International Journal of Applied Social Science ***RESEARCH PAPER***
Volume 5 (10), October (2018) : 1626-1633 ISSN : 2394-1405
Received : 06.08.2018; Revised : 19.08.2018; Accepted : 07.09.2018

Analysis of Anti-Bacterial Efficacy in Bamboo and Bamboo /Cotton Handloom Fabrics Finished with Selected Herbal Extracts

VINITHA PAULOSE*[1] AND I. JAYALAKSHMI[2]
[1]Assistant Professor (Research Scholar), Departmentof Fashion Designing, St. Teresa's College, Kochi, (Kerala) India
[2]Assistant Professor, Department of Costume Design and Fashion, Chikkanna Government Arts and Science College, Tirupur (T.N.) India

ABSTRACT

Substances which are considered anti-microbial have been used by man since ancient times for the protection and preservation of fabrics, which is one of the fundamental aspects in many of the textile applications today. These protective agents known as anti-microbial are fungi static, bacteriostatic and bactericidal. The anti-microbial agents also give special protection from different forms of textile rotting. Natural antimicrobial agents are environment friendly and can be safely used on textile materials. The study describes on the anti-bacterial activity of selected natural medicinal herbs on selected handloom bamboo and its blend materials, which exhibits a high zone of inhibition against micro-organisms.

Key Words : Bamboo, Bamboo blend material, Medicinal herbs, Anti-bacterial

INTRODUCTION

Textiles like agriculture have been an elementary part of the human need since the dawn of human civilization. Textile fabrics are made from natural as well as manmade or synthetic fibres. Textiles, in every stages of its production absorb many hazardous unwanted toxic chemicals. To reduce its contact, renewable resources are gaining popularity among the people due to their positive impact in agriculture, environment and economy states Kavitha and Christy (2014). In the 21st century, consumers around the globe demand for eco-friendly organic products.

The eco problems in textile industry start right from the manufacturing of the fibres to the making of the final goods. Pollution control is as important as making a product free from the toxic effect of chemicals. With regard to the clothing and textiles, ecology of production, ecology in the disposal of waste and also human ecology where the effect of textiles or apparels upon human skin should be the prime factors of concern in the present scenario. Kumari *et al.* (2013) is of opinion that textile industries globally should change their technology in the manufacturing processes so that eco-friendly materials are produced which will satisfy the customer needs.

"Eco textiles" refers to a select group of textiles that have reduced carbon, energy and pollution

How to cite this Article: Paulose, Vinitha and Jayalakshmi, I. (2018). Analysis of Anti-Bacterial Efficacy in Bamboo and Bamboo /Cotton Handloom Fabrics Finished with Selected Herbal Extracts. *Internat. J. Appl. Soc. Sci.*, **5** (10) : 1626-1633.

impact when compared to the standard methods used to produce textiles and manufacturing of clothing. Eco friendly fibres are those which are made with the minimum or no usage of chemicals and with a very low impact on the environment describes Sharma (2013). They are naturally resistant to mildew, moth and are also disease free. There are a number of fibres which can be considered as eco-friendly. Some of them are Organic cotton, Bamboo, Soy, Nettle, Milk, Aloe vera, Banana fibre, Pineapple fibre, Tencel and Recycled Polyester.

In the Chinese world Bamboo fibre is known as "Air Vitamin" or "long lived element". It contains anions which are very helpful in purifying blood, calming the nervous system, improving the allergic symptoms, which all helps in improving the health of the human body claims Munjal and Kashyap (2015). Bamboo is a hundred per cent natural cellulosic fibre. It is one of the fastest growing plants which grow without pesticides, fertilizers, herbicides and it requires only less water to grow. The fibre is completely biodegradable and is a solution for many of the environmental problems in the textile industry, as its generation and decomposition does not cause any harmful effects to the environment.

The bamboo fibre has a unique anti- bacterial and bio agent known as 'Bamboo Kun' states Jothilinkam *et al.* (2017). While the manufacturing of the bamboo fibre this is combined with bamboo cellulose and thus it works as a naturally anti- bacterial fabric with bacteriostatic and deodorant properties. Fabrics made from bamboo have many good properties like permeability, hygroscopibility, soft feel, which makes it an excellent eco- friendly fabric. When mixed with cotton or any other fibre, the properties of bamboo fibre get a boom which can be utilised for a variety of purposes.

