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Effect of *Musa acuminata* SAP on Whiteness Index and Physical Properties of Cotton Finished Fabrics

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ABSTRACT

Thirty-six samples of woven fabric were finished with *Musa acuminata* SAP in three different concentrations, viz., 50%, 75%, and 100% were applied on cotton fabrics using padding mangle at four different temperatures, viz., room temperature, 50°C, 75°C, and 100°C and also with three different process timings, viz., 20 min, 40 min, and 60 min, respectively. The finished fabrics have been analyzed on the whiteness and yellow index properties. It has been observed that the fabric finished with a 50% concentration of *Musa acuminata* SAP with 50°C for a prolonged time of processing shows a lesser yellow index and higher whiteness index value followed by the 100% and 75% concentration of SAP. The finished optimized fabric samples have been evaluated on the physical properties of fabric such as tensile strength, tear strength, pilling, drape coefficient, and stiffness of the fabric. It has been found that the fabric finished with a 50% concentration of *Musa acuminata* SAP with the lowest temperature at least processing time has better performance in the physical properties of the fabric when compared to the highest concentration of *Musa acuminata* SAP with the highest temperature at highest process timing.

摘要

36个机织物样品在三种不同浓度 (即50%、75%) 下用Musa acuminata SAP进行整理, 并在四种不同温度 (即室温、50°C、75°C和100°C) 下, 以及三种不同的工艺时间 (即20 min) 下使用轧棉机在棉织物上进行100%的整理, 分别为40分钟和60分钟. 对整理后织物的白度和黄度指标进行了分析. 已经观察到, 在50°C下用50%浓度的Musa acuminata SAP处理的织物在较长时间内显示出较小的黄色指数和较高的白度指数, 然后是100%和75%浓度的SAP. 对优化后的织物样品进行了拉伸强度、撕裂强度、起球、悬垂系数和织物刚度等物理性能评估. 研究发现, 与最高加工时间、最高温度、最高浓度的Musa acuminata SAP相比, 使用浓度为50%的Musa acuminata SAP (至少在加工时间内温度最低) 整理的织物在物理性能方面具有更好的性能.

KEYWORDS

Banana; cotton fabrics; finish; *Musa acuminata*; physical properties; whiteness index

关键词

香蕉、; 棉布、; 完成; 物理性质; 白度指数

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Introduction

Most of the consumer's behavior is to use the logic of touch when selecting clothing. It is important to predict and evaluate the fabric quality suitability for individual end uses. The fabric is the major component of all the clothing industry and maintaining the whiteness index properties of fabric plays a major role in the finishing of cotton fabric and also, the finishing will influence the physical properties of the specimen. Therefore the analysis of sample characteristics on the fabric specimen properties is necessary. In general, the properties of the fabric specimen will be influenced by a number of components, namely EPI, PPI fabric GSM, cover factor, count, and weave structure.

A moderate cover factor and good dimensional stability can be preferred for woven fabrics. The strength of the woven fabric strength can be evaluated by its tensile, elongation, and tear strength. However, various factors have influenced on the strength of the fabric. They are fineness of the fiber, density of the fiber, yarn count, yarn twist and twist direction, density of the yarn, stiffness, fabric construction parameters, fabric cover factor, and fabric finishes. It is very hard to bring in a statistical model to evaluate strength by considering all these preparatory process parameters. Hossain, Datta, and Rahman (2016) investigated that the preparatory process parameters directly or indirectly had an effect on the strength of the woven fabric to help further investigate the forecasting of woven fabric strength.

White is called an achromatic color and is characterized by fixed absorption between 400 and 700 nm (Zollinger 2003). In physical terms of whiteness index, the white surface is the one that reflects more than 50% strongly throughout the visible spectrum. The greater and huge uniform the spectral reflectance, the whiter is the appearance of the fabric. Geometrically, a white fabric surface reflects diffusely in all directions. Mirrors, though reflect strongly throughout the visible spectrum, but only in a single direction and hence, are not called as pure white. The difference is that white fabric materials have a high-scattering coefficient as well as less absorption coefficients (Choudhury 2006).

The evaluation of the whiteness index of a fabric is dependent upon the materials, and the end uses. Natural materials, for instance, cotton or *Wrightia tinctoria* tend to yield some yellowish tone, so the finishing industry will make rectification in the tone of that materials to compensate for this effect. A yellowish tint in a product is most often seen as a quality less flaw, e.g., yellowing due to dirt and some natural finishing using extraction of plant material will try to make the appearance of their fabric whiter. This lead to satisfaction with customer esthetic quality requirement without compromising the comfort of fabric. Bleaching is a process that removes natural colors from materials and results in a more uniform spectral reflectance (Sonaje and Chougule 2013).

Banana SAP has immense profitable nutrients for crop growth. A *Musa acuminata* stem includes 10–15% central core remaining 85–90% are banana fiber, waste materials, suture, and SAP. In this, around 35–40% SAP were present in a *Musa acuminata* stem. Kumara (2014) studied herbaceous plants of the genus *Musa*. The *Musa* stem SAP has a few appropriate characteristics dealing with numerous development such as browning of fruits after harvesting, permanent staining of cloth and fibers, antioxidant, antimicrobial, and anti-hemorrhagic properties. From this study, it was found that *Musa* SAP contains a good amount of antioxidants along with different phytochemical compounds like carbohydrate, protein, and phenolic compounds. The phytochemical screening and analysis of *Musa* SAP indicated the presence of carbohydrate, protein, and phenolic compounds. The antimicrobial studies with different fungal and bacterial strains indicated the antimicrobial properties of the SAP. Muhsina and Thamaraiselvi (2017) focused on the preparation and finishing of textile material from *Mirabilis jalapa* leaf extract. The tensile and tear strength values were identified. The tensile strength value of treated fabric was in a tolerable range when compared to control. In coated fabric, the wrap strength reduction takes place from 42.95 kg to 35.28 kg, and warp elongation was found to be 1.56%. A significant tear strength difference was recognized in the treated samples both in wrap and weft ways.

