

COMPARATIVE EVALUATION OF MECHANICAL AND COMFORT PROPERTIES OF PURE BAMBOO AND VISCOSE BAMBOO FABRICS

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Abstract: The paper investigates the mechanical and comfort properties of pure bamboo and viscose bamboo woven fabrics. The mechanical properties considered in the study are breaking strength, elongation at break, tear strength, bending length, bending rigidity, drape coefficient and comfort properties includes air-permeability, water absorption and crease recovery. Both the fabrics were compared well in terms of these properties. The results indicate that viscose bamboo fabric give better result from the point of view of tenacity and bending and from point of view of comfort pure bamboo fabric perform better. The pure bamboo fabric perform better in terms of elongation break and bending rigidity and viscose bamboo in terms of breaking strength, tear strength, bending length and drape. Viscose content in the blend has enhanced the tensile properties.

Keywords: Bamboo, viscose, comfort, mechanical, evaluation.

Introduction: The performance of clothing material can be classified as utility and comfort performance. Consumers prefer garments that not only look good but also feel good. It is not enough for fabrics to have only good colour, texture or durability but should also have good comfort properties. Comfort plays an important role in selection of fabric for apparel. Assessment of mechanical and comfort properties is essential for new developed fabric as its sensorial feel towards body is different as compared to regular synthetic fabrics (Hussain et al. 2014). The demand from fabric has altered with the developments in technology and the growing living standards. Currently the constraint is not only on style and durability but also clothing ease which includes psychological and sensorial comfort. The strength of a fabric is interconnected with its tearing capacity. The tearing strength is normally used to provide a realistic evaluation of durability and a fabric with short tearing strength is generally produced a low-grade product. The fabric which has good tensile and tear strength create better product but it should have capability to drape into intricate three-dimensional shapes and to provide a graceful aesthetic effect for apparel and other industrial mean and uses (Kumar, 2014). This fabric property is based on the bending of the fabric under its own weight and on the ability of producing a free flowing form. Drape decides the flow of the fabric and ultimately affects the fabric. Suppleness of the

textile material is also essential because wearer performs various activity and in each activity garment bends and stretch differently. Materials with high bending length are inflexible and have less drapability, lack in elasticity and are not comfortable due to their stiffness. These properties have direct impact on constructed garment as these properties provide an idea of serviceability of fabric and end use.

Materials and Methods

The mechanical and comfort properties of 100% bamboo and 50: 50 viscose bamboo fabrics were evaluated using standard parameters. The details of parameters taken for the experiment are as follow:

table: 1 parameters of mechanical properties

Property	Parameter	Unit	Standards
Tensile properties			
Breaking strength	Sample stretched at a constant elongation rate until it breaks by reveled-strip method	N	IS: 1969: 1985
Elongation at break	Sample stretched at a constant elongation rate until it breaks by reveled-strip method	(%)	IS: 1969: 1985
Tear strength	Tear strength of warp and weft with speed limit from 50mm/min. or 300mm/min.	N	IS: 6489-93
Bending properties			
Bending length	Bending length – warp and weft directions	(mgm.c m)	IS: 6490-71
Bending rigidity	Bending rigidity – warp and weft directions, general	(mgm.c m)	IS: 6490-71
Drape coefficient	Drape coefficient	%	IS: 8357
Pilling	Revolution cycle and grades for pilling(1-5)	cN/cm	IS: 10971
Comfort properties			
Air permeability	Under differential pressure of 10mm water column height	cc/sec/c m ²	IS:11056-84
Water absorption	Different angles in warp and	°(degree	IS:1056-09

	weft directions)	
Crease recovery	Drop test	Cms(per r minute)	AATCC TS-018

table:2 structural properties of pure bamboo and viscose bamboo fabric

Blend Ratio	Fabric weight (gm/sq m)	Yarn count(Ne)	
		Warp	Weft
Pure Bamboo	1.55	60	54
Viscose Bamboo	1.52	58	52

Results and Discussion

The results obtained are presented in table 3,4,5,6 &7. The mean values, standard deviation and significance difference of pure bamboo and viscose bamboo fabric have been reported.

