Antimicrobial Activity of Some Medicinal Herbals

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Abstract

Antimicrobial property is protecting your fabric from pathogenic microorganisms. These microbes can attack the cellulose in moist and humid conditions. To protect the textiles from these microbes, the textiles are treated with antimicrobial agents. Various synthetic antimicrobial agents are available at cheaper rate in market. But, these agents are non-eco-friendly in nature. Various medicinal herbs are available abundantly in India. These medicinal herbals have very good antimicrobial properties. These can be used as the alternative for the synthetic antimicrobial agents. The herbals, tulsi, aloe vera, garlic adamant creeper and so many medicinal herbals has antimicrobial property. In this paper some medicinal herbals that has antimicrobial properties are explained in this paper.

Keywords: *Antimicrobial Activity, Herbals, Natural Finish, Tulsi, Aloe Vera, Garlic, Adamant Creeper.*

I. Introduction

Increasing global competition in textile has created many health challenges in the present days for researchers and industrialists in textiles. One of the major factors that created interest in antibacterial finishes using textiles with highly improved functionality has a variety of applications such as infection control barriers. Antibacterial properties of fabric are being considered to be an important and essential for textile material which is in direct contact with the skin. Number of commercial products are available in the market with a wide range of antibacterial properties under different trade names. Majority of such products are synthetic based and are not environment friendly. Antibacterial finishes using natural materials have been the current trend that promotes an eco-friendly lifestyle. Natural materials like plant herbs are selected for their biological screening based on medicinal use of plants, because many diseases are known to have been treated with herbal remedies throughout the history of mankind.

II. Need for Anti-Bacterial Finishing

Anti-bacterial finishing is done on the cotton fabric to satisfy the following objectives [1]

- To protect the textile materials from bleeding of dyes, staining, quality deterioration.
- To control the spread of micro-organism over the textile material.
- To avoid infection from microbes.
- To control the metabolism of the micro-organisms to reduce the formation of odor.

III. Major herbals used for antimicrobial activity

Ocimum sanctum, commonly called as Tulsi, and in English “Holy Basil', is one of the sacred herbs for Hindus in Indian sub-continent. It is used as a valuable medicine in Indian traditional medicine. The efficacy of curing the different diseases being evaluated for the whole tulsi plant and it was very good. Tulsi has numerous chemical constituents that interact in a complex way to enrich the pharmacodynamics response. The active constituents of tulsi responsible for the medicinal properties have been isolated and characterized. The various pharmacological and phytochemical activities of Tulsi reveals the antimicrobial activities [2].

The tulsi plant is cultivated and distributed all over India. It is an erect, much branched softly pubescent undershrub, 30-60 cm high with red or purple subquadrangular branches. Leaves are simple, opposite, elliptic, oblong, obtuse or acute, with entire or sub- serrate or dentate margins, pubescent on both sides, minutely gland dotted, with slender, hairy petioles [1], [3].

Tulsi leaves are shade dried for about 1 week and then grinded. Using the Soxhlet apparatus the herbs are extracted with methanol for about 6 to 8 hours. After that the extracts are finished on the bleached cotton fabric [4], [5]. The finishing is done by direct method on cotton fabric. The main drawback of this method is that it does not have sufficient wash durability and this method can be adopted for single use disposable materials like surgical gown, surgical masks etc. If you are in need of a good wash durable finished fabric you can go for others methods like micro encapsulation, cross linking method and the combination of both microencapsulation and crosslinking method [1], [6]

Magnifera indica leaves (mango leaves) and triphala dried fruit (chebulic myrobalan, beleric myrobalan, Indian gooseberry) were bought and they are dried in sunshades. These two are selected for its good antibacterial and wound healing property [7]. Chitosan was then diluted with citric acid. Then the extract was finished on the scoured and bleached fabric with and without binder and then the finished fabric was tested for its antibacterial activity, wound healing property, washing fastness, water absorbency, air permeability, wicking ability and drop test. On seeing the final test results, it is been said that the fabric treated with the 2% extract of magnifera idica with and without chitosan as the binding agent showed good antibacterial activity and with chitosan showed goof wound healing property, So it is concluded that the sample treated with chitosan has better antimicrobial properties [8].

