RESEARCH REVIEW JOURNALS
Volume-04
Issue-03
March-2019

ISSN: 2455-3085 (Online)
RESEARCH REVIEW International Journal of Multidisciplinary
www.rrjournals.com[UGC Listed Journal]

A Study on Eco Friendly Production and Processing of Textiles

Shikha Bajaj

Assistant Professor, Department of Fashion Designing, Guru Nanak Khalsa College for Women, Ludhiana (India)

ARTICLE DETAILS

Article History
Published Online: 13 March2019

Keywords
Chemicals, Eco friendly, Environment, Harmful, Natural.

ABSTRACT

At this immensely growing fashion industry and vastly spread textile business, larger focus of the organizations go on profits, meeting consumer demands and having a place in the global trade. Under this scenario, the concern of environment and future generations somehow lags behind and is lesser addressed. Textile industry is the most ecologically harmful industry in the world. Present paper focuses on harmful effects of chemicals used in processing of textiles and their alternatives which can be produced and utilized instead. Ecofriendly fibres and dyes do not have any adverse effect on ecosystem and lead to a cleaner, healthier climate and way of living.

1. Introduction

Use of harmful chemical during processing and finishing of textile materials lie in the roots of textile industry. Largely used alkylphenol compounds including nonylphenols and octylphenols and their ethoxylates, particularly nonylphenol ethoxylates are highly suffocating for aquatic life and pollute the environment to a large extent [(1)]. Increasing environment consciousness in textile processing has forced research and development. The society demands for fibres and fabrics which have been processed by eco friendly methods. Problems related to toxicity and other health hazards have resulted in replacement of chemical processing by more eco friendly physical methods[(13)].

2. Objective

- In the present paper, author has intended to focus on hazards arising due to chemical pesticides used in fibre processing.
- It throws light on the alternatives of harmful chemical which can be safely utilized for textile processing.

3. Processing of textile materials

Textile processing means preparation of natural and manmade fibres. It involves mechanical process such as carding, spinning, weaving, knitting or tufting. The processes which mainly take place in aqueous media, such as the pretreatment, colouring and the finishing of the fibres, yarns and fabrics are also included[(7)].

4. Problems due to cotton pesticides in Punjab

Eight districts of Malwa's cotton belt, Bhatinda , Moga, Ferozpur, Muktser, Mansa, Faridkot, Barnala and Sangrur are worst affected by cancer. According to a study conducted by PGIMER, pesticide reduces are affecting 23% of people living in rural areas of the state's cotton belt [(3)].

5. Eco friendly production and processing of organic cotton

Cotton which is grown without the use of nay synthetic chemicals i.e. plant growth regulators, defoliants and fertilizers is considered 'organic' cotton. Organic cotton production means not only the absence of organic, synthetic fertilizers and pesticides but it involves very careful planning of the whole farming system. In general, organic cotton is grown using methods and materials that have low impact on the environment with the organic production systems replenishing and maintaining soil fertility reducing the use of synthetic pesticides, fertilizers and building a biologically diverse agricultural system [(11)].

1. Approach towards organic cotton:

The systemic approach aims to establish a diverse and balanced farming ecosystem which ideally includes all types of crops and farm activities, farmers need to complete a two year conversion period to change Soil fertility management and crop nutrition are based on crop diversification and organic inputs such as composts, mulch and manures. Pest management measures focus essentially on pest prevention and the stimulation their production system from conventional to organic. An essential element of organic production is the careful selection of varieties adapted to local conditions in terms of climate, soil, robustness to pests and diseases [(19)]. Organic cotton production uses natural chemical like sulphur dust and other biological control agents in pest management and organic acid based foliar sprays, such as citric acid, nitrogen and zinc sulphate in harvest preparation [(2)].

Biotech cottons containing Bt or artificially introduced genes, are not allowed to be used for the production of organic cotton- the general reason being that the technique is currently considered synthetic gene manipulation, not natural [(11)].

2. Manufacturing organic cotton:

At each manufacturing step, organic clothing manufacturers do not add petroleum scours, formaldehyde, anti-wrinkling agents, chlorine bleaches or other unauthentic materials. Natural alternatives such as natural spinning oils that biodegrade easily are used to facilitate spinning: potato starch is used for sizing, hydrogen peroxide is used for bleaching, low impact dyes and earth clays are used for colouration, natural vegetable and mineral inks and binders are used for printing on organic cotton fabrics. These natural alternatives are used to reduce and eliminate the toxic consequences found in conventional cotton fabric manufacturing [(12)].

