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INDEX

A FIELD PROJECT REPORT ON

A CHEMICAL-FREE REVOLUTION IN TEXTILE COLORING

Submitted in partial fulfilment of the requirements for the award of the degree

BACHELOR OF TECHNOLOGY

in

DEPARTMENT OF TEXTILE TECHNOLOGY

Submitted by

KONDLAPALLI GOWTHAM (231LA22003)

AKULA VENKATA SWARNA RUPA (231LA22006)

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Department of Textile Technology

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Vignan's Foundation for Science, Technology and Research (Deemed to be University)
Vadlamudi, Guntur, Andhra Pradesh-522213, India

May – 2024

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CERTIFICATE

This is to certify that the field project entitled "A CHEMICAL-FREE REVOLUTION IN TEXTILE COLORING" being submitted by KONDLAPALLI GOWTHAM (231LA22003), AKULA VENKATA SWARNA RUPA (231LA22006), ANNAPUREDDY SATWIKA, (231LA22007) in partial fulfilment of Bachelor of Technology in the Department of Textile Technology, Vignan's Foundation For Science Technology & Research (Deemed to be University), Vadlamudi, Guntur District, Andhra Pradesh, India, is a bonafide work carried out by them under my guidance and supervision.

Ch. Govardhana Rao

Head of the Department **Guide**

DECLARATION

We hereby declare that our project work described in the field project titled "A CHEMICAL-FREE REVOLUTION IN TEXTILE COLORING" which is being submitted by us for the partial fulfilment in the department of Textile Technology, Vignan's Foundation for Science, Technology and Research (Deemed to be University), Vadlamudi, Guntur, Andhra Pradesh, and the result of investigations are carried out by us under the guidance of (Name of the Guide)

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Contents

CHAPTER 1

Abstract

This study is a novel approach toward the development of a chemical-free and sustainable textile dyeing process with minimum environmental risks. Cotton fabrics were cationized with (3-chloro-2-hydroxypropyl) trimethyl ammonium chloride in four concentrations and subsequently dyed with the black tea extract. Eco-friendly colorant extraction from raw black tea leaves was carried out in aqueous media avoiding the use of hazardous organic solvents. The major coloring components in the black tea extract are polyphenols like the aflavins and thearubig in. Cationized cotton fabrics were dyed in four different shade depths without employing auxiliary chemicals in the dyeing process. For comparison, uncationized cotton was dyed with the same extract in the same shades. It was observed that un-cationized cotton samples exhibited very low color strength (K/S) values and excellent color fastness rating. However, the cationized samples showed remarkable enhancement in their color strength with an increase in the concentration of the cationizing agent. Furthermore, color fastness to washing, rubbing, and perspiration was excellent, but lightfastness was poor. Deep shades (K/S = 8.996) were obtained for cotton sample. Cationized (20 g/l) and dyed (6%) shades. Thus, the extraction of natural colorants without toxic solvents, economically viable surface modification of cotton, and chemical-free dyeing render the dyeing process cleaner, sustainable, and practicable at an industrial scale. The textile units could easily adopt this approach to regulate a pollution-free dyeing process without modifying their existing infrastructure.

CHAPTER 2

Introduction

The textile dyeing and finishing industry contributes more to water contamination and environmental pollution around the world (Hossain et al., 2018; Khan et al., 2018; Khan et al., 2020). The textile wastewater loaded with hazardous synthetic dyes, organic acids, inorganic salts, etc. becomes a pollution challenge threatening the living organisms and sustainability of the ecosystem (Dasgupta et al., 2015; Khan et al., 2019). In the recent past, the increasing demand for eco-safety has forced textile industries to implement cleaner production technologies, rather than the adoption of effluent treatment strategies. Generally, the effluent treatment approaches are expensive and inefficient to reduce pollutants completely (Ciardelli et al., 2001; Khatri et al., 2015). Thus, it is better to adopt cleaner production approaches to minimize the waste generation in textile dyeing and processing units. To this end, several advancements including the production of synthetic dyes with better fixing properties and improvements in dyeing processes have helped to reduce the use of auxiliary chemicals. But much progress is warranted to make the dyeing process green and sustainable with ideally zero emissions (von Sperling and Augusto de Lemos Chernicharo, 2002; Imtiazuddin et al., 2012).

There has been an increasing demand to minimize the negative ecological impacts of synthetic dyes in textile dyeing and replace them with bio-based colorants (Vankar et al., 2007; Vankar and Shanker, 2008; Haji, 2017). Over the years, natural dyes have emerged as biocompatible, environment-friendly, and non-toxic substitutes, and their facile applications could validate the concept of pollution-free dyeing of textile materials (Ibrahim et al., 2010; Baaka et al., 2018). The natural dyes are also known as mordant dyes as they do not adhere to cotton without the use of mordants (Ibrahim et al., 2010; Pisitsak et al., 2016). The mordants are generally inorganic salts of heavy metals (aluminum, iron, tin, copper, chrome, etc.) or other acidic or basic chemical agents which facilitate the fixing of natural dyes on fabric (cotton) through chemical reactions (Prabhu and Bhute, 2012). However, during the last few decades, the growing consciousness about eco-friendly textiles has compelled the textile industry to use natural dyes without employing toxic mordants in the dyeing process. To this end, a number of developments have been made during the past few years (Baaka et al., 2019; Manyim et al., 2021; Zhang et al., 2022a; Zhang et al., 2022b).

Problem Statement

The global textile industry, a major contributor to environmental pollution, relies heavily on synthetic dyes and chemical processes. These conventional methods lead to significant water and air pollution, as well as health hazards for workers and consumers. Additionally, the disposal of textile wastewater containing toxic dyes poses a serious threat to aquatic ecosystems.

To address these pressing environmental and health concerns, there is an urgent need to develop sustainable and eco-friendly textile coloring techniques. This project aims to explore and implement innovative chemical-free approaches to revolutionize the textile industry and minimize its negative impact on the planet.

CHAPTER 3

Objectives

1. Explore and refine natural dyeing methods using plant-based, insect-based, and mineral-based dyes.
2. Investigate the potential of nanotechnology-based dyes for eco-friendly textile coloration.
3. Experiment with plasma-based dyeing techniques to reduce chemical usage and improve color fastness.
4. Utilize supercritical CO2 as a sustainable solvent for dye delivery and fixation.

CHAPTER 4

4 Methodology

4.1 Materials

Black tea was purchased from Khan Tea Dealers, Jhang Bazaar (Faisalabad, Pakistan). Methanol was used for the extraction of colorants from raw black tea. The cotton fabric with 120 g/ m2 was used and provided by the Textile Processing Department for the project. The fabric was cationized using (3- chloro-2-hydroxypropyl) trimethylammonium chloride (65% w/w) and NaOH (50% (w/v) in the presence of the commercial wetting agent. The cationizing agent was purchased from Tokyo Chemical Industries (TCI), Japan. A non-ionic detergent was used for washing dyed samples. Sodium perborate (1 g/l) and ECE phosphate (4 g/l) were applied in washing fastness measurements. All laboratory-grade chemicals were purchased from Sigma Aldrich (Faisalabad, Pakistan). Double-distilled water was used throughout the research.

