

Properties and Manufacture Technique of Blended Bamboo Knitted Fabrics for Children's Wear

Ghada Abdalla Elkholy

Department of Apparel Design & Technology, Faculty of Applied Arts - Helwan University

Abstract: *Requirements of children's wears: Soft, comfortable, hairiness, non-flammable, Lightweight, underclothes should be made of organic fibers, allow quick transmission of sweat from skin to environment. Bamboo is an eco-friendly and multifunctional plant. And bamboo clothing is taking share in the textile market. In this study we will conduct a comprehensive experiment of the effect of the blend-ratio of bamboo fabric on the durability and its clothing comfort of single jersey knitted fabrics composed of them. Bamboo fabric blends of the two fabrics (70:30 bamboo: viscose, 95:5 bamboo: spandex). Each of the yarns so produced was converted to single jersey knitted fabrics. The relative durability and its clothing properties of the fabrics were observed to increase with increase of bamboo fiber percentage . Statistical analysis also indicates that the results are significant for properties of tested fabrics like, weight, thickness, abrasion resistance, stiffness, hairiness, wettability and properties of sewing clothes made of tested fabrics like seam pucker, seam thickness and Seam Type Effects in garment.*

Keywords: Children's wears, bamboo fabric, properties of fabric, seam pucker, seam thickness

1. Introduction

Clothing is one of the most important needs in every human life. It gives us a good appearance and protects our body from various climates and. In this world, children are given more selection of their garments. Requirements of children's wears: Soft, comfortable, hairiness, non-flammable, Lightweight, allow quick transmission of sweat from skin to environment.^(1,2)

Bamboo fiber helps keep you warm in winter and cool in summer. In addition, bamboo fiber is highly absorbent (more than cotton) also naturally wrinkle-resistant. bamboo fiber is similar to cotton, in softness, strength, and absorbency. (3)

Bamboo fiber is fast drying and accepts dyes rapidly and thoroughly, so the processing takes less energy. bamboo fibers do not have ultraviolet protection or antimicrobial properties, though many have said the fibers inherit these properties from the bamboo plant . (4, 5)

The seam puckering phenomenon a local defect of a clothing item in the form of large ridges of material inside the seam and is considered a serious defect in garment [6, 7]

The elimination of this defect during pressing is almost impossible, and therefore in practice, it is normal to accept a lower grade. Consequently, the assessment of seam puckering is essential, such that the final product will be acceptable to the client [8].

Seam pucker is also described as a differential shrinkage that happens throughout the seam and is caused by the instability of the seam. Usually, wrinkling appears due to improper selection of stitching type and material, leading to an unequal fabric lengths that are sewn together and affecting the appearance. In serious cases, puckering can look as a wave coming from the seams. Since sewing is subjected to tensions, it produces a stretching of threads, leading to an extension over the whole fabrics.(9, 10)

Sewing threads usually have a controlled elasticity, they are overstretched when large tensions are implied in process. threads tend to relax after sewing,, trying to return to the original length. As the stitches shrink, wrinkles appear in the material and cannot be detected immediately. The threads must also have a good stability to washing and ironing, as differential shrinkage between sewing thread and fabrics may cause puckering.(11, 12,13)

Fabric density and structure affect seam stability and puckering. By stitching, threads snap the fiber material into a new position and tending to change it. This is more obvious when the fabric is made of fine, dense and low resistance to compression yarns. puckers may occur due to feeding failure In the case of differences in fiber composition,, structure, extensibility and stability. to avoid this situation,, we must adjust the presser foot pressure to a minimum value. In order to reduce puckering, sewing machine and stitching parameters must be adjusted.(14,15)

In the case of the sewing machine, the stitching step should be as small as possible, while the value of cutting and sewing angle must be correlated with yarn and fabric structure.