Evaluation of tensile properties

table: 3 comparative analysis of tensile properties of pure bamboo and viscose bamboo fabric

Assessment of Properties	Pure Bamboo		Viscose Bamboo		SD		Significance (p)
	Warp	Weft	Warp	Weft	PB	VB	
Breaking Strength (N)	396.6	353.8	897.4	429.0	22.93	246.9	.002
Elongation at break (%)	50.83	49.20	31.75	34.15	1.07	1.32	.000
Tear strength (N)	35.98	30.57	45.42	38.90	2.63	3.65	.000

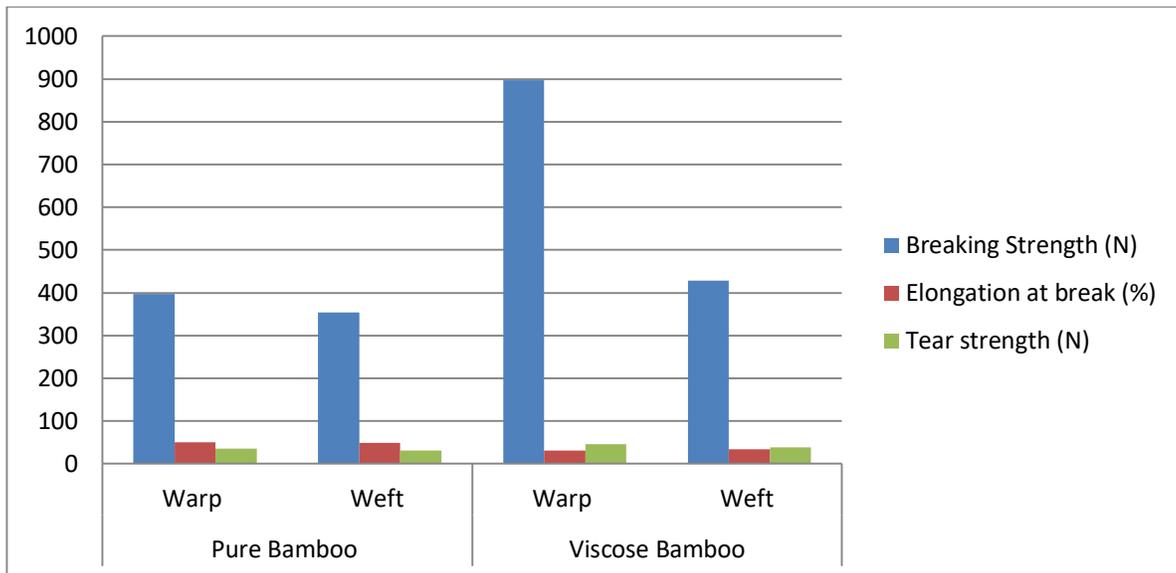


figure: 1 comparative analysis of tensile properties of bamboo fabrics

The experimental results of tensile related properties i.e. breaking strength, elongation at break and tear strength are shown in table 3 & fig. 1. The results indicate that breaking strength of pure bamboo fabric is lower in warp and weft direction as compared to viscose bamboo fabric because of the presence of cellulose content in fabric composition. Higher breaking strength of viscose bamboo fabric indicates higher durability because of the presence of viscose content in the fabric. The significant difference between both the fabrics in terms of breaking strength was also tested and results found that breaking strength property of pure bamboo and viscose bamboo fabric is highly significant at 0.05 level. It means there is a difference in breaking strength of both the fabrics. It is observed that in case of bamboo viscose fabric, blending of viscose fiber with bamboo fiber has improved breaking strength of viscose bamboo fabric. It can be inferred that the strength decreases with increase in content of bamboo.

