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Asif H Sofi
Division of Livestock Products Technology, F.V.Sc and A.H., Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Jamu & Kasmir, India

Sarfaraz A Wani
Division of Livestock Products Technology, F.V.Sc and A.H., Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Jamu & Kasmir, India

DB Shakyawar
Division of TMTC, CSWRI, Avikanagar

VK Malhotra
UPTTI Kanpur, U.P., India

Sheikh Rafeh Ahmad
Division of Livestock Products Technology, F.V.Sc and A.H., Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Jamu & Kasmir, India

MA Pal
Division of Livestock Products Technology, F.V.Sc and A.H., Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Jamu & Kasmir, India

Sayer Beig
Division of Livestock Products Technology, F.V.Sc and A.H., Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Jamu & Kasmir, India

AA Khan
Division of Livestock Products Technology, F.V.Sc and A.H., Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Jamu & Kasmir, India

Correspondence
Asif H Sofi
Division of Livestock Products Technology, F.V.Sc and A.H., Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Jamu & Kasmir, India

Subjective evaluation of Pashmina and Pashmina blended knitted fabrics

Asif H Sofi, Sarfaraz A Wani, DB Shakyawar, VK Malhotra, Sheikh Rafeh Ahmad, MA Pal, Sayer Beig and AA Khan

Abstract
A study was conducted to develop a pashmina and pashmina blended knitted fabrics with an aim to diversify the product range of pashmina and evaluate its consumer acceptability. Pashmina, wool and nylon was blended in to five different proportions, viz; T1 (60:0:40); T2 (45:15:40); T3 (30:30:40); T4 (15:45:40); T5 (0:60:40). Each blend was spun in to three types of yarn viz; 24, 36 and 48 count, making a total a 15 types of yarn. All the types of yarn were processed into interlock knitted fabric on a circular knitting machine. The subjective assessment of the fabrics revealed that along the blend composition, the stiffness score showed a decreasing trend while smoothness, fullness and softness and Total hand value showed an increasing trend from T1 to T5. Along with yarn count, the fabrics of all blends showed a decreasing trend in stiffness score and increasing trend in smoothness, softness and total hand value from thick to thin yarn. From the study it was concluded that consumers prefer and showed liking towards the fabrics having more proportion of pashmina with finer yarn.

Keywords: fabrics, pashmina, smoothness, softness and wool

Introduction
Pashmina, a down fibre or undercoat derived from domestic goat known as *Capra hircus*, native to Asia is known as prince of speciality hair fibres. It has derived its name from the Persian word *"pashm"* meaning *"soft gold", the king of fibres* [1]. It is well known for its fineness, warmth, softness, desirable aesthetic value, elegance and timelessness in fashion. It is most luxurious fibre, commanding higher price [2] and is softer than superfine merino of the same diameter. It has occupied a unique position among the fibres of animal origin because of its warmth, lightness, handle and its ability to absorb dyes and moisture [3]. In India, majority of pashmina is utilized for preparation of shawls in Kashmir valley which are mostly hand spun and hand woven with long life and no pile formation [4]. Processing of pashmina is an age old practice in Kashmir valley and are known for its quality throughout the world. Not only quality of the fibres but also the traditional method of processing has given these pashmina products a royal status in the world [5].

Knitting is the second most frequently used method, after weaving, that turns yarns or threads into fabrics [6]. It is a process of fabric development where loops are interlaced in different designs. It can also be defined as a process of using two or more needles to loop yarn into a series of interconnected loops so as to create a finished garment. There has been a growing interest in knitted fabrics due to its simple production technique, low cost, high levels of clothing comfort and wide products range [7]. Knitted fabrics of all kinds are generally popular because of its wrinkle-resistance [6] their flexibility, stretch to a particular shape when worn as well as because of their general comfortable wear [8]. Because of these added advantages, knitted products find wide application in the fields of sports, medical, hosiery, industrial, furnishing, construction etc [9].

