Research Article

Dimensional Characteristics of Knitted Fabrics Made from 100% Cotton and Cotton/Elastane Yarns

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The dimensional characteristics such as loop length (l), wales per centimeter (wpc), courses per centimeter (cpc), stitch density (s), tightness factor (K), loop shape factor (R) and take-up rate (T) of single jersey, 1x1rib, 1x1 interlock, single pique, and two-thread fleece knitted fabrics made from 100% cotton and cotton/elastane yarns (5% elastane yarn content) are investigated in this research. Dimensional properties of knitted fabrics are an important property and determine the materials consumption during production, productions parameter, and applications of different knitted structures. The sample fabrics have been conditioned for 24 hours at 20±1°C temperature and 65±2% relative humidity. The specimens used for sampling are determined as per the test standards described in the paper for each yarn type, property, and structure. As observed in the result, the properties are related to each other. It is found that the loop length, wpc, cpc, stitch density, tightness factor, loop shape factor and take-up rate of single jersey, 1x1rib, 1x1interlock, single pique, and two-thread fleece knitted fabrics made from 100% cotton and cotton/elastane yarns are significantly influenced by the presence of an elastane yarn. The loop length of single jersey, 1x1rib, and interlock knitted fabrics made from elastane yarns reduced while the single pique and fleece increased. Similarly, other dimensional properties are significantly influenced by the yarn types used during knitting.

1. Introduction

Knitted fabrics are produced by interlooping of yarns and showed increasing demand for their shape fitting, smoothness, flexibility, elasticity, and good elastic recovery. But, all knitted fabrics may not have these properties equally. These properties are determined by raw material types and characteristics, knitting machine parameters, and type of knit structures. The knitted fabrics are textile structures made of elastic interconnected stitches and characterized by two perpendicular directions, the direction of stitches courses on the direction of stitches courses in vertical direction[1].

Knitted goods of all kinds are generally popular because of their flexibility and ability to adapt as well as stretch them to a particular shape when worn and because of their general comfortable wear. The dimensional stability of knitted structures from mostly conventional yarns together with other physical properties has been one of the most extensively discussed subjects in research [2–4]. The dimensional stability of the knitted fabrics is reflected in the capability of

the products made from spandex, of maintaining the shape and dimensions in the predetermined limits, after several cycles of washing-wearing process [5].

The generic name "spandex" as defined by FTC is "A manufactured fiber in which fiber forming substance is a long chain synthetic polymer comprised of at least 85% of a segmented polyurethane" [6]. The name "spandex" is the anagram of the word expands [7]. Chemically, spandex is synthetic linear macromolecule with a long chain containing alternating hard and soft segments linked by [– NH – CO – O –] urethane bonds. The soft structure is of polyurethane block copolymer which delivers elasticity to fiber, while hard chain segment contributes molecular interaction force to fiber which confirms fiber strength and long term stability [8]. Elastane is used in all areas where a high degree of permanent elasticity is required, for example, in tights, sportswear, swimwear, corsetry, and woven and knitted fabrics. Elastane is a prerequisite for fashionable or functional apparel, intended to cling to the body making it remain comfortable. Worldwide spandex consumption and growth

is 30-40 % per year and is expected to grow high. Asian countries have a share of nearly 60% of world consumption and contribute 25% of worldwide spandex growth per year [9]. The important loop dimensions are loop length, loop width (wale spacing), and loop height (course spacing). Besides the loop dimensions, which have a great effect on fabric quality and the physical, mechanical, and dimensional properties of the cotton single jersey knitted fabric, there are the machine gauge, needle type, cam type, yarn feeding system, number of feeders, take down system, cloth rolling or spreading, monitoring and control systems, etc. [10–12].

Reference [13] investigated the dimensional and physical properties of cotton/spandex single jersey fabrics and compared the results with fabrics knitted from cotton alone. It was apparent that as the amount of spandex increased the loop length value remained nearly the same and the course and wale spacing decreased.

As the Lycra extension percent reached 232% in the case of the half plating fabrics, the course density increased by 40% and the wale density increased by 6% [14–16]. The results obtained in the present work indicated that the amount of elastane has a significant effect on dimensional and elastic properties of cotton/elastane plated plain knitted fabric [17].

