundo (Five-leaved chaste tree)**

Five-leaved chaste tree is an erect, branched tree or shrub, 2 to 5 meters high. Leaves are usually 5-foliate, rarely with 3 leaflets only and palmately arranged. Leaflets are lanceolate, entire, 4 to 10 centimetres long, slightly hairy beneath, and pointed at both
ends, the middle leaflets being larger than the others, and distinctly stalked. Flowers are numerous, blue to lavender, 6 to 7 millimetres long, borne in terminal inflorescences (panicles) 10 to 20 centimetres long.

**Properties:** Antifungal, Anxiolytic, Antidiabetic, Anti-microfilarial, Antibacterial, Anti-venom, Antimicrobial

Leaves used for reducing inflammatory and rheumatic swellings of the joints and testicular swelling associated with gonorrhoeal epididymitis and orchitis. Poultice of leaves also applied to sprained limbs, contusions, leech bites, etc. For these, fresh leaves in an earthen pot are heated over fire, and applied and applied as tolerated over the bruised parts. Leaves heated over fire are also applied with oil externally on wounds.

**Curcuma longa (Turmeric)**

Turmeric is a perennial herbaceous plant, which reaches up to 1 m tall. Highly branched, yellow to orange, cylindrical, aromatic rhizomes are found. The leaves are alternate and arranged in two rows. They are divided into leaf sheath, petiole, and leaf blade. The petiole is 50 to 115 cm long. The simple leaf blades are usually 76 to 115 cm long and rarely up to 230 cm. They have a width of 38 to 45 cm and are oblong to elliptic narrowing at the tip.

**Properties:** Antioxidants, Anti-Inflammatory and Antibacterial

Turmeric has been used in both Ayurvedic and Chinese medicine as an anti-inflammatory, to treat digestive and liver problems, skin diseases, and wounds. Curcumin is also a powerful antioxidant. Antioxidants scavenge molecules in the body known as free radicals, which damage cell membranes, tamper with DNA, and even cause cell death. Antioxidants can fight free radicals and may reduce or even help prevent some of the damage they cause. It lowers the levels of two enzymes in the body that cause inflammation. It also stops platelets from clumping together to form blood clots.
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Scientific Name</th>
<th>Common name</th>
<th>Family</th>
<th>Parts used</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td><em>Azadirachta indica</em></td>
<td>Neem</td>
<td>Meliaceae</td>
<td>leaves</td>
</tr>
<tr>
<td>2</td>
<td><em>Ocimum tenuiflorum</em></td>
<td>Tulsi</td>
<td>Lamiaceae</td>
<td>leaves</td>
</tr>
<tr>
<td>3</td>
<td><em>Vitex negundo</em></td>
<td>Nochi</td>
<td>Lamiaceae</td>
<td>leaves</td>
</tr>
<tr>
<td>4</td>
<td><em>Curcuma longa</em></td>
<td>Turmeric</td>
<td>Zingiberaceae</td>
<td>Rhizome</td>
</tr>
</tbody>
</table>

**STEPS INVOLVED IN BIO-BANDAGE PREPARATION**

**1. COLLECTION OF HERBALS**

*Azadirachta indica* (Neem) and *Ocimum tenuiflorum* (Holy basil) were collected from the medicinal plants lawn of Bannari Amman Institute Of Technology, Sathyamangalam, TN, India.*Vitex negundo*(Five-leaved chaste tree) were collected from village of Erode district of Tamilnadu. *Curcuma longa* (Turmeric) were purchased from local market of Erode, TN, India. The plant parts were identified according to various literatures.

**2. EXTRACTION**

Ten grams of the plant materials were pounded manually with mortar and pestle and soaked in 40 ml absolute ethanol in 250 ml sterile conical flasks incubated at 37°C incubator with shaking at 120 rpm for 24 h. The content was filtered with Whatman No. 1 filter paper and the residue was again treated with 40 ml of absolute alcohol and incubated as mentioned earlier. It was repeated 3 times. The pooled up filtrates were evaporated to dryness under vacuum using a distillation unit. The dried extract was finally reconstituted in 5 ml of absolute ethanol and then packed in separate sterile glass vials and stored at 4°C until use (Mehrotra *et al.*, 2010).
3. COLLECTION OF TEST ORGANISM AND PREPARATION OF STOCK CULTURE

The bacterial cultures used in this study include *Bacillus subtilis* (Gram positive) and *Escherichia coli* (Gram negative). All the test organisms were purchased from Microbial Type Culture Collection (MTCC), Institute of Microbial technology (IM-TECH), Chandigarh, India. Test organisms were sub cultured onto fresh nutrient broth media and incubated at at 37±1°C for 24 h. The stock cultures were maintained at 4°C.