4.2 Methods

4.2.1 Extraction

Raw black tea (25 g) was poured into a 500-ml beaker, and 100 ml water was added to it. The beaker containing the mixture was covered with aluminum foil and placed on a stirring plate for continuous stirring at room temperature for 24 h. Then, the beaker containing the mixture was removed from the stirring plate and filtered using a Whatman filter paper. The filtrate was transferred to another beaker and allowed to stand open at room temperature for 3 days. The remaining water was evaporated using a hot plate at 40 C. After complete evaporation of water, the dried black tea extract (5.5 g) was obtained, which was used for the dyeing purpose. The FTIR spectrum of the tea extract was found to be in agreement with that of previous studies (Figure 1). The presence of polyphenolic compounds was identified due to the characteristic peaks of C-O-C, C=C, C=O, C-H, and –OH (Hamdan and Haider, 2018; Brza et al., 2020).

4.2.2 Cationization

(3-chloro-2-hydroxypropyl) trimethylammonium chloride in four different concentrations (5, 10, 15, and 20 g/l) was added to separate beakers containing 100 ml distilled water. Then wetting agent (10 g/ l) and NaOH (20 g/l) were added to each beaker to achieve a uniform solution. Finally, the total solution was made up to 200 ml by adding distilled water and again stirred for some time. The solution was then ready for padding. Cotton was padded using this pad liquor with a pick-up of 100% using a padder (TSUJI, Japan). After padding, the fabric was batched for 18 h by covering it with a polythene film to make it airtight (Iqbal et al., 2020). After batching overnight, the fabric was properly washed to make sure that there was no chemical left inside the fabric and subsequently dried (Acharya et al., 2014).

4.2.3 Dyeing

Four dyeing solutions (1%, 2%, 4%, and 6%) were made using black tea extract and distilled water. Cationized cotton samples (5 g) were dyed using these dyeing solutions at 100 C for 60 min using High Temperature-machine with a liquor ratio of 50:1. Then, the dyed cotton samples were washed with a non-ionic detergent for 15 min at 70 C and subsequently dried at room

temperature. The dyed cotton samples were investigated for color strength and colorfastness measurements. For comparison purposes, bleached un-cationized cotton samples were dyed under the same dyeing conditions. 2.2.4 Color Strength Measurements The color strength of dyed cotton samples was measured from the reflectance (%) values recorded by using a Datacolor 650™

Chapter 5

Results and Discussion

5.1 Color Strength (K/S) Measurements

Liang et al. (2003) reported the chemical composition of the black tea extract in detail. Thus, in our study, the extract was applied directly after filtration for cotton dyeing. Color strength (K/S) values of the dyed samples were measured. It was observed that cotton cationized in the concentration (5 g/l) revealed better color strength (K/S) values when dyed with black tea extract in various shade depths (Figure 2). The modification of cotton was used useful in getting dark shades on cotton. The trend line with regression (R2) value 0.9866 exhibits best fitting to the polynomial equation (y = 0.1802x2 + 0.0381x + 2.1132) for cationized dyed cotton samples with an increase in shade depth (%). In contrast, bleached cotton dyed samples showed no significant enhancement in K/S values with an increase in shade depth (%).

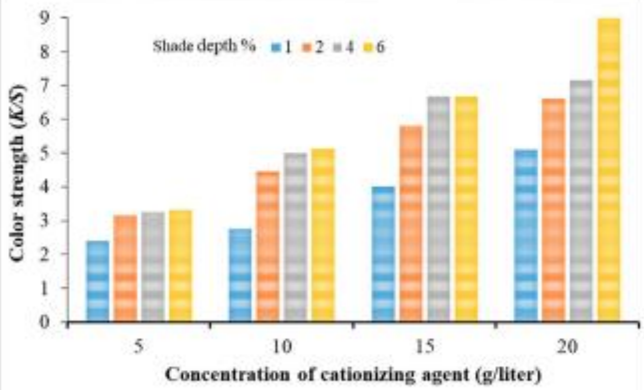

FIGURE 6 | Comparing the color strength (K/S) values obtained by increment in the concentration of cationizing agent and shade depth (%) simultaneously.

Chapter 6

CONCLUSION

This research reported a novel approach toward cationization of cotton with (3-chloro-2-hydroxypropyl) trimethyl ammonium chloride and their subsequent dyeing with an aqueous extract of black tea in a chemical-free dyeing process. The cationized samples displayed substantial enhancement in their color strength with the increase in the concentration of the cationizing agent. The color fastness to washing, rubbing, and perspiration was excellent, but the lightfastness was good. The cationized cotton fabrics dyed in four different shade depths and deep shades (K/S = 8.996) were obtained for cotton sample cationized (20 g/l) and dyed (6%) shades. As expected, the un-cationized cotton fabrics showed no significant affinity to black tea extracts and revealed very low color strength (K/S) values. Thus, the eco-friendly extraction of natural colorants and economically viable surface modification of cotton renders the auxiliary-free dyeing process sustainable and practicable at an industrial scale. This risk-free dyeing approach could easily be adopted by the textile dyeing units without the modification of existing infrastructure and could help regulate the pollution-free textile production.

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A FIELD PROJECT REPORT ON

TRANSFORMING TEXTILE WASTE INTO SUSTAINABLE FASHION

Submitted in partial fulfilment of the requirements for the award of the degree

BACHELOR OF TECHNOLOGY

in

DEPARTMENT OF TEXTILE TECHNOLOGY

Submitted by

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May – 2024

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CERTIFICATE

This is to certify that the field project entitled "TRANSFORMING TEXTILE WASTE INTO SUSTAINABLE FASHION" being submitted by SHAIK AMEERUDDEEN (221FA22001), NADIKATTU MAHALAKSHMI (231LA22001), LALAPETA MAHA LAKSHMI (231LA22004), in partial fulfilment of Bachelor of Technology in the Department of Textile Technology, Vignan's Foundation For Science Technology & Research (Deemed to be University), Vadlamudi, Guntur District, Andhra Pradesh, India, is a bonafide work carried out by them under my guidance and supervision.

Ch. Govardhana Rao

Head of the Department **Guide**

DECLARATION

We hereby declare that our project work described in the field project titled "TRANSFORMING TEXTILE WASTE INTO SUSTAINABLE FASHION" which is being submitted by us for the partial fulfilment in the department of Textile Technology, Vignan's Foundation for Science, Technology and Research (Deemed to be University), Vadlamudi, Guntur, Andhra Pradesh, and the result of investigations are carried out by us under the guidance of (Name of the Guide)

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Contents

CHAPTER 1

Abstract

The fashion industry is a significant contributor to environmental pollution, particularly due to textile waste. This research explores innovative approaches to convert textile waste into sustainable fashion. By employing advanced recycling techniques and sustainable design principles, we aim to reduce the industry's ecological footprint and promote a circular economy. This study investigates the technical feasibility of transforming textile waste into high-quality fashion garments. We explore various recycling methods, including mechanical and chemical processes, to recover valuable fibers from discarded textiles. By combining innovative design techniques with sustainable materials, we aim to develop a new generation of eco-friendly fashion products. This research highlights the potential of upcycling and recycling textile waste to create stylish and environmentally friendly fashion. By emphasizing the economic and social benefits of sustainable fashion, we encourage a shift towards a more responsible and eco-conscious industry.