The tensile strength is defined as the energy required to break a group of yarns in a fabric at the same time in the direction of both warp and weft. The tensile strength properties are still the basic properties that determine the superiority of the fabric. As per the kind of raw material and its finishes directly affects the performance of the final products. Tear strength is defined as the tenacity needed to broadcast a tear in the fabric. Tearing is also considered as the succeeding failure of yarns in the fabric under a predetermined weight. Tearing force is implemented to one or a few number of yarns in the fabric as an alternative of tensile load, where the load is uniformly shared to all the yarns. The tear strength of a fabric is essential because it directly influences the serviceability of the fabric. It is associated with the movement of yarn within the fabric construction. The tearing strength of the fabric depends upon the geometry of yarn, construction parameters of fabric, and fabric friction along with relaxation performance of fibers. The fabric made with low cover factor with very open structures that allow the yarn to move as a group will maximize tearing strength properties, then the fabric will have a high cover factor that will result in inferior tearing strength.But the tear strength of a fabric is improved by increasing compactness of the yarns in the fabric. Also, the tear strength can be superior with the fabric made up of the superior tensile strength of yarn or by declining the performance of friction in the fabric (Hossain, Datta, and Rahman 2016).

Sule (2012) studied the draping and flexibility character of woven fabrics and the influence of picks per inch, count of the weft yarn, and tension of the warp yarn. The fabrics which have more weft density exhibit lesser flexibility. Also, it is identified that the flexibility of the fabrics in the warp directions decreases with the warp tension. There are no notable changes in the flexibility in the direction of weft. The flexibility decreases with the thicker weft yarns and the fabric woven with superior warp tension. The drape coefficient is influenced by the fabrics woven with the thicker weft yarns and does not influence the warp tension of the fabric. Some of the finishing material, quality properties, and variables like the concentration, temperature, and timing of finishing the material are influence the fabric drape performances. For example, a high viscosity herb extract finished cotton woven fabric has low drape coefficient, whereas when the temperature of the extract increases while in the finishing, the drape coefficient where increases as a result of temperature of finishing and the drape coefficient were directly proportionate with each other.

The fabric finishing with *Musa acuminata* stem SAP also has a significant influence on fabric properties like whiteness and yellowness index as well as physical properties of the fabric specimen such as tensile strength, tear strength, fabric pilling, drape coefficient, and stiffness of the specimen. Therefore, this study aims to investigate the influences of fabric finished with *Musa acuminata* stem SAP on fabric whiteness, yellowness index, and physical properties of the fabric specimen.

Materials and methods

Finishing of fabric with naturally extracted stem SAP

SAP is a separate substance present in different components of plants. In the banana plant, it is present in pseudostem. Predetermined amounts of natural extract of stem SAP were taken as per required concentration on the basis of fabric weight and mixed thoroughly. Cotton fabric samples (Table 1) of over 2.5 kg were made for finishing. The fabric samples were washed with distilled water and boiled for 30 min at a maximum temperature of 60°C. The boiled fabric samples were taken out and *Musa acuminata* naturally extracted stem SAP was applied on them using padding mangle and by immersing in a bath of material–liquid (M.L) ratio 1:30. The SAP treatment was carried out at four different temperatures room temperature, 50°C, 75°C, and 100°C, and concentrations, viz., 50%, 75%, and 100%, and finishing timing, viz., 20 min, 40 min, and 60 min, respectively at 3 Psi (Pound per square inch) bar pressure. To drive out the moisture content present in the fabric, it was dried out at room temperature for a required time. The naturally extracted stem SAP coated samples were tested for their whiteness and yellowness index. Through this optimized test result from whiteness and yellowness index (12 samples) were tested for their physical properties, Thermal comfort properties and moisture

Table 1. Detailed technical parameters of cotton fabrics.

Characteristics	Cotton Fabric
Weave structure	Plain
Ends per inch (EPI)	92
Picks per inch (PPI)	82
Warp count (Ne)	40's
Weft count (Ne)	40's
Warp crimp %	7
Weft crimp %	9
Warp cover factor	14.5
Weft cover factor	12.5
GSM (gms)	1.14
Warp twist direction	S twist
Weft twist direction	S twist

Table 2. *M. acuminata* stem SAP finished fabric details.

