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Research Paper

Geometrical and handle properties of banana blended textiles

P. APARNA AND A.SHARADA DEVI

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See end of the paper for authors' affiliations

Correspondence to :
P. APARNA
Department of Apparel and Textiles, Acharya N.G. Ranga Agricultural University, HYDERABAD (A.P.) INDIA
Email:aparnakallam26@gmail.com

ABSTRACT : In India, demand for textiles and readymade garments is continuously increasing with the increase in population and spending power of consumers. Banana fibre has high potential as a textile fibre besides being eco-friendly. Among popular varieties of banana, Pusavalli variety is found to have better physical characteristics than the other varieties of banana found in the state of Andhra Pradesh. The fibre was treated with eco-friendly enzymes for softening and then blended with jute in two ratios. Six types of fabrics were developed and the fabric properties were assessed. The objective evaluation on geometrical and handle properties of the fabrics revealed that banana-jute blend (60:40) was better in all its characteristics. Fabrics can be produced with banana and banana blends by softening with enzymes for better acceptability.

KEY WORDS : Banana fibre, Fabric properties, Eco-friendly

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The growing concerns for the degrading environmental conditions have led to the development of eco-friendly and biodegradable fibres in the ever expanding horizon of textile fibres. These fibres, being environment friendly, do not pose a threat in terms of toxicity and waste disposal unlike some of the synthetic and mineral fibres. Because of these performance properties, eco-friendly fibres can be incorporated as a whole or parts of materials and products of various forms for a wide range of applications.

Among all the non conventional fibres, banana fibre is now ready to join the markets of those most useful varieties of the plant kingdom. The use of banana fibre for textiles and other purposes as natural material is a new concept for India (Arora, 1999). The fibre from the banana pseudo stem which is thrown as agriculture waste can be used to explore the possibilities of producing eco-friendly textiles of consumer demand. Banana fibres possess problems due to lack of pliability for spinning which confines to a limited utility. Addressing this aspect will certainly improve its application in textiles. Therefore,efforts are made to ascertain development in the areas of plant yield and improvement in fibre properties. Eco-processing of banana textiles will further boost up its sales in global market. Hence, enzyme treatment for banana fibre was considered to improve its pliability.

RESEARCH METHODS

Popular varieties of banana in Andhra Pradesh Pusavalli, Amruthapani, Bontha, karpura and Chakarakeli were considered for study and four laboratory grade cellulose enzymes such as Sibasof, Microsil, New smooth and Biozin (Britacel Limited, Mumbai) were selected.

Based on objective evaluation of the treated fibre, new smooth enzyme was selected. Three concentrations of enzyme of 1per cent, 1.5 per cent and 2 per cent were optimised based on the minimum and maximum recommended levels of enzyme concentration by the manufacturing company, Britacel. Among the fibre varieties, Pusavalli variety is found to have better physical characteristics before and after pretreatment at 1.5 per cent concentration level. Raw fibre was processed to get yarns that were used for making control fabrics. Enzymes treated fibre was processed separately to produce yarns that were used for making treated fabrics.

Thus, the study was carried out to assess the geometrical and handle properties of the developed banana blended textiles to augment the usage of banana textiles.

Six fabrics were developed, the details of which are furnished below :

The main focus of the study was to develop an eco-friendly process and assess the characteristics of the treated

Table A : Sample coding of tested fabric		
Sample code	Treated	Untreated
Sample-A	40: 60 (Banana-Jute)	40: 60 (Banana-Jute)
Sample-B	60:40 (Banana-Jute)	60:40 (Banana-Jute)
Sample C	100% Banana	100% Banana

and untreated fabrics. To analyse these characteristics, the standard test procedures laid down by Bureau of Indian Standards and ASTM were followed and tested samples were conditioned in an atmosphere with a relative humidity of 65±2% and a temperature of 20±2°C prior to testing for 24 hours as per BIS standards. The data obtained from the laboratory test were compiled and the mean values were calculated. ANOVA (Two Factorial, CRD) test and correlation method was adopted for analyzing the efficiency of the enzyme on various fabrics.

■ RESEARCH FINDINGS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Geometrical properties :

The geometrical properties of the tested samples is furnished in Table 1.

