

Study on dyeing behavior of cotton/organic cotton knitted fabrics

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Abstract

Organic cotton is grown using methods and materials that have a low impact on the environment. Organic cotton is grown and processed without toxic chemicals that can be absorbed easily when in contact with the user's skin. This paper describes the dyeing behavior of organic cotton vs conventional cotton to find what will be the significance between them. The ring spun yarns of 40^s combed organic (GOTS certified) and ordinary cotton were produced with similar parameters like beating point and settings. Knitted fabrics were produced with similar loop length and weight using organic and ordinary cotton yarn. Both the fabrics were processed in GOTS certified Processing unit using reactive dyes in soft flow machine in single dye bath. Processed fabrics were tested for colour fastness to washing, water, rubbing, perspiration and light. Colour difference and strength were also measured using Spectrophotometer (DATA COLOUR). Presence of metals were also analyzed in both the processed fabrics and reported here.

Keywords: Organic cotton, dyeing, fabrics, textile.

Introduction

Around the world, more toxic insecticides are used on cotton than on any other crop. A sustainable alternative is the certified organic cultivation of the "white gold". The farmers have only a chance to convert their production into a controlled organic cultivation of organic cotton is grown using methods and materials that have a low impact on the environment. Organic production systems replenish and maintain soil fertility, reduce the use of toxic and persistent pesticides and fertilizers, and build biologically diverse agriculture. Third-party certification organizations verify that organic producers use only methods and materials allowed in organic production (Punj, 2000).

The conventional cultivation of cotton leads to massive environmental and health problems (Meredith, 1945). Consumers interested in the sustainable use of clothes and textiles will find the opportunity to search for producers and retailers. Organic cotton is grown and processed without toxic chemicals that can be absorbed easily when in contact with the user's skin. Pesticides, fertilisers and chemicals used to grow and process conventional cotton fabrics may go directly to the users blood stream, which consequently affects the body's organs and tissues. Organic cotton production is not simply an elimination of fertilisers and insecticides but it is a complete production system, which requires equally sound knowledge of cotton production practices. With respect to insect control in particular, a thorough knowledge of non-chemical means of insect control is a pre-requisite for organic production. Organic cotton production requires careful planning so as to realise optimum yield. It includes a number of factors like site selection, crop rotations, variety, weed control, non-chemical means of insect control and skill to manage organic crop (Morton *et al.*, 1975). Similarly, there is a need to perfect the agronomic requirements of a crop to

be grown without synthetic fertilisers and pesticides. Besides, the naturally soft organic cotton fabric is a lot more comfortable to use and is available at competitive prices.

Organic cotton has various end uses ranging from personal care items to home furnishings and even with garments of all styles and kinds even for kids wear organic cotton is the best recommended one. Nowadays more and more spinning mills are opting for organic cotton for organic cotton yarn, to be used in knitting and wearing (Ruppenicker, 1977). Thus the future trend of organic cotton is increasing day by day as the awareness among consumers in growing for the eco friendliness from the fibre stage itself. Thus, our paper will be more useful for the industries to analyse the Dyeing behaviour of organic cotton with the conventional cotton and to identify any change in process route for organic cotton by providing them important test results.

Materials and methods

Yarn sample (Table 1)

Organic cotton yarn samples of 40s and Ordinary cotton 40s were spun in super spinning mill, Coimbatore with the following machines and process parameters.

Machine: Knitting machine make: Yearchina; Type of fabric produced: Interlock; Dia: 30; Loop length: 30 cm; GSM: 155.

