

Physical & UV Protection Properties of Knitted Bamboo Fabrics



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Few decades ago, bamboo was traditionally used for making variety of household goods such as furniture, sporting goods, handbags, flooring, cutting board etc. Nowadays, due to developments in manufacturing processes. It possible to produced fibre from bamboo stem, which has remarkable properties for its use in yarn and fabric. Bamboo fiber is a natural, eco- friendly fiber; it is regenerated cellulosic fibre produced from stem of bamboo plant, possessing some unique properties such as anti-bacterial, anti- UV radiation, hygiene, cool and soft handle etc. Due to various micro gaps and micro holes in cross section, it has better moisture absorption. Bamboo fabric can absorb and evaporates sweat very easily. Hence it gives cool and comfortable feel. The aim of present study is to focus on physical and ultra violet protection properties of single jersey & rib fabric produced from bamboo yarn. In this study yarn of 40s ne is produced from bamboo fibre. It is observed that, bursting strength of single jersey and rib fabric is 5.6 and 10.0 receptively. Rib fabric shows 44% higher bursting strength than single jersey fabric. Rib fabric shows higher protection factor than single jersey fabric. It shows 94.19 % higher UPF than single jersey fabric. Rib fabric is giving higher protection against UV radiation because of its dense and compact structure. Dense & compact structure of rib fabric enables less transmission of UV radiation to skin, hence it gives higher protection.

Bamboo plants are commonly cultivated in Asian countries. It is one kind of grass with hallow and woody stem. There are so many varieties of bamboo plant across the world. Nowadays, bamboo is widely used in the field of building and construction because of its toughness and other properties.

Bamboo fibre is a natural, eco-friendly fibre. It is regenerated cellulosic fibre produced from pulp of bamboo stem, it possesses unique properties such as anti-UV radiation, anti-bacterial, breathable, cool and soft handle etc. Due to various micro gaps and micro holes in cross section it has better moisture absorption. Bamboo fabric absorbs and evaporates sweat very easily hence it gives comfortable feel. It has many applications such as apparels, sweaters, bath suits, mats, towels, t-shirts and socks etc. Bamboo fibre has unique function of antibacteria which make it suitable for underwear, t-shirt and socks. It has also wide scope in the field of hygiene materials such as sanitary napkin, masks, mattress, bandages, surgical cloths, surgical gown, absorbent pads and food packing etc.

Due to anti-ultraviolet radiation characteristics of bamboo fibre, it is suitable for making summer clothing for the protection of human skin against damages of UV radiation (UVR). Wallpapers, curtains and sofa covers are produced from bamboo fibre because it absorbs UV radiation of different wavelength from atmosphere, hence protecting human skin from UV radiation.

Weft knitted fabrics are used for both under wear and outer wear, the tensile properties of these fabric such as their ability to recover their original size and shape after the

removal of the deforming stress, air permeability and others, are very important for the users.

Knitting yarns requires high work of rupture, good resiliency, high ratio of primary to secondary creep, high elongation at break, low flexural and tensile resistance and adequate tenacity, etc.

In knitted fabric use of doubled yarn with soft twisted singles enhanced the properties of knitted fabric. There is an overall improvement in tensile properties, hairiness, wet and thermal stability, pilling resistance and air permeability. The performance of doubled yarn in knitted fabrics even excelled that of single yarn of same count.

Spirality is a fault that appears in single jersey weft knitted fabric where it results in distortion of shape and pattern. Spirality of knitted fabric is influenced by twist multiple, tightness factor.

Materials and Methods

Materials

Fibre Properties

Properties	Bamboo
Strength (gm/tex)	34.3
Elongation (%)	16.0
Short Fibre Index	5.58
Uniformity Index (%)	92.7
UHML(mm)	38.745
ML(mm)	35.62
Moisture (%)	6.5
Micronaire	4.0

Table 1 shows physical properties of bamboo fibre such as Strength, Elongation, Short fibre index, Mean length and Uniformity index etc.

Yarn Sample Preparation

By using above said fibre specifications yarn samples of 40sNe count are produced from bamboo fibre.

Fabric Sample Preparation

Single jersey and Rib knitted fabric samples are prepared on circular knitting machine with following specifications given in table 2.