Textured threads increase thickness and area density of knits. Higher course and wale densities have knits plated with elastane thread under the same machine set stitch lengths (due to yarn relaxation) than knits from pure yarns. Loop length becomes shorter and density of knit increases so knit is more tightened and heavier [2, 14].

As reviewed in different literatures, the researchers study the effect of elastane yarn on single jersey knitted fabrics only. These may not help conclude effect of elastane on other knitted fabrics, those produced on two sets of needles and others produced as derivatives of single jersey. In this research single jersey, single pique, two-thread fleece, 1x1rib, and 1x1interlock knitted fabrics made from 100% cotton and cotton/elastane yarns are investigated for their some of dimensional properties.

2. Material and Experiments

2.1. Materials. 100% cotton and cotton/elastane blend yarns are used for this study. An elastane accounts for about 5% contents (40denier = 133Ne) while cotton accounts for 95% content (35Ne) in the 28Ne combed cotton/elastane blended yarn (cotton/elastane = 95/5%) and an elastane yarn is fed to the needles as naked filament with the cotton yarn in the same yarn feeder (carrier) but is neither plied nor core spun with cotton. Cotton fiber harvested from Upper Awash-Ethiopia has 28 mm staple lengths, 12.8 short fiber index, 300 neps, 4.06 trash percent, and 4.2 micronaire fineness. The yarns used for this study are 100% cotton and cotton/elastane blended. The cotton yarn has $750m^{-1}$ twist, 28 Ne count, 9.21% U%, 11.70 CVM, 0 thin-50%, 33.6 thick+50%, 29.8 Neps+200%, and 63.4 total imperfection percent. The single jersey, single pique, and two-thread fleece are produced by the single-bed circular knitting machine with 30 rpm, 34" diameter, 2976 needles, 4 cam tracks, and 108 feeders. 1x1Rib/interlock is produced by double-bed circular knitting

machine with 20/14 rpm, 30" diameter, 2630 needles, 94/112 feeders, and 1/2 cam tracks, respectively. The study was carried out by keeping these materials and their parameters constant except for the yarn's (raw material type).

In the single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics, the loop lengths were set equal in the knitting machine. But, during the knitting process the fabrics will have different loop lengths due to transferring of the loop and staying idle in the rib and interlock knitting machines and the floats at the technical back of fleece knitted fabrics. There are 28 needles per inch in a cylinder in single jersey, single pique, and fleece. In 1x1rib knitting machines there are 18 needles per inch in cylinder and 18 needles per inch in dial. In interlock knitting machines there are 24 needles per inch in cylinder and 24 needles per inch in dial. The working principle and arrangement of needles in 1x1rib and interlock knitting machines are different in gaiting [18].

2.2. Experiments. Single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics were produced for this study. Loop length, wales per centimeter (wpc) and courses per centimeter (cpc) of single jersey, 1x1rib, interlock, single pique, and two-thread fleece knitted fabrics made from 100% cotton and cotton/elastane yarns have been measured using crimp tester (loop length) and pick glass (wpc and cpc). Other properties such as stitch density, tightness factor, loop shape factor, and take-up rate of knitted fabrics are calculated from measured properties of knitted fabrics.

(i) The yarn properties such as U% (irregularity), CVM (coefficient of variation in mass), thin and thick places, and the amount of Neps in cotton yarn are tested using Uster tester 5 machine and Uster testing standards.

(ii) The loop length, wpc and cpc of single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics have been measured using crimp tester and pick glass, respectively.

(iii) The stitch density of these fabrics is calculated from the measured results of wpc and cpc. So, *Stitch density* (S) = wpc * cpc.

(iv) The tightness factors of knitted fabrics are calculated from the measured results of yarn count (Tex) and loop length (l). So, *Tightness factor* $(k) = \sqrt{Tex}/l$.

(v) The loop shape factors of single jersey, 1x1rib, interlock, single pique, and two-thread fleece knitted fabrics are calculated from the measured result of course per unit length (cpc) and wales per unit length (wpc). So, *Loop shape factor* (R) = cpc/wpc.