Process parameters: Grey fabric sample: Organic cotton knitted fabric and ordinary cotton fabrics are knitted in Sri Knits, Avinashi, India with following machines and process parameters (Prakash *et al.*, 2010). Dyed fabric sample (Table 2): Processing of organic and inorganic fabric based on global organic standards is done and then they are subjected to testing of behavior of organic cotton fabric vs ordinary cotton fabric (kizil *et al.*, 2005). The fabrics of both organic and inorganic nature are treated simultaneously in the same process sequence with same recipes in soft flow machine. Dyeing properties

Table 1. Process parameters

Cotton	Lap hank	Card sliver hank	Draw frame sliver hank	Comber sliver hank	Rove hank	Yarn count
Organic cotton	0.001475	0.14	0.140	0.14	1.4	40 ^s
Ordinary cotton	0.001475	0.14	0.140	0.14	1.4	40 ^s

Table 2. Dye recipe

Remazol RR	2%
Sodium chloride	50 g/l
Sodium carbonate	5 g/l
Sodium hydroxide	1 g/l
Fixation Time	60 min
Liquor ratio	1:10
Dyeing temperature	55°-60°C

Table 3. Method and instrument

Test /dyeing properties	Method	Instrument name
Wax content	SITRA/TC/G/21	Soxhlet apparatus
Scouring loss	IS1383	Caustic method
Absorbency test	IS2369	Purit
Whiteness index		MACBEPH 7000 A spectrometer
Light fastness	AATCC16	Xeno tester 150 S+ model
Washing fastness	IS105C06	RBE - Fastness machine
Washing to perspiration	IS105C06	Perspiro meter
Washing to water	IS105C06	RBE - Fastness machine
Rubbing fastness	IS105C06	Crock meter
Heavy metal	IS790	Atomic absorbion spectrophotometer
Colour difference		Spectrophotometer (DATACOLOUR)
Colour strength		Spectrophotometer (DATACOLOUR)

Table 4. Scouring loss

Ordinary cotton	Organic Cotton
6.97%	5.93 %

Table 5. Wax Content

Ordinary cotton	Organic Cotton
6.97%	5.93 %

Table 6. Absorbency rate

Ordinary cotton	Organic Cotton
6.97%	5.93 %

Table 7. Whiteness index

Ordinary cotton	Organic Cotton
48.24 (-3.97 Reddish)	45.75 (-4.28 Reddish)
Whiteness index CIE (With Bleaching)	
Ordinary cotton	Organic Cotton
78	79

Table 9. Colour fastness to perspiration (alkaline)

Colour test	Ordinary cotton			Organic cotton		
	Yellow	Blue	Pink	Yellow	Blue	Pink
Acetate	3-4	3-4	3	3-4	3-4	3
Cotton	3	3	2-3	3	3	2-3
Nylon	4	3-4	3	4	3-4	3
Polyester	4	3-4	3	4	3-4	3
Acrylic	3-4	3	3	3-4	3	3
Wool	3-4	3	3	3-4	3	3

Table 8. Colour fastness to perspiration (alkaline)