CHAPTER 2

Introduction

The fashion industry is a significant contributor to environmental pollution, particularly due to textile waste. This project aims to address this issue by exploring innovative techniques to transform textile waste into sustainable fashion. By adopting a circular economy approach, we seek to minimize waste, conserve resources, and promote ethical and eco-friendly practices.

Problem Statement

The rapid growth of the fashion industry has led to a surge in textile waste, which often ends up in landfills or is incinerated. This poses serious environmental concerns, including pollution of water bodies, air pollution, and greenhouse gas emissions.

CHAPTER 3

Objectives

1. Collect and Sort Textile Waste: Gather a variety of textile waste, including clothing, fabric scraps, and other textile materials.
2. Clean and Prepare Textile Waste: Clean the collected waste to remove dirt, stains, and other impurities.
3. Recycle and Upcycle Textile Waste: Employ various techniques such as cutting, sewing, knitting, and dyeing to transform waste into new fashion items.
4. Design and Create Sustainable Fashion: Design and create innovative and stylish fashion pieces using recycled and upcycled materials.
5. Promote Sustainable Fashion: Raise awareness about sustainable fashion practices and encourage consumers to make eco-friendly choices.

CHAPTER 4

Methodology

1. Collection and Sorting:

To initiate our project, we sourced textile waste primarily from Vamini Textiles in Guntur. This textile hub provided us with a diverse range of waste materials, including discarded fabrics, clothing remnants, and production offcuts. Once collected, the waste underwent a meticulous sorting process. Each item was categorized based on its fiber type (cotton, polyester, etc.), color, and overall condition. This categorization step is crucial for optimizing the recycling and upcycling processes, ensuring efficient material utilization and waste reduction.

2. Cleaning and Preparation:

To ensure the cleanliness and hygiene of the collected textile waste, a thorough washing process was implemented. Eco-friendly detergents were used to remove dirt, stains, and odors, minimizing the environmental impact of the cleaning process. To conserve water, efficient washing techniques were employed, such as batch washing and optimizing water temperature.

After washing, the waste was carefully dried to prevent the growth of mold and mildew. Adequate drying time was allocated, and the waste was spread out to facilitate air circulation. In some cases, low-temperature drying techniques were used to avoid damaging the fibers. By following these meticulous cleaning and drying procedures, the textile waste was prepared for the subsequent recycling and upcycling processes.

3. Recycling and Upcycling:

The collected and cleaned textile waste was subjected to various recycling and upcycling techniques to transform it into valuable resources. Mechanical recycling involved the physical disassembly of textiles into individual fibers. These fibers were then processed to create new yarn, which could be used to manufacture various textile products. This process was particularly effective for materials like cotton and linen.

Chemical recycling, on the other hand, employed chemical processes to break down textiles into their constituent polymers. These polymers could be reprocessed into new materials, such as polyester or nylon. This technique was ideal for synthetic fibers that were difficult to recycle mechanically.

Upcycling, a creative approach to waste reduction, involved repurposing textile waste into new products without significantly altering the original material. This technique required innovative design and craftsmanship to transform discarded items into functional and stylish products. For instance, old jeans could be upcycled into bags, tote bags, or even jackets. By embracing upcycling, we not only minimized waste but also created unique and sustainable fashion items.

4. Design and Creation:

The design phase of the project involved developing innovative and sustainable designs that incorporated eco-friendly materials and ethical production practices. By carefully selecting materials like organic cotton, recycled polyester, and natural dyes, we aimed to minimize the environmental impact of the fashion products. Additionally, we explored minimalist designs to reduce material consumption and promote timeless style.

To bring these designs to life, a combination of traditional and modern production techniques was employed. Skilled artisans used traditional handcrafting techniques, such as sewing, knitting, and embroidery, to create unique and high-quality garments. These techniques not only preserved traditional craftsmanship but also allowed for customization and personalization. Modern technologies, such as computer-aided design (CAD) and digital printing, were also utilized to streamline the production process and achieve precise patterns and intricate details. By blending traditional and modern techniques, we were able to create a diverse range of sustainable fashion products, including garments, accessories, and home decor items.

CHAPTER 5

Results and Discussion

1. **Successful Collection and Sorting:** A significant quantity of textile waste was successfully collected from various sources, including Vamini Textiles. The waste was meticulously sorted based on fiber type, color, and condition, facilitating efficient recycling and upcycling processes.
2. **Effective Cleaning and Preparation:** The collected textile waste underwent thorough cleaning and drying processes, ensuring the removal of dirt, stains, and moisture. Eco-friendly detergents and water-saving techniques were employed to minimize environmental impact.
3. **Successful Recycling and Upcycling:** A variety of recycling and upcycling techniques were implemented. Mechanical recycling yielded high-quality fibers, which were spun into new yarn. Chemical recycling successfully broke down synthetic fibers into their constituent polymers, allowing for their reuse. Upcycling transformed discarded textiles into functional and stylish products, minimizing waste and promoting creativity.
4. **Innovative Designs and Ethical Production:** A range of innovative and sustainable designs were developed, incorporating eco-friendly materials and ethical production practices. Traditional and modern techniques were combined to create a diverse range of garments, accessories, and home decor items.

The project successfully demonstrated the potential of transforming textile waste into sustainable fashion. By adopting a circular economy approach, we were able to reduce waste, conserve resources, and promote ethical and eco-friendly practices. The meticulous sorting and cleaning processes ensured the quality of the recycled and upcycled materials. The diverse range of recycling and upcycling techniques showcased the versatility of textile waste. The innovative designs and ethical production practices highlighted the potential for creating stylish and sustainable fashion.

However, challenges were encountered, such as the limited availability of certain types of textile waste and the technical complexities of some recycling processes. To overcome these challenges, future research could focus on developing more efficient and scalable recycling technologies, exploring new materials and design techniques, and strengthening collaborations with industry partners.

By addressing these challenges and continuing to innovate, we can further advance the field of sustainable fashion and contribute to a more sustainable future.

CHAPTER 6

Conclusion

By transforming textile waste into sustainable fashion, we can contribute to a more sustainable and environmentally friendly future. This project demonstrates the potential of upcycling and recycling to reduce waste and create innovative, stylish products. By promoting sustainable fashion practices, we can inspire individuals and businesses to adopt more eco-conscious approaches.

CHAPTER 7

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Online Resources:

- The Ellen MacArthur Foundation: A leading organization promoting a circular economy, including textile recycling and reuse.
- Textile Exchange: A global nonprofit organization working to make the textile industry more sustainable.
- Fashion Revolution: An organization advocating for transparency and ethical practices in the fashion industry.