Handloom weaving is one of the India's oldest traditions in the production of textile materials. The handloom weaving tradition preserves India's cultural heritage and provided employment to a large group of people. But in the present day, this sector is facing many challenges due to globalization and technological changes. Many of the handloom products are being replaced with powerloom products at a much lower cost. Maulik and Agarwal (2013) are of opinion that in order to create market demand for handloom products, product diversification is very much essential. The growing environmental consciousness of consumers has opened up many new interests in the field of clothing and textile like production of organic materials, application of functional finishes, dyeing of handloom fabrics all which will help in the production of goods value for the money.

Textile materials are incomplete without some properties or some properties can be improved in the textile substrates to make it environmental friendly and also to make it desirable for the consumers to use. Textile properties can be enhanced by giving suitable finishes which will improve the value of the fabric. Science today has come up with many eco-friendly textile processing methods like Plasma finishing, Enzymatic finishing, Finishing with natural products states Shrimali (2015). Now-a-days many textile industries are adopting cleaner and healthier technologies in the manufacturing of textile products.

Antimicrobial functional fabrics have become an important product now in the textile industry. The health and hygiene sector is vigilant over the rising concerns of various nosocomial infections. As textile materials have a wide surface contact area and good absorption qualities, there is an increasing chance for the materials to get infected with disease causing microbes. This in turn causes dermal infections, allergies, malodours and also the weakening of the fabric suggests Pinho *et al.* (2010). Therefore antimicrobial finishes are given to textile materials for overcoming various disease conditions and to enhance the properties of textile materials.

Antimicrobial agent present in the clothing will have a direct contact with skin of the wearer.

It will also directly affect any living organism found in the nearest environment. As antimicrobial agents are of many types like silver bases antimicrobials, triclosan based antimicrobials, which is important to produce an antibacterial material with an acceptable ecological performance.

Plants are known to possess various therapeutic effects which will help in healing common diseases. Sumathi (2017) is of opinion that these herbal antibacterial finishes are also eco- friendly when compared to synthetic anti- microbial agents like triclosan. Considering the importance of medicinal value of natural herbs, the present study focuses on the analysis of anti-bacterial activity of three selected herbs for giving antibacterial finishes on selected handloom bamboo fabrics.

METHODOLOGY

Selection of Yarns :

Bamboo is hypo-allergic, thermal regulating, pest resistant, lustrous and naturally anti- microbial. Bamboo fibres are renewable in nature and biodegradable. Bamboo is now consumed as a raw material for many textile applications states Tusief *et al.* (2015). Hence, hundred per cent bamboo yarn (100% B) was selected for the study. The fibre's natural antimicrobial characteristics and fast drying ability makes it a wonderful choice for many functional applications.

Selection of Blending Proportion :

The selected hundred per cent bamboo yarn was blended with cotton in the ratio of 50:50. So, 50:50 bamboo cotton blend yarn (50:50 BC) was also selected for the study.

Selection of Fabrication Method :

Handloom weaving was selected as the fabric construction technique for the study. The selected hundred per cent bamboo yarn (100% B) and 50:50 bamboo cotton blend (50:50 BC) yarns, were converted into material by handloom weaving, which comprises both warp and weft yarns of the same nature. Thus the following hundred per cent handloom woven bamboo (100% HB) and 50:50 handloom woven bamboo cotton blend (50:50 HBC), two fabrics were developed and taken for the study.

Selection of Herbs :

Medicinal plants have an important role in the treatment of modern medicine. They have been tested for biological, hypoglycaemic and antimicrobial activities and are considered as a safe drug for various common ailments advocates Pragadheeswari *et al.* (2016). According to Hassan (2012) one of the characteristics of medicinal plants is that it is used as a preventive medicine. Also the vital components present in medicinal plants will reduce the use of chemical remedies which in turn will help to prevent the appearances of some ailments.

