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Experimental investigation of the comfort properties of bed sheet produced from weft knitted

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Abstract

This Studying , we attempt to enhance the comfort properties of bed sheet fabrics produced using the weft knitting method. Specifically, the research problem is to address how to improve various properties of bed sheet fabrics through the weft knitting process, and determine the optimal structural weft knitting pattern suitable for bed sheet production. Objectives Study the production of bed sheet fabrics using weft knitting for properties such as weight, thickness, bursting strength, air permeability, water vapor permeability, pilling, and anti-static electricity resistance. Evaluate the distinctive properties provided by knitted fabrics, such as softness and elasticity. Achieve optimal performance of bed sheets through improved comfort, functional performance, and use efficiency properties. Assumptions the research assumes that: Weft knitting will enhance the comfort properties of bed sheet fabrics, particularly in terms of air permeability and water vapor permeability. Weft knitting will improve functional performance requirements like structural integrity, fabric thickness, and fabric weight. Weft knitting will enhance use efficiency properties including pilling resistance, bursting strength, and anti-static electricity resistance. Material and Production Parameters Material: 30/1 E Cotton, Production Method: Circular weft knitting, Knitted Structure Options: Single jersey, rib 1x1, derby rib, interlock, Machine Gauge: 20 needles/inch. Research Methodology Analytical experimental approach involving: Conducting tests to measure various fabric properties. Statistical analysis of test results. Graphical presentation of findings. Key Results Weight and Thickness: Derby rib exhibited the highest weight and thickness, followed by rib, interlock, and jersey. Bursting Resistance: Interlock demonstrated the highest bursting resistance, followed by derby rib, rib, and jersey. Air Permeability: Jersey showed the highest air permeability, followed by interlock, rib, and derby rib. Water Vapor Permeability: Derby rib showed the highest water vapor permeability, followed by rib, jersey, and interlock. Pilling: Jersey, rib, and interlock performed equally well in pilling resistance, while derby rib showed lower performance. Anti-Static Electricity Resistance: Interlock demonstrated; properties.

Introduction

A typical individual spends approximately one-third of their life in sleeping. Sleep is critically important in our lives, akin to eating, drinking, and breathing. It is an essential factor in maintaining robust mental and physical health, as well as providing the necessary energy for increased activity during the day. Additionally, sleep plays a crucial role in bolstering the body's ability to combat diseases by enhancing the immune system's defensive response. [1].

During sleep, bed sheets are among the items in closest contact with the human body. They act as a transitional layer between the mattress and other bedding, such as blankets or quilts, and are used to cover and sleep on mattresses. [2]

Therefore, the bed sheets should ensure the person's comfort during their sleep time reflected in his health, performance, and production. [3]

- Sleep is essential for maintaining mental and physical health, as well as daily productivity. Bed sheets, being in close contact with the body, play a crucial role in ensuring comfort during sleep.

Research Problem

- To what extent can the different properties of bed sheet fabrics be improved by using the weft knitting method in their production?
- What is the best structural weft knitting suitable for the production of bed sheet fabrics?

Objectives

- To study the production of bed sheet fabrics using the weft knitting method.

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- Evaluate the characteristics of weft-knitted fabrics such as air permeability, thermal conductivity, moisture absorption, softness, and elasticity.
- Identify the optimal performance of bed sheets produced by weft knitting.

Research Hypotheses

- The use of the weft knitting method in the production of bed sheets will contribute to:
  - Improving the comfort properties of bed sheet fabrics, including moisture absorption, air permeability, and water vapor permeability.
  - Enhancing the functional performance requirements of bed sheet fabrics in terms of thickness and weight.
  - Boosting the use efficiency properties of bed sheet fabrics, such as resistance to pilling, bursting, and static electricity.

Research Limits

Material: - 30/1 E Cotton.

Production Method: Circular weft knitting.

Knitted Structures

- Single jersey
- Rib 1×1
- Derby rib
- Interlock

Gauge Machine: *20 needles per inch.*

Methodology: Analytical and experimental

Procedures

- Produce bed sheet fabrics using specified materials and knitting methods.
- Analyze and compare the performance of different knitted structures.

Bed linen includes a wide range of classifications and sections, especially when it comes to the fabrics used in bed covers, as can be seen in **Figure 1**.

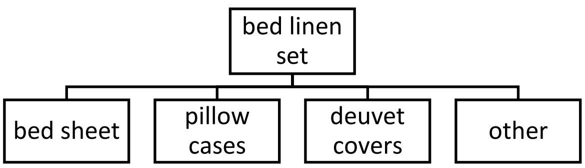


Figure 1: bed linen classification

Bed sheets are an essential component in the production of sheet fabrics, where a variety of raw materials are used to meet the diverse needs of consumers. As shown in **Figure 2,** these raw materials include cotton, linen, silk, and synthetic blends. Each material offers unique properties that make it suitable for different applications. This classification of bed sheet fabrics emphasizes the importance of choosing the right material to achieve the desired balance between comfort, durability and aesthetics.

