KALAMKARI ON POLYESTER AND POLYESTER-COTTON BLENDS

By

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B.Sc.(H.Sc.)

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CERTIFICATE

Ms.JALLI JANANI has satisfactorily prosecuted the course of research and that the thesis entitled **KALAMKARI ON POLYESTER AND POLYESTER-COTTON BLENDS** submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by her for a degree of any University.

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CERTIFICATE

This is to certify that the thesis entitled **KALAMKARI ON POLYESTER AND POLYESTER-COTTON BLENDS** submitted in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE IN HOME SCIENCE** of the Andhra Pradesh Agricultural University, Hyderabad, is a record of the bonafide research work carried out by **Ms.JALLI JANANI** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee.

No part of the thesis has been submitted for any other degree or diploma. The published part has been fully acknowledged. All assistance and help received during the course of the investigations have been duly acknowledged by the author of the thesis.

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ABSTRACT

Kalamkari is an ancient textile art of painting. It is a kind of mordant dyeing which is exclusively done on cotton Kora cloth. Eventhough still popular, it has limited use due to all cotton fabrics. An attempt was thus made in this study to try it on a polyester-cotton blend and polyester, a synthetic fabric which has dominated the textile scene in India. It was comprehended that this study would provide scope for application of Kalamkari on polyester and polyester-cotton blend and help to improve the natural dye stuff which are ecofriendly. The objectives of the study were to select suitable method for kalamkari to assess the colour fastness of painted fabrics; to estimate cost of painted fabrics; to study the consumer acceptability and to compare the appearance of kalamkari produced on polyester and polyester cotton blend.

A survey was conducted to select common polyester-cotton blend preferred by consumers 67:33 per cent polyester-cotton blend was selected. Mordants alum, stannous chloride and chrome were found to be suitable in preliminary testing and hence selected for the study. Experiments were conducted to find out suitable mordanting technique for kalamkari on polyester-cotton blend and polyester. Red colour was extracted from Suruduchekka and yellow from myrobalan flower. Premordanting and simultaneous mordanting methods were selected for red and

yellow colours respectively. Colour fastness tests to washing, light, perspiration, crocking and pressing were conducted. Consumer's preferences with regard to the aesthetic appeal were selected by subjective evaluation.

The results of colour fastness tests revealed that red colour with all three mordants was excellent to washing on cotton and polyester-cotton. Yellow colour showed fair to good wash fastness on cotton, polyester cotton and polyester with the three mordants used. The light fastness of these colours were found to be not promising. Only fair light fastness was shown by all fabrics tested. However, polyester-cotton and polyester fabrics painted with chrome mordant were found to be better in fastness. These painted fabrics were found to have good fastness to perspiration in both acidic and alakline conditions. The crock fastness of these colours was poor due to the method of application of the dye i.e., painting and not dyeing. However these fabrics showed excellent fastness to dry and wet pressing.

Use of alum as mordant was found to be much cheaper besides its good colour fastness properties when compared to other two mordants used. Chrome was considered to be a reasonable mordant. Stannous chloride as a mordant on these fabrics had limited use due to high cost and also poor fastness properties.

From the subjective evaluation, it was found that preference of the respondents for the three fabrics dyed in red colour using the mordant alum, cotton was rated high followed by polyester cotton and polyester. Order of preference for fabrics dyed in yellow colour was also cotton, polyester-cotton and polyester.

From the above findings, it can be concluded that Kalamkari technique can be successfully employed on polyester-cotton with two mordants i.e., alum and potassium dichromate. A study can be taken up to improve the colour on polyester through after treatments.

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J. Janani

Date : 27/9/96 *(**J. JANANI**)*

DECLARATION

I, J. **JANANI**, hereby declare that the thesis entitled **KALAMKARI ON POLYESTER AND POLYESTER-COTTON BLENDS** submitted to the Andhra Pradesh Agricultural University for the degree of **MASTER OF HOME SCIENCE** is a result of the original research work done by me. I also declare that the thesis or part thereof has not been published earlier elsewhere in any manner.

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Date: 27/9/96

Place: Hyderabad

INTRODUCTION

CHAPTER I

INTRODUCTION

India is famous for its impressive arts. It is India's pride to have these arts which grew up naturally around places of pilgrimage where they could get patronage and repeated buyers. The dyeing, printing and painting on fabric were highly developed from ancient times. The brilliant colours of the dyed cotton were long lasting and had the reputation of glowing with use.

According to M.N.Upadhyay, chronologically Kalamkari fabrics of Andhra Pradesh are among the earliest and are unique in many respects. The industry has been in existence since 6th century BC and supplied a large variety of cloth all over the country and abroad.

Kalamkari is an amalgamation of the words 'Kalam' meaning pen in persian and 'Kari' which signifies work. Kalamkari is an ornate tradition of arts and crafts that grew up in South India drawing its inspiration from puranas and folklore. Kalahasti which is a famous pilgrimage centre in Andhra Pradesh depicts the temple architecture in its kalamkari paintings and Machilipatnam on the east coast show this art in the form of printing.

Kalamkari is done exclusively on cotton kora cloth. Here natural dyes of deep rich shades were being used since ages. Black, red, yellow, blue and green were the colours used mainly for making these paintings.

The name natural dye covers all the dyes derived from plants, insects and minerals. These dyes which had a glorified past had been waxing and waning through years due to evolution of synthetic dyes. The synthetic dyes have ease of application and availability in standardised form. But because of hazardous bye-products produced by the synthetic dye stuff industry and use of carcinogenic intermediaries, researcher's attention was again focussed on revival of the old art of dyeing with natural dyes. Further natural dyes are ecofriendly, as they are based on raw materials available in the nature and do not create any pollution problem. In some cases like harda, indigo etc. the waste in the process becomes an ideal fertilizer for use in agricultural fields.

Besides aesthetic appeal, natural dyes are very soothing to human eyes. They are excellent for their endurance and soft lustrous colouring. Due to the above facts it is highly imperative to revive the use of natural dyes on textiles for home consumption as well as for export. As these natural dyes have export potential, it is worthwhile to try the art of Kalamkari on materials other than cotton. At present in the recent past, there is a sudden increase of export of textiles from India due to the liberalised policies of government. India is exporting not only cotton but a number of other textiles too.

Polyester, a light weight synthetic fibre has dominated the textile scene in India. Due to its durability , crease recovery and excellent shape retention it could win the hearts of millions of people residing both in urban and rural areas. As polyester-cotton blend is more comfortable for Indian climate the art of Kalamkari is being tried out both on polyester and its blend in this study.

It is with this back drop that the present study was undertaken to produce the kalamkari on polyester and polyester-cotton blend. Hence, this study is taken up with the following objectives.

The general objective of this study is to develop kalamkari on polyester and polyester cotton blends.

Specific objectives are:

1 To develop a suitable method of kalamkari on polyester and polyester-cotton blend
2 To assess the colour fastness of the painted fabrics
3 To estimate the cost of painted fabrics
4 To study the consumer acceptability

5 To compare the appearance of kalamkari produced on polyester and polyester-cotton blend with cotton.

Limitations of the study

The study is limited to two colours, red and yellow and three types of fabrics cotton, polyester and polyester-cotton with three types of mordants only, due to limited period of study.

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REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

Review of literature is important and necessary for any scientific investigation. It gives the opinion stated by several earlier researchers. It supports the findings and it forms a basis for any study. It provides a frame of reference for theoretical insight. Much literature is not available on Kalamkari, but a few were published regarding processing of fabric for Kalamkari and dyes used for it. The available literature collected from different sources are presented under the following sections.

2.1 History and famous centres of Kalamkari

2.2 Fabrics used for Kalamkari

2.3 Dyes used for Kalamkari

2.4 Mordants used for natural dyes

2.5 Export value of Kalamkari fabrics

2.6 Polyester dyeing

2.7 Related studies on colour fastness of natural dyes

2.1 HISTORY AND FAMOUS CENTRES OF KALAMKARI

The Kalamkari technique has been practiced over a wide area. The main two centres are India and Persia. The terms Pintado (Portuguese) Chintz (English) kalamkari

(Persian) sits (Dutch) all referred to trade textiles of woven cotton patterned by means of the pen with mordant and resist prior to the dyeing operations (Varadarajan, 1979).

Kalamkari industry is one of the most ancient industries of India. It was reported that dyed sheets of Kalamkari were traded from 1st century A.D. (Thomas, 1983).

Kalamkari is world famous and were greatly appreciated by foreigners, even before the Christian era. The tradition of this painting flourished throughout India from 14th century long before chemical colours and dyes were discovered (Marg, 1979).

Kalamkari an ornate tradition grew up in south India, drawing its inspiration from puranas and folklore, influenced by the enthralling social customs and convention supported by the kings and nobles of the land. Painting was very much in vogue in the 16th and 17th centuries (Damodar, 1983).

Kalamkari has been developed in India for generations as a handicraft. This ancient art survived throughout the age not merely because it had royal patronage during successive periods of Indian history, but chiefly because of its intrinsic worth and its intimitable character (Balaji, 1995).

The great painting centres of Machilipatnam, Palakolu, Srikalahasti, Nagapatnam, Salem, Madurai and Tanjore produced kalamkari that are surpassed in vigour of design and freshness and richness of colour (Jayakar, 1979).

Kalahasti, a famous piligrim centre in Chittor district is one of the well known centres of cloth printing and cloth painting. The temple and the river in Kalahasti both contributed towards the growth of kalamkari (Joshi, 1983). Kalamkari is exclusively hand painted to be used as tapestries and hangings in temples. This kind of picturisation on cloth is done in other parts of India too, but the best known are in Gujarat, Rajasthan, Orissa and West Bengal (Chatopadhyay, 1985).

At present kalamkari is done both in Srikalahasti and Machilipatnam which are hand painting and block printing respectively. Kalamkari industry in Machilipatnam is known as 'Addakam' and in kalahasti it is 'Rathapani' however vegetable dyes are used in both.

2.2 FABRICS USED FOR KALAMKARI

For kalamkari painting, thick unbleached cotton cloth of about 25s count of required size is used (census of India 1961, Joshi, 1983). Kalamkari relates exclusively to the category of cotton fabric (Varadarajan, 1979).

Kalamkari denotes art in which attractive designs are hand drawn on cotton fabrics (Balaji, 1995). According to Gurrappa chetty who is a National award winner in the field of Kalamkari, silk can be used for painting. Sheila Subramanyam (1974) had studied about Kalamkari work on silk and cotton.

According to Nikhil Verma (1994) observation, natural dyes and mordants suitable for wool products are being developed in India.

The fabrics most readily dyed with mordant dyes are natural protein fibres and synthetic fibres (Gohl, 1983).

2.3 DYES USED FOR KALAMKARI

Natural dyes have been synonymous with the traditional Indian textiles like Kalamlari and Madhubani paintings, the Patola and Kashmiri shawls. Vegetables dyes have been used to enhance design and ornamentation to create a harmonious combination that has been responsible for the popularity of these textiles over the ages (Gahlot, 1996).

Until the middle of the last century dyes were obtained from natural sources. Indigo extracted from the plant *"Indigofera tinctoria"* and *"Alizarin"* obtained from the root of madder have been used in India since the beginning of recorded history (Paul, 1996).

The dyes used for Kalamkari were all vegetable dyes. Black, red, blue, and yellow were colours usually preferred for making the paintings. The three basic dyes generally found in Kalamkari are blue from Indigo, Yellow from myrobalan and mango bark with alum solution and green made from Indigo used over yellow and Kasam (black) from solution of sugarcane, jaggery and salt water (Damodar 1983).

Vegetable dyes of deep rich shades were used with strong outlines in brown and black all of which produced a bold and stricking effect (Chatopadhyay, 1985).

The dyes used in the Kalamkari follow mostly the old tradition of extracting colours from the plants, roots, trees and similar natural sources, as also from minerals like iron, coal and compounds like alum (Marg, 1980).

According to Jayakar (1979) the colours of these Kalamkari are deep lustrous red, black, indigo, off white or dusty pink and purplish brown. At times two tones of the same colour are used to produce the designs, where the background is left white. It is never a dead white but a dull pinkish tone. The design being stamped in terrakota red or dull brown. The colours mainly used are of various tones of madder red, indigo, green and yellow.

Plants belonging to the family *Rubiaceae* have been used in India and else where for imparting various shades of red, scarlet, coffee brown and mauve to cotton fabrics (Gulrajani, 1993). Turmeric or Curcumin is historically one of the most famous and brightest of naturally occuring yellow dyes. It is extracted from the fresh or dried rhizomes of turmeric *Curcuma tinctoria* (Nayak et al., 1994). Indigo the king of the dyes of blue madder, lac, safflower, sandal wood for red cutch for brown, turmeric and saffron for yellow and many other indigenous dyes were here as sole monopoly. A natural dye yellow colour is extracted from pomegranate rind (Paul, 1993).

According to Balaji (1995) the vegetable colouring materials used in Kalamkari are with the botanical name and the equivalent local name and with the details of part used and colour obtained are given below.

Table 2.1: Natural dyes used for Kalamkari

S.No.	Botanical name	English name	Local name	Part used	Colour obtained
1.	*Terminalia chebula*	Myrobalan	Karakkaya	Ripe & unripe fruits	Used as base to develop black colour & fix the alum for red
2.	*Rubia cardifolia*	Indian Madder	Manjista	Root	Red
3.	*Ventilago Madraspatna*	Buckthorn	Surudu chekka	Bark	Red
4.	*Indigo tinctoria*	Indigo	Neeli	Leaves extract	Blue
5.	*Terminalia chebula*	Myrobalan	Karakkaya	Flower	Yellow
6.	*Punica granatum*	Pomegranate	Danimma	Fruit rind	Yellow
7.	*Magnifera indica*	Mango	Mamidi	Bark	Yellow
8.	*Casiatora*		Tagirisa	Seeds	Used for fermenting indigo
9.	*Nagrigama alta*	Goanese ipeccacuanna	Pobbaku	Leaves	Used as carrier in red boiling process

Source: G.Watt dictionary of Economic Products, Vol.VI

2.4 MORDANTS USED FOR NATURAL DYES

Early efforts at colouring fabrics were hampered by the fact that natural dyes were not colour fast on the fibre. Eventually scientists found that the defect could be partially overcome by the use of mordants, compounds that render the dye insoluble on the fiber (Marjory, 1980).

The fibres had to be prepared for the reception of the dye by impregnation with metallic oxides such as those of alum, iron or tin. These substances were known as mordants derived, from the French word "Mordre" which means "to bite". (Thampi, 1996). The mordant has affinity both for the fibre and the dye. Those dyes which do not have any affinity for a fibre can be applied by using the mordant. In the case of having affinity for the fibre, the use of mordant increases the fastness properties by forming an insoluble compound of the dye and mordant within the fibre.

Mordant dyes combine with the metallic oxide and hydroxides by forming both covalent and coordinate bonds to give metal-dye complexes which are generally called lakes. Salts of chromium, aluminium, copper, iron and tin, forming sparingly soluble hydroxides are eminently suitable as mordants. Potassium dichromate is important among the chromium compounds. It is anhydrous (Shenai, 1983).

Anthony (1994) stated in his recent book "From turkey red to Tyrian purple-Textile colour for the industrial revolution". He stated that the importance of mordant was realised by 18th century as the nature of the mordant determined the final colour and this offered possibilities for extending the range.

