INTERNATIONAL RESEARCH JOURNAL OF PHARMACY
www.irjponline.com
ISSN 2230 – 8407

Research Article

INVESTIGATING THE EFFICACY OF BAMBOO BLENDED FABRICS FOR MEDICAL APPLICATIONS

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Article Received on: 25/10/17 Approved for publication: 28/11/17

DOI: 10.7897/2230-8407.0811240

ABSTRACT

Wound healing is a natural process and dressing and medication enhance the process. There has been a sharp increase in the use of wound dressing materials in the recent past. In this research work blends of bamboo/polyester and bamboo/cotton blended knitted fabrics made from ring spun yarns were studied in this project. The yarn samples developed out of different blend proportions were used to produce single jersey knitted fabric samples and the comfort properties such as air permeability, thermal conductivity, thermal resistance and moisture management are evaluated to find suitable combination material for wound dressing. Air permeability, thermal resistance and moisture management are high for bamboo/cotton blended knitted fabric. As it has high thermal resistance, the thermal conductivity is less. As per the studies we have concluded that 67/33% bamboo/cotton blended knitted fabric is better for developing wound dressing material.

Keywords: Cotton, bamboo, polyester, air permeability, moisture management

INTRODUCTION

Bamboo fibre has been used in various applications such as building and construction, decoration, slope maintenance and high performance composites for the past many years. Regenerated bamboo fibre has characteristic mechanical properties of superior tensile strength, excellent UV protection, antibacterialandbiodegradablecharacteristics, high moisture absorption, softness, brightness and high flexibility under flexible and compressive loads.[1] With its high moisture absorption capacity, breathability and fast drying behaviour, regenerated bamboo cellulose fibre ensures excellent comfort in various applications. Currently, regenerated bamboo fibre is used in intimate apparels, wound dressing and sanitary materials.

Sudipta S Mahisha et al [2] presentsthe functional properties of bamboo/polyester blended knitted fabric and their findings states that the increase in bamboo content in the blend increases the ultra-violet protection factor, water vapour permeability and wicking ability. On the other hand with the increase in bamboo content in the fabric there is a decrease in bursting strength, air permeability and thermal resistance. The fabric loss their anti-bacterial property when bamboo is gradually replaced by polyester. The findings of the study suggest that polyester/bamboo blends must contain more than 80% bamboo fibres in order to retain sufficient anti-bacterial property of bamboo fibres in the fabrics.

Prakash C and Ramakrishnan Govindan[3-6] conduct a study on the thermal properties of bamboo/cotton blended single jersey fabrics in relation to linear density, loop length and blend proportion on thickness, air permeability, thermal conductivity, thermal resistance and water vapour permeability. Cotton, bamboo fibre and blends of the two fibres (100% cotton, 100%bamboo, 50:50% bamboo/cotton) were spun in to yarns of linear densities (20s,25s,30s Ne). Each of the yarns so produced was converted to single jersey knitted fabric with three loop lengths. The thermal conductivity of the fabrics was generally found to decrease with increase in the proportion of bamboo fibre. The water vapour permeability and air permeability of the fabrics were observed to increase with increase in bamboo fibre content. An increasing presence of bamboo fibre in the fabric causes a reduction in fabric thickness and GSM for all linear densities of yarn. As the constituent yarn gets finer, fabric air and water-vapour permeability both increase in value while the thermal conductivity falls.

Tanveer Hussain and Faheem Ahmed[7] conduct a study on the mechanical and comfort properties of polyester/bamboo and polyester cotton knitted fabric. Four different ratios P/B 65/35, P/B 50/50, P/B 35/65, P/C 20/80, P/C 65/35, P/C 50/50, P/C 35/65, P/C 20/80 of both blends were produced on a single jersey weft knitting machine.

It was observed that by increasing bamboo and cotton fiber content in the blends, yarn breaking force and tenacity were decreased. Bursting strength, bending rigidity, and thermal resistance of the blended fabrics decreased by increasing bamboo and cotton fiber content in the blends, while air permeability and moisture management capability was found to increase with the increase in bamboo and cotton fiber content in the blends, No antimicrobial activity was shown by any of the P/B blended fabric, but to some extent, 100% bamboo fiber showed antibacterial activity against gram positive bacteria, no activity was observed.

The above literature states that the comfort properties of bamboo blended knitted fabrics were analysed for limited blend proportion and combinations.

This work aimed to study in detail the influence of all the blend proportions and combinations to develop suitable wound dressing material. The yarn samples developed out of different blend proportions were used to produce single jersey knitted fabric samples and the comfort properties such as air permeability, thermal conductivity, thermal resistance and moisture management are evaluated to find suitable combination material for wound dressing.

