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Short Communications

Sensory evaluation of different pashmina shawls

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Pashmina shawls prepared from different hand spun, machine spun and blended yarns have been evaluated subjectively. The important handle properties, such as softness, smoothness, lustre and total hand value, have been assessed by sensory evaluation through expert judges of different age and gender. The correlation coefficient between the groups for individual property has been determined. The softness and smoothness values show highest agreement between different groups followed by smoothness and total hand value. The good agreement between groups indicates that the difference in pashmina shawl manufacturing and blend composition can be distinguished. The subjective test results have been compared with FAST objective values and a good correlation is observed.

Keywords: Blended fibre, Nylon, Polyvinayl alcohol, Pashmina shawl, Sensory evaluation, Smoothness, Softness

Fabric handle is one of the most important attributes that determine whether a particular fabric is suitable for a given end-use, which, in turn, decides the commercial success or failure of textile-manufacturing processes or products[1]. Sensory properties of fabrics are appreciated through manipulation usually performed by textile manufactures, tailors and also by consumers. The assessment of handle characteristics is an important tool not only for innovative product development but quality of traditional fabrics. Consumers purchase textile product usually after touching and comparison of tactile properties with personal expectations in terms of fabric quality[2]. Sülar *et.al.*[3] studied the objective and subjective evaluations of fabrics to predict fabric handle and suitable model to predict total handle value by using simple laboratory measurements. Hiroyuki *et al.*[4] reported that end-use performance of fabric in terms of handle, which measures the quality of fabrics as evaluated by tactilely and visually as well.

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They identified two common factors, namely 'lustre and depth sensation' and 'surface roughness sensation' as the principal factors of fabric aesthetics.

Bacci *et al.*[5] assessed fabrics manufactured with 100% Sardinian sheep wool and with local Tuscan wool (50% Sardinian and 50% Comisana sheep wool). These fabrics were subjected to sensory evaluation performed by a trained panel, and to an instrumental evaluation method through FAST. They investigated the correlation between instrumental data and sensory attributes. The principal component analysis (PCA) indicated a high correlation for grittiness, stiffness and force of compression in one direction, whereas tensile stretch, softness, warmth and fullness in the opposite direction thus clearly discriminating these fabrics. This discrimination appears to be an effect of the wool used for the different fabrics. Further, the canonical correlation analysis indicated that measurements performed using FAST were correlated with a number of basic touch traits, including softness, stiffness, force of compression and tensile stretch. FAST measurements have also been studied for their correlations with the tactile feeling of crispness and coolness and with softness and warmth of woollen and worsted fabrics made up of pure wool and wool/other animal hair blends[6]. FAST is proved useful for textile industries that need to control and manage the processes aimed at specific handle characteristics using an objective system.

Pashmina is the most luxurious fibre and fetch higher price among all natural fibres, mainly owing to its fineness, softness, pureness, warmth and long life[7]. Pashmina shawl also possesses unique character of [illegible] women wear due to its excellent handle and feel to touch[8]. Keeping these facts in view, a detail investigation on sensory evaluation of pashmina shawl was carried out. In addition, the subjective evaluation of visual characteristics of pashmina fabric has not been reported till now. The objective evaluation was carried out using FAST[9].

In the present study, two tactile properties i.e. stiffness and smoothness and one aesthetic properties i.e. lustre of the fabrics were evaluated by a panel of 20 individuals, in four categories according to gender (male & female) and age (24-40 & 41-60 years). The correlations between the categories has been observed.

The ccorrelations between visual and touch sensory evaluation of fabric and FAST measurements have also been investigated.

Experimental

Preparation of Shawl Fabric

The pashmina yarns were prepared using hand spinning and machine spinning process. The raw pashmina fibre was scoured by using non ionic detergent (1%) and sodium carbonate (0.5%) at 50ºC. The dehairing was carried out on modified cotton card at slow speed (2 m/min) with 5 passages. For machine spun yarn, the dehaired pashmina sliver was blended separately with nylon (50:50) and polyvinyl alcohol (PVA) sliver (70:30) on gill box before machine spinning at Mahadev Woollen Mills, Sundernagar. The machine spun yarn of 100 Nm and 80 Nm was produced from pashmina: nylon and pashmina: PVA blend respectively. Both yarns were doubled to get desired strength and used as warp on light weight handloom to weave shawl using 2/2 twill design. In order to make pure pashmina shawls, nylon and PVA component of shawls was removed using commercial grade hydrochloric acid and hot water respectively[10]. The dehaired card sliver was converted into hand spun yarn using traditional, improved, small and ball bearing charkha to use as a weft yarn during weaving. Besides this, different blends of speciality hair fibres were also used as weft yarns. The details of the yarn samples prepared are shown in Table 1.