The mordant dye technique was practiced in India long before the term Kalamkari came to be associated with it. It was evolved to resolve the technical difficulties associated with the dyeing of cotton fabrics with vegetable dyes (Varadarajan, 1979).

Most of the natural dyes will not give a fast colour unless a mordant is used. Usually alum (Aluminium Sulphate) is used to fix some of the dyes. When used in large quantities it tends to brighten up the colours (Brand, 1907).

The cloth is prepared with various mordants prior to the use of the dye. When the cloth is then immersed in a dye bath, a chemical reaction of the dye on the mordant produces different colours on the cloth. Only those portions which have been prepared take the dye. Various shades are produced by variable use of the mordant (Jayakar, 1979).

Nishida et al. (1992) studied the dyeing properties of natural dyes from vegetable sources. In this also, mordants and mordanting methods were used. Mordants used were alum, sodium corbonate, iron and the method used was premordanting. From the mechanism it is apparent that the dye components of the dyes from vegetable sources were metalized on the fabrics.

Agarwal et al. (1993) studied the effect of mordentisation on natural dyes. A study was undertaken to dye silk fabric with red sandalwood powder to study the effect of mordants and mordanting methods on colour obtained from the dye. The results showed that nine wide range of soft lustrous and bright colours on silk can be produced by red sandalwood dye with the use of different kinds of mordants.

Gulrajani et al. (1993) studied dyeing with red natural dyes. In this mordanting was carried out by three methods namely pre-mordanting, simultaneous mordanting and post-mordanting. Mordants were alum, tin, iron and chrome. Samples mordanted with alum and tin had good light fastness despite their light colours. Wash fastness for all samples was generally good.

Gupta et al. (1993) tried out dyeing fabric with pomegranate rind. Mordants used in this research were copper sulphate, potassium dichromate, aluminium potassium and ferrous sulphates, stannous chloride and hydrochloric acid. The concentration of each mordant was optimised. In order to find out the best method of mordanting for the dye three methods of mordanting were tried with all five mordants. The sample dyed and mordanted with copper sulphate (post mordanting) had given good fastness properties.

Adiverekar et al. (1994) studied dyeing of cotton with turmeric. In this different mordants such as potassium, antimony tartarate, stannous chloride, zinc chloride, copper sulphate, ferrous sulphate, citric acid, potassium dichromate, alum, magnesium chloride and aluminium sulphate of L.R. grade were used. The fabric pretreated with tannic acid and/or metal salts and dyed showed improved depth and performance properties such as fastness to light, washing, rubbing etc. Various mordants on pretreatment brought about total variations. Copper sulphate and ferrous sulphate showed distinct improvement in light fastness of the turmeric dyed cotton which was mainly inferior in almost all the cases. The influence of concentrations of mordants on depth of dyeing and performance properties were studied.

Nawathe et al. (1994) studied dyeing of cotton with catechu. In this he dealt with dyeing of cotton fabric with catechu before and after mordanting with alum, citric acid, potassium dichromate, iron sulphate and copper sulphate. The performance properties have also been studied.

Verma et al. (1994) studied dyeing of woollen knitting yarn with natural dyes using different mordants like alum, chrome iron, tin, acetic acid and sulphuric acid. The methods of mordanting such as premordanting, simultaneous mordanting and post mordanting were used their colour fastness were assessed.

2.5 EXPORT VALUE OF KALAMKARI FABRICS

According to Jayakar (1979) trade in cotton cloth which was then known as sindu existed between Harappa, Baluchistan and Babylon five thousand years ago. Right from the beginning of this era, land and sea routes carried cotton printed fabrics to Egypt, Arabia, Turkistan, China, Siam and Java. By 17th Century these cottons had become extremely fashionable in England and France.

The printed and painted cottons had market abroad. These were exported to Europe. There was a fairly good market for printed and painted fabrics (Joshi, 1983).

The richly coloured and elegant Indian printed calicoes were first brought to Europe during the sixteenth century. There was an immediate sensation and in France they were called "Indeinnes" chintzes (from the hind chint) were similar painted cotton fabrics kalamkari and Madhubani that soon became available in the drapery shops of major cities (Travis, 1994)

Some of the products dyed with vegetable dyes such as indigo, alizarin were probably exported to countries such as Iran (Paul, 1996).

The world trade in textile is still cotton based but shifting in favour of man mades and blends. World trade in man made and blended textiles and clothing is on the increase (Shankar, 1996).

According to Shridhar (1996) an export assistant, kalamkari durries were being exported since four months to U.K., Germany from Andhra Pradesh handicrafts and emporium. The export value was Rs.3 to 4 lakhs for 1000 to 1250 durries.

2.6 POLYESTER DYEING

Kalamkari on silk is now slowly picking up demand and many private institutions are engaged in exporting these goods.

As cotton became costly in India man made and synthetic fabrics are becoming more popular. As a result consumers are looking for more variety. There is scope for trying out this kalamkari art on man-made and synthetic fabrics. No studies have been quoted so far in this regard.

Polyester is a crystalline fibre and it is difficult to dye polyester fabrics. So high pressure and high temperature dyeing procedures are used to dye these fabrics. By using high temperature eg. 100°C, polyester molecules are more free to move and the dye molecules can penetrate faster and pale shades can be dyed fairly satisfactorily in a reasonable time. Even then the penetration is poor and most of the dye stuff is located on the surface of the fibres. If temperature is still taken higher to 120°C the chain molecules are more free to move and the dye stuff can penetrate the fibres well. So that good medium and heavy shades can be obtained within a reasonable dyeing time of one hour.

Selection of dye stuff must be made for high temperature dyeing because some decompose at 120°C (Moncrieff, 1982).

When polyester is treated with high temperature and pressure, thermal action of the chain molecules getting voilent and the disperse dyes occupy the space in between the space, thereby building up the fastness and stability. The advantages of high pressure, high temperature dyeing are;it can be carried out in short time, dark shades can be easily dyed and colour fastness will be good (Jagannathan, 1975).

Those fibres which are most difficult to dye like polyester give the fastest dyeings. It is no easy matter to introduce dye molecules into the orderly arrangement of chain molecules in a polymer, but when once they are in, it is equally difficult to get them out. Wash fastness is excellent, light fastness is good provided that a carrier has not been used (Moncrieff, 1982).

Studies on colour fastness property

Iravathy (1964) studied the dyeing qualities of indeginous and synthetic dyes and compared the qualities by conducting colour fastness tests. It was reported that catechu a natural dye when subjected to washing test was inferior in quality to vat dyes but superior to direct dyes. The study on the natural sources revealed that fabric dyed in Mehendi extracts had good colour fastness.

Simon (1966) studied on certain indeginous vegetable dyes and their application in printing cotton and silk fabrics and assessed the colour fastness properties to washing, crocking and perspiration. It was reported that in alkaline perspiration, colour transference on silk was less but colour change in both cotton and silk were minimum.

Subramaniam (1974) reported the relative merits of certain indeginous dyes and direct dyes with reference to their colour fastness and the uses of these dyes in kalamkari work. It was indicated that though the kalamkari dyes did not have as bright shades as the direct dyes they are proved to be superior in colour fastness to almost all the tests such as laundering, sunlight pressing etc.

Vasugi (1984) conducted an experimental study on the behaviour of alizarin red (natural dyes) on cotton and silk. The visual inspection proved that the evenness of dye on both cotton and silk had excellent rating. The results of the sunlight test proved that silk showed excellent rating than cotton. Both cotton and silk dyed samples had good resistance to laundering. On crocking, they both showed negligible colour staining and colour change but for wet crocking there was noticeable colour staining and colour change.

Udayini (1988) developed new vegetable dyes for kalamkari painting and assessed their colour fastness property. It was reported thatwith regard to overall efficiency it was found that the blue had the best colour fastness followed by orange, garnet and lavender.

Nishida et al. (1992) studied dyeing properties of natural dyes, chest nut peels and leaves of persimmon, oak, coffee and green tea using aluminium salt as mordant on different fabrics such as silk, cotton, silk sillook blend and cashmilon. The colour fastness tests were carried out. Light fastness was found to be fair to good on cotton with green tea, poor on all fabrics with coffee and leaf of oak, fair to good with leaf of persimmon on silk-sillook blend and on cashmilon and silk-sillook blend it was fair to good. Wash fastness was found to be good.

It was reported that red natural dyed samples mordanted with alum and tin showed good light and wash fastness (Gulrajani _et al_., 1993).

Gupta _et al_. (1993) studied effect of mordants namely stannous chloride, copper sulphate, potassium dichromate, alum, ferrous sulphate on natural dyes and assessed their colour fastness to washing. It was reported that all the samples had fair to good fastness to washing except stannous chloride mordanted sample which showed poor wash fastness.

Agarwal (1993) dyed material from pomegranate rind and wash fastness of the samples were assessed. It was reported that the samples dyed along with mordant stannous chloride showed poor to fair fastness to washing where as the other samples dyed with ferrous sulphate, copper sulphate, alum and chrome showed fair to good fastness.

Teli (1994) tried cotton with catechu dye and assessed light fastness. It was reported that light fastness of these samples and also other performance properties were quite satisfactory.

Neelam (1996) dyed silk with natural dye made from kamala fruits using aluminium potassium sulphate, copper sulphate, stannous chloride, potassium dichromate and ferrous sulphate as mordants. The dyed samples were subjected to tests for fastness to washing and light as per ISO specification. It was found that they were rated as fair to good light fastness and good to excellent fastness to washing.

Gahlot (1996) studied some of the natural dyes extracted from different sources. These dyes had been applied by different mordanting techniques and their colour fastness was assessed. It was concluded that natural dyes are fast and permanent unlike chemical ones are fast to washing and light as well. These dyes produced beautiful and elegant shades which even synthetic dyes could not produce.

According to Moncrieff, if carriers are used in dyeing the light fastness would be reduced.

MATERIALS AND METHODS

CHAPTER III

MATERIALS AND METHODS

3.1 SELECTION OF FABRIC

The cotton grey cloth which is commonly used for Kalamkari, 100 per cent polyester and most commonly used polyester-cotton blend were selected for this study. To find out the most commonly used polyester cotton blend, a preliminary survey was done among the textile markets in Hyderabad. The survey schedule is appended in Appendix No. 1 seventy per cent of consumers preferred 67:33 polyester cotton blend. So the above three types of fabrics were selected for this study.

3.2 PREPARATION OF FABRIC

The fabrics were desized by boiling in water for ten minutes and then pretreated by steeping overnight in the solution of myrobalan seed powder and milk at the ratio of 1:4 (1 part of myrobalan seed powder in 4 parts of milk). The fabric was exposed to sunlight dried thoroughly without rinsing. Milk was used to prevent spreading of dye and myrobalan seed powder to react with kasam to give black colour on cloth.

3.3 SELECTION OF MORDANTS

Aluminium potassium sulphate is the most commonly used mordant in kalamkari. Other mordants that are included for study are potassium dichromate and stannous chloride of L.R. grade.

3.4 MORDANTING

To arrive at the best concentration of the mordant preliminary testing was done using mordanting solutions from 1 per cent to 10 per cent concentrations. The fabrics were mordanted with these subsequently and dyed with a single dye of 5 per cent concentration. The concentration of these mordants is then optimised by visual evaluation of these samples. Ten per cent concentration was found to be best and hence used for this study.

In order to find out the best method of mordanting for the dye, three methods of mordanting such as premordanting, simultaneous mordanting and post mordanting were tried with all three mordants selected. Series of preliminary tests were done. Based on these methods, post-mordanting was found to be unsuitable for these colours used in this study. Based on visual evaluation, premordanting was selected for red dye and simultaneous mordanting was selected for yellow dye. The details of proportions and methods of mordanting are given below.

3.4.1 Premordanting

In this method the fabric was first mordanted and then dyed in red colour. At first, required amount of mordant was dissolved in distilled water at room temperature. This was applied on cloth. The cloth was left to dry for half-an-hour before dyeing. The sample was then dyed.

3.4.2 Simultaneous mordanting

In this method mordant was added to the dye liquor itself. For this, required amount of mordant was dissolved in the dye liquor at 60 C. The temperature was gradually raised to 100 C and then the liquor was allowed to cool. This was then applied on to the required areas of the cloth.

3.5 Selection of dyes

As red and yellow were the main colours used for Kalamkari these were extracted from *"Ventilago madraspatna"* bark and *"Terminalia Chebula"* respectively.

3.6 PREPARATION OF DYE SOLUTIONS

Five per cent concentration of the dye was selected as it was found to give required colours and also commonly used for Kalamkari. The details of ingredient proportions used and method of preparation are given below.

3.6.1 Preparation of red dye

The base for red colour was from '*Ventilago madraspatna*' bark. It was commonly called as Surudu chekka. The bark was dried and made into powder. This powder was mixed in boiling water. Five gram of powder in one litre was taken. Water taken was 3.5 litres/one metre of cloth.

3.6.2 Preparation of yellow dye

The base for this colour was taken from '*Terminalia chebula* (Myrobalan)' flower. The flowers were dried and powdered. They were boiled at 90^{o}C for 30 minutes. Five gram of powder was mixed in one litre of water. Extract was taken and 10 gm of alum was mixed in one litre of extract liquor.

3.7 APPLICATION OF THE DYE

The dye was applied on the cloth with the help of 'Kalam made by bamboo stick on which a porous cloth was tied. The dye continuously flowed by pressing the kalam tip. For red colour, the cloth was premordanted at required areas and boiled in the dye liquor. Yellow dye was applied to the cloth with the help of kalam. This was simultaneously mordanted.

3.8 SELECTION OF DESIGN

One of the commonly used design was selected from the traditional Kalamkari painting.

3.9 COLOURFASTNESS TESTS

3.9.1 Colour fastness to washing

Colour fastness test to washing was conducted following BIS test procedure IS 687-1979. Composite specimen of 10x4 cm was prepared as per the standard procedure. Composite specimen was put in the soap solution (5 g /L) previously heated to $40\pm2^{o}C$ to give liquor to material ratio of 50:1. This was placed in laundero metre and worked for 30 minutes. Then the samples were removed and dried. Samples were evaluated for colour change and staining of the undyed piece with the help of geometric grey scales.

3.9.2 Colour fastness to light

Colour fastness test to artificial light was conducted following BIS-test procedure IS 2454-1967. A specimen of the textile of area not less than 1x4.5 cm was exposed under prescribed conditions along with 8 dyed wool standards to the xenon arc lamp. The fastness was assessed by comparing the fading of the specimen with that of standards.

3.9.3 Colour fastness to perspiration

Colour fastness test to perspiration was conducted following BIS test procedure IS 971-1956. Colour fastness to acidic and alkaline perspiration was carried out.

Acidic test solution

The test solution was prepared by dissolving 2.65 gm of sodium chloride and 0.75g of urea per litre of water and pH was adjusted to 5.6 by addition of acetic acid.

Alkaline test solution

The test solution was prepared by dissolving 3 g of sodium chloride per litre of water and pH was adjusted to 7.2 with addition of sodium bicarbonate.

The test piece of 5x4 cm was kept in between (5x5) cm pieces and stitched along two opposite sides. Thus composite specimen was made. This was kept in test liquor using liquor to specimen ratio of 50:1 for 30 minutes at room temperature. The specimen was removed from the liquor and placed in the apparatus in the air oven for 4 hours at $36 \pm 2^{o}C$. Then specimen was separated and dried. The samples were evaluated for change in colour and for staining using geometric grey scales.