Sample No.	Concentration	Temperature	Time	Pressure
S1	100	RT	20	3 Psi
S2	100	RT	40	
S3	100	RT	60	
S4	100	50	20	
S5	100	50	40	
S6	100	50	60	
S7	100	75	20	
S8	100	75	40	
S9	100	75	60	
S10	100	100	20	
S11	100	100	40	
S12	100	100	60	
S13	75	RT	20	
S14	75	RT	40	
S15	75	RT	60	
S16	75	50	20	
S17	75	50	40	
S18	75	50	60	
S19	75	75	20	
S20	75	75	40	
S21	75	75	60	
S22	75	100	20	
S23	75	100	40	
S24	75	100	60	
S25	50	RT	20	
S26	50	RT	40	
S27	50	RT	60	
S28	50	50	20	
S29	50	50	40	
S30	50	50	60	
S31	50	75	20	
S32	50	75	40	
S33	50	75	60	
S34	50	100	20	
S35	50	100	40	
S36	50	100	60	

management properties by adopting standard procedures. Table 2 shows the detailed combination of fabric samples. Table 3 shows the detailed optimized fabric samples from the whiteness and yellowness index test report.

Table 3. Optimized fabric sample details from whiteness and yellowness index test report.

Sample No.	Concentration	Temperature	Time	Pressure
S1	50	50	60	3 Psi
S2	100	75	20	
S3	50	RT	60	
S4	50	100	20	
S5	50	50	40	
S6	50	50	20	
S7	50	75	40	
S8	75	50	20	
S9	50	75	60	
S10	100	75	40	
S11	75	75	60	
S12	75	100	60	

Testing methods

The whiteness and yellowness index of untreated and treated samples were measured by a reflectance spectrophotometer (data color 650) in order to determine the effects of finishing on the changes in whiteness and yellowness values (Haque and Islam 2015). D65-10 and U35-10 illuminate were considered in all the samples. Each sample was tested 5 times and the average value was considered. The tensile strength of untreated and *Musa acuminata* stem SAP finished cotton fabric samples were conducted on an Instron tensile strength tester. Ten repetitive tests were carried out for each and every sample in both the warp and weft direction of samples with the standard test method of ASTM D 5034, the distance between the upper and lower jaws was 75 mm, and the test was conducted at the speed of 300 mm/min. All the evaluations were performed under the standardized test condition at 20°C ± 2°C and RH (Relative Humidity) of 65 ± 2%.

Tearing strength of finished and controlled cotton fabric samples are evaluated by Elmendorf tearing strength tester with the ASTM D 1424 standard test method. The fabric sample was prepared for the standard size of 63 ± .15 mm in width and 100 ± 2 mm in length. Ten repetitive tests were carried out for each and every sample in both the warp and weft direction. The fabric specimens were torn up to 43 ± .15 mm and scale reading were noted.

Tearing strength in grams = 63 × Scale reading

All the evaluations were conducted under the standardized test condition of 20°C ± 2°C and RH (Relative Humidity) of 65 ± 2%.

Before the tests, all fabrics were conditioned under standard atmospheric conditions (20 ± 2°C, 65 ± 4% RH) in the laboratory. The pilling tests of unfinished and all finished fabrics were carried out according to EN ISO 12945–2 standard with Martindale instrument by 2000 cycles. Then all the fabrics were placed for pilling tests by Martindale instrument, fabric surfaces were investigated objectively using Pill Grade system. To develop an objective and repeatable pilling assessment in compliance with both ASTM and ISO test methods Pill Grade system is determined with automated grading points. Once the scanning was finished the detecting and measuring of each and every pill in the mid area of the specimen was done with the help of Pill Grade, uses the Pill Grade Grading system from 1.0, which means excessive pilling to 5.0, which means no pilling (Dalbaşi and Kayseri 2015).

The drape coefficient of finished and controlled fabric was evaluated using Cusick's drape instrument as per the BS 5058 standard test method. To determine the stiffness of fabric the cantilever test method was used. In this test, both treated and untreated fabric samples were allowed to bend under their own weight as the length of the overhanging portion of the sample is gradually increased. The free length which bends under its original weight, is enough to make it is leading-edge intersects with a plane of 41.5° inclination and is taken as the measure of stiffness (Jaswal, AgyaPreet, and Goel 2017). Finally, using these values of length, the bending modulus and flexural rigidity were calculated.

Results and discussion

Whiteness and yellowness index properties of the fabric

The whiteness and yellowness index properties of all the finished fabric samples from *Musa acuminata* stem SAP as described in Table 4. A clear evidence has been observed from Table 4 that the whiteness and yellowness index of fabric are influenced by the variables such as the concentration of SAP, processing time, and temperature. This variable will give a neutral platform to all the finished fabric samples to determinetheir surface tone properties. The samples are optimized and selected on the basis from the lowest yellowing index of the finished fabric for further analysis, which is shown in Table 5.

An clear evidence has been found from Table 5 that the yellow index of the finished specimen with *Musa acuminata* stem SAP, increases by increasing the concentration of SAP, process temperature, and process timing. This result is proven from by conducting experimental studies for all 36 samples through a spectrophotometer. Sample S1 was finished at 50% concentration and 50°C temperature shows the lowest yellow index among the group of the optimized samples. This is because of the reduction of viscosity of *Musa acuminata* SAP at a 50% concentration level when compared to 75% as well as 100%. Generally, if the process timing increases, the yellowing index value also increases. The yellowness index value decreases even at a higher concentration level by reducing the process temperature and timings. In general, all the optimized 12 samples showed a lower yellowness index

Table 4. Whiteness and yellowness index of finished fabric.

