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Effect of guava leaves extract treatment on physical properties of cotton

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ABSTRACT : Guava leaves extract treatment was prepared and applied on cotton fabric, to find out the efficiency of guava leaves extract treatment the physical properties of controlled, treated and washed samples were compared. Extraction of guava leaves was conducted by cold aqueous maceration and was applied on woven cotton fabric by exhaust method using 5g/1 concentration. After guava leaves extract treatment, fabric weight and bulk of fabric increased significantly while tensile strength in warp and weft directions, flexural rigidity and air permeability decreased significantly. The changes in thickness, bending length, fabric count in both warp and weft directions and moisture regain were found to be non significant. After washing, weight, bulk, flexural rigidity and tensile strength in warp and weft directions of guava leaves extract treated samples decreased significantly while air permeability increased significantly. The changes in thickness, bending length, fabric count in both warp and weft direction and moisture regain were found to be non-significant. Conclusively, the guava leaves extract treated fabrics exhibited excellent efficacy against antibacterial activity and washing. However, it is needed to be renewed after every wash for good resistivity to washing.

Keywords: Bulk, guava leaves extract, physical properties, washing, weight

Nature has endowed mankind with trees and plants for survival much before his arrival on earth. They fulfilled the need of protection and modesty of humans and provided them with fruits to satisfy their hunger. Fruits are known to be an integral part of diet and are consumed fresh as juices, salads or fruit based drinks. Besides their delicious taste and flavour, the fruits are known to reduce risk of several chronic diseases including cancer. The protective nature of fruits is due to presence of phyto constituents such as polyphenolic compounds. guava, the most popular fruit is a powerhouse of nutrients (Madhuri *et al.,* 2014). Health benefits of guava fruit are known to most of us but we are unaware of the fact that even guava leaves have several medicinal properties and offer an array of health benefits. There are bioactive components in the guava leaf that can fight against pathogens. Aqueous extract of guava leaves is described to be effective against a number of microbial strains (Kumar, 2012).

Micro-organisms include a variety of organisms like bacteria, fungi, algae and viruses. Bacteria grow very rapidly in warm and moist conditions. Some specific types of bacteria are pathogenic and cause cross infection. Pathogenic micro organisms like *Pseudomonas* *aeuroginosa*, *Staphylococcus aureus, Bacillus* spp. and *Candidaalbicans* have been found on textiles. Microbes may also cause a decrease in fabric mechanical strength.

Natural fibres have cellulose and protein which provide basic requirements for bacterial growth and their multiplication. Cotton covers almost all the possible fields of human living from formal to informal clothing. Cotton textiles in contact with the human body offer an ideal environment for microbial growth (Salah, 2011). Antimicrobial textiles can improve functionality of textile articles, especially of garments, worn close to the skin and also of medical textiles used as infection control and barrier material. Bacterial growth on the textiles can be inhibited by applying chemical and natural botanical anti-microbial agents. Synthetic anti microbial agents leads to fabric strength loss, make the fabric stiff, change the colour of the fabric and also harm the environment (Hussain, 2006). Due to these problems application of natural products in textile substrate are gaining significant momentum. Herbal treatments improve some physical properties of the fabric like non wettability, resistance to abrasion and microbial resistance. guava leaves are available in abundance especially in autumn and its aqueous extract had been described to be effective against a number of microbes like *Shigella* spp., *Vibrio* spp., *Staphylococus aureus, Escherichia coli, Pseudomonas aeruginosa* and *Bacillus* spp. Considering the health problems faced by the consumers due to environmental hazards like microbes as well as understanding the importance of cotton in our life, the present study was conducted for the application of guava leaves extract treatment on cotton fabric for microbial resistance with the objective to study the efficacy of treatment on physical properties of the fabric

MATERIALS AND METHODS

Two types of materials namely woven cotton fabric and leaves of guava plant were procured. A survey was conducted in local market of Hisar city of Haryana state to procure woven cotton fabric. On the basis of visual inspection, woven pure cotton fabrics suitable for apparel during summer season were collected. The collected fabrics were subjected to burning, physical and chemical tests for conformity of pure cotton fabric. The cotton fabric exhibiting light to medium weight was selected for the study.

Fresh, fleshy, mature and green leaves of guava plant (ver. Hisar *Surkha*) were collected from Agriculture Farm, CCS Haryana Agricultural University, Hisar because of easy accessibility.