Yarn count :

Among all the pretreated fabrics, sample B was found with more decrease in yarn count due to the treatment of fibre that ranged from 108.1g/m to 100.7g/m and became finer fabric when compared with the other samples. The tables clearly indicates that it was possible to produce fine blended yarns with the higher proportion of banana fibre.

The results of the statistical analysis are furnished in Table 1 which indicate that there was significant difference at 1 per cent level between the samples and treatments.

The yarn count exhibited positive correlation with fabric weight (0.976), thickness (0.979), stiffness (0.88), thermal conductivity (0.833), moisture regain (0.718) and moisture absorbency (0.759). Negative correlation was found with crease recovery (-0.961) and tensile strength (-0.808).

Generally, yarn count directly influences fabric weight, fabric thickness and stiffness. Thermal conductivity of the fabric is also influenced by yarn count and thickness of the fabric to some extent as stated by Angappan and Gopal Krishnan (1997). The positive correlations obtained between the properties confirmed the same. Due to better orientation of fibre in finer yarns, the yarns will be able to take up more tensile load. Firmness in yarns and fabric might lead to better crease recovery too.

Fabric count :

Three fabrics were constructed with the same fabric count of 13 x 23 based on the thickness of the yarn.

Fabric weight :

Among the control fabrics, sample C was heavy followed by A and B. Control fabrics had more weight ranging from 305.1 g/m^2 to 379.6g/m^2. It was apparent that the fabric weight decreased in pretreated samples. Sample B had registered low weight with 298.3g/m^2 due to treatment compared to other samples. It was interesting to note that the blend with higher content of banana weighed less.

The results confirm the findings of Gulrajini and Shailaja (1995) where it was found that the fabric weight was decreased after enzyme treatment and the decrease was corresponding to the enzyme concentration.

The results of the statistical analysis showed that there existed high significant difference at 1 perc ent level between samples and treatments.The fabric weight in general influences the properties such as fabric thickness, stiffness, its drape and thermal conductivity.

In this study, positive correlation was observed with fabric thickness (0.910), stiffness (0.963), drape co- efficient (0.784) and thermal conductivity (0.934). Negative correlation was found with crease recovery (-0.998) and tensile strength (-0.918), which concluded that heaviness in fabrics was inversely proportional to crease recovery and tensile strength.

Handle properties :

The handle of any woven fabric is determined by its thickness, crease recovery, drape co-efficient etc.

Thickness :

Among all the fabrics sample C had registered highest

Table 1 : Geometrical properties of tested fabrics

Sr. No.	Sample		Yarn count (g/m)	Fabric count		Fabric weight (g/m^2)
				Warp	Weft	
1.	Sample-A	Control	261.9	13	23	366.1
		Treated	254.2 (-3.1)	13	23	362.7 (-1)
2.	Sample-B	Control	108.1	13	23	305.1
		Treated	100.7 (-6.9)	13	23	298.3 (-2.3)
3.	Sample-C	Control	303.8	13	23	379.6
		Treated	294.5 (-3.1)	13	23	369.1 (-2.8)

thickness of 0.42 mm followed by sample A with 0.38 mm and B with 0.33 mm thickness. The thickness of the fabrics decreased considerably in pretreated samples. The trend was noticed in all the samples irrespective of 100 per cent banana or jute banana blend ratio. In pretreated fabrics, sample B had registered lowest thickness of (0.31) mm followed sample A with 0.36 mm and C with 0.40 mm thickness. As yarn count of banana jute blended fabric (60:40) was low, it reflected in fabric thickness also (Table 2).

There was significant difference between samples and treatments.The difference between samples vs treatments was not found significant. Positive correlation was observed with yarn count (0.979), fabric weight (0.910), stiffness (0.763), (0.725) thermal conductivity (0.702), moisture regain (0.846), moisture absorbency (0.876) and abrasion resistance (0.432). Negative correlation was observed with crease recovery (-0.883) and tensile strength (-0.670).

Thickness of the fabrics was influenced by the yarn count of the threads. This property seemed to have influenced on fabric weight, stiffness, moisture regain and absorbency. It is a known fact that thickness influences the thermal conductivity and also abrasion resistance. Thicker fabrics can hold heat for a longer time than thinner fabrics. During abrasion, the upper layers get abraded first reducing the possibility of hole formation.

