SUMMARY AND CONCLUSION

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Growing consciousness of the world's limits of dwindling fossil fuels and raw materials have made the mankind question the first phase of industrial manufacture that saw materials as cheap and endlessly renewable and fashion as primary stimulant to demand .The future of textiles lies in the development of new fibres and fabrics. Recent advances have been truly innovative where aesthetics is as important as performance. Today textile companies are very aware of potentially harmful effects to the environment and work within strict guidelines with ecology often being a main concern. The needs, both of the consumer and the environment are being more closely considered with textiles being developed from renewable sources and manufactured with minimum impact on the environment.

The successful manufacture of soyabean protein fibre is break through and follows the developmental direction of world wide fibres. Because its major raw materials come from natural soyabean cake, the quantity of raw material is large and can be readily regenerated. Furthermore, it will not cause waste development. It is abundant and cost- effective. Although price of petroleum increased 21 times over last 50 years, the price of soyabean increased only 6.5 times.

Consumer demand calls for value addition, diversified products and innovation to ensure demand both in domestic and international market. An attempt has been made in this study to utilize the soyabean fibre in blend with wool fibre. The present study has been undertaken to find out the influence of blending these two fibres of different origin on performance of yarns and fabrics with the aim of establishing the best blend.

Objectives of the study were:

1) To analyze properties of soyabean and wool fibre
2) To optimize the process of manufacturing soyabean/wool blended yarns.
3) To test the effect of blending on properties of yarn.
4) To study and compare the properties of fabrics.
5) To study dyeing performance of blended fabrics.

Merino wool fibre was chosen for blending with soyabean fibre because of compatibility of diameter and to some extent length of both the fibres. Blending and Spinning of fibres was done at R.S.W.M., New Product Development Plant, Banswara on ring spinning system. Properties of soyabean and merino wool fibres were tested. Soyabean fibres and wool fibres were blended in three different ratios viz., 80/20, 70/30, 50/50, 0/100 of soyabean/wool. For each blend ratio yarns of 30 Ne were prepared on ring spinning system. The yarns were tested for various yarn properties. Woven and knitted fabric samples (plain weave and single jersey) were prepared on simple hand loom and flat bed knitting machine. Grey fabric samples were tested to measure various fabric properties. Blended fabrics were also judged by the panel of thirty judges. Dyeing of blended fabrics was done with acid, reactive, basic and vegetable dye. Dyeing performance of fabrics in terms of percent dye exhaustion and colour fastness was evaluated. Four prototypes of ladies' garments viz. jacket, top, strap and trouser were developed and their aesthetic appeal was assessed by a panel of clothing textile experts.

Result can be summarized as:

Properties of fibres

1. Soyabean fibre is finer and stronger than Merino fibre. The length of soyabean fibre is less than merino fibre. The number of crimps per inch of merino fibre is more than soyabean fibre. Percent moisture regain of merino fibre is higher than soyabean fibre.

Properties of yarns

2. The properties of pure and blended yarns have been studied and it is found that soyabean 100 and merino 100 has almost similar amount of twist. The yarn twist increases as the % of wool in the blend increases.
3. The yarn count of all the pure and blended yarns ranges from 29.3 Ne to 33.9 Ne.
4. S100 yarn is stronger than 100M yarn. In blended yarns, strength increases as ratio of soyabean fibre increases. The strength of S80:M20 yarn is equal to S100 yarn and that of S70:30M yarn is equal to 100M yarn. Minimum

strength is found for S50:M50 yarn. The elongation % decreases as the content of wool in the blend decreases.

5. Merino 100 yarn exhibits higher percentage unevenness and more number of imperfections than Soya 100.The unevenness increases as % of merino fibre in the blend increases.

