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EVALUATING THE EFFICACY OF GUAVA LEAF PERMEATED COTTON FABRIC

[1]ARCHANA V C
DEPARTMENT OF FASHION TECHNOLOGY AND COSTUME DESIGING
JAMAL MOHAMED COLLEGE
TRICHY, TAMILNADU INDIA

Abstract: The Concerns about synthetic chemicals in textiles are growing, and this, together with an increase in skin allergies and infections, highlights the need for safer and more environmentally friendly textile finishing options. However the study aspects into the use of extracts from Psidium guajava plants as functional finishes on cotton fabrics to improve their dermatological qualities and add antifungal and antibacterial capabilities. Selected guava leaves, known for their skin-friendly qualities, were processed using the Soxhlet extraction method to yield strong extracts that were then used as finishes on cotton textile materials. The guava leaves extracts shows low toxicity levels, biodegradability, and environmentally gentle profile make them attractive green substitutes for synthetic chemical agents that are frequently utilized in textile industry. The study was to determine the fabric property and change due to the finishing process. The Antibacterial activity of the coated materials were analyzed with *Klebisiella pneumonia, Streptococcus pneumonia, Staphylococcus aureus and Pseudomonas aeruginosa* was within an acceptable level.

Index Terms - Textile finishing, Cotton, Psidium guajava, extract, Soxhelet, Antibacterial, Physical properties.

I. INTRODUCTION

Textiles finishing are mostly done to enhance the properties of any textile material. Many forms of synthetic finishes are coated over any textile material so as to increase the value that acts an emphasis. These value addition provides better properties, increase the fabrics usage, or any sorts of special addition to the textiles. Natural fibers and textiles provide an inbuilt physical properties that are mostly adaptable to human skin. Many finishes over these natural materials are done by synthetic chemicals so as to improve the ability of fabric thereby providing the necessity enhancement done by using finishing

Cotton is one of the natural and most commonly used material used by people all around the world .The world wide cotton consumption increases year by year as people look forward for the sustainability and chemical free materials. The world consumption of cotton is 26.16 million tons. These tons of cotton are used in various forms as clothing, medicinal purposes, home furnishings, etc .Cotton has certain properties of its own but as to increase a medicinal property cotton can be treated with various herbs based on the herbs specifications. psidium guajava a well-known plant known for antioxidant and antibacterial antifungal activity paves way for the skin friendly clothing suited for acnes, and skin allergies.

The leaves of psidium guajava, commonly called guava has medicinal property internally as well as externally. Quercetin, the antioxidant present in the leaves helps to cure the irritations caused in the skin by the staphylococcus bacterium. The extraction of certain phytochemical from the guava leaves through the soxhelet process enables the active particles to directly combine with the textile material .The fabric count determines the rate of absorbency and the efficiency of the handle property of any finished material .80's count fabric suited for any clothing and in garments making.

The tests to analyze the antimicrobial properties against the bacteria, causing skin allergies are conducted before and after the coating of extract on the fabric. The change in the dimensions physical and chemical changes are also examined before and after the treatment of the fabric through various textile testing methods.

The textile materials can be converted into garments that are closely attached to skin. The test results forecasts that the extracts helps the fabric from the microbes that causes skin allergies, acne etc. This also is best suited for people having body acne, eczema, and other commonly caused skin related issues. The fabric can be also in cooperated in the textiles such as hand kerchiefs, bath towels, masks and even in home furnishings. The application of these natural herbs over the natural fibers paves way for the ecofriendly and sustainability.

II. MATERIALS

2.1 Preparation of the fabric

The grey fabric of 80's count, plain weave is obtained from the power loom factory considering that no chemical treatments are undergone over the fabric. The fabric exposed to standard testing conditions for 3 to 4 days with a room temperature of 28 degree and relative humidity of 65% during the sourcing period. The grey fabric is subjected to the preparatory process such a sizing and scouring, so as to remove the starch from the warp yarns of the woven fabric. The further process are carried out after the fabric is set for a relaxation period of 24 hours.

2.2 Preparation of the leaf extract

Plant leaves are gathered in order to prepare the plant extract. The leaves are thinly sliced. Using sun shadow areas, the plant sample was dried after being thoroughly cleaned with the assistance of running tap water two or three times. The most important thing is to keep the leaves away of the sun. The leaves have undergone fine-cut drying. The plant leaves are crushed finely with the mortar. A container held the ground-up leaves. The container needs to be airtight, and the powder should be stored in a cool, dry, and dark area. When making ethanol extract, 10g of powder is added to 100 ml of ethanol and let to soak using the hot percolation method for 24 hours. Following incubation, filter paper was used to filter the extract through a funnel. The stock solution should then be moved to a container and kept at room temperature.