Elongation at break or fabric elongation is deformation in the direction of load caused by tensile force. Higher the elongation point, better is the fabric quality from the point of view of handle. A high elongation value also signifies greater wearing comfort. Elongation percentage of pure bamboo fabric is higher than viscose bamboo. It directly affects the strength of fabric, if it is low then fabric will break easily in processing. Significance values of both the fabrics were tested and result shows that elongation at break of pure bamboo and viscose bamboo is highly significant at 0.05% level. This indicates that there is a difference in terms of elongation break in both the fabrics.

The above table also depicts the tear strength value of both pure bamboo and viscose bamboo fabric in warp and weft direction. It is clear that tear strength of pure bamboo fabric is lower than viscose bamboo because it has higher amount of cellulose content in its composition and viscose bamboo contains a good amount of viscose which makes it better in terms of tearing. The significant difference between both the fabrics is highly

significant at 0.05 level which indicates that there is difference between pure bamboo and viscose bamboo fabric in terms of tear strength.

Evaluation of bending properties

table: 4 comparative analysis of bending properties of bamboo fabrics

Assessment of Properties	Pure Bamboo		Viscose Bamboo		SD		Significance (p)
	Warp	Weft	Warp	Weft			
Bending length(cm)	17.7	13.8.	13.2	12.4	.876	2.10	.001
Bending rigidity(mg.cm)	22.75	19.45	20.70	17.74	.839	2.68	.849
Drape coefficient	18.98		34.25		.325	1.78	.000

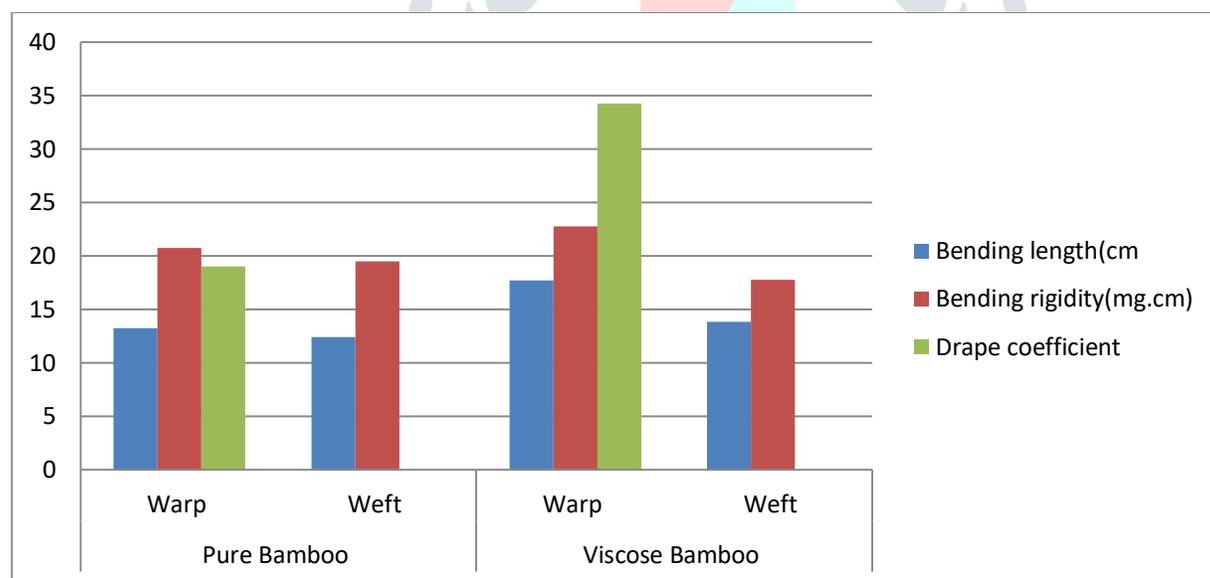


figure: 2 comparative analysis of bending properties of bamboo fabrics

Results of bending properties of 100% bamboo and viscose bamboo fabric are given in table 4. The fabric bending is depends on the yarn bending and rigidity of constituent fiber from which the fabric is manufactured. Higher the rigidity, lower the fabrics handle. The bending length is very important factor which determines the flexibility of the fabric. Fabrics with high bending length are stiffer, they lack drapability and flexibility. The result shows that pure bamboo fabric exhibit higher bending length and rigidity than viscose bamboo fabric due to higher amount of cellulose content in fiber composition and yarn thickness. The