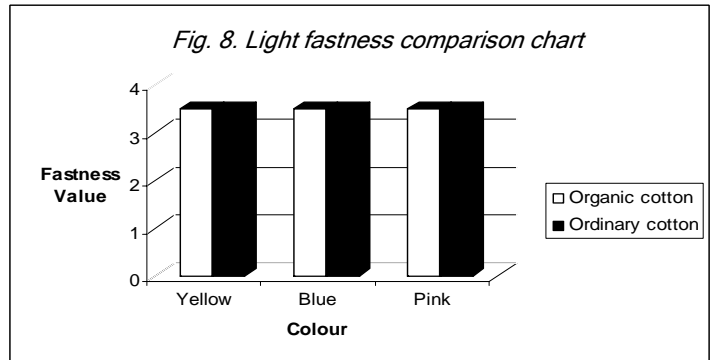
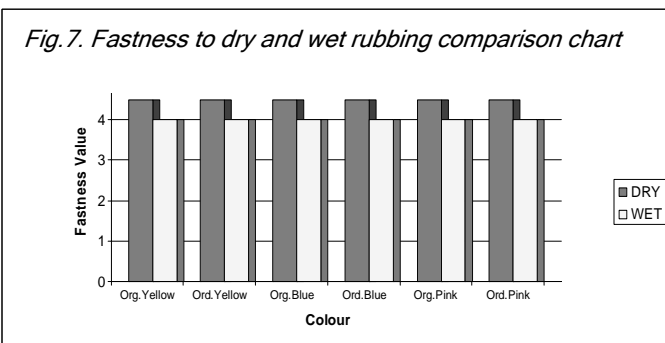
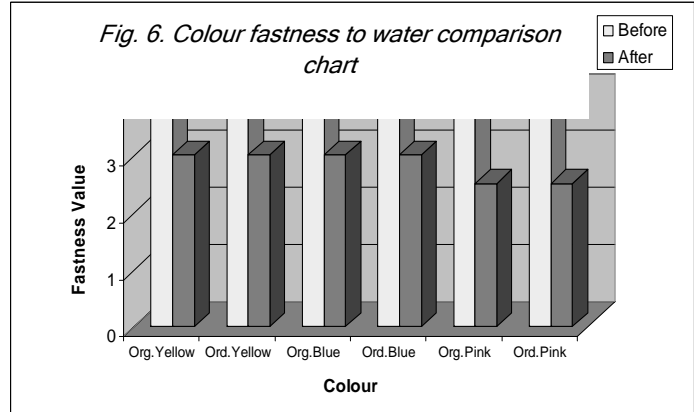
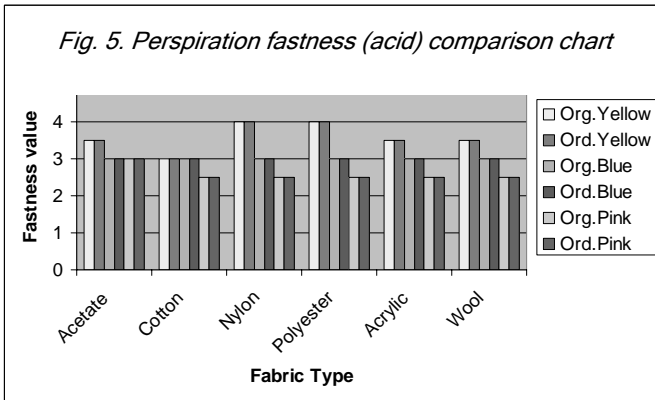
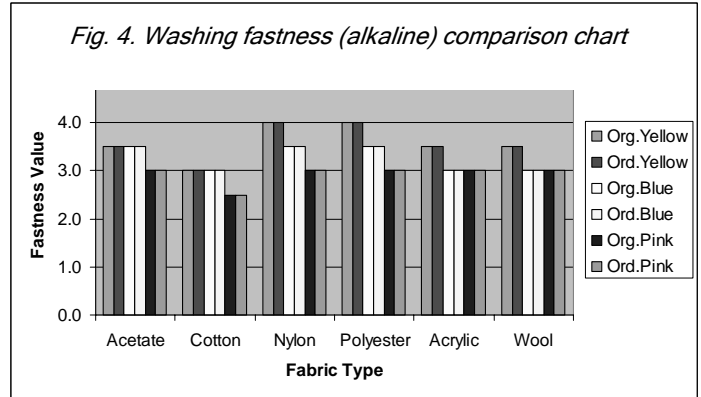
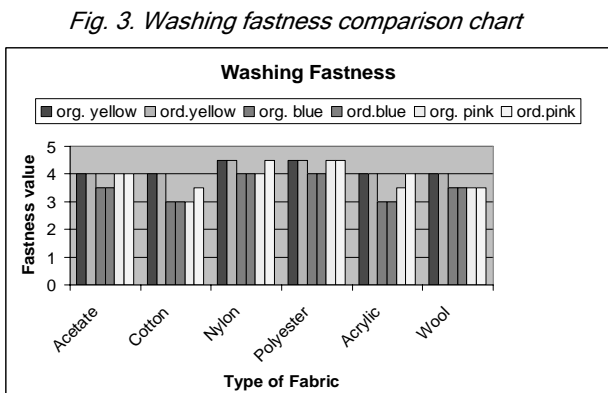
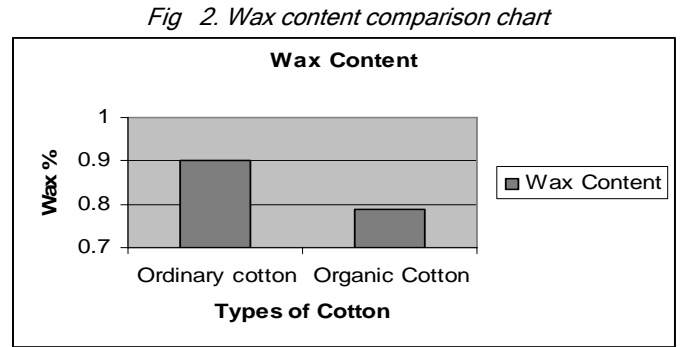
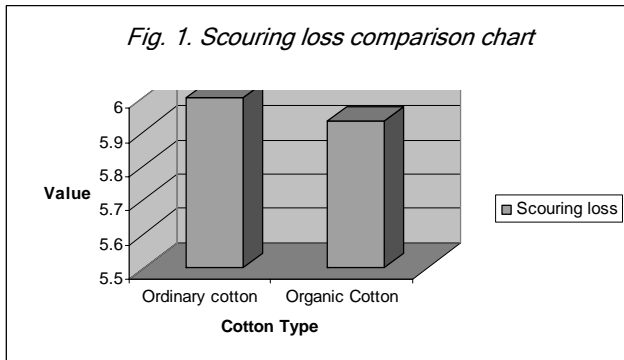
Colour Test	Ordinary cotton			Organic cotton		
	Yellow	Blue	Pink	Yellow	Blue	Pink
Acetate	3-4	3-4	3	3-4	3-4	3
Cotton	3	3	2-3	3	3	2-3
Nylon	4	3-4	3	4	3-4	3
Polyester	4	3-4	3	4	3-4	3
Acrylic	3-4	3	3	3-4	3	3
Wool	3-4	3	3	3-4	3	3

