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Influence of Water Repellent Treatment on the UV Protection Properties of 100% Cotton Knitted Fabrics

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Short Communication

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ABSTRACT

This paper investigated the influence of water repellent treatment on the UV protection properties of 100% cotton knitted fabrics. *In vitro* UV measurement was conducted according to international standard with a spectrophotometer and the results revealed that water repellent treatment could improve the UV protection properties of cotton knitted fabric.

Keywords: Water repellent; UV protection; cotton; knit.

1. INTRODUCTION

Water repellency is related to the degree of resistance of fabric to surface wetting, water penetration, water absorption or any combination of these properties [1]. Therefore, it is difficult to define water repellency as there is various dynamic and static tests are used to evaluate the performance of water repellency. Generally speaking, water repellency can be described as the ability of a fabric to withstand penetration or wetting by water drop under test conditions. Comparing with waterproof, water repellent is made by applying hydrophobic material on fabric;

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waterproofing is made by filling pores with substance that are impermeable to water and air. Water repellent treated fabric has open pores that maintaining small to large water vapour and air permeability. In order to provide wearer a warm and dry condition with high levels of thermophysical and thermophysiological comfort, a fabric in garment form should allow air and water vapour generated by exudation of perspiration from skin to pass through the fabric. Therefore, casual wear with knitting structure is usually treated with water repellent treatment. In summer time, knitwear is a commonly used garment which may help to protect us against ultraviolet (UV) radiation under sunshine [2-6]. Therefore, this study will investigate the effect of water repellent management treatment on the UV protection properties of 100% cotton knitted structure which is seldom reported.

2. EXPERIMENTAL DETAILS

2.1 Material Preparation

Six 100% ready-for-dyeing cotton knitted fabrics were used and their specifications were shown in Table 1.

2.2 Water Repellent Treatment

The fabrics were treated with water repellent finishing agent according with below recipe using pad-dry-cure method under industrial condition. The fabrics were padded with UNIDYNE TG-5601 with a wet pick-up of 100% in stenter. The pH value of water repellent finishing solution was controlled by using malic acid at pH 5-6. The padded fabrics were dried completely at 130℃ and then were cured at 175℃ for 40 seconds.

UNIDYNE TG-5601 (<C8 fluoroalkyl compounds) 80g/l
Malic acid (for pH control) 0.5g/l

2.3 UV Measurement

After water repellent treatment, all the fabrics were conditioned at a temperature of 20±1℃ and relative humidity of 65±2% for four hours. After conditioning, three swatches with size at 3 inches x 3 inches were randomly cut from each treated fabric. The UV measurement was carried out using Cary model 50 UV/VIS Spectrophotometer in accordance with AS/NZS 4399:1996 standard for *in vitro* evaluation. The mean ultraviolet protection factor (UPF), average percentage of ultraviolet A (UVA) and ultraviolet B (UVB) transmission values were obtained.

3. RESULTS AND DISCUSSION

Table 2 shows the UVA transmission, UVB transmission and UPF of the control and water repellent treated fabrics. The UV transmission and UPF can be used for describing the UV protection effect of a material. The control fabrics refer to the fabric without water repellent treatment. According to Table 1, all fabrics treated with water repellent agent have significant improvement on the transmission of UV transmission values and UPF ratings. This may because the fluorocarbon had the ability to absorb the UV radiation. As a result, the fabrics treated with this water repellent agent could have this value-added property on fabric.

When the fabric structure was compared, the single jersey structure generally gives the lowest UPF values while the rib and interlock structures give better UPF values as shown in Table 2.

Table 1. Information of six selected fabrics

Fabric	Structure	Yarn count (Ne)	Fabric weight (g/m^2)	Fabric thickness (mm)
1	Single jersey	30	140	0.47
2	Single jersey	32	145	0.44
3	One-by-one Rib	30	185	0.70
4	One-by-one Rib	32	180	0.77
5	Interlock	40	190	0.77

Table 2. UV protection properties (95% confident level)

Fabric	UVA transmission (%)		UVB transmission (%)		UPF	
	Control	Water repellent treated	Control	Water repellent treated	Control	Water repellent treated
1	7	7	9	6	15	25
2	8	7	9	6	15	30
3	5	4	6	5	40	45
4	5	5	6	5	40	45
5	3	2	3	2	50+	50+

Since the single jersey is a single knitted structure but the rib and interlock are double knitted structure. The double knitted structure would have better UPF than single knitted structure [7]. However, when rib and interlock structures are compared, the interlock is able to provide excellent UV protection because of its high fabric thickness and weight as shown in Table 1 of fabric specification [8].

4. CONCLUSION

UV protection effect was measured for different water repellent treated 100% cotton knitted structures. Experimental results revealed that water repellent treatment did improve the UV protection effect.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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