4. TEST FOR EFFECTIVENESS OF HERBS

The agar well diffusion method was used for the plant extracts against test organisms. Mueller-Hinton agar was used for antimicrobial assay. Wells are made in Mueller-Hinton agar solid media plates using cork borer (5 mm diameter) and inocula containing bacteria were spread on the solid plates with a sterile swab moistened with the bacterial suspension and 25, 50, 75, 100 microliters of the working suspension/solution of different plant extract and same volume of extraction solvent for control was filled in the wells with the help of micropipette. Plates were left for some time till the extract diffuse in the medium with the lid closed and incubated at 37°C for 24 h. After overnight incubation plates were observed for zone of inhibition (ZI) Antimicrobial activity of the extracts was determined by measuring the diameter of inhibition zone in millimetre produced against the test organisms. The experiment was done three times and the mean values were calculated.

5. FORMULATION OF HERBAL EXTRACTS

Antimicrobial activity of coated bandages has been also assessed by agar well diffusion method. Activity against gram positive *B. subtilis* is more important as it is the bacterium present on the epidermis of the skin. Gram negative *E.coli* is present in intestine of human beings. All the coated bandages showed activity against both *B.subtilis* and *E.coli*, where effective zone of inhibition was shown in the plant extracts of *C.longa* and
A. indica against both organisms. The extracts of O. tenuiflorum and V. negundo against gram negative bacteria E. coli shows minimum zone of inhibition, but for gram positive bacteria B. subtilis do not show any zone of inhibition. So plants of C. longa and A. indica are taken for formulating the drug.

6. LOADING OF DRUG ON TO THE FABRIC

The fabric coating was carried out using exhaust method. The nonwoven fabric with treated with each of the extracts Azadirachta indica (Neem), and Curcuma longa (Turmeric) of by exhaust method. The fabric samples were loaded into a bath of 1N:2T solution of the plant extract and were allowed to soak for an hour. The soaked fabric was later washed with water without and dried squeezing at atmospheric conditions. The soaking time was varied by trials to find an optimum pick-up for which the loss of extensibility in coated bandages is negligible.

7. DEVELOPMENT OF BIO BANDAGE

Adhesive bandages have an absorbent pad, which is medicated with herbal composition. The formulated quantity of herbal composition was loaded in the nonwoven fabric pad. Then the non-woven fabric pad is placed at the central position of the bandage. Natural adhesive glue from neem tree was used as an adhesive to make this bandage. Bandages have a thin, porous-polymer coating over the pad to keep it from sticking to the wound. The bandage is applied such that the pad covers the wound, and the fabric to the surrounding skin to hold the dressing in place and prevent dirt or other microorganism from entering the wound. The curative bandages were developed by coating with plant extracts and placing it properly in correct position by these methods.

RESULTS AND DISCUSSION

Based on the antimicrobial activity test conducted in the four plants Azadirachta indica (Neem), Ocimum tenuiflorum(Holy basil), Vitex negundo(Five-leaved chaste tree) and
Curcuma longa (Turmeric) against two target test organism B.subtilis and E.coli.

(a) Antimicrobial Activity of Four Herbal plants.

The Azadirachta indica (Neem) and Curcuma longa (Turmeric) shows the best performance against these bacteria. The Neem and Turmeric combinations were tested as 1:2, 1:1 and 2:1 ratio respectively for antimicrobial activity.

(b) Antimicrobial Activity on Neem and Turmeric(Ratio)
One percentage of *Azadirachta indica* (Neem) with two percentage of *Curcuma longa* (Turmeric) showed a effective zone of inhibition.

The non-woven fabric pad is coated with neem and turmeric in 1: 2 ratio respectively. According to this ratio 10 mL turmeric and 5 mL neem is used to made this bandage. The fabric pad is attached to the adhesive bandage with glue extracted from neem. The bandage is prepared. The bandage is applied over the wound, were the fabric to the surrounding skin to hold the dressing in place and prevent dirt or other microorganism from entering the wound.

**CONCLUSION**

Extracts of Neem, Tulsi, Nochi, and Turmeric showed effectiveness against the test organism *B.subtilis* and *E.coli* in controlling their growth. Hence, band aid with herbal preparations can best be used as curative aid towards microbial infections for human.

**REFERENCES**