Experimental Methods

Fibre Properties

Fibre properties such as strength, elongation, micronaire and uniformity index and moisture % etc. of bamboo and cotton fibre are measured on Uster HVI SW 3.1.1.0 version.

Yarn Properties

Yarn properties such as strength and elongation are measured on Uster Tensorapid Tester (3 V 6.1) with gauge length- 20 inches, velocity of jaw 2000 mm / min. While unevenness, imperfection and hairiness were measured on IQ Qualicentre (version A 3.0.2) with 400 meter test length.

Table 2: Fabric Construction Parameters

Structure	Wales/inch	Coarse/inch
Single Jersey	36.5	49.8
Rib	35	19

Result and Discussion

Yarn Properties

Table 3: Yarn Properties	
Properties	Bamboo Yarn
Strength (Rkm Kgf*Nm)	17.03
Elongation (%)	13.28
Unevenness (U %)	10.56
Hairiness (HJ)	392.6
Coefficient of variation (CVm %)	1334
Breaking Force (N)	2.47
Breaking Work (N.cm)	10.06

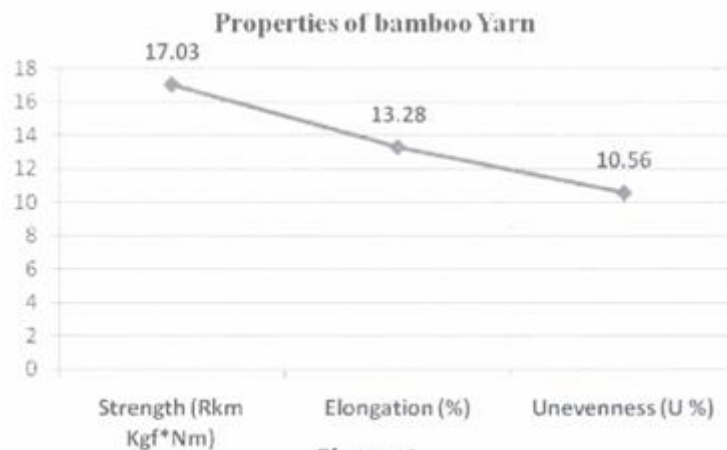


Figure 1

Table 3 and Fig.1 illustrates physical properties exhibited by bamboo yarn. It is seen from above table that, Strength of bamboo yarn is 17.03, Elongation is 13.28 %, and Unevenness (U %) is 10.56. Hairiness (H) is 392.6.

Physical Properties of Fabric

Bursting Strength (kg/cm^2)

Table 4	
Sample Type	Bursting Strength (kg/cm^2)
Single jersey	5.6
Rib	10.0

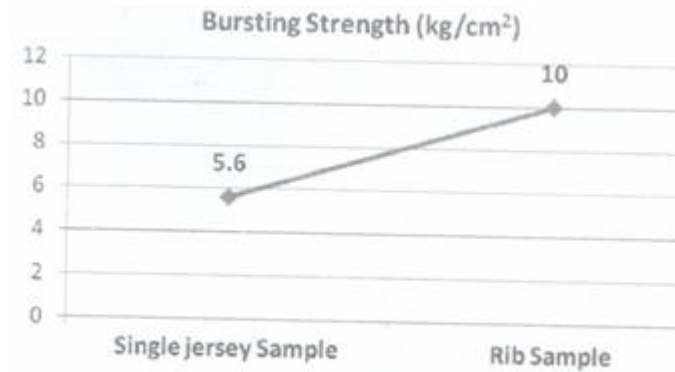


Figure 2

Table 4 and Fig.2 shows result of bursting strength. Bursting strength of single jersey and Rib fabric is 5.6 and 10 respectively. Rib fabric shows higher bursting strength than single jersey fabric. It shows 44 % higher bursting strength than single jersey fabric. This difference in bursting strength can be attributed to difference in fabric structure.