The fabric hand or handle has been defined as the quality of a fabric or yarn assessed by the reaction obtained from the sense of touch or the sum total of the sensation expressed when a textile fabric is handled by touching, flexing of the fingers and so on [10]. It implies the ability of the fingers to make a sensitive and discriminating assessment and of the mind to integrate and express the results in a single valued judgment. Touching a fabric is the first action customers perform so as to evaluate the fabric quality for garments development as well as its performance for the end use.

Keeping in view the qualities of pashmina as well as benefits of knitting, the present study was aimed at value addition and diversification of pashmina product range through development of pashmina and pashmina blended knitted fabrics and evaluate for consumer acceptability.

Material and Methods

Changthangi pashmina (13µ), Australian merino wool (21µ) and Nylon (2.5 denier) were blended into five proportions viz; T1 (60:0:40); T2 (45:15:40); T3 (30:30:40); T4 (15:45:40); T5 (0:60:40). Each blend was spun in to three types of yarn viz; 24, 36 and 48 count on a ring frame spinning machine, making a total a 15 types of yarn. All the types of yarn were processed into interlock knitted fabric on a circular knitting machine with specifications: (Make: new national mechanical works Ludhiana; gauge: 12 GG; diameter: 12 inch; number of needles: 1400; and speed: 30 rpm). The fabrics were scoured at 40ºC for 30 minutes using non-ionic synthetic detergent, followed by rinsing for the same time period. The samples were tumble dried followed by ironing.

The fabrics in the form 20x20 cm dimension pieces were presented to 60 consumers, both young and middle aged, belonging to both sexes for subjective evaluation as per the proforma of [11]. They were asked to rate the fabric in batches, first along the blend composition and then along the count for Primary Hand value and Total Hand value. Primary hand value comprising of stiffness (Koshi), smoothness (Numeri) and fullness and softness (Fukarami) were rated on 10 point scale where 1 means lowest feeling and 10 means strongest feeling for stiffness, smoothness and fullness and softness. Fabrics were rated by the consumers for Total hand value on 5 point scale where 1 means poor and 5 means excellent. The scores obtained were evaluated by adapting the non-parametric tests viz; Kruskal wallis and Mann Whitney test.

Results and Discussion

The results pertaining to the Primary Hand Value and Total Hand Value of pashmina and pashmina blended knitted fabrics on the basis of blend composition and yarn count are delineated in Table 1and 2.

On the basis of blend composition, the stiffness score which is governed by the flexural rigidity of the constituent fibres and yarn [12] revealed that within 24 count yarn fabrics, T_1 showed a significant difference with T_2, T_3 T_4 and T_5; while as T_5 showed a significant difference with other treatments. However non-significant difference was found between T_2 and T_3; as well as between T_3 and T_4. Within 36s yarn, comparable results were found between T_1 & T_2; and T_4 & T_5. However T_3 showed a significant difference with other treatments. Within 48s count yarn fabrics, T_1 and T_2 as well as T_3, T_4 and T_5 showed comparable scores among each other. However, latter three showed significantly higher scores than T_1 and T_2. The fabrics rated by the consumers subjectively showed an increasing trend for stiffness from T1 to T5, indicating that with the increase in the wool proportion in the blends, the stiffness of the fabric increases. Our results were in agreement with the study of [12] who also reported higher stiffness score (> 7) for the pure woolen as well as woolen–synthetic fabric blends. The stiffness score of the cotton and linen fabrics obtained by [13] were also in agreement with the results of blends having higher wool proportion in our study.

Smoothness value of a fabric is a function of surface characteristics of fibre and yarn used for fabric manufacture [12]. The pashmina and pashmina blended fabrics within 24s count yarn showed a comparable smoothness score among T_3, T_4 and T_5. However, T_1 and T_2 showed a significant difference among each other as well as with T_3, T_4 and T_5. Within 36 yarn count, T1 and T2 as well as T4 and T5 showed non-significant difference among each other while T3 showed significant difference with other treatments. Non-significant difference was found between T1 and T2 as well as between T3, T4 and T5 within 48s count yarn fabrics. From the results, it was revealed that as the proportion of pashmina in the blend increases, the smoothness score also increase. It could be probably because of the difference in the surface characteristics of the wool and pashmina [12] as the pashmina fiber is smoother than wool which is reflected in the smoothness score of the fabric also. [12] Reported the smoothness score of different woolen and woolen–synthetic fabric blends ranged from 2-4, which was also in agreement with scores obtained for the fabrics having more proportion of wool in our study.

