Comparison of the physical properties of woven and warp knitted bathrobe towel fabrics produced with similar properties

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ABSTRACT – REZUMAT

Comparison of the physical properties of woven and warp knitted bathrobe towel fabrics produced with similar properties

In recent years, the use of towel fabrics produced by warp knitting machines in the production of bathrobe fabrics has gradually increased. These fabrics, which can be produced more massively at a lower cost, also show a more flexible character than woven towel fabrics. When working with two pile yarn groups whose raw materials or properties are different from each other, the creation of fabric structures with a completely different face and back is seen among the reasons for choosing these fabrics. In this study, after determining the basic performance characteristics such as weight, tensile strength, tear strength, bursting resistance, shrinkage, and water absorbency of the bathrobe towel fabrics produced with the weaving and warp knitting technique, which has undergone the same finishing processes, their performance and strength properties were compared with each other and the results were evaluated using statistical analysis methods. It has been determined that while woven towel fabrics give higher strength values, warp-knitted towel fabrics show higher stretch. The degree of hydrophilicity degree is increased significantly after sequential finishing processes in both towel fabrics. As a result of the finishing processes, there was a general decrease in the tear strength of the woven bathrobe terry fabric, while there was no systematic decrease in the other strength parameters and the strength properties of the warp-knitted towel fabric. In consequence of the finishing processes in both towel fabric structures, a significant reduction in size was observed in the warp direction.

Keywords: *bathrobe towel fabric, weaving, warp knitting, finishing processes*

Comparația dintre proprietățile fizice ale țesăturilor și tricoturilor din urzeală pentru halatele de baie, produse cu proprietăți similare

În ultimii ani, utilizarea tricoturilor produse de mașinile de tricotat din urzeală în producția de materiale pentru halate de baie a crescut treptat. Aceste materiale, care pot fi produse masiv la un cost mai mic, prezintă, de asemenea, un caracter mai flexibil decât țesăturile. Atunci când se lucrează cu două grupuri de fire de pluș ale căror materii prime sau proprietăți sunt diferite una de cealaltă, crearea unor structuri cu față și spate complet diferite este văzută printre motivele alegerii acestor materiale. În acest studiu, după determinarea caracteristicilor de bază ale performanței, cum ar fi masa, rezistența la tracțiune, rezistența la rupere, rezistența la plesnire, contracția și absorbția apei materialelor tip prosop pentru halate de baie produse prin tehnica de țesere și tricotare din urzeală, care au trecut prin aceleași procese de finisare, proprietățile lor de performanță și rezistență au fost comparate între ele, iar rezultatele au fost evaluate folosind metode de analiză statistică. S-a stabilit că, în timp ce țesăturile pentru prosoape oferă valori mai mari de rezistență, tricoturile din urzeală pentru prosoape prezintă o întindere mai mare. Gradul de hidrofobie este crescut semnificativ după procesele secvenţiale de finisare în cazul ambelor materiale pentru prosoape. Ca urmare a proceselor de finisare, a existat o scădere generală a rezistenței la rupere a țesăturii pentru halate de baie, în timp ce nu a existat o scădere sistematică a celorlalți parametri de rezistență și a proprietăților de rezistență ale tricoturilor din urzeală pentru prosoape. Ca urmare a proceselor de finisare în ambele structuri pentru prosoape, s-a observat o reducere semnificativă a dimensiunii în direcția urzelii.

Cuvinte-cheie*: material pentru halat de baie, țesere, tricotare din urzeală, procese de finisare*

INTRODUCTION

According to ASTM D 123-03 standard terminology for textiles, towel fabric is defined as “a textile product which is made with loop pile on one or both sides generally covering the entire surface or forming stripe, checks, or other patterns” [1].

Towels and bathrobes in the home textile group, which have an important place in the textile and apparel industry, are among the indispensable items of daily life. Especially today, where health problems are more common, the need for such textile products that provide hygiene is increasing.

Towel fabrics are produced with three yarn systems: ground warp, ground weft and pile warp. Here, while ground warp provides mechanical strength, pile warp gives water absorption properties due to its increased surface area [2–4].