(vi) Take-up rates of knitted fabrics are calculated from the measured and calculated results of loop length (l) and loop pitch. So,
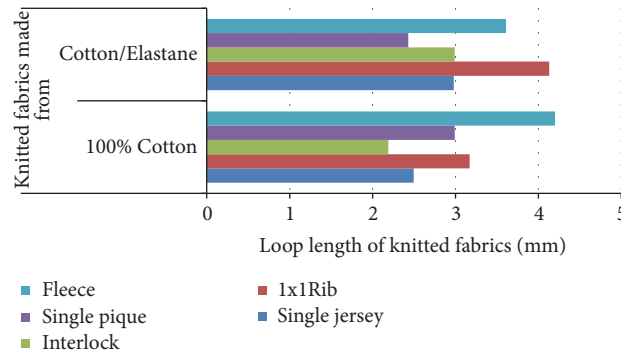
$$Take-up\ rate\,(T) = \frac{l}{loop\ pitch} \tag{1}$$

FIGURE 1: Loop lengths of knitted fabrics made from 100% cotton and cotton/elastane yarns.

$$loop\ pitch = \frac{1}{cpc * wpc}, \tag{2}$$

$$cpc * wpc = s\,(stitch\ density)$$

$$T = \frac{l}{s} \tag{3}$$

3. Result and Discussion

3.1. Knitted Fabric Loop Length. Loop length of single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics has been studied and the results are shown in Figure 1.

As shown in Figure 1, the loop length of single jersey, 1×1rib, interlock, single pique, and fleece knitted fabrics made from 100% cotton and cotton/elastane (95/5%) blended yarns is different. Single jersey, 1x1rib, and interlock knitted fabrics made from 100% cotton have lower loop length as compared to the same fabrics made from cotton/elastane blended yarn while single pique and fleece knitted fabrics made from 100% cotton have higher loop length as compared to the same fabrics made from cotton/elastane blended yarns. The loop length of 1x1rib knitted fabric made from cotton/elastane yarn is the highest as compared to other knitted fabrics made from the same yarns while fleece made from 100% cotton has the highest loop length as compared to other fabrics made from the same yarns. This is because in 1x1rib knitted fabrics the yarn is pulled by two needles in opposite directions. Though the pulling forces applied to the yarn are equal the two yarns are not pulled equally with the same amount of force. With this regard cotton/elastane yarn gives high loop length in 1x1rib knitted fabrics as compared to the other knitted fabrics made from the same yarns, but this is not working for interlock because interlock is made when two 1x1rib loops are locked together to form a four-loop interlock. The lowest loop length is observed in two-thread fleece knitted fabrics made from cotton/elastane blended yarn. This is because in two-thread fleece knitted fabrics two threads are floating at the technical back of the fabrics which limits the loop length from the main thread (ground thread).

In Table 1, the mean, standard deviation, standard error, and minimum and maximum values of the test specimens are shown. The standard deviations of all sampled fabrics made from 100% cotton and cotton/elastane are similar with slight deviations from their mean. This shows that the values in a statistical data set are closest to the mean of the data set, on average.

The loop length of single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics mean differences are significant at 0.05 levels. As shown in Table 2, the loop length of single jersey is significantly influenced by the presence of 5% elastane in the Upper Awash combed cotton yarn (F = 6.309; Sig. = 0.022000). 1x1Rib (F = 9.026; Sig. = 0.008000), interlock (F = 442.312; Sig. = 0.000000), single pique (F = 7.649; Sig. = 0.013000), and fleece (F = 30704.168; Sig. = 0.000000) knitted fabrics are significantly influenced by elastane yarns. Fleece has the greatest F-value as compared to other knitted fabrics, and this shows that fleece has a high dispersion rate as compared to other knitted fabrics.

3.2. Wales and Courses Per Unit Length. The wales and courses per unit length of single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics have been studied and the results are shown in Figures 2 and 3. The wales and courses per unit length of these fabrics were measured using pick glass to count the course per centimeter and wales per centimeter and abbreviated as cpc and wpc, respectively.

