International Journal of Physical and Social Sciences
Vol.15 Issue 6, June 2025
ISSN: 2249-5894 Impact Factor: 6.644
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

Functional and Aesthetic Assessment of Jute–Acrylic Blended Yarns

Ritu Hooda[1], Mani Narwal[2]

[1]Associate Professor, Government PG College for Women (GPGCW), Rohtak – 124001; email: ritusunilhooda@gmail.com

[2]Associate Professor, Government PG College for Women (GPGCW), Panchkula – 11111; email: maninarwal5@gmail.com

ABSTRACT

This study investigates the development and evaluation of jute–acrylic blended yarns and fabrics as a cost-effective and sustainable alternative to wool for knitted textiles. Acrylic fibers, primarily used in hand-knitting yarns, hosiery, blankets, and woven suitings, have seen a significant production increase in India. Acrylic is valued for its warmth, soft hand feel, good bulk and pile properties, and superior resistance to abrasion, chemicals, heat, and light. In contrast, jute has certain functional limitations but is eco-friendly and suitable for fabrics, garments, and home furnishings when blended. Techno-economic analyses show that jute–acrylic blends can be 5–25% cheaper than conventional cotton, wool, or polypropylene products, largely due to the lower manufacturing cost of jute yarn, while also supporting livelihoods for jute-farming families. In this study, jute and acrylic fibers were first tested for fineness, length, tenacity, and elongation. Based on these results, jute and acrylic were blended in various ratios (10:90, 20:80, 30:70, 40:60, and 50:50) and converted into yarns, which were evaluated for count, twist, tensile strength, and tenacity. The yarns were then knitted into plain fabrics, which underwent subjective assessment by 30 experts to determine consumer preference and suitability for different applications. Results showed that jute is coarser and stiffer, while acrylic is finer, stronger, and more flexible. Increasing jute content produced coarser, weaker yarns, whereas acrylic-rich blends demonstrated superior mechanical performance. Expert evaluation revealed that 20:80 and 30:70 jute–acrylic blends offered the best balance of strength, flexibility, warmth, texture, lustre, and aesthetic appeal, making them suitable for apparel, hosiery, and home textiles. The study concludes that jute–acrylic blends provide an eco-friendly, cost-effective, and functional alternative to wool, addressing raw material shortages while supporting sustainable textile production.

KEYWORDS

Blended yarns, Jute–acrylic blend, Wool alternatives, Knitted fabrics

INTRODUCTION

Traditionally, knitted fabrics were made entirely from wool. However, wool is expensive. The woollen industry also faces several challenges, such as a limited supply of high-quality wool, a shortage of skilled technicians, and high production costs. Today, the textile industry offers a wide variety of blended yarns to meet the increasing demands of consumers (Booth, 1968). India experiences extreme variations in temperature and humidity. In such conditions, garments made from natural fibers or blends of natural and man-made fibers are generally preferred over purely synthetic fabrics for environmental and health reasons. Blended fabrics not only meet basic clothing needs but also offer style, elegance, and fashion appeal. Blended fabrics have become a dominant choice in textiles due to their role in shaping fashion trends and providing comparatively better functional performance (Parikh and Aiyer, 1980). Blending man-made fibers with natural fibers helps address the raw material shortage of natural fibers and offers the textile industry a more affordable alternative, thereby meeting the demands of a growing population.

Therefore, studies have been conducted to identify affordable alternatives for knitted fabrics, with acrylic being a potential substitute (Vasantha and Jacob, 1993). Acrylic has a distinctive role in the knitting industry. As a man-made fiber, it possesses a wool-like feel, high resilience, and good strength, making it suitable for both knitting and weaving a variety of textile products. Its lower cost has led to acrylic increasingly replacing wool in many applications. It is estimated that of all acrylic fibers produced, 60% are used in knitting, 29% in weaving, and 11% in carpets. Acrylic fibers are primarily used for hand-knitting yarns, hosiery, blankets, and woven suitings (Sharma and Mishra, 1984). In India, the production of acrylic fiber increased significantly, from 7,890 tonnes in 1980 to 80,000 tonnes in 1990. Much of this growth is due to acrylic replacing wool. Similar to wool, acrylic fibers are appreciated for their warmth, soft hand feel, good bulk, and pile properties. Additionally, acrylic fibers are more resistant to abrasion and chemical damage, and they exhibit greater stability against heat and light-induced degradation (Bajaj and Kumari, 1987).