Towel fabrics have been produced since ancient times using the weaving technique, and recently they have been produced with the warp knitting technique as well as weaving. Towel fabric formation with warp

knitting technique is more economical than weaving technique due to the higher production rate.
In order to add strength and stability to the fabric, filament polyester or polyamide ground yarn is also used in addition to cotton ground yarn in the towel fabrics produced by warp-knitting machines. In contrast to their cost effectiveness, very limited academic studies have been conducted on warp knitted towel fabrics [5, 6].
Bathrobe woven fabrics are produced with 2, 3, 4, 5 or more wefts per loop. Towels with the most common production are of the type with 3 wefts [7]. The sectional view of the bathrobe fabric along the warp direction can be given as in figure 1.

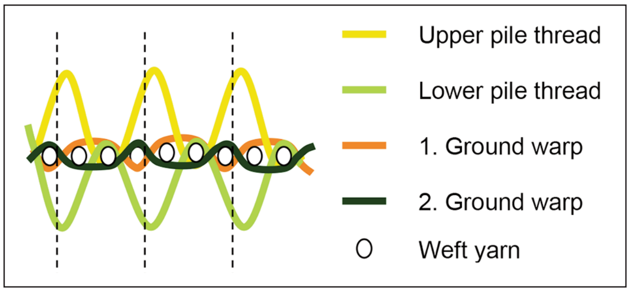

Fig. 1. Sectional view of the bathrobe fabric along the warp direction [8]

In the basic towel structure, the upper and lower loop warp groups and the first and second ground warps form a 2/1 ribs weave between themselves. Here, the ribs weave of the loop warps is one weft phase ahead of the ribs weave of the ground warps. This improves towel fabric strength by increasing the bonds along the warp [7].
In the warp knitting machine with two investment rails, if one rail has normal knitting needles and the other rail has plush/ pile loop platins, towel fabric is produced. In these towel structures formed on a single side, a basic (ground) pattern is formed on the rear comber rail. In the front comber rail, the warp threads are wrapped on the plush platins and form the towel loops. The pile length is adjusted by increasing or decreasing the distance between the needle rails [5, 6].
Warp knitting towel fabrics are pile fabrics with projecting loops on one or on each fabric face. The principle of loop formation consists in creating drop stitches, resulting in so-called terry loops. Such a terry loop is formed as follows: a loop, that has been placed around a needle, is cast off, but the loop head is not bound into the fabric ground. This situation appears if there is a loop on the needle shaft, but no new yarn is inserted into the needle head so that the loop is knocked over during the next stitch forming cycle, the loop head, however, is not tied in. İn other words: the head of the loop will stand out of the fabric ground in form of a terry loop [8]. The notation of warp-knitted terry bows is shown in figure 2.
While studies on towel fabrics mostly focus on woven towel fabrics, warp-knitted towel fabrics have been the subject of limited research studies. In addition, the water absorption phenomenon of towel fabrics has been extensively investigated and therefore other performance properties have been studied relatively poorly [2].
One of the earliest studies on knitted towel fabrics is a study comparing woven and warp knitted towel fabrics in terms of various performance properties including tensile strength, tear strength and dimensional stability. In this study, it was concluded that the mechanical performances of woven towel fabrics were better than knitted towel fabrics [6]. In another study, the loss of strength caused by washing warp knitted towel fabrics knitted with polyester and nylon ground warps and drying them in drum dryers was investigated and it was determined that warp knitted towel fabrics knitted with polyester ground warps were more durable [5].
The warp and weft densities applied in bathrobe towel fabrics vary between 20 and 30 and 15 to 25 threads/cm, respectively. The loop length per unit length (1 cm) can vary between 20–10 cm. It can be called pile/ground ratio. This length has a great effect on the weight of the bathrobe fabric [9]. Weft and warp densities are determinant in shrinkage that will occur immediately after the machine exit and after washing of the fabric [4].
The tensile strength and elongation values at rupture of fabrics with three different wales densities (wales per cm) produced in a warp knitting machine with two comber rails were reviewed and how they affect the fatigue values were investigated [10].