As shown in Figures 2 and 3, the wpc and cpc of single jersey, 1×1rib, interlock, single pique, and fleece knitted fabrics made from 100% cotton and cotton/elastane (95/5%) blended yarns are different. Single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics made from 100% cotton have lower wpc as compared to the same fabrics made from cotton/elastane blended yarn. The wpc of interlock knitted fabric made from cotton/elastane yarn is the highest as compared to other knitted fabrics made from the same yarn while two-thread fleece made from cotton/elastane has the lowest wpc as compared to other knitted fabrics made from the same yarns. Similarly, the cpc of single jersey made from both 100% cotton and cotton/elastane yarns is the highest as compared to the other fabrics made from the same materials. Interlock knitted fabric has the lowest cpc as compared to other knitted fabrics because the interlock knitted fabric is made when two 1x1rib structures locked together.

The wpc of single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics is increased due to the presence of 5% elastane in 95% cotton yarns as compared to the same

TABLE 1: Description for loop lengths of knitted fabrics made from 100% cotton and cotton/elastane yarns.

		N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
	95.00	10	2.9820	.05712	.01806	2.86	3.05
Loop length of single jersey	100.00	10	3.0360	.03688	.01166	3.00	3.09
	Total	20	3.0090	.05438	.01216	2.86	3.09
	95.00	10	4.1270	.97313	.30773	3.49	5.55
Loop length of 1x1rib	100.00	10	3.1710	.25614	.08100	3.09	3.90
	Total	20	3.6490	.84862	.18976	3.09	5.55
	95.00	10	2.9880	.02251	.00712	2.95	3.03
Loop length of interlock	100.00	10	2.1910	.11770	.03722	2.04	2.33
	Total	20	2.5895	.41709	.09326	2.04	3.03
	95.00	10	2.4350	.63458	.20067	.63	2.66
Loop length of pique	100.00	10	2.9900	.00000	.00000	2.99	2.99
	Total	20	2.7125	.52135	.11658	.63	2.99
	95.00	10	3.6130	.01059	.00335	3.60	3.63
Loop length of fleece	100.00	10	4.2000	.00000	.00000	4.20	4.20
	Total	20	3.9065	.30121	.06735	3.60	4.20

TABLE 2: Analysis of variances of knitted fabrics loop length made from 100% cotton and cotton/elastane.

		Sum of Squares	Df	Mean Square	F	Sig.
	Between Groups	.015	1	.015	6.309	.022
Loop length of single jersey	Within Groups	.042	18	.002		
	Total	.056	19			
	Between Groups	4.570	1	4.570	9.026	.008
Loop length of 1x1rib	Within Groups	9.113	18	.506		
	Total	13.683	19			
	Between Groups	3.176	1	3.176	442.312	.000
Loop length of interlock	Within Groups	.129	18	.007		
	Total	3.305	19			
	Between Groups	1.540	1	1.540	7.649	.013
Loop length of pique	Within Groups	3.624	18	.201		
	Total	5.164	19			
	Between Groups	1.723	1	1.723	30704.168	.000
Loop length of fleece	Within Groups	.001	18	.000		
	Total	1.724	19			

fabrics made from 100% cotton. But, cpc of some of the fabrics such as interlock and 1x1rib is reduced and cpc of some of the fabrics such as single jersey, single pique, and fleece is increased due to the presence of 5% elastane yarn in 95% cotton yarn. This is due to the high shrinkage rate differences of these fabrics due to the presence of elastane yarns in the structures.

The ascending order of wpc of the five knit structures made from cotton/elastane blended yarns is two-thread fleece, single pique, single jersey, 1x1rib, and interlock knitted fabrics (see Figure 2) while fleece, 1x1rib, single pique, interlock, and single jersey is an ascending order wpc of knitted fabrics made from 100% yarn. An ascending order of cpc of knitted fabrics made from 100% cotton and cotton/elastane blended yarns is interlock, 1x1rib, single pique, fleece, and single jersey. In Tables 3 and 4, the mean, standard deviation, standard error, and minimum and maximum values of test

specimens are shown. The standard deviations of all sampled fabrics made from 100% cotton and cotton/elastane are similar with slight deviations from their mean. This shows that the values in a statistical data set are closest to the mean of the data set, on average.

