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**Dr. Santosh Hooda**  
Associate Professor,  
Dept. of Home science, BPS  
IHL, Khanpur Kalan (Sonepat),  
Haryana, India

### Bio-processing and herbal treatment on textile: A route to sustainability

**Dr. Santosh Hooda**

#### Abstract

Sustainability is the necessity of the present scenario. This paper highlights the major processes of textile industry which leads to environmental degradations. Clothing and textile industry is accused of being the most polluting industry. The problem of pollution in textile industry arises especially through wet processing. It is a complex process, which depends on the raw textile material and other reagents used. Textile industry is chemically intensive industries which is harmful to the environment. So, new efficient technologies of fabric wet processing are required, which are cost-effective and have less harmful impact on the environment. During scouring, bleaching, dyeing and finishing processes the consequent fabric creates toxics and lead to environmental pollution. So it is very essential to check the environmental pollution during the wet processing and make the process eco-friendly. Textile industry is committed to produce herbal treated textiles towards sustainability. So the wet processing is made environmental friendly using enzymes and plants like enzymatic desizing and bioscouring, enzymatic bleaching, bio-polishing, herbal dyeing and herbal finishing. The plants used for processing are easily accessible in India. For a sustainable textile, it has to be made from renewable resources like plants and enzymes. These enzymatic and herbal treated fabrics showed good results and accordingly products were made. This paper reviews all the bio processes and herbal treatments which are done on the fabric and various utility products accordingly.

**Keywords:** bio-processing, herbal treatment, sustainability, enzymatic scouring, herbal finishing.

#### Introduction

Indian Textile industry contributes more in Indian economy and employment generation followed by the agriculture industry but textile industry is facing remarkable environmental and recourse challenges. It is also accused of being the most polluting industry and most chemically intensive industry. Some chemicals are carcinogenic and have allergic reactions which may affect the health. Textile industry releases the effluent full of chemicals such as formaldehyde, chlorine, heavy metals like lead and mercury which are significant causes of environmental degradation. The ever-growing costs for water and energy, global researches were carried out to replace the conventional chemical textile processes by eco-friendly bioprocesses using enzymes and herbs. As a result, at international level there is a need of eco-friendly production processes and technologies in favour of environmental sustainability.

The world Commission on Environment and Development defines sustainable development as 'meeting the needs of the present without compromising the ability of future generation to meet their needs and desires'. In modern times sustainability is a primary attribute of clothing and textile goods. So there is a need to adopt the eco-friendly raw material and wet processes so that we can meet the environmental sustainability.

With growing environment awareness, people and industries are turning towards eco-friendly products. Scientists and Researchers are finding novel ways to find solutions by proposing natural herbal extracts for finishing and dyeing of fabrics. Along with the herbal treatment, bio-processing is also the need of the hour in favour of environment. Bio processing is the application of living organisms on fabric and production processes, which are mainly based on enzymes. Enzymatic desizing, enzymatic scouring, enzymatic bleaching and bio-polishing are the examples of bio-processing.

**Corresponding Author:**  
**Dr. Santosh Hooda**  
Associate Professor,  
Dept. of Home science, BPS  
IHL, Khanpur Kalan (Sonepat),  
Haryana, India

### Enzymatic scouring

Enzymes are the substitute of the conventional chemical textile processes in favour of safe guard of environment. They are best alternate of harsh chemicals used in the textile industry as they are biologically degradable and pollution free.

Michelle and Hsieh (1998) <sup>[10]</sup> studied the application of different enzymes like pectinase, cellulase, protease, and lipase to scour the cotton and wool fabric in order to improve the wettability. They found that when enzymes were used individually results were satisfactory but when used in combinations they showed very good results. When cotton fabric was scoured with pectinase and cellulose enzymes simultaneously then wetting properties of treated fabric increased as similar to the chemically treated fabric. It showed that pectinase treated cotton improved wettability when fabric is pre-treated with 100°C water. Enzymatically scoured fabrics were also found dimensionally stable with minimum weight loss.