The woven cotton fabric was subjected to preparatory processes to ensure complete wetting and uniform absorbency of the extract. Woven cotton fabric was desized in a solution containing 1per cent sulphuric acid at 50^{o}C for 60 min with material to liquor ratio 1:40. The fabric was thoroughly rinsed to remove starch and acid residues. The fabric was dried and weighed. After desizing the fabric was soaked, squeezed and treated in a solution containing 1 per cent soap, 3 per cent soda ash and 0.5 per cent sodium sulphide at boiling temperature (100°C) with 1:40 material to liquor ratio for 60 min for scouring. After that the fabric was rinsed thoroughly and dried on a flat surface (Saini, 2014). Samples taken from scoured cotton fabric was kept as controlled sample.

Collected leaves were washed and allowed to dry in shade to avoid breakdown of important phytochemicals. These were crushed and ground into fine powder by grinder mixer. After that, the powder was sieved to remove the dirt and unkind particles. Extraction was conducted through cold aqueous maceration.

Extract was applied in 5 per cent concentration on scoured cotton fabric by using standard exhaust method (Hooda, 2012). The concentration was selected on the basis of analysis of antibacterial property of extract. On the basis of weight of fabric samples, quantity of guava leaves extract and citric acid as cross linking agent was calculated. The material to liquor ratio was taken as 1:20. guava leaves extract was taken in one concentration (5g/l). This was set in a bath. Eight per cent citric acid on the basis of weight of the fabric was used. The water was taken in water bath. The temperature of the water bath was raised upto boiling point. Acetic acid was used to maintain the pH of bath *i.e.* 5-6. guava leaves extract was mixed in water in a beaker. The solution was filtered. The extract was added into the water bath and stirred continuosly. The samples were dipped into the bath. The bath temperature was maintained upto boil and it was kept for 30 min. After 30 min, the bath was cooled down to room temperature. The samples were taken out, rinsed with lukewarm water and washed with cold water and dried. A post treatment was given with 8 per cent citric acid on the basis of the weight of fabric as fixing agent. The samples were immersed in respective water bath having the fixing agent and kept at room temperature for 30 min which can be excluded at household level. The samples were taken out, rinsed with cold water and air dried (Hooda, 2012).

The effectiveness of the treatment was analyzed by washing all treated samples in the 'Launder-o-meter' by using standard ISO: 6330-1984E.

Soap (4g/l) and sodium carbonate (2g/l) were mixed with water by taking 1:20 M:L:R. A homogeneous soap solution was obtained by stirring the solution for few min. The fabric samples and soap solutions were taken together in the steel cups of the 'Launder-o-meter'. The cups were fastened inside the instrument and the lid was closed. The time was set for 20 min at 30°C temp. After the completion of washing, the samples were air dried.

Physical properties of treated and washed samples were tested to analyze the effect of guava leaves extract, with respect to their controlled samples. The fabric samples were conditioned for 24 h prior to determination of fabric properties dimensions under standard test conditions, *i.e.* relative humidity of 65±2 per cent and 21±1° C. All the tests were performed for three types of samples *i.e.* controlled (scoured), samples treated with guava leaves extract and treated samples after subjecting to one wash cycle. The samples were subjected to tests according to the test standards as mentioned in Table 1 for respective physical property tests.

RESULTS AND DISCUSSION

After the application of the guava leaves extract treatment on cotton fabric the weight/ unit area and bulk increased significantly while tensile strength in both warp and weft directions,

Table 1. Physical properties, instruments and standards used

Physical properties	Sample size	Instruments used	Standards used
Fabric count(ends and picks/sq. inch)	6"× 6"	Paramount pick glass with pointer	ASTM-D123
Weight/unit area (g/m^2)	Template size	GSM quadrant balance	ASTM-D3776-90
Thickness(mm)	5"× 5"	Thickness TesterBS 2544:1967	
Bulk(cm^3/g)	2"×2"	Electronic weighing balance and thickness tester	BS 2544:154
Tensile strength (kg)	12" × 2.5"	Paramount universal tensile tester	ASTM-D1682-64
Bending length (cm) Flexural rigidity(mg-cm)	25 × 200 mm	Paramount stiffness tester	BS 3356:1961
Air permeability(m^3/m^2/min.)	Template size	Shirley air permeability tester	BS 3321:1960
Moisture regain (%)	6" × 6"	Oven dry method and weighing balance	BS1051:1964

The change in physical properties of the fabric at various stages were studied.

flexural rigidity and air permeability decreased significantly. The changes in physical properties of the treated fabric may be because of the absorption, spreading and exhaustion of guava leaves extract as antibacterial ingredient into the fibrous substrate.

The increase in weight/unit area and bulk of the treated fabric may be due to the absorption of the guava leaves extract and swelling of the fibres. The increase in weight is similar to the findings of Hooda *et al.,* (2013) who reported that weight add on per cent increased as the concentration of extract increased.

