

Review Article

Pashmina fibre —Production, characteristics and utilization

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Pashmina, popularly known as 'Cashmere', is well known for its fineness, warmth, softness, desirable aesthetic value, elegance and timelessness in fashion. It is most luxurious, softer and warmer than superfine merino wool. The word pashmina is originated from a word 'pashm' means 'soft gold' in local language, and 'wool' in Persian language. India produces about 40-50 tonnes of fibre annually. The fibre is mostly used for preparing shawls with intricate designs by the artisans of Srinagar. An attempt has been made to provide comprehensive review covering production, processing and utilization aspects of pashmina fibre.

Keywords: Cashmere, Dehairing, Fibre, Pashmina, Shawl, Wool

1 Introduction

Speciality animal fibres have special attributes of fineness, softness and lustre that are rarely associated with any other fibres. Besides adding softness or lustre to the product, specialty hair fibres in many cases have glamour of being very rare. Their scarcity is due to the fact that they are difficult to produce on a large scale, because of climatic conditions and/or genetic factors. They have the ability to add warmth to the fabric without the addition of proportionate weight. Among these fibres, pashmina is the finest animal fibre produced in fairly large quantity in the world. Pashmina is the down fibre derived from the hair of domesticated goat *Capra hircus* indigenous to Asia¹. It is always mixed with coarse outer coat known as guard hair which needs to be separated before processing for value-added products. The objective of this study is to provide comprehensive review of pashmina fibre production, processing and utilization due to non availability of such information in literature.

2 Production

The world-wide total production of pashmina fibre is about 10000-15000 tons/annum. The major fibre producing countries are China, Mongolia, Iran, Afghanistan, Pakistan, Nepal, and India. Apart from

these countries, Australia, Britain and New Zealand also produce this cashmere fibre. However, it is worth to note that the qualities of fibre produced in different countries is not same. There is significant variation in fibre qualities. Therefore, it is named based on its origin like Mongolian, Chyangara (Nepal), Australian cashmere etc. China is the major producer of pashmina with the share of 70% followed by Mongolia with 20% share. The rest 10% of the total production is from other countries including India, which produces less than 1% of the total production².

In India, two pashmina producing goat breeds are found i.e. Changthangi and Chegu. Changthangi breed is domesticated in Ladakh region of Jammu and Kashmir and Chegu in Lahul and Spitti and Kinnaur region of Himachal Pradesh and Uttarkashi, Chamoli and Pithoragarh region of Uttarakhand. The annual production of pashmina in India is 40-50 tons harvested from nearly 2 lakh goats. The net value of the dehaired pashmina is approximately Rs. 35 crores, which, in turn fetches value approximately Rs. 200 crores after value addition through shawl manufacturing. The changthangi area, producing the majority of Indian pashmina, is situated at 3000 to 5000 m above sea level. The area is extremely arid with very low humidity and rainfall. The temperature in these areas ranges from -40°C to +40°C.

In India, bulk of pashmina fibre is used for the manufacture of shawls, mainly in Kashmir valley. The fabric produced from pashmina is usually hand spun

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and hand woven product. The processing of pashmina involves lot of labour in sorting, spinning, weaving and dyeing which are usually done manually. The shawl made of pashmina with intricate and unique designs, with the help of local sticks (*Kani*) using hand jacquard is known as *Kani shawl*. Recently, these hand-woven pashmina shawls have received a Geographical Indication (GI) for its unique nature. Most of the pashmina products produced in Kashmir are export oriented and realize very high price. Ladies shawl woven on the specially designed Pashmina loom with unique design and embroidery work may fetch from Rs. 10000 to Rs. 50,000 in Indian market, whereas as in international market it would fetch much higher price.

3 Properties

3.1 Physical Properties

Fibre fineness is the most important quality parameter giving value to pashmina fibre and differentiates it from the sheep wool. The average fibre fineness is 12-13 μ . The fineness distribution lies in the range 9-20 μ . The average fibre length is 55-60 mm. The fibre length depends on its source, origin/genotypes and grade. The mean fibre length of guard hair varies from 25mm to 93 mm, which needs to be combed/sorted for better spinnability³.