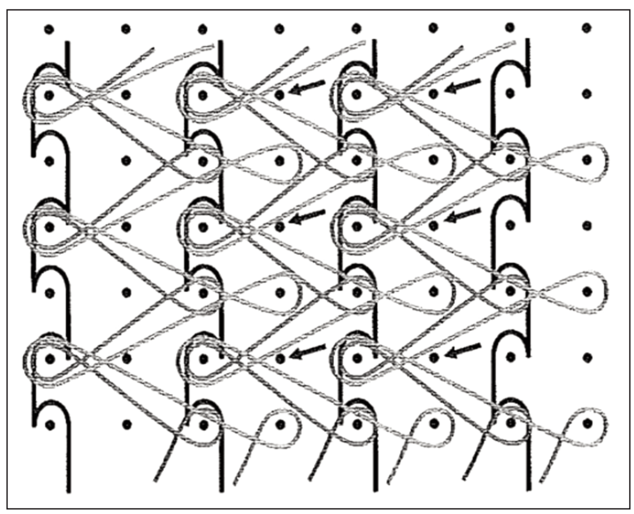

Fig. 2. Warp knitted bathrobe fabric structure [8]

MATERIAL AND METHODS

Material

In this research study, woven and warp knitted towel fabric structures were used.
Woven fabrics were produced on the Vamatex towel weaving machine with the following properties:
- Comb number 10 dents/cm;
- Pile warp open-end Ne 16/1 cotton;
- Ground warp open-end Ne 20/2 cotton;
- Weft yarn open-end Ne 16/1 cotton.

Warp knitted fabrics were produced on Karl Mayer KS4 FBZ warp knitting machine with four guide bars with the following properties:

- Machine fineness 24 fine;
- Machine width 136 inches;
- Backside pile warp open-end Ne 16/1 cotton;
- Front side pile warp open-end Ne 16/1 cotton;
- Ground warp 100 denier polyester (36 filaments);
- Weft yarn 100 denier polyester (36 filaments).

Methods

Pre-treatment and dyeing processes were carried out in a dyeing machine that can operate at high temperatures. Samples were exposed to finishing procedures representative of those currently used in industrial practice. Raw woven terry fabric was desized in a high-temperature machine prior to bleaching. Bleaching was carried out in presence of NaOH and H_2O_2 at 110°C for 20 min in the same machine. Following bleaching, the fabric was neutralized at 90°C for 10 min. The terry fabric was treated with enzymatic biopolishing agent Cellusoft Combi® at 50°C for 60 min. Then, the fabric was dyed with reactive dyestuff in presence of salt and soda at 90°C. After dyeing, the fabric was neutralized, washed, and then treated with a softening agent at 40°C for 20 min. In the last step, the fabric was treated with the mechanical whisking effect in the turbang (finishing machine) used in the mechanical finishing of the towel fabrics, and finally, a more voluminous and softer touch was achieved.

Test methods and standards applied to towel fabrics

Towel samples were conditioned at 22°C and 65% relative humidity for at least 24 hours before physical test processes. Tests were carried out using a set of 5 pieces from each sample prepared to determine fabric properties.

The fabric mass per unit area was determined according to the TS 251 method. The mass of the sample fabrics per unit area was measured by weighing the samples each consisting of 100 cm^2 area with a precision of 0.001 g.

The tear strength of the fabrics was measured according to the method of TS EN ISO 13937-2 using samples of 50 mm × 200 mm. Measurements were carried out in both warp and weft directions using the Tinius Olsen H10KT (R) tester equipped with QMat for Textiles (R) software. The crosshead speed was kept at 100 mm/min and the gauge length was set at 100 mm.

Tensile strength and elongation at break were measured according to the TS EN ISO 13934-1 method using 50 mm × 300 mm samples and then tested in both warp and weft directions. Measurements were carried out using the Tinius Olsen H10KT (R) Tester equipped with QMat for Textiles (R) software. The crosshead speed was kept at 100 mm/min, the gauge length was set to 200 mm, and a 5 N preload was applied during the measurements.

Bursting strength was measured according to the method of TS EN ISO 13938-2 using samples of 140 mm × 140 mm for measurement.

Dimensional change tests during washing and drying were carried out according to TS 5720 EN ISO 6330 method, using samples of 500 mm × 500 mm.

500 mm. Washing was carried out using detergent ECE without optical brightener in a washing machine at 40 + 3°C for 47 minutes. The loading weight was kept at 2000 + 100 g. The fabrics were laid flat on the floor and dried.

The water absorption of towel fabrics was determined using 500 mm × 500 mm sized samples according to the TS 866 method. According to the testing procedure, the fabric sample was placed horizontally on a cup of distilled water, and the time it took for the sample to sink (i.e., fully wet the fabric with water) was recorded using a stopwatch.