Subjective Sensory Assessment of Shawl

Subjective assessment of developed shawls for present study was carried out using methodology adopted by Kawabata & Niwa[2]. The judges were asked to estimate single fabric attributes, rather than to express overall performances for fabrics on the basis of total hand to reduce inherent errors in subjective measurement. Hence, two tactile properties (stiffness and crispness) of the fabrics were subjectively evaluated by a panel of 20 individuals (10 men and 10 women; both men and women groups were sub-divided into two groups i.e. young and adult), in two blind tests for each property, and under the same controlled laboratory conditions which are generally used for the objective FAST measurements. The judges were asked to wash and dry their hands before the test. The expert panel was educated about how to define the specific tactile property of the fabric and how to handle the fabric for a specific tactile property of the fabric according to Kawabata and others[6, 11]. They were asked to rank fabrics on 11 point scale, from 0 (no feeling) to 10 (the strongest feeling), according to the HESC (Hand Evaluation and Standardization Committee), reproduced sets of primary hand standard samples for smoothness, softness and luster[6,11,12]. Total hand value was ranked by judges on 6-point scale, 0 (no feeling) to 5 (strongest feeling). The assessed values awarded by judges were statistically analyzed to find out agreement within and between them. The score given by different judges was averaged out, and the correlation between averaged hand value and subjectively assessed hand value by individual judge was observed.

Results and Discussion

Sensory Assessment for Softness

The sensory assessment of shawls for softness indicates that among all hand spun yarns, ball bearing charkha yarn has outperformed other three hand spun yarns. Surprisingly, highest softness is recorded for machine spun yarn followed by hand spun yarn and lowest for yarn blends of wool and rabbit hair. The inherent degree of variability associated with the charkha hand spinning in relation to machine spun yarn may be adversely affected while judging the fabric at different places. The softness of machine spun nylon and PVA is comparable. It is also observed that silk/wool blended yarn in weft gives comparable softness with hand spun yarns. It may be because of higher softness of silk fibre. The analysis of subjectively assessed softness values by different judges according to age and gender reveals that rank response of male adult is significantly higher among all other sub groups. The young judges, both male and female, have better correlation than adult ones in assessing the softness value (Table 2). It is further observed that cumulative response, irrespective of age and gender, adversely affects the agreement among observers.

Table 1—Details of pashmina shawls

Shawl code	Spinning process	Yarn used in shawl
PTC	Hand spun	Pashmina traditional charkha
PIC	Hand spun	Pashmina innovative charkha
PSC	Hand spun	Pashmina small charkha
PBC	Hand spun	Pashmina ball bearing charkha
PNB	Machine spun	Pashmina nylon (carrier) blend yarn
PPB	Machine spun	Pashmina PVA (carrier) blend yarn
PWB	Machine spun	Pashmina-wool blend yarn
SWB	Machine spun	Silk –wool blend yarn
RWB	Machine spun	Rabbit hair-wool blended yarn

Sensory Assessment of Smoothness

Fabric smoothness/roughness has been considered as one of the most important parameters which govern clothing comfort. It is also a significant factor in consumer's buying decision. Smoothness-roughness sensation has a power function related to fabric handle. In Kawabata's fabric handles properties evaluation system, a factor named "Numeri" (smoothness) is related to bending, surface (friction and roughness) and compression properties[2]. Recently, Bishop concluded that roughness is associated with friction, shear, bending stiffness, and thickness[1]. For subjective assessment, Matsuo has chosen types of trained judges depending on the purpose and objectives of the study being conducted[4]. However, Kawabata selected expert panel members as part of a committee to evaluate fabric hand[2]. Kawabata used a single descriptor term and a scale where subject rates how well the terms describe the fabric[2].

The smoothness of shawl has been subjectively assessed by the individuals on the scale of 0-10 (Table 3). It shows that there is no significant difference in smoothness among the different shawls except PNB and PPB shawl which show significantly higher smoothness than pure Pashmina and PWB/Silk/Rabbit hair blended shawl. It is further observed that the judges do not have very high agreement (95%) for smoothness, which infers that the observers could not differentiate clearly the smoothness characteristic of different shawls. Further, the rank awarding response of female adult is found significantly higher than adult male and younger male and female group. The correlation coefficients among adult male and female are found higher than that of young male and female. It reveals that adult male and female group of observers give better response in assessing the smoothness of pashmina shawl than young ones. It is further observed that cumulative response, irrespective of age and gender, adversely affects the agreement among observers.