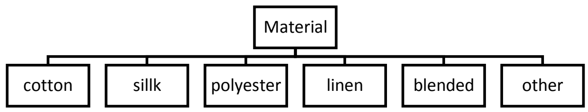


Figure 2: the most common raw materials in bed sheets

Market size of bed sheet

The global bed sheet market reflects the growing demand for these diverse materials. In 2022, the market size was valued at $1.4 billion and is projected to grow at a compound annual growth rate (CAGR) of 6.4% from 2023 to 2031, reaching $2.2 billion by the end of 2031. To determine the size of the bed sheet market specifically, we examine its share within the total bedding market. As shown in **Figure 3**, bed sheets rank second, accounting for 22% of the market, following pillows. This significant share highlights the essential role of bed sheets in the broader bedding market and their importance to consumers seeking quality and comfort. [4]

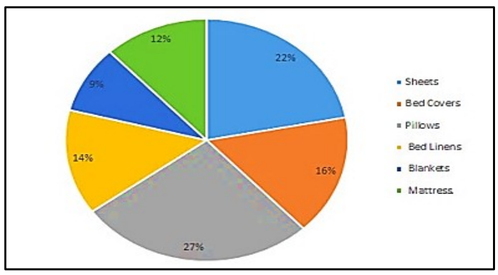


Figure 3: bedding market segment market share ,by product type 2020 [5]

Increased customer demand for convenience and comfort, along with better living standards driven by rising disposable incomes, are key drivers boosting the expansion of the fitted bed sheet sector. Additionally, the growth of the hotel and tourism sectors further fuels this demand. According to forecasts in the global bed linen market, cotton is expected to dominate as the top material for bed linens. Regarding sizes, double bed sheets are anticipated to be the most widespread, while floral patterns are likely to acquire a large market share. Residential use is expected to maintain an increasing market share in the near future, with a growing trend toward online distribution channels. The Asia-Pacific region is projected to dominate the global market during the forecast period, as illustrated in **Figure 4**.

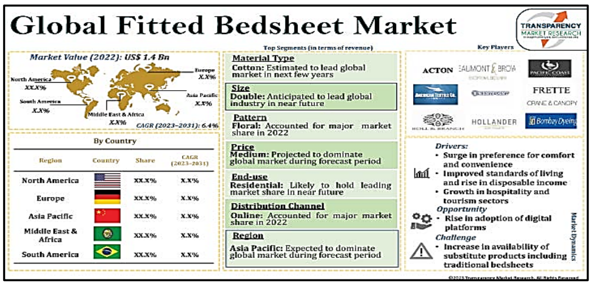


Figure 4: global fitted bedsheet market [4]

The COVID-19 pandemic has further amplified the demand for household essentials, including mattresses, bed sheets, and bed linens, particularly larger ones. With people spending more time at home due to illness or lockdown measures, there has been an increased focus on comfort, especially in bedding. Reports from sleep research in the United States indicate that uncomfortable sleep due to the wrong temperature increased by 30%, uncomfortable pillows by 19%, and uncomfortable bed sheets and mattresses by 14%, along with issues related to noise and other factors. These insights underscore the heightened importance of quality bed linens in ensuring comfort during extended periods at home. [6]

Knitted fabrics, which are often used in bed sheets, are made up of a series of loops created from one or more yarns that are interlocked, with each row of loops catching into the previous row. Unlike woven cloth, the threads in knitted fabrics do not follow a straight path but rather a meandering pattern. When exposed to external stress, these loops quickly stretch in multiple directions, providing more flexibility than woven materials. Knitted cloth can stretch up to 500%, making it an excellent choice for fitted sheets that need to conform to various mattress shapes and sizes. [7]

Weft knitting is particularly noteworthy for its increasing use in various applications. From the user side, weft knitted fabrics offer several advantages: they provide a quick response to market requirements by offering controllable stretch through construction, easy care, good body fitting, a soft handle, and the ability to cool or warm depending on the construction. From the manufacturing side, weft knitting boasts higher productivity—three times higher than weaving looms. Additionally, manufacturing costs for knitted goods are approximately 50% lower than for woven fabric, require lower capital investments, and are suitable for all types of fibers. Moreover, sizing and desizing operations are not necessary, further enhancing the efficiency and cost-effectiveness of weft knitting. [8]

The quality of knitted fabrics varies depending on the type of machine used and the conditions in which they are produced. Different fabric structures and finishing processes greatly influence the physical properties and usability of knitted fabrics. Fabric structure plays a crucial role in determining the various properties of the weft knitted fabric when the processing parameters are carefully controlled, ensuring consistency and desired performance attributes. [9]

One of the most important properties that should characterize bed sheets is the feeling of comfort, which can be defined as a state of psychological, and physical harmony between a person and his surrounding environment.

Bed sheets must also have the properties of efficient use and the characteristics of functional performance requirements.

Accordingly, we can classify the different properties as follows:

A-Comfort properties

- Air permeability.
- Water vapor permeability (breathability).
- Water permeability (sweat).
- Thermal insulation.
- Surface contact with the skin (hand feel).
- Moisture absorption.
- Antistatic electricity resistance.

B- Thermal properties

- Thermal absorption.
- Exothermic.
- Heat transfer.

C- Properties of efficiency of use:

- Dimensional stability.
- Tearing Strength.
- Friction resistance.
- Bursting resistance.
- Pilling.

D- Properties of job performance requirements:

- Stitch density per unit of measure (the number of wale and course per unit of measure).
- Measure the length and width.
- Weight.
- Thickness.
- Shrinkage.
- Elongation and resilience.
- Stiffness.
- Drape.
- Wrinkle resistance.