significance difference between both the fabrics were also tested and result indicates that significance value is lower than 0.05 and bending property of pure bamboo and viscose bamboo is highly significant at 5% level. The significance value of bending rigidity of pure bamboo and viscose bamboo fabric is not significant at 5% level because significant value is higher than 0.05. It indicates that there is no difference between pure bamboo and viscose bamboo fabric in terms of bending rigidity.

Drape coefficient, is the percentage of graceful folding in the warp and weft way direction. The drape coefficient percentage of pure bamboo fabric is lower than viscose bamboo fabric because of higher content cellulose in fabric inner structure. Another reason was the higher bending length and rigidity of pure bamboo fabric. Higher the bending length and rigidity of the fabric indicates that fabric is stiffer and lack of flexibility. The significant difference was also calculated and result indicates that drape coefficient of pure bamboo and viscose bamboo is highly significant at 5% level. This indicates that there is a difference between drape coefficient property of pure bamboo and viscose bamboo.

Evaluation of comfort properties

table: 5 comparative analysis of air permeability of pure bamboo and viscose bamboo fabric

Fabric ratio	Air permeability (cc/sec/cm ²)	SD	Significance (p)
Pure bamboo	63.49	6.32	.000
Viscose bamboo	93.64	7.52	

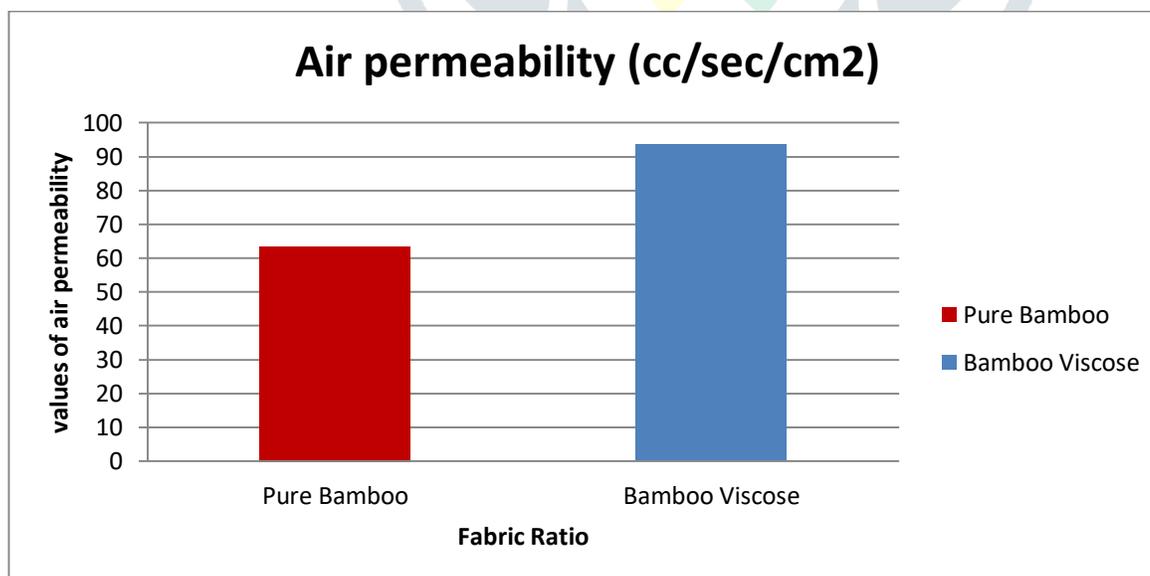


figure.3 comparative analysis of air permeability of bamboo fabrics

