Research Paper Textile

Effects of Woodfordia Fructicosa Herbal Antibacterial Extract Treatment on Physical Properties of Non-Woven Polyester Fabric

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ABSTRACT

Functional antibacterial treated fabric is in demand due to its excellent properties. However, application of one property should not impair the inherent desirable properties of the fabric. Measurement of the physical & performance properties of the treated fabrics was done to assess the effect of the herbal antibacterial treatments on these properties of the herbal treated fabric viz. fabric weight, fabric thickness, bulk, fabric stiffness, air permeability & wetting. An attempt was made to study the effect of functional herbal extract treatment of Woodfordia fructicosa on fabrics of non-woven polyester covering fabric of sanitary napkins. There was a significant change in the performance properties of the treated polyester fabric.

KEYWORDS Woodfordia fructicosa, polyester, non-woven, fabric properties

Introduction

Functional finishes are treatments that are applied to the fabrics to make them suited for specific uses & contribute a specific attribute to fabric. Functional antibacterial treated fabric is in demand due to its excellent properties. The anti-bacterial extracts of the plants can be used as a textile finishing agents, as effective ecofriendly alternative to synthetic antimicrobials for textile applications.

However, application of one property should not impair the inherent desirable properties of the fabric. During the application of these extracts to the textile substrate, there may be the blocking of the active functional groups which are responsible for the antimicrobial activity, which may result in loss of physical & other performance properties such as air permeability, stiffness of treated textiles (Joshi et.al., 2009). The present study was conducted to evaluate the effect of functional antibacterial herbal extract treatment of Woodfordia fructicosa leaves on non-woven polyester fabric used as the covering fabric of sanitary napkins.

Methods

Preliminary data of the selected non-woven fabric i.e. polyester was taken under three parameters i.e. weight, thickness & bulk. The fabric was conditioned prior to determination of fabric dimensions under standard test conditions i.e. relative humidity of 65 ± 2 percent & temperature of 27 ± 2^{0}C.

1. Fabric weight: The weight of fabric is defined as weight of a known area of the material & then computing the weight per unit area. Weight per unit area of the test samples was taken on the Paramount Precision Scale for GSM using ASTM D3776-90 test method. An average of five reading was calculated as fabric weight.

2. Fabric thickness: Fabric thickness is defined as the distance between two parallel surfaces while exerting a specific pressure on the material by the pressure foot of the tester. Paramount Fabric Thickness Gauge was used to determine thickness of the samples using BS 2544: 1967 test method. An average of five readings was calculated as the fabric thickness.

3. Bulk: Fabric bulk (cm^3 /gm) expresses the specific volume of a material. Bulk is the inverse of density. Bulk was calculated by dividing the thickness of a fabric by its basis weight.

$$\text{Bulk (cm}^3\text{/gm)} = \frac{\text{Thickness (cm)}}{\text{Weight (gm/sq.cm)}}$$

4. Fabric stiffness: The Stiffness Tester determines the stiffness of the fabrics by cantilever method in which the fabric specimen are allowed to bend under its own weight as the length of the overhanging portion of the specimen is gradually increased. The bending length of the fabric samples was determined by Paramount Stiffness Tester using BS 3356: 1961 test method. Five samples were observed & each sample was tested four times i.e. at each edge. An average of 20 readings in warp & weft direction each was calculated.

5. Air permeability: It is the property of the fabric to allow air to pass through under the effect of a difference in pressure. The corresponding measurement is that of the quantity of air passing through a surface of defined magnitude, under defined pressure difference & within a determined period of time. Prolific Air Permeability Tester was used to find the air permeability of the fabrics using BS3321: 1960 test method at 10 mm water column. The experiment was repeated five times & mean was calculated. The experiment was conducted for the control & herbal treated fabrics at different places where lengthwise & widthwise threads do not repeat. Air permeability was calculated by the following formula:

$$\text{Air permeability (AP)} = \frac{\textit{Rate of air flow}}{\textit{Exposed area}} \times 100$$

AP = k ✕✕ Rotameter reading

where k is the conversion factor i.e. = 0.01667 (the 10cm^2 area of fabric exposed for checking the air permeability in cubic m/m^2/minute)

6 Wetting: Wetting is defined as the time in seconds for a drop of distilled water to sink into the fabric. The extent of hydrophilicity is inversely proportional to the time taken by the water to sink into the fabric completely. AATCC Test Method 79 for testing the absorbency of textiles was used to test the propensity of the fabrics to take up water. A total of five readings were taken for each fabric sample & mean was calculated.

Results

Weight of untreated control polyester fabric was 36.28±.014 gm/m^2, was of 0.20 mm thickness & its bulk was 5.51±.002 cm^3/gm. Woodfordia fructicosa extract treated polyester fabric displayed an increase of 8.20±.55 & 10 percent in the weight & fabric thickness respectively. The bulk was also observed to increase by 1.81 percent.