Puckers can be decreased or avoided by using a similar fabric fiber composition thread with thermo stability, low elongation and recovery.(16, 17)

Puckering can be caused when one of the components sewn into a seam (shell fabric, interlining, zipper tapes, stay tapes and the thread) shrinks at a different rate than the other components. All these components should have minimum shrinkage to produce the flattest pucker-free seam.(18, 19)

2. Experimental Work

2.1. Tested fabrics specifications

Three samples (100% bamboo, 70:30 bamboo:viscose, 95:5

bamboo: spandex) knitted fabrics were produced Single Jersey. Table (1) shows the specifications of the tested fabrics .



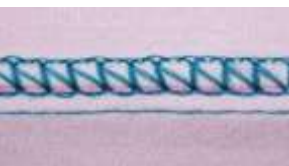

Table 1: Specifications of the tested fabrics

No	Fabrics	Density		Weight g/m ²	Thickness m.m
		Courses/ inch.	Wales/ inch.		
1	100% bamboo	53	36	1.34	0.05
2	70:30 bamboo:viscose	44	35	2.34	0.22
3	95:5 bamboo: spandex	80	42	3.67	0.372

2.2. Stitch types

Fabrics are sewing by 4 difference stitches for fabrics in warp and weft (3 thread overlock 503, 4 thread overlock 504, 5 thread overlock 505, Coverstitch 602).using 80 round needle, 120 polyester corespun for thread sewing, by Singer machine. These stitching methods are shown in table 2.

Stitch and seam construction. Table 2.

Stitch type	Stitch Description	Seam appearance
503	Formed by 1 needle thread and 1 looper thread producing a purl on the edge of the seam. Use: serging or blindhemming.	
504	Formed by 1 needle thread and 2 looper threads producing a purl on the edge of the seam. Use: overedge seaming and serging	
505	Formed by 1 needle thread and 2 looper threads forming a double purl on the edge of the seam. Use: serging with Double purl on Edge	
602	Formed with 2-needle threads, a top cover thread and a bottom looper thread. uses: Binding A Shirts, Infants Clothing, etc.	

2.3. Experimental tests. (25)

Some physical factors determining the functional properties of textiles were tested. All tests were done in conditioned atmosphere of 20°C ± 2 and 65% ± 2 RH. These properties were weight, thickness, abrasion resistance, pilling, Stiffness and seam pucker.

- 1) **Weight of fabric** measurements were carried out according to ASTM Standards .D1910-64(1970).
- 2) **Thickness of fabric** measurements were carried out according to ISO5084.
- 3) **Abrasion resistance** test was carried out on Taber 515

Abrasion Tester, according to the (ASTM 3884).

- 4) **Hairness** test was carried out by using ICI Pilling Box Tester, according to (BS 5811: 1986).
- 5) **Stiffness** test was carried out according to American Standard Specifications of (A.S.T.M. D1388).
- 6) **Wettability** test was carried out according to AATCC 79:2000.
- 7) **Seam thickness** measurements were carried out according to ISO5084.
- 8) **Seam pucker.** (22, 23)

This method is based of measurement of fabric thickness. The increase of thickness can be used as an indicator of the extent of puckering layers from fabric plane. The thickness of unpuckered fabric seam equals the addition of thickness of individual.

$$SP\% = \frac{(L - L_s)}{L_s} \times 100$$

Where SP is seam pucker %, *l* = length of unraveled fabric, *l_s* = length of sewn assembly. This method though considered better than subjective evaluation, but suffers the limitation like more time consumption and inconsistency.

3. Results and Discussion

3.1. Properties of tested fabrics

Results of experimental examination on the produced samples are presented in the following tables and graphs. Results were statically analyzed for data listed, table 3.