RRIJM 2015, All Rights Reserved

3. Pest management for organic cotton

The organic approach adopts completely different approach. The aims is first and foremost to prevent pests from even becoming a problem by establishing a diverse and balanced farm ecosystem and monitoring pest populations carefully. Organic pest management strategies include:

i. **Crop rotation**: Monocultures provide potential cotton pests with abundant food sources, causing their population to increase rapidly. Furthermore, the use of pesticides against major pests can result in secondary pests (internal link) becoming a problem. Crop rotation, however, helps to keep pests at a low level by establishing a natural balance.

ii. **Mixed cultivation**: It has a similar effect to crop rotation but on a smaller area within the same cultivation period and the same field.

iii. **Promotion of natural enemies**: It is not using pesticides and diversifying crops benefits natural enemies of cotton pests such as birds, ladybirds, beetles, spiders, parasitic wasps, bugs and ants. They help the farmer keep pest attacks at tolerable levels proving suitable habitats for natural enemies such as ladybirds or lacewings can help to increase and establish their populations.

iv. **Trap crops**: Some cotton pests prefer crops like maize, sunflowers, okra, sorghum or pea to cotton. By growing these crops alongwith cotton as a trap crop, the cotton crop is spared. In Tanzania, experience has shown that sunflower is an efficient trap crop for the American ballworm. In West Africa, the use of okra as a trap crop shows satisfying results in fighting ballworms and cotton pests. In addition to their positive impact in terms of pest control, these crops can be harvested and thus continued to diversify production systems [(9)].

v. **Natural pesticides**: If preventive measures are not sufficiently efficient and pest population exceeds an economic threshold, a number of natural pesticides can be used in organic cotton cultivation. Some of these are neem spray, prepared from the neem kernels extract, effective against sucking pests, liquids extracts of chrysanthemum, effective against red cotton bug, cutworms, grasshoppers, botanical mixtures, combination of extracts from different plants such as castor, thorn apple, custard apple.

4. Limitation of organic cotton production

According to the survey undertaken by the Organic fibre council in 2002, the main problems of organic cotton producers are weed management in the absence of herbicide use, defoliation (due to the prohibition of herbicides) and insect control. Some farmers also complain about absence of seed treatment, which is not permitted in organic certification.

5. Benefits of organic cotton

- Balanced ecosystem, enhanced health and social sustainability
- Improved access to market
- Traceability, risk and quality management
- Clear standards and labels

6. Standards and certification of organic cotton

Organic cotton has the powerful advantage of following internationally recognized organic farming standards that are enshrined in law. In India, Indian Standard for Organic textiles (ISOT)

This regulation provides the basis for the sustainable development of organic production while ensuring the effective functioning of the internal market, guranting fair competition, ensuring consumer confidence and protecting consumer interests.

6. Naturally coloured cotton

Naturally colored cotton is unique and exceptionally different from white cotton as it does not need to be dyed. It has been bred to have colors other than the yellowish off-white typical of modern commercial cotton fibres. Colors grown include red, green and several shades of brown. The cotton's natural color does not fade. Yields are typically lower and the fiber is shorter and weaker but has a softer feel than the more commonly available "white" cotton.

Naturally colored cotton is believed to have originated in the Americas around 5000 years ago in the Andes [(4)].

1. Natural Colouring

Natural color in cotton comes from pigments found in cotton plant and produce shades ranging from tan to green and brown. Naturally pigmented green cotton derives its color from caffeic acid, which is deposited in alternating layers with cellulose around the outside of the cotton fiber. Brown and tan cottons derive their color from tannin vacuoles in the lumen of the fiber cells [(14)].

2. Commercial cultivation

A new arrival on the Western fashion market, naturally pigmented cotton originally flourished some 5,000 years ago. Its revival today draws on stocks first developed and cultivated by Indians in South and Central America. Commercial cultivation still continues in South America as many big US companies are buying naturally grown cotton along with white cotton [(6)].

3. Advantages of coloured cotton

There is experimental evidence to demonstrate that naturally pigmented cottons, especially green cotton, have excellent sun protection properties, when compared with unbleached white cotton that needs to be treated with dyes or finishes to obtain similar properties. It is hypothesized that the pigments in naturally pigmented cotton fibers are present to provide protection from ultraviolet radiation for the embryonic cotton seeds, however they can also provide protection from the sun's harmful rays for consumers who wear garments manufactured from these naturally pigmented fibers [(14)].