Sensory Assessment of Visual Appearance (Lustre)

The handle measures the quality of fabrics as evaluated by reactions obtained not only tactilely but also visually. The well-known Kawabata evaluation system includes both an objective evaluation and a prediction method of the handle. However, objective evaluations of the handle based on a visual perception of fabric aesthetics have been investigated rarely. Hiroyuki *et al*.[4] attempted to carry out a sensory evaluation of fabric aesthetics by experts on textile and

Table 2 — Sensory assessment for softness of pashmina shawls

Shawl code	Male adult	Male young	Female adult	Female young	Male	Female	Cumulative
PTC	6.8	7.1	6.4	5.8	7.0	6.1	6.5
PIC	7.3	6.9	7.1	5.7	7.1	6.4	6.8
PSC	7.2	7.0	6.6	5.6	7.1	6.1	6.6
PBC	8.3	7.0	7.4	6.4	7.7	6.9	7.3
PNB	8.9	8.9	8.6	9.1	8.9	8.9	8.9
PPB	8.5	8.1	8.6	8.3	8.3	8.4	8.4
PWB	6.6	6.1	5.8	5.2	6.4	5.5	5.9
SWB	7.8	6.8	7.0	7.6	7.3	7.3	7.3
RWB	6.5	5.6	5.4	5.2	6.2	5.3	5.7
Mean	7.5	7.1	7.0	6.5	7.3	6.8	7.0
Correlation coefficient	0.89[a]	0.92[a]	0.89[a]	0.92[a]	0.88[a]	0.89[a]	0.88[a]

[a]Significant at 99% confidence level.

Table 3 — Sensory assessment for smoothness of pashmina shawls

Shawl code	Male adult	Male young	Female adult	Female young	Male	Female	Cumulative
PTC	6.0	6.7	4.7	6.0	6.4	5.2	5.8
PIC	6.3	6.5	5.0	5.9	6.4	5.3	5.9
PSC	6.9	6.6	5.0	6.1	6.8	5.4	6.1
PBC	7.5	6.3	6.2	6.5	6.9	6.2	6.5
PNB	8.5	8.6	7.9	8.4	8.6	8.2	8.4
PPB	7.9	8.1	7.4	8.1	8.0	7.8	7.9
PWB	7.0	6.5	5.2	5.3	6.8	5.3	6.0
SWB	8.1	6.7	6.9	7.2	7.3	7.1	7.2
RWB	6.0	5.9	4.1	4.6	6.0	4.4	5.2
Mean	7.1	6.9	5.8	6.5	7.0	6.1	6.6
Correlation coefficient	0.85[a]	0.75[b]	0.91[a]	0.80[a]	0.75[b]	0.79[a]	0.71[b]

[a]Significant at 99% confidence level; [b]Significant at 95% confidence level.

untrained consumers using worsted and spun silk woven fabrics, which have different material and structural effects. They reported two common factors — 'lustre and depth sensation' and 'surface roughness sensation' as the principal factors of fabric aesthetics. In similar line, lustre of pashmina fabrics in pure form and blended with other fibres has been evaluated. The values awarded by observers for lustre are given in Table 4. The visual appearance in term of lustre on 0-10 scale shows that shawls made from weft yarn spun on charkha have dull appearance. The higher values for PNB and PPB indicate that the lustre gets improved after blending with nylon and PVA. The judges also recorded high lustre value wherever there was silk and rabbit hair component in pashmina blends. It may be due to the smooth and lustrous surface of silk fibre and rabbit hair.

Sensory Assessment of Total Hand Value

The total hand value (THV) of pashmina shawls has been subjectively assessed on the scale of 0-5 (Table 5). It indicates that shawls made of machine spun nylon/PVA as well as SWB give very high THV (4-4.3). However, shawl made of yarn on different charkha, PWB as well as RWB yarn gives the THV between 2.8 and 3.4. It indicates that the method of shawl manufacturing plays an important role with respect to its tactile properties. The judges recorded poor THV for shawl made using silk filament in the weft. Hence, it may be inferred that silk filament in the wet does not give feel of shawl and may not be accepted by the consumer's as a shawl.