Table 3: The Measurements for fabrics

No	Fabrics type	wettability Sec	Hairness After 5000 R	Stiffness gm/cm	Abrasion Resistance (%)
1	100% bamboo	9	4	0.5	130
2	70:30 bamboo:viscose	7.8	0.75	1	203
3	95:5 bamboo: spandex	22.5	0.33	1.25	357

Table 4: One-way ANOVA of The Measurements for fabrics

Property	df	F	P-value	F _{critical}
Abrasion resistant	2	2874.293	8.17E-17	3.885294
Stiffness	2	63	5.1E-06	4.256495
Hairness	2	129.935	1.15	5.143253
Wettability	2	2301.705	2.21E-09	5.143253
Seam pucker	2	3.744015	0.040677	3.4668
Seam thickness(mm)	2	168.476	1.17	3.4668

3.1.1. Abrasion resistance

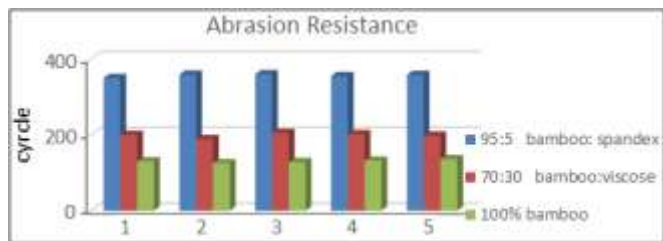


Figure 1: Abrasion Resistance

The fabrics were tested for abrasion resistance using Taber 515 Abrasion Tester testing and the values are given in Table 3.

Figure 1 shows the abrasion resistance behavior of the fabrics. The fabric mass per square meter and fabric thickness that are the main structural properties of fabrics have an effect on abrasion resistance. Higher values of these factors ensure higher abrasion resistance. (1, 20)

These results follow the order: bamboo\ spandex> bamboo\viscose> bamboo.

It can be noticed that bamboo\ spandex has the highest abrasion resistance when compare with another fabric. Also bamboo\ spandex has the highest weight and thickness results when compared to another fabric as shown in table 1. It can be noticed that bamboo fabric give highest abrasion resistance when blended with spandex and viscose fabric and the best abrasion resistant result for bamboo when blended spandex. There is a significant difference in abrasion resistant characteristics of these fabrics because p-value (8.17)>0.05 due to blend composition and F values (2874.3) greater than F critical (3.885). Table 4

3.1.2. Hairiness

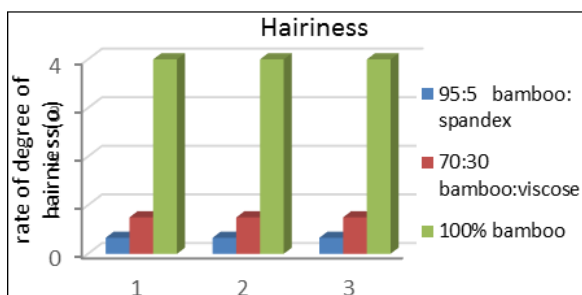


Figure 2: Hairiness

The fabrics were tested for hairiness using ICI Pilling Box Tester and the values are given in Table 3.

Figure 2 shows the hairiness behavior of the fabrics.

These results are follows the order: bamboo\ spandex> bamboo\viscose> bamboo.

It can be noticed that bamboo\ spandex has the lowest hairiness when compare with another fabric.

It can be noticed that, this result may be attributed to higher hairiness of 100% bamboo fabric. But when blended with spandex and viscose fabric the lowest hairiness result for

bamboo when blended spandex because Greater the hairiness, higher the tendency of hairiness because of easier pull out hairs from the yarn bundle. Natural fabrics shed loose fibers easier than man-made fabrics. Man-made fabrics are extremely tight and strong so loose fibers are secured to the fabric. Natural fabrics are not as tight, so loose fibers can easily escape from the fabric without pilling.

-Synthetic fabrics are more susceptible to hairiness than natural fabrics because fabrics have low abrasion resistance as compared to those fabrics.(19, 20)

There is a significant difference in hairiness characteristics of these fabrics because p-value (1.15)>0.05 due to blend composition and F values (65535) greater than F critical (5.143253). Table 4.