Aloe vera belonging to Lilyaceae is also known as “Lily of the desert” was washed, weighed and dried in the hot air oven at 40^{o}C [9], [10]. After drying they were grinded into fine powder. The powder was weighed again and extract was taken by using methanol. Extract was taken by Maceration method as per standards. Finish was applied on the fabric with methanol extract by pad-dry-cure method [11]. Based on the weight of the fabric methanol extract and crosslinking agents were calculated. Different concentrations of the extract were applied on the fabric along with acetic acid to maintain the pH. After that the fabric was padded at 2.5psi and then dried at 80^{o}C for 3 minutes and cured at 120^{o}C for 2 minutes [12].

A natural ecofriendly antibacterial finishing agent has been extracted from the herbs like Chamomile [13], sage [14] and green tea [15] which have been applied on the cotton fabric in the absence and presence of formaldehyde which is used as a cross linking agent using pad dry cure method. Chamomile, sage and green tea are used to give the cotton fabric an antimicrobial finish. These extracts include ingredients which are active they are rich and contribute to controlling a variety of diseases. 10 grams of the dried herbal powder was mixed in 100 ml of hot water shake in shaking water bath for mixing the herbal powder with hot water at 100^{o}C for one hour after the extract solution left to cool and then filtered. The filtrate extract was collected and kept in the bottles stored at 4^{o}C for further use [16].

Garlic is an edible plant which has created lot of interest through human history because of its high medicinal values. A wide range of micro organisms like bacteria, protozoa, fungi and viruses have shown to be sensitive to crushed garlic preparation. Not only antimicrobial properties but also garlic has been reported to reduce blood lipids and have anticancer effects [17], [18]. Chemical analyses show that garlic contains unusual concentration of Sulphur containing compounds. These Sulphur containing groups are then called as allicin. Alliin was found to be a stable precursor that is converted to allicin by the action of an enzyme termed alliinase which is also present in the cloves of the garlic [18]. The transformation of alliin to allicin takes place within seconds when the garlic is crushed.

Inhibition of certain enzymes in the microbes by the rapid reaction of thiosulfinates with thiol groups was assumed to be the main mechanism of the antimicrobial effect. On studying the mechanism of allicin it was confirmed that allicin reacts with model thiol compounds. The main antimicrobial effect of allicin was due to the interaction with the thiol containing enzymes. In some parasites like amoeba, allicin was found to strongly inhibit the cysteine proteinases, alcohol dehydrogenases and thioredoxin reductases which are the main components in the parasite [19]. These inhibition capacities for ajoene, having oxygenated Sulphur group suggest that additional microbe specific enzymes may also be targets for allicin. Various garlic preparation has shown activity against gram-positive and gram-negative bacteria like Escherichia, salmonella etc. Even acid-fast bacteria like Myco-bacterium tuberculosis are sensitive to garlic [18].

Adamant creeper is commonly known as Hadjod is a perennial plant of the family Vitaceae. Is is also known as cissus quadrangularis, square stalked vine, veldt grape, devil’s backbone, pirandai, mangara valli. It is native in India, Bangladesh and Sri Lanka. It is also found on Africa and Southeast Asia. Adamant creeper reaches a height of 1.5m and has a quardrangular-sectioned branches with internodes of about of about 8 to 10 cm long and 1.2 to 1.5 cm wide. It is one of the commonly used medicinal plants in Africa, Thailand and India. Traditionally it was mostly used in treating female disorders like menopause, libido and menstrual disorders and treating bone disorders like increasing fracture healing, increasing bone mass. It is also used for treating ulcer [20].