Experimental

The following is the Egyptian standard specification for Bed sheets: Egyptian Standard 6733/2008 for cotton. Bed sheets and covers Physical and mechanical properties [10-12]:

Table 1: Egyptian standard specification for Bed sheets

N sample	Fabric case	break tensile strength\kg		Average weight m^2\g
		warp	Weft	
1	finished	80	65	180
2	finished	70	70	212.5
3	finished	60	40	190
4	finished	50	35	120
5	finished	60	70	208.5
6	finished	70	50	166
7	finished	60	45	164
8	finished	55	50	148
9	finished	55	50	130
10	finished	75	65	170

Executive Specification

Based on the foregoing, we have produced four weft knitted samples for the purpose of using them as bed sheets and their specifications are as follows:

As can be seen from Tables [2,3,4,5] the four study samples were produced using fixed data, gauge which is 20 needles per inch, and the Material & Yarn count used, which is 30/1cotton.

Table 2: Machine specification for single jersey

N	Machine specification for single jersy	
1	Machine number	371
2	Machine manufacturer	PILOTELLI
3	Machine Model	JVCE3
4	Machine diameter	34 inch
5	Machine gauge	20 n\inch
6	Number of needles	2990
7	Row \cm	21
8	Structural composition	Single jersy
9	Material and count of yarn	30\1 cotton
10	Number of feeders	102
11	Percentage of usufruct	75 %
12	Speed range	20 : 25
13	Average speed	23
14	Hoop number	90 : 200

Table 3: Machine specification for rib 1×1

N	Machine specification for rib 1×1	
1	Machine number	1038
2	Machine manufacturer	ORIZIO
3	Machine Model	CMOLAA
4	Machine diameter	36 Ich
5	Machine gauge	20 n\inch
6	Number of needles	4272
7	Row \cm	18
8	Structural composition	Rib 1×1
9	Material and count of yarn	30\1 cotton
10	Number of feeders	72
11	Percentage of usufruct	90%
12	Speed range	20:22
13	Average speed	21
14	Hoop number	90:165

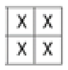
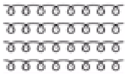
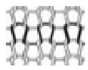
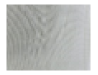
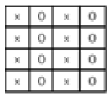
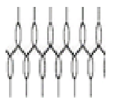
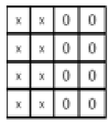
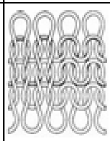
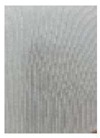
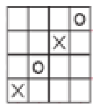
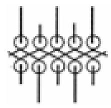
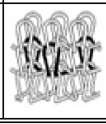
Table 4: Machine specification for derby rib

N	Machine specification for derby rib	
1	Machine number	1014
2	Machine manufacturer	ORIZIO
3	Machine Model	CMO4A
4	Machine diameter	34 Inch
5	Machine gauge	20 n\inch
6	Number of needles	4272
7	Row \cm	*18*
8	Structural composition	Derby rib
9	Material and count of yarn	30\1 cotton
10	Number of feeders	68
11	Percentage of usufruct	90%
12	Speed range	20:22
13	Average speed	21
14	Hoop number	90:230

Table 5: Machine specification for interlock

N	Machine specification for interlock	
1	Machine number	1039
2	Machine manufacturer	ORIZIO
3	Machine Model	CMOLAA
4	Machine diameter	36 Ich
5	Machine gauge	20 n\inch
6	Number of needles	4272
7	Row \cm	16
8	Structural composition	Interlock
9	Material and count of yarn	30\1 cotton
10	Number of feeders	72
11	Percentage of usufruct	90%
12	Speed range	20:22
13	Average speed	21
14	Hoop number	90:165

Table 6: specifications of the weft knitted fabrics structure

specifications of the weft knitted fabrics structure				
	Symbolic Style	Diagrammatic style	Graphic style	Samples produced
Jersey				
Rib				
Derby rib				
Interlock				

Subsequently, the implemented samples were subjected to tests in order to evaluate the outcomes and confirm the research assumptions. The following were the tests that were administered:

Measurements

Fabric Weight

This test was followed Standard Test Methods for Mass Per Unit Area (Weight) of Fabric (ASTM D3776 / D3776M – 20). [13] In this test, several 10 x 10 cm samples are made. The weight of each sample is then determined using a sensitive scale with four decimal places. The arithmetic average of the samples is then determined, and the result is multiplied by 100 to obtain the weight of the square meter. The results are as follows:

Table 7: Test readings for weight per square meter of fabric

N	Type of structure	Reading cm^2\gm.			Average	Weight g\m^2
		1	2	3		
1	Single jersey	0.7342	0.7135	0.7233	0.723667	144.7333
2	Rib 1×1	1.8865	1.8969	1.873	1.885467	377.0933
3	Derby Rib	2.1245	2.1554	2.175	2.151633	430.3267
4	Interlock	1.3303	1.2952	1.3207	1.3154	263.08

Fabric thickness

This test was followed ASTM D1777 - Standard Test. [14] The fabric is measured for thickness in multiple locations after it has been straightened and is not subjected to outside pressure or influence. The fabric is passed under the device's foot while bearing only the weight of the foot. The measurements yield the following results

