

The Effects of Repeated Laundering and Structural Parameters on the Terry Fabric Preference of Japanese Consumers and Comparison with Turkish Consumers

Ece KALAYCI¹ ORCID 0000-0002-7331-7629
Deniz Mutlu ALA^{*2} ORCID 0000-0002-5864-308X
Hüseyin TOPÇU¹ ORCID 0000-0003-2156-1782
Tetsuya SATO³ ORCID 0000-0001-5356-6647
Yüksel İKİZ¹ ORCID 0000-0001-9412-8926

¹Pamukkale University, Faculty of Engineering, Department of Textile Engineering, Denizli, Türkiye

²Çukurova University, Adana Organized Industrial Zone Vocational School of Technical Sciences, Adana, Türkiye

³School of Science and Technology, Kyoto Institute of Technology, Kyoto, Japan

Geliş tarihi: 22.05.2023

Kabul tarihi: 29.09.2023

Atıf şekli/ How to cite: KALAYCI, E., ALA, D.M., TOPÇU, H., SATO, T., İKİZ, Y., (2023). The Effects of Repeated Laundering and Structural Parameters on the Terry Fabric Preference of Japanese Consumers and Comparison with Turkish Consumers. Cukurova University, Journal of the Faculty of Engineering, 38(3), 695-704.

Abstract

The objective of this research is to determine the effects of weft yarn count, weft density and repeated laundering effects on terry fabric preference of Japanese participants and to compare with the preferences of Turkish participants. In addition, the terry fabric samples are evaluated by Japanese panelists in order to determine the importance of characteristics related to preference. Terry samples woven with nine different constructions are subjected to 5, 10, 20 and 40 washing cycles in a household washing machine before subjective evaluations. The subjective evaluations are performed in two steps with a total of 40 Japanese volunteers consisting 20 men and 20 women at the ages of 18-25 years. Both Japanese and Turkish participants preferred terry fabric samples woven with finer weft yarns at a higher rate. The preference rate for terry fabrics decreased with increasing washings cycles among the participants of both countries. In addition, the most important characteristics related to preference of Japanese participants has been revealed.

Keywords: Terry fabric, Subjective evaluation, Softness, Laundering

Tekrarlı Yıkamaların ve Yapısal Parametrelerin Japon Tüketicilerin Havlu Kumaş Tercihine Etkisi ve Türk Tüketicilerle Karşılaştırılması

Öz

Bu çalışmada atkı ipliği numarası, atkı sıklığı ve tekrarlı yıkamaların Japon katılımcıların havlu kumaş tercihi üzerindeki etkileri araştırılmış, elde edilen sonuçlar Türk katılımcıların tercihleri ile

*Sorumlu yazar (Corresponding Author): Deniz Mutlu ALA, denizmutluala@hotmail.com

karşılaştırılmıştır. Ayrıca Japon katılımcılar ile yapılan ikinci aşama değerlendirmelerde, tercihi etkileyen özelliklerin önem dereceleri araştırılmıştır. Bu amaçla, üç farklı kalınlıkta atkı iplikleri ile üç farklı atkı sıklığında dokuz farklı yapıya sahip havlu kumaş numuneleri üretilmiştir. 18-25 yaş arası 20 erkek ve 20 kadın olmak üzere toplam 40 Japon gönüllü ile iki aşamada gerçekleştirilen subjektif değerlendirmeler öncesinde havlu kumaşlara ev tipi çamaşır makinesinde 5, 10, 20 ve 40 kez tekrarlı yıkama yapılmıştır. Çalışma sonucunda Japon ve Türk katılımcıların, daha ince atkı iplikleri ile dokunan havlu kumaşları daha yüksek oranda tercih ettiği ve yıkama sayısı arttıkça, her iki ülke katılımcılarının tercih oranının azaldığı görülmüştür. Ayrıca Japon katılımcıların tercihi etkileyen özelliklerin önem dereceleri ortaya konulmuştur.

Anahtar Kelimeler: Havlu kumaş, Subjektif değerlendirme, Yumuşaklık, Yıkama

1. INTRODUCTION

Terrycloth, believed to have come into our lives through faulty weaving, is now one of the most widely used home textiles around the World [1]. It is an indispensable material for bath and beach products such as towels and bathrobes with its excellent water absorption capacity [2]. Although traditionally made from yarns of 100% cotton fibers, in recent years it is also made from regenerated cellulose fibers such as viscose, modal, bamboo or blended yarns with synthetic fibers such as polyester/micropolyester, depending on the application [3].