3.9.4 **Colour fastness to crocking**

Dry rubbing test was carried out by the procedure given by BIS IS 766-1956. The sample size was 14x5 cm. Undyed cotton piece of 5x5 cm was taken. Sample was fixed to the rubbing device. The undyed piece was fixed to the rubbing device. The undyed piece was fixed to the end of the finger of rubbing device. It was rubbed to and fro in a straight line for 10 seconds. Testing was done in warp and weft directions. Now the samples were evaluated for change of colour and staining of undyed cloth using geometric grey scales.

3.9.5 Colour fastness to pressing

Colour fastness to dry and wet pressing was carried out as per BIS test number IS 689-1956.

3.9.5.1 **Dry pressing:** Test specimen of 10x4 cm was placed on dry undyed bleached cotton cloth of 14x14 cm. Iron heated to required temperature was kept on the test pieces for 15 seconds. The sample was evaluated for change in colour and for staining of undyed cloth with the help of geometric grey scales.

3.9.5.2 **Wet pressing:** The test piece was wetted and kept on dry piece of undyed cloth. On the test piece wet piece of undyed cloth was kept. It was pressed with appropriate temperature moving the iron to and fro for 15 seconds. The sample was evaluated for change in colour and for staining of undyed cloth with the help of geometric grey scales.

3.10 SUBJECTIVE ANALYSIS

Subjective evaluation was undertaken to compare and to assess aesthetic characteristics of the three types of clothes cotton, polyester and polyester-cotton blend.

Three types of fabrics dyed with two colours using three mordants were displayed for subjective evaluation. Thirty judges from college of Home Science, Hyderabad were selected for subjective evaluation. The rating schedule was prepared to evaluate the characteristics like lustre, colour, texture and overall appearance. A copy of rating schedule was appended (Appendix II).

3.11 STATISTICAL ANALYSIS OF THE DATA

The statistical analysis of the data was done under the following heads.

1. To compare within the treatments (mordants)
2. To compare between the types of fabrics

   Analysis of variance was used to assess the results of colour fastness tests.

The results of the subjective evaluation were analysed using percentages.

3.12 ESTIMATION OF COST

Cost of raw materials used in Kalamkari painting was calculated for each colour separately. The cost of painting was estimated per one metre of cloth. The cost differences between the three types of fabrics namely cotton, polyester cotton and polyester were given in Appendix IV.

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RESULTS AND DISCUSSION

CHAPTER IV

RESULTS AND DISCUSSION

The three types of fabrics namely cotton, polyester-cotton blend and polyester were painted with two colours of Kalamkari red and yellow using three mordants alum, stannous chloride and potassium dichromate. These samples were tested for their colour fastness to washing, light, perspiration, crocking and pressing.

One way analysis of variance was used to evaluate the degree of agreement between the treatments and types of the fabrics.

The analysed data is presented and discussed under the following sections.

4.1 Analysis of the preliminary survey

4.2 Assessment of colour fastness property

4.2.1 Colour fastness to washing

4.2.2 Colour fastness to light

4.2.3 Colour fastness to perspiration

4.2.4 Colour fastness to crocking

4.2.5 Colour fastness to pressing

4.3 Subjective analysis

4.4 Cost analysis

4.1 ANALYSIS OF PRELIMINARY SURVEY

A preliminary survey (Appendix I) was conducted to select a common polyester-cotton blend available in the market which enjoyed the consumer's preference. Majority

(75 per cent) of consumers prefered polyester-cotton blend of 67:33 per cent and hence selected for study besides 100 per cent cotton and 100 per cent polyester fabrics.

4.2 ASSESSMENT OF COLOURFASTNESS PROPERTY

According to Lyle (1977), the following are the terms used to describe the colour change and colour staining to washing, light, perspiration, crocking and pressing.

Table 4.1: Terms used to describe the colour change and colour staining

Colour change	Property	Rating
Negligible or no change	Excellent	5
Slight change	Good	4
Noticeable change	Fair	3
Considerable change	Poor	2
Much change	Very poor	1
Colour staining	**Property**	**Rating**
White	Negligible or no stain	5
Slightly tinted	Slight stain	4
Noticeably coloured	Noticeable stain	3
Considerably coloured	Considerable stain	2
Much coloured	Heavily stained	1

The following abbreviations are used to quantamise the colour fastness.

C.S. : Colour staining
C.C. : Colour change

4.2.1 Colour fastness to washing

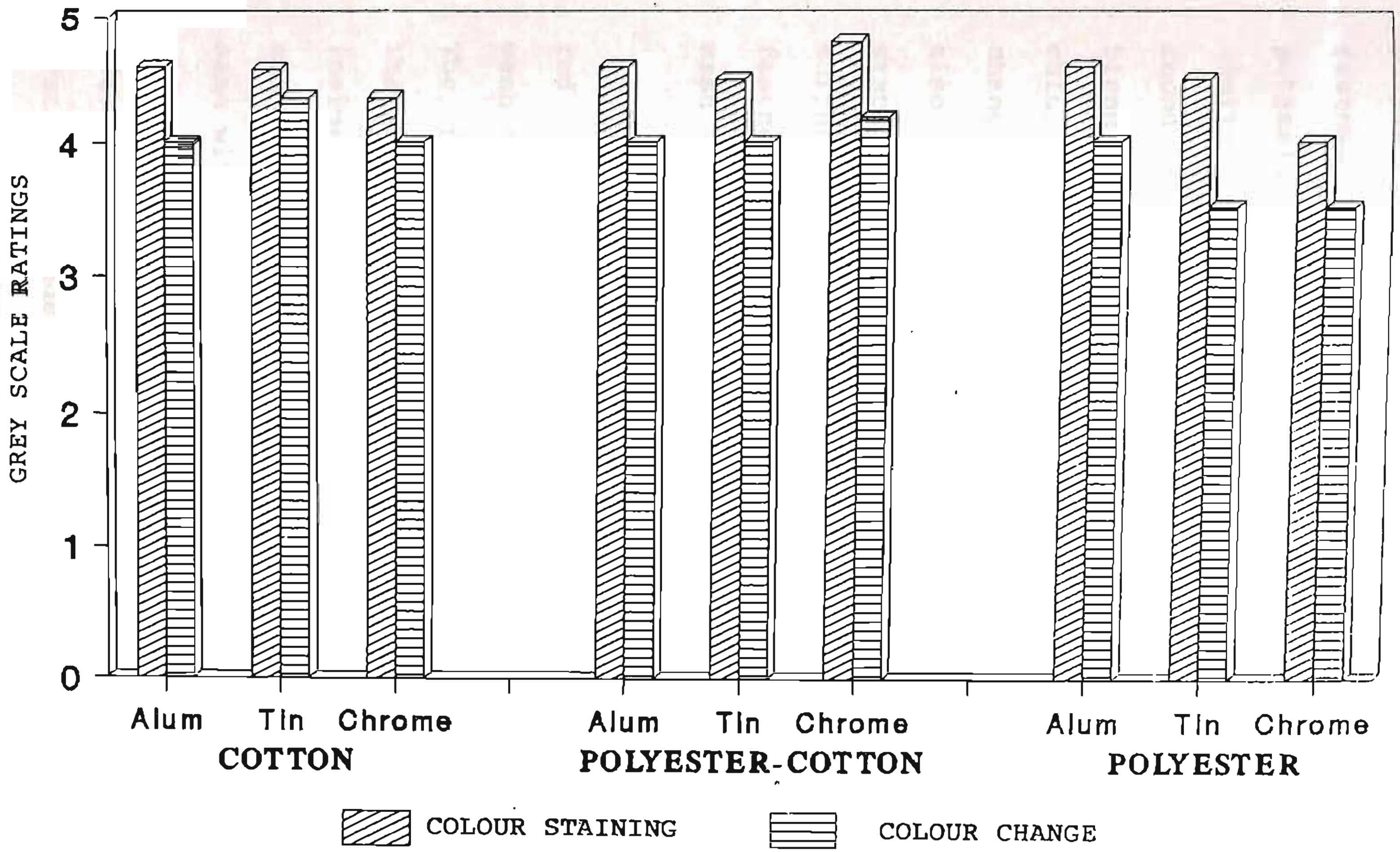
All dyed and printed textiles suitable for apparels and household purposes need to be fast to washing. The following table gives the grey scale ratings for colour change and colour staining after testing the fabrics for colour fastness to washing.

Table 4.2: Colour fastness to washing (Colour : Red)

	Cotton		Polyester -cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Alluminium potassium sulphate	4.6	4.0	4.6	4.0	4.6	4.0
Stannous chloride	4.58	4.36	4.5	4.0	4.5	3.5
Potassium dichromate	4.36	4.0	4.8	4.2	4.0	3.5

As per the data given in Table 4.2 and Figure 1 all the three fabrics viz., cotton, polyester-cotton blend and polyester fabrics showed negligible colour change after washing indicating good to excellent colour fastness. Among the mordants used for applying the red colour aluminium potassium sulphate (alum) was found to exhibit good to excellent colour fastness to washing on all the three fabrics selected. Colour staining was found to be negligible. Stannous chloride was also found to

1: COLOUR FASTNESS TO WASHING (Colour:Red)



give good to excellent wash fastness on cotton and polyester cotton blend. It showed fair to good colour fastness on polyester fabric. Fabrics dyed using potassium dichromate (chrome) were also found to have similar degree of washfastness. The colour change was found to be negligible on cotton and polyester-cotton blend. However, polyester samples mordanted with stannous chloride and chrome showed slightly noticeable colour change with the rating of 3.5. Similar results were also found by Gupta et al. (1993) in their study. The samples mordanted with copper sulphate alum, ferrous sulphate, potassium dichromate showed fair to good wash fastness but sample with stannous chloride showed poor wash fastness.

The good to excellent colour fastness property of red colour with all three mordants on cotton cloth after washing may be due to good absorbing property of cotton. The polymer system of cotton enables the fibre to absorb the dye molecules along with moisture and entrap them inside the polymer. Thus the colour change was not seen much and colour staining was also very negligible. It was same with polyester-cotton blend because polyester-cotton blend had cotton content which contributed to colour fastness. It is a known fact that polyester polymer system responds to high temperature and high pressure dyeing. As pre-mordanting method facilitated only for high temperature dyeing, it has not contributed much for dye uptake and thus polyester showed only fair to good colour fastness to washing.

One way analysis of variance was used to find whether there was any significant difference between three types of fabrics with three mordants for red colour after washing.

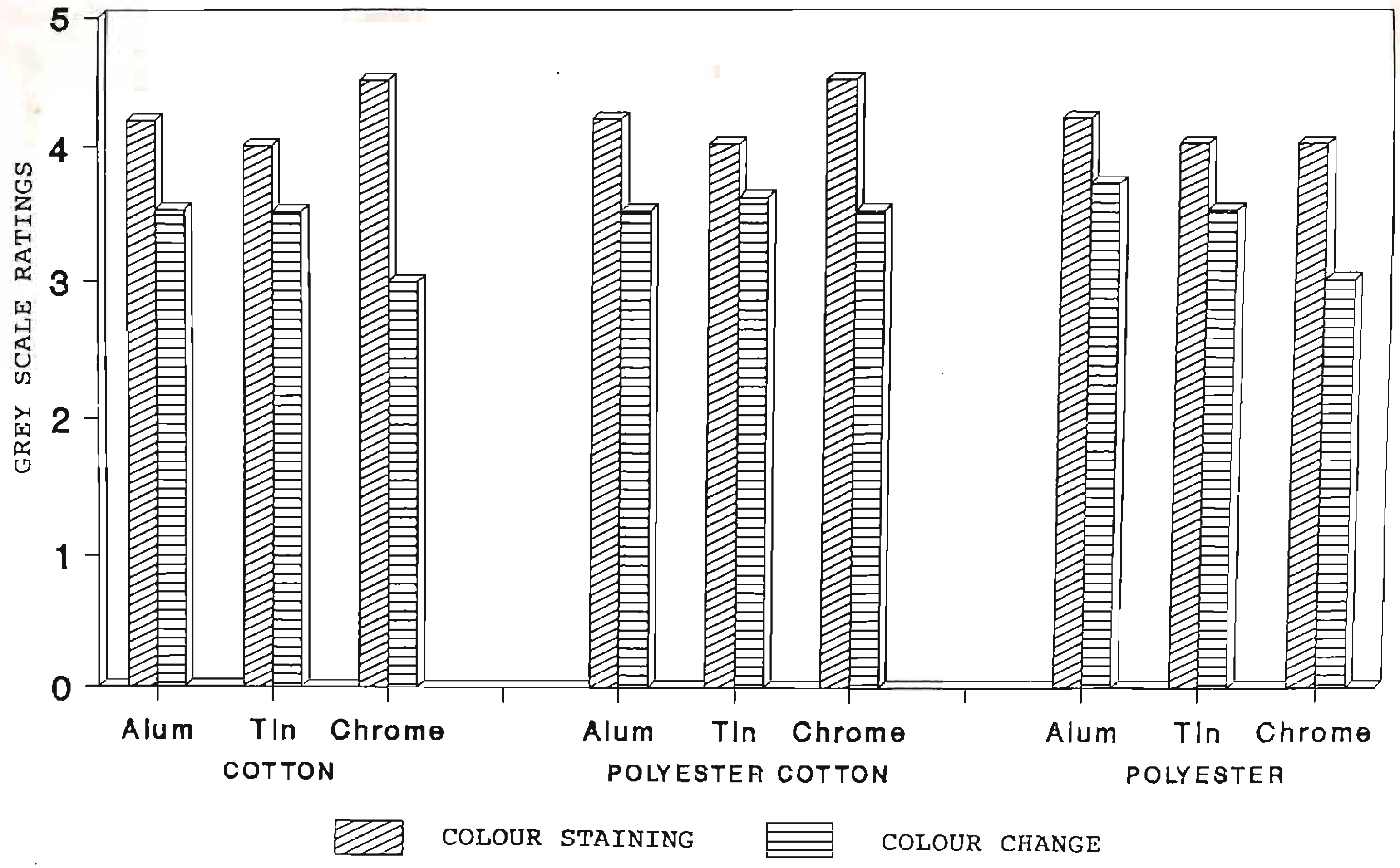
It was found that there was no significant difference between the mordants used for red colour on the three types of fabrics. The ANOVA Tables 1 and 2 for colour staining and colour change are given in Appendix II.

Table 4.3: Colour fastness to washing (Colour : Yellow)

	Cotton		Polyester -cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Alluminium potassium sulphate	4.2	3.52	4.2	3.5	4.2	3.7
Stannous chloride	4.0	3.5	4.0	3.6	4.0	3.5
Potassium dichromate	4.5	3.0	4.5	3.5	4.0	3.0

Table 4.3 gives the ratings given to samples of yellow dye to express the colour change and colour stain noticed after washing the fabrics.

FIG 2: COLOUR FASTNESS TO WASHING (Colour: yellow)



As per the data given in Table 4.3 and Figure 2 all three fabrics cotton, polyester-cotton and polyester showed slight noticeable colour change after washing indicating fair to good colour fastness. Among the mordants used for applying yellow colour alum and stannous chloride were found to give fair to good colour fastness to washing on all the three fabrics selected. Colour staining was found to be negligible. Chrome was found to give fair washfastness on cotton and polyester but on polyester-cotton it showed fair to good colour fastness. In general, yellow colour using these three mordants showed fair to good wash fastness on all three types of fabrics with an average rating of 3-4.