Fabric Weight (mg/cm^2)

Table 5	
Sample Type	Fabric Weight (mg/cm^2)
Single jersey	11.7
Rib	35.93



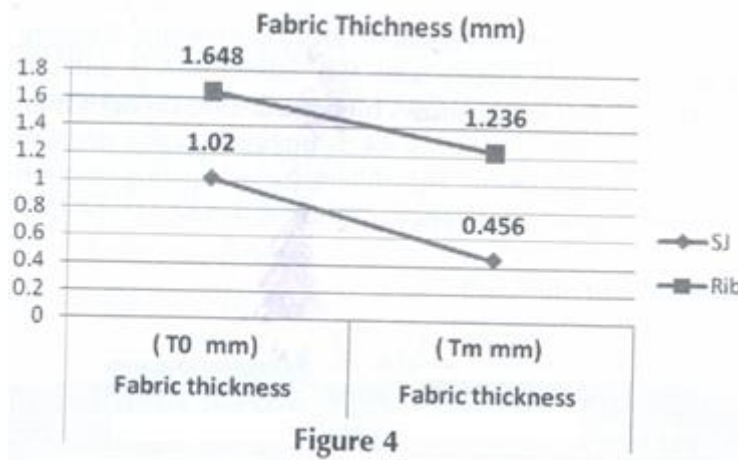
Figure 3

Table 5 and Fig.3 shows result of fabric weight (mg/cm^2). Fabric weight of single jersey and Rib fabric is 11.7 and 35.93 respectively. Rib fabric shows higher fabric weight than

single jersey fabric. It shows 67.43% higher fabric weight than single jersey fabric. This difference in fabric weight can also be attributed to difference in fabric structure.

Fabric Thickness (mm)

Sample Type	Fabric thickness (T _o mm)	Fabric thickness (T _m mm)
Single jersey	1.020	0.456
Rib	1.648	1.236



At T_o (mm)

Table 6 and Fig.4 shows result of fabric thickness (mm). Fabric thickness of single jersey and Rib fabric is 1.020 and 1.648 respectively. Rib fabric shows higher thickness than single jersey fabric. It shows 38.10 % higher fabric thickness than single jersey fabric. This difference in thickness may be because of difference in fabric structure.

At T_{max} (mm)

Table 6 and Fig.4 shows result of fabric thickness (mm) at maximum load. Fabric thickness of single jersey and Rib fabric is 0.456 and 1.236 respectively. Rib fabric shows higher thickness than single jersey fabric. It shows 63.10 % higher fabric thickness than single jersey fabric.

Ultra Violet Protection Properties

Ultra Violet Protection Factors (UPF)

Material	Count	Structure	UPF
Bamboo	40 Ne	Single Jersey	11.8
Bamboo	40 Ne	Rib	203.2

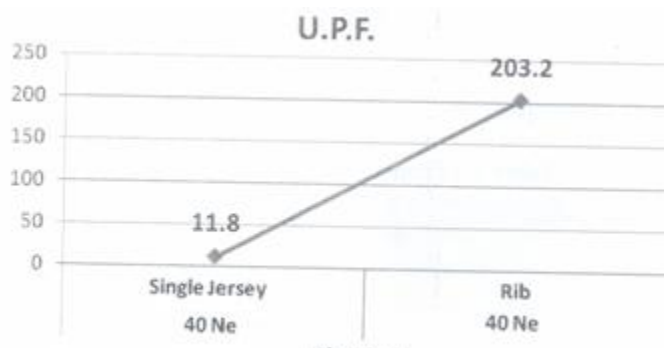


Figure 5

Table 7 and Fig.5 shows result of Ultra violet protection factor (UPF). UPF of single jersey and rib fabric is 11.8 and 203.2 respectively. Rib fabric shows higher protection factor than single jersey fabric. It shows 94.19 % higher UPF than single jersey fabric. Rib fabric is giving higher protection against UV radiation because of its dense and compact structure. Dense & compact structure of rib fabric enables less transmission of UV radiation to skin, hence gives higher protection.

Conclusion

- Strength of Bamboo yarn is 17.03 (Rkm Kgf*Nm), Elongation is 13.28% and Unevenness (U %) is 10.56. Hairiness (H) is 392.6.
- Rib fabric shows higher bursting strength than single jersey fabric. It shows 44% higher bursting strength than single jersey fabric.
- Rib fabric also shows higher fabric weight than single jersey fabric. It shows 67.43% higher fabric weight than single jersey fabric.
- Rib fabric shows higher protection factor than single jersey fabric. It shows 94.19% higher UPF than single jersey fabric. Rib fabric is giving higher protection against UV radiation because of its dense and compact structure. Dense & compact structure of rib fabric enables less transmission of UV radiation to skin, hence gives higher protection.

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