Properties of fabrics

6. Among blended woven fabrics, thread count is maximum for S50: M50 followed by S70: M30; it is minimum for S80: M20 fabric. There is slight variation in end and pick density of different woven fabrics. Trend similar to woven fabric is observed in knitted fabrics.
7. Weight of woven merino100 fabric has been found more than soya100 fabric. Among woven blended fabrics, weight of S80: M20 is minimum. Knitted fabrics are heavier in weight than the woven fabrics.
8. Thickness of M100 is more than S100 in case of woven as well as knitted fabrics. Among blended fabrics, the maximum value of thickness has been found for S50: M50 for woven and knit fabrics.
9. Cloth cover of blended fabrics is little less than that of pure fabrics. Among blended fabrics, cloth cover increases as % of wool component in the blend increases.
10. Tightness factor of blended fabrics is less than pure soya and merino fabrics. In case of blended fabrics, the tightness factor of S50:M50 is little more than S70: M30 and S50: M50 blends.
11. The tenacity of M100 is more than S100 for woven fabrics. The tenacity is higher for S 50:M50 and minimum for S80:M20. M100 has more elongation % than S100 in both the direction. Among blended woven fabrics, the elongation % decrease. It is highest for S80:M20 and lowest for S50:M50. For knitted blended fabrics the opposite trend follows, the elongation % increases as the wool % increases.
12. Tearing strength of M100 is higher than S100 fabric. This is similar for woven as well as well as knitted fabrics. It is observed that in case of blended woven fabrics, blending of merino fibre with soya fibre has improved tearing

strength a little which is more than S100. In case of knitted fabrics, strength of blended fabrics is more than S100 and M100.

13. It is found that S100 has marginally higher bursting strength than M100 fabric. It is found that bursting strength of blended fabrics is substantially higher than pure fabrics.
14. Soya/wool blended knitted fabrics have higher abrasion resistance than woven fabrics. In blended fabrics, as ratio of wool in blend increases, abrasion resistance decreases slightly.
15. The pilling tendency of M100 is less than that of S100. In case of blended fabrics, the pilling tendency of S80:M20 is rated as moderate in both woven and knitted fabric. However, in S50:M50 Knit fabric severe pilling is observed. In S70:M30 blend moderate pilling is observed in both woven and knit fabrics.
16. Air permeability of blended fabrics is more than pure soya and merino wool fabrics. The air permeability of knitted fabrics is less than that of woven fabrics.
17. Thermal insulation value of M100 fabric is more than S100 fabric. The T.I.V. of blended fabrics increases as wool percent increases in both woven and knitted fabrics. The T.I.V. of knitted fabrics is more than woven fabrics.
18. Wickabiliy of soya 100 is more than merino 100 for both woven and knitted fabrics. In case of blended fabrics, the rate of wetting increases as percentage of soya increases in the blend in both woven and knitted fabrics.
19. The maximum value of bending length is found for S50: M50 and minimum is for S80: M20 blended fabric. The same trend is observed for knitted fabrics.
20. The knitted fabrics are more drapable than woven fabrics. The percent drape coefficient of pure soya fabric (woven and knitted) is less than that of pure merino fabric (woven and knitted). After blending soya fibre with merino fibre percent drape coefficient of woven fabrics increases further. On the other hand percent drape coefficient of blended knitted fabrics is found to be less than that of pure merino fabric indicating improvement in drape characteristics of knitted fabrics after blending soya fibre with merino. S80: M20 has minimum drape coefficient.

21. Hand of S50: M50 is rated lowest (harsh) among blended fabrics by the judges. Hand of 100S is rated highest, from soft to very soft followed by S70: M30.
22. M100 has better crease recovery than S100. Also it is found that crease recovery angle of blended fabrics is more than pure soya and merino fabrics. Crease recovery improves as wool percent increases in blend fabrics.
23. In case of woven fabrics, the dynamic and static friction of merino 100 is more than soya 100 in both the directions. Among blended woven fabrics, the coefficient of friction increases as the wool component in the blend increases. In case of knitted fabrics, the pure soya and merino fabrics follow the similar trend as woven fabrics but among blended fabrics no trend is observed.
24. S100 knit fabric records the lowest value of surface thickness while M100 the highest value. The maximum value of surface thickness has been found for S70:M30 and lowest value is for S50:M50 among blended fabrics. Among blended fabrics the highest value of STR has been found for S70:M30 and minimum for S50:M50.

    Among woven fabrics, similar trend has been found in pure soya and merino fabric. The thickness increases as the wool component increases in blended fabrics. The released thickness of merino 100 is more than soya 100 fabrics.
25. Bending rigidity of woven fabrics shows similar trend as knitted fabrics. It is maximum for S50:M50 and minimum for S80:M20 in warp wise direction. In course wise direction, the bending rigidity is maximum for S70:M30 followed by S50:M50 and it is minimum for S80:M20.

