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STANDARDIZATION OF DEGUMMING FOR ERI SILK: AN EFFECTIVE ECO FRIENDLY PROCESSING TECHNOLOGY

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ABSTRACT

India is the only country in the world which produces all varieties of silk namely mulberry, Tussar, Eri and Muga and ranks second largest producer of both mulberry and non mulberry silks next to Chaina. Both fibroin and sericin are protein in nature; the treatment necessary to remove sericin from fibroins tends to hydrolyze both proteins. To address this problem, enzymatic treatment was suggested to remove sericin in place of conventional soap soda treatment. Proteases improved the degumming efficiency. Soft feel and maximum weight reduction were possible without affecting the fiber strength and hairness. Concentration level of 3% enzyme and 3% soda was selected for degumming of eri silk. At this particular concentration levels there was increased whiteness of the yarns from yellow. As the fiber production is increased, it has become necessary to develop process that helps in improving its value chain. Hence the present study was taken up with an objective of developing eco friendly finishing for eri silk to promote its value chain.

Introduction

The history of silk traces back more than seven thousand years. It was a trade secret for centuries and the trade route to Europe from Asia was popularly called as the “Silk route”. Chaina is the still the fore most in the terms of quantum of silk production followed by India

with production averaging about 80,000 tons per annum. India has unique distinction of producing all the four varieties of silk mulberry, eri, tussar and muga.

Eri and muga are the native silk varieties of Assam. In Arthasastra, Kautilya mentioned that several regions of ancient Kamarupa (Assam) had produced three varieties of silk fabrics, viz, Dakula, Khauma and Patrorna. Historians have identified Dhakula as muga (*Antheraea assama*). Khauma as Eri (*Philosamia ricini*) and Patrorna as patar or patta (*Bombax mori*) (Baishya, 1998). William Roberson revealed that plantation of mulberry was taken up by only few families and the grandees, every cultivator had a patch of land in his homested, full of *Ricinus Communis* (Castor) for rearing eri, the fabric of the common.

The word eri is derived from the castor plant, in Sanskrit i.e. eranda. Castor leaf is the main food for the eri silk worms and so named as eri. It is also known as endi or errand. Eri is a multivoltine silk spun from open ended cocoons, unlike other varieties of silk. Eri culture is a house hold activity practiced mainly for protein rich pupae, a delicacy for the tribals (Saratchandra B, 2003).

Now, eri silk is grown in the other parts of the country, in which Andhra Pradesh is striving forward very fast. Eri silk cultivation has been initiated in Andhra Pradesh in recent years due to the suitability of its climate and also abundant availability of host plants. The tribes were trained in eri silk worm rearing and production is initiated. At present efforts are being made by government to initiate spinning unit, better market abilities of eri within the state.

Eri silk is cotton like fiber obtained from eri silk cocoons. Eri silk is unique in its characteristics. It is lustrous fibre that behaves like cotton, with warmth and bulkiness of wool (Kariyappa, 2006). It has natural off white colour that provides aesthetic appeal. Eri silk can be dyed in different shades. It is the only silk which is drawn without killing the pupae and hence qualifies as most eco friendly and 'ahimsa silk' among other varieties of silk. Besides eco-friendly, Eri silk possess certain medicinal properties. Eri is silk friendly and it is best suited for hosiery and apparels and may replace the synthetics that cause itching and other skin diseases.

According to Joy Oommen, Member secretary and CEO, Central Silk Board (2004), 'Eri worm rearing is easier than mulberry silk worm rearing as it is less diseases ridden, requires less

area of cultivation. Tapioca (Cassava) and Kesseru plants, are very easy to cultivate and can be grown anywhere in the country. These plants can be cultivated inter crops of other crops'.

Even through eri silk farmers in Andhra Pradesh are able to produce eri cocoons in sufficient quantities; the processing has not been taken up in Andhra Pradesh. Therefore processing of eri silk and promotion of eri textiles are necessarily be taken up with immediate effect to increase the demand for these products. As standard procedures of degumming, dyeing and further processing are not available to the optimum level, need to be established at present. Enzyme degumming with proteases carries more value to eri fiber and increases its surface characteristics that make it suitable for apparels.

Methodology

Selection of yarn: Hand spun eri silk was selected for traditional degumming as well as enzymatic degumming due to its ready availability. It was procured from Central Silk Technology Research Institute (CSTRI), Bangalore.

Selection of chemicals for testing

The following chemicals of LR grade were used for conducting this research.

S.No	Chemicals used	Purpose
1	Sodium Carbonate	Traditional degumming
2	Lycerin ESD powder (Enzyme)	Enzymatic degumming

Selection of methods:

Experimental research design was selected for the study as it involved experiments and laboratory tests.

Preparatory processes for fabrics

Traditional/ Alkaline degumming

Recipe:

Soda (or) Sodium Carbonate - 2g per liter

Neutral soap/ Non ionic detergent - 5g per liter

Silk contains sericin, which interferes with the luster and dye absorption of silk fibers. Hence sericin was removed by degumming process suggested and optimized by CSTRI. Silk was boiled in 2g/liter soda and 5g per liter of non – ionic detergent solution maintaining the material to liquor ratio 1:40 for 45 minutes. The yarn was then thoroughly rinsed to remove traces of detergent and dried in shade. Care was taken to avoid entangling of yarns during degumming process.

Enzymatic degumming

Recipe:

Liserin ESD powder - 2.0 -4%

Sodium Carbonate - 2.0-3.0g/ lt

ML Ratio - 1: 40

pH - 9.5

Two to four per cent Liserin ESD powder and 2-3 g/ lt sodium bi carbonate were mixed thoroughly in water to maintain the material to liquor ratio 1:40. After placing the material in the liquor, its temperature was raised slowly to 90^0C. the material was left for 30-45 minutes in the liquor by stirring occasionally. Then the yarn was removed and washed and washed with cold water and dried in shade.