2.3 Machineries used for processing

The fabric is then subjected to the preparatory process .The preparatory process

Includes Desizing, the removal of Dust, oil and grease and other impurities present in the fabric. This also helps the fabric to evenly absorb the finishing extract.Pad dry cure method is carried out to the fabric for the impregnation of the extract.The tumble wash machine is used for coating the extract over the fabric. The tumble drier is used for drying and curing the fabric

2.4 Collection of test organisms:

To examine the antibacterial activity of fabric sample, two strains [Streptococcus pneumoniae (MTCC 1936), Pseudomonas aeruginosa (MTCC 424), Klebsiella pneumonia (MTCC 432) and Staphylococcus aureus(MTCC 96)] were prepared as test organisms. All the strains were procured from the Microbial Type Culture and Collection (MTCC) at Chandigarh, India. Bacterial strains were cultivated at 37ºC and maintained on nutrient agar (Difco, USA) slant at for 4ºC..

III. EXPERIMENTAL PROCEDURE

3.1 Preparatory Process

The fabric is then subjected to the preparatory process .The preparatory process includes Desizing, the removal of Dust, oil and grease and other impurities present in the fabric. This also helps the fabric to evenly absorb the finishing extract. The fabric is subjected to cold wash that includes the water mixed with 0.1% of wetting oil and washed for about 10 min in the tumble and the water is drained out from the tumble wash machine shown in figure 1. The hot wash is carried out for 1 min with caustic peroxide 0.1ml for 30 to 45 min in a temperature of 110oC, Hydrogen peroxide, is added to the tumble that acts a fabric killer used to remove the chemicals substance present in the fabric, and is washed for 15 min at 110^{O}C.The material is treated with Silicone softener at 160^{O}C and dried in a drier at a temperature of 140^{O}C.

Fig 2 Tumble wash with the extract

3.2 Finishing process

The Finishing Process is carried out after letting out the fabric under relaxed state for 24 hours. The process is carried out with a hot wash at 85oC as this helps the fabric to be more absorbent while treating with the extract. The Guava leaves extract is mixed in water in a MLR of 2:5 and circulated for 2 min. The fabric is immersed in the solution and treated for 16 min at 90^{O}C. The silicone wash is done finally as to improve the handle and it acts a softener and is dried at 105oC for 90 sec. The curing is done at 175^{0}C for 45 sec using tumble drier as in figure 3. The fabric is finally checked.

Fig 3 Tumble drying

IV. RESULTS AND DISCUSSION

The Physical properties of the fabric are determined to ensure the handle properties of the fabric. This is established to ensure the fabric are best suited for the hand kerchiefs and can used for the masks. The physical properties include thickness of the fabric using the thickness tester. The handle properties of the fabric tested for the study are the stiffness and the crease recovery test are determined to evaluate the fabrics suitability

4.1 Stiffness Test

The stiffness of the fabric is determined using the stiffness tester with ASTM D1388. The bending length and the flexural rigidity is determined using the stiffness tester. This is done by using the cantilever principle

From table I it is clear that the sample that has undergone no processing or it's the grey fabric. The S# is the sample that has undergone processing suitable for coating of the extract over the textiles. The average bending length in the warp direction is 4.6 after processing and 5.0 before processing and in the weft direction is 4.6 and before processing it is 4.8.From these data it is known that there is slight changes in the stiffness of the fabric before and after processing. This handle properties also determines that fabrics softness and capability to flow. The Fig.3 represents the graphical representation of the stiffness of the fabric before and after coating.

Table I Stiffness in the warp and weft direction

S.No	Bending length in warp		Bending length in weft	
	S#	S*	S#	S*
1.	4.2	5.2	4.4	4.8
2.	4.6	5.0	4.6	4.8
3.	4.7	4.8	4.8	4.9
4.	4.6	4.9	4.5	4.7
5.	4.6	5.0	4.6	4.8