The wpc and cpc of single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics mean differences are significant at 0.05 levels. As shown in Table 5, the wpc of single jersey is significantly influenced by the presence of 5% elastane in the Upper Awash combed cotton yarn (F = 222.618; Sig. = 0.000000). 1x1Rib (F = 874.975; Sig. = 0.000000), interlock (F = 611.861; Sig. = 0.000000), single pique (F = 859.260; Sig. = 0.000000), and fleece (F = 674.165; Sig. = 0.000000) knitted fabrics are significantly influenced by elastane yarns. Fleece has greater F-value as compared to other knitted fabrics which shows that fleece has a high dispersion rate as compared to other knitted fabrics.
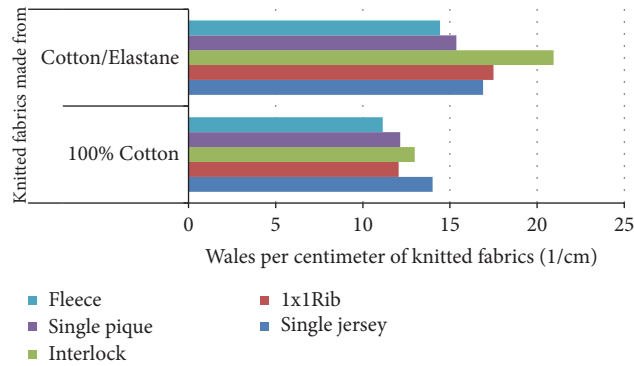
FIGURE 2: Wales per centimeter of knitted fabrics made from 100% cotton and cotton/elastane yarns.
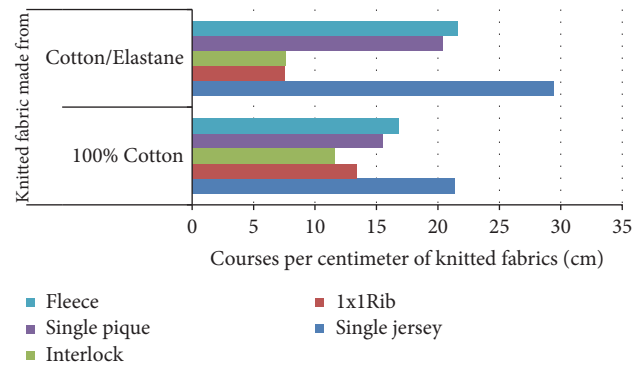

FIGURE 3: Courses per centimeter (cpc) of knitted fabrics made from 100% cotton and cotton/elastane yarns.

As shown in Table 6, the cpc of single jersey is significantly influenced by the presence of 5% elastane in the Upper Awash combed cotton yarn (F = 1026.939; Sig. = 0.000000). 1x1Rib (F = 765.224; Sig. = 0.000000), interlock (F = 334.884; Sig. = 0.000000), single pique (F = 421.299; Sig. = 0.000000), and fleece (F = 414.720; Sig. = 0.000000) knitted fabrics are significantly influenced by elastane yarns. Single jersey has the highest F-value as compared to other knitted fabrics which shows that single jersey has a high dispersion rate as compared to other knitted fabrics.

3.3. Stitch Density. The stitch density per unit area of single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics has been studied and the results are shown in Figure 4.

As shown in Figure 4, the stitch density of single jersey, 1×1rib, interlock, single pique, and fleece knitted fabrics made from 100% cotton and cotton/elastane (95/5%) blended yarns is different. Single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics made from 100% cotton have the lowest stitch density as compared to the single jersey, single pique, and fleece made from cotton/elastane blended yarn. 1x1Rib and interlock knitted fabrics made from cotton/elastane yarn have the lowest stitch density as compared to other fabrics made from the same materials. This is because cpc of 1x1rib and interlock are lower than other fabrics made from cotton/elastane yarns.

The presence of 5% elastane yarn in 95% cotton yarn influences the stitch density of knitted fabrics. The stitch density single jersey, single pique, and fleece knitted fabrics increased due to the presence of 5% elastane in 95% cotton yarns whereas the stitch density of 1x1rib and interlock knitted fabrics decreased. An ascending order of stitch density of knitted fabrics made from cotton/elastane blended yarns is 1x1rib, interlock, single pique, fleece, and single jersey.