Table 8: Test readings for thickness per mm of fabric

No.	Type of structure	reading									average
1	Jersey	0.04	0.02	0.02	0.02	0.02	0.02	0.04	0.05	0.02	0.03
2	Rib	0.94	0.96	0.97	0.95	0.90	0.91	0.94	0.92	0.97	0.952
3	Derby rib	0.37	1.05	1.15	1.03	1.02	1.07	1.05	0.98	1.03	1.012
4	Interlock	0.45	0.46	0.44	0.45	0.46	0.42	0.43	0.41	0.41	0.436

Bursting Strength

This test was followed Bursting Strength of Textiles –Ball Burst Test (ASTM D 3787). [15] It is a test method specific to textiles that demonstrate significant ultimate elongations. The test determines the bursting strength of textiles by exerting a force on the clamped material with a spherical plunger until the material breaks. Before conducting ASTM D3787, it is important to read the entire specification in the relevant ASTM publication. In response to any outside force or effect, the outcomes are as follows:

Test Fabric Air permeability

This test was followed Standard test method for air permeability of textile (ASTM D 737), [16] this test method covers the measurement of the air permeability of textile fabrics. This test method applies to most fabrics. The values stated in SI units are to be regarded as the standard. The values stated in $CM^3/CM^2/SEC$ units may be approximate. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

Table 9: Test readings for Bursting Strength of fabric

NO	Type of Structure	Reading1	Reading2	Reading3	Mean
1	Jersey	416	401	397.6	404.9
2	Rib1×1	539	462	506	502
3	Derby Rib	600	612	616	609
4	Interlock	837	794	829	820

Table 10: Test readings for air permeability

No	Type of structure	Reading			Aveage
1	Jersey	158	163	132	151
2	Rib1×1	65.6	68	62.7	65.4
3	Derby Rib	59.8	59.9	57.5	59.06
4	Interlock	70.9	77.9	75.4	74.7

Water vapor permeability

A cup filled with distilled water is used, leaving a small gap of air space between the sample and the water. The cup is then closed to prevent steam loss except through the test sample. The initial weight of the device is taken and then weighed periodically over time until the results are linear. Care is taken to ensure that all weight loss is caused by the transfer of water vapour through the sample.

Table 11: Test readings for Fabric Water vapor permeability

no	Structure	Wet. Before	Wet. After		Average	Result
			24h	48h		
1	Jersey	105.150	102.612	100.3235	0.35023	0.35023
2	Rib1×1	102.514	100.330	98.3140	0.03711	0.37118
3	Derby Rib	107.124	100.7941	98.4885	0.06985	0.6985
4	Interlock	105.519	103.0468	100.7996	0.34079	0.34079

Pilling

This test was followed pilling resistance of fabric [ICI Method]) [17, 18]

The sample tube with the test sample is placed in the pilling test chamber, the instrument is started, and the sample is flipped and rubbed in the box body. After the number of rollovers is agreed, the sample is taken out for rating, the degree of fabric pilling is assessed. On an arbitrary scale from 5 to 1, which represents no pilling to extremely severe pilling, the observed resistance to pilling is reported.

In response to any outside force or effect, the outcomes are as follows.

Table 12: Test readings for pilling of fabric

NO	Type of Structure	Reading
1	Jersey	4
2	Rib1×1	4
3	Derby Rib	2
4	Iterlock	4

Antistatic electricity resistance

This test was followed Standard Test Method for Electrostatic Propensity of textiles, (ASTM D 4238). [19] This test method covers the determination of the relative electrostatic propensity of fibres, yarns, and fabrics by a corona discharge. This includes the measurement of the m3aximum charge voltage and the decay half-life. The outcomes are as follows:

Table 13: Test readings for Antistatic electricity resistance:

No	Type of Structure	Reslt (kv)
1	Jersey	-0.23
2	Rib1×1	-0.23
3	Derby Rib	+0.8
4	Interlock	-0.20

Accordingly, the following tables have been made to illustrate the different tested properties of the four samples: Table 11 for jersey composition, Table 12 Rib, Table 13 Derby Rib and Table 14 Interlock.

Table 14: Values of tested properties for jersey

Jersey	
Weight	144.733
Thickness	0.03
Bursting Strength	404.9
Air Permeability	151
Water Vapour Permeability	0.35023
Pilling	4
Anti-Static electricity Resistance	-0.23

Table 15: Values of tested properties for rib:

Rib1×1	
Weight	377.09
Thickness	0.952
Bursting Strength	502
Air Permeability	65.4
Water Vapour Permeability	0.3711
Pilling	4
Anti-Static electricity Resistance	-0.23

Table 16: Values of tested properties for Derby rib:

Derby Rib	
Weight	430.32
Thickness	1.012
Bursting Strength	609
Air Permeability	59.06
Water Vapour Permeability	0.698
Pilling	2
Anti-Static electricity Resistance	+0.8

Table 17: Values of tested properties for interlock

Interlock	
Weight	263.08
Thickness	0.436
Bursting Strength	820
Air Permeability	74.7
Water Vapour Permeability	0.34
Pilling	4
Anti-Static electricity Resistance	-0.20

Results and discussion

As evidenced by our experimental results, it becomes clear that knitted fabrics exhibit highly suitable characteristics for use as comfortable bed sheets. The various structural types of knitted fabrics, such as Single Jersey, Rib, Derby Rib, and Interlock, each possess unique properties that contribute to their overall suitability. The following discussion delves into the detailed analysis of these structures based on the results obtained from the tests.