Fresh healthy parts of *Rincinus Communis* (Castor plant), *Holoptea Integrofolia* (Indian Elm) and *Terminalia Chebula* (Myrobalan) were chosen for the study owing to the plants medicinal values. The castor plant has anti-inflammatory, wound healing, anticancer, antioxidant, anti-diabetic, antimicrobial, antifungal and insecticidal properties. The leaves and barks of Indian Elm or Indian beech tree are used as astrigents, anthelmintic, for rheumatism and for wound healing declares Khushboo (2013). In most of the Asian and African countries Terminalia Chebula is used as a popular medicine. Commonly known as Myrobalan, it has antibacterial, anti-fungal, anti-diabetic, and anti-viral and would healing properties. Hence the investigator has selected three medicinal

herbs namely *Rincinus Communis* (Castor plant)(RC), *Holoptea Integrofolia* (Indian Elm) (HI) and *Terminalia Chebula* (Myrobalan)(TC)which possess important medicinal properties for the study.

Preparation of Herbal Extracts :

The plant parts collected were dried in a temperature of 100 to 150 degree Celsius and were then stored in air tight containers. This avoids the breakage of important compounds and contamination of microorganisms. Calculated amounts of the selected herbal powder was taken separately and mixed into 80 ml of Ethanol and 20 ml of water in conical flasks, respectively. The flask was sealed and kept on a magnetic stirrer for 5 hours. The conical flask was incubated for 24 hours in room temperature. The supernatant was filtered using Whatman no: 1 filter paper and then evaporated to get a concentrated extract. The same method was used to collect the filtrates of herbal powder from the other two samples.

Selection of Herbal Combinations of the Three Selected Herbs :

Ethanolic extracts of the three selected herbs, *Rincinus Communis, Holoptea Integrofolia and Terminalia Chebula* were taken in two different ratios of 1:1:1 and 1:2:3, respectively and kept ready for finishing.

Preparation of the Sample :

The selected hundred per cent handloom woven bamboo fabric (100%HB) and 50:50 handloom woven bamboo cotton blend fabric (50:50 HBC) were de-sized and cut in a diameter of 2.5cm $\pm$ 0.1 cm. Tenrandom samples from each 100 %HB and 50:50 HBC were cut and treated to find the best herbal combination for finishing the bamboo fabric. The samples were sterilized with UV rays in a laminar air flow for 30 minutes .This was kept in sterile containers for further study.

Application of the Herbal Extracts to Selected Woven Bamboo Fabrics :

The herbal extracts of two different ratios were finished on to the selected bamboo 100% HB and 50:50 HBC fabrics by Dip Method. Ten random samples taken from each 100% HB and 50:50 HBC were cut and treated to find the best herbal ratio combination for the study.

The extracted herbal solvents were taken in desired ratio in a beaker. The two selected handloom samples namely 100%HB and 50:50 HBC were immersed in the desired ratio such as 1:1:1 for 30 minutes. The samples were removed from the solvent and dried on hot plate without washing. The samples were then sterilized in UV rays in the laminar air flow chamber to avoid microbial growth on the surface of the fabric. The same procedure was repeated for the herbal ratio 1:2:3. The treated samples were kept ready in sterile containers for further study.

The herbal combinations were analysed from randomly selected and treated ten samples of 100%HB and 50:50 HBC by evaluating their antibacterial activity. The antibacterial activities of the finished fabrics were measured qualitatively by Agar Diffusion Plate Test.

Agar Diffusion Test :

For testing the antimicrobial activity of the selected three herbs on the two handloom woven bamboo fabrics (100% HB and 50:50 HBC), the Agar Diffusion Plate Test was used .The test was mainly conducted to give an antibacterial finish to the selected two handloom fabrics. The assessment for anti-bacterial activity was carried out following AATCC Test method 147 (Qualitative Method).