The fukurami value is mainly indicative of softness, compressibility and surface smoothness [14]. The pashmina and pashmina blended fabrics made from 24s yarn showed a non-significant difference in fullness and softness score between T1, T2, T3, and T4 as well as between T3, T4 and T5. However, T5 showed a significant difference with T1 and T2. The 36 count yarn showed a non-significant difference scores between T3, T4 and T5 while as T1 and T2 showed a significant difference with T3, T4 and T5 as well as among each other. The fabrics made from 48 count yarn showed a non-significant difference between all the treatments. In general, the softness scores decreases from T1 to T5 indicating that by increasing the wool proportion in the blend, the softness of the fabric also decreases. [12] Also reported the lower softness scores for the different wool and woolen blends.

On the basis of the primary hand value viz; stiffness, smoothness and fullness and softness, the consumers gave an overall acceptability called Total Hand value. The total hand value of 24s pashmina and pashmina blended fabrics showed comparable scores between T2 & T5; T2 & T3; as well as between T3 and T4. However T1 showed a significantly higher score than other treatments. The 36s pashmina and pashmina blended fabrics showed a decreasing trend from T1 to T5. Non-significant difference was found between T1 & T2; T2 & T3; T3 & T5; and T4 and T5. The 48s pashmina and pashmina blended fabrics also showed a scores in decreasing trend from T1 to T5. In general the score obtained for Total hand value indicate that the pashmina-nylon (T1) blend was having a rating ranging from medium to excellent as compared to wool-nylon (T5) blend which got a score ranging from medium to average. The decreasing trend in the Total hand value scores indicates that consumers have liking towards the smoother and softer fabrics. [15] Also reported that the consumers have a better liking towards hand spun pashmina shawls as they rated them with a THV ranging from 3.60 to 4.25. However, [16] reported that as the proportion of the camel hair fibre is increased in the merino: camel blended knitted fabric, the THV score decrease which is not in agreement with our results. This could probably be because of the difference in surface characteristics of pashmina and camel fibre.

On the basis of yarn count, the subjective assessment of pashmina and pashmina blended fabrics with nylon in terms of stiffness showed a decreasing trend from 24s to 36s to 48s. While in case of smoothness and softness, increasing trend was found from lower to higher yarn count fabrics. This could probably be because of the difference in the linear density of yarn utilized for the product development as the handle of the fabric is affected mainly by yarn composition, yarn properties as well as on the fabric structure and fabric geometry [17]. The trend in the subjective score indicates that with the increase in yarn count of the fabrics, the fabric becomes smoother and softer. As the yarn count of the fabric increase, the total hand

value also showed an increasing trend. Since the total hand value is a function of stiffness, smoothness and softness scores, the increase in the THV along the yarn count is because of the increase in smoothness and softness scores and decrease in stiffness scores [12].

Table 1: Effect of blend composition on subjective assessment of pashmina and pashmina blended knitted fabrics.