1By weight

Analysis Figure 5: **Single Jersey** fabric is lightweight, providing a soft and breathable material that is suitable for warmer climates and individuals seeking cooler sleep environments. Its lower weight contributes to high air permeability and moisture management.

Rib 1×1 fabric is significantly heavier than Single Jersey, offering a robust and durable structure. This higher weight provides better thermal insulation and resilience, making it ideal for cooler climates and enhanced durability.

Derby Rib is the heaviest structure tested, offering the highest thermal insulation and durability. Its substantial weight ensures excellent warmth retention, making it suitable for cold environments and high durability needs.

Interlock fabric strikes a balance between weight and comfort. It provides moderate thermal insulation and durability, suitable for a wide range of climates. Its structure ensures a smooth hand feel and excellent moisture management.

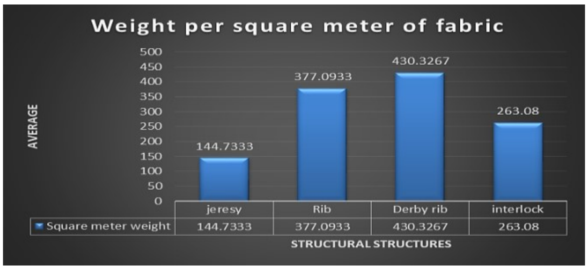


Figure 5: Comparative analysis of Fabric weight

By thickness

Analysis Figure 6: **Single Jersey** fabric exhibited the lowest average thickness among the tested samples. This characteristic contributes to its lightweight and breathable nature, making it highly suitable for warmer climates and individuals seeking cooler sleep environments. The minimal thickness ensures high air permeability and efficient moisture management.

The Rib 1×1 fabric showed a significantly higher average thickness compared to Single Jersey. The increased thickness provides better thermal insulation and durability, making Rib 1×1 ideal for cooler climates and users seeking more substantial and warm bed sheets. The dense structure contributes to its robustness and long-lasting performance.

Derby Rib fabric had the highest average thickness, reflecting its thick and robust nature. This structure offers excellent warmth retention and durability, making it suitable for cold environments and long-term use. The substantial thickness ensures optimal thermal insulation, providing a cosy and comfortable sleeping experience.

The Interlock fabric, with its moderate average thickness, offers a balance between weight and comfort. It provides good thermal insulation and durability, making it versatile for various climates and user preferences. The balanced thickness ensures a smooth hand feel and efficient moisture management, enhancing overall comfort.

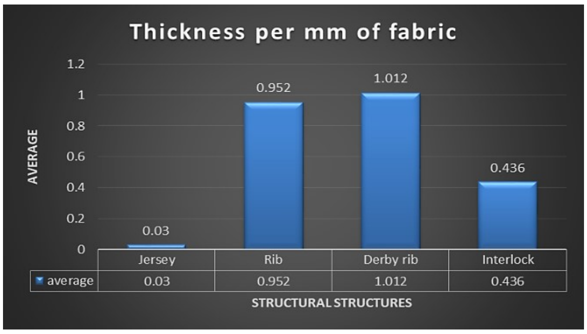


Figure 6: Comparative analysis of Fabric thickness

By bursting strength

Analysis Figure 7: **The Single Jersey** fabric exhibited the lowest mean bursting strength among the tested samples. This indicates that while it may be suitable for applications requiring lower mechanical stress, it may not be ideal for environments demanding high durability and resistance to mechanical forces.

The Rib 1×1 fabric demonstrated a moderate mean bursting strength, higher than Single Jersey but lower than Derby Rib and Interlock. This suggests that Rib 1×1 fabric can withstand moderate mechanical stresses, making it a good choice for applications requiring a balance between flexibility and strength.

Derby Rib fabric showed a significantly higher mean bursting strength compared to Single Jersey and Rib 1×1. Its robust nature makes it suitable for environments where higher mechanical strength and durability are essential.

The Interlock fabric exhibited the highest mean bursting strength among the tested samples. This suggests that Interlock fabric is highly durable and capable of withstanding substantial mechanical stress, making it ideal for heavy-duty applications.

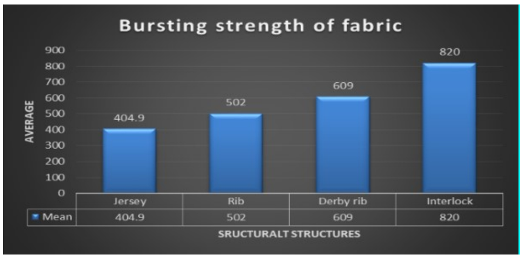


Figure 7: Comparative analysis of Fabric bursting strength

By air permeability

Analysis Figure 8: **Jersey fabric** tends to have higher air permeability compared to the other fabric structures tested. This indicates that it allows more air to pass through the fabric per unit area per second. Higher air permeability can contribute to better breathability and comfort, particularly in warmer environments or for individuals who prefer cooler bedding**.**

Rib 1×1 fabric has lower air permeability compared to Jersey fabric. This suggests that it allows less air to pass through, potentially providing better insulation and warmth retention. Lower air permeability can be beneficial in cooler climates or for those seeking warmer bedding**.**

Derby Rib fabric exhibits similar air permeability to Rib 1×1 fabric, indicating moderate airflow through the fabric. It provides a balance between breathability and insulation, suitable for a variety of climates and preferences**.**

Interlock fabric demonstrates higher air permeability compared to Rib 1×1 and Derby Rib fabrics but lower than Jersey fabric. This suggests it balances between breathability and insulation similarly to Derby Rib fabric, making it versatile for various climates and user preferences.