Sample No.	Illuminant observation		Yellow Index (YI)
	D65-10	U35-10	
S1	58.08	64.67	8.84
S2	64.01	69.43	7.22
S3	58.21	64.75	8.63
S4	52.64	58.47	7.98
S5	40.47	48.66	11.32
S6	46.22	53.61	9.98
S7	61.34	63.29	2.03
S8	51.97	56.06	4.95
S9	36.73	44.39	9.79
S10	61.49	66.23	6.34
S11	50.42	57.11	9.19
S12	48.79	55.99	9.94
S13	58.7	64.99	8.38
S14	58.05	64.72	8.85
S15	57.3	63.8	8.67
S16	67.71	70.62	3.89
S17	54.78	59.77	6.39
S18	56.2	61.62	7.52
S19	60.04	64.51	6.34
S20	50.22	56.28	8.72
S21	62.19	66.2	5.21
S22	50.28	55.93	7.61
S23	56.19	60.46	5.64
S24	64.85	68.6	5.16
S25	59.48	64.94	7.29
S26	61.04	66.03	6.88
S27	69.32	71.09	2.19
S28	65.22	67.28	2.82
S29	62.91	65.23	2.64
S30	70.66	72.07	1.97
S31	56.79	60.53	5.58
S32	61.64	64.39	3.88
S33	62.58	65.52	4.23
S34	69.57	71.26	2.3
S35	54.65	59.95	7.54
S36	56.28	61.1	6.87
Control sample	70.88	74.78	5.34

Table 5. Optimized fabric sample.

Sample No.	Illuminant observation		Yellow Index (YI)
	D65-10	U35-10	
S1	70.66	72.07	1.97
S2	61.34	63.29	2.03
S3	69.32	71.09	2.19
S4	69.57	71.26	2.30
S5	62.91	65.23	2.64
S6	65.22	67.28	2.82
S7	61.64	64.39	3.88
S8	67.71	70.62	3.89
S9	62.58	65.52	4.23
S10	51.97	56.06	4.95
S11	64.85	68.6	5.16
S12	62.19	66.2	5.21
Control sample	70.88	74.78	5.34

value than controlled samples. So from Table 5 it is clear that the optimized sample did not affect the whiteness of the fabric. This evidence makes the researcher take over these samples for further analysis.

Physical properties of the fabric

Tensile properties

Figures 1 and 2 exhibit the influences of *Musa acuminata* SAP on the tensile properties of all the specimens (treated and controlled) in both warp and weft direction. It is strongly proven that the fabric specimen finished at room temperature exhibits greater tensile strength both in the direction as shown in Sample 3 than the rest of the samples specimen. This is because of the diluted concentration at a 50% level and also due to the risk-free of fibers molecules while finishing the specimen at room temperature. It is also found that Sample specimen 3 (50% conc., RT, 60 min) exhibits major improvement in tenacity while compared to Sample specimen 6 (50% conc., 50°C, 20 min) and Sample 5 (50% conc., 50°C, 40 min). The tensile strength of the specimen was reduced significantly

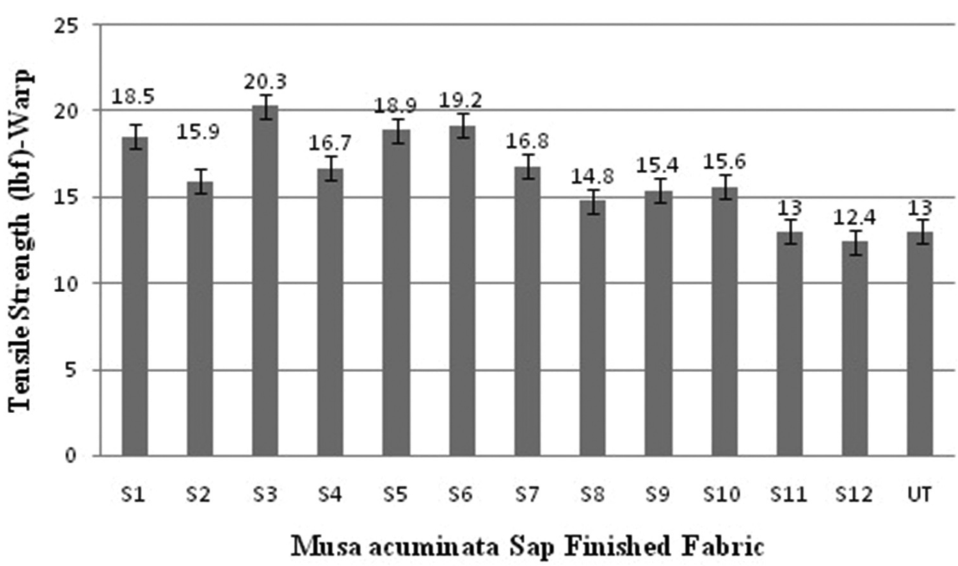

Figure 1. Effect of *Musa acuminata* SAP on tensile strength in the warp direction of finished cotton fabric.