The test was performed on two un-dyed original samples named as 100% OHB and 50:50 OHBC, which were kept as control and ten randomly treated samples such as 100% THB and 50:50 THBC. The treated 100% THB samples was named as 100% THB1, 100%THB2, 100%THB3, 100%THB4, 100%THB5, 100%THB6, 100%THB7, 100%THB8, 100%THB9 and 100% THB10. Similarly, for treated 50:50 THBC it was named as 50:50THBC1, 50:50 THBC2, 50:50THBC3, 50:50THBC4, 50:50THBC5, 50:50THBC6, 50:50THBC7, 50:50 THBC8, 50:50THBC9 and 50:50THBC10. The following procedure was followed for the study.

Preparation of Inoculums :

The test organisms selected for the study are *Escherichia coli* (Gram negative bacteria) and *Bacillus Subtillis* (Gram-positive bacteria). The above two strains of bacteria were inoculated into a sterile nutrient broth in a conical flask. The conical flask containing the bacterial samples was then incubated at 37 degree Celsius for 24 hours. The inoculums were then ready for the further process.

For the study, 100%THB1, 100%THB2, 100%THB3, 100%THB4, 100%THB5 and 50:50THBC1, 50:50THBC2, 50:50THBC3, 50:50THBC4, 50:50THBC5 was used to test gram positive bacteria (*Bacillus Subtillis*) and 100%THB6, 100%THB7, 100%THB8, 100%THB9 and 100%THB10 samples and 50:50THBC6, 50:50THBC7, 50:50 THBC8, 50:50THBC9 and 50:50THBC10 samples were used to test gram negative bacteria (*Escherechia Coli*) .

Preparation of the Culture Medium :

The desired grams of Agar was taken and mixed with the required grams of nutrient broth in 100 ml of distilled water. The culture medium was autoclaved for 15 minutes at 120 degree Celsius at a pressure of 15lb. The medium was then transferred into sterile petri plates and allowed to solidify. This nutrient agar was used as a substrate to grow the selected bacteria.

Procedure for Qualitative Antibacterial Inhibition :

Sterilized cotton swabs were dipped in the bacterial inoculums and were then swabbed on the surface of the Nutrients agar uniformly. The sterile dried herbal samples were then placed on the nutrient agar surface using a sterile spatula and forceps. The samples along with Nutrient agar petri dishes were incubated at 37 degree Celsius for 24 hours.

The plates were examined for the zone of inhibition around the fabric samples after 24 hours. The size of clear zone of bacterial growth around the control 100%OHB against its treated ten 100%THB samples for *Bacillus Subtillis* (gram positive bacteria) and *Escherichia Coli* (gram negative bacteria) and clear zone of bacterial growth around the control 50:50 OHBC against its treated ten 50:50THBC samples for *Bacillus Subtillis* (gram positive bacteria) and *Escherichia Coli* (gram negative bacteria) were evaluated, which was the inhibitory effect of the herbal extract. The zone of inhibition was measured which gives an assessment on how effective the herbal extract is against the action of micro-organisms.

RESULTS AND DISCUSSION

The results analysed are discussed and tabulated below:

Analysis of Antibacterial Activity :

From Table 1, it is clear that results of the Agar Diffusion Test, when compared with the

original and treated bamboo samples for the gram positive and gram negative bacteria, the original bamboo samples 100% OHB and 50:50 OHBC did not reveal any zone of inhibition. Further, the test results also confirm that the treated samples 100%THB and 50:50THBC shows a clear zone of inhibition which indicates that there is no inhibition of microorganisms. From the test results it is found that the antimicrobial activity is at its highest for all the five treated samples 100%THB and 50:50 THBC, respectively for the ratio 1:1:1, which contains all the herbs- *Rincinus Communis* (RC), *Holoptea Integrofolia* (HI) and *Terminalia Chebula* (TC) in equal proportion.

When the antibacterial activity is compared with *Escherichia Coli* (Gram negative) and *Bacillus Subtillis* (Gram Positive), it is observed that the activity against *Bacillus Subtillis* (Gram Positive) is more than that of *Escherichia Coli* (Gram negative).

When compared between the two selected ratios 1:1:1 and 1:2:3, the test results also confirm that the herbal extracts of the two ratios have a broad spectrum of activity against for all the samples, both gram positive and gram negative bacteria. The average results obtained from five treated bamboo samples for the anti-bacterial finish are presented in Table 1 and in Fig. 1, respectively.

