Analysis of Comfort Properties of Plasma and Enzyme treated with untreated cotton/linen fabric

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ABSTRACT:

In this study, atmospheric pressure plasma and cellulase enzyme were applied to enhance the comfort properties of cotton/linen (C/L) blend woven fabric (70/30%) for tropical climatic conditions. More attention was given to the evaluation of wickability, water vapour permeability, air permeability, and surface characterization. The results of the water vapour permeability test showed that enzyme-treated cotton linen blends have better water permeability than plasma-treated and untreated cotton linen blend woven fabrics, and the results of the air permeability test show that plasma-treated cotton linen blend fabrics have better air permeability than enzyme-treated and untreated cotton linen blend fabrics. Wickability testing shows that plasma treatment improves wickability compared to enzyme treatment and untreated cotton linen blend materials.

***Key Words*:** Plasma and enzyme surface modification, wickability, Air permeability, water vapour permeability, cotton/linen blend.

1.INTRODUCTION :

The fibres of the flax plant are used to make linen, a type of cloth. The strong tensile strength, high moisture absorption, cooling effect, and good comfort of linen are only a few of its qualities. Due to their high moisture absorption, linen fibres dry relatively quickly (1). Cotton is used to make around half of all textile products, including apparel, home textiles, and industrial goods(2) . Non-thermal plasma treatment was performed in ambient air, by a diffuse coplanar surface barrier discharge (DCSBD) type equipment .water contact angle decreases strongly upon plasma treatment, reflecting an increase in surface hydrophilicity air-plasma treatment leads to a significant increase in hydrophilicity, characterized by wicking and wetting properties and water contact angle, and to a slight but perceptible change in color of the fabrics (3). Change the surface chemistry and topography properties using atmospheric pressure plasma treatment. Hydrogen peroxide bleaching using an aqueous solution for linen fabric bleaching process.The optimization of parameters such as plasma gas, exposure time, ageing period, and power input results in a significant improvement in the hydrophilic properties of treated substrates as well as an increase in the extent of subsequent H_2O_2 bleaching. Depending on the power supply and the type of plasma gas used, plasma-treated linen-containing fabrics can be scoured for shorter periods of time, resulting in a significant reduction in pollutants as well as costs for effluent treatment.(4)

The cotton is blended into the linen to give the fabric a better hand value (5). The processing of textiles is a growing industry that historically has required a lot of energy, water, and harsh chemicals. Enzymes are also easily biodegradable, making them potentially safe and eco-friendly. Enzymes are also used to speed up processes, save energy and water, and enhance product quality Because enzymes can operate in mild settings, processes can be carried out without further damaging the fibres (6). Wicking and water drop tests revealed that plasma treatment significantly increased the wettability of grey cotton fabrics and produced results that were superior to those of traditional desizing and scouring(7). Strong wicking clothing systems may quickly absorb liquid perspiration from the skin and convey it to the fabric's top side, giving the wearer a high level of comfort through evaporative cooling. A couple of these The wicking property of a textile structure is influenced by a number of factors, including the amount of fibre, the cross-section of the fibres, and their density(8). Wicking is the naturally occurring, capillary-driven flow of a liquid through a porous material(9). The physiological comfort experienced by a person wearing clothing is greatly influenced by the permeability of textile materials to air and water vapour. Both characteristics result from the porous structure of textile fabrics(10). Air permeability (AP) of textile materials is the capacity of an air-permeable fabric to convey air under clearly specified circumstances. Standard measurement tools create a negative pressure inside the apparatus, which draws air through the fabric under test. The structure of the textile material in nature has a strong relationship with the fabric's air permeability(11).Water vapour permeability indicates a body's capacity to transport body vapour. Physiological comfort is significantly influenced by clothing's ability to transport water vapour. The fabric of clothing worn next to the skin should be able to absorb sweat from the skin's surface. When the body has stopped sweating, the fabric should release the atmospheric vapour, lowering the humidity on the skin's surface(11).Thus, in this paper, cotton linen blended samples of untreated, atmospheric pressure plasma treated, and cellulase enzyme treated fabric properties such as air permeability ,water vapour permeability, and wickability were tested and results are analysed.