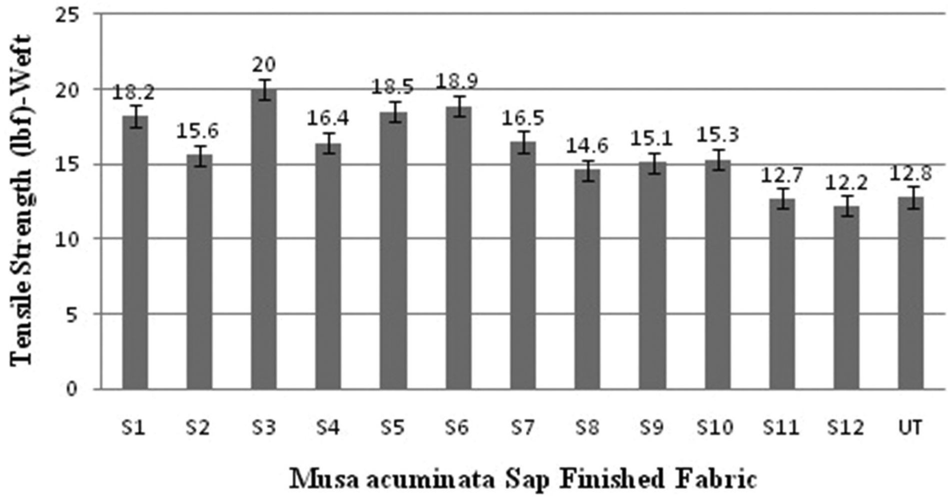

Figure 2. Effect of *Musa acuminat*a SAP on tensile strength in the weft direction of finished cotton fabric.

when the temperature and process time was increased. So it is advisable to process the fabric with moderate concentration (≤50%) and moderate temperature (≤50°C). If the concentration and temperature increase above 50% the fiber molecules in the fabric start to damage. It is also recommended to minimize the process timing of finishing enhancing the elongation of the finished specimen sample.

Figures 3 and 4 describe the result of *Musa acuminat*a SAP on the elongation properties of all the specimens (treated and controlled) samples in both warp and weft direction. It has strong evidence that the specimen elongation in the weft way is higher than the warped way even in the untreated samples due to the highest crimp % of woven fabric. Sample 3 (50% conc., RT, 60 min), provided significant improvement in elongation when compared to the rest of the finished samples. The

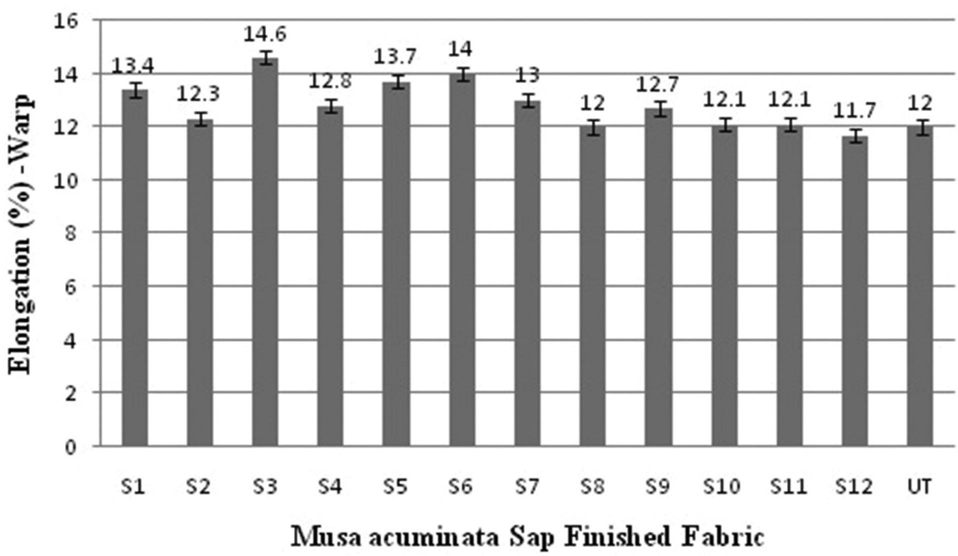

Figure 3. Effect of *Musa acuminata* SAP on elongation % in the warp direction of finished cotton fabrics.

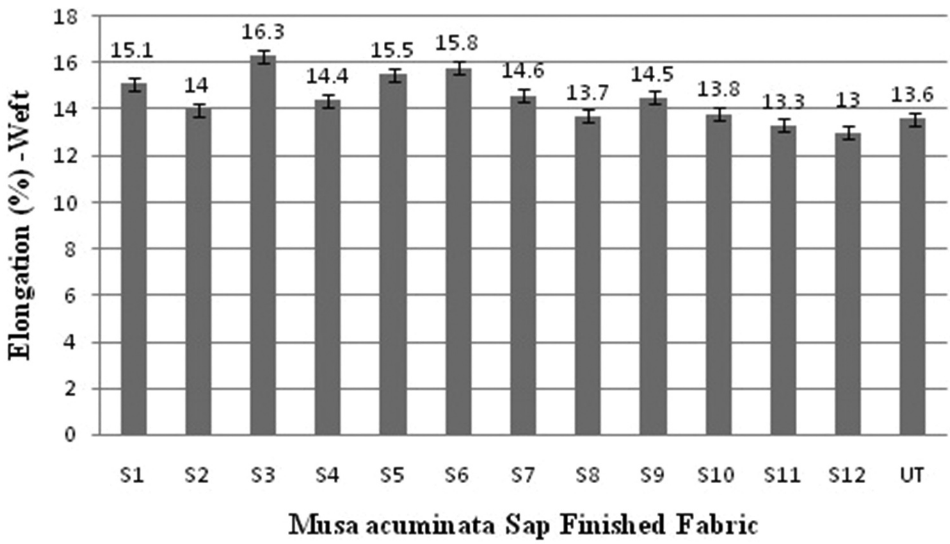

Figure 4. Effect of *Musa acuminat*a SAP on elongation % in the weft direction of finished cotton fabrics.

elongation at break reduces while increasing the temperature and concentration of the SAP of fabric finishing. This is due to the damages occurring in fiber molecules and increasing of the rigidity of fabric, respectively.