Yarn count	Blend Composition				
	T1	T2	T3	T4	T5
Stiffness					
24s	4.43±0.23^{a}	5.15± 0.22^{b}	5.70± 0.24^{bc}	6.07± 0.24^{c}	7.05± 0.24^{d}
36s	4.39±0.24^{a}	4.52± 0.28^{a}	5.49± 0.26^{b}	6.49± 0.26^{c}	6.50± 0.22^{c}
48s	4.25±0.22^{a}	4.60± 0.21^{a}	5.74± 0.23^{b}	5.78± 0.17^{b}	6.31± 0.25^{b}
Smoothness					
24s	6.39±0.20^{c}	5.72± 0.21^{b}	5.00± 0.21^{a}	5.07± 0.20^{a}	4.53± 0.19^{a}
36s	6.92±0.19^{c}	6.52± 0.20^{c}	5.82± 0.23^{b}	4.92± 0.22^{a}	4.84± 0.22^{a}
48s	6.92±0.19^{b}	6.62± 0.19^{b}	5.80± 0.19^{a}	5.72± 0.20^{a}	5.29± 0.21^{a}
Fullness and Softness					
24s	5.98±0.20^{b}	5.96± 0.22^{b}	5.56± 0.19^{ab}	5.58± 0.21^{ab}	5.17± 0.25^{a}
36s	6.70±0.20^{c}	6.03± 0.24^{b}	5.39± 0.23^{a}	5.19± 0.18^{a}	5.35± 0.22^{a}
48s	6.21±0.25^{a}	6.21± 0.19^{a}	5.70± 0.20^{a}	6.03± 0.23^{a}	5.70± 0.22^{a}
Total Hand Value					
24s	3.62±0.12^{d}	3.40± 0.11^{ac}	3.14± 0.13^{bc}	3.02± 0.13^{b}	2.65± 0.11^{a}
36s	3.57±0.15^{d}	3.22± 0.11^{cd}	3.02± 0.13^{bc}	2.62± 0.12^{a}	2.67± 0.12^{ab}
48s	3.62±0.13^{c}	3.49± 0.11^{c}	3.39± 0.13^{bc}	3.02± 0.13^{ab}	2.89± 0.18^{a}

Row wise means with different lower case superscript differ significantly.
Stiffness; smoothness; and fullness and softness rated on 10 point scale where 1 means lowest feeling and 10 means strongest feeling.
Total hand value rated on 5 point scale where 1 means poor and 5 means excellent.

Table 2: Effect of yarn count on subjective assessment of pashmina and pashmina blended knitted fabric.

Yarn count	Blend Composition				
	T1	T2	T3	T4	T5
Stiffness					
24s	6.05±0.25^{c}	6.39±0.26^{b}	6.43±0.22^{b}	6.66±0.24^{b}	6.96± 0.22^{b}
36s	5.15±0.24^{b}	4.92±0.26^{a}	5.82±0.28^{b}	6.09±0.23^{b}	5.70± 0.21^{a}
48s	4.31±0.24^{a}	4.54±0.27^{a}	4.58±0.26^{a}	4.52±0.26^{a}	5.11± 0.22^{a}
Smoothness					
24s	5.62±0.24^{a}	5.58±0.20^{a}	5.64±0.20^{a}	5.37±0.21^{a}	5.17± 0.22^{a}
36s	5.92±0.20^{a}	6.37±0.18^{b}	5.96±0.20^{a}	5.74±0.19^{a}	6.03± 0.23^{b}
48s	6.60±0.21^{b}	6.62±0.22^{b}	6.76±0.24^{b}	7.17±0.20^{b}	6.98± 0.22^{c}
Fullness and softness					
24s	6.01±0.23^{a}	5.54± 0.19^{a}	5.74±0.24^{a}	5.43±0.22^{a}	5.50± 0.22^{a}
36s	6.35±0.19^{ab}	6.21± 0.20^{b}	5.76±0.18^{a}	5.41±0.20^{a}	6.23± 0.20^{b}
48s	6.74±0.20^{b}	6.68± 0.22^{b}	6.27±0.22^{a}	6.62±0.24^{b}	6.68± 0.24^{b}
Total Hand Value					
24s	3.16±0.15^{a}	2.94± 0.12^{a}	3.14±0.13^{a}	3.19±0.14^{a}	2.89± 0.12^{a}
36s	3.47±0.08^{a}	3.60± 0.10^{b}	3.26±0.11^{a}	3.28±0.12^{a}	3.96± 0.12^{b}
48s	3.85±0.13^{b}	3.62± 0.12^{b}	3.66±0.14^{b}	4.01±0.12^{b}	3.99± 0.15^{c}

Column wise means within each parameter with different lower case superscript differ significantly.
Stiffness; smoothness; and fullness and softness rated on 10 point scale where 1 means lowest feeling and 10 means strongest feeling.
Total hand value rated on 5 point scale

Conclusion

The study revealed that consumers have a liking and preference towards pashmina fabrics because of the smoother surface characteristics as compared to the wool. Further, the fabrics made from finer yarn are more preferred by the consumers than the fabrics made from thicker yarn, irrespective of their blend composition.

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