3.2 Structural Properties

The morphological structure of pashmina fibre is similar to fine wool fibre comprising outer cuticle and cortex. However, there is no medullation in the fibre. The cortex is the main fibre compound surrounded by outer cuticle scales. The microscopic structure⁴ of the fibre is given in Fig. 1. The figure shows the presence of cuticles and the diameter of the fibre is uniform

and even. This aspect of uniform diameter of the pashmina fibre differentiates it from sheep wool. The SEM of pashmina fibre is given in Fig. 2. It shows the pashmina fibre⁵ having even diameter and relatively distant and smooth cuticle scales. The mean scale frequency is 10-15 per 100 μ m. The pashmina fibre has unique scale pattern which differentiate it from wool. It has regular, flatter and ladder type cuticle cells compared to sheep wool which is irregular with higher scale height. The lower scale height of the pashmina fibre provides the soft handle, lustrous surface, lower shrinkage and slippery nature. The cortex of pashmina fibre has a predominance of ortho-cortical and meso-cortical cell rather than para-cortical cell. Meso-cortical cells have higher microfibril packing density than wool of same diameter, which may results lower crimp pashmina fibre⁶. The differential shrinkage between ortho and para cortex may also be the reason for low crimp in the fibre. However, further studies are required to know the exact reason of lower crimp in pashmina.

3.3 Chemical Properties

Pashmina fibre is a protein fibre with polyamide polymer made up of 18 amino acids with α -keratin

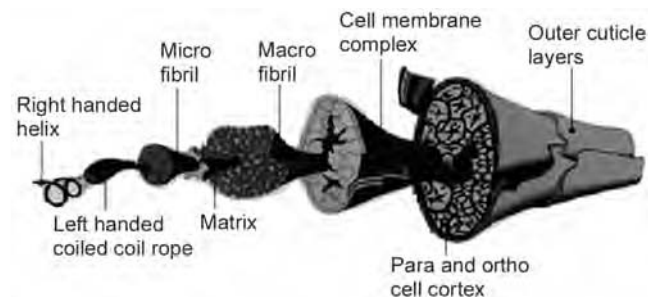


Fig. 1—Morphological structure of wool

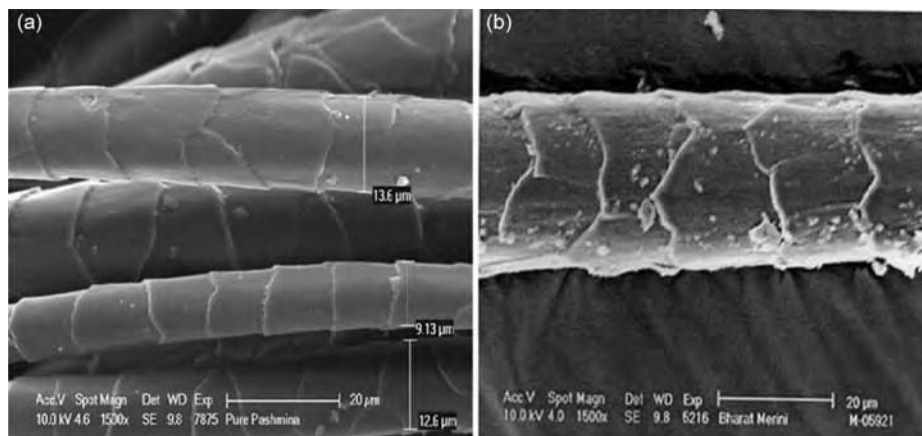


Fig. 2—SEM of (a) pashmina (b) wool fibres

arranged in helical structure like that in wool. Chemically, it is identical to wool and mohair fibres⁷. The amino acid composition of pashmina fibre is very similar to that of fine wool except cystine, tyrosine (12% more than wool) and proline (9% lower than wool). It is also observed that the pashmina fibre has more polar amino acids viz. serine, threonine and tyrosine than in fine wool, with the result its cuticle is more hydrophilic⁸. The disulphide linkage is more susceptible to alkalis and bleaching agents than in wool. Pashmina is more sensitive towards the chemicals due to its more hydrophilic groups and less hydrophobic groups than in wool. The breakdown of the fibre even at relatively low temperature and low concentration in alkali, acid and bleaching solutions can be marked¹. The sensitivity of pashmina to chlorine is especially high and its use in any form must be avoided.