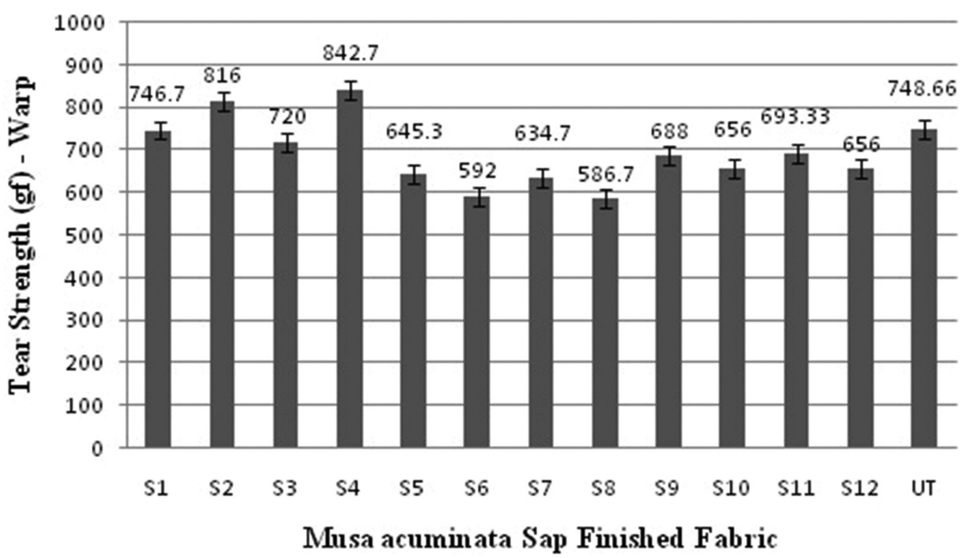

Figure 5. Effect of *Musa acuminat*a SAP on tear strength in the warp direction of finished cotton fabrics.

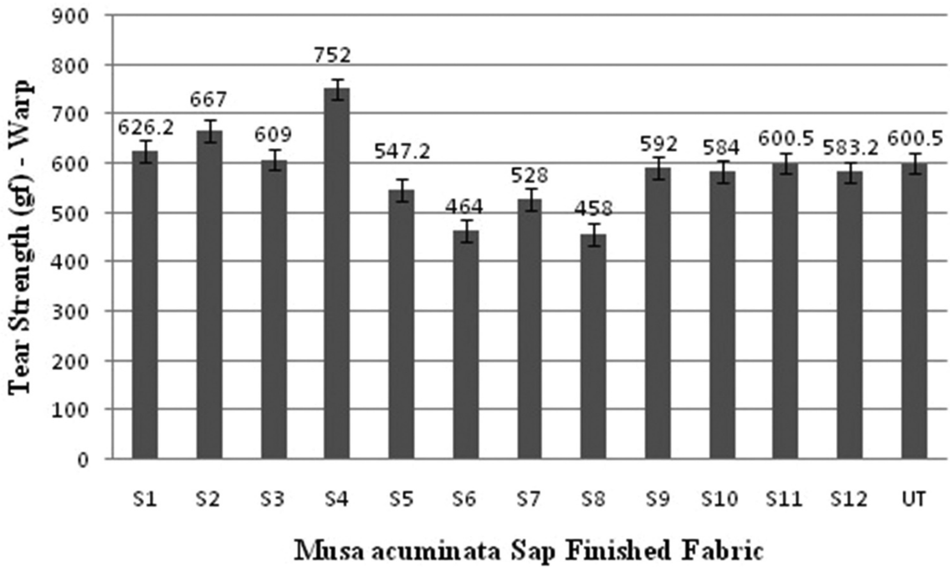

Figure 6. Effect of *Musa acuminata* SAP on tear strength in the weft direction of finished cotton fabrics.

Tear strength

Figures 5 and 6 describe the influence of *Musa acuminata* SAP on the tear strength of the entire specimen in both warp and weft directions. It is clearly evident that the woven fabric finished with moderate concentration and less process timing as mentioned as Sample 4 (50% conc., 100°C, 20 min) exhibits greater tear strength both in the warp and weft directions than rest of the specimens. This is mostly because of the contact time of the fabric with SAP while finishing and diluted concentration at 50% level of SAP. The reduced contact time and moderate concentration of SAP allows superior specimen distortion and additionally it allows more fabric to endure the weight as a group with more slippage and liberty of the movement. However, increasing the temperature and process timing of fabric affects the tear strength property of the finished fabric (Rathinamoorthy and Thilagavathi 2013). Hence, the fabric finished with a 50% concentration level and its less processing time of finishing has significant importance on the tearing strength properties of the specimen in both warp and weft directions. Although, the finished fabric specimen with the higher temperature and higher processing time has low tearing strength properties of the sample due to its higher loss of strength and higher stiffness on *Musa acuminata* SAP finished fabric.