7. Eco friendly production and processing of natural dyes

1. Potential sources of natural dyes

Natural dyes are derived from natural resources and based upon their source of origin, these are broadly classified as plant, animal, mineral and microbial dyes, although plants are the major sources of natural dyes [(16)]. A brief account of the

RRIJM 2015, All Rights Reserved

potential dye resources according to their source of origin is listed in table 1.

Table 1: Classification of natural dyes

SOURCE/ ORIGIN	NAME	PART USED	COLOUR OBTAINED
Plant	Indigo	Leaves of Indigofera plant	Blue
	Madder	Roots, stems and other parts of plant	Red
	Turmeric	Rhizomes of turmeric	Yellow
	Ratanjot	Roots	Red
	Henna	Leaves	Orange
	Arjun	Bark	Brown
Animal	Cochneal	Insects of species called Dactylopius coccus	Crimson red
	Lac	Hardened sectretions of Kerria Lacca	Red
Mineral	Red ocher	Mixture of iron oxide and clay	Yellow-brown

Source: (Saxena and Raja 2014)[16]

2. Production techniques for natural dyes

Unlike synthetic dyes, which are synthesized from chemical precursors, natural dyes are mostly obtained from various plant parts. In order to make them suitable for textile dyeing purposes and to make them available throughout the year, these are subjected to some processing operation. Collected plant materials are first dried, either in shade or in a hot air dryer at a low temperature to reduce their water content. Many materials can also be sundried. Dried material is then powdered. These powdered and dried materials in the most cases can be stored in airtight bags and containers for the least a year and can be used for dyeing whenever required. Storage under nitrogen can further prolong their shelf life. However these powders are unsuitable for use in various dyeing machines [10].

3. Extraction methods

i. **Aqueous extraction**: In this method, the dye containing material is first broken into small pieces or powdered and sieved to improve extraction efficiency.

ii. **Acid and alkali extraction process**: The addition of acid or alkali facilitates the hydrolysis resulting in better extraction and higher yield of colouring materials.

iii. **Ultrasonic and microwave extraction**: When the natural dye containing plant materials is treated with water or any other solvent in the presence of ultrasound, very small bubbles or caviations are formed in the liquid. These increase in size but upon reaching a certain size, they cannot retain their shape. When this happens, the cavity collapses or the bubbles burst creating high temperature and pressure.

iv. **Enzyme extraction**: As plant tissues contain cellulose, starches, pectins as binding materials, commercially available enzymes including cellulase, amylase, and pectinase have been used by some researchers to loosen the surrounding material leading to the extraction of dye molecules.

v. **Solvent extraction**: Natural colouring matters depending upon their nature can also be extracted by using organic solvents such as acetone, petroleum, ether, chloroform ethanol, methanol [5].

4. Application of natural dyes

The process for the dyeing of textiles with the natural dyes differs from the synthetic dye application process because only some natural dyes can be applied directly to textiles. In most of the cases, the dye is not substantive to the fibre on which it is being dyed, therefore an additional step of mordanting is involved making it a two step process.

- **Mordanting**: Textile fibres especially cellulosic, don't have much affinity for the majority of natural dyes, hence these are subjected to an additional step known as mordanting. Mordants are the substances that have affinity for both textile fibres and dyes, thus they act as link between the fibre and dyestuff.
- **Dyeing**: As the dye content of raw material is low, it is common to use 10-30% shade whereas the amount can be reduced to 2-5% for purified dye extract. There may be different optimum temperature, time, and the pH of dyeing but the basic steps remain the same [15].

5. Advantages of natural dyes

- Natural dyes are considered to be ecofriendly as these are obtained from renewable resources as compared to synthetic dyes which are derived from non renewable petroleum resources.
- These are biodegradable and residual vegetable material left after extraction of dyes can be easily composited and used as fertilizer.
- Many of the natural dyes absorb in ultraviolet region and therefore fabrics dyed with such dyes should offer good protection from ultraviolet light.
- Fabrics dyed with natural dyes have been reported by the wearers to be free of odour perhaps due to antibacterial and bacteriostatic properties of natural dye materials [18].
- Many natural dyes such as turmeric and sunflower among other poses curative properties and have been used in various traditional medicinal system.
- As natural dyes are biodegradable and complex chemicals, auxiliaries and extreme pH conditions are

RRIJM 2015, All Rights Reserved

not used in dyeing process, effluent produces during their uses is considered to be easily treatable and inexpensive. Elaborate effluent treatment plants needed for synthetic dyes are not required in this case [8].