Correlation between Groups in Sensory Assessment

The correlation coefficients between different judges, irrespective of gender and age, are found significant (Table 6). It is found that there is a good agreement in the opinions of various judges, especially for softness and lustre. The correlation coefficients for all the properties are highly significant at 99% confidence level, except smoothness which is significant at 95% level. The correlation coefficients among the different groups are also worked out and it is observed that there is a very good correlation between young and adult, female and male for lustre and softness. The relative disagreement for THV

Table 4 — Sensory assessment for lustre of pashmina shawls

Shawl code	Male adult	Male young	Female adult	Female young	Male	Female	Cumulative
PTC	4.0	4.6	4.6	4.1	4.3	4.4	4.3
PIC	4.2	4.6	4.4	3.6	4.4	4.0	4.2
PSC	4.2	4.8	4.6	4.4	4.5	4.5	4.5
PBC	4.7	4.8	5.0	4.6	4.8	4.8	4.8
PNB	6.6	6.6	7.6	8.0	6.6	7.8	7.2
PPB	5.8	7.0	6.8	6.1	6.4	6.4	6.4
PWB	5.4	6.3	5.5	5.9	5.9	5.7	5.8
SWB	8.0	6.8	8.1	7.1	7.4	7.6	7.5
RWB	6.4	5.7	6.6	6.1	6.1	6.4	6.2
Mean	5.5	5.7	5.9	5.5	5.6	5.7	5.7
Correlation coefficient	0.91[a]	0.83[a]	0.89[a]	0.91[a]	0.84[a]	0.89[a]	0.86[a]

[a]Significant at 99% confidence level.

Table 5 — Sensory assessment for THV of pashmina shawls

Shawl code	Male adult	Male young	Female adult	Female young	Male	Female	Cumulative
PTC	3.0	3.1	3.1	2.3	3.1	2.3	2.9
PIC	3.0	3.0	3.1	2.2	3.0	2.2	2.8
PSC	2.9	3.0	3.2	3.1	3.0	3.1	3.0
PBC	3.2	3.5	3.6	2.7	3.5	2.7	3.2
PNB	4.0	4.1	4.5	4.8	4.1	4.8	4.3
PPB	3.7	4.1	3.9	4.3	4.1	4.3	4.0
PWB	3.7	4.0	3.1	2.8	4.0	2.8	3.4
SWB	4.4	4.2	4.3	4.1	4.2	4.1	4.2
RWB	3.1	3.5	3.6	2.7	3.5	2.7	3.2
Mean	3.4	3.6	3.6	3.2	3.6	3.2	3.4
Correlation coefficient	0.90[a]	0.89[a]	0.89[a]	0.82[a]	0.87[a]	0.70[b]	0.81[a]

[a]Significant at 99% confidence level; [b]Significant at 95% confidence level.

Table 6 — Correlation among the panel categories

Particulars	Lustre	Softness	Smoothness	THV
Between young and adult male	0.86[a]	0.93[a]	0.75[b]	0.95[a]
Between young and adult female	0.95[a]	0.90[a]	0.71[b]	0.67
Between male and female	0.97[a]	0.95[a]	0.70[b]	0.62
Between cumulative and male	0.99[a]	1.00[a]	0.98[a]	0.98[a]
Between cumulative and female	0.99[a]	0.99[a]	0.94[a]	0.81[a]

[a]Significant at 99% confidence level; [b]Significant at 95% confidence level.

between groups may be attributed to subjective integration of different factors during assessing the total hand value of shawl.

Correlation between Sensory Assessment and FAST Properties

The correlation coefficients between subjectively assessed hand values and FAST properties are shown in Table 7. It is observed that the extensibility at different loads and direction shows positive relation with softness, smoothness and THV. The correlation between THV and weft extensibility at 5 g/cm load (E5) is found 0.74 which is significant at 95% confidence level. The correlations between THV and weft extensibility at higher loads (E20 and & E100) are 0.81 and 0.77 respectively, which are significant at 99% confidence level. The bending length and rigidity are negatively correlated with softness, smoothness and THV. The correlation between softness and weft bending length (C-2) is 0.69 which is significant at 95% confidence level. However, correlation coefficients between softness and bending rigidity are 0.80 and 0.82 for warp and weft respectively and are significant at 99% confidence level. A negative correlation is found between shear rigidity (G) and subjectively assessed hand values, however they are non-significant. The thickness at different loads shows negative correlation with subjectively assessed hand values. It is found significant for T100 at 95% and non-significant for others. The surface thickness shows positive correlation with softness and negative correlation with smoothness and THV, however, they are non-significant.