Air permeability is often used in evaluating and comparing breathability of fabrics. The fabric air permeability is mainly determined by its inner yarn pores. The air permeability is related with the porosity of the fabrics, higher the porosity of fabrics greater will be the air permeability. The data given in table shows that air permeability of bamboo viscose fabric is higher than pure bamboo fabric. There are many factors like weight thickness and density of the fabric which contribute for increasing or decreasing the amount of air permeability. Increase in fabric thickness and weight leads to decrease in number of pores and simultaneously decreases the air permeability of the fabric. Viscose bamboo fabric is light in weight as compare to pure bamboo fabric due to porous fabric structure and viscose content present in it. Significance values of both the fabrics were tested and result shows that air permeability of pure bamboo and viscose bamboo fabric is highly significant at 0.05% level. It means both the fabrics have different air permeability because of their structure and weight.

Water Absorption

table 6: comparative analysis of absorbency time of pure bamboo and bamboo viscose fabric

Fabric ratio	Time of wetting (cms per minute)	SD	Significance (p)
Pure bamboo	0.05	.015	.000
Viscose bamboo	0.20	.024	

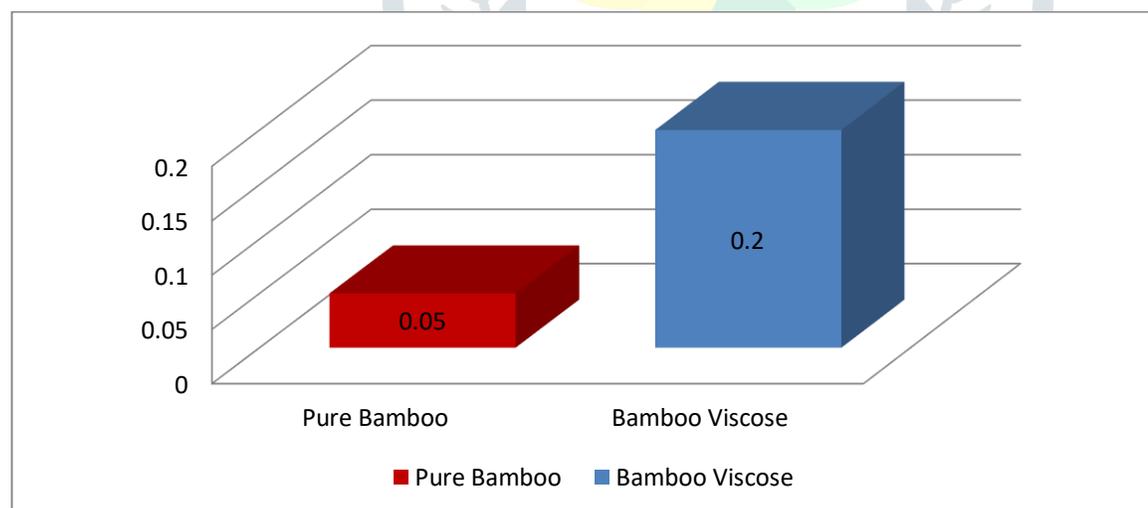


figure. 4 comparative analysis of absorbency time of pure bamboo and bamboo viscose fabric

The table 6 clearly depicts that water absorption time of bamboo viscose is higher than pure bamboo fabric because of viscose content present in the fabric. Higher the absorption time of the fabric lower is the absorbency of the fabric. The results indicate that pure bamboo fabric is highly absorbent as compare to viscose bamboo fabric. Significance values of both the fabrics were tested and result shows that water

absorbency property of pure bamboo and viscose bamboo fabric is highly significant at 0.05% level. It means both the fabrics have difference in their absorbency due to difference in fiber content and fabric structure.