3.4. Tightness Factor. The tightness factor of single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics has been studied and the results are shown in Figure 5.

The tightness factor of single jersey, 1×1rib, interlock, single pique, and fleece knitted fabrics made from 100% cotton and cotton/elastane (95/5%) blended yarns is different. The two-thread fleece and 1x1rib knitted fabrics made from 100% cotton and cotton/elastane blended yarns have the lowest stitch density as compared to other fabrics made from the same yarns. Interlock knitted fabric made from 100% cotton is the tightest as compared to other fabrics made from 100% cotton and cotton/elastane yarns. The tightness factor of knitted fabrics had a different influence due to the presence of 5% elastane yarns in the 95% cotton yarns. The tightness of interlock, single jersey, and 1x1rib knitted fabrics decreased with cotton/elastane yarns while single pique and two-thread fleece knitted fabrics increased with the same yarn.

3.5. Loop Shape Factor. The loop shape factor of single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics has been studied and the results are shown in Figure 6.

Table 3: Description for wpc of knitted fabrics made from 100% cotton and cotton/elastane yarns.

		N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Wales per centimeter of single jersey	95.00	10	16.9000	.39441	.12472	16.50	17.50
	100.00	10	14.0000	.47140	.14907	13.50	14.50
	Total	20	15.4500	1.54664	.34584	13.50	17.50
Wales per centimeter of 1x1rib	95.00	10	17.5000	.52705	.16667	17.00	18.00
	100.00	10	12.0600	.24585	.07775	11.80	12.50
	Total	20	14.7800	2.81922	.63040	11.80	18.00
Wales per centimeter of interlock	95.00	10	20.9400	1.00687	.31840	20.00	23.00
	100.00	10	12.9800	.14757	.04667	12.80	13.20
	Total	20	16.9600	4.14302	.92641	12.80	23.00
Wales per centimeter of pique	95.00	10	15.3700	.30569	.09667	15.00	15.80
	100.00	10	12.1500	.16499	.05217	12.00	12.40
	Total	20	13.7600	1.66904	.37321	12.00	15.80
Wales per centimeter of fleece	95.00	10	14.4300	.31640	.10006	14.00	14.90
	100.00	10	11.1400	.24585	.07775	10.90	11.60
	Total	20	12.7850	1.71012	.38239	10.90	14.90

Table 4: Description for the cpc of knitted fabrics made from 100% cotton and cotton/elastane yarns.

		N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Courses per centimeter of single jersey	95.00	10	29.4500	.43780	.13844	29.00	30.00
	100.00	10	21.3500	.66875	.21148	20.00	22.00
	Total	20	25.4000	4.19147	.93724	20.00	30.00
Courses per centimeter of 1x1rib	95.00	10	7.5000	.47140	.14907	7.00	8.00
	100.00	10	13.3500	.47434	.15000	13.00	14.00
	Total	20	10.4250	3.03608	.67889	7.00	14.00
Courses per centimeter of interlock	95.00	10	7.6000	.51640	.16330	7.00	8.00
	100.00	10	11.6000	.45947	.14530	11.00	12.00
	Total	20	9.6000	2.10638	.47100	7.00	12.00
Courses per centimeter of pique	95.00	10	20.3500	.57975	.18333	20.00	21.50
	100.00	10	15.5000	.47140	.14907	15.00	16.00
	Total	20	17.9250	2.54059	.56809	15.00	21.50
Courses per centimeter of fleece	95.00	10	21.6000	.45947	.14530	21.00	22.00
	100.00	10	16.8000	.58689	.18559	16.00	17.50
	Total	20	19.2000	2.51522	.56242	16.00	22.00

Table 5: Analysis of variances of knitted fabrics wpc made from 100% cotton and cotton/elastane yarns.