A look at the global market statistics for terry products for 2019 shows that China is the world's leading exporter of towel products, with a market share of 41.6%. Pakistan, India, Turkey and Vietnam follow China with market share of 12.5%, 11.2%, 6% and 3.2% respectively, and the total exports of these five countries account for 70% of global exports. Global import statistics show that the U.S. is the world's largest importer of toweling materials, accounting for 32.2% of total imports. It is followed by Japan (8%), Germany (6.1%), France (4.7%), the United Kingdom (4.5%), the Netherlands (2.7%), Italy (2.5%) and Spain (2.4%) [4].

The basic parameters that determine the quality of terry products are the weight of the fabric, softness/hand feel, orientation of the pile, amount of lint, absorbency and dimensional stability. Absorbency is one of the most important parameters for terry fabrics. Softness/hand feel, one of the defining characteristics of terry quality, is directly related to the type of raw material used for the pile

yarn, pile orientation and finishing processes, such as the use of softeners. The strength of terry fabrics and the change in physical and structural properties of terry products after the washing process are considered to be other important parameters affecting the quality of terry fabrics [2,4,5].

In contrast to these objective evaluations that determine the quality of terry cloth, consumers in retail stores usually make a subjective decision by looking at and touching the appearance of the product. For this reason, there are many studies in the literature that aim to establish a correlation between the objective and subjective evaluation of textile products [2,5-7]. For cases where an objective evaluation of the quality of textile surfaces is not possible, subjective evaluation methods have been developed that come closest to an objective evaluation. The evaluation is done by touching, squeezing and rubbing to analyze the fabric quality by experts in the field [8-10]. When one wishes to test the softness of textile surfaces using an objective method, the softness of the fabric is usually obtained by determining its stiffness. This is possible with measurements made with a bending rigidity tester or a stiffness tester [11-13]. However, subjective evaluation of softness is done by touching the fabric and manipulating it with a finger [11-14].

Terry fabrics are textile materials that, like all products of daily use, get dirty and need to be washed frequently. These washing processes can sometimes cause changes, such as deformation of the surface of the fabric, increase in hairiness, decrease in thickness, decrease in weight, hardening, decrease in air permeability, decrease in water absorption, fading of color, etc. For this

reason, physical and structural changes in the fabric structure as a result of washing processes also have a very strong influence on the quality of terry products [15-19]. There are also studies show that different geographies, different climates and different cultures can have an impact on the results of subjective assessments [20].

As a part of the previous study the effects of weft yarn count, weft density and repeated laundering on the predictability of terry fabrics for both purchasing and servicing are evaluated. In subjective evaluations, the fabrics are assessed by Turkish participants and the statistical relationship between subjective and objective evaluations are investigated [2]. In the present study subjective evaluations are carried out to determine the effects of weft yarn count, weft density and repeated laundering effects on the terry fabric preference of Japanese participants. However the effects of target market's cultural background on consumer behaviour and preferences should also be taken into account. The important feature of this study was to investigate and compare the effects of the repeated laundering and structural parameters on the terry preference of the consumers of different countries. Therefore, the results are compared with the results obtained in the previous study by the subjective assessments conducted with Turkish participants. By this way, it is aimed to investigate and compare the effects of the repeated laundering and structural parameters on the towel preference of the consumers of two different countries and to determine whether the subjective responses would be in correlation with each other. In addition, the terry fabric samples are evaluated by Japanese panelists to determine the importance of characteristics related to preference, considering requested properties such as heaviness, thickness, softness, moisture feeling, length of pile, type of fabric, shininess, hand-feel, roughness and warmth.

2. EXPERIMENTAL

100% carded ring-spun cotton Ne 12/1, Ne 16/1 and Ne 20/1 weft yarns spun from the same cotton blend were used. In the warp direction, 100% carded ring-spun cotton Ne 20/2 ground warp and Ne 16/1 pile warp were used. To investigate the effects of

parameters such as weft yarn count, weft density and repeated laundering on the subjective ratings of terry fabrics, a total of 9 terry fabrics were woven with three different weft densities as given in Table 1. Bleaching, dyeing and washing processes are applied to terry fabrics in the same bath in order to produce comparable samples. The dyed fabrics were subjected to 5, 10, 20, and 40 washing cycles before subjective evaluations. Laundering operations performed in a domestic washing machine at 40 °C together with commercial detergents and fabric softeners readily available and commonly used in the market, as performed in daily life. Terry fabrics were dried by laying on a flat surface for 24 hours after each washing cycle. Terry fabrics were cut into dimensions of 10×10 cm to be used in subjective evaluations.