For statistical analysis, observed data were subjected to one-factor and two-factor repeated variance analysis at α: 0.05 significance level.

RESULTS AND DISCUSSION

Results of weight measurements

The weight of woven and warp knitted fabric for the bathrobe was measured and the measurement results of the samples are given in table 1.

In woven towel fabrics, a continuous increase in fabric weight was observed with the compression effect of the turbang machine after the pre-treatment, dyeing processes and then the mechanical finishing process, respectively. It has been determined that warp knitted towel fabrics also increase in fabric weight in each process step. The reason for this can be explained as the polyester yarn used in the ground knitting structure of the knitted fabric shows the effect

Table 1

WEIGHT MEASUREMENT RESULTS OF BATHROBE FABRICS

Treatment operations	Woven towel fabric			Warp knitted towel fabric		
	Measurement avg. (gr/m²)	Std. Deviation (g/m²)	Change between stages* (%)	Measurement avg. (g/m²)	Std. Deviation (g/m²)	Change between stages* (%)
Raw fabric	370	5.41	-	367	3.51	-
Dyed fabric	438	10.46	18.3	390	4.16	6.2
Finished fabric	440	6.84	0.4	396	4.96	1.5

of gathering-shrinkage due to the temperature effect and collects in the fabric.

Results of tear strength measurements

The rupture strength measurements of woven and warp knitted bathrobe fabrics were made and the tear strength results in the warp direction are given in table 2.

In woven towel fabrics, the tear strength in the warp direction was higher due to the effect of impurities such as fats, waxes, oils and pectins on the raw fabric, while the tear strength values in the warp direction gradually decreased after the dyeing process and the subsequent turbang process. After finishing and subsequent mechanical finishing, the tear strength of warp knitted fabrics in the warp direction (wales direction) tended to increase.

The tear strength results of woven and warp knitted bathrobe towel fabrics in the weft direction are given in table 3.

The tear strength in the weft direction was initially high due to the impurities such as fats, waxes, oils and pectins on the raw fabric in woven towel fabrics. After the pre-treatment and dyeing process, these non-cellulose chemicals and sizing agents were removed, resulting in a serious decrease in the tear strength of the fabric in the weft direction. It was determined that the tear strength values decreased further after the mechanical end (turbang) process. Although the tear strength of warp-knitted towel fabrics in the weft direction increased after finishing, a decrease was observed after the mechanical finishing process.

Compared to their raw form, warp-knitted towel fabrics did not lose their tear strength in both warp and weft directions compared to woven towel fabrics, while a decrease in tear strength was observed in woven towel fabrics. As a result, it was determined that the tear strength of the finished towel fabrics was higher than warp knitted towel fabrics.

Results of tensile strength measurements

The tensile strength measurements of woven and warp knitted bathrobe fabrics were made and the results of the warp tensile strength are given in table 4. In woven towel fabrics, the tensile strength in the warp direction was higher due to the effect of impurities such as fats, waxes, oils and pectins on the raw

Table 2

MEASUREMENT RESULTS OF RUPTURE STRENGTH OF BATHROBE FABRICS IN WARP DIRECTION

Treatment operations	Woven towel fabric			Warp knitted towel fabric		
	Measurement avg. (N)	Std. Deviation (N)	Change between stages* (%)	Measurement avg. (N)	Std. Deviation (N)	Change between stages* (%)
Raw fabric	62	6.23	-	25	1.98	-
Dyed fabric	56	1.32	–9.7	26	1.42	4.0
Finished fabric	47	2.13	–16.1	26	1.52	0.0

Table 3

MEASUREMENT RESULTS OF RUPTURE STRENGTH OF BATHROBE FABRICS IN WEFT DIRECTION

Treatment operations	Woven towel fabric			Warp knitted towel fabric		
	Measurement avg. (N)	Std. Deviation (N)	Change between stages* (%)	Measurement avg. (N)	Std. Deviation (N)	Change between stages* (%)
Raw fabric	53	2.96	-	28	1.79	-
Dyed fabric	41	2.04	–22.6	32	1.48	14.3
Finished fabric	34	6.05	–17.0	29	2.85	–9.3

