Feasibility Studies on Contact Dermatitis Buffering Textile Finish Using Certain Plant Natural Products

P D Munasinghe, T Wanniarachchi

Abstract

Contact Dermatitis (CD) is a skin disease which can make humans fearful of wearing certain fabrications. Formaldehyde and its compounds are the main causative agents and Nickel and Chromium also work as allergens for CD. Chemicals used in finishing processes are also identified as causative agents and Fiber types can have an effect on the disease. Symptoms of the disease were reviewed using books and previous researches in this study. Reddish blisters, itching and reddish skin are common symptoms of CD. As there is no evidence about CD in Ayurveda, Western medicine and Ayurveda were linked by matching symptoms to find the connectivity of the skin diseases. Ayurveda described about “Kshudra Kushta” which has similar symptoms to those of CD. Herbs such as aswistle snakegourd, white sandalwood, red sandalwood and Heart leaved Moonseed are used in Ayurveda to cure “Kshudra kushta”. Mixtures of herbs with fixing agents were applied to cotton and polyester fabrications through a natural dyeing method to find a fabric finishing method for CD. Two types of fixing agents; Copper Sulphate and Aluminum Sulphate were applied separately with different amounts to identify best recipe. The herbal mixture has a reddish colour. The mixture was tested with colour fastness to wash test ISO – 165-C01:1987 and pH value of the solutions was also checked to study the feasibility. Cotton fabrications showed acceptable durability up to three (3) washes and polyester had poor durability. Wash durability is also dependent on the amount of fixing agents. There were slight colour changes after Copper sulphate treatment; Aluminum sulphate did not show any colour change. It has neutral pH range. Fourteen (14) different garments which cause symptoms of CD were treated with the herbal mixture and wear trials were carried out. All garments showed positive results up to 3 domestic washes.

1. Introduction

Contact dermatitis (CD) is caused by a hypersensitivity reaction of the skin. Common allergens like nickel, chromate, dyes and synthetic rubber are some causes of this hypersensitivity reaction. Many compounds which cause contact allergic dermatitis are low molecular weight haptens which require combining with an epidermal protein to become immunogenic1. Sri Lankans and many people from all over the world are suffering from this disease. Millions of Americans suffer from constant recurring mysterious skin rashes. These irritating flares may indicate that humans are allergic to formaldehyde which is used to treat fabric finishes on a large portion of the clothing we wear each day. The nacreous area, waist area, inner and posterior thighs, popliteal fossae, axils, abdomen and buttocks are the main places where this disease can often be seen, because garments are highly contacting these areas. Itching, irritations [blisters], papules and reddish skin are the common virtual symptoms of the disease.

The allergens most likely to cause CD are dyes used to colour fabrics and resins used in finishing processes. Especially, resins like Ethilenurea and Melamine Formaldehyde which are used to get wrinkle free and shrink free effects are the causes for the disease2. Polyester and spandex may be a sensitizer because of Mercaptobenzothiazole which is used in these fabrics. Especially Formaldehyde and its resins which are used in the fabric preparation process could be a high sensitizer. Garment types such as diapers, socks, girdles, brassieres and most undergarments and tight garments with above fabrications may lead to this disease3. “Further, Disperse blue 106 and 124 can be other sensitzers. These chemicals are used in the 100% polyester blue, black, green and orange color of women’s clothing. There is a possibility in flame retardant fabrics to generate this disease. 2.3- Dibromopropyl phosphate and 2.3- Dibromoalslyglycidyl ether has been reported as a causative agent. Basic red 46 dyes are also reported as causative agent of CD4.”

In eastern medicine “Kushta” is related to skin diseases. There are 18 types of “Kushta” including seven “Mahakushta” and eleven “Kshudra kushta”. In Western medicine “Mahakushta” is known as Leprosy and “Kshudra Kushta” as Skin diseases. Eastern medicine also describes reasons and symptoms of each “Kshudra Kushta”.

“Alasakaya” and “Dhdrawaya” and “Charmadalakushtaya” [three of eleven “kshudra kushta”] have the same symptoms as contact Dermatitis described below.

“Alasakaya” – itching, little reddish blisters on skin
“Dhdrawaya” – little itching, reddish blisters on skin
“Charmadala kushtaya” – reddish skin with itching and blisters

“Charma Roga Nidhana Chikithasa Sanghrhay” explains in depth about skin diseases and “Kushta”5. Herbs;Trichosanthes cucumerina L.(wild snake gourd), Santalum album (white sandalwood), Pterocarpus santalinus L.f. (red sandalwood), Tinospora cordifolia (Heart leaved Moonseed)cures “Kushta” and itching6.

Heart wood of white sandalwood (Santalum album) includes 10% essential oil, 90% sequiterpene alcohols, santalols, (Z)-α-santalol (45-47%), (Z)-β-santalol(20-30%), Sesquiterpene alcohols, epo-β-santalol, (E) & β-santalol,spiro-santalol, Cis-nuciferols, cis-lanceol7,8,9,10.