MATERIALS AND METHODS

Materials

- Cotton
- Polyester
- Bamboo

The fibres used in this study have the specifications as shown in Table 1. The yarns are tested for strength, elongation-at-break and U %.

Table 1 - Fibre Specification

Fibre	Dry tensile strength (CN/Tex)	Wet tensile strength	Linear density (Denier)	Denier (CV %)	Fibre length (mm)
Bamboo	2.11	1.18	1.40	0.70	38
Polyester	3.96	3.90	1.40	0.40	44
Cotton	3.10	2.80	1.54	0.60	38

Single jerseys knitted fabrics were tested for structural and physical properties such as courses per inch, wales per inch, fabric thickness and GSM. The thickness of the fabric increases with the increase in bamboo content. Table 2.

Table 2 Blended Fabric specification

Yarn linear density	Blended Ratio	Wales per inch	Courses per inch	GSM	Fabric Thickness (mm)
30 Ne	100% cotton	46	36	140	0.50
	100% bamboo	48	33	95	0.38
	100% cotton	34	32	106	0.35
	67% bamboo/33% cotton	34	38	126	0.43
	33% bamboo/67% cotton	36	34	35	0.48
	20% bamboo/80% cotton	60	42	125	0.40
	80% bamboo/20% cotton	38	32	09	0.42
	50% bamboo/50% cotton	40	34	98	0.38
	67% bamboo/33% cotton	34	38	107	0.38
	33% bamboo/67% polyester	42	52	120	0.43
	20% bamboo/80% polyester	34	60	85	0.37
	80% bamboo/20% polyester	34	54	111	0.43
	50% bamboo/50% polyester	40	64	129	0.40

Methods

In this study, a series of bamboo cotton and bamboo polyester blended yarns of 30 (Ne) (19.68 tex) was produced from 100% cotton, 100% bamboo, 100% polyester fibres and blends consisting of bamboo/cotton and bamboo/polyester. (Figure 1). The single jersey fabrics are produced.

Testing

The following test are carried out as per ASTM standards

Air permeability

The air permeability of the fabric is the measure of how well it allows the passage of air through it. Shirley air permeability tester is used to measure the air permeability of the fabric.

Thermal conductivity

Thermal conductivity is the property of the fabric to conduct heat. Sweating hot guard plate is used to measure thermal conductivity of the fabric.

Thermal resistance

Thermal resistance is the ability of the fabric to resist the flow of heat. Sweating guard hot plate method is used to measure the thermal resistance of the fabric.

Moisture management

Moisture management is understood to be the ability of a textile to absorb gaseous or liquid humidity from the atmosphere. Moisture management is an essential feature of a textile material especially its comfort appeal. Blending also has a vital role in moisture related capability of textile material

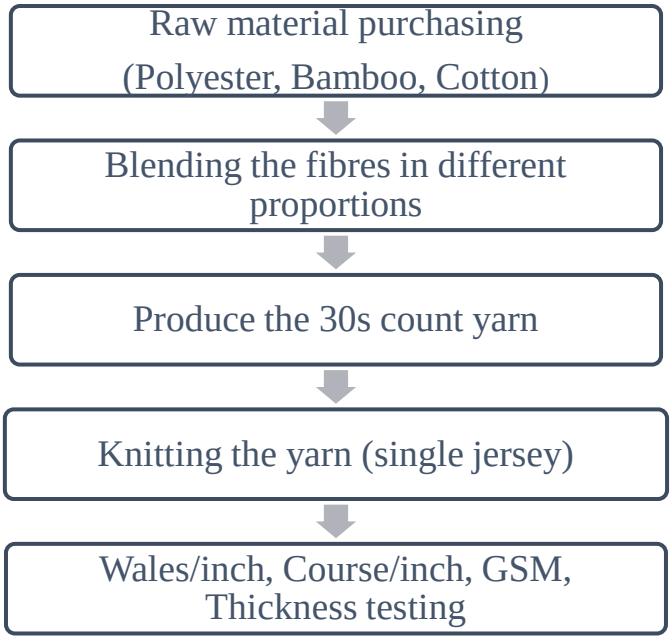

Figure.1 Process flow chart

RESULTS AND DISCUSSION

Air permeability

The air permeability results are shown in Table.2 for different blend proportions of bamboo, cotton and polyester fabrics.