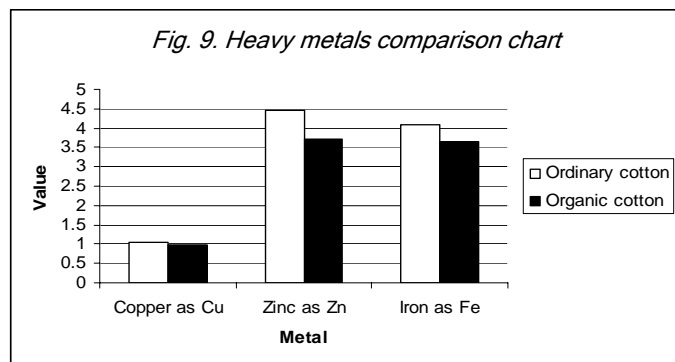
Table 10. Colour fastness to perspiration (acid)

Colour Test	Ordinary cotton			Organic cotton		
	Yellow	Blue	Pink	Yellow	Blue	Pink
Acetate	3-4	3	3	3-4	3	3
Cotton	3	3	2-3	3	3	2-3
Nylon	4	3	2-3	4	3	2-3
Polyester	4	3	2-3	4	3	2-3
Acrylic	3-4	3	2-3	3-4	3	2-3
Wool	3-4	3	2-3	3-4	3	2-3

Table 11. Colour fastness to water

Colour test	Ordinary cotton			Organic cotton		
	Yellow	Blue	Pink	Yellow	Blue	Pink
Before	4	4	4	4	4	4
After	3	3	2-3	3	3	2-3