The bending length of the control fabric in length wise & width wise direction was 5.30±.05 & 2.40±.05 cm respectively. The air permeability of the control fabric was 299.50±.30 m^3/m^2/min & the wettability was observed to be 12.42±.04 seconds. The bending length observed was 5.90 cm in length wise direction & 3.10 cm in width wise direction of fabric. There was an increase of 11.32 & 29.17 percent in bending length in length wise & width wise direction respectively. The air permeability was observed as 293.56±.17 m^3/m^2/min, which was 1.98 percent less than untreated control while wettability decreased by 88.39 percent compared to untreated control fabric.

Table 1: Physical properties of Woodfordia fructicosa treated polyester fabric

		Untreated Control		Treated Polyester		Percent change	t-value
S. No	Variable/ Parameter	Mean	S.E.	Mean	SE		
1	Fabric weight (gm/m^2)	36.28	0.014	39.23	0.19	+8.20	15.15**
2	Fabric thickness (mm)	0.20	0.00	0.22	0.0023	+10.00	6.53**
3	Bulk (cm^3/gm)	5.51	0.002	5.61	0.028	+1.81	3.29*
4	Bending length- length wise (cm)	5.30	0.05	5.90	0	+11.32	10.95**
5	Bending length- width wise (cm)	2.40	0.05	3.10	0	+29.17	12.78**
6	Air permeability (m^3/m^2/min)	299.50	0.30	293.56	0.17	-1.98	17.09**
7	Wettability (seconds)	12.42	0.04	23.4	0.25	-88.39	42.92**

**** 1% level of significance; * 5% level of significance**
+ indicates increase in property; - indicates decrease in property; S.E.= Standard error

Discussion

Change in physical & performance properties of treated fabrics were compared with contemporary literature.

i. Fabric weight: Significant increase in weight of polyester non-woven fabrics observed after treatment may be due to the absorbance of the herbal extracts into the fabric. The results are supported by the findings of Sumithra & Raaja (2012) that weight of herbal finished denim fabric was higher as compared to untreated fabric due to absorbance of the extract in the fabric structure. Santosh (2012) also reported increase in weight of the neem & aloe vera treated cotton & woollen fabrics.

ii. Fabric Thickness: Increase in thickness of herbal treated fabrics compared to untreated controls may be due to absorbance of the herbal extracts by the fabric. The results are supported by the findings of Sumithra & Raaja (2012) which stated that thickness of the herbal finished denim fabric was found to be higher as compared to the untreated fabric. Similarly Santosh (2012) & Nagarajan (2009) also reported significant increase in the thickness of herbal treated fabrics than untreated ones.

iii. Bulk: The bulk of treated polyester fabric increased by 1.81 percent which was due to higher increase in the fabric thickness, which was more in comparison to the increase in the fabric weight.

v**. Fabric Stiffness:** The stiffness of fabric increased after the application of herbal extracts than untreated controls. It is observed that as fabric weight increases, stiffness increases. The difference in the bending length of fabrics with different treatments was due to difference in the structure of the fabric & their fabric thickness. Similar findings were reported by Midha et.al. (2013) that significant increase in the fabric stiffness was observed in the spunbond, SMS & spunlace non-woven polypropylene fabric when treated with quaternary ammonium salt based compounds. The findings were also supported by Ali et.al. (2011) that the bending length increased after chitosan application using Pad-Dry-Cure method as compared to untreated control. Purwar (2005) & Santosh (2012) also stated that bending length of the neem finished fabric increased in both directions with increase in concentration of the extract.

v. Air permeability: The air permeability of treated samples decreased after the application of the herbal extracts compared to untreated controls. It was observed that with the increase in fabric weight, air permeability decreased. Higher fabric thickness & more number of fibres per unit area offer more resistance to air flow leading to lower air permeability. The findings are supported by the study conducted by Midha et.al. (2013) in which loss of air permeability was reported in the spunbond fabric treated with quaternary ammonium salt based compounds due to the fusion & thermal bonding of fibres at certain locations which made the fabric compact, thereby reducing the air permeability. The results are also in line with the findings of Ali et.al. (2011) that significant decrease in the air permeability of the chitosan treated fabric samples as compared to untreated ones. Significant loss in air permeability was also observed by Santosh (2012) in all the neem & aloe vera treated cotton fabrics as compared to the untreated samples.

vi. Wetting: There was loss in wettability which may be due to the increase in fabric weight & absorbance of the extract by the fibres which offered more resistance to water penetration because of higher fabric thickness & more number of yarns per unit area for cotton fabric & resulted in compact fabric structure. The results are in line with findings of Santosh (2012). Similar results were obtained by Midha et.al. (2013) where significant decrease in wettability was observed in spunbond & SMS polypropylene fabrics treated with quaternary ammonium salt based compounds.

Conclusion

There was a significant change in the performance properties of the polyester fabric treated with extracts of Woodfordia fructicosa from properties of untreated control fabric.

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