3.1.3. Stiffness

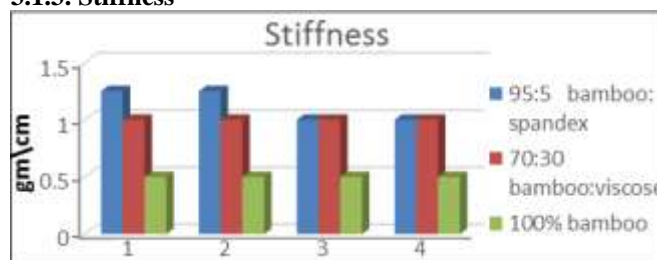


Figure 3: Stiffness

The fabrics were tested for Stiffness the values are given in Table 3. Figure 3 shows the Stiffness behavior of the fabrics. The result follows the order: bamboo\ spandex> bamboo\viscose> bamboo.

It can be noticed that bamboo\ spandex has the highest Stiffness when compare with another fabric.

It can be noticed that bamboo fabric give highest Stiffness when blended with spandex and viscose fabric and the best Stiffness result for bamboo when blended spandex because Fabric has a smooth surface that gives it the lowest stiffness, bamboo has smooth surface when compare with another fabric, and the fabric mass per square meter and fabric thickness that are the main structural properties of fabrics have an effect on stiffness. Higher values of these factors ensure higher stiffness. (1, 19)

There is a significant difference in stiffness characteristics of these fabrics because p-value (5.1)>0.05 due to blend composition and F values (63) greater than F critical (4.256495). Table 4.

3.1.4 Wettability

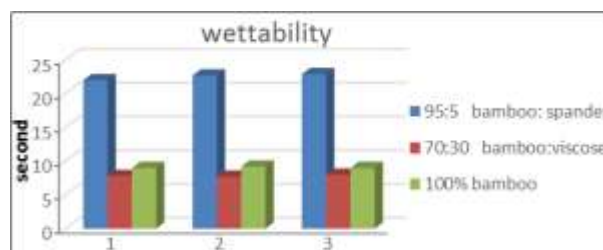


Figure 4: Wettability

The fabrics were tested for wettability the values are given in Table 3.

Figure 4 shows the wettability behavior of the fabrics.

These results are follows the order: bamboo\viscose> bamboo> bamboo\ spandex.

It can be noticed that bamboo\ viscose has the highest wettability when compare with another fabric. It can be noticed that bamboo fabric give highest wettability when blended with viscose fabric when compare with 100% bamboo fabric, bamboo fabric give lowest wettability when blended with spandex when compare with 100% bamboo fabric.

Because the changes of fabric thickness would affect the absorption water/moisture. the fabric mass per square meter and fabric thickness that are the main structural properties of fabrics have an effect on wettability. Higher values of these factors ensure higher wettability. (22, 23)

There is a significant difference in wettability characteristics of these fabrics because p-value (2.21)>0.05 due to blend composition and F values (5.143253) greater than F critical (2301.705). Table 4.

3.2 Properties of sewing clothes made of tested fabrics

3.2.1 Evaluation of seam puckering

Table 5: The effect of fabrics type on seam pucker

type of stitch	direction	100% bamboo	Bamboo \viscose 70\30	Bamboo \spandex 95\ 5
503(stitch A)	warp	2.36%	1.01%	1.35%
	weft	2.36%	1.79%	1.06%
504(stitch B)	warp	2.38%	2.72%	1.35%
	weft	2.67%	1.11%	1.55%
505(stitch C)	warp	1.49%	1.09%	1.14%
	weft	1.21%	1.39%	1.12%
602(stitch D)	warp	1.43%	1.21%	1.07%
	weft	1.17%	0.81%	1.01%

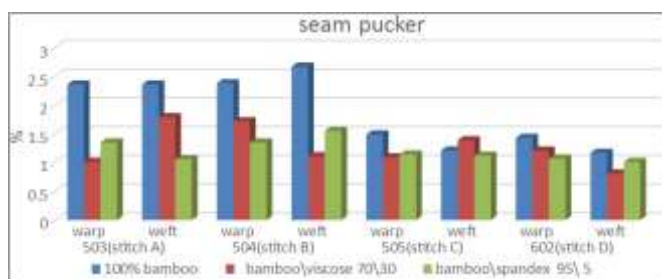


Figure 5: Seam pucker

The data of seam puckering (SP %) for tested fabrics as show in figure 5 and table 5 indicates to little decrease SP% for bamboo blended with(viscose and spandex) fabrics when compare with 100% bamboo at warp and weft direction This can be attributed.