Table 4

MEASUREMENT RESULTS OF TENSILE STRENGTH OF BATHROBE FABRICS IN WARP DIRECTION

Treatment operations	Woven towel fabric			Warp knitted towel fabric		
	Measurement avg. (N)	Std. Deviation (N)	Change between stages* (%)	Measurement avg. (N)	Std. Deviation (N)	Change between stages* (%)
Raw fabric	390	148.71	-	222	26.67	-
Dyed fabric	369	137.71	–5.3	210	21.81	–5.4
Finished fabric	366	138.88	–0.8	236	25.57	12.4

fabric, while the tensile strength values in the warp direction gradually decreased after the dyeing process and the subsequent turbang process. Although the tensile strength of warp knitted fabrics in the warp direction (wales direction) decreased after finishing processes compared to their raw state, the tensile strength increased again after mechanical finishing.

Table 5 shows the tensile strength results of woven and warp knitted bathrobe towel fabrics in the weft direction.

In woven towel fabrics, the tensile strength of the fabric in the weft direction has increased after the pretreatment and dyeing processes. However, after the mechanical finishing (turbang) process, the tensile strength in the weft direction decreased again. The tensile strength of warp-knitted towel fabrics in the weft direction continued to increase both after finishing and after mechanical finishing.

As a result, it was determined that the tensile strength in the warp direction was higher in the warp-knitted towel fabrics, while the tensile strength in the weft direction was lower than the warp-knitted towel fabrics.

Results of burst strength measurements

Burst strength measurements of woven and warp knitted bathrobe towel fabrics were made and the results are given in table 6.

While the bursting resistance of the raw fabric was higher in woven towel fabrics, although there was a decrease in the bursting strength of the fabric applied with pretreatment and dyeing processes, an increase was determined again at the bursting strength after tightening-gathering of the fabric upon the mechanical finishing process. The bursting resistance of the warp-knitted towel fabrics continued to increase along with the finishing process. As a result, it has been determined that the bursting strength of woven towel fabrics is higher.

Results of hydrophilicity determination measurements

Hydrophilicity measurements of woven and warp knitted bathrobe towel fabrics were made and the measurement results are given in table 7.

It was determined that the hydrophilicity of both woven towel fabrics and warp knitted towel fabrics after pretreatment, dyeing and mechanical finishing

Table 5

MEASUREMENT RESULTS OF TENSILE STRENGTH OF BATHROBE FABRICS IN WEFT DIRECTION

Treatment operations	Woven towel fabric			Warp knitted towel fabric		
	Measurement avg. (N)	Std. Deviation (N)	Change between stages* (%)	Measurement avg. (N)	Std. Deviation (N)	Change between stages* (%)
Raw fabric	288	53.77	-	284	30.81	-
Dyed fabric	348	80.89	20.8	309	23.46	8.8
Finished fabric	301	68.62	–13.5	335	33.94	8.4

Table 6

BURST STRENGTH MEASUREMENT RESULTS OF BATHROBE FABRICS

Treatment operations	Woven towel fabric			Warp knitted towel fabric		
	Measurement avg. (kPa)	Std. Deviation (kPa)	Change between stages* (%)	Measurement avg. (kPa)	Std. Deviation (kPa)	Change between stages* (%)
Raw fabric	878	34.31	-	600	11.49	-
Dyed fabric	761	63.88	–13.3	626	36.42	4.3
Finished fabric	852	58.28	11.9	671	28.16	7.2

Table 7

HYDROPHILICITY MEASUREMENT RESULTS OF BATHROBE FABRICS

Treatment operations	Woven towel fabric			Warp knitted towel fabric		
	Measurement avg. (s)	Std. Deviation (s)	Change between stages* (%)	Measurement avg. (s)	Std. Deviation (s)	Change between stages* (%)
Raw fabric	178	0.54	-	1022	159.16	-
Dyed fabric	4	0.46	–97.7	5	0.54	–99.5
Finished fabric	3	0.53	–25	5	0.27	0.0

Table 8

MEASUREMENT RESULTS OF DIMENSIONAL CHANGE DETERMINATION OF BATHROBE FABRICS IN WARP DIRECTION						
Treatment operations	**Woven towel fabric**			**Warp knitted towel fabric**		
	Measurement avg. (mm)	**Std. Deviation (mm)**	**Change between stages* (%)**	**Measurement avg. (mm)**	**Std. Deviation (mm)**	**Change between stages* (%)**
Raw fabric	32	0.63	-	33	0.67	-
Dyed fabric	34	0.55	–6.2	35	0.50	–6.0
Finished fabric	34	0.36	0.0	35	0.49	0.0