S*-grey fabric sample S# -Processed fabric sample

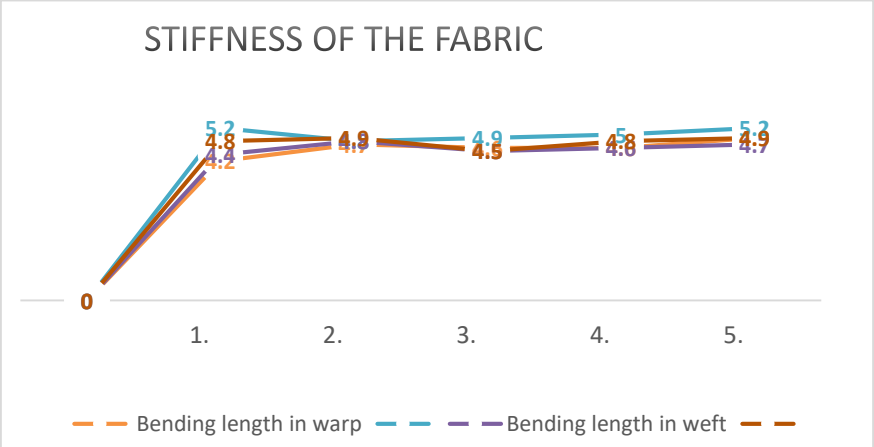

Fig 4 variation in stiffness of the fabric at warp and weft direction

4.2 Thickness Test

The thickness of the fabric is the perpendicular distance of the fabric from the face to the back side of the fabric. The thickness is evaluated using the thickness gauge. The ASTM standard of the thickness tester is the ASTM D1777-96. The thickness before and after treatment of the fabric is determined

From table II the mean thickness of the fabric before the treatment is 39.6μm and after the fabric treatment is 38.6 μm.The thickness of the fabric varies slightly in 1μm before and after treatment. The Fig. 4 displays the variations of thickness of the fabric

Table II .Stiffness in the warp and weft direction

S.No	Thickness of fabric Before treatment S#(µm)	Thickness of fabric after treatment S*(µm)
1.	39	37
2.	41	39
3.	40	40
4.	39	38
5.	39	39

S*-grey fabric sample S# -Processed fabric sample

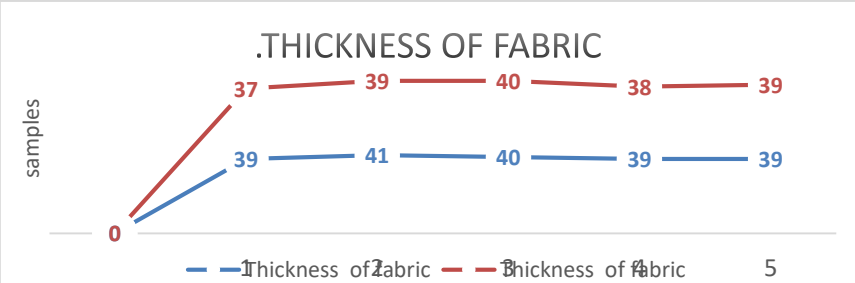

Fig 5 variation in thickness of the fabric

4.3 Crease Recovery

The crease recovery of the fabric is the fabrics tendency to regain its wrinkles or crease to its original form in ASTM D 1295. This is determined using the Shirley Crease recovery tester. The crease recovery is evaluated in angle.

From the table III and IV it can be concluded that the crease recovery angle has slight change in the angles with the before and after treatments. These angles proves that the creases are formed before the treatment and slightly increased after the process which is also shown in Fig. 5 and Fig.6 and Fig 6.1.

Table III -Crease recovery in warp direction

S.No	Crease Recovery direction in angle S#	Crease Recovery direction in angle S*
1.	**97 ^{O}**	**100^{O}**
2.	**100^{O}**	**105^{O}**
3.	**95 ^{O}**	**110^{O}**
4.	**98^{O}**	**110^{O}**
5.	**100^{O}**	**105 ^{O}**

S*-grey fabric sample S# -Processed fabric sample

Table III a -Crease recovery in Weft direction

S.No	Crease Recovery in weft direction S#	Crease Recovery in weft direction S*
1.	100 ^{O}	101 ^{O}
2.	98 ^{O}	98 ^{O}
3.	95 ^{O}	96 ^{O}
4.	101^{O}	98 ^{O}
5.	105 ^{O}	104 ^{O}