Kiro Mojsov (2012) <sup>[7]</sup> reported that bio-scouring process boosts the absorbency of the fabric without hindering the property like strength loss and also assists dyeing and finishing of the fabric with better results. When the bio-scoured fabric was compared with chemically scoured fabric it was observed that Enzymatic scouring required less energy, water, chemicals and times compared to the chemical scouring process.

### Enzymatic desizing

The Worldwide awareness concerning the sustainable development and need to cope with it had led the industries to adopt eco-friendly processes. Enzymatic desizing is an effective replacement approach for the chemical-based desizing processes and is commercially successful. Research shows that Amylase converts the water insoluble starch in to the soluble one which is washed away from the fabric during washing and enhances the performance of the fabric. This process is eco-friendly and efficient in wide range of temperature.

According to Bipin and Agrawal (2016) <sup>[3]</sup> the performance of the enzymatically desized fabric towards dyeing, printing and finishing is improved.

Aly Sayed (2010) <sup>[1]</sup> studied and reported that desizing of cotton fabric with  $\alpha$ -amylase and polygalacturonase showed very good results regarding the parameter of fabric like weight loss, violet scale shades, residual starch in fabric, tensile strength, and wettability of the fabric.

### Enzymatic bleaching

Enzymes saves water, energy, chemicals and shorten bleaching process cycle to make the process eco friendly and give the whiteness equal to chemically bleached goods. Enzymatic bleaching is the best alternate of bleaching the textile goods which is based on non-toxic and eco-friendly process.

Buschle-Diller Gisela *et al.* (2001) <sup>[4]</sup> studied that cotton fabric was desized, scoured and bleached with amyloglucosidase, pectinase and cellulose enzymes. All three preparatory processes were combined. Different parameters of treated fabric like whiteness, water absorbency and tensile strength were evaluated and concluded that treated fabric had excellent whiteness very close to the whiteness equal to commercially bleached goods and very good mechanical properties. Requirement of water for rinsing the fabric was also reduced.

A S M Raja *et al.* (2017) <sup>[13]</sup> studied that enzyme based single

bath scouring and bleaching process was carried out using neutral pectinase and cellulase enzymes individually and also in combination. The result showed that like conventional scouring and bleaching processes the enzymatic process with a combination of pectinase and cellulase produces required parameters for the cotton fabric. The weight loss of treated fabric was found 18% less as compared to conventional process without any change of whiteness index and absorbency. The developed process is eco-friendly which saves the natural resources essential for sustainable development without any change in physical and chemical properties of fabric.

### Bio-polishing

It is a biological process in which enzymes are applied on the surface of the fabric to improve the fabric quality. Usually cotton fabrics have minute loose fibers and yarns on the surface, which entangled with each and cause the pilling on the fabric and give the appearance of old fabric. Bio-finishing is not only useful for cotton but also beneficial for regenerated cellulose fabrics. The purpose of bio-polishing is to remove the fibre ends protruding from the yarn surface and thereby reduces the hairiness or fuzz of the fabrics of cotton through the hydrolysis action of cellulase enzyme. Bio-polishing is a finish which helps to improve the texture and appearance of fabrics. Raghav Bhala *et al.* (2012) <sup>[12]</sup> reported that bio-polishing increase the fabric softness, appearance and feel of the fabric.

According to S K Laga (2010) <sup>[8]</sup> when cotton fabric is treated with a cellulase enzyme for surface improvement and found that the fabric surface becomes smooth and soft. There is loss in fabric strength relative to the amount of weight reduction.

### Herbal Dyeing

Natural dyeing of textile was in progress from the early time by the traditional dyers. At global level textile industries are favoring the use of natural dyes for protecting the environment from pollution and ecological imbalances. Herbal dyeing is carried out entirely with herbal extractions, without using any chemical. These are the vegetable dyes which come from different parts of plant like root, stem, bark, leaves, flower and fruit. They also have medicinal value and no chemical is used while dyeing.

Gyanendra Tripathi *et al.* (2015) <sup>[5]</sup> studied the application of *Pomegranate and Marigold* flower extract on cotton/synthetic fabric as herbal dye and were tested for washing fastness, rubbing fastness, light fastness. It was seen that dyed fabric shows good results with CuSO<sub>4</sub>, FeSO<sub>4</sub> used as a mordant in dyeing process.