A FIELD PROJECT REPORT ON

WEAVE AND CHARACTERISATION OF BANANA & COTTON BLEND FABRIC FOR COMFORT PROPERTIES

Submitted in partial fulfilment of the requirements for the award of the degree

BACHELOR OF TECHNOLOGY

in

DEPARTMENT OF TEXTILE TECHNOLOGY

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May – 2024

CERTIFICATE

This is to certify that the field project entitled "WEAVE AND CHARACTERISATION OF BANANA & COTTON BLEND FABRIC FOR COMFORT PROPERTIES" being submitted by SANKA MEGHANA (211FA22001) MADA SUKRUTHI (211FA22003), MOGHAL AFREEDH (221LA22003) in partial fulfilment of Bachelor of Technology in the Department of Textile Technology, Vignan's Foundation For Science Technology & Research (Deemed to be University), Vadlamudi, Guntur District, Andhra Pradesh, India, is a bonafide work carried out by them under my guidance and supervision.

Ch. Govardhana Rao

Head of the Department **Guide**

DECLARATION

We hereby declare that our project work described in the field project titled "WEAVE AND CHARACTERISATION OF BANANA & COTTON BLEND FABRIC FOR COMFORT PROPERTIES" which is being submitted by us for the partial fulfilment in the department of Textile Technology, Vignan's Foundation for Science, Technology and Research (Deemed to be University), Vadlamudi, Guntur, Andhra Pradesh, and the result of investigations are carried out by us under the guidance of (Name of the Guide)

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Contents

CHAPTER 1

Abstract

This research aims to develop and characterize a banana and cotton blend fabric with enhanced comfort properties. Banana fiber, extracted from the pseudostem of the banana plant, is a sustainable and biodegradable natural fiber with excellent moisture absorption and breathability properties. Cotton, another natural fiber, is known for its softness and comfort. By blending these two fibers, we aim to create a fabric that combines the best of both worlds: the moisture-wicking and breathability of banana fiber with the softness and comfort of cotton.

CHAPTER 2

Introduction

The textile dyeing and finishing industry contributes more to water contamination and environmental pollution around the world (Hossain et al., 2018; Khan et al., 2018; Khan et al., 2020). The textile wastewater loaded with hazardous synthetic dyes, organic acids, inorganic salts, etc. becomes a pollution challenge threatening the living organisms and sustainability of the ecosystem (Dasgupta et al., 2015; Khan et al., 2019). In the recent past, the increasing demand for eco-safety has forced textile industries to implement cleaner production technologies, rather than the adoption of effluent treatment strategies. Generally, the effluent treatment approaches are expensive and inefficient to reduce pollutants completely (Ciardelli et al., 2001; Khatri et al., 2015). Thus, it is better to adopt cleaner production approaches to minimize the waste generation in textile dyeing and processing units. To this end, several advancements including the production of synthetic dyes with better fixing properties and improvements in dyeing processes have helped to reduce the use of auxiliary chemicals. But much progress is warranted to make the dyeing process green and sustainable with ideally zero emissions (von Sperling and Augusto de Lemos Chernicharo, 2002; Imtiazuddin et al., 2012).

There has been an increasing demand to minimize the negative ecological impacts of synthetic dyes in textile dyeing and replace them with bio-based colorants (Vankar et al., 2007; Vankar and Shanker, 2008; Haji, 2017). Over the years, natural dyes have emerged as biocompatible, environment-friendly, and non-toxic substitutes, and their facile applications could validate the concept of pollution-free dyeing of textile materials (Ibrahim et al., 2010; Baaka et al., 2018). The natural dyes are also known as mordant dyes as they do not adhere to cotton without the use of mordants (Ibrahim et al., 2010; Pisitsak et al., 2016). The mordants are generally inorganic salts of heavy metals (aluminum, iron, tin, copper, chrome, etc.) or other acidic or basic chemical agents which facilitate the fixing of natural dyes on fabric (cotton) through chemical reactions (Prabhu and Bhute, 2012). However, during the last few decades, the growing consciousness about eco-friendly textiles has compelled the textile industry to use natural dyes without employing toxic mordants in the dyeing process. To this end, a number of developments have been made during the past few years (Baaka et al., 2019; Manyim et al., 2021; Zhang et al., 2022a; Zhang et al., 2022b).

Problem Statement

The global textile industry, a major contributor to environmental pollution, relies heavily on synthetic dyes and chemical processes. These conventional methods lead to significant water and air pollution, as well as health hazards for workers and consumers. Additionally, the disposal of textile wastewater containing toxic dyes poses a serious threat to aquatic ecosystems.

To address these pressing environmental and health concerns, there is an urgent need to develop sustainable and eco-friendly textile coloring techniques. This project aims to explore and implement innovative chemical-free approaches to revolutionize the textile industry and minimize its negative impact on the planet.

CHAPTER 3

Objectives

1. Explore and refine natural dyeing methods using plant-based, insect-based, and mineral-based dyes.
2. Investigate the potential of nanotechnology-based dyes for eco-friendly textile coloration.
3. Experiment with plasma-based dyeing techniques to reduce chemical usage and improve color fastness.
4. Utilize supercritical CO_2 as a sustainable solvent for dye delivery and fixation.

CHAPTER 4

4 Methodology

4.1 Materials

Black tea was purchased from Khan Tea Dealers, Jhang Bazaar (Faisalabad, Pakistan). Methanol was used for the extraction of colorants from raw black tea. The cotton fabric with 120 g/ m2 was used and provided by the Textile Processing Department for the project. The fabric was cationized using (3- chloro-2-hydroxypropyl) trimethylammonium chloride (65% w/w) and NaOH (50% (w/v) in the presence of the commercial wetting agent. The cationizing agent was purchased from Tokyo Chemical Industries (TCI), Japan. A non-ionic detergent was used for washing dyed samples. Sodium perborate (1 g/l) and ECE phosphate (4 g/l) were applied in washing fastness measurements. All laboratory-grade chemicals were purchased from Sigma Aldrich (Faisalabad, Pakistan). Double-distilled water was used throughout the research.

4.2 Methods

4.2.1 Extraction

Raw black tea (25 g) was poured into a 500-ml beaker, and 100 ml water was added to it. The beaker containing the mixture was covered with aluminum foil and placed on a stirring plate for continuous stirring at room temperature for 24 h. Then, the beaker containing the mixture was removed from the stirring plate and filtered using a Whatman filter paper. The filtrate was transferred to another beaker and allowed to stand open at room temperature for 3 days. The remaining water was evaporated using a hot plate at 40 C. After complete evaporation of water, the dried black tea extract (5.5 g) was obtained, which was used for the dyeing purpose. The FTIR spectrum of the tea extract was found to be in agreement with that of previous studies (Figure 1). The presence of polyphenolic compounds was identified due to the characteristic peaks of C-O-C, C=C, C=O, C-H, and –OH (Hamdan and Haider, 2018; Brza et al., 2020).