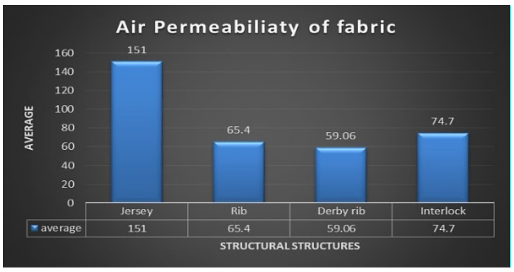


Figure 8: Comparative analysis of Fabric air permeability

By water vapor permeability

Water vapour permeability refers to the amount of moisture a fabric allows to pass through over time (see Figure 9).

Jersey fabric exhibits good moisture vapour permeability, allowing moisture to be efficiently transported away from the body. This feature is beneficial for comfort, especially in bedding where moisture management is essential for a good night's sleep.

Rib1x1 fabric shows slightly higher water vapour permeability compared to jersey fabric. This suggests that it may provide slightly better moisture transfer capabilities, which is beneficial for maintaining a dry and comfortable sleeping environment.

Derby Rib fabric shows much higher water vapour permeability compared to Jersey and Rib 1×1 fabrics. This indicates that it allows moisture to pass through effectively, which helps in moisture management and maintaining comfort.

Interlock fabric shows good water vapour permeability, similar to jersey fabric. Allows for effective moisture transfer while maintaining comfort and dryness.

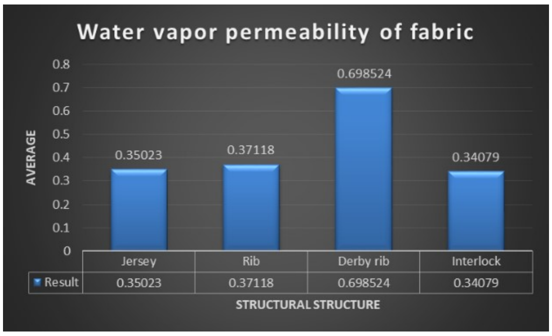


Figure 9: Comparative analysis of Fabric water vapor permeability.

By pilling

Jersey fabric: A rating of 4 indicates moderate resistance to pilling. This suggests that Jersey fabric is somewhat resistant to forming pills but may show signs of pilling with extended use or friction. For bedding applications, a rating of 4 indicates reasonable durability against pilling, suitable for moderate use.

Rib 1×1 fabric: Similar to Jersey fabric, Rib 1×1 shows moderate resistance to pilling. It is likely to maintain its appearance well over time but may develop some pills under frequent use.This rating suggests good durability against pilling, making Rib 1×1 fabric suitable for bedding where durability is important.

Derby Rib fabric: A rating of 2 indicates lower resistance to pilling compared to Jersey and Rib 1×1 fabrics. It is more prone to developing pills with use and friction. This lower rating suggests that Derby Rib fabric may not be as durable against pilling, potentially requiring more care to maintain its appearance in bedding applications.

Interlock fabric Similar to Jersey and Rib 1×1 fabrics, Interlock shows moderate resistance to pilling. It is likely to withstand moderate wear and maintain its appearance well over time. This rating indicates good durability against pilling, suitable for bedding where longevity and appearance retention are important.

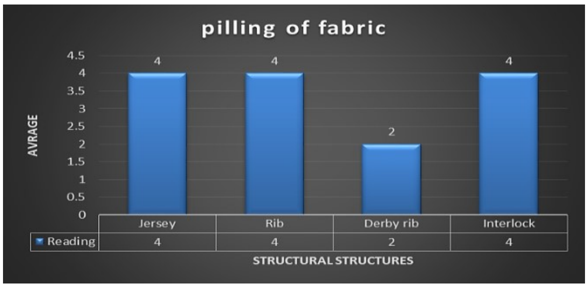


Figure10: Comparative analysis of Fabric pilling.

By Anti-static electricity resistance

Single Jersey a negative value indicates that the fabric exhibits a slight repulsion to static electricity, which is generally favorable as it means the fabric is less likely to attract static charges. This result suggests that Jersey fabric can help in reducing static cling, making it suitable for comfortable bedding where static electricity can be a nuisance.

Rib 1×1 Similar to Jersey fabric, Rib 1×1 demonstrates a slight repulsion to static electricity, indicating it has properties that resist static cling. This characteristic is beneficial for bedding materials, contributing to user comfort by minimizing static build-up.

Derby Rib A positive value indicates that the fabric has a tendency to attract static electricity. This result suggests that Derby Rib fabric may be more prone to static cling, which can be less desirable in bedding as it can cause discomfort and affect sleep quality.