4 Processing

Pashmina is used to produce different aesthetic products like knitwear, scarves, blankets, gloves, hats, woven fabrics, outer coats, etc. However in India, majority of the pashmina is utilized for the preparation of shawls, mainly in Kashmir valley.

4.1 Fibre Harvesting and Marketing

Raw pashmina is collected during spring moulting season when animals naturally shed their undercoat. On the basis of weather conditions and region, the goats start moulting over a period from February to late May. In India, combing is the major method of harvesting pashmina using special type of comb. After harvesting, pashmina is dusted manually to remove adhered impurities like sand, dust, etc. The percentage of dusting loss varies and ranges 10-20 %. The fleece is also sorted based on its colour. The natural colours of the fibre are white, grey mixed with brown and brown. Generally, white fibres with long fibre length fetch higher price since longer fibres are easy to spin. Apart from the colour and fibre length, the fibre is also graded on the basis of down fibre per cent. The grades and colour of different pashmina wool⁹ are presented in Table 1.

The price of the fibre mainly depends on its fineness, length, colour and down fibre content. Finer, longer and white pashmina realizes better price as compared to coarser, coloured and shorter fibre. In India, the procurement of pashmina is generally done from all Changthangi Pashmina growers Association, Leh Ladakh. Only small quantity of the fibres is used

locally. Major portion of the fibre is sold and sent to Srinagar and Kullu Valley for utilization. The price of raw pashmina fibre is 10-15 times more than that of crossbred fine wool in India. The price of scoured and dehaired pashmina fibre becomes 30-40 times more than that of scoured fine wool. The presences of guard hair in the dehaired pashmina fibre adversely affect its price.

4.2 Dehairing

Dehairing is a process by which outer coat of guard hair is separated from the under coat fine fibres. Raw pashmina fibre is having 50-60% guard hair. The guard hair is very thick with 50-100 μ diameter, covering the fine down fibre of 10-13 μ diameter. The guard hair should be removed completely before processing for improving the spinnability and for development of best quality products¹⁰. The presence of more than 5% guard hair would definitely affect the appearance, handle and quality of the final products. In India, the dehairing process was previously carried out manually followed by teasing on wooden combs. The process was time consuming and laborious. With the change in technology, the dehairing process is now mechanized. Pashmina fibre after dusting is passed through flats and cylinder type cotton carding machine running at much lowered speed. The coarser guard hairs get removed due to the differential speed mechanism between flats and cylinder. For complete dehairing, 4-5 passages of dehairing are used. Hence, major demerits associated with machine dehairing are the lowering of fibre strength and fibre breakage. During dehairing process, fibre is subjected to mechanical action which results in fibre breakage.

There are also other types of commercial dehairing machines available mainly developed by Western countries. These machines are costly and require large quantity of fibres for processing. In market, 3% residual guard hair is allowed and legally considered

Table 1 —Colour and proportion of the fine and guard hair in pashmina wool

Grade	Colour	Down hair %	Guard hair %
Unsorted	White / grey /brown	40-80	60-20
Sorted-1	White / light grey /dark grey/ brown	78-82	22-18
Sorted-2	White /light grey /dark grey/ brown	48-60	52-40
Sorted 3	White / light grey / dark grey/ brown	20-40	80-60

as pashmina for export. Similarly, the acceptable level of guard hair presence in shawl is 0.5% and below 0.2% level in knitted goods.

A study was conducted to compare the quality of pashmina fibres dehaired manually and with machine. It is reported that fibre diameter and bundle strength show non-significant difference, whereas fibre length and co-efficient of friction show significant difference between manual and machine dehairing. Scanning electron microscopic images clearly show surface damage in case of machine dehaired pashmina fibre¹¹.