Results and discussion

Traditional degumming method, which was standardized by Central Silk Technological Research Institute (CSTRI), was adopted for degumming eri silk. However, there was deviation in case of temperature among the varieties of silk. Hence the degumming temperature was varied and the results were noted in table 1.

Table 1. **Traditional degumming process**

S. No	Samples	Temperature	l*	a*	b*	DE
1	Control	-	53.55	3.13	16.59	15.83
2	Sample 1	80^0C	77.03	0.795	11.9	20.33
3	Sample 2	90^0C	68.1	1.145	13.1	23.38
4	Sample 3	100^0C	75.24	0.702	11.36	21.06

As per the number of sequential experiments were conducted near boiling temperatures i.e. 80^0C, 90^0C and 100^0C. DE value of standard sample was found to be 15.83. Among 3 temperatures, 80^0C degummed sample was selected based on l*, a*, b* and DE values. Compared with control sample, degummed samples showed good lusture and smoothness.

Standardization of enzymatic degumming

The enzymes, which are mainly protein, are biocatalysts. They are being introduced in various stages of wet processing of textiles as enzymes are biodegradable and eco friendly and do not cause any effluent problems. These enzymes generally reduce time of treatment, considerably saving in energy, chemicals substantially increasing the production. Therefore, chemicals were being replaced by enzymes (Pant. S and Sariya. R, 2000).

l*, a*, b* values and DE values of different varieties of degummed eri silk was measured through colour flex spectrophotometer interfaced with computer under D 65 illumination and 10^0 observing angle. The results are given in table 2.

Table 1. **Standardization of enzymatic degumming**

S.No	Enzyme (%)	Sodium Carbonate	l*	a*	b*	DE
1	Control	-	54.07	2.37	14.1	15.83
2	2	2	69.45	1.15	13.43	21.85
3	2	2.5	80.21	1.02	13.55	19.83
4	2	3	74.91	0.7	12.3	22.87
5	2.5	2	77.95	0.96	13.23	16.91
6	2.5	2.5	78.1	0.72	13.29	17.29
7	2.5	3	77.34	1.24	14.45	22.47
8	3	2	80.49	1.08	13.97	23.1

9	3	2.5	76.61	1.12	13.83	10.13
10	3	3	69.75	1.29	13.68	7.76
11	3.5	2	74.9	1.15	14.2	16.99
12	3.5	2.5	77.79	1.1	14.18	19.18
13	3.5	3	80.12	1.08	14.09	19.57
14	4	2	77.55	1.2	14.26	19.88
15	4	2.5	77.78	1.15	14.15	22.58
16	4	3	79.1	1.27	14.67	19.92

- Indicates the selected concentrations of enzyme and sodium carbonate

In silk, sericin and fibroin are proteins but due to specific action of protease (Liserine ESD), it only degrades sericin without damaging fibroin which is not possible otherwise with conventional soap- soda treatment. It improves degumming efficiently, imparts soft feel and ensures maximum weight reduction without affecting the fiber strength and hairiness. (Kariyappa, 2003).

The enzyme percentage and sodium carbonate percentage were standardized based on the DE values compared with control sample. The DE values of control sample was found 15.88. Among the enzyme treated samples, concentration of 3% enzyme with 2.5% soda and also 3% soda were found with lower DE values of 10.13 and 7.76 respectively showing the increased whiteness of the yarns from natural yellow. The smoothness and lusture of the samples were good compared with control sample and other enzymatic degummed samples. So the concentration level of 3% enzyme and 3% soda was selected for dyeing eri silk.

The whiteness obtained by enzymatic treatment was more when compared to traditional degumming method as indicated by DE values keeping the white as standard. In case of lusture and brightness, enzymatic degummed samples showed better results compare with traditional degummed samples. Enzyme treatment provided eri silk with white finish by decreasing yellowness. Similar finding was reported by Pant. S and Sariya R (2000).

Summery and conclusion

Eri silk is one of the varieties of silk produced only in India. Recently eri culture was introduced in Andhra Pradesh due to the availability of host plants. Eri silk fabrics are suitable in the fields of apparel, furnishing and home textiles. Due to the market potential for eco- friendly fabrics, it became mandatory to develop eco processing for eri silk. Therefore, the present study

was undertaken with major objective of developing eco- friendly finishing for eri silk to promote its value chain.

Eri is wild silk that cannot be reeled, due to piercing of cocoons by the moths. Hence it is used for the production of spun yarn only. Importance of eri silk cannot be underestimated as a fine textile fiber. It has got certain excellent textile properties and is unique in many respects.

Increased the awareness and concerns about the environment and pollution had paved way for eco friendly process in wet processing. Traditional soap – soda boiling method of degumming silk had many disadvantages coupled with the convenience of the time. Traditional degumming method, which was standardized by CSTRI, was adopted for degumming eri silk. The enzymatic degumming processes were gaining importance due to less degradation of eri silk protein, ease of process control, better hand properties of silk besides being environmental friendly.

The findings of the study were summarized as follows

- Eri silk sample degummed at 80^0 C temperature was selected based on L*, a*, b* and DE values. Compared with standard sample, degummed samples showed good lusture and smoothness**.**
- Concentration level of 3% enzyme and 3% soda was selected for degumming of eri silk, based on good lusture and whiteness. The smoothness and lusture or these samples were found good compared with control sample.
- Enzymatic degummed eri silk yarns showed better lusture, smoothness and dye uptake compared with traditional degummed eri silk yarns.

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