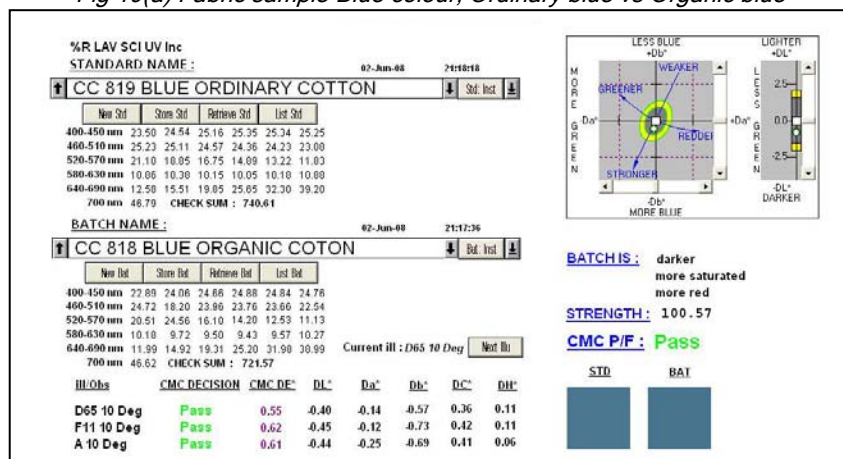


measured (Table 3): Dyeing properties are tested at South India Textile Research Association in Coimbatore and Trinity Colours India Pvt. Ltd., Perundurai, India. All tests are carried out under the ISO Standards (Table 2).

Table 12. Colour fastness to wet and dry rubbing

Colour test	Ordinary cotton			Organic cotton		
	Yellow	Blue	Pink	Yellow	Blue	Pink
Dry	4-5	4-5	4-5	4-5	4-5	4-5
Wet	4	4	4	4	4	4

Fig 10(a) Fabric sample-Blue colour; Ordinary blue vs Organic blue



Results and discussion

The grey hosiery fabric samples (organic cotton, ordinary cotton) were scoured and dyed as desired using 2% Remazol Yellow RR, 2% Remazol Blue RR and 2% Remazol Red RR on the same bath. The dyed sample test results are as follows:

Scouring loss (Table 4 & Fig. 1)

Organic cotton (6.97%) is having less scouring loss when compare to ordinary cotton (5.93%).

Wax content (Table 5 & Fig. 2)

Wax content is comparatively less in organic cotton (0.9%) when compare to ordinary cotton (0.79%).

Table 15. Heavy metals detection in Colour strength

Metals	Ordinary cotton	Organic cotton
Copper	1.04	0.98
Nickel	ND	ND
Zinc	4.45	3.72
Cobalt	ND	ND
Iron	4.09	3.66

ND-Not detected up to 1 ppm

Absorbancy (Table 6)

Absorbancy is below 1 for Ordinary cotton (sec) and Organic Cotton (sec).

Whiteness index (Table 7)

Test: Whiteness index CIE (Without Bleaching)

Test: Whiteness index CIE (With Bleaching)

Colour fastness to washing (Table 8 & Fig. 3)

Washing fastness range is good (Avg. scale value is 4) in organic and conventional cotton except in blue colour sample (Avg. scale value is 3-4).

Colour fastness to perspiration (alkaline) (Table 9 & Fig. 4)

Colour fastness to perspiration (alkali) report for the both organic and ordinary cotton gives same performance ie., avg. scale value is 3-4. Except for pink colour where, it is pink colour comparatively less.

Colour fastness to perspiration (acid) (Table 10 & Fig. 5)

Colour fastness to perspiration (acid) report for the both organic and ordinary cotton gives same performance ie., avg. scale is 3-4, except for pink colour where, it is pink colour comparatively less. Colour fastness to perspiration for alkali is better than acid.

Colour fastness to water (Table 11 & Fig. 6)

In washing fastness with water, organic cotton and ordinary cotton gives same performance before and after wash.