Sumithra (2018) <sup>[16]</sup> studied that cotton fabric was dyed with *acacia catechu* using the pomegranate and myrobolan as natural mordants. Dyed fabric gives the brilliant result after herbal application in fabric.

Taame Berhanu Teklemedhin (2018) <sup>[17]</sup> studied the application of natural dye with natural mordant extracted from *Cassia singueana* plant and mango bark respectively. Dyeing was carried out in different concentrations of extracted dye solution. It was seen that dyed samples showed excellent fastness to washing, rubbing and light fastness.

Ms. Pooja Kumari (2016) <sup>[11]</sup> studied the colouring performance of *kalanchoe pinnata* herbs on wool fabric. This herb show good affinity of dyeing towards wool fabric. The natural mordants like dry goose berry powder, harda powder, orange peel powder along with the chemical mordants i.e. alum, ferrous and copper sulfate were used in dyeing. Dyed

fabric was tested for colour strength and fastness properties. It was concluded that a broad colour range in yellow-green region with excellent fastness properties was obtained.

Jyothirmai and Sasmita (2016) <sup>[6]</sup> carried out a research on Ayurveda i.e. textile with medicinal properties. A new technology developed by the directorate of handloom and department of industries, India, with a vision of giving medicinal value to the fabric known as ayurveda. Around 200 herbs are used to attain various colors on vastra like turmeric, heena, tulsi, amla, neem etc. These herbs showed the good results regarding the coloring agent, antimicrobial and anti-allergic properties on textiles.

### Herbal Finishing

Any process which is applied on the fabric surface to improve the appearance, physical and functional properties of the fabric is finishing. Eco-friendly fabric finishing is the need of the society due to health and environment concern. Fabric finishing with natural products is gaining high popularity in these days. Finishing of textiles with herb and plant extracts have great medicinal value. Various functional properties of the fabric like anti-microbial, fragrance, anti-allergic and wound-healing, etc. can be incorporated in the fabric by the application of herbal extracts.

Different studies are focusing on developing antibacterial finishes using natural herbs. Sumithra (2018) <sup>[16]</sup> studied the application of Acacia catechu extract with natural mordants pomegranate and myrobalan on 100% cotton fabric. After dyeing the fabric was finished with three herbal extracts of *Tridax procumbens*, *Plectranthus amboinicus* and *Mentha piperita*. The finished fabric was tested against Gram positive and Gram negative bacteria and showed excellent result to protect the skin infections and fungal growth.

M P Sathiyarayan (2010) <sup>[14]</sup> studied that plant extract (Tulsi leaf and pomegranate) used for textile application by the method of direct application and microencapsulation showed good antibacterial properties on fabric. Treated fabric also showed that there was no significant change in tensile strength and crease recovery of the fabric.

Wasif and Rubal (2007) <sup>[18]</sup> also reported that a cotton woven fabric treated with Aloe vera extract at different concentrations in the presence of eco-friendly cross linking agent by pad-dry-cure method shows significant reduction in bacterial colony.

M Joshi *et al.* (2009) <sup>[9]</sup> studied and reported that neem extracts have been broadly used in herbal pesticide formulation and applied on fabric. Finished fabric showed good pest repellent properties and also has a potential to inhibit growth of bacteria both gram positive (*Staphylococcus aureus*) and gram negative (*Escherichia coli*).

Specos *et al.* (2010) <sup>[15]</sup> studied the application of citronella oil on cotton fabrics for mosquito repellent effect. The finish was applied with microencapsulation technique and it was concluded that microencapsulation of finish by pad-dry-cure method gives good results. Banupriya and Maheshwari (2013) <sup>[2]</sup> reported that the fabric treated with extract of *Rosa Damascena* flower for aroma finish found to be odourless, very hygienic with less fungi and bacterial growth.

### Conclusion

Bio-processing and herbal treatments are gaining importance in the consumer market. Bio-processed and herbal treated textiles are Sustainable textiles because they are grown and created in an environmental friendly way using minimal or no chemicals. It is very important for the society to check

pollution and save the environment for the ultimate goal of sustainable development. Therefore the textile industry is gradually becoming aware of it and efforts are being initiated in the production process of textiles.

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