A study conducted by Susan (1993) also gave the similar results in which the samples dyed with the mordant stannous chloride showed poor to fair fastness whereas chrome showed fair to good fastness.

This may be due to the painting of the dye on fabric in simultaneous mordanting and not boiling the fabric in the dye bath. However in priliminary testing, pre-mordanting method was found to be unsuitable for yellow colour.

The ANOVA Tables 3 and 4 in the Appendix III showed that there was no significant difference between the mordants used for yellow colour on three types of fabrics.

4.2.2 Colour fastness to light

For majority of the end uses of fabrics, the dyes used on fabrics need colour fastness to light. Testing fabrics under xenon arc lamp was found to be similar to natural sunlight and more uniform (Lyle, 1977) and hence used for this study. The ratings given to describe the colour fastness of the samples are given in the following.

Table 4.4: Colour fastness to light (Colour : Red)

	Cotton	Polyester -cotton	Polyester
Aluminium potassium sulphate	3.0	3.5	3.0
Stannous chloride	1.5	1.5	2.0
Potassium dichromate	2.5	4.5	4.0

As indicated in Table 4.4 and Figure 3, all three fabrics showed variability in colour fastness properties with the three mordants. Among the mordants used for applying the red colour, alum was found to give fair to good colour fastness to light on all three fabrics selected with gray scale rating of 3.0 to 3.5. Stannous chloride was found to give poor light fastness on all three fabrics. Red colour dyed using chrome mordant were found to have good to excellent light fastness on polyester cotton and polyester fabrics. It showed poor to fair light fastness on cotton fabrics. The chrome part

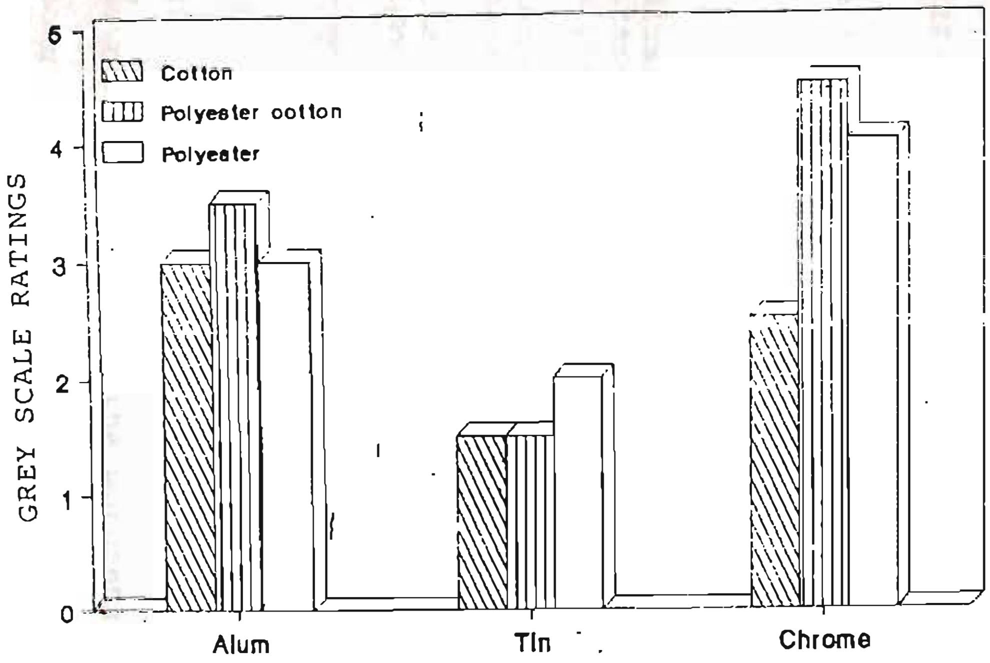


FIG 3: COLOUR FASTNESS TO LIGHT (Colour:Red)

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present in the dye seems to have helped the polyester and polyester-cotton blend fabrics to stabilise the colour. Moreover presence of chromium adds to the stability of chromophores resulting in added resistance to the ultravoilet component of sunlight (Gohl and Vilensky, 1983).

As indicated in the ANOVA Table 5 in Appendix No.2, it was found that there was no significant difference at 5 per cent.

Table 4.5: Colour fastness to light (Colour : Yellow)

	Cotton	Polyester -cotton	Polyester
Alluminium potassium sulphate	3.0	4.0	2.5
Stannous chloride	3.5	2.0	1.5
Potassium dichromate	1.5	3.0	2.0

As per the data given in Table 4.5 and Figure 4 all three fabrics showed difference in their light fastness according to the mordants used for yellow colour. Among the mordants used for applying the yellow colour alum was found to give fair light fastness on cotton and polyester. It showed good light fastness on polyester-cotton fabric. Stannous chloride was found to give fair

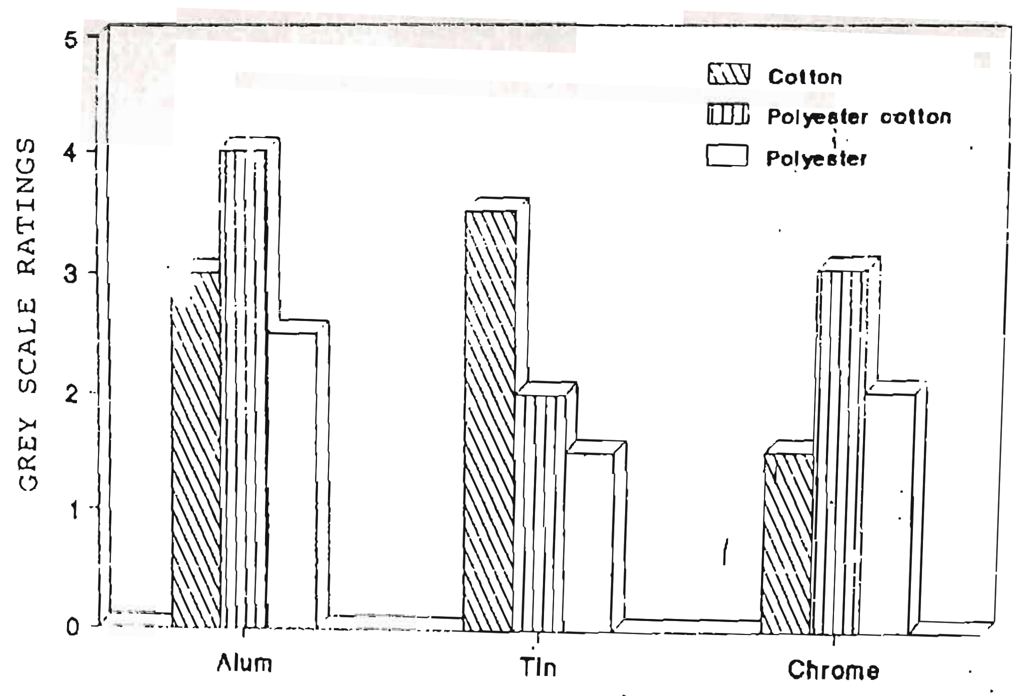


FIG 4: COLOUR FASTNESS TO LIGHT (Colour:yellow)

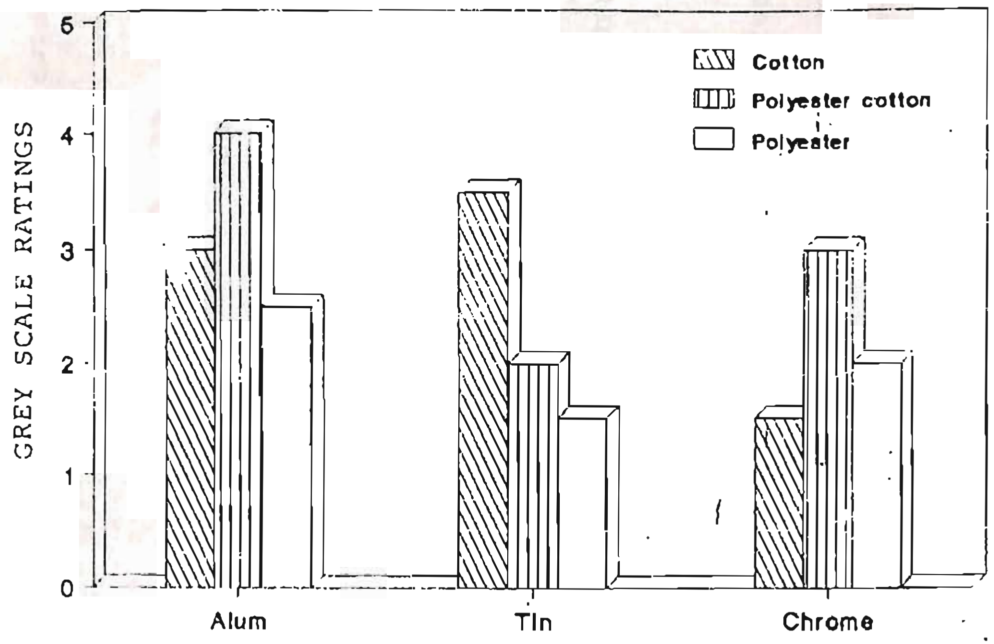


FIG 4: COLOUR FASTNESS TO LIGHT (Colour:yellow)

to good light fastness on cotton and poor light fastness on polyester-cotton and polyester fabrics dyed using chrome were also found to give poor light fastness on cotton and polyester. It was found that chrome showed fair light fastness on polyester cotton with yellow colour.

As indicated earlier, the method of application of yellow colour on fabric seems to have played a role which reflects in the form of poor to fair light fastness. Painted fabric may be affected much readily than dyed fabrics because most of the dye is on the surface and not inside the fabrics (Lyle, 1977).

As given in the ANOVA Table 6, it was found that there was no significant difference between the mordants used for yellow colour on the three types of fabrics.

4.2.3 Colour fastness to perspiration

Colour fastness to perspiration should be considered in selecting fabrics for apparels. Fabrics were tested for colour fastness to perspiration in both acidic and alkaline conditions. The data pertained to colour change and colour staining after exposing the samples to acidic condition is presented in the following Table.

Table 4.6: Colour fastness to perspiration (Colour : Red)

	Cotton		Polyester cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Alluminium potassium sulphate	4.0	3.5	4.0	3.8	4.5	4.5
Stannous chloride	4.5	3.5	4.0	4.0	4.5	4.0
Potassium dichromate	4.0	3.5	4.0	4.0	4.5	4.0

As per the data given in Table 4.6 and Figure 5 colour staining was negligible on all the three types of fabrics with all mordants. Among three mordants studied, alum showed fair to good colour fastness to perspiration on cotton and polyester-cotton. It showed good to excellent fastness to perspiration on polyester. Stannous chloride and chrome were found to give good colour fastness to perspiration on polyester-cotton and polyester with a rating of 4.0 to 4.5. They showed fair to good fastness on cotton fabric with the rating of 3.5-4.0.

It was interesting to note that, with regard to colour staining there was significant difference between the fabrics with different mordants for fastness of red colour to acidic perspiration (ANOVA Table 7 in Appendix II). With regard to colour change there was no significant difference (Table 8 in Appendix II).

FIG 5: COLOUR FASTNESS TO ACIDIC PERSPIRATION (Colour:Red)

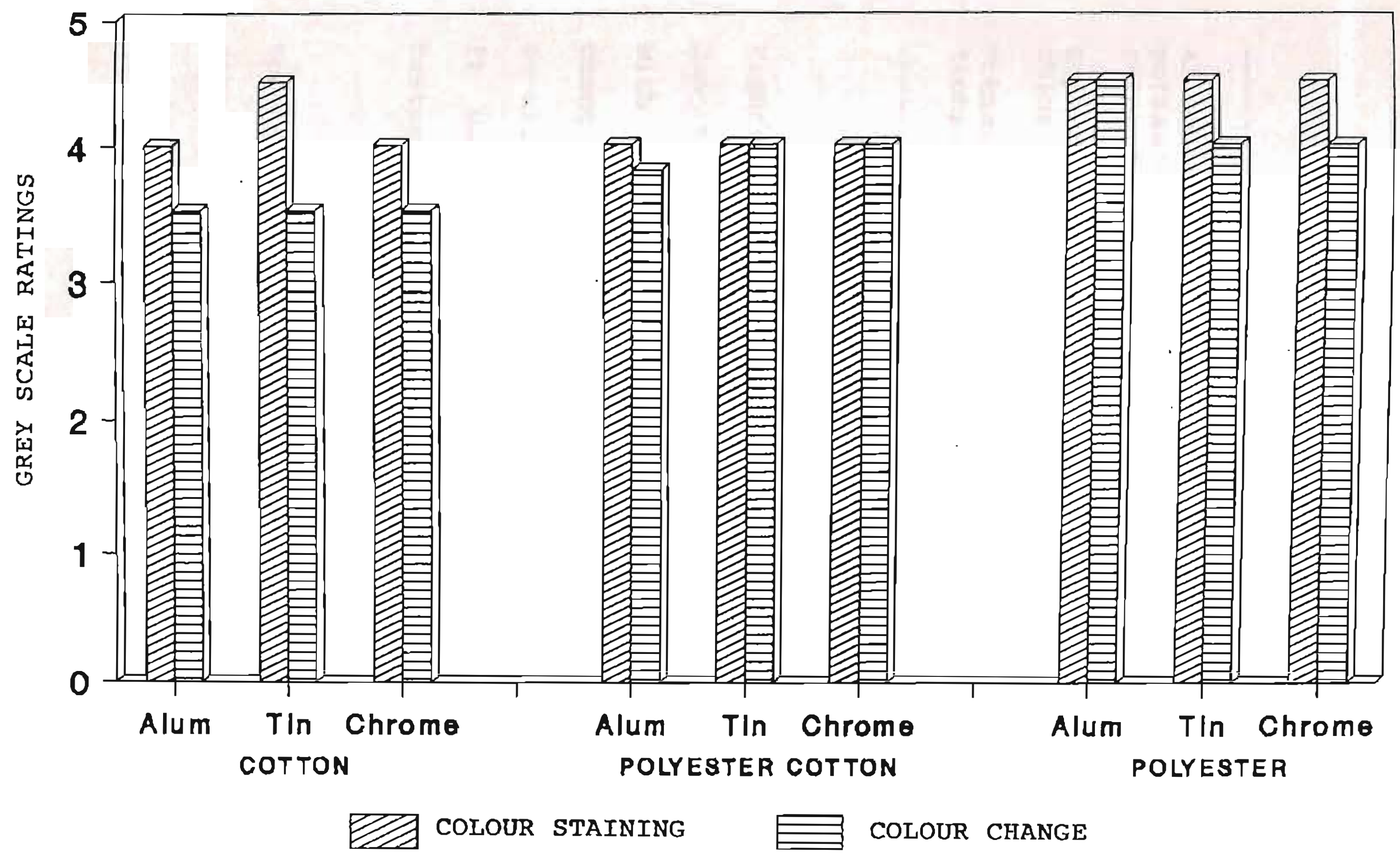


Table 4.7: Colour fastness to acidic perspiration (Colour : Yellow)

	Cotton		Polyester -cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Alluminium potassium sulphate	4.5	4.0	5.0	4.0	5.0	4.5
Stannous chloride	5.0	4.0	5.C	4.0	5.0	4.0
Potassium dichromate	4.5	4.5	5.0	4.0	5.0	4.0

As per the ratings recorded in Table 4.7 and Figure 6 it was found that the staining of yellow colour due to acidic liquor on all the three types of fabrics with all mordants was negligible. With regard to colour change also it was found that there was negligible change on all the three types of fabrics with all mordants. Thus it was found that yellow colour has good to excellent fastness to perspiration in acidic conditions.