Before conducting the subjective assessments, terry samples were conditioned for a minimum of 24 hours under standard atmospheric conditions (20 ± 2 °C temperature, $65 \pm 2\%$ relative humidity) and assessments were completely performed under these conditions. A total of 40 volunteers consisting 20 men and 20 women at the age of 18-25 years from Japan participated in the survey as panelists. The participants were informed about the aim of the research and the properties like fiber content, construction and finishing method. Subjective assessment was performed in two steps.

In the first step of the subjective evaluations, each of the unwashed fabric samples were randomly compared in pairs with other fabric samples. The structures of the fabrics were not explained to the participants. Each panelist performed the subjective assessment by holding the sample pairs with hands. The fabric samples were evaluated by handling, rubbing and squeezing them with hands for about 1-2 minutes and comparing the two samples with each other in terms of primary handle impressions and appearance. After each evaluation the participants made a decision and chosen one of the samples as preferred (Figure 1). By this way all fabric samples were compared with each other. To determine the effect of laundering on panelists' preference, all 45 types of unwashed and washed samples were evaluated by panelists by handling, rubbing and

squeezing and rated as preferred or not preferred in terms of primary handle impressions and appearance. In addition, the results of the first stage are compared with the results of the subjective assessment conducted with Turkish participants in the previous study.

In the second part of the evaluation, all fabric samples (9 unwashed, 9 five times washed, 9 ten times washed, 9 twenty times washed, 9 forty times washed) were presented to Japanese participants randomly one by one and the panelists were requested to make a choice according to given properties such as “heaviness”, “thickness”, “softness”, “moisture feeling”, “length of pile of terry fabrics”, “type of fabric”, “shininess”, “hand-

feel”, “roughness” and “warmth feel” for each fabric sample.

The experimental results have statistically evaluated by using SPSS software. Firstly the normality of experimental data obtained in the first step are tested with Shapiro-Wilk test. Independent sample t-test was used to determine whether 2 group variances can be assumed equal or not. Correlation analysis was carried out to determine the statistical relationship between the evaluation results of Turkish participants and Japanese participants. The preference counts of terry fabric samples in the first step of the survey and the requested properties evaluated in the second step are also statistically evaluated by correlation analysis.

Table 1. Structural properties of terry fabric samples [2]

	Sample Numbers								
	1	2	3	4	5	6	7	8	9
Linear Densities of Weft (Ne)	12/1	16/1	20/1	12/1	16/1	20/1	12/1	16/1	20/1
Density of Weft (weft/cm)	22	21.6	21.2	20	20	20.2	17.2	17.6	17.2
Mass per Unit Area (gr/m ²)	449	445	468	458	471	448	431	446	432



Figure 1. Subjective evaluation is performed in the light cabin under D65 daylight

3. RESULTS AND DISCUSSIONS

3.1. Subjective Evaluation Results “First Step”

In the first step of the subjective evaluation, all the 9 unwashed fabric samples that are in different constructions compared with other fabric samples randomly with participation of 20 Japanese men and 20 Japanese women at the age of 18–25. In our

previous work, the first step of the subjective evaluation had been performed exactly under the same conditions to only the Turkish participants consisting of 20 men and 20 women between the ages of 18-45. The results of the fabric ratings of unwashed fabrics and comparison of Turkish and Japanese consumers’ preferences are given in Table 2. Preference count expresses the total number of the preference of terry fabric samples, in other

words how many times the fabric sample preferred when compared with any other. Then a whole comparison of all 45 types of samples consisting of unwashed and washed samples was made by panelists. It is obvious that, the weaving construction of terry fabrics is effective on the preferences of both Turkish and Japanese panelists. Among the ratings of Turkish panelists, the terry fabric that is woven with Ne 20/1 weft yarn and 17,2 weft/cm weft density was the most preferred one with a rating count of 223. However, among the ratings of Japanese panelists the terry fabric that is woven with Ne 20/1 weft yarn and 20,2 weft/cm weft density was the most preferred one with a rating count of 241. Moreover, both Japanese participants and Turkish participants preferred terry fabric samples woven with finer weft yarns at a higher rate.