		Sum of Squares	Df	Mean Square	F	Sig.
Wales per centimeter of single jersey	Between Groups	42.050	1	42.050	222.618	.000
	Within Groups	3.400	18	.189		
	Total	45.450	19			
Wales per centimeter of 1x1rib	Between Groups	147.968	1	147.968	874.975	.000
	Within Groups	3.044	18	.169		
	Total	151.012	19			
Wales per centimeter of interlock	Between Groups	316.808	1	316.808	611.861	.000
	Within Groups	9.320	18	.518		
	Total	326.128	19			
Wales per centimeter of pique	Between Groups	51.842	1	51.842	859.260	.000
	Within Groups	1.086	18	.060		
	Total	52.928	19			
Wales per centimeter of fleece	Between Groups	54.120	1	54.120	674.165	.000
	Within Groups	1.445	18	.080		
	Total	55.565	19			

TABLE 6: Analysis of variances of knitted fabrics cpc made from 100% cotton and cotton/elastane yarns.

|		Sum of Squares	df	Mean Square	F	Sig.
Courses per centimeter of single jersey	Between Groups	328.050	1	328.050	1026.939	.000000
	Within Groups	5.750	18	.319		
	Total	333.800	19			
Courses per centimeter of 1x1rib	Between Groups	171.113	1	171.113	765.224	.000000
	Within Groups	4.025	18	.224		
	Total	175.138	19			
Courses per centimeter of interlock	Between Groups	80.000	1	80.000	334.884	.000000
	Within Groups	4.300	18	.239		
	Total	84.300	19			
Courses per centimeter of pique	Between Groups	117.613	1	117.613	421.299	.000000
	Within Groups	5.025	18	.279		
	Total	122.638	19			
Courses per centimeter of fleece	Between Groups	115.200	1	115.200	414.720	.000000
	Within Groups	5.000	18	.278		
	Total	120.200	19			
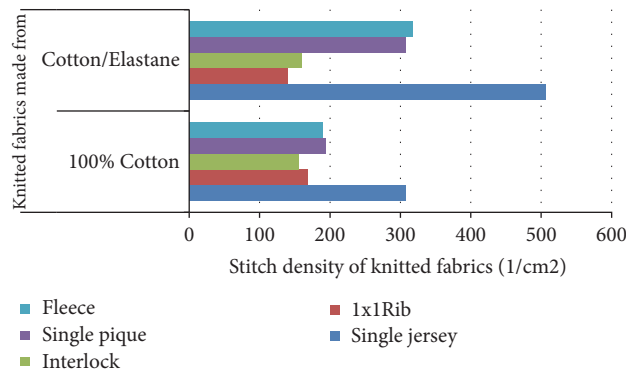
FIGURE 4: Stitch density of knitted fabrics made from 100% cotton and cotton/elastane yarns.
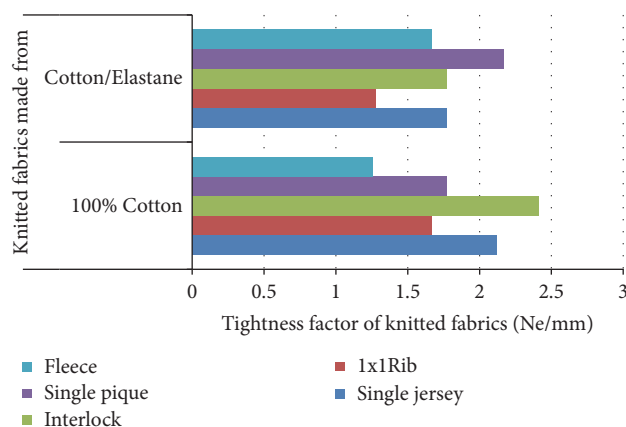

FIGURE 5: Tightness factor of knitted fabrics made from 100% cotton and cotton/elastane yarns.