Table 9

MEASUREMENT RESULTS OF DIMENSIONAL CHANGE DETERMINATION OF BATHROBE FABRICS IN WEFT DIRECTION						
Treatment operations	**Woven towel fabric**			**Warp knitted towel fabric**		
	Measurement avg. (mm)	**Std. Deviation (mm)**	**Change between stages* (%)**	**Measurement avg. (mm)**	**Std. Deviation (mm)**	**Change between stages* (%)**
Raw fabric	32	1.06	-	34	0.54	-
Dyed fabric	35	0.59	–8.5	35	0.46	–2.8
Finished fabric	35	0.57	0.0	35	0.53	0.0

processes continuously improved, reached the desired hydrophilicity in both fabric types, and the hydrophilicity value of woven towel fabrics was slightly better than warp knitted towel fabrics.

Results of dimensional variation determination measurements

Dimensional changes of woven and warp knitted bathrobe fabrics were measured and the dimensional change results in warp and weft directions are given in tables 8 and 9.

Compared to their raw state, a shrinkage rate of 6.2% in the warp direction, 8.5% in the weft direction were observed in the finished woven towel fabrics, while a shrinkage rate of 6.0% in the rod direction and 2.8% in the row direction was observed in warp-knitted towel fabrics. Accordingly, dimensional change in warp-knitted towel fabrics is less seen than in woven towel fabrics.

Statistical evaluation of the effects of the dyeing process

While the dyeing process caused an average increase of 18.3% on the weight of woven bathrobe towel fabric, it had an increasing effect of 6.2% on the weight of warp-knitted bathrobe towel fabric. (p values, respectively, $3{,}94 \times 10^{-4}$ and $1{,}26 \times 10^{-5}$). A small amount of shortening was observed in the weft and warp direction after washing and drying the towel fabrics with softening chemicals added after dyeing. Table 10 shows the effects of the dyeing process on the woven bathrobe fabric.

While there was no difference in tensile strength between the dyed and washed textile fabric and the fabric with softening chemical added ($p = 0.82$), a slight increase in the elasticity in the warp direction was recorded ($p = 0.0004$).

While there was a decrease in the tensile strength ($p = 0.0003$) between the dyed and washed bathrobe warp knitted fabric and the fabric added with softening chemicals, there was no statistical difference on the basis of elasticity ($p = 0.17$).

It was observed that the dyeing process caused an increase in the tear strength of the bathrobe towel woven fabric, especially in the warp direction ($p = 0.005$). This process did not cause a significant change in the rupture strength of the warp knitted fabric ($p = 0.17$).

While the dyeing process increased the burst pressure of the woven bathrobe fabric from an average of 761 kPa to 852 kPa, the warp-knitted bathrobe fabric burst pressure increased from an average of 626 kPa to 671 kPa (p values respectively 0.01 and 0.006).

Table 10

EFFECTS OF DYEING PROCESS ON WOVEN BATHROBE FABRIC		
Feature	**Effect of dyeing**	
	Statistical meaning	**p value**
Weight	There is a significant increase	3.94×10^{-4}
Tear	There is a significant increase (warp)	0.005
Tensile	No meaningful change	0.82
Burst	There is a significant increase	0.01
Hydrophilicity	No meaningful change	0.3

As a result of the softener addition process, there was no significant change in woven and warp knitted fabric hydrophilicity (p values 0.30 and 0.85, respectively).
Table 11 shows the effects of the dyeing process on warp knitted bathrobe fabric.

Table 11

EFFECTS OF DYEING PROCESS ON WARP KNITTED BATHROBE FABRIC		
Feature	**Effect of dyeing**	
	Statistical meaning	**p value**
Weight	There is a significant increase	1.26×10^{-5}
Tear	No meaningful change	0.17
Tensile	There is a significant decrease	0.0003
Burst	There is a significant increase	0.006
Hydrophilicity	No meaningful change	0.85

Statistical evaluation of the effects of mechanical (turbang) finishing processes

It was determined that the mechanical finishing process tended to have an increase of 0.4% on the weight of dyed bathrobe woven towel fabric, while it was also determined that it increased 1.5% on the weight of warp-knitted fabric (p values 0.006 and 7.67×10^{-6}, respectively).
Table 12 shows the effects of the finishing processes on the woven bathrobe towel fabric.