Table 1 : Analysis of Herbal Extracts for Antibacterial Activity

Sr. No.	Combinations (RC) (HI) (TC)	Zone of Inhibition			
		Treated Samples			
		Escherechia Coli (Gram -ve)		Bacillus Subtilis (Gram +ve)	
	Ratio of herbs	100% Treated Handloom woven Bamboo (100%THB)	50:50 Treated Handloom woven bamboo cotton blend (50:50 THBC)	100%Treated Handloom woven Bamboo (100%THB)	50:50 Treated Handloom woven bamboo cotton blend (50:50 THBC)
1.	1:1:1	25	33	35	35
2.	1:2:3	25	25	30	35

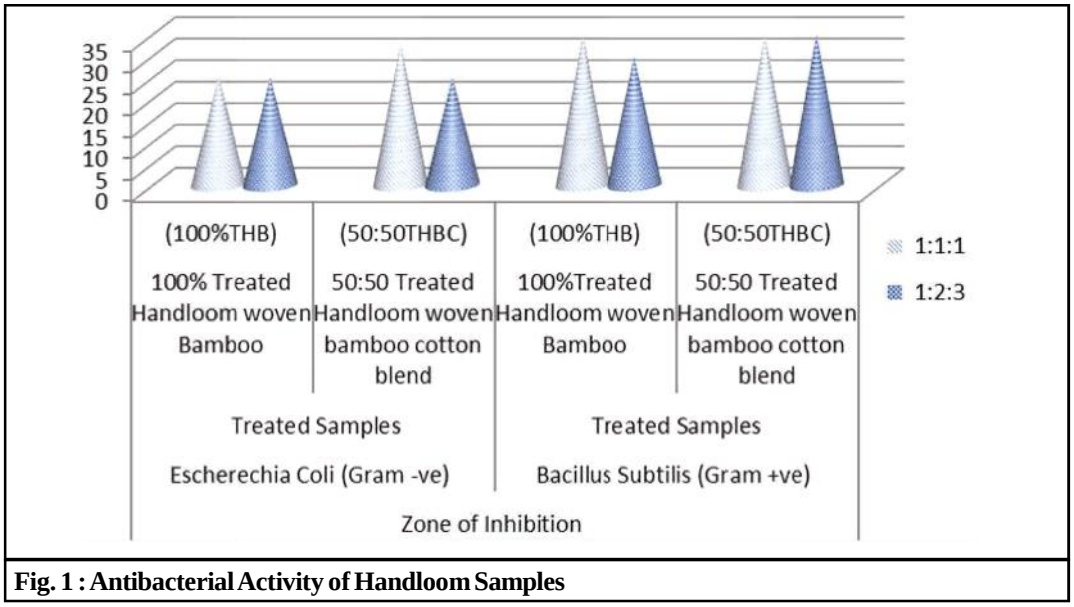

Fig. 1 : Antibacterial Activity of Handloom Samples

Conclusion :

Finishes given to textile fabrics have a large impact on the environment .The textile waste and

chemical wastes are important issues which the finishing companies face, in addition to water and air pollution. In order to avoid the waste and protect our environment, new finishes are being developed for textile fabrics. Herbal anti-bacterial finishes on fabrics are gaining momentum in the present day. Plants are found abundantly in nature which man always resorts to for treating various common ailments. Due to the eco-friendly nature of medicinal plants with its potential vital components present in them, many medicinal plants can be used to give anti-bacterial finishes to fabrics.