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(3-chloro-2-hydroxypropyl) trimethylammonium chloride in four different concentrations (5, 10, 15, and 20 g/l) was added to separate beakers containing 100 ml distilled water. Then wetting agent (10 g/ l) and NaOH (20 g/l) were added to each beaker to achieve a uniform solution. Finally, the total solution was made up to 200 ml by adding distilled water and again stirred for some time. The solution was then ready for padding. Cotton was padded using this pad liquor with a pick-up of 100% using a padder (TSUJI, Japan). After padding, the fabric was batched for 18 h by covering it with a polythene film to make it airtight (Iqbal et al., 2020). After batching overnight, the fabric was properly washed to make sure that there was no chemical left inside the fabric and subsequently dried (Acharya et al., 2014).

4.2.3 Dyeing

Four dyeing solutions (1%, 2%, 4%, and 6%) were made using black tea extract and distilled water. Cationized cotton samples (5 g) were dyed using these dyeing solutions at 100 C for 60 min using High Temperature-machine with a liquor ratio of 50:1. Then, the dyed cotton samples were washed with a non-ionic detergent for 15 min at 70 C and subsequently dried at room

temperature. The dyed cotton samples were investigated for color strength and colorfastness measurements. For comparison purposes, bleached un-cationized cotton samples were dyed under the same dyeing conditions. 2.2.4 Color Strength Measurements The color strength of dyed cotton samples was measured from the reflectance (%) values recorded by using a Datacolor 650™

Chapter 5

Results and Discussion

5.1 Color Strength (K/S) Measurements

Liang et al. (2003) reported the chemical composition of the black tea extract in detail. Thus, in our study, the extract was applied directly after filtration for cotton dyeing. Color strength (K/S) values of the dyed samples were measured. It was observed that cotton cationized in the concentration (5 g/l) revealed better color strength (K/S) values when dyed with black tea extract in various shade depths (Figure 2). The modification of cotton was used useful in getting dark shades on cotton. The trend line with regression (R2) value 0.9866 exhibits best fitting to the polynomial equation (y = 0.1802x2 + 0.0381x + 2.1132) for cationized dyed cotton samples with an increase in shade depth (%). In contrast, bleached cotton dyed samples showed no significant enhancement in K/S values with an increase in shade depth (%).

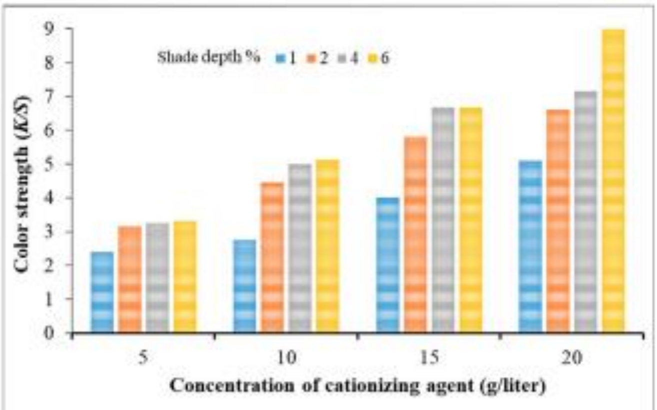

FIGURE 6 | Comparing the color strength (K/S) values obtained by increment in the concentration of cationizing agent and shade depth (%) simultaneously.

Chapter 6

CONCLUSION

This research reported a novel approach toward cationization of cotton with (3-chloro-2-hydroxypropyl) trimethyl ammonium chloride and their subsequent dyeing with an aqueous extract of black tea in a chemical-free dyeing process. The cationized samples displayed substantial enhancement in their color strength with the increase in the concentration of the cationizing agent. The color fastness to washing, rubbing, and perspiration was excellent, but the lightfastness was good. The cationized cotton fabrics dyed in four different shade depths and deep shades (K/S = 8.996) were obtained for cotton sample cationized (20 g/l) and dyed (6%) shades. As expected, the un-cationized cotton fabrics showed no significant affinity to black tea extracts and revealed very low color strength (K/S) values. Thus, the eco-friendly extraction of natural colorants and economically viable surface modification of cotton renders the auxiliary-free dyeing process sustainable and practicable at an industrial scale. This risk-free dyeing approach could easily be adopted by the textile dyeing units without the modification of existing infrastructure and could help regulate the pollution-free textile production.

CHAPTER 7

Reference

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A FIELD PROJECT REPORT ON

"DESIGNING SURGICAL GOWNS: BALANCING PROTECTION, COMFORT, AND SUSTAINABILITY IN MEDICAL PROTECTIVE CLOTHING"

Submitted in partial fulfilment of the requirements for the award of the degree

BACHELOR OF TECHNOLOGY

in

DEPARTMENT OF TEXTILE TECHNOLOGY

Submitted by

V MOKSHAGNA VARUN **(211FA22002)**

PATAN SHARUK KHAN **(221LA22001)**

VEERA KARTHIK **(221LA22002)**

Department of Textile Technology

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May – 2024

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be University)
-Estd. u/s 3 of UGC Act 1956

CERTIFICATE

This is to certify that the field project entitled "DESIGNING SURGICAL GOWNS: BALANCING PROTECTION, COMFORT, AND SUSTAINABILITY IN MEDICAL PROTECTIVE CLOTHING" being submitted by V MOKSHAGNA VARUN (211FA22002) PATAN SHARUK KHAN (221LA22001) VEERA KARTHIK (221LA22002) in partial fulfilment of Bachelor of Technology in the Department of Textile Technology, Vignan's Foundation For Science Technology & Research (Deemed to be University), Vadlamudi, Guntur District, Andhra Pradesh, India, is a bonafide work carried out by them under my guidance and supervision.

Head of the Department **Guide**

DECLARATION

We hereby declare that our project work described in the field project titled “"DESIGNING SURGICAL GOWNS: BALANCING PROTECTION, COMFORT, AND SUSTAINABILITY IN MEDICAL PROTECTIVE CLOTHING" which is being submitted by us for the partial fulfilment in the department of Textile Technology, Vignan’s Foundation for Science, Technology and Research (Deemed to be University), Vadlamudi, Guntur, Andhra Pradesh, and the result of investigations are carried out by us under the guidance of (Name of the Guide)

V MOKSHAGNA VARUN	**(211FA22002)**	
PATAN SHARUK KHAN	**(221LA22001)**	
VEERA KARTHIK	**(221LA22002)**	

Contents

CHAPTER 1

Abstract

Surgical gowns play a crucial role in maintaining aseptic conditions during surgical procedures. However, traditional surgical gowns often compromise comfort and sustainability while prioritizing protection. This research aims to explore innovative design strategies that balance these three critical aspects in medical protective clothing. By investigating advancements in materials science, ergonomics, and sustainable manufacturing practices, we propose design guidelines for surgical gowns that enhance wearer comfort, reduce environmental impact, and maintain optimal protection against infection. This interdisciplinary approach seeks to contribute to a more sustainable and efficient healthcare environment.

CHAPTER 2

Introduction

Surgical gowns are an indispensable component of medical protective clothing, safeguarding both healthcare professionals and patients from the transmission of infectious diseases. While traditional surgical gowns prioritize protection, they often compromise on wearer comfort and environmental sustainability. The increasing demand for sustainable healthcare practices and the growing awareness of the impact of single-use plastics have necessitated a re-evaluation of surgical gown design.