Table 12

EFFECTS OF FINISHING PROCESSES ON WOVEN BATHROBE TOWEL FABRIC		
Feature	**Effect of dyeing**	
	Statistical meaning	**p value**
Weight	There is a significant increase	0.006
Tear	There is a significant decrease	3.89×10^{-6}
Tensile	There is a significant decrease	0.055
Burst	No meaningful change	0.81
Hydrophilicity	There is a significant increase	0.02

There was no dimensional change in the woven and warp knitted towel fabric samples after the mechanical finishing process according to the situation after the dyeing process.
Mechanical finishing negatively affected the tensile strength of the bathrobe towel woven fabric in the weft direction and the elasticity in both directions (p values 0.055 and 2.18×10^{-7}, respectively). The reason for this decrease may be the decrease in elasticity values with the force applied to the weft length during the mechanical finishing process.
Mechanical finishing positively affected the tensile strength of the bathrobe warp knitted towel fabric ($p = 5.07\times10^{-6}$) and increased the elasticity ($p = 0.0006$). The increase in elasticity may be the reason for this increase. Table 13 shows the effects of the finishing processes on the warp-knitted bathrobe towel fabric.

Table 13

THE EFFECTS OF FINISHING PROCESSES ON WARP KNITTED BATHROBE TOWEL FABRIC		
Feature	**Effect of dyeing**	
	Statistical meaning	**p value**
Weight	There is a significant decrease	7.67×10^{-6}
Tear	There is a significant decrease	0.02
Tensile	There is a significant increase	5.07×10^{-6}
Burst	No meaningful change	0.16
Hydrophilicity	No meaningful change	0.4

Mechanical finishing caused a decrease in the rupture strength of the bathrobe weaving and warp knitted towel fabric in the warp and weft direction (p values of 3.89×10^{-6} and 0.02, respectively). The drop was felt more in the woven fabric. The decrease in elasticity and adjustment of shrinkage may have caused this.
The mechanical finishing process did not significantly affect the burst pressure values of woven and warp knitted bathrobe fabrics (p values 0.81 and 0.16, respectively).
As a result of washing after the dyeing process, the immersion time of the woven fabric in water decreased from 3.7 seconds to 2.6 seconds, while the hydrophilicity of the warp knitted fabric did not change significantly (p values 0.02 and 0.40, respectively).

CONCLUSION

In this study, the effects of pre-treatment, dyeing and mechanical finishing steps applied to bathrobe towel fabrics on basic performance properties such as weight, tensile strength, tear strength, bursting strength, shrinkage, and water absorbency of woven and warp knitted towel fabrics with similar properties were investigated and the physical properties of these fabrics were compared with each other in terms of performance and strength.
Weight: In each of the towel fabrics per unit area, the increase in the finishing process continued. Although sizing and foreign materials are removed from the fibre and fabric structure in bleaching processes, weight loss is experienced, but an increase in unit area (g/m²) has been detected as a result of the changes in the width and length of the fabric.

Tear strength: Although it decreased 25–35% in bathrobe woven towel fabric, it increased in the warp-knitted towel fabric by 5%. Further studies can be done on the significant strength reduction in woven fabric.

Tear strength: Considering the weft-warp direction together, the increase and decrease in woven towel fabric neutralized each other, while there was a significant increase in warp-knitted towel fabric. After mechanical finishing processes, more intensive research can be done on the fact that both fabrics give approximately opposite results.

Hydrophilicity feature: It increased very markedly in both fabrics after hydrophilization. In order to prevent both hydrophilicity and strength losses, studies can be carried out on the ideal working conditions of the hydrophilization processes of towel fabrics.

Burst resistance decreased slightly in woven towel fabric and increased noticeably in warp-knitted towel fabric.

Dimensional shrinkage: Since finishing operations are carried out according to the shrinking method, although the fabric has been treated in the warp direction, it is higher in both fabrics.

Each finishing process had a positive or negative effect on the towel fabric performance properties. As a result of the finishing processes, there was a general decrease in the tear strength of the woven bathrobe towel fabric, while there was no systematic decrease in other strength parameters or in any strength properties of the warp-knitted towel fabric.

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