Interlock: Like Jersey and Rib 1×1 fabrics, Interlock exhibits slight repulsion to static electricity, indicating it resists static cling. This property contributes to the fabric's suitability for bedding, helping to maintain comfort by minimizing static build-up.

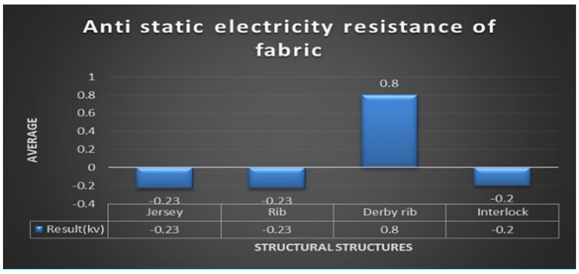


Figure 11: Comparative analysis of Fabric Anti-static electricity resistance

Discussion

Comparative analysis of the properties tested of jersey

Jersey fabric proves to be a promising material for bedding due to its lightweight, breathable nature, moderate bursting strength, efficient moisture management, good pilling resistance, and anti-static properties. These attributes make it suitable for enhancing sleep comfort and ensuring durability over extended use.

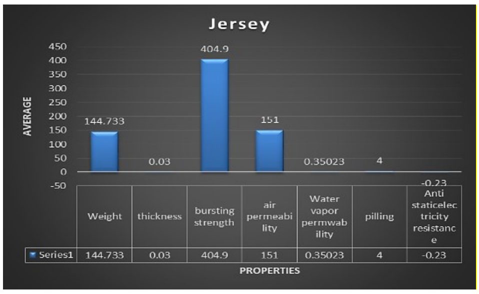


Figure 12: Comparative analysis of jersey

Comparative analysis of the properties tested of Rib

Rib 1×1 knitted fabric shows promising characteristics for bedding applications, particularly in cooler climates. Its substantial weight and thickness provide excellent warmth and durability, while the good bursting strength ensures long-term usability. Although its air permeability is moderate, it still offers sufficient breathability and effective moisture management. Additionally, the high pilling resistance and anti-static properties further contribute to the fabric's comfort and longevity.

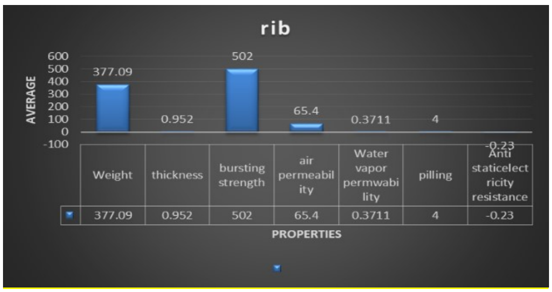


Figure 13: Comparative analysis of rib

Comparative analysis of the properties tested of Derby rib

Derby Rib knitted fabric exhibits several characteristics that make it suitable for bedding applications, particularly in colder climates. Its substantial weight and thickness provide excellent thermal insulation and durability, while the high bursting strength ensures long-term usability. Although its air permeability is lower, it compensates with effective moisture management. The lower pilling resistance requires attention, but overall, the fabric's properties contribute to a warm and durable bedding option.

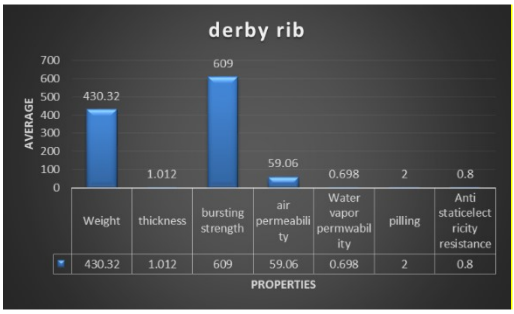


Figure14: Comparative analysis of derby rib

Comparative analysis of the properties tested of Interlock

Interlock knitted fabric exhibits a range of characteristics that make it highly suitable for bedding applications. Its moderate weight and thickness provide a balanced combination of insulation and breathability, making it versatile for various climates. The high bursting strength ensures durability, while the good air permeability and moisture management properties enhance comfort. Additionally, the fabric's high resistance to pilling and its tendency to repel static electricity further contribute to its suitability for bedding use.

Thus, we reach that the use of knitted weft fabrics in the production of bed sheets achieves distinct functional values that achieve excellent performance, which we recommend applying on a large scale.

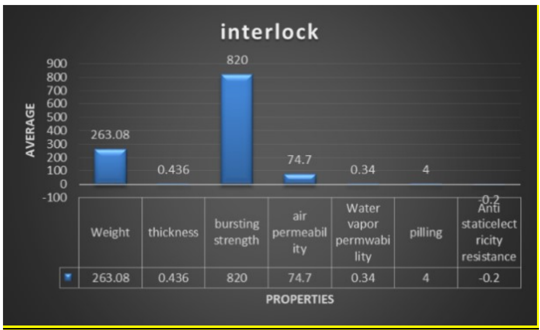


Figure 15: Comparative analysis of interlock

Conclusions

Bed sheets are one of the most important types of fabrics, as they touch the human being and affect him during his sleep, which reaches 8 hours, so they must provide the necessary comfort properties, and knitted fabrics are characterized by the properties of flexibility and softness that are achieved by the distinctive loop style of knitting, and the study of producing 4 samples with different structural compositions in the style of weft knitting in order to be used as bed sheets and by conducting tests on the samples produced to measure weight, thickness, bursting strength, air permeability, water vapor permeability, pilling and Anti-static electricity.