As indicated in the ANOVA Tables 9 and 10 in the Appendix II it was found that there was no significant difference between three types of fabrics with three mordants for yellow colour after perspiration test.

FIG 6: COLOUR FASTNESS TO ACIDIC PERSPIRATION (Colour:Yellow)

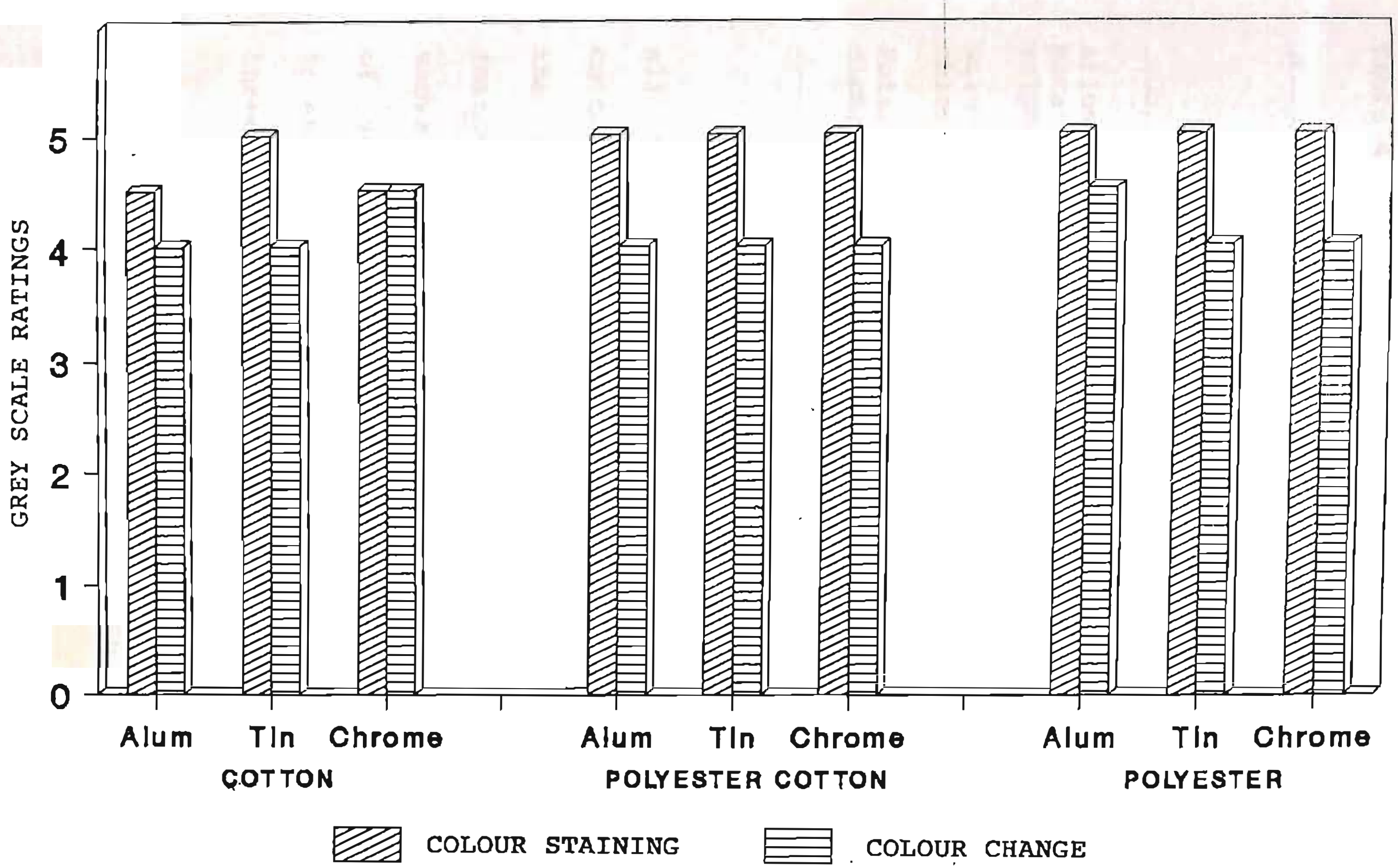


Table 4.8: Colour fastness to alkaline perspiration (Colour : Red)

	Cotton		Polyester -cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Alluminium potassium sulphate	4.5	3.5	5.0	4.0	5.0	5.0
Stannous chloride	4.5	3.5	5.0	4.0	5.0	4.5
Potassium dichromate	5.0	4.0	5.0	4.0	5.0	4.0

As indicated in the above Table 4.8 and Figure 7, all the three fabrics showed negligible colour staining. Cotton showed fair to good fastness to perspiration with the mordants alum and tin. With chrome it showed good fastness to alkaline perspiration. Polyester - cotton showed good fastness to perspiration with all three types of mordants alum, tin and chrome. Polyester showed good to excellent fastness to alkali perspiration with all the three mordants used.

As listed in Tables 11 and 12 in appendix No.II, it was found that there was no significant difference at 5 per cent level.

FIG 7: COLOUR FASTNESS TO ALKALI PERSPIRATION (Colour:Red)

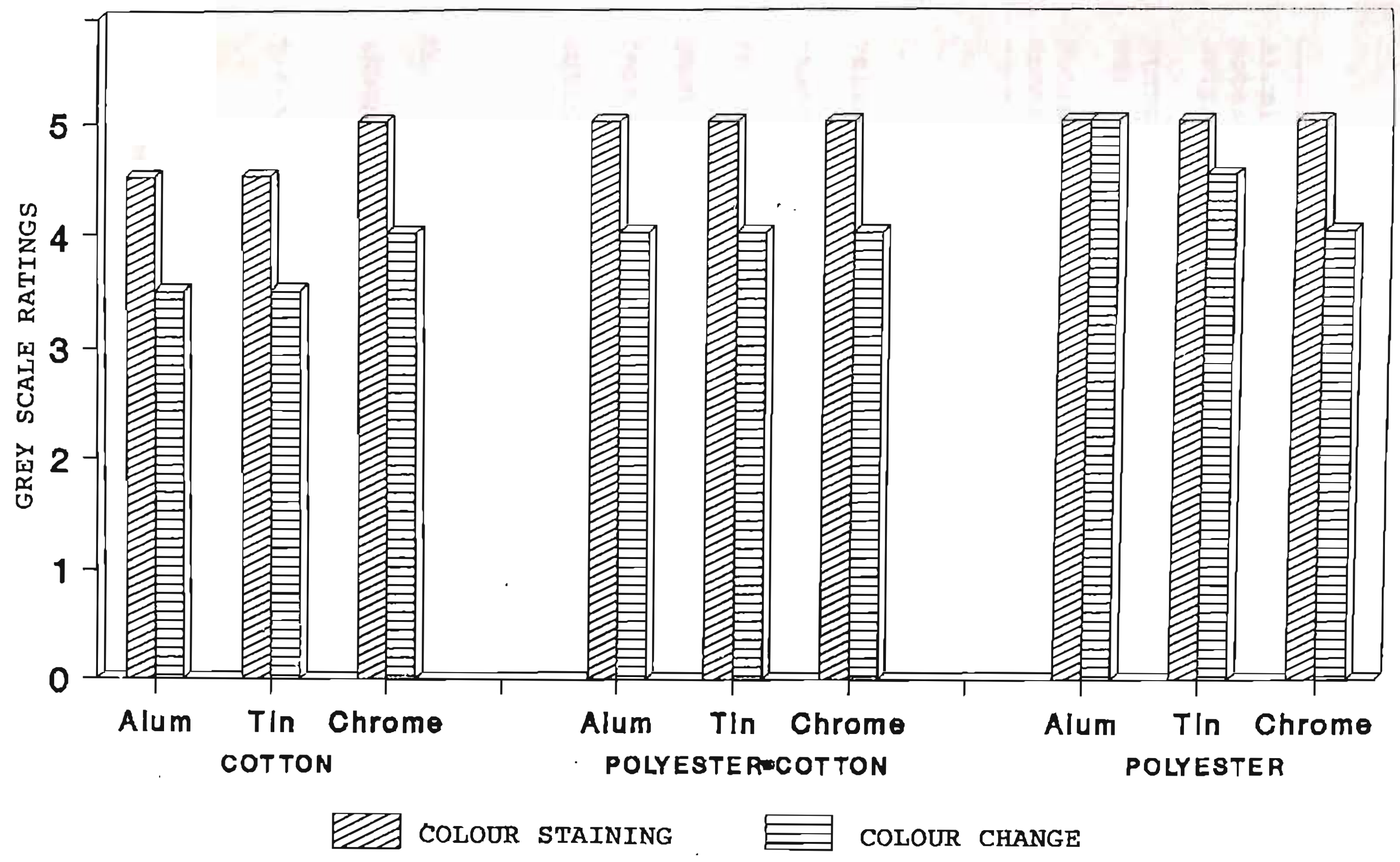


Table 4.9: Colour fastness to alkaline perspiration (colour : yellow)

	Cotton		Polyester - cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Aluminium potassium sulphate	4.5	4.0	5.0	4.0	5.0	4.5
Stannous chloride	5.0	4.5	5.0	4.0	5.0	4.5
Potassium dichromate	5.0	4.0	5.0	4.0	5.0	4.5

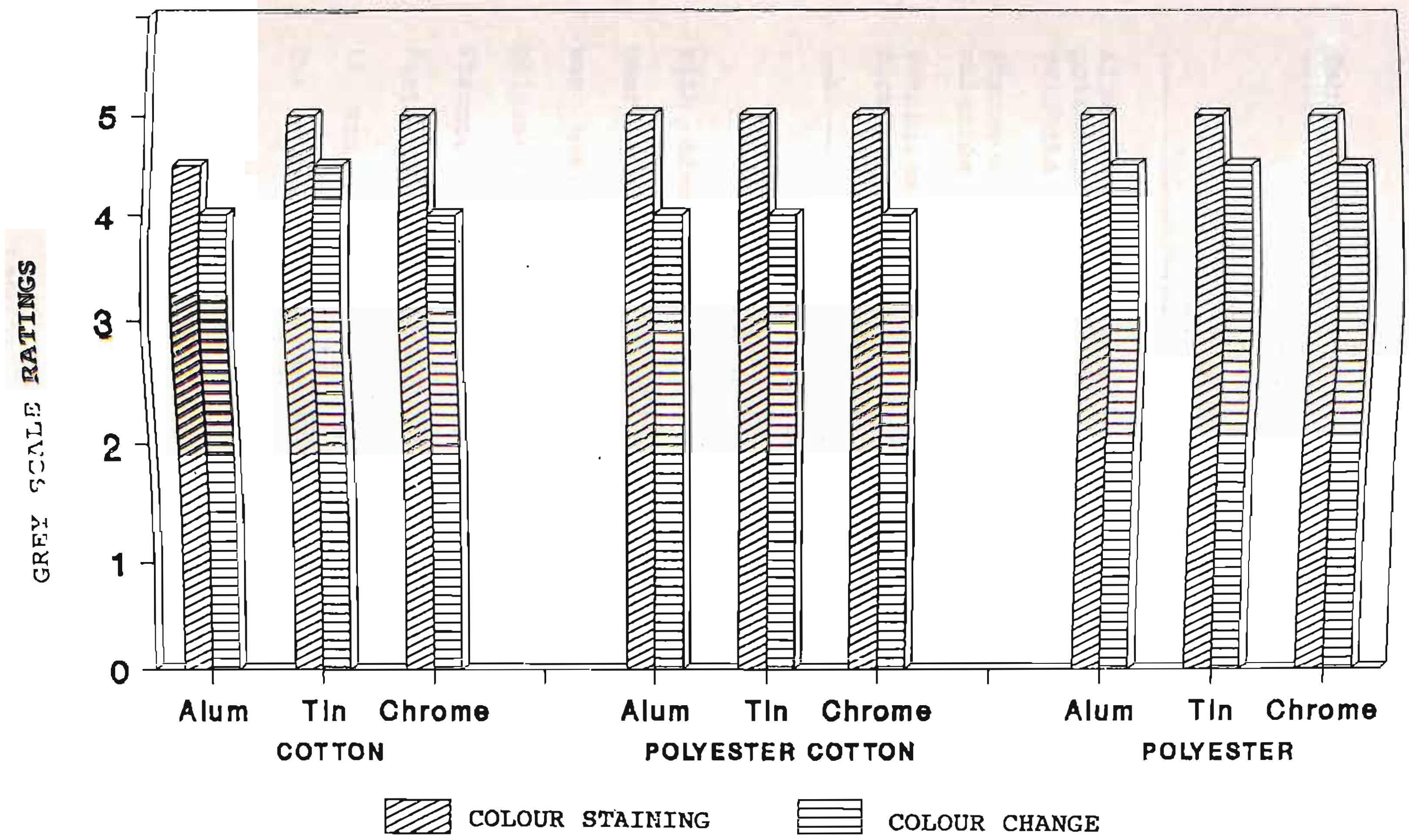
As indicated in the Table 4.9 and Figure 8, yellow colour showed negligible colour staining and colour change on three types of fabrics with all three mordants to alkaline perspiration test. All the mordants showed good to excellent colour fastness to alkaline perspiration test on the three types of fabrics cotton, polyester-cotton and polyester.

There was no significant difference found between the three types of fabrics to alkaline perspiration test. ANOVA Tables 12 and 13 were given in Appendix II.

4.2.4 Colour fastness to crocking

Crocking is defined as the colour transference from one coloured textile material to another by rubbing. Colour fastness to crocking is important for apparel fabrics and equally important for household fabrics.