Table 13. Colour fastness to light

Colour	Ordinary cotton	Organic cotton
2% Remazol yellow RR	3-4	3-4
2% Remazol blue RR	3-4	3-4
2% Remazol red RR	3-4	3-4

Table 14. Heavy metals detection

Colour	Organic cotton dye strength	Ordinary cotton dye strength
Yellow	97.74	99.32
Blue	100.57	99.84
Red	99.03	100.98

Fig 10 (b) Organic blue vs Ordinary blue

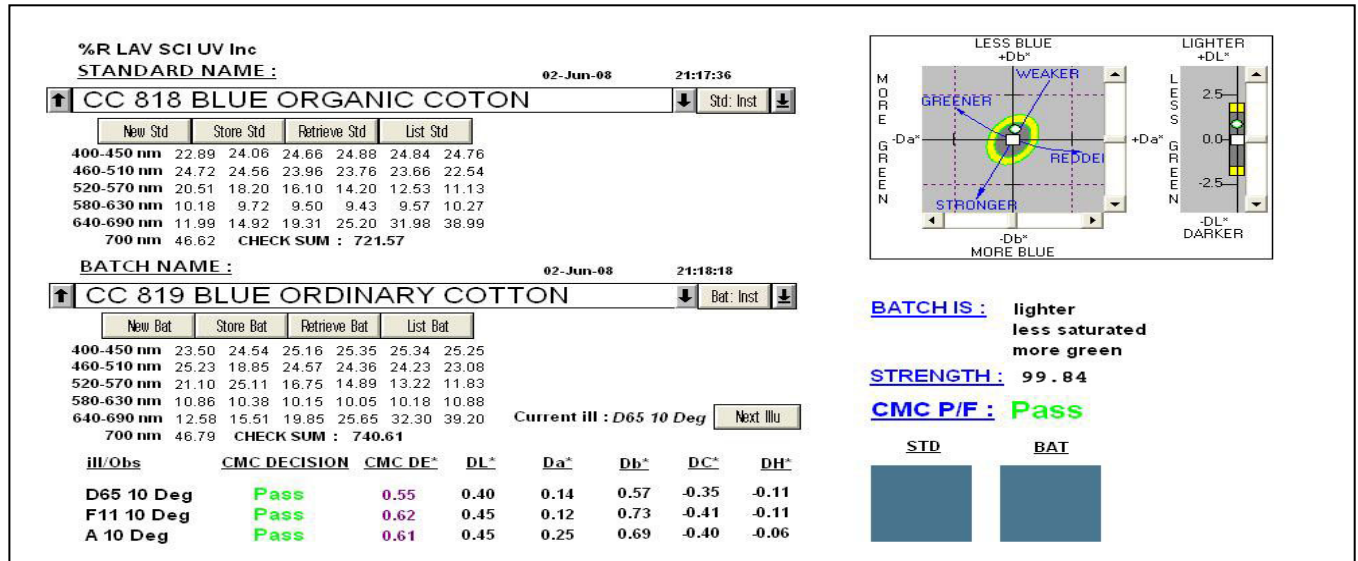


Fig 10 (c) Fabric sample-Pink colour; Ordinary pink vs Organic pink

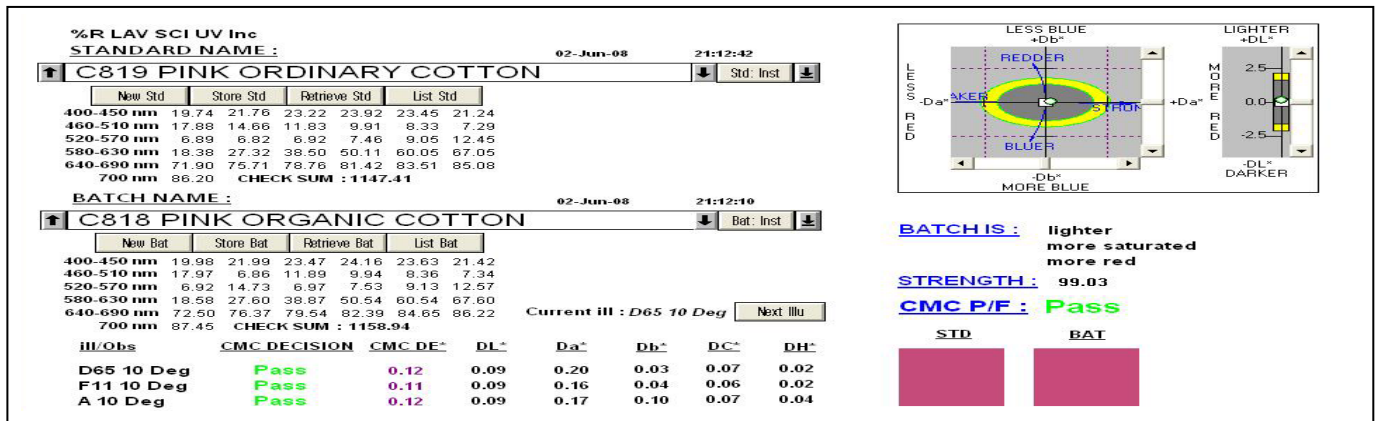
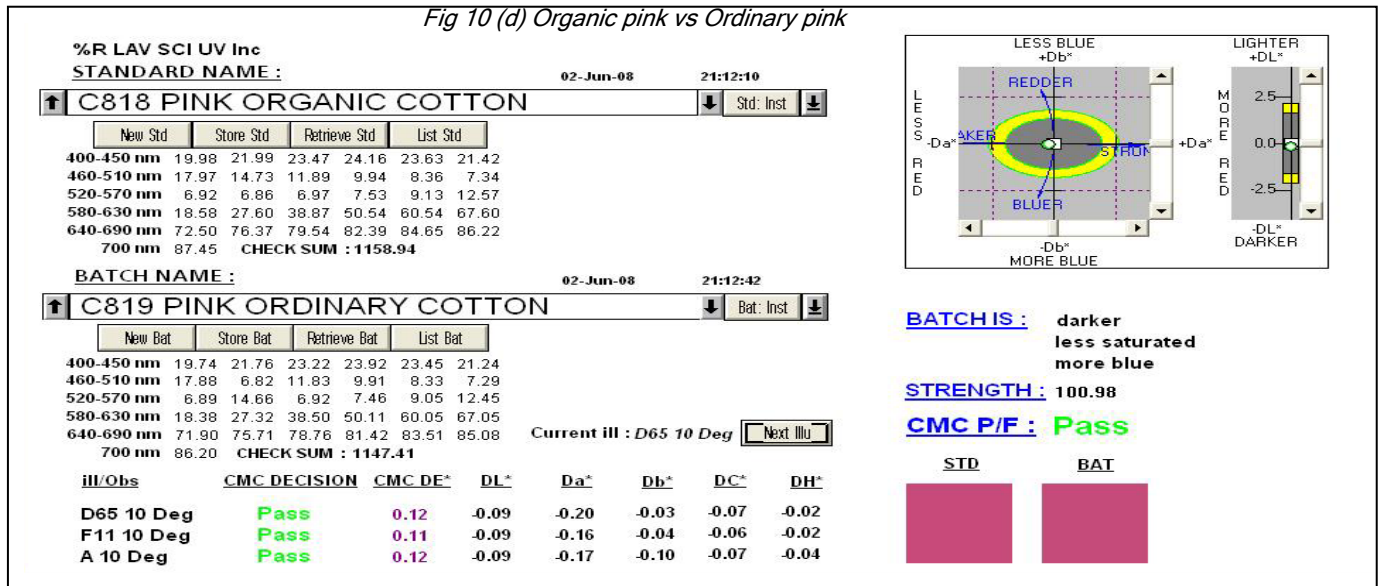


Fig 10 (d) Organic pink vs Ordinary pink



Colour fastness to wet and dry rubbing (Table 12 & Fig. 7)

In dry and rubbing, both the cotton gave similar result.