Table 3. Comparison Table on Air Permeability

Bamboo/Polyester	Air Permeability (mm/s)	Bamboo/Cotton	Air Permeability (mm/s)
100%/0%	541.8	100%/0%	542.75
80%/20%	413.7	80%/20%	510.65
67%/33%	410.4	67%/33%	450.98
50%/50%	390.4	50%/50%	333.54
33%/67%	370.5	33%/67%	303.87
20%/80%	349.8	20%/80%	286.34
0%/100%	341.3	0%/100%	265.76

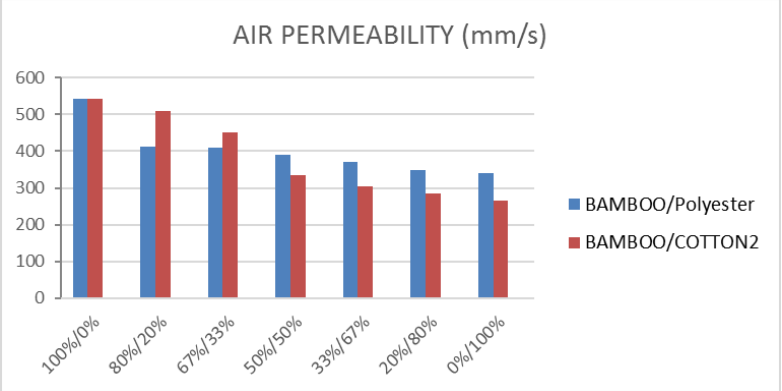

Figure.2 Air permeability

In bamboo/polyester blended knitted fabric as the bamboo content increases the air permeability also increases and as the polyester content increases air permeability decreases. From the table, we observed that 100% bamboo have the highest air permeability value. In blended fabric air permeability tends to be decreased as the thickness increases. Bamboo gives highest air permeability because of the micro spaces in the fabric structure. (Figure.2)

As compared80/20% bamboo/cotton blended knitted fabric is better than bamboo/polyester blended knitted fabric.

Thermal Conductivity

The Thermal conductivity results are shown in Table.3 for different blend proportions of bamboo, cotton and polyester fabrics.

Table 4. Comparison Table on Thermal Conductivity

Bamboo/Polyester	Thermal Conductivity (W/m²K)	Bamboo/Cotton	Thermal Conductivity (W/m²K)
100%/0%	40.42	100%/0%	40.42
80%/20%	41.52	80%/20%	42.12
67%/33%	40.63	67%/33%	40.20
50%/50%	43.11	50%/50%	45.21
33%/67%	42.27	33%/67%	45.30
20%/80%	44.36	20%/80%	48.00
0%/100%	50.60	0%/100%	42.41

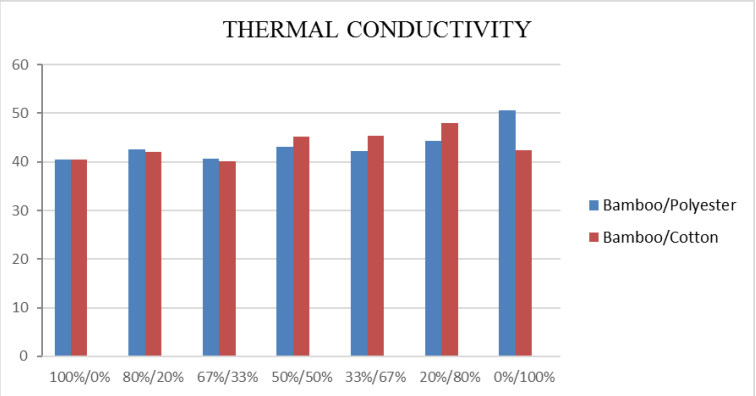

Figure.3 Thermal Conductivity

In bamboo/polyester blended knitted fabric as the polyester content increases conductivity increases. Thermal conductivity mainly depends on thickness and porosity nature of fabric. As the fabric thickness increases the thermal conductivity decreases.(Figure.3)

So it is conclude that 67/33% bamboo/cotton has less conductivity than bamboo/polyester blended knitted fabric.

Thermal Resistance

The Thermal Resistance results are shown in Table.4 for different blend proportions of bamboo, cotton and polyester fabrics.

Table 5. Comparison Table on Thermal Resistance

Bamboo/Polyester	Thermal Resistance (m²K/W)×10³	Bamboo/Cotton	Thermal Resistance (m²K/W)×10³
100%/0%	25.0	100%/0%	24.7
80%/20%	24.0	80%/20%	23.7
67%/33%	24.6	67%/33%	24.8
50%/50%	23.1	50%/50%	21.9
33%/67%	23.6	33%/67%	22.0
20%/80%	22.5	20%/80%	20.8
0%/100%	19.7	0%/100%	23.5