FIG 8: COLOUR FASTNESS TO ALKALI PERSPIRATION (Colour:Yellow)



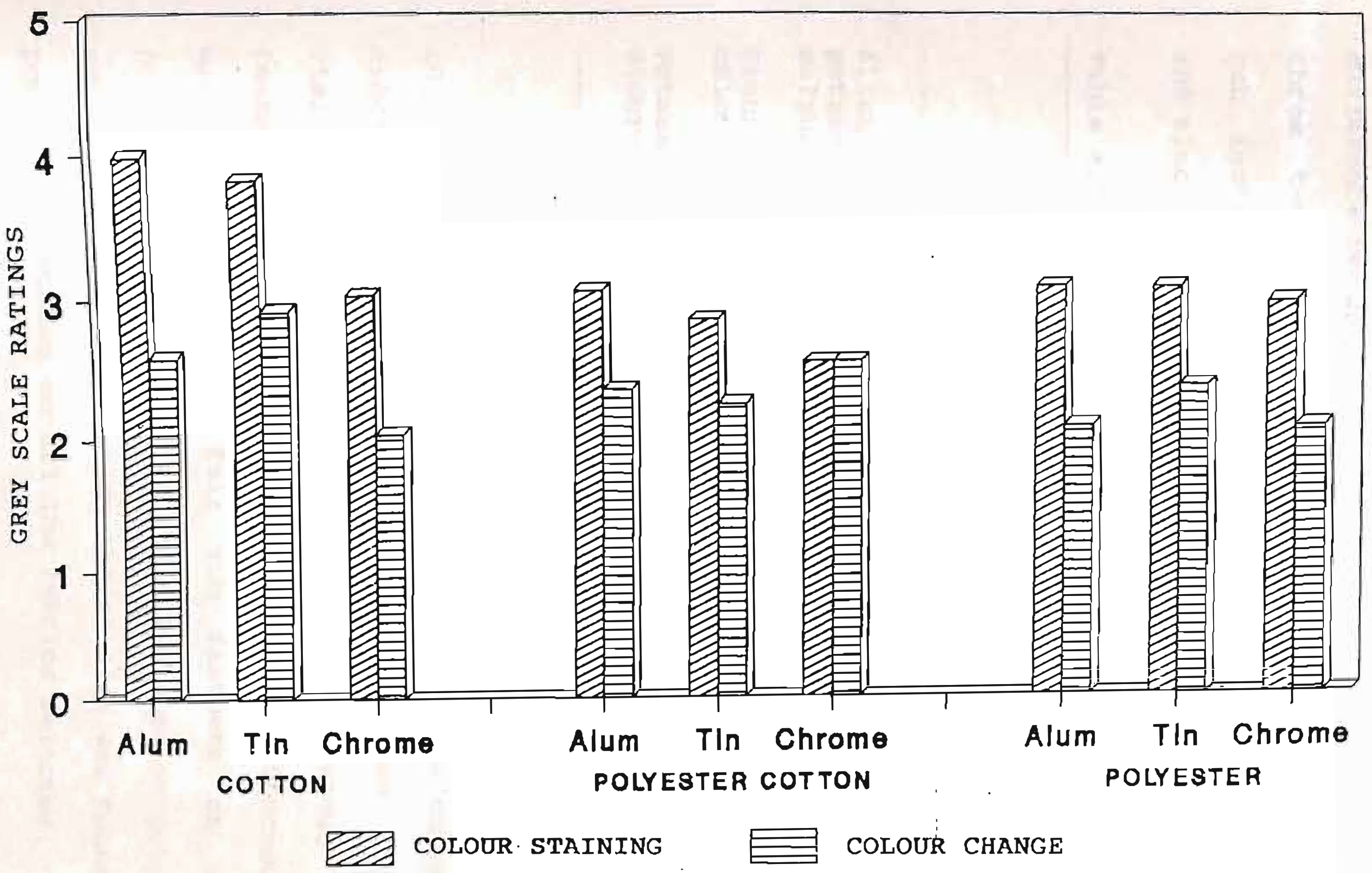
The data pertaining to colour change and colour staining after crocking is presented below.

Table 4.10: Colour fastness to crocking (Colour : Red)

	Cotton		Polyester - cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Aluminium potassium sulphate	3.98	2.58	3.0	2.3	3.0	2.0
Stannous chloride	3.8	2.9	2.8	2.2	3.0	2.3
Potassium dichromate	3.0	2.0	2.5	2.5	2.9	2.0

As recorded in Table 4.10 and Figure 9 red colour with alum showed considerable colour change indicating poor rub fastness on all three fabrics selected. There was noticeable colour staining on polyester-cotton and polyester. On cotton it showed only slight stain. Stannous chloride was found to give poor to fair rub fastness to red colour on polyester-cotton and polyester. It was found that it gave fair rub fastness on cotton. The fabric dyed using chrome were also found to have similar degree of rub fastness i.e. poor to fair rub fastness. As the larger molecules of natural dyes cannot penetrate the polymer system, they tend to be present on the surface. Hence poor to fair crocking was seen in all samples. As recorded in ANOVA Tables 14 and 15 given in

FIG 9: COLOUR FASTNESS TO CROCKING (Colour:Red)



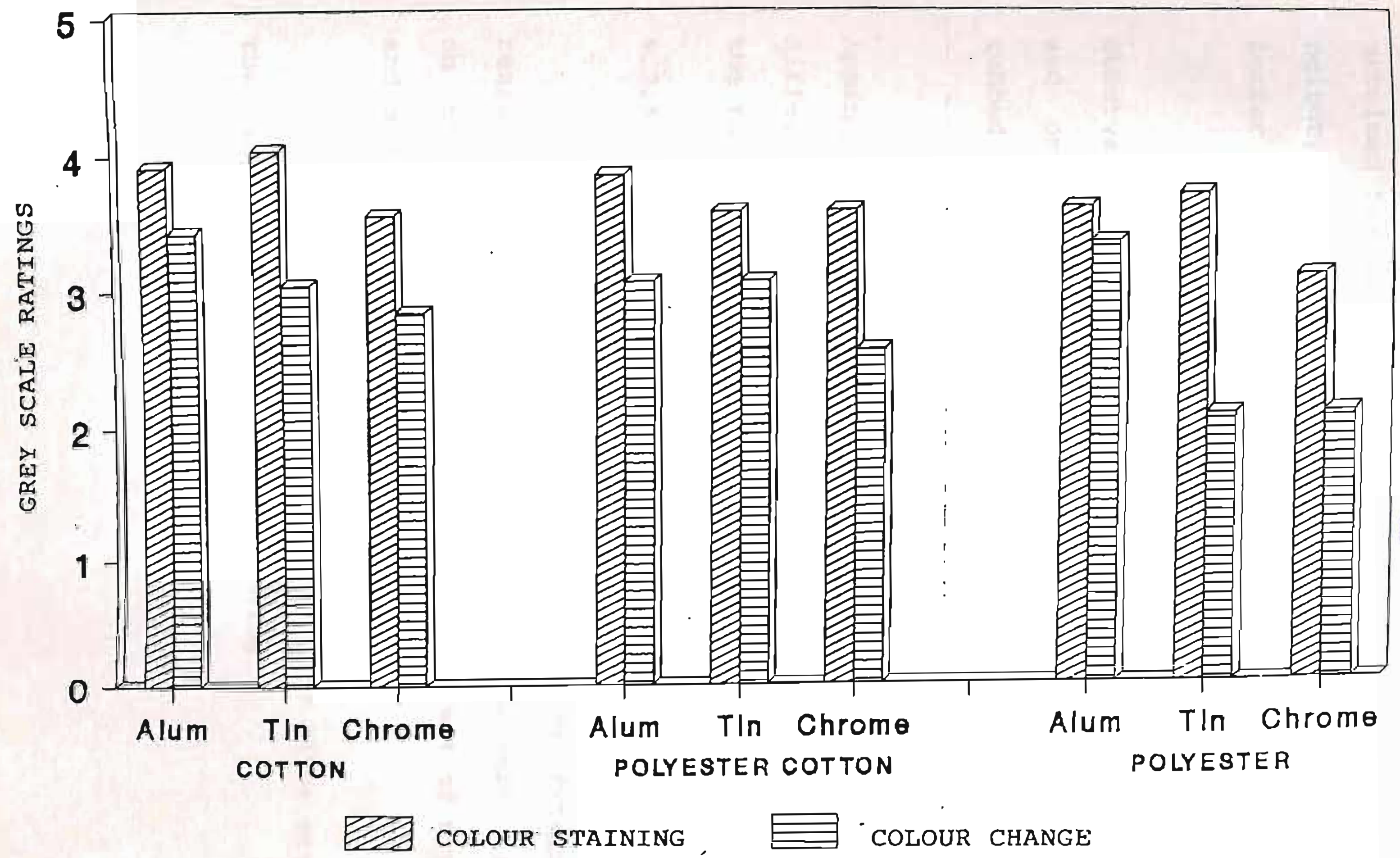
Appendix No.II it was found that there was no significant difference between the mordants used for red colour on the three types of fabrics. Thus they were showing similar rub fastness properties with respect to colour staining and also colour change.

Table 4.11: Colour fastness to crocking (Colour : Yellow)

	Cotton		Polyester -cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Alluminium potassium sulphate	3.9	3.4	3.78	3.0	3.5	3.24
Stannous chloride	4.0	3.0	3.5	3.0	3.6	2.0
Potassium dichromate	3.5	2.8	3.5	2.5	3.0	2.0

By observing the ratings in Table 4.11 and Figure 10 it was found that the change in yellow colour due to crocking was noticeable. It was found that colour staining was also noticeable. Alum shows fair rub fastness on the three types of fabrics. Stannous chloride was found to give fair rub fastness on cotton and polyester-cotton. Rub fastness was poor on polyester with mordant stannous chloride chrome also was found to give poor rub fastness on all the fabrics selected.

FIG 10: COLOUR FASTNESS TO CROCKING (Colour:Yellow)



It was observed that eventhough the shade obtained for yellow colour was light when compared to red colour, its colour fastness was found to be slightly better than the red colour.

This observation was agreeable with the observations of Lyle (1977) that dark shades are more in and on the fabric. So there is more dye that can be rubbed off.

As recorded in ANOVA Tables 15 and 16 given in Appendix No.II, it was found that there was no significant difference between the mordants used for yellow colour on the three types of fabrics.

4.2.5 Colour fastness to pressing

Colour fastness to pressing determines the resistance of the colour of textiles to heat. The colour on the fabrics were tested to the effect of dry pressing and also wet pressing.

The grey scale ratings given after dry pressing the samples is given in Table below.

Table 4.12: Colour fastness to dry pressing (Colour : Red)

	Cotton		Polyester -cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Alluminium potassium sulphate	5.0	4.5	5.0	4.5	5.0	4.0
Stannous chloride	5.0	4.0	5.0	4.0	5.0	4.0
Potassium dichromate	5.0	4.5	5.0	4.0	5.0	4.0

Table 4.12 gives the colour fastness grades for red colour to dry pressing. The colour staining and colour change was found to be negligible. It was evident from the table that red colour has excellent colour fastness to dry pressing on all the three types of fabrics using three mordants with the rating of 4.5 to 5.0. It indicates that all the fabrics could be easily pressed after use.

There was no significant difference in colour staining pertaining to the three mordants on the three types of the fabrics. ANOVA Tables 17 and 18 were given in Appendix II.

Table 4.13: Colour fastness to dry pressing (Colour : Yellow)

	Cotton		Polyester -cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Alluminium potassium sulphate	5.0	5.0	5.0	5.0	5.0	4.8
Stannous chloride	5.0	4.9	5.0	4.85	5.0	4.8
Potassium dichromate	5.0	5.0	5.0	5.0	5.0	4.8

Table 4.13 gives colour fastness grades of yellow colour to pressing. It shows almost complete absence of colour change and colour staining in all samples tested. Hence yellow colour on cotton, polyester-cotton and polyester showed excellent fastness to dry pressing with all mordants used - alum, tin and chrome with the rating of 5.0.

As indicated in the ANOVA Tables 19 and 20 in Appendix II, it was found that there was no significant difference at 5 per cent level of significance for colour staining and colour change after dry pressing.

Table 4.14: Colour fastness to wet pressing (Colour : Red)

	Cotton		Polyester -cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Alluminium potassium sulphate	5.0	4.5	5.0	4.5	5.0	4.0
Stannous chloride	5.0	4.0	5.0	4.0	5.0	4.0
Potassium dichromate	5.0	4.5	5.0	4.0	5.0	4.0

Red colour shows good to excellent colour fastness to wet pressing on all three types of the fabrics with rating of 4-5. They were found to be equally good with three mordants alum, tin and chrome. There was no significant difference regarding colour staining and colour change as given in the ANOVA Tables 21 and 22 in Appendix II.

Table 4.15: Colour fastness to wet pressing (Colour : Yellow)

	Cotton		Polyester -cotton		Polyester	
	C.S.	C.C.	C.S.	C.C.	C.S.	C.C.
Aluminium potassium sulphate	4.0	3.2	4.0	3.5	4.0	3.5
Stannous chloride	4.0	3.5	4.0	3.6	4.0	3.2
Potassium dichromate	4.0	3.4	4.0	3.5	4.0	3.3

Colour staining of yellow colour was found to be slightly negligible on all the three fabrics using alum, tin and chrome. Colour change was found to be noticeable with a ratio of 3.2 to 3.6. Thus it was found to have fair to good colour fastness to wet pressing with all the three mordants. In wet pressing the moisture assists in the removal of dye. This might be the reason for fair to good fastness to wet pressing.

ANOVA Tables 23 and 24 in Appendix II show that there was no significant difference between the mordants used for yellow colour on the three types of fabrics.

4.3 SUBJECTIVE EVALUATION

In order to compare the effect of Kalamkari on 100 per cent polyester and 67:33 per cent polyester-cotton blend with that of cotton, subjective evaluation was conducted using a schedule given in Appendix III. Rating was done based on the magnitude of aesthetic characteristics. The ratings given by the respondents were tabulated and analysed statistically using percentages. The results were as follows:

Three types of fabrics were dyed in red colour using three mordants and were subjected to evaluation based on aesthetic characteristics such as lustre, colour, texture and overall appearance. The percentages of

Table 4.16:Ratings given for lustre of fabrics dyed in red colour (in per cent)

	Aluminium Potassium Sulphate			Stannous Chloride			Potassium dichromate		
	C	P/C	P	C	P/C	P	C	P/C	P
Dull	20	33	-	13	23	6	16	23	3
Medium	36	37	76	37	27	70	26	20	46
Bright	44	30	24	50	50	24	58	57	51

The percentage of ratings as given in the Table 4.16 revealed that most of the respondents observed change in the lustre of the fabrics dyed in red colour.

All fabrics dyed using alum showed variations. Thirty six per cent of respondents rated it as medium. Forty four per cent of respondents rated it as bright.

On polyester-cotton blend the lustre was rated as dull by 33 per cent of respondents. Thirty seven per cent of respondents rated it for medium lustre while only 30 per cent rated it for bright lustre. Majority of respondents felt that polyester dyed in red colour using alum had medium lustre (76 per cent), while only 24 per cent rated it as having bright lustre.

Stannous chloride as mordant for red colour on cotton, fifty per cent had a rating for bright lustre and thirty seven per cent for medium lustre. On polyester cotton less than half of respondents rated it as having dull and medium lustre, while half of the respondents felt that this had a bright lustre. In case of polyester, majority of the respondents rated it for having medium lustre (70 per cent).

More than 50 per cent of respondents felt that all the three fabrics dyed in red colour using chrome mordant were bright. However a considerable majority of respondents felt that polyestser was having medium lustre.

The above results show that, the red colour mordanted with alum was bright on cotton, medium on polyester-cotton and polyester. With the use of stannous chloride, cotton and polyester-cotton were bright and polyester was medium. The three fabrics dyed in red colour using chrome mordant were bright.

Table 4.17:Ratings given for intensity of red colour (in per cent)

	Aluminium Potassium Sulphate			Stannous Chloride			Potassium dichromate		
	C	P/C	P	C	P/C	P	C	P/C	P
Pale	0	21	23	13	16	16	26	13	3
Moderate	6	53	66	40	23	54	16	33	54
Dark	94	26	11	47	61	30	58	54	43

It is evident from the table that majority of respondents (94 per cent) had classified the colour on cotton fabric with alum mordant as dark in shade. Half of the respondents rated polyester cotton blend as having medium colour shade and only one forth of the respondents felt that the shade was dark.

Around one forth of respondents rated polyester as having pale colour (23 per cent). More than half of respondents rated it for medium shade.