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Heart wood of red sandalwood includes Isoflavone, liquiritigenin, isoliquiritigenin, savinin, calocedrin, santalinsA, santalinsB, santalinsC, santarubin, santalic acid(16%), 7-hydroxy-6-methoxy-coumarin-7-O-[β-D-apiofuranosyl(16)]-β-D-glucopyranosyl, 7-hydroxy-6-methoxy-coumarin-7-O-[α-L-arabinopyranosyl[(13)]-β-D-glactopyranosyl[(16)]-β-D-glactopyranoside, 5-hydroxy-7-O-(3-methyl-β-2-enylcoumarin)

Bark of Heart leaved Moonseed includes Daucane-type sesquiterpeneglucoside, Tinocordifolioside. Furanooiditerpeneglucosides, palmatosides C.

Diterpenes, norditerpene-furanolactone, tinosporidine, columbi...
Amount of Water: 1l per 100g of fabric
Amount of Herbs: 200g per liter

Table 2: Recipe of category A

<table>
<thead>
<tr>
<th>Fixing Agent</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
<th>A5</th>
</tr>
</thead>
<tbody>
<tr>
<td>CuSO₄</td>
<td>3g/l</td>
<td>6g/l</td>
<td>9g/l</td>
<td>12g/l</td>
<td>15g/l</td>
</tr>
</tbody>
</table>

Table 3: Recipe of category B

<table>
<thead>
<tr>
<th>Fixing Agent</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>B4</th>
<th>B5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al₂(SO₄)₃</td>
<td>3g/l</td>
<td>6g/l</td>
<td>9g/l</td>
<td>12g/l</td>
<td>15g/l</td>
</tr>
</tbody>
</table>

2.4 Measurement of the pH Value of Herbal Mixture

pH value of each herbal mixture was measured using a digital pH meter.

2.5 Testing With Humans to Find the Effectiveness with Skin

Seven patients who are suffering from Contact Dermatitis were tested with the 14 identical garments which caused them to contract CD. All garments were cleaned and treated with recipe in Table 4.

Wear trials were then done with the patients with their relevant garments. Effects of the herbal treatment were observed by collecting feedbacks after 12 hours of wearing treated garments in their day to day activities. Wear test was replicated three times with three normal domestic wash cycles.

3. Results and Discussion

3.1 Colour Fastness to Wash Test

After discussions with Ayurveda doctors was decided to take “Alasakaya”, “Dhdrawaya”, and “Charmadala kushtaya” as having the same symptoms as CD. Ayurveda doctors confirmed that wild snake gourd, white sandalwood, red sandalwood, Heart leaved Mooneed are used to cure the above skin diseases. The results of colour fastness to wash test; ISO – 165-CO1:1987, for each fabrication with different amounts of fixing agents are given below.
Both CuSO₄ and Al₂(SO₄)₃ fixing agents show acceptable results with cotton fabrications. CuSO₄ helps to keep the same standard reading in a positive value with cotton fabrications while keeping colour stability at a poor value with polyester fabrications. Standard reading with Al₂(SO₄)₃ and cotton fabrication showed an positive increment of colour stability while keeping a slight increment and stability with polyester fabrication. Both CuSO₄ and Al₂(SO₄)₃ fixing agents have poor results with polyester fabrications when compared to cotton fabrications. The best value for the fixing agent for each herbal solution is ≥6g/l for cotton fabrications.

3.2 Effect With the pH Value of the Herbal Solution With Fabrics

pH value of each solution used in the research has 7.2 which is in the neutral range. Therefore the herbal solution (new application) would not affect the composition of cotton or polyester fabrications.

3.3 Effect of the Treated Clothing for the Skin

According to the feedback of all 7 patients, 14 items of clothing which caused them to contract CD did not create any skin problem after treatment of the clothing with the new herbal mixture. Further more, none of the patient report any negative feed backs after three normal domestic washing cycles.

3.3 Conclusion

This study was conducted to find the best herbal fabric finishing method for the people suffering from Contact dermatitis. Formaldehydes, Disperse dyes, various fiber types, construction methods and chemicals normally used in textile finishing processes were identified as the main causative agents. In Ayurveda, skin problems such as “Kshudra Kushtha” which is similar to CD are treated with herbs such as wild snake gourd, white sandalwood, red sandalwood, Heart leaved Moonseed.

Researchers identified a herbal mixture with different plant parts of wild snake gourd, white sandalwood, red sandalwood, Heart leaved Moonseed and different amounts of CuSO₄ and Al₂(SO₄)₃ as fixing agents.

Cotton and polyester fabrications treated with herbal mixture have shown positive reactions against CD after three domestic washes. Herbal treatment of polyester fabrications resulted in poor colour stability with both fixing agents while herbal treatment of cotton fabrications resulted in better performances with both fixing agents. The use of ≥6g/l fixing agents for each herbal solution resulted in strong colour feasibility for cotton fabrications.

This study opens new research avenues for western and Ayurveda doctors, chemists, scientists, textile engineers, fashion brands and apparel retailers.

- For further research on herbs with textile printing and Nano technology.

References