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Effect of Chitosan On Printing Behaviour of Silk Fabric

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Abstract

In the present study, the effect of chitosan on printing quality, stiffness and crease recovery of the silk fabric has been presented. Effect of pre-treatment of silk with varying concentration of chitosan (0.5%, 1%, 1.5% and 2%) in printing and varying concentration of chitosan (15ml, 25ml, 35ml and 45ml) when incorporated into the printing paste was studied. Pre-treatment with chitosan does not affect the color yield of the printed sample. Evenness of print decreased as compared to control fabric. As concentration of chitosan increased from 0.5% to 1.5%, sharpness of print decreased. The texture of the printed silk fabric became harsh in pre-treated fabric but there was no effect on texture in simultaneous use of chitosan in printing paste. It was also found that, stiffness of silk fabric increased progressively with increase in concentration of chitosan in pre-treatment of silk fabric in printed fabric, whereas in simultaneously treated silk fabric, stiffness slightly increased. Treatment of silk fabric with chitosan before printing caused more reduction in crease recovery of silk than simultaneous treatment in printing.

Keywords: Chitosan | crease recover | printing | silk | stiffness

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Introduction

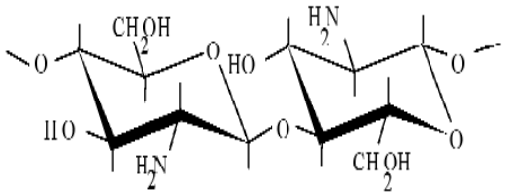

Fig. 1: Chemical Structure of Chitosan

With growing awareness of people towards environmental friendly approaches, natural fibre and natural polymer have received much more attention than ever before from the researcher. Eco-friendly textiles are becoming one of the priority areas that have turned attention towards environmentally benign products. Chitosan is a natural biopolymer of poly [β-(1-4)-2-amio-2-deoxy-D-glucopyranose]- obtained by chitin de-acetylation. The monomer unit is found in the exoskeleton of many animal species like crustaceans, arthropods and mollusces'. It is

one of the chief constituent of cell walls of certain fungi (Enescu, 2008).

Many researchers reported that chitosan having unique properties like biodegradability, biocompatibility, non-toxicity, and antimicrobial properties (Hosseini *et al.,* 2013; Lim and Hudson, 2003; Jia et al., 2001). The non-toxic and biodegradable properties are specifically gaining attention of research and commercial communities like biomedical, textile and chemical industrial (Jocic et al., 2005).

Treatment of textile material with chitosan which is considered as multifunctional finishes which not only provide antimicrobial properties but also enhance the color strength (Bondyopadhyay *et.al.* 2001).

Abdou (2013) reported that printed samples have similar colorfastness to that of commercial samples, but chitosan film on fabric surface create the problem of poor handling i.e. makes the fabric stiff. Chitosan is applied on all type of natural fabrics. In the present study silk fabric was used. Silk fibre is known as "Queen of Fibres" because of its graceful lustre and soft texture which makes it different from others (Peng *et. al.,* 2012). Chitosan is used as an auxiliary in textile printing.

Therefore, keeping in view the importance and utility of the chitosan, this paper focused on, studying the effect of chitosan on printing of silk fabric with acid dye and depth of shade, evenness of dyeing and texture of printed sample were evaluated. Also, the effect of chitosan concentration of stiffness and crease recovery of the printed sample were studied.

Experimental procedure

1. Raw Materials

Silk fabric was purchase from Khadi Bhandar Haldwani, Uttarakhand and others chemical which are used in this work was available in College of Home Science laboratory, Banasthali Vidhayapith, Jaipur (Rajasthan). Chitosan and Glycerin was used as an auxiliary agent, Gum Tragacanth as a thickener, Ammonium Oxalate and Ezee for scouring of the silk fabric.

2. Procedure

Scouring: Scouring bath was made up with ezee (5gm/lt) and fabric was treated for 30 minutes at 40˚-50˚C and MLR was 1:30. The fabric was taken out from bath, rinsed thoroughly in running water and dried at room temperature (Gupta *et al.*, 2013 and Upreti *et al.,* 2017).

Simultaneous treatment with Chitosan in printing paste: 5gm chitosan was dissolved into 500ml of water. 7.5 ml of 10% acetic acid was added. This solution was divided according to the requirement during printing. In printing, the paste was divided into 5 equal parts and various concentrated chitosan solutions (15ml, 25ml, 35ml and 45ml) were added into the paste respectively. Then the print paste was applied on the silk fabric with the help of screen.

Pre-treatment of silk fabric with Chitosan in Screen Printing: Pad-dry-cure method was followed to apply Chitosan on silk fabric. In this technique first Chitosan solution of different concentrations were prepared. Silk fabric was immersed for 5 minutes in the solution for better impregnation and then the fabric was passed between two rollers to squeeze out air and to

force liquor inside material, excess liquor being sent back along the fabrics. Fabric was dried at 90˚C for 3 minutes and cured at 150˚C for 1 minute. Four concentrations of Chitosan (0.5%, 1%, 1.5%, 2%) were applied individually. Application of different concentrated Chitosan solution paste into the silk fabric was done with the help of padding mangle. After that, printing was done.

Drying: Printed sample was dried at room temperature (30˚C) for 24 hrs and Prints were fixed by steaming. Steaming of printed samples was done in laboratory in open bath at 100˚C for 30-45 minutes.