    The blended fabrics have less shear rigidity than pure soya fabrics, except for S50:M50. Shear rigidity of soya pure fabrics is less than merino pure fabrics. For blended fabric the shear rigidity value is same for S80: M20 and S50: M50 but there is slight increase in shear rigidity for S70:M30 fabric.
26. When extensibility of woven and knitted is compared, it is found that knit fabrics have higher values than woven fabrics except at 5gm load in warp direction. Relaxation shrinkage of M100 knit fabric is more than S100 fabric

in course wise direction where as in wale wise direction the merino 100 knit fabric shows expansion.

27. Hygral expansion of the merino 100M knitted fabric is more than S100 knitted fabric. The formability of knitted fabrics of M100 is more than S100 fabrics. Among blended fabrics in wale wise direction when compared with S100, the formability increases but no particular trend is found as the ratio is increased. Relaxation shrinkage of woven fabrics increases in wale wise and course wise direction after blending fibres. It is same for S100 and M100 in case of wale wise direction but in case of course wise direction S100 has higher value. The hygral expansion of M100 woven fabric in wale wise direction is higher than S100 for but less in course wise direction. Among blended fabrics the formability increases in both the direction up to 30 % but decrease after 30 % increase.

28. The felting shrinkage of 100M fabrics is more than 100S fabric. In 100S relaxation shrinkage is observed. It increases with increase in number of wash cycles. The felting shrinkage decreases as ratio of soya fibre increases. Felting shrinkage in knitted fabrics is higher than in woven fabrics. After chlorination treatment, reduction in felting shrinkage is observed.

29. Percent dye exhaustion has been found maximum for acid dye followed by reactive dye and it is minimum for basic dye. Similar trend has been observed when woven and knitted fabrics are compared. However, knitted fabric shows better dye exhaustion than woven fabrics.

30. It is clear that % dye exhaustion of M100 fabric dyed with vegetable dye is maximum followed by S70: M30 and it is minimum for S100. When % dye exhaustion is analyzed in context of woven and knitted fabric, it is clear that % dye exhaustion of all knitted fabrics is higher than woven fabrics dyed with vegetable dyes.

31. Colour fastness of M100 is more than S100. Among woven blended fabrics, colour fastness to light increases as % of wool in the blend increases. Among knitted fabrics, it is from moderate to excellent. S100 and M100 knitted fabrics exhibit good fastness to light. Among knitted blended fabrics, the same trend follows, the colour fastness increases as the % of wool increases.

32. Dry cleaning fastness of samples dyed with acid dye is rated from very good to excellent for woven and blended fabrics.

33. Washing fastness of all pure and blended fabrics is rated from 3 to 3-4, which indicates noticeable change in color after washing.

34. In case of woven samples, acidic perspiration fastness is rated from average to good. Alkaline perspiration fastness of acid dyed woven samples has been rated from average to moderate with noticeable staining. In case of knitted fabric also acidic perspiration fastness of acid dyes has been rated from 2-3 to 3.Alkaline perspiration fastness of acid dyes is from average to moderate in case of knitted fabric with noticeable staining.

35. Blended fabrics have better color fastness to rubbing than pure fabrics. For knitted fabrics it is rated from very fair to very good.

36. Dry ironing fastness of all the samples has been found from good to excellent with negligible staining. Excellent damp ironing fastness has been observed in all the dyed samples. Samples dyed with acid dyed show slight staining on adjacent fabric. Wet ironing fastness has been found from moderate to very good.

    For knitted fabrics dry ironing fastness of all the samples has been found excellent with negligible staining. Damp ironing fastness has been observed from moderate to very good with slight staining on the adjacent samples. In case of wet ironing fastness it is rated from moderate to good with negligible staining.

37. Aesthetic appeal of jacket has been rated best. Shawl and top have been rated second and third for aesthetic appeal respectively. However, not much difference has been found between the weighted mean score of two garments (i.e. shawl and top).When assessed on criteria of suitability of fabric for garments, maximum weighted score has been found for jacket, then came shawl followed by top and strap/trouser respectively. Price of jacket and shawl has been found most acceptable. Next in order are strap/trouser and top respectively in terms of price of garment.

Conclusion

On the basis of results, it can be concluded that adding wool fibre has improved thickness, stiffness, drapability, crease recovery, thermal insulation, frictional properties, and tensile properties of soya/wool blended fabric. On contrary adding soya has improved tearing strength, bursting strength, abrasion resistance and also pilling properties of soya/wool blended fabric. Also addition of soya has reduced felting propensity of wool. It can be concluded that it that adding soya to wool or soya/wool blending is a successful innovation and it will serve the dual purpose of aesthetics and performance for the textile as well as fashion industry.