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FUNCTIONAL PROPERTIES OF ERI SILK

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Abstract

The article provides a comprehensive review of the recent insights on research in eri silk. Investigations have been done on eri silk knit fabrics adopting varied knit structures with different yarn count and tightness level and considering a set of test parameters. The overall moisture management capacity indexes of eri silk knitted fabric are found to range from 'very good' to "excellent' category, which indicates the suitability of eri silk yarn to skin fit as well as active wear applications.The UV protection property of eri silk fabric dyed with natural dyes from plant extracts and their wash fastness properties have been studied. A variety of silk products have been developed which exhibited excellent UV protection property.

Key words: Eri Silk, Moisture Management, UV Protection, Knitted Fabric, Natural Dyes, Eco Friendly Textiles.

1 Introduction

Eri silk (*Samiaricini*) is a wild silkmoth which has a number of benefits and it is cultivated with the complete life cycle. The characteristic of eri silk are smooth, shiny and white. However, with its crimp characteristic, the spun yarns are often blended with other fibers such as cotton fiber [1]. The eri silk has the unique characteristic of lightness, soft-smooth feel, thermal property and additionally, it can easily absorb sweat and it is well ventilated. Dyeing and physical properties of the eri and cotton fiber blended yarns at different blend ratios were found differently depending on physical nature of eri silk and cotton fibers [2]. Moreover, there are large amount of cassava plantations in Thailand, accounting for 1,600 million square meters and the cassava leaves are wasted and do not create a value. Since cassava and castor leaves were feed for eri silkworm then production of eri silk can generate subsidiary income to farmers.

Moisture management properties are very important for any textile material for transportation of liquid moisture from skin through fabric to environment, which provides necessary comfort for the wearer [3]. Many researchers have explored the influence of fibre type, physical properties of fibres, yarn variables, fabric structure on moisture management properties [4,5]. On ofrei*et al*. studied the influence of fabrics and structure on the thermo physiological properties of knitted fabrics made of Coolmax® and Outlast® [6]. They demonstrated that the type of knit structure has greater influence on wicking ability than knitted structure parameters. Moisture management properties of bamboo-cotton knitted fabric were also investigated and it was reported that when the bamboo content is increased, the wetting time, maximum wet radius, spreading speed and OMMC decrease, whereas the rate of absorption increases [7].

2 UV protection properties

Natural dyes extracted from plants are non-toxic, non-hazardous, and environmentally friendly. Dyeing fiber with natural dyes not only adds further elegance to clothing but it also has special properties including bacteria and UV protection [8,9]. However, the level of UV protective property depends on the plant and materials used in the process of production. Moreover, in these days, people are more concerned about functional properties of product like sun protection. This affected on purchasing fabric goods such as coats, scarves, hats and dresses of customers. As a result, an increasing trend on health and environmental awareness, together with consumer needs of UV protection goods, made our research group interested in the studies of the improvement on UV protection property of eri silk. Study of different natural dyes extracted from Thai plants in order to enhance its ability of UV protection for design the dyed eri silk products to be more appropriate use.

Eri silk yarns dyed with Andaman satinwood leave, Golden shower pods, Neem bark, Sappan, Acacia bark and Burma padauk bark had an excellent level on UV protection. Moreover, with post-mordanting by AlK(SO4)2 and FeSO4, the UV protection property was observed in the UPF value [10]. As a result, natural dyes together with post-mordanting were applied in order to UV protection for eri products which were hat, scarf and dress. The color of a reddish-brown color from Sappan and Burma padauk bark was matched with natural indigo in order to develop the products with a trendy stylish color and a greater quality on UV protection.

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3 Moisture management properties

Zhou *et al.* posited the overall moisture management capacity of pure wool,wool/polyester and wool/cotton blended knitted fabrics with different structures [11]. They reported that wool/cotton blended fabrics are better than other combination of fabrictypes. Süpüren*et al.*investigated the moisture management property of double-face knitted fabricsby using cotton and polypropylene materials and reported that the fabric with cotton (outer layer) and polypropylene (inner layer), provides high level of comfort and can be preferred for summer, active and sportswear [12].

Moisture management characteristics of knitted casein fabric were compared with cotton and it was reported that the casein fabric has better absorption rate and spreading rate, whereas cotton fabric possess better properties like maximum wetting radius and one way transport index values8 [13]. Yamini*et al.*studied the effect of yarn count used in inner and outer layer as well as the difference in yarn count of both layers on moisture management properties of polyester-cotton knit structures [14]. The yarn counts of inner and outer layer affect the sweat transfer rate and sweat spreading on the surface of outer layers.