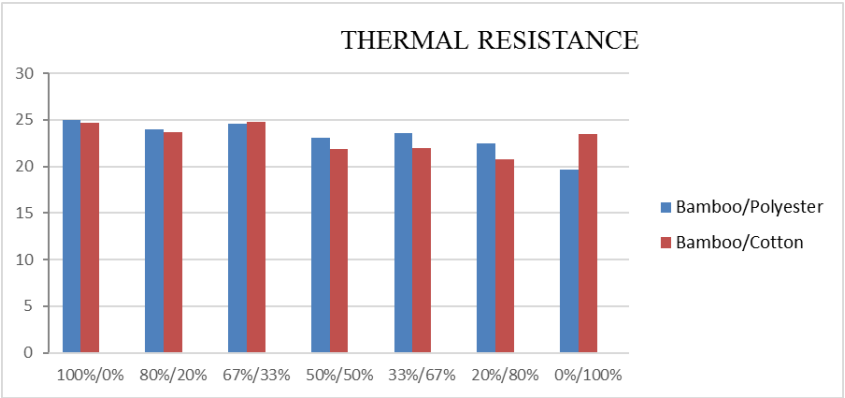

Figure.4 Thermal Resistance

In bamboo/polyester blended knitted fabric as the bamboo content increases the thermal resistance also increases and as the polyester content increases thermal conductivity decreases. Compare with bamboo/cotton blended knitted fabric, the bamboo content increases thermal resistance of the blend. (Figure.4)

Thermal resistance mainly depends on thickness and porosity nature of fabric. As the fabric thickness increases the thermal resistance increases. So it is conclude that 67/33% bamboo/cotton is better than bamboo/polyester blended knitted fab

Moisture Management

The Moisture Management results are shown in Table.5 for different blend proportions of bamboo, cotton and polyester fabrics.

Table 6. Comparison Table on Moisture Management

Bamboo/Polyester	OMMC	Bamboo/Cotton	OMMC
100%/0%	0.7410	100%/0%	0.7410
80%/20%	0.5941	80%/20%	0.5241
67%/33%	0.4824	67%/33%	0.5161
50%/50%	0.4535	50%/50%	0.3901
33%/67%	0.4944	33%/67%	0.4903
20%/80%	0.4619	20%/80%	0.6020
0%/100%	0.6372	0%/100%	0.3694

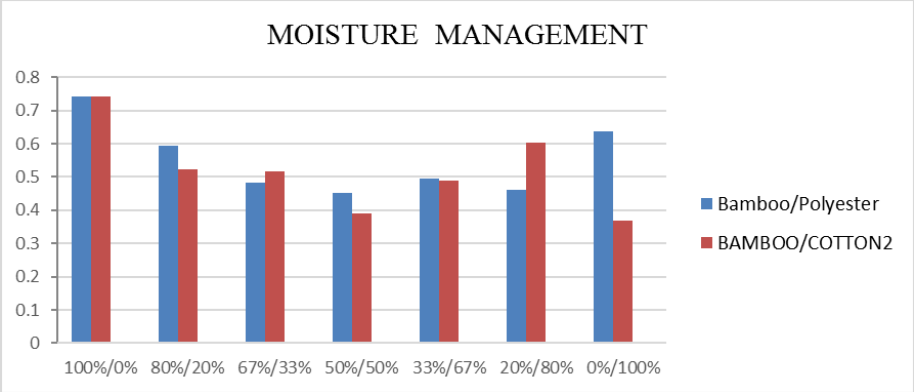

Figure.5 Moisture Management

In bamboo/polyester blended knitted fabric as the bamboo content increases the moisture absorptivity also increases and as the polyester content increases moisture absorptivity decreases. Compare with bamboo/cotton blended knitted fabric, the bamboo content increases the moisture absorptivity of the blend. (Figure.5)

The moisture absorption increases with as increases bamboo and cotton fibre content. In case of P/B blends, increasing hygroscopic absorption and result drying of sweat from the skin. So it is conclude that 20/80% bamboo/cotton is better than bamboo/polyester blended knitted fabric.

CONCLUSION

Bamboo blended knitted fabrics of various combinations were studied in this research work to find the suitable material for wound dressing. The significant properties for wound dressings are tested. Air permeability, thermal resistance and moisture management are high for bamboo/cotton blended knitted fabric. As it has high thermal resistance, the thermal conductivity is less. As per the studies we have concluded that 67/33% bamboo/cotton blended knitted fabric is better than bamboo/polyester blended knitted fabric. Hence the 67/33% bamboo/cotton blended single jersey knitted fabric may be used to develop wound dressing material.

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Cite this article as:

C.Kayalvizhi *et al*. Investigating the efficacy of bamboo blended fabrics for medical applications. Int. Res. J. Pharm. 2017;8(11):196-200 http://dx.doi.org/10.7897/2230-8407.0811240

Source of support: Nil, Conflict of interest: None Declared