Bamboo blended with (viscose and spandex) fabrics are the best result SP%. There is a significant difference in seam puckering % (SP %) characteristics of these fabrics because

p-value (0.06)>0.05 due to blend composition and F values (3.744015) greater than F critical (3.6678). Table 4.

3.2.2. seam thickness.

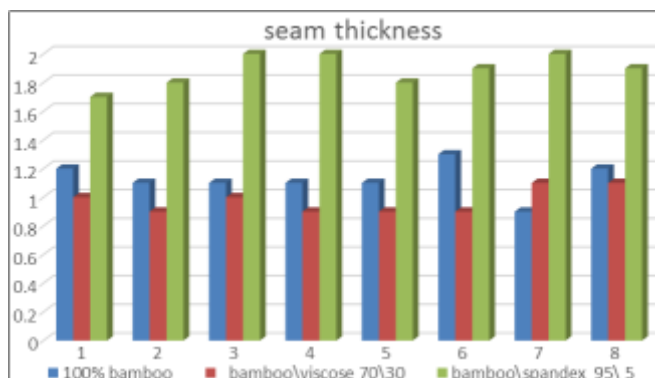


Figure 6: seam thickness

Stitches: A, B, C and D give nearly seam thickness results. The thickness of tested fabrics were the different results between the tested fabrics as shown in table 1., it was found that seam thickness differs as shown in figure 6, This can be attributed to the kind of stitches, in addition bamboo blended with spandex fabrics increase seam thickness when compare with 100% bamboo and bamboo \viscose at warp and weft direction, seams become more compact and for then thicker. There is a significant difference in seam thickness characteristics of these fabrics because p-value (1.17)>0.05 due to blend composition and F values (168.476) greater than F critical (3.4668). Table 4.

3.2.3. Seam Type Effects

The results obtained with respect to seam type effects of fabrics are represented in figure 6, seam type effects of fabrics, these results are nearly between 100% bamboo and bamboo\ viscose.

Cover stitch 602(stitch B) is the best type of stitch can use for sewing clothes made of bamboo when compare with stitches A, B and D. 5 thread overlock 505(stitch C) is the best type of stitch can use for sewing clothes made of bamboo\viscose. 4 thread overlock 504(stitch A) is the best type of stitch can use for sewing clothes made of bamboo\spandex.

4. Conclusion

Children's wear always look for new products and better substitutes fabrics. This study reports an investigation of the effect of the blend-ratio of bamboo fabric on the durability properties and its clothing of single jersey knitted fabrics composed of them.

Three fabric samples were produced (100% bamboo, 70:30 bamboo: viscose, 95:5 bamboo: spandex). Each of the yarns so produced was converted to single jersey knitted fabrics. The following are the conclusions derived from this study: bamboo\ spandex> bamboo\viscose> bamboo.

1) It can be noticed that bamboo\ spandex has the highest abrasion resistance when compared with other fabrics.

- 2) Bamboo\ spandex> bamboo\viscose> bamboo, It can be noticed that bamboo\ spandex has the lowest hairiness when compared with other fabrics.
- 3) Bamboo\ spandex> bamboo\viscose> bamboo, It can be noticed that bamboo\ spandex has the highest Stiffness and wettability when compared with other fabrics. -
- 4) Little decrease SP% for bamboo blended with (viscose and spandex) fabrics when compare with 100% bamboo at warp and weft direction.
- 5) Bamboo blended with (viscose and spandex) fabrics are the best result SP%.
- 6) Bamboo blended with spandex fabrics increase seam thickness when compare with 100% bamboo and bamboo \viscose at warp and weft direction
- 7) 4 thread overlock 504(stitch A) is the best type of stitch can be used for sewing clothes made of bamboo\spandex.

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