The use of natural finishing agents for textile fabrics ensures a safe and sustainable end product. Under this context the investigator selected eco-friendly bamboo yarn and blended it with cotton in the ratio of 50:50. The hundred per cent pure bamboo yarn and 50:50 bamboo cotton blend yarns were constructed into fabrics by handloom weaving technique. Of the many varieties of medicinal plants, the investigator selected three commonly available herbs, *Rincinus Communis* (Castor Plant), *Holoptea Integrofolia* (Indian Elm) and *Terminalia Chebula* (Myrobalan) for giving an antibacterial finish to the developed handloom fabrics. The anti-bacterial activity was analysed using Agar Diffusion Test with two strains of bacteria. The test results of herbal extracts in two different proportions showed a high zone of inhibition. The herbal ratio 1:1:1 also revealed best zone of inhibition at its highest in the study. Thus the study can be concluded that the herbal extracts of the three medicinal plants selected in equal proportion can be used to develop herbal anti-bacterial finished eco-fabrics for a healthier life.

REFERENCES

Christy, B.P. and Kavitha, S. (2014). Go Green Textiles for Environment. *Advanced Engineering & Applied Sciences: An Internat. J.*, **4**(3) : 26-28.

Gangola, S. (2017). India as the Heritage of Medicinal Plant and their Use. *Curr. Trends Bio Medical Engg. & Bio Sci.*, **4**(4) : 1-2.

Hassan, B. (2012). Medicinal Plants -Importance and Uses. *Pharmaceutica Analytica Acta*, **3**(10) :139.

Jothilinkam, M.D. and Ramachandran, T. (2017). A study of Overall Moisture Management Capability of Plasma Treated Bamboo/Cotton Blended Fabrics for Medical Applications. *Internat. Res. J. Pharmacy*, **8**(12) : 62.

Kumari, P., Jeet Singh, S.S. and Rose, N.M. (2013). Eco – Textiles: For Sustainable Development. *Internat. J. Scientific & Engineering Res.*, **4**(4) : 1379-1390.

Kushboo, S., Irchhaiya, R. and Dixit, V.K. (2013).Analytical and Medicinal properties of leaves of Holoptelea Integrifolia. *Internat. J. Drug Development & Res.*, **5**(3).

Maulik, S.R. and Agarwal, K. (2014). Painting on Cotton Handloom Fabric with Colourants extracted from Natural Sources. *Indian J. Traditional Knowledge*,**13**(3) : 589-595.

Munjal, K. and Kashyap, R. (2015). Bamboo Fibre:An Approach to Towards Sustainable Development. *Internat. J. Sci. & Res.*, **4**(4) : 1081.

Pinho, E., Magalhaes, L. and Henriques, M. (2010).Antimicrobial Activity Assessment of Textiles: Standards Methods Comparison. *Annals of Microbiology*, **6**(3) : 493-498.

Pragadheeswari, R. and Sangeetha, K. (2016). Herbal finishing for anti-bacterial property with Chromolaena Odorata Herb. *Internat. J. Home Sci.*, **2**(1) : 232-233.

Ramya, K. and Maheswari, V. (2013). Analysis of the Antimicrobial Efficacy of Bamboo/Cotton Knitted Fabric

Finished with the Extracts of the SyzygiumAromaticum Buds. *J. Textile Sci. & Engg.*, **3**(3) : 1-5.

Sharma, A. (2013). Eco-friendly Textiles: A boost to sustainability. *Asian J. Home Sci.*, **8**(2) : 768-771.

Shrimali, K. (2015). Eco-Friendly Textile Finishes: Finishes for Well-being. Textile value chain.com, December 2015.

Sumathi, S. and Thomas, A. (2017). Eco-friendly and Antibacterial Finishes of Organic Fabrics using Herbal Composite Micro capsules. *Internat. J. Pharma & Bio Sciences*, **8**(3) : 310-321.

Thangamani, K. and Periasamy, R. (2017). Study on Antimicrobial Activity of Cotton, Bamboo and Soyabean Fabrics with Herbal Finishing. *Internat. Res. J. Pharmacy*, **8**(5) : 115-119.

Tusief, M.Q., Amin, N., Mahmood, N., Ahmad, I. and Abbas, M. (2015). Antimicrobial Studies of Knitted Fabrics from Bamboo, Soybean and Flax Fibres at Various Blends. *J. Textile Sci. & Engg.*, **5** (3) : 1-4.

Uddin Faheem (2014). Environmental Concerns in Antimicrobial Finishing of Textiles. *Internat. J. Textile Sci.*, **3**(1A) : 6.

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