Phytochemical studies on methanol extracts revealed the presence of triterpenes including α and β-amyrins, β-sitosterol, ketosterrrroids, phenols, tannins, carotene and vitamin C. Seven alicyclic lipids constituents have also been reported from Cissus quadrangularis. unsymmetric tetracyclic triterpenoids such as d-amyrin, onocer-7-ene-3a, 21b-diol, damyrone and 3,3',4,4'-tetra hydroxy biphenyl, 3,3',4,4'- tetrahydroxybiphenyl have been isolated from plant and were quantitatively determined by HPTLC and HPLC methods in samples collected from five different geographic zones of India. Several other constituents such as flavonoids quercetin and kaempferol, and stilbene derivatives, quadrangularins A,B,C and many others e.g. resveratrol, piceatanon, pallidol, perthenocissi and phyto-sterols have been isolated from plant. Stem extract contains a high

percentage of calcium ions and phosphorus, both essential for bone growth [21].

Methanol extract (90%) and dichloromethane extract of stems possess antibacterial activity against *S.aureus*, *E.coli*, and *P.aeruginosa* and mutagenicity against Salmonella microsome. Antimicrobial activity has also been reported from stem and root extract. The alcoholic extract of aerial part was found to possess antiprotozoal activity against Entamoeba histolytica. Alcoholic extract of the stem showed activity against E. coli. Methanol and dichloromethane extract of whole plant were screened for in vitro anti-plasmodial activity [22].

IV. Application methods

The antibacterial agents can be applied over the textile material by exhaust method, pad dry cure method, coating, spray and foam techniques. The extracts can be also be directly mixed into the fibre spinning dope. It is already known that the commercial agents can be applied over the fabric during the time of dyeing and finishing operations.

A. Direct Application Method

Methanol extracts of the herbs were directly applied on the textile material by using pad dry cure method. The herbal extract was applied on the textile material along the 6 to 8 % citric acid as a binding agent. Padding was carried out in the pneumatic padding mangle at a required pressure to get a good wet pick up. Drying and curing were done at 80ºC for 5 minutes and 120ºC for 2 minutes [6], [23].

B. Micro Encapsulation Method

It is one of the novel methods of giving functional finish to the textile material. It is process by which tiny droplets of the liquid particles of solid are covered with a continuous film of polymeric material. This method is more advantageous to conventional process in term of economy and efficiency. Micro encapsulation was done using the herbal extract as the core material and the gum acacia ass the cover material [24]. Ten grams of acacia powder was allowed to swell for 15 minutes in 100 ml of hot water. To this mixture, 50 ml of hot water was added and stirred for 15 minutes maintaining the temperature between 40ºC and 50ºC. One and a half gram of core material was slowly added under stirring condition. Stirring was continued for another 15 minutes and then 10 ml of 20% sodium sulphate and 6 g of citric acid were added. The stirring was stopped and the mixture was freezer to develop microcapsule solution and padded through the pneumatic padding mangle at a required pressure. The treated fabric was dried at 80ºC for 5 minutes [6], [23], [25], [26].

C. Cross Linking Method

One gram of the herbal extract was mixed with 100 ml non-formaldehyde based resin and 2 g of $MgCl_2$ was added as a catalyst. Cotton fabric was dipped in the resin solution and padded through a pneumatic padding mangle. The treated fabric was dried at 80ºC for 5 minutes and cured at 120ºC for 2 minutes [6], [27]–[29].

V. Conclusion

Antimicrobial properties are very important for textile materials especially children's wear. Nowadays, almost all children' garments are finished with some antimicrobial finish. In this paper, various natural antimicrobial agents and their properties are explained. These natural antimicrobial agents are eco-friendly and available abundantly in India. The problem in these natural antimicrobial agent is the durability of the finishing. The durability can be increased by applying the finish in encapsulation method along with binders the crosslinking agents. These natural herbals can be used as an alternative for synthetic antimicrobial agents by applying the herbals in encapsulation method for increasing the durability.

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