The loop shape factor of single jersey, 1×1rib, interlock, single pique, and fleece knitted fabrics made from 100% cotton and cotton/elastane (95/5%) blended yarns is different. The loop shape factor of fleece knitted fabric is not changed due to elastane yarn. Interlock and 1x1rib knitted fabric's loop shape factor reduced due to elastane content in cotton yarn. Only single jersey knitted fabric has significant change in increasing due to 5% elastane yarn in 95% cotton while 1x1rib and interlock are decreasing. Single pique shows a slight change in the reduction of loop shape factor because of the
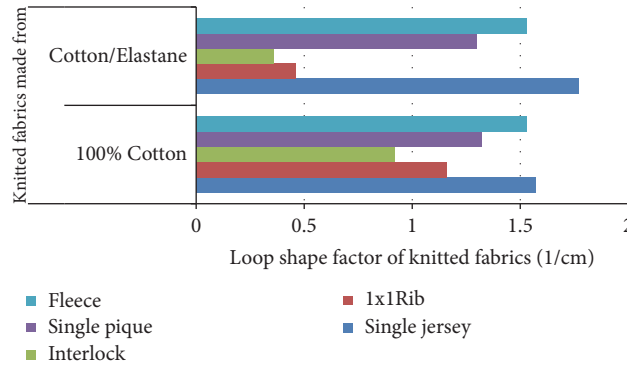
FIGURE 6: Loop shape factor of knitted fabrics made from 100% cotton and cotton/elastane yarns.
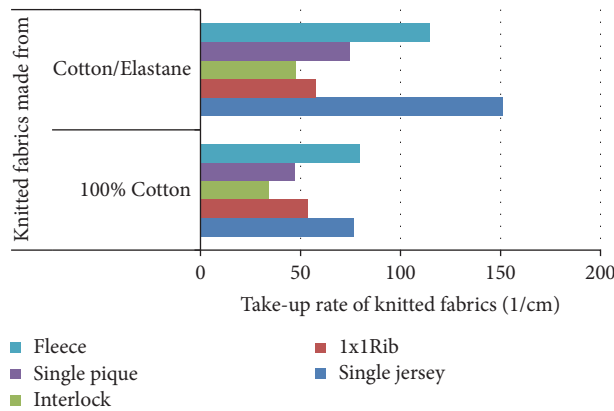

FIGURE 7: Take-up rate of knitted fabrics made from 100% cotton and cotton/elastane yarns.

presence of 5% elastane yarn in 95% cotton. So, the loop shape of knitted fabrics made from 100% cotton and cotton/elastane yarns had a different influence due to structural stability, needle working, and idle time in each structure.

3.6. Take-Up Rate. The take-up rate of single jersey, 1x1rib, interlock, single pique, and fleece knitted fabrics has been studied and the results are shown in Figure 7.

The take-up rate of single jersey, 1×1rib, interlock, single pique, and fleece knitted fabrics made from 100% cotton and cotton/elastane (95/5%) blended yarns is different. The take-up rate of single jersey, 1x1rib, single pique, interlock, and two-thread fleece knitted fabrics made from 100% cotton is lower as compared to the same fabrics made from cotton/elastane blended yarns. Take-up rate of knitted fabrics is inversely proportional to stitch density and directly to loop length. Low take-up rate of knitted fabrics means that knitted fabric is with low loop length and high stitch density and vice versa. An ascending order of take-up rate of knitted fabrics made from cotton/elastane blended yarn is interlock, 1x1rib, single pique, two-thread fleece, and single jersey knitted fabrics.

4. Conclusion

The dimensional characteristics of five knitted structures made from 100% cotton and 95% cotton/5% elastane blended

yarns were studied. As investigated in the results and discussion, the loop lengths of the primary knitted fabrics such as single jersey, 1x1rib, and 1x1interlock knitted fabrics made from cotton/elastane yarn have been increased for the needles were able to frequently receive new loop and release an old loop during knitting. The other fabric properties such as wales per centimeter (wpc), courses per centimeter (cpc), stitch density (s), tightness factor (K), take-up rate (T), and loop shape factor (R) are significantly influenced by the presence of elastane yarns in the knitted fabrics.

The dimensional properties are interrelated to each other. Once the loop length is influenced by the presence of elastane yarns it is obvious that other characteristics are influenced. From this research, it is observed that the other dimensional properties (except take-up rate) are inversely proportional to loop length. wpc and cpc of the knitted fabrics depend on loop length, shrinkage, and action of sets of the needles. On the other hand, stitch density, loop shape factor, and take-up rate of knitted fabrics depend on wpc and cpc in addition to loop length, as shown in the results of this research.

Data Availability

The data used to support the findings of this study are cited in the article.

Conflicts of Interest

Acknowledgments

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