The preferences of Turkish and Japanese panelists comparing with fabric constructions and repeated laundering cycles are given in Table 3. According to results, it can be said that Japanese and Turkish panelists made similar preferences when repeated laundering cycles and fabric constructions were considered. According to the ratings of both Turkish and Japanese participants, the preference of terry fabrics decreases with more washing cycles.

The experimental results are also statistically evaluated by using SPSS software. In the statistical analysis, the Shapiro-Wilk test was applied to determine whether the experimental data fit a normal distribution. As shown in Table 4, Shapiro-Wilk test confirm that the experimental data are normally distributed under 95 % confidence level.

Table 2. The preference counts of terry fabric samples in the first step of the survey

	Sample Nnumbers								
	1	2	3	4	5	6	7	8	9
	The preference count of the samples								
Turkish men participants	21	58	80	61	93	102	79	106	110
Turkish women participants	8	64	96	60	95	102	83	109	113
Turkish whole participants	29	122	176	121	188	204	162	215	223
Japanese men participants	20	92	120	48	95	125	58	71	91
Japanese women participants	23	82	119	54	97	116	65	71	93
Japanese whole participants	43	174	239	102	192	241	123	142	184

Table 3. The preference counts of terry fabric samples comparing with fabric constructions and repeated laundering cycles

Repeated laundering cycles	Nationality	Sample numbers								
		1	2	3	4	5	6	7	8	9
		The preference count of the samples								
Unwashed	Turkish	25	35	36	31	33	34	29	33	35
	Japanese	29	37	33	31	36	36	30	35	36
5 times	Turkish	10	21	32	11	23	26	16	28	27
	Japanese	27	30	29	26	20	20	18	26	33
10 times	Turkish	7	20	20	13	17	24	13	19	20
	Japanese	7	13	18	9	17	21	8	16	33
20 times	Turkish	4	10	21	9	12	20	7	17	14
	Japanese	9	10	15	7	10	20	10	15	23
40 times	Turkish	4	12	11	3	4	15	4	6	13
	Japanese	2	12	7	3	3	12	12	10	22

Table 4. Tests of normality (Shapiro-Wilk test)

Nationality	Treatment type	Statistic	df	Sig.
Turkish	Unwashed	,884	9	,174
	5 washing cycles	,933	9	,507
	10 washing cycles	,918	9	,375
	20 washing cycles	,964	9	,834
	40 washing cycles	,850	9	,075
Japanese	Unwashed	,874	9	,135
	5 washing cycles	,935	9	,528
	10 washing cycles	,902	9	,261
	20 washing cycles	,887	9	,184
	40 washing cycles	,894	9	,217

Independent sample t-test was used to determine whether the evaluation results of Turkish whole participants and Japanese whole participants agree about the preference of terry fabrics. The results of independent samples t-test are given in Table 5. As seen in Table 5, the p-value (sig.) is above 0,05 which indicates that the preference of Turkish and Japanese participants are not significantly different. Correlation analysis was also carried out to determine the statistical relationship among the

evaluation results of Turkish whole participants and Japanese whole participants and the results are given in Table 6. According to the correlation analysis, the preference of Turkish whole participants has a positive correlation ($r = 0,860$) between the preference of Japanese whole participants. As washing cycles increased, preference of both Turkish and Japanese participants decreased.

Table 5. Independent samples t-test

	Levene's test for equality of variances		t-test for equality of means					95% confidence interval of the difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	Lower	Upper
Equal variances assumed	,401	,528	-,534	88	,595	-1,15556	2,16408	-5,45622	3,14510
Equal variances not assumed			-,534	87,688	,595	-1,15556	2,16408	-5,45643	3,14532

Table 6. The correlation between the evaluation results of Turkish whole participants and Japanese whole participants

		Japanese
Turkish	Pearson correlation	,860**
	Sig. (2-tailed)	,000
	N	45

**Correlation is significant at the 0.01 level (2-tailed).

3.2. Subjective Evaluation Results “Second Step”

The second part of the subjective evaluation, is only applied to Japanese panelists. All the terry fabric

samples are evaluated by considering requested properties such as heaviness, thickness, softness, moisture feeling, length of pile, type of fabric, shininess, hand-feel, roughness and warmth. The evaluation results are given in Table 7. When the second part of subjective evaluation is examined, it is observed that fabric construction and increased repeated laundering cycles have influence on the subjective evaluation of the all terry fabric samples.