Wetting time and spreading speed are enhanced with the increase in inner and outer layer yarn counts. Bivainyte*et al.*analyzed the influence of yarn count on wicking properties of cotton- acrylic yarns and fabrics and indicated that the linear density of yarn has a positive correlation with wicking properties [15]. Suganthi*et al.* assessed the moisture management characteristics of bi-layer knittedfabrics with different yarn combinations of viscose, polypropylene, modal and polyester for outer and inner layerse better comfort properties and are the most suitable for active sportswear [16].

Eri silk is one of the wild silk varieties, produced in India by the tribals in the north-eastern states of thecountry on commercial scale. It possesses excellent strength and elongation, soft feel, excellent thermal comfort and moderate lustre properties [17]. Gupta*et al.* examined the physical characteristics and structures of four commercial varieties of Indian silkfibres and reported that eri silk fibres usually have aflat, elongated near rectangular-like cross-sectional shape, with the presence of fewer striations on thefibre surface [18]. The mill spun eri silk yarn wasproduced in worsted spinning system and the yarncount ranges from 10s Nm to 210s Nm [19-21].

Senthilkumar*et al.* reported that eri silk is suitablefor functional knitted apparels and discussed thesuitable process parameters of eri silk knittedfabric production [22]. Though the moisture propertieshave been studied by different researchers,there is hardly any research work on the moisturemanagement characteristics of eri silk knittedfabrics. Hence, it was thought apt to developdifferent eri silk knitted structures and to analyse the moisture management properties of the fabric,thereby establishing the use of eri silk products fordiversified end uses.

Knitted structures, yarn count and tightnesshave significant effect on vertical wicking ability;single jersey has better wicking property than singlepique and honeycomb structure.Eri knit single jersey has instant waterabsorbing capacity of 0.65-0.55 mm/s, followed bysingle pique 0.52 - 0.47 mm/s and honeycombstructure 0.48 - 0.35 mm/s.Eri knit fabric has shorter wicking heights incourse-wise direction than in wale-wise direction forall knit structures. Coarser eri yarn and tighter knitstructures possess better wicking properties in bothdirections.Fabrics made out of finer yarn show fasterwetting rate, absorption rate, spreading speed and maxwetted radius as compared to those for coarser yarns [23].Tightness has a significant influence on the moisture management properties of knitted fabrics.Slack structures show increased absorption rate &spreading speed, max wetted radius and reduced time to wetting as compared to tight structures.Knitted fabrics with pique and honeycomb structures show better absorption rate, faster wetting, and maximum wetted radius. The inner layer of the fabrics shows lower absorption rate than that of outer layer, which indicates that eri knit fabric is suitable for skin fit as well as active wearer applications. Accumulative one way transport capacity and OMCC of single pique and honeycomb structures arein the ‘very good-4’ to “excellent-5’ category. It isalso observed that the single jersey fabrics made outof finer yarn and slack structure also have sealedupto Grade 4. This also supplements the suitability of eri silk yarn to skin fit as well as active wearapplications. The studies reveal that the all eri knitted fabric in general have good moisture management properties and confirm their suitability for performance based garments.

5 Conclusion

Eri silk fabrics developed are analyzed in terms of wetting time, spreading speed, absorption rate, and maximum wetting radius, accumulative one way transport index (AOTI) and overall moisture management capacity(OMMC). It is discerned that the variables, such as yarn count, fabric tightness and knitting structure, have a significant influence on the wicking and moisture management properties. The OMMC indexes of eri silk knitted fabric are found torange from ‘very good’ to “excellent’ category, which indicates the suitability of eri silk yarn to skin fit as well as active wear applications.Eri silk fabrics were woven by the dyed eri yarn providing an excellent protection (UPF 50+) with a proper shade for making 3

prototype clothing products. The result shows that UPF property of eri silk fabric dyed with Burma padauk bark, Gloden shower seed, Neem bark, Andaman satinwood leave and mordanted with iron (II) sulfate presented highest UPF (>100) with good washing fastness. Three prototype products were designed with color matching with natural dyes and fabricated which were hat, scarf and dress. The first product, hat, made from the hand-weave fabric comprised of Ne 20/2 eri spun silk yarn as a warp yarn and Ne 20/2 eri spun silk yarn that dyed from Burma padauk bark as weft yarns. Second product was scarf which made from Ne 20/2 eri spun silk yarn as a warp yarn and Ne1.2 eri hand-reel silk yarn dyed from natural indigo and Burma padauk bark as weft yarns. The last product was dress which made from Ne 30/2 eri spun silk yarn that dyed from sappen as a warp yarn and Ne 30/2 eri spun silk yarn that dyed from indigo as weft yarns. These eco-friendly eri silk products exhibited excellent functional UV-protection property.

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