2.MATERIALS AND METHEDOLOGY:

2.1.Materials :

The woven cotton 30% linen 70% blended fabrics were procured from Master linen’s inc home textile industry in Karur .

2.2.METHODOLOGY

2.2.1.Wickability:

It was possible to assess the wickability of cotton linen blended fabrics constructed from untreated, atmospheric plasma-treated , and enzyme-treated fabrics by measuring the wicking height in the warp and weft directions in accordance with DIN 53924. Warp and weft directions were divided based on sample size. In a reservoir of distilled water containing 1% reactive red dye, a strip sample was positioned vertically with 15 mm of its lower end immersed. The dye was used to track the flow of water as it defied gravity on the strip.

An average of three readings of the wicking height were collected from the clamped ruler for each sample after it had been wicking for 5 minutes.

2.2.2 Air Permeability:

The air permeability of untreated fabric, atmospheric plasma treated and enzyme treated cotton linen blended fabric samples were tested on air tronic tester with the model of 3240A air permeability tester at an air pressure of 100 Pa and 20 cm2 of test area, in the standard conditions according to ASTM D737. An average of ten readings was taken for each sample and measuring volume of 10 litres/ min the woven cotton linen blended fabrics were tested and readings were recorded .

2.2.3 Water Vapour Permeability

The untreated, plasma-treated, and enzyme-treated woven cotton linen blended fabric samples are tested using the Water Vapour Permeability Tester Model M261 with ASTME 96 specifications. Each open dish is filled with 46 ml of water at 20°C±2°C according to the dish's dimensions, creating an air layer that is 10±1mm deep between the water's surface and the supported specimens' underside.

3.RESULT AND DISCUSSION:

3.1 COMFORT PROPERTIES:

Table -1: Physical properties of the woven fabrics

S/NO	Properties/fabric	Values
1	Thickness(mm)	53
2	GSM	200
3	Weave	Plain

3.2.1 Wickability :

The distance that water travels up in the fabric material is measured at various intervals to determine the cotton linen fabric samples' wicking properties. The results show that the wicking properties of plasma-treated fabric are higher than those of untreated and enzyme-treated fabric in both the warp and weft directions of the fabric.

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Table -2: Wickability Values Of Fabric Samples

WICKABILITY						
SAMPLES	**WARP**			**WEFT**		
	1min	**3min**	**5min**	**1 min**	**3min**	**5min**
Untreated	1.84cm	3.78cm	5.34cm	1.32cm	2.98cm	4.38cm
Plasma treated	3.34cm	5.76cm	7.2cm	2.34cm	5.04cm	6.88cm
Enzyme treated	0.44cm	1.78cm	3.36cm	0.32cm	1.24cm	2.82cm