This research delves into the critical need for a paradigm shift in surgical gown design, focusing on balancing protection, comfort, and sustainability. By exploring advancements in materials science, ergonomics, and sustainable manufacturing practices, we aim to develop innovative design guidelines that enhance the overall wearer experience, minimize environmental impact, and maintain optimal infection prevention. This interdisciplinary approach seeks to contribute to a more sustainable and efficient healthcare environment.

Problem Statement

Traditional surgical gowns, while effective in preventing infection transmission, often present challenges in terms of wearer comfort and environmental sustainability. The rigid, non-breathable materials used in these garments can lead to discomfort, heat stress, and reduced dexterity, potentially impacting surgical performance. Furthermore, the widespread use of single-use, non-biodegradable plastics in surgical gowns contributes to environmental pollution and resource depletion.

This research aims to address these challenges by exploring innovative design strategies that prioritize protection, comfort, and sustainability. By investigating advancements in materials science, ergonomics, and sustainable manufacturing practices, we seek to develop surgical gown designs that:

1. **Enhance wearer comfort:** Improve breathability, reduce heat stress, and enhance mobility.
2. **Minimize environmental impact:** Utilize sustainable materials and manufacturing processes.
3. **Maintain optimal protection:** Ensure effective barrier protection against infectious agents.

By balancing these three critical aspects, we can contribute to a more sustainable and efficient healthcare environment.

CHAPTER 3

Objectives

This research aims to:

1. **Identify key factors:** Analyze the current state of surgical gown design, identifying the primary factors influencing protection, comfort, and sustainability.
2. **Explore innovative materials:** Investigate advanced materials that offer improved breathability, moisture-wicking properties, and durability while maintaining barrier protection.
3. **Optimize ergonomic design:** Conduct ergonomic assessments to identify areas for improvement in terms of fit, movement, and stress reduction.
4. **Develop sustainable manufacturing processes:** Explore sustainable manufacturing techniques, such as reduced material usage, energy-efficient production, and biodegradable or recyclable materials.
5. **Prototype and evaluate:** Design and prototype innovative surgical gown concepts, testing their performance in terms of protection, comfort, and sustainability.
6. **Provide design guidelines:** Develop a set of design guidelines for future surgical gown development, incorporating the findings of this research.

CHAPTER 4

4 Methodology

4.1 Materials

Black tea was purchased from Khan Tea Dealers, Jhang Bazaar (Faisalabad, Pakistan). Methanol was used for the extraction of colorants from raw black tea. The cotton fabric with 120 g/ m2 was used and provided by the Textile Processing Department for the project. The fabric was cationized using (3- chloro-2-hydroxypropyl) trimethyl ammonium chloride (65% w/w) and NaOH (50% (w/v) in the presence of the commercial wetting agent. The cationizing agent was purchased from Tokyo Chemical Industries (TCI), Japan. A non-ionic detergent was used for washing dyed samples. Sodium perborate (1 g/l) and ECE phosphate (4 g/l) were applied in washing fastness measurements. All laboratory-grade chemicals were purchased from Sigma Aldrich (Faisalabad, Pakistan). Double-distilled water was used throughout the research.

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Chapter 5

Results and Discussion

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Liang et al. (2003) reported the chemical composition of the black tea extract in detail. Thus, in our study, the extract was applied directly after filtration for cotton dyeing. Color strength (K/S) values of the dyed samples were measured. It was observed that cotton cationized in the concentration (5 g/l) revealed better color strength (K/S) values when dyed with black tea extract in various shade depths (Figure 2). The modification of cotton was used useful in getting dark shades on cotton. The trend line with regression (R2) value 0.9866 exhibits best fitting to the polynomial equation (y = 0.1802x2 + 0.0381x + 2.1132) for cationized dyed cotton samples with an increase in shade depth (%). In contrast, bleached cotton dyed samples showed no significant enhancement in K/S values with an increase in shade depth (%).

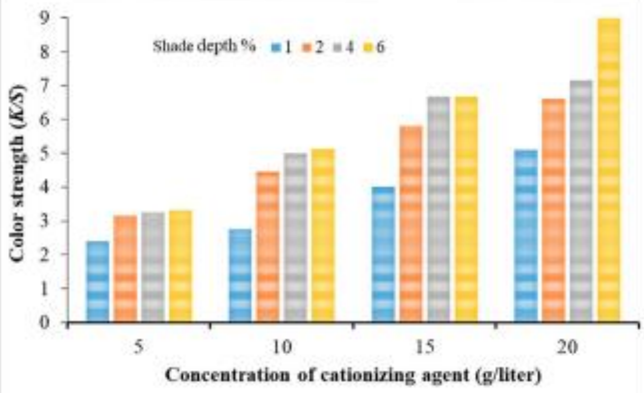

FIGURE 6 | Comparing the color strength (*K/S*) values obtained by increment in the concentration of cationizing agent and shade depth (%) simultaneously.

Chapter 6

CONCLUSION

This research reported a novel approach toward cationization of cotton with (3-chloro-2-hydroxypropyl) trimethyl ammonium chloride and their subsequent dyeing with an aqueous extract of black tea in a chemical-free dyeing process. The cationized samples displayed substantial enhancement in their color strength with the increase in the concentration of the cationizing agent. The color fastness to washing, rubbing, and perspiration was excellent, but the lightfastness was good. The cationized cotton fabrics dyed in four different shade depths and deep shades (K/S = 8.996) were obtained for cotton sample cationized (20 g/l) and dyed (6%) shades. As expected, the un-cationized cotton fabrics showed no significant affinity to black tea extracts and revealed very low color strength (K/S) values. Thus, the eco-friendly extraction of natural colorants and economically viable surface modification of cotton renders the auxiliary-free dyeing process sustainable and practicable at an industrial scale. This risk-free dyeing approach could easily be adopted by the textile dyeing units without the modification of existing infrastructure and could help regulate the pollution-free textile production.

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A FIELD PROJECT REPORT ON

"PROTECTIVE TEXTILES FOR SAFEGUARD WORKERS"

Submitted in partial fulfilment of the requirements for the award of the degree

BACHELOR OF TECHNOLOGY

in

DEPARTMENT OF TEXTILE TECHNOLOGY

Submitted by

PISKA MANOJ	**221LA22004**
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May – 2024

CERTIFICATE

This is to certify that the field project entitled "PROTECTIVE TEXTILES FOR SAFEGUARD WORKERS" being submitted by PISKA MANOJ 221LA22004, SARODE VINAY 221LA22006, JAGADEESHWARAN.S 221LA22007 in partial fulfilment of Bachelor of Technology in the Department of Textile Technology, Vignan's Foundation For Science Technology & Research (Deemed to be University), Vadlamudi, Guntur District, Andhra Pradesh, India, is a bonafide work carried out by them under my guidance and supervision.