4.3 Scouring and Bleaching

Pashmina fibre contains about 5% contaminants like wax, skin flakes, suint and dirt. Traditionally, in India, scouring is not done at fibre stage but is carried out in yarn stage before dyeing and weaving. However, in some countries like Australia, the pashmina fibre is scoured at fibre stage itself before dehairing. Now-a-days, machine dehairing is commonly carried out in India and hence scouring of raw pashmina is done before dehairing. The scouring is done by using 0.2 gpl non-ionic detergent at 50°C for 10 min. The other impurities like burrs and vegetable matters are removed manually. Generally, the process of carbonization, used in wool to remove vegetable matters, is not carried out, as pashmina is very delicate and it may damage the fibre.

Bleaching is not normally carried out for pashmina in India. However, for white fibres or fabrics to be dyed with pale shades, bleaching is required. In such cases, bleaching with hydrogen peroxide is used under mild alkaline condition. Bleaching of pigmented pashmina is common in other countries. In order to achieve good bleach on dark cashmere fibres, the material has to undergo a pre-treatment with ferrous sulphate, in presence of reducing agent such as sodium hydrosulphite and organic acids such as formic acid and citric acid. The iron penetrating into the fibre is absorbed by the pigment granules and firmly bound forming a metal-chelate complex. After this mordanting process, the yarn is bleached with hydrogen peroxide¹.

4.4 Spinning

On account of small availability of this specialty fibre, most of it is utilized locally with the help of specially designed manually operated traditional charkha locally known as *yander*. Traditionally, combing is done by impaling dehaired raw pashmina repeatedly on an upright comb (10 cm wide, set on a

wooden stand). Combed pashmina is obtained in the form of a loaf called *Tumb* followed by *gluing* usually with soaked powdered rice. The yarn can be spun up to 108 Nm (92.6 tex). Generally, 2/64-2/108 Nm yarn is spun for making high quality shawls¹².

With the advent of technology, efforts have been made by the industries to spun 100% pashmina yarn by mixing with nylon fibre¹³. The nylon portion of the yarn is then dissolved by treating with commercial grade hydrochloric acid either after spinning or after product development. In this process, the dehaired and carded sliver of pashmina fibre is passed through gill box 3-4 times to remove the short fibres and to parallelize them. At this stage, the nylon fibre in sliver form is blended with the pashmina fibre in the proportion of 50:50 and allowed to undergo 5-6 passages in gill box for proper blending. The resultant sliver is then converted into roving on last pre-spinning machine i.e. bobbiner. The roving is taken to ring frame for spinning. The produced yarn is doubled to get the required strength which is then used for product development.

Nylon portion of the machine spun yarn made fabric is removed using commercial grade hydrochloric acid. The principle behind is that nylon gets dissolved in HCl while pashmina fibre does not dissolve in acids. Based on this, the pashmina-nylon blended fabric is treated with hydrochloric acid in a bath for three times with consecutive rinsing on every treatment. By this acid treatment, nylon portion of the fabric gets dissolved completely. The results (Table 2) indicated that the hand spun yarn made fabrics are as good as traditional hand spun yarn made shawls in terms of their strength, handle and other performance properties. However, the abrasion loss is 50% higher which is the only limiting factor. One of the demerits of this process includes weakening of fibre in the fabric (decreasing life of the product), due to the use of higher amount of hydrochloric acid for dissolving nylon (not considered as ecofriendly).

Table 2—Performance properties of pashmina fabrics produced from hand spun and machine spun yarns

Property	Hand spun yarn	Machine spun yarn
Breaking strength, kg	4.964	4.975
Extension, %	40.72	25.67
Alkali solubility, %	38.00	46.00
Abrasion loss, %	3.75	5.73
Thermal insulation, tog	2.00	1.95

Pashmina fibre is also spun in machine using polyvinyl alcohol fibre (PVA) instead of nylon as carrier fibre¹⁴. PVA fibres are soluble in hot water. To remove the PVA from the fabric, the fabric is treated with hot boiling water instead of hydrochloric acid. The advantage of this technique is that pashmina fibre does not get damaged in hot water as in case of HCl. This method of spinning is considered as ecofriendly but costly due to the higher price of PVA fibre. Compared to nylon and PVA fibre, the PVA based spinning of pashmina is ecofriendly due to the use of only hot water in place of hydrochloric acid used for removing nylon.