Colour fastness to light (10 h exposer) (Table 13 & Fig. 8)

In colour fastness value, both the organic and ordinary cotton responded similarly.

Heavy metals detection (Table 14 & Fig. 9)

Presence of Heavy metals in organic cotton is lesser than

ordinary cotton.

Colour strength and colour difference (Table 15 & Fig. 10(a)-10(g))

The colour strength value also similar for both the ordinary and organic cotton. However, there is very less significance of colour difference value was noticed.

Conclusion

There was no major significant difference in fastness properties, colour difference value, dyeing strength of organic cotton when compare to ordinary cotton. Also there is no major difference in dyeing behavior of organic cotton when compare to ordinary cotton except the feel or smoothness of the organic cotton fabric, less metal content, wax content and better absorbency when compare to ordinary cotton. Our investigation concludes that organic cotton processing does not require any new kind of modification in the already existing process sequence for conventional cotton.

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Fig 10(e) Fabric sample–Yellow colour; Ordinary yellow vs Ordinary yellow

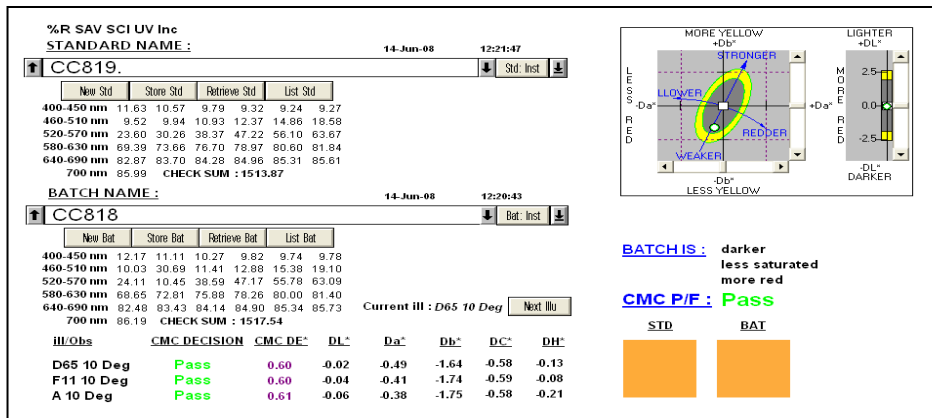


Fig. 10(f). Organic yellow vs Ordinary

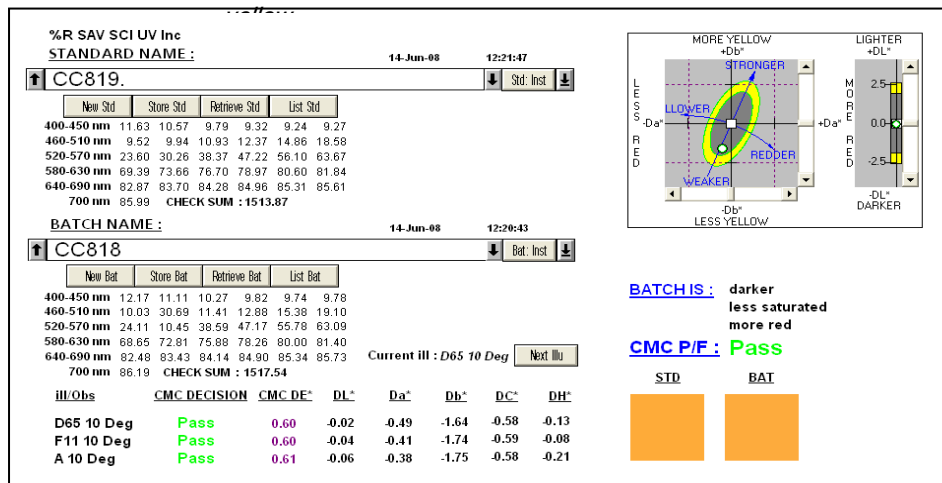


Fig. 10(g). Organic yellow vs Ordinary yellow