Crease recovery

table: 7 comparative analysis of crease recovery of pure bamboo and viscose bamboo fabrics

Fabric ratio	Crease recovery angle (°)			
	Warp	Weft	SD	Significance (p)
Pure Bamboo	92	95	.764	.000
Viscose Bamboo	113	104	1.70	

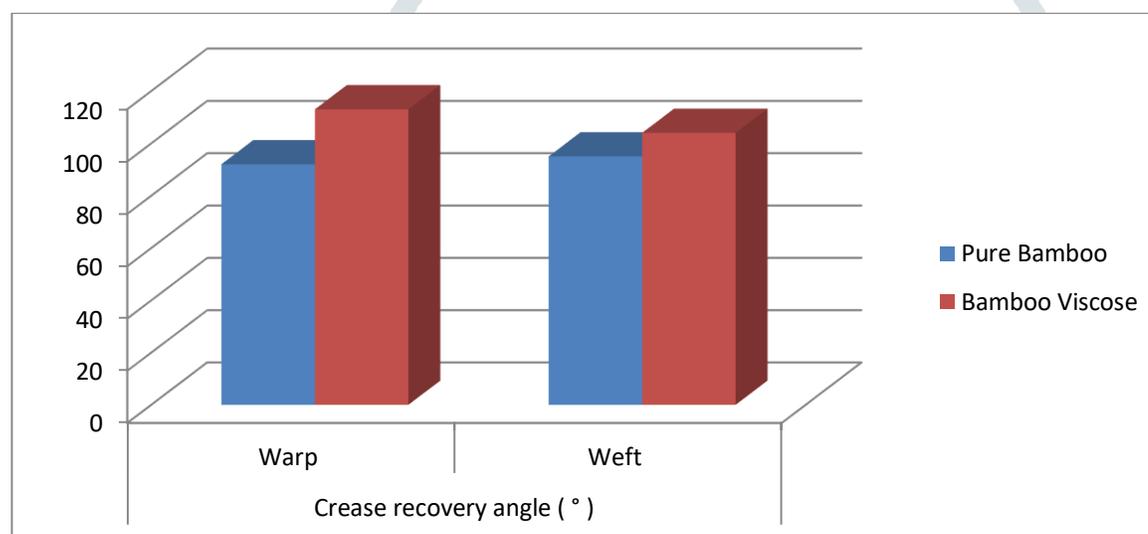


figure. 5 comparative analysis of crease recovery of bamboo fabrics

Table 7 gives the summary of the results of crease recovery test of both the fabrics. The more is the crease recovery angle, better is the crease recovery of the fabric. The results found that mean crease angle of bamboo viscose fabric is more than pure bamboo fabric indicating that bamboo viscose fabric has better crease recovery than pure bamboo fabric. The maximum value of crease recovery angle has been found for bamboo viscose fabric as 113° in warp direction and 104° in weft direction and minimum is 92° in warp direction and 95° weft direction in pure bamboo fabric respectively. Thus it can be figure out that increase in viscose content enhances the crease recovery of bamboo viscose fabric. Significance values of both the fabrics were tested and result shows that crease recovery of pure bamboo and viscose bamboo fabric is highly significant at 0.05% level. The reason is the higher bending length and thickness difference of both the fabrics.

Conclusion

In this paper comparative evaluation of mechanical properties of pure bamboo and viscose bamboo fabric is made from the structural point of view. The results show that there exists wide difference in mechanical properties of both the fabric. Mechanical properties are main factors that contribute to the easy handling of the fabric. From the results obtained, it can state that fabric made of viscose bamboo fiber have better tensile and bending properties as compare to fabric made of 100% bamboo fiber from the point of view of performance. But from the point of view of the comfort pure bamboo fabric is superior. Therefore the choice of raw material depends on the subjective point of view for the user. The present paper clearly showed that by an assessment of mechanical and comfort properties that are necessary to get the best comfort levels, it is possible to engineer a fabric by appropriately selecting fiber, yarn and fabric constructional parameters based on their established relationships with different comfort parameters. The results obtained from this study can be used for modifying fabric features required at the garment level by appropriately choosing bamboo fabrics with different yarn size and thickness.

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