4.5 Weaving

Traditionally, pashmina yarn is wound on a small flange bobbin manually using *parota*. The sizing of yarn is done in hank form using *Saresh* as an adhesive to improve strength and weavability of yarn. The warping of yarn is carried out manually using sticks. The process is time consuming and creates non-uniform tension during the weaving¹².

The weaving of pashmina yarn into shawl is carried out in a special type of handloom. Before weaving, pashmina yarn is sized with special type of starch/resin. The handloom woven pashmina shawl has more value in the market. The handloom weaving of shawl is usually done by the skilled artisans. The weight of the hand woven shawl is approximately 200 g. The ends and picks per inch of pashmina shawl are generally kept between 50-60 and 46-56 respectively. The dimensions of the ladies, gents and stole are 2.1m × 1m, 2.5m × 1.37m and 2.0 × 0.8m respectively. The fabric weight (GSM) is kept at 50-70g. After weaving, the fabric is hand massaged for releasing the stress inserted during spinning and weaving. The shawl is produced with intricate and unique designs viz. chasma bulbul, ribbed weave, etc. One of the unique designs generally used in pashmina shawl is known as Kani shawl. Some quantity of hand spun yarn is also used in knitting for manufacturing of pullover and sweaters.

4.6 Dyeing and Finishing

The dyeing behaviour of pashmina is identical with sheep wool. However, due to hydrophilic outer cuticle, the uptake of dye is faster. The acid dyes, 1:1 metal-complex dyes, 1:2 metal-complex dyes and reactive dyes are used for dyeing pashmina fabrics. Generally, pashmina fabrics are dyed with dark and bright colours like red, blue, yellow, green and black. Dyeing with

acid dyes is carried out at pH 2-3 with the addition of sulphuric acid. The dyeing is carried out in weak acidic condition by adding acetic acid or sodium acetate. The other important dye used for dyeing pashmina products is 1:2 metal complex dyes. This class of dye provides excellent washing and light fastness to the pashmina fabrics. The metal complex dyes are mainly used for producing pale shades. The use of reactive dyes for pashmina is limited. The local dyers at Srinagar use different type of levelling agents in order to facilitate quick and even dyeing. The dyeing of shawls is carried out in a pot type vessel heated with gas stove by exhaust method. The dyeing of shawl is done individually by hand dyeing technique. After dyeing the fabrics are air dried under relaxed condition.

Pashmina fabrics/yarns are also dyed using natural dyes¹⁵⁻¹⁷ obtained from different sources. The dyers are using Indigo for blue colour, Annota seed for getting red colour, and henna, myrobolan etc for getting yellow and brown shades. They are also using mordants like aluminium sulphate and ferrous sulphate for getting bright yellow and grey shades respectively.

Pashmina products have unique softness property along with lustre. Therefore, normally it does not require any finishing process. The addition of any type of finishing agent may spoil the unique softness of the product. However, now-a-days, the pashmina fabrics are produced out of machine spun yarn in blends with other fibres. Such blended pashmina products are treated with thermoplastic softening agents like silicone softener, nano-based softening agents, etc. in order to improve the handle. Generally, the softening finishing treatment is done after dyeing using 0.5-1.5% softener under acidic condition. The other important finishing treatments carried out on pashmina fabrics by few dyers include anti-moth finishing and aroma finishing. Anti-moth chemical such as Eulon is added during dyeing under acidic conditions. The aroma finishing is carried out by using commercially available fragrance micro capsules.

4.7 Designing and Embroidery

The value addition of pashmina shawls is being done by designing and embroidery work. Traditionally pashmina shawls are prepared with some unique designs. One such design is *Kanizamar* fabric produced on the principle of hand jacquard technique. Similarly, hand embroidery is done on pashmina shawls with unique and intricate designs. *Sozani* is one such hand embroidery design produced in Kashmir valley. The embroidery is done with fine

stitches using needles to intricate and unique designs. In some cases, block printing is also employed with the use of pigments, silver and gold to decorate the fabrics with intricate designs. The Kashmir artisans use different type of designing techniques and produce the unique pashmina shawls by hand jacquard, hand embroidery, block printing, etc.