Jute, as a textile fiber, has certain limitations for functional applications. However, blending techniques are being used to overcome these drawbacks and produce quality products suitable for both domestic and export markets. It is now well established that jute can be incorporated into fabrics, garments, and home furnishings. The increasing applications of jute, along with its recognition as an environmentally friendly material, have renewed optimism for fully utilizing its potential. With focused research to address its weaknesses, the golden fiber could have a promising future and appeal to a wide range of consumers.

The use of jute in apparel, furnishings, luggage, and fashion garments may create new avenues for jute consumption. Blending jute with other fibers also enhances its knitting efficiency, and jute–acrylic blends are one such promising combination. Although extensive research has been conducted by various institutes to utilize jute in non-conventional and hosiery products, there is still scope for further studies using modern technological approaches to develop diversified jute products. The success of blended yarns is often measured by improvements in one or more material properties, making testing a crucial step before large-scale production. Such testing can help introduce new blends into the fashion market, providing a significant boost to the Indian woollen industry. Jute, therefore, can be seen not only as a major textile fiber but also as a raw material for environmentally friendly products that support ecological balance. Moreover, jute–acrylic blends are cost-effective, offering a lower-priced alternative to wool and pure acrylic. Techno-economic analyses indicate that jute and jute-blended fabrics can be 5% to 25% cheaper than conventional products made from cotton, wool, or polypropylene, making them both economically and functionally advantageous. This difference is primarily attributed to the lower manufacturing cost of jute yarn compared to other fibers, which in turn reduces the cost of the finished product (Prem and Kansal, 1993). Blending jute with acrylic can also help farming families involved in jute cultivation explore new opportunities to enhance their livelihoods. Therefore, this study on jute–acrylic blends will involve both objective and subjective tests to evaluate their suitability. The findings may provide an important alternative to the woollen industry, helping to address raw material shortages while promoting the use of an eco-friendly fiber.

REVIEW OF LITERATURE

Chaudhary and Das (1991) investigated the blending of jute fibre with both natural and synthetic fibres to evaluate the performance and economic viability of the resulting products. Their findings showed that jute-blended products were superior to 100% synthetic products in terms of cost effectiveness as well as several important technical properties. The study highlighted that the inclusion of jute not only reduced production costs but also improved the overall utility of the blended products. Furthermore, the authors emphasized that the demand and popularity of diversified jute products were expected to increase steadily over time, particularly in rural areas.

Prem and Kansal (1993) reported several non-traditional uses of jute, such as in upholstery, bed sheets, curtains, carpets, blankets, jeans, sweaters, and jackets. They observed that jute yarn added noticeable weight and bulk to fabrics while remaining economical. Treatment of jute yarn with caustic soda further increased its bulk and imparted additional crimp and better heat-retention properties, making it similar to wool. Consequently, jute was considered suitable for carpet fabrics as a substitute for wool. The study also found that caplon fabrics, made by blending jute with polypropylene, showed good aesthetic appeal and performance. Their techno-economic analysis indicated that products made from jute and jute blends were 5 to 25 per cent less expensive than those made from cotton, wool, or polypropylene, primarily due to the lower production cost of jute yarn, which affected the overall cost of the finished products.

Vasantha and Jacob (1993) conducted a study on blending jute with polypropylene and acrylic fibers to explore alternative uses for jute in textiles. They observed that a blend of jute and acrylic in a 20:80 ratio closely resembled pure wool in terms of texture, thickness, and overall appearance, while remaining more affordable. The yarn produced from this combination demonstrated greater strength than wool yarn, making it suitable for a range of textile applications. Their findings also emphasized that incorporating acrylic with jute offered an economical approach to producing yarns that were both durable and visually appealing, suggesting that such blends could serve as practical substitutes for more expensive natural fibers.