The correlations between the preference counts of terry fabric samples by Japanese participants and rating results of Japanese participants by considering requested properties are presented in

Table 8. When the pearson correlation coefficient approach to +1 or -1, it means that there is positive or negative strong relationship between data.

As seen in Table 8, softness, moisture feeling, type of fabric, shininess, hand-feel, roughness and warmth feel are the most significant properties for fabric hand. Also thickness and length of pile of terry fabrics but the influence isn't so significant. According to the correlation analysis, the preference of Japanese whole participants has positive correlation between soft ratings (r=0,907),

wet ratings (r=0,898), natural ratings (r=0,871), shiny ratings (r=0,807), good feel ratings (r=0,948), smooth ratings (r=0,930) and warm ratings (r=0,897). Whereas the preference of Japanese whole participants has negative correlation between hard ratings (r=-0,907), dry ratings (r=-0,898), unnatural ratings (r =- 0,871), non shiny ratings (r=-0,807), bad feel ratings (r=-0,948), rough ratings (r=-0,930) and cold ratings (r=-0,897). Heaviness did not have a significant effect on the preference of Japanese whole participants.

Table 7. Rating results of Japanese participants by considering requested properties

Laundering Cycles	Compared Properties	Sample Numbers								
		1	2	3	4	5	6	7	8	9
Unwashed	Heavy / Light	12 / 28	16 / 24	13 / 27	9 / 31	13 / 27	19 / 21	12 / 28	12 / 28	6 / 34
	Thick / Thin	17 / 23	30 / 10	27 / 13	18 / 22	33 / 7	33 / 7	23 / 17	21 / 19	22 / 18
	Soft / Hard	26 / 14	38 / 2	38 / 2	35 / 5	38 / 2	40 / 0	31 / 9	39 / 1	36 / 4
	Wet / Dry	14 / 26	29 / 11	29 / 11	19 / 21	30 / 10	28 / 12	23 / 17	33 / 7	31 / 9
	Short pile length / Long Pile Length	35 / 5	18 / 22	12 / 28	27 / 13	12 / 28	8 / 32	17 / 23	7 / 33	8 / 32
	Natural / Unnatural	32 / 8	36 / 4	34 / 6	31 / 9	35 / 5	35 / 5	27 / 13	29 / 11	34 / 6
	Shiny / Non Shiny	16 / 24	18 / 22	19 / 21	15 / 25	23 / 17	19 / 21	13 / 27	21 / 19	24 / 16
	Bad feel / Good Feel	11 / 29	2 / 38	6 / 34	9 / 31	1 / 39	3 / 37	9 / 31	2 / 38	5 / 35
	Rough / Smooth	16 / 24	3 / 37	4 / 36	11 / 29	4 / 36	5 / 35	11 / 29	6 / 34	3 / 37
5 washing cycles	Warm / Cold	22 / 18	34 / 6	30 / 10	27 / 13	33 / 7	35 / 5	28 / 12	28 / 12	32 / 8
	Heavy / Light	8 / 32	12 / 28	15 / 25	10 / 30	19 / 21	18 / 22	6 / 34	18 / 22	7 / 33
	Thick / Thin	9 / 31	15 / 25	25 / 15	14 / 26	29 / 11	24 / 16	12 / 28	23 / 17	14 / 26
	Soft / Hard	6 / 34	28 / 12	33 / 7	8 / 32	27 / 13	26 / 14	20 / 20	24 / 16	34 / 6
	Wet / Dry	4 / 36	17 / 23	22 / 18	5 / 35	16 / 24	19 / 21	9 / 31	16 / 24	30 / 10
	Short pile length / Long Pile Length	38 / 2	34 / 6	19 / 21	31 / 9	19 / 21	15 / 25	26 / 14	10 / 30	7 / 33
	Natural / Unnatural	16 / 24	28 / 12	26 / 14	24 / 16	21 / 19	21 / 19	18 / 22	28 / 12	27 / 13
	Shiny / Non Shiny	9 / 31	20 / 20	14 / 26	9 / 31	16 / 24	13 / 27	15 / 25	14 / 26	19 / 21
	Bad feel / Good Feel	28 / 12	8 / 32	8 / 32	25 / 15	21 / 19	19 / 21	22 / 18	13 / 27	6 / 34
10 washing cycles	Rough / Smooth	33 / 7	11 / 29	13 / 27	34 / 6	25 / 15	24 / 16	29 / 11	19 / 21	8 / 32
	Warm / Cold	12 / 28	24 / 16	26 / 14	19 / 21	23 / 17	24 / 16	19 / 21	29 / 11	30 / 10
	Heavy / Light	8 / 32	14 / 26	17 / 23	9 / 31	16 / 24	15 / 25	11 / 29	20 / 20	18 / 22
	Thick / Thin	9 / 31	18 / 22	25 / 15	14 / 26	24 / 16	25 / 15	17 / 23	28 / 12	28 / 12
	Soft / Hard	2 / 38	11 / 29	18 / 22	8 / 32	15 / 25	24 / 16	13 / 27	26 / 14	36 / 4
	Wet / Dry	1 / 39	6 / 34	9 / 31	3 / 37	12 / 28	15 / 25	7 / 33	11 / 29	25 / 15
	Short pile length / Long Pile Length	40 / 0	30 / 10	24 / 16	31 / 9	20 / 20	7 / 33	23 / 17	7 / 33	4 / 36
	Natural / Unnatural	10 / 30	25 / 15	20 / 20	18 / 22	22 / 18	21 / 19	18 / 22	15 / 25	32 / 8
	Shiny / Non Shiny	10 / 30	11 / 29	14 / 16	10 / 30	13 / 27	12 / 28	9 / 31	12 / 28	19 / 21
10 washing cycles	Bad feel / Good Feel	35 / 5	24 / 6	21 / 19	30 / 10	27 / 13	22 / 18	30 / 10	21 / 19	4 / 36
	Rough / Smooth	39 / 1	32 / 8	29 / 11	38 / 2	28 / 12	27 / 13	35 / 5	27 / 13	7 / 33
	Warm / Cold	10 / 30	14 / 26	22 / 18	14 / 26	15 / 25	22 / 18	13 / 27	25 / 15	34 / 6