The bulk of the treated fabric also increased significantly. The increase in bulk was observed due to the increase in the fabric weight. The results are supported by the findings of Hooda (2012) who reported significant increase in the bulk of the scoured cotton and wool fabrics after the treatment with *neem* and aloevera extracts applied for bacterial resistance. Likewise, increase in bulk was reported by Saini (2014) after the application of *Karanja* extract on the samples treated with two different concentrations *i.e.* 2.5g/l and 5g/l.

The decrease in tensile strength could be attributed to the formation of inter molecular and intra molecular cross links which reduced the possibility of equalizing the stress distribution, causing reduction in the capacity to withstand load, as well as prevents the movement of the fiber molecules causing severe tensile strength loss as reported by Sunder and Nalankilli (2012). Similarly, Gupta (2016) reported that the tensile strength of treated woven fabric decreased by 4.12 percent after the finishing treatment of *Syzygium cumini* (L.) leaves extract. The results are in line with Sathianayranam *et al.,* (2010) who revealed that pomegranate extract cross linked with resin decreased the tensile strength by about 15 percent and that of *Tulsi* by about 13 per cent in warp direction.

The decrease in flexural rigidity may be because of the swelling of the fibres due to take up of the treatment along with citric acid used during treatment. The results are in line with the results obtained by Gupta (2016) as she reported the decrease in flexural rigidity fabrics treated without resin cross linking agent and magnesium chloride in the presence of *Syzygium cumini* (L.) leaves extract, which indicated that the fabric have become pliable.

The decrease in air permeability may be attributed to compactness and closeness of weave due to entry in water bath and blockage of the pores of the treated fabric due to the size of herbal particles, which in turn leads to lower air permeability. Increased fabric thickness and more number of fibres/unit area offer more resistance to air flow leading to lower air permeability.

The decrease in air permeability after the application of treatment have also been reported by Hooda (2012), Saini (2014), Gupta (2016) and Chandrasekar *et al.,* (2013). Agne and Rasa (2014) investigated air permeability of plain knits and revealed that knitted samples after antimicrobial treatments have significantly lower air permeability comparing with untreated fabric.

It was evident from Table 3 that after washing there was significant decrease in weight/unit area, bulk, tensile strength in both warp and weft directions and flexural rigidity whereas significant increase in air permeability. The changes in physical properties may be because of removal of extract from the surface of fabric after washing.

The decrease in weight and bulk might be due to removal of guava leaves extract as well as loose fibers. The results obtained are in alignment with the results obtained by Hooda (2012), Verma (2013), Saini (2014) and Gupta (2016) who reported the decrease in weight and bulk of the fabric with increased number of wash cycles.

The decrease in tensile strength and flexural rigidity might be due to the frictional action involved in washing as well as decrease in weight and thickness of the fabrics. These results are again in line with the findings of by Hooda (2012), Verma (2013), Saini (2014), Sumithra (2015) and Gupta (2016) who reported

Table 2. Effect of guava leaves extract treatment on physical properties of fabric

Physical properties		Fabric		Change	t-value
		Controlled Mean ± S.E	Treated Mean ± S.E	(%)	
Weight/unit area (g/m^2)		149 ± 0.44	154.6 ± 0.51	+3.75	6.89**
Bulk (cm^3/gm)		2.93 ± 0.03	3.07 ± 0.03	+4.77	6.32**
Air permeability (m^3/m^2/min)		194.3 ± 0.59	191.35 ± 0.45	-1.51	5.50**
Tensile strength (kg)	Warp	19.43 ± 0.21	17.68 ± 0.37	-9.00	5.77**
	Weft	23.98 ± 0.38	21.98 ± 0.5	-8.34	3.20*
Flexural rigidity (mg-cm)		5.43 ± 0.04	5.07 ± 0.10	-6.62	3.55*
Fabric count (ends and picks/sq. inch)	Warp	36 ± 0.05	38± 0.06	+5.55	1.98
	Weft	25 ± 0.30	26 ± 0.30	+4.00	1.14
Thickness (mm)		0.288 ± 0.003	0.306 ± 0.008	+6.25	2.09
Bending length(cm)	Warp	4.08 ± 0.17	3.74 ± 0.09	-8.33	1.33
	Weft	3.44 ± 0.07	3.18 ± 0.08	-7.55	1.76
Moisture regain (%)		0.18 ± 0.09	0.16 ± 0.01	-11.11	2.52