Around half of the respondents rated cotton with stannous chloride mordant as dark shade. While 40 per cent of them felt that shade was medium. On polyester-cotton more than half of the respondents (61 per cent) rated it as medium colour shade. The shade on polyester sample was considered to be dark by 30 per cent of respondents. Half of the respondents felt that the colour was medium.

More than half the respondents rated cotton with mordant chrome as having dark shade (58 per cent). Similar trend was observed in polyester-cotton with chrome. Half the percentage of respondents rated polyester as having moderate shade (54 per cent).

The above rating for red colour clearly showed that among the three mordants used, shade obtained using alum was found to be darker on cotton and stannous chloride on polyester-cotton. All mordants used were able to produce only medium shades on polyester.

Table 4.18: Ratings given for texture of fabrics dyed in red colour (in per cent)

	Aluminium potassium sulphate			Stanuous chloride			Potassium dichromate		
	C	P/C	P	C	P/C	P	C	P/C	P
Smooth	23	43	43	36	36	13	40	23	33
Medium	50	30	37	23	48	66	26	46	60
Rough	27	27	20	41	16	21	34	31	7

Among the samples mordanted with alum around one fourth of the respondents felt that the surface was rough. Cotton was rated as having medium texture as rated by half of the respondents. Polyester-cotton was felt as having smooth texture by 43 per cent of the respondents. Only thirty per cent of respondents rated polyester-cotton as having medium texture. It was almost same with that of polyester.

Cotton sample with stannous chloride had rough texture as rated by 41 per cent of respondents. Only one fourth of them rated it as having medium texture. Half of the respondents felt polyester cotton as having medium texture. Majority of respondents (66per cent) felt that polyester had medium texture.

Cotton fabric with chrome mordant showed smooth texture as felt by forty per cent of respondents. Polyester-cotton was found to have medium texture as rated by 46 per cent of respondents. More than half of the respondents felt polyester as having medium texture (60 per cent).

It is evident from the above result that cotton had medium texture and polyester-cotton and polyester had smooth texture when dyed in red using alum. With stannous chloride cotton had rough texture and polyester cotton and polyester had medium texture. Cotton had smooth texture and polyester-cotton, and polyester had medium textures with the use of chrome mordants.

Table 4.19: Preferences of respondents based on overall appearance for red colour

	Aluminium potassium sulphate	Stannous chloride	Potssium dichromate
Cotton	40	23	20
Polyester cotton	33	60	50
Polyester	27	17	30

Regarding the prefernce of the respondents for the three fabrics dyed in red colour using the mordant alum, cotton was rated high, followed by polyester cotton and polyester.

With the mordant stannous chloride the preference of the respondents preferred polyester-cotton followed by cotton and polyester. The fabrics that are dyed with chrome mordant rated in order of preference was polyester-cotton, polyester and cotton.

Three types of selected fabrics were dyed in yellow colour using three mordants and were subjected to evaluation based on aesthetic charecteristics such as lustre, colour, texture and over all appeareance. The percentages of rankings in terms of lustre are given in Table 4.20.

Table 4.20: Ratings given for lustre of fabrics dyed in yellow colour (in per cent)

	Aluminium potassium sulphate			Stanuous chloride			Potassium dichromate		
	C	P/C	P	C	P/C	P	C	P/C	P
Dull	16	16	13	16		13	10	26	3
Medium	27	37	40	47	50	30	60	60	63
Bright	57	47	47	37	50	57	30	14	34

The percentage of rankings as given in table 4.20 revealed that most of the respondents observed change in the lustre of the fabrics dyed in yellow colour.

More than half of the respondents (57per cent) had rated cotton as having bright lustre.

On polyester-cotton blend the lustre was rated as medium by 37 per cent of respondents, while forty seven per cent had rated both polyester-cotton and polyester as having bright lustre. Forty per cent rated polyester as having medium lustre.

For stannous chloride as mordant for yellow colour on cotton, forty seven percent rated it for having medium lusture. Polyester-cotton blend also was rated as having medium lustre by half of the respondents and the other half (50 per cent) rated it as having bright lustre. In the case of polyester more than half rated it as having bright lustre. Thirty per cent of respondents felt that it had medium lustre.

More than 50 per cent of respondents felt that the chrome mordanted cotton, polyester-cotton and polyester fabrics were of medium lustre.

The above results indicate that all fabrics dyed in yellow colour using alum were bright. With the use of stannous chloride, the lustre seemed to have improved on polyester-cotton and polyester. All the three fabrics were found to have medium lustre with the use of chrome mordant.

Table 4.21: Ratings given for intensity of yellow colour in (per cent)

	Aluminium potassium sulphate			Stanuous chloride			Potassium dichromate		
	C	P/C	P	C	P/C	P	C	P/C	P
Pale	3	3	27	10	7	3	13	7	3
Medium	23	67	63	20	23	57	23	30	40
Dark	74	30	10	70	70	40	64	63	57

It is clear from the Table 4.21 that majority of respondents (74per cent) felt that the colour on cotton fabric using alum mordant was dark. On polyester-cotton blend and polyester it was medium as viewed by more than half of the respondents (63 - 67 per cent).

With the mordant stannous chloride, majority of respondents (70 per cent) rated cotton and polyester-cotton fabrics as having dark shades. It was found that only 20 - 23 per cent of respondents rated medium for cotton and polyester-cotton. More than half of the respondents rated polyester as having medium shade and 40 per cent for having dark shade.

More than half of respondents (57-64 per cent) rated all the three chrome mordanted fabrics as having dark shade.

Shade of yellow colour using alum was dark on cotton and medium on polyester-cotton and polyester. With stannous chloride it was dark on cotton and polyester-cotton. Colour shade was medium on polyester. With Chrome all the three fabrics were found to have dark shade.

Table 4.22: Ratings given for texture of fabrics dyed in yellow colour (in per cent)

	Aluminium potassium sulphate			Stanuous chloride			Potassium dichromate		
	C	P/C	P	C	P/C	P	C	P/C	P
Smooth	17	27	34	43	33	30	27	16	40
Medium	43	23	33	27	40	43	53	67	47
Rough	40	50	33	30	27	27	20	17	13

The percentage of ratings as given in Table 4.22 revealed that most of the respondents observed change in the texture of the fabric and dyed in yellow colour.

40 to 43 per cent of respondents rated cotton as having medium to rough texture. Less than half of the respondents (23-27 per cent) rated polyester-cotton as having smooth to rough texture. Half of the respondents rated it as having rough texture. Less than half of the percentage of respondents (33-34 per cent) rated polyester as having smooth, medium and rough textures.

With stannous chloride 43 per cent of respondents felt that cotton has smooth texture. Less than half of the respondents (27-30per cent)rated cotton as having medium and rough textures. On polyester-cotton 40 per cent of respondents rated that texture was medium. Only 27 to 30 per cent rated polyester-cotton and polyester as having smooth to rough textures. Fourty three per cent of respondents rated polyester as having medium lustre.

Cotton with chrome as mordant had medium texture as rated by 53 per cent. One fourth of respondents rated it as smooth and rough textures. On polyester-cotton and polyester also around half of the respondents rated it as medium texture.

Above results indicate that texture on cotton was medium and on polyester it was rough with alum. With stannous chloride cotton was smooth and polyester-cotton and polyester were medium. With chrome mordant all the three types of fabrics showed medium textures.

Table 4.23: Overall appearance of yellow colour

	Aluminium potassium sulphate	Stannous chloride	Potssium dichromate
Cotton	54	43	43
Polyester cotton	33	37	30
Polyester	13	20	27

In terms of overall appearance, more than half of the respondents preferred cotton with mordant alum. Next to cotton polyester-cotton fabric was preferred by 33 per cent. Only 13 per cent preferred polyester.

rough textures. On polyester-cotton 40 per cent of respondents rated that texture was medium. Only 27 to 30 per cent rated polyester-cotton and polyester as having smooth to rough textures. Fourty three per cent of respondents rated polyester as having medium lustre.

Cotton with chrome as mordant had medium texture as rated by 53 per cent. One fourth of respondents rated it as smooth and rough textures. On polyester-cotton and polyester also around half of the respondents rated it as medium texture.

Above results indicate that texture on cotton was medium and on polyester it was rough with alum. With stannous chloride cotton was smooth and polyester-cotton and polyester were medium. With chrome mordant all the three types of fabrics showed medium textures.

Table 4.23: Overall appearance of yellow colour

	Aluminium potassium sulphate	Stannous chloride	Potssium dichromate
Cotton	54	43	43
Polyester cotton	33	37	30
Polyester	13	20	27

In terms of overall appearance, more than half of the respondents preferred cotton with mordant alum. Next to cotton polyester-cotton fabric was preferred by 33 per cent. Only 13 per cent preferred polyester.

PLATE 2: RED COLOUR ON COTTON, POLYESTER-COTTON AND POLYESTER WITH MORDANT STANNOUS CHLORIDE.

S1 : COTTON
S2 : POLYESTER-COTTON
S3 : POLYESTER

PLATE 5: YELLOW COLOUR ON COTTON, POLYESTER-COTTON AND POLYESTER WITH MORDANT STANNOUS CHLORIDE.

S1 : COTTON
S2 : POLYESTER-COTTON
S3 : POLYESTER

PLATE 6: YELLOW COLOUR ON COTTON, POLYESTER-COTTON AND POLYESTER WITH MORDANT CHROME.

C1 : COTTON
C2 : POLYESTER-COTTON
C3 : POLYESTER

With stannous chloride yellow colour was preferred on cotton by 43 per cent of respondents. Next to cotton polyester-cotton was preferred by 37 per cent. With chrome also cotton was preferred for yellow colour. Next come polyester-cotton which was preferred by 30 per cent.

4.4 COST ANALYSIS

The costing of the raw materials was done to compare between the three mordants as well as to find out whether the technique was acceptable to the manufacturers and consumers at that cost.

For the sake of ease in comparison the costing of only the materials used in painting was done for both red colour and yellow colour. The costing was done for 1 metre of cloth.

Table 4.24: Cost of materials for Kalamkari painting with different mordants for red colour per one metre of cloth

S.No.	Item	Cost	Amount required	Cost (Rs.)
1.	Red dye (Surudu chekka)	45/kg	5 gm	0.25
2.	Alum	35/kg	10 gm	0.35
	Total			0.60

S.No.	Item	Cost	Amount required	Cost (Rs.)
1.	Red dye (Surudu chekka)	45/kg	5 gm	0.25
2.	Stannous chloride	131.50/100 gm	10 gm	13.15
	Total			13.40

S.No.	Item	Cost	Amount required	Cost (Rs.)
1.	Red dye (Surudu chekka)	45/kg	5 gm	0.25
2.	Chrome	191.80/500 gm	10 gm	3.85
	Total			4.10

Table 4.25: Cost of the materials for Kalamkari painting with different mordants for yellow colour per one metre of cloth

S.No.	Item	Cost	Amount required	Cost (Rs.)
1.	Yellow (myrobolan flower)	15/kg	5 gm	0.10
2.	Alum	35/kg	10 gm	0.35
	Total			0.45

S.No.	Item	Cost	Amount required	Cost
1.	Yellow (myrobolan flower)	15/kg	5 gm	0.10
2.	Stannous chloride	131.5/100 gm	10 gm	13.15
	Total			13.25

S.No.	Item	Cost	Amount required	Cost (Rs.)
1.	Yellow (myrobolan flower)	15/kg	5 gm	0.10
2.	Chrome	191.80/500 gm	10 gm	3.85
	Total			3.95

Tables 4.24 and 4.25 give the assessment of cost that includes the cost of mordants, materials and the dye required for one metre of cloth. From the table, it was clearly seen that the mordant alum was very cheap and the colour obtained was also good. Stannous chloride was

costliest mordant. It was also noticed that the black out line in the painted design was being rubbed off by stannous chloride (Plate 5). Therefore it was not that acceptable unless some after treatments were given. The cost was also very high. Potassium dichromate costed more than alum but it was at a reasonable price because it gave good colour on polyester-cotton and polyester fabrics (Plate 3 and 6)

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SUMMARY AND CONCLUSIONS

CHAPTER VI

SUMMARY AND CONCLUSIONS

Kalamkari is an ancient art of painting or printing with natural vegetable dyes. Machilipatnam and Srikalahasti in Andhra Pradesh are famous for Kalamkari industry. Kalamkari involves mordant dyeing. Despite its popularity, this art is limited in terms of the medium on which it is used that is cotton kora cloth only. Hence an attempt has been made in this study to try kalamkari on a synthetic fabric which is polyester. Polyester a light weight synthetic fibre has dominated the textile scene in India due to its durability, crease recovery and excellent shape retention. It was comprehended that this study could not only widen the application of kalamkari on polyester and polyester cotton blend but also help to improve the natural dyes which are ecofriendly.

Though Kalamkari has been tried out on silk, for the first time an attempt has been made in this study to use kalamkari technique by mordant dyeing method on polyester and polyester-cotton using the vegetable dyes. The objectives of this study are:

1. To develop a suitable method of kalamkari on polyester and polyester cotton blend

2. To assess the colour fastness of the painted fabrics

3. To estimate the cost of painted fabrics.
4. To study the consumer acceptability
5. To compare the appearance of kalamkari produced on polyester and polyester-cotton blend and cotton.

Most of the work was done in the kalamkari institute, Srikalahasti. A survey was conducted to select common polyester-cotton blend preferred by consumers. 67:33 per cent polyester-cotton blend was selected. Mordants alum, stannous chloride and chrome were found to be suitable in priliminary testing and hence selected for study. Experiments were conducted to find out suitable mordanting technique for kalamkari on polyester cotton and polyester. Premordanting and simultaneous mordanting methods were selected for red colour extracted from suruduchekka and yellow colour extracted from myrobalan flower respectively. Colour fastness tests to washing, light, perspiration, crocking and pressing were conducted. Consumers preferences with regard to the aesthetic appeal were studied by subjective evaluation. The data obtained was analysed statistically by converting the ratings into percentages and by analysis of variance.

The findings of the study were as follows:

The results of the colour fastness tests revealed as under -

The colour fastness of red colour on cotton and polyester-cotton with all three mordants was good to excellent to washing while it was fair to good on polyester.

The colour fastness of yellow colour on cotton, polyester - cotton and polyester was found to be fair to good to washing with every mordant used, alum, stannous chloride, chrome.

Light fastness of red colour on cotton, polyester-cotton and polyester was fair with the use of mordant alum. Cotton, polyester-cotton, polyester showed poor light fastness with stannous chloride. Polyester-cotton and polyester showed good light fastness with chrome while cotton showed poor light fastness.

Yellow colour on polyester-cotton had good light fastness with alum while cotton and polyester had fair to poor light fastness. With stannous chloride cotton had fair to good light fastness while polyester-cotton and polyester had poor light fastness. With the use of chrome polyester-cotton showed fair light fastness while cotton and polyester had poor light fastness.

Colour fastness of red colour to perspiration using acidic liquor on cotton with all the three mordants alum, stannous chloride and chrome was fair to good.

Polyester-cotton and polyester showed good fastness to perspiration with all three mordants.

Colour fastness of yellow colour to perspiration using acidic liquor with all three mordants was good to excellent on all the three fabrics; cotton, polyester-cotton and polyester.

Colour fastness of yellow colour to perspiration using alkali liquor on cotton was good to excellent with all mordants used. Polyester-cotton had good fastness to perspiration while polyester had good to excellent fastness with all three mordants.