The Effects of Repeated Laundering and Structural Parameters on the Terry Fabric Preference of Japanese Consumers and Comparison with Turkish Consumers

20 washing cycles	Heavy / Light	8 / 32	13 / 27	13 / 27	11 / 29	15 / 25	14 / 26	9 / 31	19 / 21	7 / 33
	Thick / Thin	6 / 34	19 / 21	17 / 23	15 / 25	20 / 20	26 / 14	16 / 24	23 / 17	17 / 23
	Soft / Hard	1 / 39	6 / 34	18 / 22	2 / 38	7 / 33	20 / 20	8 / 32	12 / 28	28 / 12
	Wet / Dry	1 / 39	7 / 33	9 / 31	1 / 39	7 / 33	11 / 29	7 / 33	10 / 30	23 / 17
	Short pile length / Long Pile Length	40 / 0	32 / 8	21 / 19	35 / 5	23 / 17	17 / 23	23 / 17	12 / 28	8 / 32
	Natural / Unnatural	13 / 27	23 / 17	18 / 22	17 / 23	15 / 25	19 / 21	16 / 24	13 / 27	18 / 22
	Shiny / Non Shiny	8 / 32	9 / 31	11 / 29	12 / 28	10 / 30	10 / 30	6 / 34	10 / 30	15 / 25
	Bad feel / Good Feel	37 / 3	25 / 15	25 / 15	33 / 7	32 / 8	24 / 16	34 / 6	26 / 14	14 / 26
	Rough / Smooth	40 / 0	29 / 11	29 / 11	35 / 5	35 / 5	24 / 16	34 / 6	32 / 8	15 / 25
Warm / Cold	4 / 36	16 / 24	19 / 21	7 / 33	16 / 24	27 / 13	13 / 27	20 / 20	24 / 16	
40 washing cycles	Heavy / Light	6 / 34	10 / 30	9 / 31	11 / 29	13 / 27	16 / 24	5 / 35	10 / 30	15 / 25
	Thick / Thin	5 / 35	12 / 28	15 / 25	10 / 30	14 / 26	24 / 16	6 / 34	18 / 22	21 / 19
	Soft / Hard	0 / 40	8 / 32	1 / 39	1 / 39	3 / 37	10 / 30	9 / 31	8 / 32	25 / 15
	Wet / Dry	1 / 39	4 / 36	1 / 39	0 / 40	2 / 38	8 / 32	4 / 36	3 / 37	19 / 21
	Short pile length / Long Pile Length	39 / 1	34 / 6	25 / 15	33 / 7	20 / 20	12 / 28	27 / 13	16 / 24	14 / 26
	Natural / Unnatural	15 / 25	19 / 21	17 / 23	11 / 29	7 / 33	11 / 29	22 / 18	13 / 27	27 / 13
	Shiny / Non Shiny	12 / 28	13 / 27	8 / 32	10 / 30	6 / 34	12 / 28	10 / 30	12 / 28	16 / 24
	Bad feel / Good Feel	38 / 2	28 / 12	33 / 7	37 / 3	34 / 6	31 / 9	29 / 11	30 / 10	15 / 25
	Rough / Smooth	38 / 2	32 / 8	36 / 4	39 / 1	39 / 1	34 / 6	34 / 6	31 / 9	21 / 19
Warm / Cold	3 / 37	9 / 31	11 / 29	5 / 35	7 / 33	17 / 23	14 / 26	15 / 25	24 / 16	