**Significant at 1%level of significance

* Significant at 5%level of significance

Table 3. Effect of washing on physical properties of fabric

Physical properties		Fabric		Change	t-value
		Treated Mean ± S.E	Washed Mean ± S.E	(%)	
Weight/unit area (g/m^2)		154.6 ± 0.51	148.2 ± 0.37	-4.13	7.87**
Bulk (cm^3/gm)		3.07 ± 0.03	2.78 ± 0.01	-9.44	9.72**
Air permeability (m^3/m^2/min)		191.35 ± 0.45	195.12 ± 0.59	+1.97	4.36*
Tensile strength (kg)	Warp	17.68 ± 0.37	16.32 ± 0.19	-7.69	2.78*
	Weft	21.98 ± 0.5	19.82 ± 0.08	-9.82	3.71*
Flexural rigidity (mg-cm)		5.07 ± 0.10	4.63 ± 0.06	-8.6	3.06*
Thickness (mm)		0.306 ± 0.008	0.288 ± 0.003	-5.88	2.09
Bending length(cm)	Warp	3.74 ± 0.09	3.44 ± 0.09	-8.02	1.82
	Weft	3.18 ± 0.08	2.96 ± 0.04	-6.91	2.00
Fabric count (ends and picks	Warp	38± 0.06	36 ± 0.09	-5.26	1.90
sq inch)	Weft	26 ± 0.30	25 ± 0.04	-3.84	1.36
Moisture regain (%)		0.16 ± 0.01	0.17 ± 0.003	+6.25	1.00

**Significant at 1%level of significance
*Significant at 5%level of significance

the decrease in tensile strength and and reduction in stiffness predominantly in the fabric when subjected to several washes.

Increase in the air permeability of cotton woven fabric was observed, after washing. Such an increase may be attributed due to the removal of guava leaves extract and binding agent (citric acid) from the fabric surface, thus empting the interfiber pores of cotton fabrics. Air permeability has a linear relationship with thickness of the fabric. It is noted that the decrease in thickness after different number of wash cycles also might have led to increased air permeability. The results are in line with the observations made by Saini (2015) and Gupta (2016) who reported that air permeability of the treated fabric increased after laundering.

CONCLUSION

Extract of guava leaves were applied on plain weave cotton fabric to improve its antibacterial activity. Understanding the importance and significance of cotton in day to day lives of Indian people and this being a comfortable habitat for most of the microbes, was used as a substrate for the application of guava leaves extract. guava leaves extract treatment applied with exhaust method with 5 g/l concentration exhibited remarkable improvement in physical properties of the treated fabric. Though the treated fabrics showed good efficacy against washing however it needed to be renewed after every wash for good resistivity to washing as there was a downfall in the improvement of properties after washing.

REFERENCES

Agne, M. and Rasa, T. 2014. The structure characteristics and air permeability of PA and PES plain and plated knits influenced of antimicrobial treatment conditions. *Materials Science* **20 :** 306-10.

Chandrasekar, S., Vijayakumar, S., Rajendran, R., Rajesh, R. and Elayarajah, B. 2013. Herbal-Chitosan nanocomposites for durable antibacterial finishing on cotton materials. *Internat. Jour. Biopharma.* **4 :** 219-24.

Gupta, V. 2016. UV Protective and antibacterial finish on cotton using plant extracts. *Ph. D. Thesis,* CCS Haryana Agricultural University, Hisar.

Hooda, S. 2012. Herbal finishes on cotton and woolen fabrics. *Ph. D. Thesis*, CCS Haryana Agricultural University, Hisar.

Hooda, S., Khambra, K., Yadav, N. and Sikka, V.K. 2013. Antimicrobial activity of herbal treated wool fabric. *Amer. Internat. Jour. Res. Formal, Appl. Nat. Sci.* **3 :** 66-69.

Kumar, A. 2012. Importance for Life '*Psidium guajava*' (L.). *Internat. Jour. Res. Pharma. Biomed. Sci.* **3 :** 137-48.

Madhuri S., Hegde A.U., Srilakshmi N.S. and Prashith K.T.R., 2014. Antimicrobial activity of citrus sinensis and citrus aurantium peel extracts. *Jour. Pharma. Sci. Inno.* **3 :** 366-68.

Saini, P. 2014. Utilization of *Karanja* extracts on cotton fabric for microbial resistance. *Ph. D. Thesis.* CCS Haryana Agricultural University, Hisar.

Salah, S.M. 2011. Antibacterial activity and ultraviolet (UV) protection property of some Egyptian cotton fabrics treated with aqueous extract from banana peel. *African Jour. Agri. Res.* **6 :** 4746-52.

Sathianarayanan, M. P., Bhat, N. V., Kokate, S. S. and Walunj, V. E. 2010. Antibacterial finish for cotton fabric from herbal products. *Ind. Jour. Fib. Text. Res.* **35 :** 50-58.

Sunder, A.E. and Nalankilli, G. 2012. Polyfunctional finishes on cotton textiles. *Indian Jour. Fib. Text. Res.* **37 :** 364-71.

Verma, M. 2013. Effect of crease resistant finish on antibacterial property of cotton. *M. Sc. Thesis*, CCS Haryana Agricultural University, Hisar.

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