5 Marketing of Pashmina Products

Marketing of pashmina product is very important from consumer point of view. Any product having soft feel and lustre is being marketed in the name of pashmina. Therefore, for many items the consumer is not sure about their quality and pure pashmina products. As per the wool products labelling act of USA, the pashmina product labels must accurately reflect the item's fibre content, the country of origin, and the name of the manufacturer or marketer. Moreover, the product must be labelled to show a safe cleaning method. The label must accurately disclose the content of fibre. It would be illegal to say that for pashmina or pashmina blend, the percentages must be stated. There is only one exception to the requirement that percentages must be replaced by the word 'All' if product is made of 100% fibre¹⁸, e.g. 'All Wool or All Cashmere'.

Recently, in order to check the sale of fake plain pashmina and Kani shawls, Government of India has awarded the GI patent recognizing handmade shawls of Kashmir origin. Under the GI of goods, Kashmiri handmade pashmina shawls now can use their own logos¹⁹. The patent came after an agreement among Kashmir Handmade Pashmina Promotion Trust, Wild Life Trust of India and Craft Development Institute, Srinagar. GI registration was issued into two categories. In first category, the entire process of shawl making would be hand made using vegetable colours and the second category contain material process evolved over decades would be permitted with both vegetable and synthetic colours.

6 Identification and Differentiation from other Fibres

The pashmina fibre is one of the finest fibres in the world. It is an expensive resource for the textile industry which makes it susceptible to falsifications. Instead of pashmina, the cheaper sheep wool is used and the product is then declared as genuine pashmina. Or products contain only a small amount of pashmina while the rest is wool which is processed without declaration. The products such as shawl and sweater

made out of pashmina fibre are sold at about 10 times higher price compared to the similar products produced from merino sheep wool. Therefore, the textile industry and testing laboratories need detection methods which guarantee reliable testing of cashmere products. The problem is further aggravated after the introduction of super fine merino wool. Both cashmere and super fine merino wool fibres are having similar attributes like diameter, chemical constitution, etc. Due to this reason, the cashmere fibre is often adulterated with superfine merino wool.

A fibre blend of pashmina and sheep wool will give similar results in the conventionally used textile testing methods like light microscopic analysis, chemical analysis, solvent method and burning test. Chemically, there is little difference between wool and pashmina. At present, scanning electron microscope (SEM) is used to differentiate pashmina and wool fibres based on the cuticle scale pattern. Cuticle scale characteristics and scale height have been used as the main diagnostic features to classify wool and pashmina. Current standard test methods for analyzing blends of pashmina with sheep wool are based on scanning electron microscopy (SEM) (IWTO test method 58), light microscopy²⁰ (LM) and American Society for Testing and Materials²¹. The test accuracy that can be achieved depends largely on the operator's expertise with the visual/microscopic appearances of different fibres. The current operator-based methods are tedious and subjective²². It is desirable to develop an objective, automatic method to identify and subsequently classify animal fibres

The cuticle scale pattern of pashmina and sheep wool is given in Fig. 2. In brief, pashmina fibre has flatter cuticle cell profiles. However, the cuticle scales of fibres can be easily modified by using oxidizing agents, reducing agents, softeners and enzymes. In addition, there are some fibre combinations, that even an experienced microscopist cannot differentiate (e.g. fine yak hair and brown cashmere; the dark pigmentation of these fibres prevents assessment of their internal structure)²³. Hence, several alternative methods like morphological studies, protein and lipid analysis, DNA analysis etc. are developed by the researchers. Molecular analyses of animal fibres for their amino acids²⁴, polypeptides²⁵ and lipids²⁶ have been developed for the identification of different animal fibres. However, these techniques are not accurate enough to differentiate animal fibres due to variations in fibre processing, climate and diet of the

animal. In contrast, DNA based animal fibre identification tools are very sensitive, stable and reliable.

The DNA analysis based method is promising one since pashmina and wool are from different animal species. By this method, it is possible to distinguish raw pashmina and wool. However, when the fibres are mixed and subjected to conventional process like dyeing, finishing, almost all the research studies pointed the difficulties in extracting DNA²⁷.