Ch. Govardhana Rao

Head of the Department **Guide**

DECLARATION

We hereby declare that our project work described in the field project titled "PROTECTIVE TEXTILES FOR SAFEGUARD WORKERS" which is being submitted by us for the partial fulfilment in the department of Textile Technology, Vignan's Foundation for Science, Technology and Research (Deemed to be University), Vadlamudi, Guntur, Andhra Pradesh, and the result of investigations are carried out by us under the guidance of (Name of the Guide)

PISKA MANOJ	**221LA22004**	
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Contents

CHAPTER 1

Abstract

Protective textiles play a crucial role in safeguarding workers across various industries. These specialized fabrics are engineered to provide protection against a wide range of hazards, including heat, cold, chemicals, radiation, and physical threats. This research explores the latest advancements in protective textile technologies, focusing on their design, materials, and applications. By examining the critical factors influencing the performance and comfort of protective clothing, we aim to highlight the importance of innovative textile solutions in ensuring worker safety and well-being. This interdisciplinary approach combines material science, textile engineering, and ergonomics to provide insights into the future of protective textiles and their potential to revolutionize workplace safety.

CHAPTER 2

Introduction

Protective textiles have become an indispensable component of occupational safety equipment, safeguarding workers in hazardous environments. These specialized fabrics are engineered to provide protection against a wide range of threats, including heat, cold, chemicals, radiation, and physical hazards. As industries evolve and workplace risks diversify, the demand for advanced protective textiles continues to grow.

This research delves into the critical role of protective textiles in safeguarding workers across various industries. By exploring the latest advancements in materials science, textile engineering, and ergonomic design, we aim to shed light on the factors influencing the performance and comfort of protective clothing. This interdisciplinary approach will provide insights into the future of protective textiles and their potential to revolutionize workplace safety.

Problem Statement

While protective textiles have significantly improved worker safety, challenges remain in balancing protection, comfort, and durability. Traditional protective clothing often compromises on breathability, flexibility, and wearer comfort, leading to heat stress, fatigue, and reduced productivity. Additionally, the increasing complexity of workplace hazards necessitates the development of multifunctional textiles that can adapt to diverse environmental conditions.

This research aims to address these challenges by exploring innovative textile technologies that:

1. **Enhance protection:** Improve barrier properties against various hazards, including chemicals, heat, cold, and radiation.
2. **Optimize comfort:** Enhance breathability, moisture-wicking properties, and flexibility to reduce heat stress and fatigue.
3. **Ensure durability:** Improve the durability and longevity of protective textiles to withstand harsh working conditions.
4. **Integrate smart technologies:** Explore the integration of smart sensors and wearable technology to monitor worker health and environmental conditions.

By addressing these challenges, we can contribute to the development of more effective and comfortable protective textiles that safeguard workers in hazardous environments.

CHAPTER 3

Objectives

This research aims to:

1. **Review existing protective textile technologies:** Analyze the current state-of-the-art in protective textile materials and their limitations.
2. **Identify emerging trends:** Explore emerging technologies, such as nanotechnology, phase-change materials, and smart textiles, and their potential applications in protective clothing.
3. **Investigate material properties:** Characterize the physical and chemical properties of protective textile materials, focusing on factors such as permeability, thermal conductivity, and mechanical strength.
4. **Optimize textile design:** Develop design guidelines for protective clothing, considering factors such as fit, ergonomics, and ventilation.
5. **Evaluate performance:** Conduct laboratory and field tests to assess the performance of protective textiles under various conditions, including exposure to chemicals, heat, cold, and physical hazards.
6. **Promote sustainable practices:** Explore eco-friendly manufacturing processes and the use of sustainable materials in protective textile production.

CHAPTER 4

4 Methodology

4.1 Materials

Black tea was purchased from Khan Tea Dealers, Jhang Bazaar (Faisalabad, Pakistan). Methanol was used for the extraction of colorants from raw black tea. The cotton fabric with 120 g/ m2 was used and provided by the Textile Processing Department for the project. The fabric was cationized using (3- chloro-2-hydroxypropyl) trimethyl ammonium chloride (65% w/w) and NaOH (50% (w/v) in the presence of the commercial wetting agent. The cationizing agent was purchased from Tokyo Chemical Industries (TCI), Japan. A non-ionic detergent was used for washing dyed samples. Sodium perborate (1 g/l) and ECE phosphate (4 g/l) were applied in washing fastness measurements. All laboratory-grade chemicals were purchased from Sigma Aldrich (Faisalabad, Pakistan). Double-distilled water was used throughout the research.

4.2 Methods

4.2.1 Extraction

Raw black tea (25 g) was poured into a 500-ml beaker, and 100 ml water was added to it. The beaker containing the mixture was covered with aluminum foil and placed on a stirring plate for continuous stirring at room temperature for 24 h. Then, the beaker containing the mixture was removed from the stirring plate and filtered using a Whatman filter paper. The filtrate was transferred to another beaker and allowed to stand open at room temperature for 3 days. The remaining water was evaporated using a hot plate at 40 C. After complete evaporation of water, the dried black tea extract (5.5 g) was obtained, which was used for the dyeing purpose. The FTIR spectrum of the tea extract was found to be in agreement with that of previous studies (Figure 1). The presence of polyphenolic compounds was identified due to the characteristic peaks of C-O-C, C=C, C=O, C-H, and –OH (Hamdan and Haider, 2018; Brza et al., 2020).

4.2.2 Cationization

(3-chloro-2-hydroxypropyl) trimethylammonium chloride in four different concentrations (5, 10, 15, and 20 g/l) was added to separate beakers containing 100 ml distilled water. Then wetting agent (10 g/ l) and NaOH (20 g/l) were added to each beaker to achieve a uniform solution. Finally, the total solution was made up to 200 ml by adding distilled water and again stirred for some time. The solution was then ready for padding. Cotton was padded using this pad liquor with a pick-up of 100% using a padder (TSUJI, Japan). After padding, the fabric was batched for 18 h by covering it with a polythene film to make it airtight (Iqbal et al., 2020). After batching overnight, the fabric was properly washed to make sure that there was no chemical left inside the fabric and subsequently dried (Acharya et al., 2014).

4.2.3 Dyeing

Four dyeing solutions (1%, 2%, 4%, and 6%) were made using black tea extract and distilled water. Cationized cotton samples (5 g) were dyed using these dyeing solutions at 100 C for 60 min using High Temperature-machine with a liquor ratio of 50:1. Then, the dyed cotton samples were washed with a non-ionic detergent for 15 min at 70 C and subsequently dried at room

temperature. The dyed cotton samples were investigated for color strength and colorfastness measurements. For comparison purposes, bleached un-cationized cotton samples were dyed under the same dyeing conditions. 2.2.4 Color Strength Measurements The color strength of dyed cotton samples was measured from the reflectance (%) values recorded by using a Datacolor 650™

Chapter 5

Results and Discussion

5.1 Color Strength (K/S) Measurements

Liang et al. (2003) reported the chemical composition of the black tea extract in detail. Thus, in our study, the extract was applied directly after filtration for cotton dyeing. Color strength (K/S) values of the dyed samples were measured. It was observed that cotton cationized in the concentration (5 g/l) revealed better color strength (K/S) values when dyed with black tea extract in various shade depths (Figure 2). The modification of cotton was used useful in getting dark shades on cotton. The trend line with regression (R2) value 0.9866 exhibits best fitting to the polynomial equation (y = 0.1802x2 + 0.0381x + 2.1132) for cationized dyed cotton samples with an increase in shade depth (%). In contrast, bleached cotton dyed samples showed no significant enhancement in K/S values with an increase in shade depth (%).