Pilling effect of the fabric

Figure 7 describes the influence of the *Musa acuminata* SAP on the pilling properties of the entire finished specimen. It has been obtained with strong proof that the fabric finished with a 50% concentration exhibits higher anti-pilling properties than the rest of the fabric specimen. This is due to the finishing of fabric at a moderate concentration (50%), the fibers at the surface of the fabric get compact bindings and act as a lubricant on the surface of the fabric while making the frictional contact. Fabric sample finished with a higher temperature of above 50°C for prolonged time makes losing of fibers binding on the surface of the fabric. This result tends to the generation of protruding fibers on the surface of the fabric, which tends to pill. Hence it is concluded that moderate concentration (50%) and the minimum temperature and processing time reveal a better anti-pilling performance. Even in the higher temperature level, if lesser is, the processing time gives the better pilling performance.

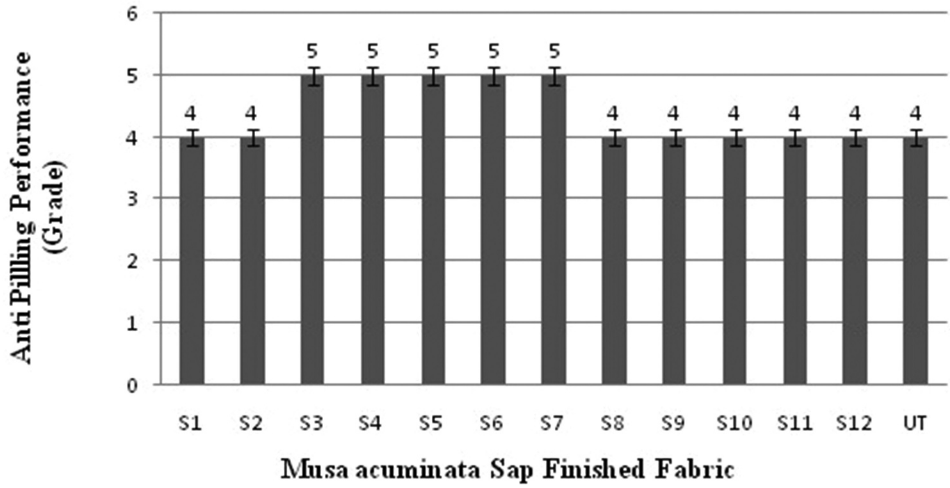

Figure 7. Effect of *Musa acuminata* SAP on anti pilling properties of cotton fabric.

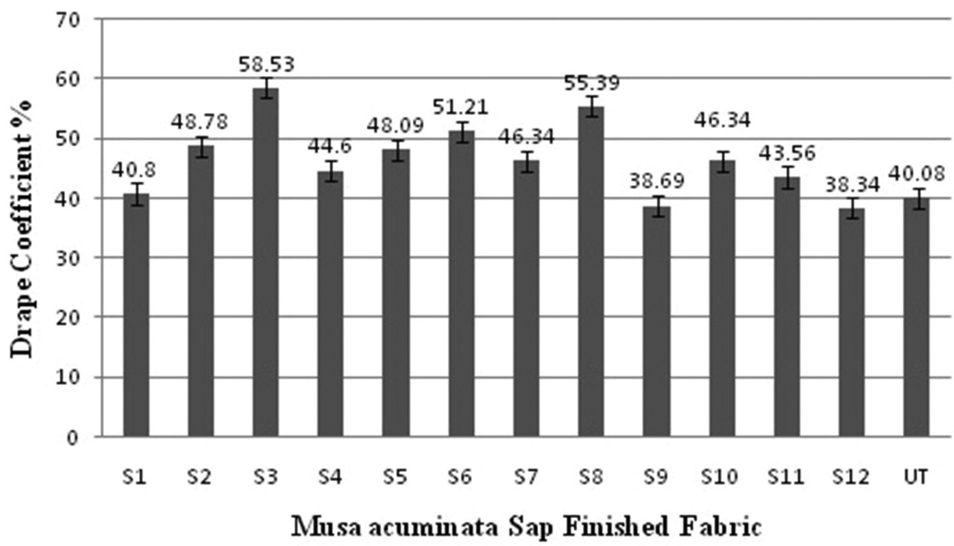

Figure 8. Effect of *Musa acuminata* SAP on drape coefficient (%) of cotton fabric.

Drape coefficient of the fabric

Figure 8 describes the influence on *Musa acuminata* SAP on the drape coefficient of all the finished specimens. It has been found with strong proof that the specimen finished as mentioned in Sample 3 (50% conc., RT, 60 min) exhibits a superior drape coefficient in weft direction than rest of the fabric specimen. This is due to the moderate concentration (50%) and prolonged processing time (60 min) at room temperature. This makes the fabric stiffer when compared to finishing of fabric with higher temperatures and more process timing. Following these samples, 8 (75% conc., 50°C, 20 min) exhibits the next higher drape coefficient because of higher concentration with minimum temperature and minimum processing time (20 min). Even though the fabric is finished with a higher concentration, it will be shown the poor drape coefficient when the fabric sample is subjected to a higher temperature in prolonged process timing due to the fiber molecular damages, which makes the fabric softer.

Stiffness of the fabric

Figures 9 and 10 describe the influence of *Musa acuminata* SAP on the stiffness properties of the entire finished specimen. It has strong proof that the specimen finished as mentioned in Sample 3 (50% conc., RT, 60 min) exhibits higher stiffness properties than all other fabrics. This is because of the non-losing of the viscosity of *Musa acuminata* SAP at room temperature. This makes the fabric stiffer when compared to the finishing of fabric with the highest temperature. Following this, Sample 2 (100% conc., 75°C, and 20 min) and Sample 8 (75% conc., 50°C and 20 min) show the higher stiffness due to its higher concentration and minimum temperature at the lowest processing time. When the sample is subjected to process at a higher temperature and processing time, the fabric loses its strength, which increases the flexibility of fabric samples.