7 Future Thrust Area of Research

Several interventions made in processing and product development of pashmina fibre by different agencies have increased productivity of spinning and weaving processes which resulted in enhanced profitability of artisans engaged in this sector. However, there is still more work need to be carried out to make the profession more economic sustainable to face future challenges in this sector. Areas identified for future research are given below:

7.1 Improvisation in Dehairing

Dehairing process of pashmina fibre is mechanized using modified cotton card based machine on the principle of differential speed of cylinder and flats. During this process, 15-17% reduction in fibre length is observed due to fibre breakage as well as loss of fine fibres. A method based on air flow principle is more appropriate for reducing fibre breakage. It is mainly used by machine manufactures of Australia and Mongolia. Hence, a proto type model of dehairing machine having air flow principle is needed to be developed in future.

7.2 Identification of Pashmina Fibre

PCR based technique has been developed for identification of pashmina-wool and pashmina – angora rabbit hair blending. However, a protocol for identification of yak and silk fibre with pashmina is required to be developed in future research. Estimation of blend proportion of different fibres in the processed fabrics is also need of time using RT-PCR based technique.

7.3 Product Diversification

Generally, pashmina fibres are not blended with any fibre. However, in order to reduce cost of product, now-a-days they are generally blended with different synthetic and natural fibres for producing value-added products. Sheep wool due to their identical physical and chemical properties is most

preferable fibre for blending. The production cost of pashmina shawls can be reduced by blending pashmina with fine merino tops, angora, silk, etc. Studies on this aspect carried out at Division of Livestock Products Technology, SKUAST-K, Srinagar, revealed that pashmina - wool blend ratio of 80:20, 70:30, and 50:50 reduced costs up to 30-40%. It was found that up to 30% blending can be done without deteriorating the quality of the product²⁸. Now-a-days, pashmina fibre is blended with superfine merino wool (14-16 μ). The product made out of that blend is having almost similar handle and comfort like that of pure pashmina product. Another important fibre blended with pashmina is silk. A high quality union fabric with silk as warp and pashmina as weft is prepared with unique design which has high demand in global market. In China, pashmina -silk blended yarns in different proportion are prepared for making these blended products.

There is ample scope to develop diversified knitted products using Pashmina fibres and its blends with Nylon and Polyvinyl alcohol. Knitwear is also more economical in production. Hence, there is need to develop pashmina based knitted products. Silk is comparable with pashmina in terms of quality and cost. Blending of silk fibre with pashmina is an important thrust area of research. Silk is compatible with Pashmina in respect of fineness and dyeing behaviour. Moreover, silk is more lustrous than pashmina which enhances final appearance of the product.

Now-a-day, pashmina fibre is also converted in to valuable products like jacket, hat, purses, etc. by using felting process. The process of felting is same like that of wool by layering the web of fibres in a particular design followed felting with the addition of detergents and mechanical force.

7.4 Value-addition to Pashmina Guard Hair

A good amount of guard hairs having diameter more than 40 μ are obtained from pashmina fleece after dehairing. These hairs are generally used for preparing nonwoven felts. However, these are not fetching any value to farmers. Therefore, there is need to develop bio-composites using nonwoven technology. Similarly, powder technology further may help to convert guard hairs into valuable products.

7.5 Introduction of Printed Designs

Ornamentation of pashmina products is being carried out through designing during weaving and

embroidery work. These are costlier methods. Printing technology is one of the cheaper methods for ornamentation of textile product. This technology could be introduced for value addition of pashmina products.

7.6 Improved Dyeing Techniques

The felting of pashmina fabric during dyeing is one of the problems pointed out by the processors. In order to solve this problem, development in dyeing techniques with high exhaustive dyes using the levelling agent/penetration aiding agents is necessary. By this way, the time of dyeing and temperature of dyeing can be reduced which will solve the felting problem. The handle of pashmina products developed using carrier fibres and blended fibres is more easy compared to the traditional hand-made products. The quality of these products could be improved by applying nano chemicals and enzymes. By this way, it is possible to produce machine made pashmina products with same texture and handle like that of traditional products. The value of the pashmina products can be improved by developing functional finishes like antimicrobial, fragrance finish, anti-moth and UV-protection.

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