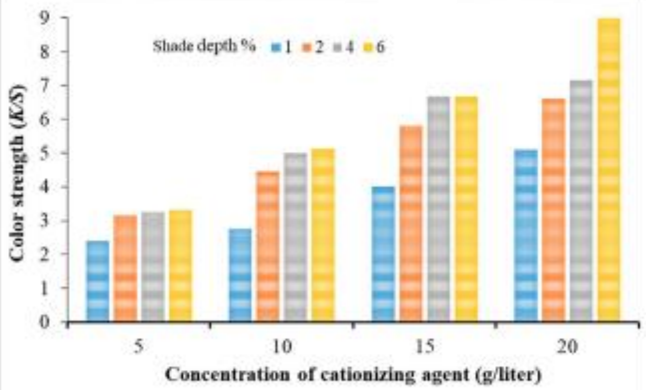

FIGURE 6 | Comparing the color strength (*K/S*) values obtained by increment in the concentration of cationizing agent and shade depth (%) simultaneously.

Chapter 6

CONCLUSION

This research reported a novel approach toward cationization of cotton with (3-chloro-2-hydroxypropyl) trimethyl ammonium chloride and their subsequent dyeing with an aqueous extract of black tea in a chemical-free dyeing process. The cationized samples displayed substantial enhancement in their color strength with the increase in the concentration of the cationizing agent. The color fastness to washing, rubbing, and perspiration was excellent, but the lightfastness was good. The cationized cotton fabrics dyed in four different shade depths and deep shades (K/S = 8.996) were obtained for cotton sample cationized (20 g/l) and dyed (6%) shades. As expected, the un-cationized cotton fabrics showed no significant affinity to black tea extracts and revealed very low color strength (K/S) values. Thus, the eco-friendly extraction of natural colorants and economically viable surface modification of cotton renders the auxiliary-free dyeing process sustainable and practicable at an industrial scale. This risk-free dyeing approach could easily be adopted by the textile dyeing units without the modification of existing infrastructure and could help regulate the pollution-free textile production.

CHAPTER 7

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This is to certify that, Internship project report titled **"DEVELOP THE COLLECTION OF MACARONI CHEESE** "submitted by B I N D U M A D H A V I (201FA22001), in a partial fulfillment for the award of degree in Textile Technology, to the Vignan's Foundation for Science, Technology and Research (Deemed to be University), is a record of Bonafide work carried out by him/her under my guidance and supervision. The results embodied in this work have not been submitted to any other universities or Institute's.

Ms. P.Sumanjali — Project guide

External Examiner

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V. SAI SRI KRISHNA (211LA22002), A. SUSHANTH (211LA22007) been proposed to be carried out as Internship Project work under my supervision. I approve this Internship project work for submission towards partial fulfillment of the requirements. Bachelor of Technology (Textile Technology) R19 regulation of VFSTR (Deemed to be University).

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This is to certify that, internship project report **"Modern technologies employed for Manufacturing Sustainable Products, Importance of Sustainability and Profit Contribution by Sustainable Products in Decathlon Sports India, Cyber Hub, Gurgoan"** that is being submitted by **VADIYARA GOPICHAND (211LA22003), S O MOHAN (211LA22008)** in a partial fulfilment for the award of degree B.Tech in Textile Technology, in the Vignan's Foundation for Science, Technology and Research, deemed to be university, is a record of bonafide work carried out by him /her under my /our guidance and supervision. The results embodied in this work have not been submitted to any other universities or Institute.

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This is to certify that, internship project report **"FABRIC SOURCING AND SHORTAGE ANALYSIS IN ARVIND BRAND""** that is being submitted by **CHIRANJEEVI (211LA22005)**, in a partial fulfilment for the award of degree in Textile Technology, to the Vignan's Foundation for Science, Technology and Research, deemed to be university, is a record of bonafide work carried out by him /her under my /our guidance and supervision. The results embodied in this work have not been submitted to any other universities or Institute's.

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This is to certify that Social centric and related project report titled social centric project **"FINISHING OF COTTON FABRIC WITH CHITOSAN ACRYLATE"** submitted by Ms. K. SYAMASUKANYA(211LA22006) been proposed to be carried out as Internship Project work under my supervision. I approve this Internship project work for submission towards partial fulfillment of the requirements. Bachelor of Technology (Textile Technology) R19 regulation of VFSTR (Deemed to be University).

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This is to certify that, Internship project report **"STUDY AND ANALYSIS OF FABRIC SOURCING IN ARVIND BRANDS"** that is being submitted by **CHAITANYA (211LA 22009)**, in a partial fulfilment for the award of degree in Textile Technology, to the Vignan's Foundation for Science, Technology & Research, (deemed to be University), is a record of bonafide work carried out by our guidance and supervision, the results embodied in this work have not been submitted to any other universities or institute's.

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This is to certify that Internship project report titled **"METHOD IMPROVEMENT IN GARMENT PRODUCTION PROCESS"** submitted by CH. CHAKRADHAR (211LA22010), C. VENKATA SAITEJA (211LA22013) been proposed to be carried out as Internship Project work under my supervision. I approve this Internship project work for submission towards partial fulfillment of the requirements. Bachelor of Technology (Textile Technology) R19 regulation of VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH (Deemed to be University).

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This is to certify that, internship project report **"STUDY AND ANALYSIS OF SOCK, MACHINARY AND MERCHANDISING IN GTN INDUTRIES - IMPERIAL SOCKS"** that is being submitted by **GAJULA PRANAY (211LA22012),** in a partial fulfilment for the award of degree in Textile Technology, to the Vignan's Foundation for Science, Technology and Research, (deemed to be university), is a record of bonafide work carried out by our guidance and supervision. The results embodied in this work have not been submitted to any other universities or Institute's.

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Mr. Siva Jagadish Kumar	**External Examiner**	**Mr. Govardhana rao Chilukoti**
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This is to certify that, internship project **"Garment Sourcing" Under Sourcing Department** that is being submitted by **RAJANALA ANKARAO (211LA22001)**, *in a* partial fulfilment for the award of degree in Textile Technology, to the Vignan's Foundation for Science, Technology and Research, deemed to be university, is a record of bona fide work carried out by him /her under my /our guidance and supervision. The results embodied in this work have not been submitted to any other universities or Institute's.

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CERTIFICATE

This is to certify that, Internship project report titled **"DEVELOP THE COLLECTION OF MACARONI CHESSE** "submitted by

Ratna Jyothi(211LA22011), in a partial fulfillment for the award of degree in Textile Technology, to the Vignan's Foundation for Science, Technology and Research (Deemed to be University), is a record of Bonafide work carried out by him/her under my guidance and supervision. The results embodied in this work have not been submitted to any other universities or Institute's.

23/05/2024. 24/5/24

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