Table 8. The correlation between requested properties and preference

Requested properties		Preference	Requested properties		Preference
Heavy	Pearson Correlation	,196*	Light	Pearson Correlation	-,196*
	Sig. (2-tailed)	,197		Sig. (2-tailed)	,197
Thick	Pearson Correlation	,565**	Thin	Pearson Correlation	-,565**
	Sig. (2-tailed)	,000		Sig. (2-tailed)	,000
Soft	Pearson Correlation	,907**	Hard	Pearson Correlation	-,907**
	Sig. (2-tailed)	,000		Sig. (2-tailed)	,000
Wet	Pearson Correlation	,898**	Dry	Pearson Correlation	-,898**
	Sig. (2-tailed)	,000		Sig. (2-tailed)	,000
Short Pile Length	Pearson Correlation	-,511**	Long Pile Length	Pearson Correlation	,511**
	Sig. (2-tailed)	,000		Sig. (2-tailed)	,000
Natural	Pearson Correlation	,871**	Unnatural	Pearson Correlation	-,871**
	Sig. (2-tailed)	,000		Sig. (2-tailed)	,000
Shiny	Pearson Correlation	,807**	Non Shiny	Pearson Correlation	-,807**
	Sig. (2-tailed)	,000		Sig. (2-tailed)	,000
Bad Feel	Pearson Correlation	-,948**	Good Feel	Pearson Correlation	,948**
	Sig. (2-tailed)	,000		Sig. (2-tailed)	,000
Rough	Pearson Correlation	-,930**	Smooth	Pearson Correlation	,930**
	Sig. (2-tailed)	,000		Sig. (2-tailed)	,000
Warm	Pearson Correlation	,897**	Cold	Pearson Correlation	-,897**
	Sig. (2-tailed)	,000		Sig. (2-tailed)	,000

**Correlation is significant at the 0.01 level (2-tailed) and *Correlation is significant at the 0.05 level (2-tailed).

4. CONCLUSION

This study assessed the effect of structural parameters of terry fabrics such as weft yarn count and weft density on the sensorial preferences of Japanese participants. The results are compared with the results obtained in the previous study which conducted with Turkish participants. Both Japanese and Turkish participants preferred terry fabric samples woven with finer weft yarns at a higher rate among the terry fabrics with close weights. In daily use terry fabrics are one of the frequently washed home textile products. It is well known that the physical and structural properties of textile products can change after repeated washing. These changes can affect customer satisfaction with the product. For this reason, this study has also evaluated the change of preference of Japanese participants on terry fabrics after repeated washings with household detergent and fabric softener. When the data from Japanese participants were compared with the data from Turkish participants, it was found that the preference rate for terry fabrics decreased with increasing number of washings among the participants of both countries. According to the results of the second step of the study, conducted with Japanese participants, it was found that softness, moisture feel, fabric type, shininess, hand feel, roughness and warmth are the most important characteristics for the hand of the fabric. The presented assessment can be helpful in designing new assortments of preliminarily accepted structural properties, on the basis of the importance of characteristics related to preference of terry woven fabrics.