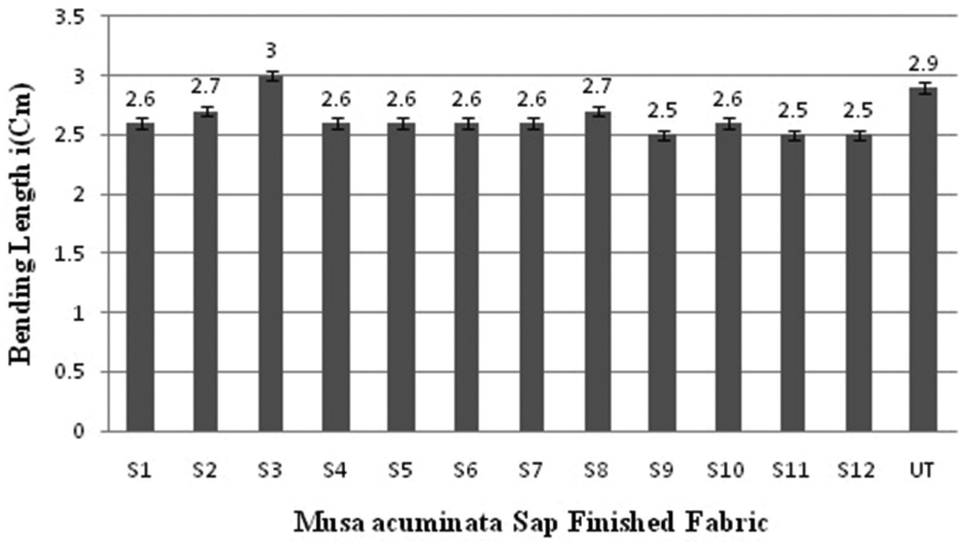

Figure 9. Effect of *Musa acuminata* SAP on stiffness properties in the warp way direction of finished cotton fabrics.

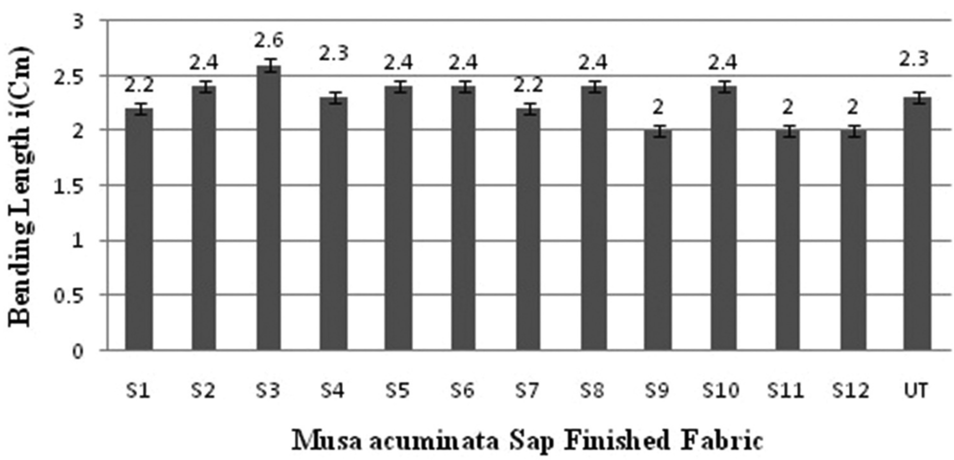

Figure 10. Effect of *Musa acuminata* SAP on stiffness properties in the weft way direction of finished cotton fabrics.

Conclusions

The specimen finished with *Musa acuminata* SAP has a considerable improvement on the overall whiteness index, and physical properties of the fabric specimen were observed. The fabric finished with a 50% concentration of SAP irrespective of temperature and time majorly exhibits higher whiteness and lesser yellowness index of the fabric. Followed by 75% and 100% concentrations of SAP finished fabric exhibits good whiteness index at lower temperature and in lesser processing time. The fabric finished with *Musa acuminata* SAP shows higher tensile strength while finishing at room temperature. Increasing the temperature and processing time leads to degrading the fabric strength irrespective of the concentration of finishing. The fabric finished with *Musa acuminata* SAP shows higher tear strength while finishing the fabric at minimum processing time and at lower temperature level, which permits greater fabric distortion to the fabric and further permits more fabric to withstand the load, exhibits more slippage and freedom of movement. Even though in the higher temperature, if the process timing reduces, it revels the good tear strength property of the finished fabric. The fabric finished with *Musa acuminata* SAP shows higher anti-pilling properties at 50% concentration of SAP irrespective of temperature and process timing. The increased temperatures such as 75°C and 100°C and increased concentrations such as 75% and 100%, makes the fabric lose its strength and become brittle after drying due to the higher viscosity of SAP, respectively.The fabric finished with *Musa acuminata* SAP shows a higher drape coefficient and stiffness at room temperature in a prolonged time of processing. This makes the fabric stiffer and becomes a higher drape coefficient. Therefore, the performances such as the whiteness index and physical properties of the finished specimen are improved by the *Musa acuminata* SAP finishing.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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