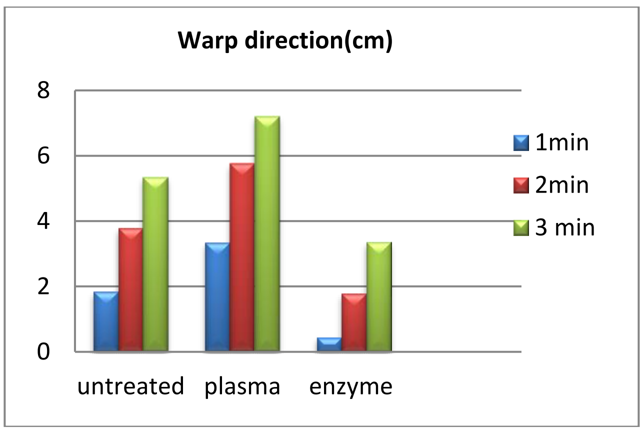

Chart -1: warp direction

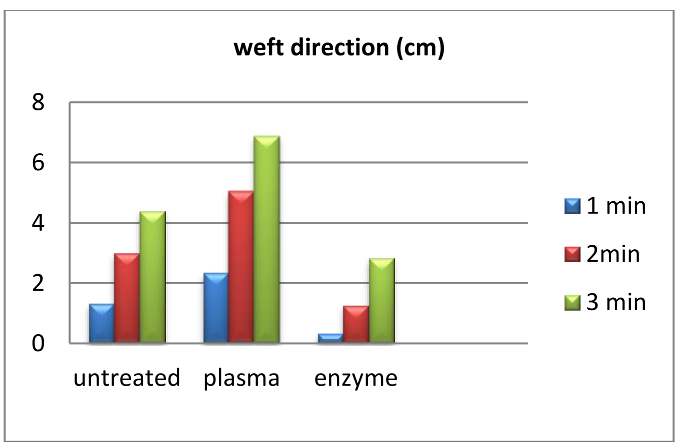

Chart -2: weft direction

3.1.2 Air Permeability:

The air permeability of the fabric samples have been given in the table .The result shows that plasma treated woven fabric has the highest and good air permeability property when compared to the untreated woven fabric and enzyme treated fabric.

The least air permeability property was observed in the enzyme treated fabric.

Table -3: Air Permeability Values Of Fabric Samples

Samples	Air Permeability ($Cm^3/Cm^2/Sec$)
Untreated Fabric	49.683
Plasma Treated Fabric	52.06
Enzyme Treated Fabric	44.53

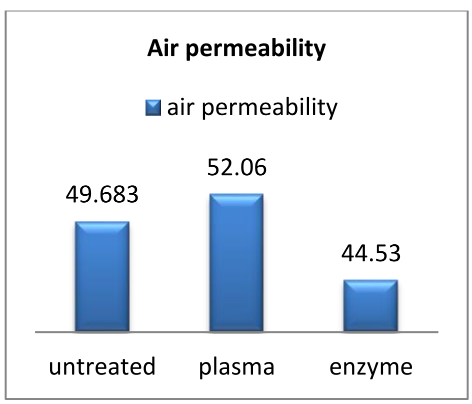

Chart -3:Air Permeability

3.1.3 Water Vapour Permeability:

The water vapour permeability of the fabric samples have been given in the table 4.The result shows that enzyme treated fabric has the highest and good water vapor permeability property when compared to both the untreated and plasma treated fabric. The least water vapor permeability property was observed in plasma treated fabric.

Table -4: Water vapour permeability Values Of Fabric Samples

Samples	**Water Vapor Permeability ($g/m^2/24$ hr)**
Untreated Fabric	1862.768
Plasma Treated Fabric	1774.065
Enzyme Treated Fabric	3503.779

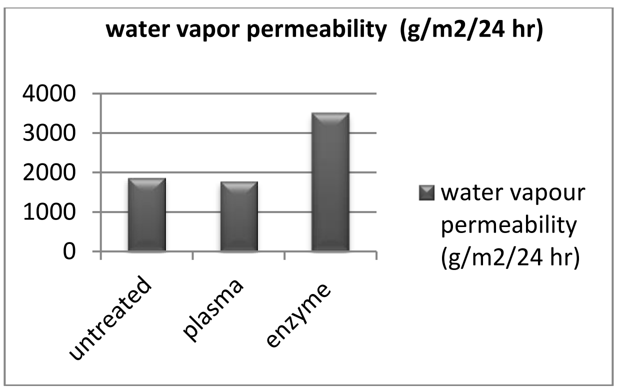

Chart-4 water vapour permeability

3. CONCLUSIONS:

In this paper, the influence of plasma and enzyme surface modification on the comfort properties of C/L blend fabric was illustrated and discussed. According to the results of a test for water vapour permeability, enzyme-treated cotton linen blend fabrics have better water permeability than plasma-treated and untreated cotton linen blend fabrics, and plasma-treated cotton linen blend fabrics have better air permeability, according to a test for air permeability. According to wickability testing, plasma treatment enhances wickability in comparison to enzyme treatment and untreated cotton linen blend materials. The plasma-treated cotton linen fabric has excellent air permeability and wickability properties.

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