5. REFERENCES

1. Yılmaz, N. D., Powell, N., Durur, G., 2005. The Technology of Terry Towel Production. *Journal of Textile and Apparel, Technology and Management*, 4(4), 115-160.
2. Ala, D.M., İkiz, Y., 2017. Subjective and Objective Evaluations of Terry Fabrics: Effects of Structural Parameters and Repeated Laundering. *Textile and Apparel*, 27(4), 361-365.
3. Kalayci, E., Avinc, O., Yavas, A., Coskun, S., 2019. Responsible Textile Design and Manufacturing: Environmentally Conscious Material Selection. In *Responsible Manufacturing: Issues Pertaining to Sustainability*. Editors: A.Y. Alqahtani, E. Kongar, K.K. Pochampally, S.M. Gupta, Boca Raton, 413.
4. Khan, M.A., 2022. Product Report on Towel Industry 2022. Trade Development Authority Pakistan, Shahrah-e-Faisal, Karachi.
5. Ala, D.M., 2021. An Experimental Study on Selected Performance Properties of 100% Cotton Terry Fabrics. *Textile and Apparel*, 31(1), 43-52.
6. Yick, L.K., Cheng, K.P.S., How, Y.L., 1995. Subjective and Objective Evaluation of Men's Shirting Fabrics. *International Journal of Clothing Science and Technology*, 7(4), 17-29
7. Slater, K., 1997. Subjective Textile Testing. *Journal of the Textile Institute*, 88(2), 79-91.
8. Luible, C., Varheenmaa, M., Magnenat-Thalman, N., Meinander, H., 2007. Subjective Fabric Evaluation. 2007 International Conference on Cyberworlds (CW'07), 2007: IEEE, 285-291.
9. Valatkienė, L., Strazdienė, E., 2006. Accuracy and Reliability of Fabric's Hand Subjective Evaluation. *Materials Science (Medžiagotyra)*, 12(3), 253-257.
10. Zhao, Y., Yin, L., İkiz, Y., Sato, T., Yu, Q., Zhang, Z., Zhu, K., Li, Q., 2020. A Study on Customer's Preference Toward Summer-Shirt Fabric. *Journal of Engineered Fibers and Fabrics*, 15, 1-7.
11. Sülar, V., Okur, A., 2007. Sensory Evaluation Methods for Tactile Properties of Fabrics. *Journal of Sensory Studies*, 22(1), 1-16.
12. Koç, E., Zervent, B., 2006. An Experimental Approach on the Performance of Towels-Part I. Bending Resistance or Softness Analysis. *Fibres and Textiles in Eastern Europe*, 14(1), 39-46.
13. Susurluk, G., Türker, E., İkiz, Y., 2021. Effect on Bending Rigidity of Towel Samples with Different Fiber Content. *The Online Journal of Science and Technology-January*, 11(1), 17-21.

14. Au, K.F., Chan, C.N., Ho, Y. M., 2002. An Assessment of Softness Property of Knitted Golf Fabrics. *Research Journal of Textile and Apparel*, 6(2), 37-49.
15. Singh, J., Behera, B., 2015. Performance of Terry Towel. *Indian Journal of Fibre & Textile Research (IJFTR)*, 40(1), 112-121.
16. Uttam, D., Sethi, R., 2016. Impact of Repeated Washings on Dimension Stability and Fabric Physical Factors of Woven Cotton Fabric. *International Journal of Research in Engineering&Applied Sciences*, 6(2), 126-135.
17. Duru, S.C., Candan, C., 2013. Effect of Repeated Laundering on Wicking and Drying Properties of Fabrics of Seamless Garments. *Textile Research Journal*, 83(6), 591-605.
18. Avinc, O., Wilding, M., Gong, H., Farrington, D., 2010. Effects of Softeners and Laundering on the Handle of Knitted PLA Filament Fabrics. *Fibers and Polymers*, 11(6), 924-931.
19. Ala, D.M., Bakıcı, G., 2016. Ev Tipi Yıkama ve Kurutma İşlemlerinin Denim Görünümlü Örme Kumaşların Kalınlık ve Hava Geçirgenlik Özelliklerine Etkisi. *Tekstil ve Mühendis*, 23, 263-270.
20. İkiz, Y., Sato, T., Arik, B., Matsumoto, Y., Sarıkaya, G., 2017. The Effects of Psychological Manners on Visual and Tactile Evaluation of Towel Preferences of Turkish and Japanese Consumers. *The Journal of the Textile Institute*, 108(7), 1150-1156.