Evaluation Methods: Subjective analysis technique was used to analyse the printing quality of the dyed samples. Five point rating scale was used to evaluate the depth of shade, evenness of print and texture of the silk fabric. The result of depth of shade, evenness and texture has been presented in terms of weighted mean score whereas stiffness and crease recovery and colour fastness of the silk fabric were determined with standard procedure.

Rating Scale

Depth of shade

Very Deep	Deep	Slightly Light	Moderately Light	Very light
5	4	3	2	1

Evenness of Print

Very Even	Even	Slightly Uneven	Moderately Uneven	Very Uneven
5	4	3	2	1

Texture of the silk fabric

Very Soft	Soft	Slightly Harsh	Moderately Harsh	Very Harsh
5	4	3	2	1

Result and discussion

Effect of chitosan on printing quality and texture of the silk fabric

On the visual inspection, it was found that the controlled sample showed deepest shade. There was no effect on the color yield of the print either in pre-treated silk fabric with Chitosan or incorporation of Chitosan on printing paste. Evenness of print improved slightly when silk was treated with 0.5% Chitosan. Other samples showed decrease in evenness of print as compared to control fabric. Analysis of sharpness of print revealed that pre-treatment with 0.5% Chitosan resulted in increase in sharpness of print. As concentration of Chitosan increased from 0.5% to 1.5%, sharpness of print decreased. In case of incorporation of Chitosan in printing paste, almost similar trend was observed. Texture analysis revealed that as the percentage of Chitosan increased in pre-treated sample, texture of the silk fabric became harsh but here is no effect on texture of the simultaneous use of Chitosan in printing paste.

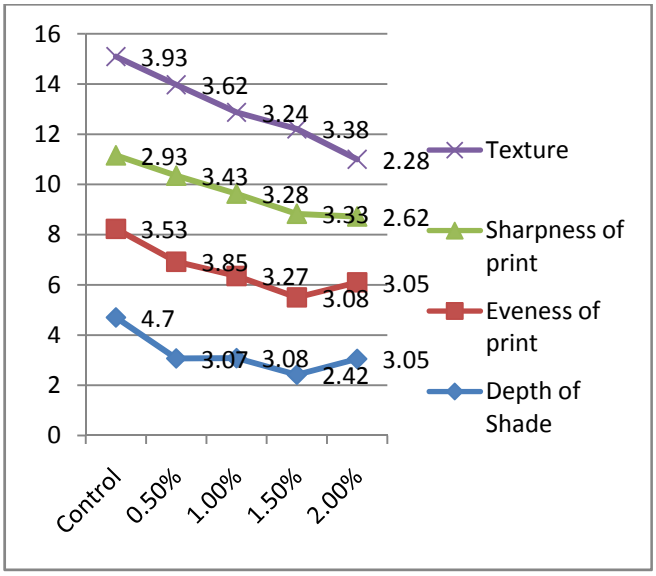

Fig. 2: Effect of Chitosan on Printing quality and Texture of pre-treated Silk fabric

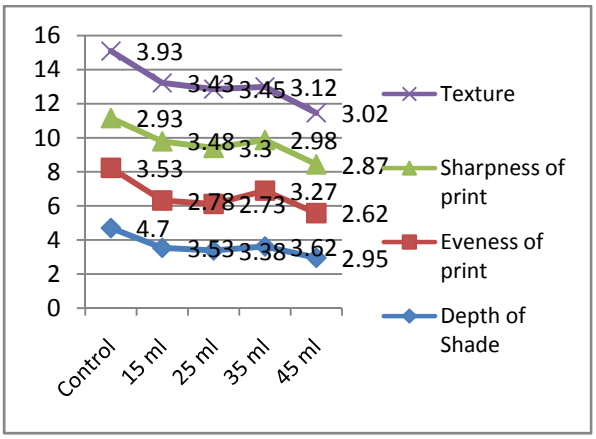

Fig. 3: Effect of Chitosan on Printing quality and Texture of Simultaneous treated Silk fabric

Effect of Chitosan on selected properties of silk fabric

Stiffness: It is clearly shown in table 1 that, in case of printed silk fabric pre-treated with chitosan, stiffness is more in warp wise direction as compared to weft wise direction; but in case of incorporation of Chitosan in printing paste the weft wise stiffness is more as compared to warp wise stiffness.

Crease recovery: Treatment of silk fabric with Chitosan before printing caused more reduction in crease recovery of silk than simultaneous treatment in printing. This may be due to the fact that Chitosan made silk stiffer. Stiff fabrics are more prone to creasing than soft fabric. Abdou (2013) also reported chitosan film on fabric surface create the problem of poor handling i.e. makes the fabric stiff.

Sample	Concentration of Chitosan	Stiffness		Crease Recovery	
		Warp	Weft	Warp	Weft
Control		2.65	3.42	68.3	85
Pre-treated	0.5%	2.67	3.3	90	85
	1%	4.21	3.5	78.33	76.67
	1.5%	4.97	3.1	70	66.67
	2%	5	3.4	80	61.67
Simultaneous	15ml	5.2	3.4	55	60
	25ml	2.51	3.38	66.67	66.67
	35ml	2.57	3.15	66.67	73.33
	45ml	2.75	3.03	53.33	70

Table 1: Effect of Chitosan on stiffness and crease recovery

Conclusion

Chitosan is the second abundantly available natural nontoxic biopolymer, which can be used as an antimicrobial finish and can be used with the combination of starch which might be increase the color strength. To permanently fix the chitosan on silk fabric anchoring chemicals like Cyanuric chloride, hydroxydichlorotrizine or glutaraldehyde may be used in further studies.

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