It is reported that compression, extension and bending FAST properties of hand-spun shawl are comparable with machine-spun shawls and better than the blends with wool/silk/rabbit hair[9]. The sensory

Table 7 — Correlation between subjective assessment and objective FAST measurements

FAST properties	Softness	Smoothness	THV
Weft extension at			
5 g/cm width (E5)	0.46	0.56	0.74[b]
20 g/cm width (E20)	0.51	0.49	0.81[a]
100 g/cm width (E100)	0.38	0.39	0.77[a]
Bias extensibility (EB5)	0.49	0.27	0.59
Warp bending length (C-1)	-0.50	-0.04	-0.35
Weft bending length (C-2)	-0.69[b]	-0.25	-0.44
Warp bending rigidity warp (B-1)	-0.80[a]	-0.40	-0.56
Weft bending rigidity weft (B-2)	-0.82[a]	-0.43	-0.52
Shear rigidity (G)	-0.53	-0.24	-0.57
Thickness at 2 g/cm² load (T2)	-0.28	-0.66	-0.27
Thickness at 100 g/cm² load (T100)	-0.49	-0.68[b]	-0.19
Surface thickness (ST)	0.11	-0.35	-0.26

[a]Significant at 99% confidence level, [b]Significant at 95% confidence level.
E5–Extensibility at 5g/ cm load, E20–Extensibility at 20g/cm load, E100–Extensibility at 100 g/ cm load, EB5– Biaxial extensibility at 5 g/cm load, C-1–Warp bending length, C-2–Weft bending length, B-1–Warp bending rigidity, B-2–Weft bending length, G-Shear rigidity, T2–Fabric thickness at 2 g/cm^2, T100–Fabric thickness at 100 g/ cm^2, and ST- Fabric surface thickness.

subjective analysis shows the similar trend. Instead, the judging panel has given better ratings to machine spun yarn as compared to hand spun yarn made shawls.

The sensory assessment reveals that pashmina shawls made up of machine spun yarns are soft and smooth as compared to hand spun yarns and blends with wool/silk/rabbit hairs. The ball bearing charkha yarn provides highest softness, smoothness and among all charkha yarns. The blends of silk and rabbit hair show higher lustre value among all yarns followed by machine spun yarn. The judges invariably have given higher ratings of total hand value to the shawls prepared from machine spun yarns as compared to hand spun yarn. The subjective assessment of softness, smoothness and total hand value of pashmina shawls has good correlation with some of the objectively measured FAST properties such as extension and bending properties. The young judges, both male and female, have better correlation than adult ones in assessing the softness whereas vice-a-versa in the smoothness assessment. The cumulative agreement on lustre and softness properties is found higher as compared to smoothness and total hand value of shawl.

Overall agreement of judges, irrespective of age and gender, clearly indicates that difference in the

manufacturing method and blend composition in the pashmina shawls can be distinguished through subjective sensory evaluation.

References

1 Bishop D, *Text Prog,* 26 (3) (1996) 1.
2 Kawabata S & Niwa M, *J Text Inst,* 80 (1) (1989) 19.
3 Sülar V & Okur A, *Text Res J*, 78 (10) (2008) 856.
4 Hiroyuki K, Mika M, Kentaro N, Toyonori N, Kiyohiro S & Toshio M, *Text Res J*, 81 (12) (2011) 1216.
5 Laura B, Francesca C, Serena D, Massimiliano M, Enrico V, Antonio M Stefano Predieri, *Text Res J,* 82 (14) (2012) 1430.
6 Mazzuchetti G, Demichelis R, Bianchetto Songia M & Rombaldoni F, *Fibres Text East Eur,* 16 (4) (69) (2008) 67.
7 Yaqoob I, Sofi A H, Wani S A, Sheikh F D & Bumla N A, *Indian J Trad Know*, 11 (2012). 329.
8 Shakyawar D B, Raja A S M, Kumar A, Pareek P & Wani S A, *Indian J Fibre Text Res,* 38 (2013) 207.
9 Shakyawar D B, Raja A S M, Wani S A, Kadam V V & Pareek P K, *J Text Inst,* 106 (3) (2015) 327.
10 Raja A S M, Shakyawar D B, Pareek P K & Wani S A, *Indian J Small Rumi*, 17 (2011) 203.
11 Hollies N R S, Custer A G, Morin C J & Howard M E, *Text Res J*, 49 (1979) 557.
12 Matsuo T, *J Text Mach Soc Japan*, 25 (1972) 742.