Colour fastness of red colour to perspiration using alkali liquor on cotton was fair with alum and stannous chloride while with chrome it was good. Polyester cotton and polyester showed good to excellent colour fastness.

Crock fastness of red colour was poor on cotton, polyester cotton and polyester with all three mordants alum, stannous chloride and chrome.

Crock fastness of yellow colour was fair on cotton, polyester-cotton and polyester with alum and stannous chloride. The colour fastness was poor to rubbing all three fabrics with all three mordants.

The colour fastness of both the colours yellow and red was excellent to dry pressing with all three mordants. While yellow colour had fair to good fastness to wet pressing with all the three mordants. Red colour showed good fastness to wet pressing.

The results of the subjective evaluation revealed that:

The red colour mordanted with alum had bright lustre on cotton, medium lustre on polyester- cotton and poly ester. With stannous chloride cotton and polyester-cotton were bright and polyester had medium lustre. The three fabrics dyed in red colour using chrome mordant were bright.

Intensity of the red colour was found to be dark on cotton with the mordant alum and on polyester-cotton with stannous chloride. All mordants used were able to produce only medium shades on polyester.

Cotton had medium texture and polyester-cotton and polyester had smooth texture when dyed in red colour using alum. With stannous chloride cotton had rough teture and polyester-cotton and polyester had medium texture. Cotton had smooth texture and polyester-cotton and polyester had medium textures with the use of chrome mordant.

Regarding the preference of the respondents for the three fabrics dyed in red colour using the mordant alum, cotton was rated high followed by polyester- cotton and polyester.

The order of preference for fabrics mordanted with stannous chloride was polyester cotton, cotton and polyester.

The order of preference for fabrics mordanted with chrome was polyester-cotton, polyester and cotton.

Of all three red coloured fabrics with the use of tin and chrome polyester was preferred by the respondents while cotton was preferred with the use of alum.

All fabrics dyed using alum showed bright lustre with yellow colour. With the use of stannous chloride the lustre was bright on polyester-cotton and polyester, and medium on cotton. With use of chrome all the three fabrics were found to have medium lustre.

Shade of yellow colour using alum was dark on cotton and medium on polyester-cotton and polyester. With stannous chloride it was dark on cotton and polyester-cotton and medium on polyester with chrome all the three fabrics were found to be dark in shade.

Texture on cotton was medium when the fabrics were dyed in yellow colour using alum as mordant.

Polyester-cotton had rough texture with stannous chloride. Cotton was smooth. Polyester cotton and polyester were medium. All the three types of fabrics showed medium textures with the use of alum.

Order of preference for fabrics dyed with yellow colour with all the mordants was cotton, polyester-cotton and polyester.

Estimation of cost also revealed that stannous chloride makes costliest choice, potassium dichromate was reasonable while alum was most economical.

From the above findings, it can be concluded that Kalamkari technique can be successfully employed on polyester-cotton and polyester with alum, stannous chloride and chrome.

Suggestions for further Research

Since cotton and polyester fabrics are different in their chemical nature, a separate bleaching method can be developed for polyester-cotton and polyester.

Study can be taken up to improve the colour fastness to light and crocking through after treatments.

Study can be done to improve the vegetable dye uptake of polyester and its blends.

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LITERATURE CITED

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Ajita A 1993 Effect of mordants on natural dyes. The Indian Textile Journal pp.110.

Ajita A 1993 Dyeing material from pomegranate rind. Textile Magazine 34(12): 45.

Anchal J 1994 Natural dyes : Renaissance or false start?, Clothesline 7(2): 68.

Anthony S 1994 From turkey red to tyrian purple. Textile colours for the industrial revolution. American Dyestuff Reporter p.40.

Balaji T 1995 Kalamkari painting an ancient tradition art of Srikalahasti town (India).

Brand G E 1907 Indegenous dyes on woolen yarn published by school of art - Madras pp.83-85.

Chattopadhyay K D 1985 Handicrafts of India. Indian Council of Cultural Relations, New Delhi pp.40-41.

Corbmann 1985 Dyeing, Textiles - Fiber to Fabric p.201.

Damodar N D 1983 Kalamkari painting technique. Colourage 30(26): 31.

Gohl E P G and Vilensky C D 1983 Mordant dyes, Textile Science p.147.

Gulrajani M L 1993 Dyeing with red natural dyes. The Indian Textile Journal p.90.

Hunt P K and Etters J N 1994 Dyeing process in wearable art. American Dye stuff reporter 83(9): 112.

Indian Standards Institution (BIS) Handbook of Textile Testing 1982 Manak Bhawan, New Delhi.

Indian Standards Institution (BIS) Handbook of Textile Testing 1982 Method of evaluating change in colour (IS 768-1956) pp.469-470.

Indian Standards Institution (BIS) Handbook of Textile Testing 1982 Method of evaluating staining (IS 769-1956) pp.474-475.

Indian Standards Institution (BIS) Handbook of Textile Testing 1982 Determination of colourfastness of textile materials to washing test (IS 687-1969) pp.569-571.

Indian Standards Institution (BIS) Handbook of Textile Testing 1982 Determination of colourfastness of Textile materials to artificial light (IS 2454-1967).

Indian Standards Institution (BIS) Handbook of Textile Testing 1982 Determination of colourfasthess of textile materials to perspiration (IS 971-1956) pp.550-555.

Indian Standards Institution (BIS) Handbook of Textile Testing 1982 Determination of colourfasthess of textile materials to crocking (IS 766-1956).

Indian Standards Institution (BIS) Handbook of Textile Testing 1982 Determination of colourfasthess of textile materials to hot pressing (IS 689-1956) pp.533-534.

Iravathy 1964 A study of dyeing qualities of indeginous and synthetic dyes. Master's Thesis, University of Madras.

Jagannathan R 1975 Polyester blends, Bleaching Dyeing and finishing 111:165.

Jagdeesh T 1996 Dye effluents A natural Remedy. The Indian Textile Journal Vol.CV1, No.4 p.98.

Jahan S 1996 Dyeing silk with natural dyes. The Indian Textile Journal CV1(4): 66.

Jayakar P 1979 Gaiety in colour and form - Homage to kalamkari, Marg Publications p.25.

Lal R A 1994 Sanganeri and Bagru prints. Colourage 41(1): 11.

Lyle D S 1977 Aesthetic appearance, performance of textiles. John Willey and Sons, New York p.108.

Mahale G and Kulloli S 1995 Effect of bleaching agent on grey cotton fabrics. Textile dyer and printer 28(5): 21-23.

Manisha G and Satinder K 1996 Rebirth of natural dyes, The Indian Textile Journal CV1(5): 46.

Moncreiffe R W 1975 Polyesters : Terylene, Dacron, Koiel Vycron, Manmade Fibers p.434.

Nikhil Verma 1994 Dyeing of woolen knitting yarn with natural dyes. The Indian Textile Journal CIV(7): 82.

Nishida K and Kobayashi K 1992 Dyeing properties of natural dyes from vegetable sources : II American Dye stuff reporter p.26.

Phalgumani and subramanian S 1996 Dye application and eco friendly textiles. The Indian Textile Journal CV1(5): 126.

Roshanpaul 1996 Dyestuff Industries of India. The Indian Textile Journal CV1(4): 46.

Shah R K and Shukla J P 1995 Ecological standards and requirements : New challenges for Indian Exports. New Cloth Market 9(12):

Shankar R M 1996 MFA Phase-out and its implications. The Indian Textile Journal CV1(5): 153.

Sharada D V 1981 A critical study of Kalamkari paintings on cotton and silk and to test their fastness to washing and sunlight - Master's Thesis, University of Madras.

Shenai V A 1984 Dyeing of polyester and its blends. Technology of dyeing VI: 338.

Shenai V A 1993 Dyeing of silk with natural dyes. Dyeing of silk p.251.

Simon M 1966 A study on certain indigenous vegetable dyes and their application in printing cotton and silk fabrics - Master's thesis, University of Madras.

Sing S 1993 Standardisation of dyeing of silk by natural dye. The Indian Textile Journal 103(5): 72-74.

Subramanium S 1974 A study on the relative merits of certain indigenous dyes and direc dyes with reference to their colour fastness and the uses of these dyes in Kalamkari work - Master's Thesis, University of Madras.

Teli M D 1994 Dyeing of cotton with catechu. Journal of the Textile Association p.297.

Teli M D 1994 Dyeing of cotton with turmeric. Journal of the textile association p.249.

Thomas A and Banipant 1983 Historical evolution of kalamkari. The Indian Textile Journal 1(24): 43.

Udayini 1988 Development of new vegetable dyes for kalamkari painting and to assess their colourfastness property. Master's thesis, Andhra Pradesh Agricultural University.

Varadarajan L 1979 Towards a definition of kalamkari, Homage to kalamkari, Marg publications, Bombay 20.

Vasugi N 1984 An experimental study on the behaviour of alizarin red (natural dyes) on cotton and silk. Master's thesis, University of Madras.

- 1979 Technique of Kalamkari, Homage to kalamkari. Marg Publications, Bombay p.129.

- 1982 Kalamkari painting of Andhra. Textile dyer and printer 28(14): 32-35.

- 1995 Polyester staple fibre prices fall. New cloth market 9(12): 74.

- 1995 Emerging challenges for the Indian. Colourage Vol.XLII, No.11.

APPENDICES

APPENDIX -I

A SURVEY TO SELECT COMMON POLYESTER-COTTON BLEND

COLLEGE OF HOME SCIENCE, HYDERABAD

This survey is being done to select the most common polyester - cotton blend preferred by the consumer. So I request you to please give the following information.

Name of the shop :

Address :

Polyester-cotton blends available in your shop :

Most common blend preferred by the consumer :

Thank you.

APPENDIX II

ANOVA tables for colourfastness tests

Table 1: Analysis of variance for washing test to colour staining (RED)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.1	0.05	1.25N.S
Error	6	0.28	0.04	
Total	8	0.38	0.09	

N.S: Not significant at 5% level

Table 2: Analysis of variance for washing test to colour change (RED)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.36	0.18	4.5N.S
Error	6	0.28	0.04	

N.S: Not significant at 5% level

Table 3: Analysis of variance for washing test to colour staining (yellow)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.14	0.07	1.75N.S
Error	6	0.28	0.04	

N.S: Not significant at 5% level

Table 4: Analysis of variance for washing test to colour change (yellow)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.06	0.03	0.42N.S
Error	6	0.44	0.07	

N.S: Not significant at 5% level

Table 5: Analysis of variance for light test to red colour

Sources	df	SS	MSS	F.cal
Between treatments	2	1.16	0.58	0.38N.S
Error	6	0.90	1.5	

N.S: Not significant at 5% level

Table 6: Analysis of variance for light test to yellow colour

Sources	df	SS	MSS	F.cal
Between treatments	2	2.16	1.08	0.94N.S
Error	6	8.5	1.41	

N.S: Not significant at 5% level

Table 7: Analysis of variance for perspiration test with acidic liquor to colour staining (Red)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.39	0.195	6.96*
Error	6	0.17	0.028	

* Significant at 5% level

Table 8: Analysis of variance for perspiration test with acidic liquor to colour change

Sources	df	SS	MSS	F.cal
Between treatments	2	0.04	0.02	0.6*
Error	6	0.23	0.03	

not Significant at 5% level

Table 9: Analysis of variance for perspiration test alkali liquor to colour staining (Red)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.22	0.11	1.83N.S
Error	6	0.39	0.06	

N.S: Not significant at 5% level

Table 10: Analysis of variance for perspiration with alkali liquor to colour change (Red)

Sources	df	SS	MSS	F.Cal
Between treatments	2	1.06	0.53	4.81N.S
Error	6	0.67	0.11	

N.S.: Not significant at 5 per cent level

Table 11: Analysis of variance for perspiration test with alkali liquor to colour staining (Yellow)

Sources	df	SS	MSS	F.Cal
Between treatments	2	0.06	0.03	1.5N.S
Error	6	0.17	0.02	

N.S.: Not significant at 5 per cent level

Table 12: Analysis of variance for perspiration test with alkali liquor to colour change (Yellow)

Sources	df	SS	MSS	F.Cal
Between treatments	2	0.39	0.195	6.96*
Error	6	0.17	0.028	

* Significant at 5 per cent level

Table 13: Analysis of variance for crocking test to colour staining (Red)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.32	0.16	2.6N.S
Error	6	0.41	0.06	

N.S: Not significant at 5% level

Table 14: Analysis of variance for crocking test to colour change (Red)

Sources	df	SS	MSS	F.cal
Between treatments	2	1.00	0.5	2.96 N.S
Error	6	1.06	0.17	

N.S: Not significant at 5% level

Table 15: Analysis of variance for crocking test to colour staining (yellow)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.26	0.13	1.62N.S
Error	6	0.49	0.08	

N.S: Not significant at 5% level

Table 16: Analysis of variance for crocking test to colour change (yellow)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.65	0.32	1.39N.S
Error	6	1.38	0.23	

N.S: Not significant at 5% level

Table 17: Analysis of variance of dry pressing test to colour staining (Red)

The ratings were same for all mordants. So there was no significant difference at 5 per cent level of significance.

Table 18: Analysis of variance of dry pressing test to colour change (Red)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.16	0.08	1.6N.S
Error	6	0.34	0.05	

N.S: Not significant at 5% level

Table 19:

There were no significant difference in colour staining of yellow colour as the ratings given for dry pressing test were same.

Table 20: Analysis of variance for dry pressing test to colour change (yellow)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.02	0.01	1.25N.S
Error	6	0.05	0.08	

N.S: Not significant at 5% level

Table 21: There was no significant difference in colour staining of red colour as the ratings given for wet pressing test were same.

Table 22: Analysis of variance for wet pressing to colour change (Red)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.02	0.01	1.25N.S
Error	6	0.05	0.008	

N.S: Not significant at 5% level

Table 23: There was no significant difference for colour staining of yellow colour to wet pressing.

Table 24: Analysis of variance for wet pressing to colour change (yellow)

Sources	df	SS	MSS	F.cal
Between treatments	2	0.05	0.025	0.543N.S
Error	6	0.28	0.046	

N.S: Not significant at 5% level

APPENDIX III

SUBJECTIVE ANALYSIS

Kalamkari the popular art of Andhra Pradesh was tried out on cotton, polyester-cotton blend and polyester. As an educated consumers you are requested to examine the samples and indicate your opinion regarding acceptability of the displayed kalamkari samples giving a (✓) mark with respect to lustre colour and texture. In rating (✓) the one which in your opinion shows very good overall effect among I, II, III.

S.No.	Sample		Lustre			Colour			Texture			Rating		
			D	M	B	P	M	D	S	M	R	I	II	III
RED														
1.	A	I												
2.		II												
3.		III												
4.	B	I												
5.		II												
6.		III												
7.	C	I												
8.		II												
9.		III												
Yellow														
10.	A	I												
11.		II												
12.		III												
13.	B	I												
14.		II												
15.		III												
16.	C	I												
17.		II												
18.		III												

Key : Lustre D : Dull M : Medium B : Bright
Colour P : Pale M : Moderate D : Dark
Texture S : Smooth M : Medium R : Rough

APPENDIX NO. IV

COST OF THE FABRICS PER ONE METRE

S.No.	Fabrics	Cost (Rs.)
1.	Cotton	15.00
2.	Polyester-cotton	23.00
3.	Polyester	18.00