Stiffness :

Among the control fabrics, sample A had registered highest stiffness (2.4 cm) and flexural rigidity, 14.9 mg-cm. Sample B had registered more decrease in stiffness, 2.0 cm and flexural rigidity 7.2 mg-cm than the other fabrics followed by sample C due to the enzyme treatment. The difference was statistically significant between samples and treatments, but not with the samples VS treatments (Table 2).

As per the correlation observed, stiffness was influenced by yarn count. The higher the count, the stiffer it would become. As per the results of this study stiffness seemed to a have bearing on fabric weight, thickness, drape and thermal conductivity. Negative correlation was observed with crease recovery which indicated that stiffer fabrics creased more. It should be observed here that banana jute fabric of higher banana ratio (60:40) became more pliable due to enzyme treatment.

Crease recovery :

Among the control fabrics, sample B had highest crease recovery angle compared to other samples, but closely followed by A and C. The crease recovery was higher along warp than weft way. This might be attributed to the higher bending rigidity of the blended yarns. Crease recovery angle was increased both in warp and weft directions due to the enzyme treatment which is a positive attribute to the consumers.

Statistical values indicated that the difference between the samples and treatments was highly significant. There was impact of treatment on crease recovery. Positive correlation was observed with air permeability tensile strength (0.940). Negative correlation was found with yarn count (-0.961), fabric weight (-0.998), fabric thickness (-0.883), stiffness (-0.977), drape co-efficient (-0.820) and thermal conductivity (-0.954) as all these were detriments for good recovery from wrinkles. The blended fabric with higher ratio of banana (60:40) faired well in improving crease recovery after treatment.

Drape co-efficient :

Among the control fabrics, sample A had highest drape co-efficient of 98 followed by sample C with 97.3 and B with 96.3. Higher co-efficient value showed lower drapability of the fabric. The drape co-efficient level decreased for all pretreated samples indicating improved drapability. Among the pretreated fabrics sample B had registered high drape co-efficient of 92.6 followed by samples C (93.6) and A (95.6).

Statistical analysis showed significant difference at 1 per cent level with treatments. Drape is a complex process involving the pliability of a fabric folds while hangings on its own weight. The drape of banana fabrics and its blends showed positive correlation with yarn count (0.629), fabric weight (0.784),stiffness (0.923) and thermal conductivity (0.954) and abrasion resistance (0.654). Negative correlation was observed with crease recovery (-0.820), air permeability (-0.968) and tensile strength (-0.966) indicating opposite trend.

Table 2: Handle properties of tested fabrics

Sr.No.	Sample		Thick ness (mm)	Stiffness		Crease recovery		Drape co-efficient
				BL (cm)	FR (mg-cm)	Warp	Weft	
1.	Sample-A	Control	0.38	2.4	14.9	117.2	98	98.2
		Treated	0.36 (-5.3)	2.28 (-5)	12.6 (-15.5)	120.5 (2.8)	111 (11.8)	95.6 (-2.5)
2.	Sample-B	Control	0.33	2.0	7.2	119	113	96.3
		Treated	0.31 (-6.1)	1.96 (-2)	6.6 (8.4)	124 (4.1)	115.2 (2)	92.6 (-4.1)
3.	Sample-C	Control	0.42	2.3	13.6	112	99	97.3
		Treated	0.40 (-4.8)	2.2 (-4.4)	10.6 (22.1)	123 (9.3)	113.5 (12.2)	93.6 (-3.6)

(Values in parenthesis indicate gain or loss over control), BL- Bending Length; FR- Flexural rigidity

Conclusion :

It could be concluded that pre treated fabrics showed better properties compared to untreated fabrics. Blend of Banana - Jute (60:40) was found to be better than other fabrics. This might be due to the decrease in thickness of the fabric which influences yarn count of the thread, fabric weight, stiffness, crease recovery and drapability. This also indicated that fine fabrics can be produced with banana and banana blends by increasing the enzyme concentration for better acceptability.

Authors' affiliations:
A. SHARADA DEVI, Department of Apparel and Textiles, Acharya N.G. Ranga Agricultural University, HYDERABAD (A.P.) INDIA

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