S*-grey fabric sample S# -Processed fabric sample

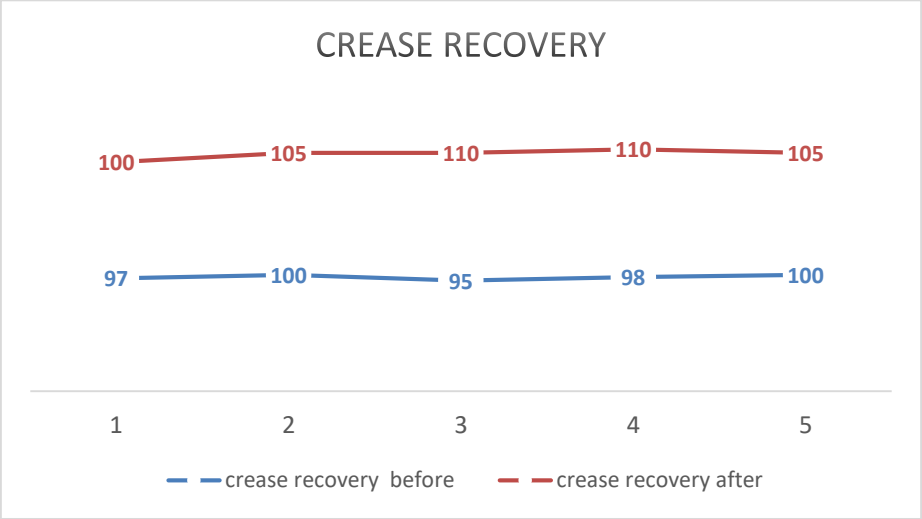

Fig 6 variation in crease recovery warp

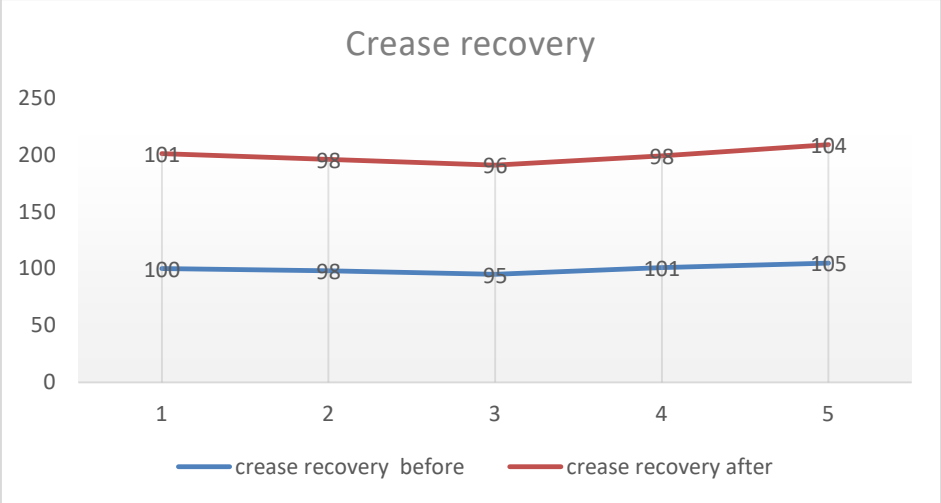

Fig 6.1 variation in crease recovery weft

4.4 Antibacterial Activity

The antibacterial activity of fabric samples treated with extracts were analyzed against pathogens are revealed in table V indicates that the samples showed a maximum inhibition was observed against *Staphylococcus aureus* (13 mm) at a concentration 40 µg/ml.

From the table the antibacterial activity of the fabric samples against four different bacteria shows a good zone of inhibition where the concentration of the extract is 40µl.so that we can conclude that the material liquor ratio should be 2:5 and the fabric after processing shows the same inhibition zone.it is clear from the figures 7 to figure 10 .

Table IV: Antibacterial activity of fabric sample.

Sample	Concentration (µg/ml)	Organisms/Zone of inhibition (mm)			
		Klebsiella pneumoniae	***Streptococcus pneumonia***	***Staphylococcus aureus***	***Pseudomonas aeruginosa***
Extracts coated fabric sample	20 µl	0	5mm	2mm	0
Extract coated fabric sample	40µl	10 mm	11mm	13 mm	8 mm

From the study we can conclude that the guava leaves extract treated on the cotton have a good antibacterial property towards four different bacterium. The Staphylococcus aureus that causes skin related problems like acne, pimples etc has the maximum inhibition towards the extracts. The physical and the handle properties are best suited for the construction of garments

VI Conclusion

From this study we can conclude that the herbal extracts can be coated over the textiles in any methods and the extraction can be done in different methods. The property varies with the herbs used for extraction. The guava leaves extract shows its property in the fabric which can be used for fabrics that are closely related to skin. The fabric can be used for hand kerchiefs, masks, inner wear garments, sweat pads, eye masks etc.

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