6. Limitations of natural dyes

- Tedious application process
- Limited shade range is available
- Non reproducible shades
- Only a few natural dyes pose fastness properties confirming to modern textile requirements.

Table 2 Comparison of natural and synthetic dyes

	Natural dyes	Synthetic dyes
Source	Natural sources- Plant, animal or minerals	Organic compounds
Intensity and Brilliance	Achieved by mixing different mordants, manipulating the PH of the dye baths	Recent developments in synthetic dyes does not need mordanting to produce fast colours
Price	Scarce and expensive	low cost
Health and Wellness	Skin friendly, many natural dyes are bacteriostatic or curative also	May carry toxic residuals, or the dyeing process may involve use of toxic materials
Effluent	No toxic effluent produced, expensive treatments not required	Toxic effluents produced, expensive ETPs required to treat
Application process	Tedious	Mostly simple, varies from dye to dye
Colours	Limited shades	Vast range of shades
Reproducibility	Non reproducible	Reproducable
Colour fastness	Low	High (although varies from dye to dye)
Disposal	Biodegradable	Non biodegradable

Source: (Weber *et al* 1992)[17]

8. Conclusion

For a textile to be sustainable, it has to be made from a renewable resource, it has to have a good ecological footprint. Looking at the present scenario of ecological imbalance, use and promotion of ecofrindly textile materials must be counted on. Meanwhile, researches and exploration of new sources for dyes and organic processing techniques can certainly help in recovering issues faced by textile industry. Shade range of natural dyes for good fastness properties can be achieved; however, extensive research on the safety of these materials to humans and environment would be needed before propagating their usage as everything of natural origin may not be safe.

References

1. Anonymous (2012) Hazardous chemicals in clothing Retrieved from http://www.greenpeace.org/eastasia/campaigns/toxics/science/eleven-flagship-hazardous-chemicals/ on 16.3.19.
2. Carr C M (1995) *Chemistry of Textile Industry* Pp 157-280 Blackie academic & professionals.
3. Central Ground water Board (2014) Water quality issues and challenges in Punjab Retrieved from http://cgwb.gov.in/WQ/Punjab%20Book%20Final%20for%20Printing.pdf on 18.3.19.
4. Cegarra J Puente P and Valldeperas J (1993) *Dyeing, Printing, Finishing* P 45 The Textile Institute.
5. Geetha B and Sumathy J (2013) Extraction of Natural Dyes from plants 1. 502-509.
6. Gillow J (1993) *Traditional Indian textiles* P 34 Thames and Hudson.
7. Gupta and Kothari (1997) Manufactured Fibre Technology DOI: 10.1007/978-94-011-5854-1.
8. Krizova H (2015) Natural dyes: their past, present, future and sustainability.
9. Lapidot M and Polston J E (2014) Control of Plant Virus Diseases *Advances in Virus Research* 90:147-206.
10. Mansour R and Yusuf M (2018) *Natural dyes and pigments* Handbook of Renewable Materials for Coloration and Finishing. 75-102. 10.1002/9781119407850.ch5.
11. *Menezes E 2019 Organic cotton processing* Retrieved form fibre to fashion.com on 18.3.2019.
12. Michael (2007) Cotton; facts Behind the fiber Retrieved form *Organiclothing.bogs.com* on 18.3.19.
13. Periyasamy A P, Rwahwire S and Zhao Y (2019) *Environmental Friendly Textile Processing* Handbook of ecomaterials 1551-1558.
14. Saif (2015) Naturally coloured cotton Cotton news Oc tober 8/.
15. Samanta A K and Agarwal P (2009) Application of Natural Dyes on Textiles. *Indian Journal of Fibre & Textile Research* 34: 384-399.
16. Saxena S and Raja A S M (2014) Natural Dyes: Sources, Chemistry, Application and Sustainability Issues *Central Institute for Research on Cotton Technology 38-78.*
17. Weber P C, Wendoloski J J, Pantoliano M W and Salemme F R (1991) Crystallographic and thermodynamic comparison of natural and synthetic ligands bound to streptavidin *J. Am. Chem. Soc.*, 1992, 114 (9), pp 3197–3200 DOI**:** 10.1021/ja00035a004.
18. Wells K (1997) *Fabric Dyeing and Printing* P 14 The Textile Institute.
19. *Yu C (2015) Natural Textile Fibres Textile and Fashion.*

RRIJM 2015, All Rights Reserved