By analyzing the results, we found that the weft knitting samples did well as bed sheets. The research highlights the diverse properties of different knitted fabric structures and their implications for bed sheet applications. Jersey fabric is best suited for warmer climates due to its lightweight and high breathability. Rib 1×1 fabric is ideal for cooler climates with its better thermal insulation and durability. Derby Rib fabric provides excellent thermal insulation for very cold environments but has lower resistance to pilling. Interlock fabric offers a balanced combination of properties, making it versatile for various climates with high durability and comfort. Each fabric type has unique attributes that make it suitable for specific environmental conditions and user preferences. This research provides a detailed understanding of how these fabrics can be optimally used in bedding applications to enhance comfort and durability.

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The authors declare that there is no funder

Conflict of Interest

There is no conflict of interest in the publication of this article.

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التحقيق التجريبي لخصائص الراحة لملاءات الاسرة المنتجة من تريكو اللحمة

مروة ياسين

جامعة بنها ـ كلية الفنون التطبيقية ـ قسم الغزل والنسيج والتريكو ـ بنها ـ مصر.

المستخلص

استهدفت الدراسة إنتاج عينات تريكو لحمة للاستخدام كملاءات اسرة ، وتم إجراء الدراسة وكانت **مشكلة البحث** هي كيفية تحسين الخصائص المختلفة لأقمشة ملاءات الأسرة من خلال إنتاجها من أقمشة تريكو لحمة ؟ وما هو أفضل تركيب بنائي لتريكو اللحمة يناسب أقمشة ملاءات الأسرة ؟ **أهداف البحث** هي دراسة إنتاج أقمشة ملاءات الأسرة من أقمشة تريكو لحمة والتي تحقق خصائص متميزة مثل الوزن والسمك ومقاومة الانفجار ونفاذية الهواء ونفاذية بخار الماء والتوبير ومقاومة الكهرباء الساكنة والخصائص المميزة التي توفرها اقمشة التريكو مثل النعومة والمرونة وغيرها، حيث نطمح إلى تحقيق الأداء الأمثل لملاءات السرير. **ويفترض البحث** أن استخدام طريقة تريكو اللحمة في إنتاج ملاءات الأسرة سوف يساهم في : تحسين خصائص الراحة لأقمشة ملاءات الأسرة من حيث (نفاذية الهواء - نفاذية بخار الماء)، تحسين خصائص الأداء الوظيفي لمتطلبات أقمشة ملاءات الأسرة من حيث (التركيب البنائي – سمك القماش - وزن القماش) تحسين خواص كفاءة إستخدام أقمشة ملاءات الأسرة من حيث (التوبير - مقاومة الانفجار - مقاومة الكهرباء الساكنة)، **حدود البحث** الخامات المستخدمة : E 1\30 قطن، طريقة الإنتاج: تريكو لحمة دائرية، تراكيب بنائية(جيرسيه –ريب –ديربي ريب –انترلوك)، الماكينة المستخدمة في الانتاج جوج : 20 إبرة / بوصة، **منهجية البحث**: تجريبي تحليلي ،وتم اختبار العينات المنتجة للخصائص الاتية (الوزن –السمك –مقاومة الانفجار –نفاذية الهواء –نفاذية بخار الماء –التوبير-مقاومة الكهرباء الساكنة) ثم تحليل وعرض نتائج الاختبارات احصائياً وبيانيا ، وتوصلت الدراسة لعدة نتائج أهمها:أن أقمشة تريكو اللحمة تبلي بلاءاً حسناً للاستخدام كملاءات أسرة حيث ان من خصائص التريكو المرونة والنعومة كما ان نتائج الاختبارات أظهرت أداء جيد للغاية للعينات عامة واذا ما عرضنا بصورة اكثر تفصيلا سنجد انه من حيث الوزن قد حققت عينة الدريبي ريب اعلي وزن يليها الريب ثم الانترلوك ثم الجيرسيه، اما من حيث السمك فتاتي ايضا عينة الديربي ريب في المقدمة يليها الريب ثم الانترلوك وفي النهاية الجيرسيه،في حين أنه بالنسبة لمقاومة الانفجار فالانترلوك يأتي في المقدمة يليه الدريبي ريب ثم الريب ثم الجيرسيه،وفيما يخص نفاذية الهواء فتصد الجيرسيه ثم تلاه الانترلوك وجاء بعد ذلك الريب واخيرا الديربي ريب ،ومن حيث نفاذية بخار الماء أتي في المقدمة الديربي ريب ثم الريب ثم الجيرسيه واخيرا الانترلوك،ومن حيث التوبير تساوي الجيرسيه والريب والانترلوك في حين جاء في النهاية الديربي ريب ، ومن حيث مقاومة الكهرباء الساكنة كان الانترلوك في المقدمة يليه الجيرسيه والريب في نفس المستوي واخيرا يأتي الديربي ريب ، لذلك ننصح بالتوسع في استخدام أقمشة تريكو اللحمة كملاءات أسرة لما توفره من خصائص مميزة في هذا المجال.

الكلمات المفتاحية: ملاءات الاسرة ، تريكو اللحمة ، تراكيب بنائية ، خواص الراحة.