Khambra and Deepak (2007) carried out a study on jute-acrylic knitted blends with the aim of developing low-cost blended products that could support and promote cottage industries. In their research, jute and acrylic fibers were blended in a ratio of 20:80, and the yarn was prepared using the rotor spinning method. Knitting was then performed on a circular knitting machine. The study revealed that blending jute with acrylic fibers was feasible for both yarn production and the creation of knitted fabrics. After the woolenisation process, the overall appearance and feel of the fabric showed noticeable improvement. There was a considerable decrease in fabric count, fabric weight, stitch density, and tightness factor. At the same time, properties such as air permeability, porosity, drapability, and crease recovery showed a significant increase when compared to 100% acrylic yarn. Additionally, the blended yarn was found to have a lower yarn count.

Sengupta and Debnath (2012) carried out a study focusing on the development of jute-based ternary blended yarns. They created two distinct types of blended yarns using a conventional jute spinning system: one combining jute, polypropylene, and hollow polyester, and the other combining jute, shrinkable acrylic, and hollow polyester. These ternary blends were found suitable for producing home textile products. In their experiments, jute-shrinkable acrylic-hollow polyester yarn was blended in a 50:30:20 ratio to produce a bulky yarn appropriate for warm garments. On the other hand, the jute-polypropylene-hollow polyester yarn was prepared in a 50:25:25 ratio, making it suitable for items such as cushions, mattresses, tablecloths, and bedsheets. The blending process not only improved the yarn's quality but also resulted in a more uniform and regular structure. Fabrics made from these yarns, when used in the weft direction, were noted to be heavier, more rigid, and more economical compared to commercial samples. Additionally, the fabrics exhibited good dimensional stability and maintained their quality even after repeated washing.

Shahid et al. (2016) studied the physical properties of jute-blended yarns using standard jute processing equipment. They blended Bangla White B jute fibers with polyester, acrylic, and wool fibers at 80:20 ratio. The blending was carried out at the feed stage of the breaker carding machine. The resulting slivers were carded, drawn three times, and spun using a slip draft flyer spinning machine. The researchers measured key tensile properties, including tenacity, elongation, and quality ratio. Among the blends, jute-polyester yarn exhibited the highest tenacity (15.81 gm/tex), the best quality ratio (120%), and the lowest unevenness (22.94%). Jute-acrylic and jute-wool yarns showed slightly lower performance but were still superior to 100% jute yarn in both strength and surface uniformity. The study highlighted that blending jute with synthetic or wool fibers significantly improved yarn performance compared to pure jute yarn.

Dr. Nurul (2022) investigated the preparation and performance of yarns produced by blending etherified jute fibre with natural and synthetic fibres, including cotton, rayon, polyester, and silk waste. In the study, yarns were manufactured using a 50:50 blend ratio, where etherified jute fibre constituted 50% of each blend, and 30 tex yarns were produced using ring spinning. The physical properties of the blended yarns were compared with those of same-count 100% cotton yarns. The results showed that yarns containing 50% etherified jute fibre exhibited tenacity values ranging from 10.9 to 11.9 g/tex, which were comparable to the tenacity of cotton yarn (11.5 g/tex). The breaking elongation, modulus, and count strength product of etherified jute–cotton and etherified jute–rayon blends were also found to be close to those of cotton yarn. However, yarns blended with polyester and silk showed much higher breaking elongation (12.4 to 12.7%), which was attributed to the high extensibility of polyester and silk fibres.

Shahid et al. (2024) studied the properties of denim fabrics made from cotton and polyester blended weft yarns by comparing different cotton/polyester blending ratios of 100% cotton, 75/25, 50/50, 25/75, and 100% polyester, along with different weft yarn types. The study evaluated fabric weight, dimensional stability, stiffness, tensile strength, tearing strength, stretch, and comfort properties. The results showed that denim fabrics with higher polyester content exhibited improved tensile and tearing strength, while weight loss, dimensional changes, and stretch properties were reduced. The comparison confirmed that both the blending ratio and weft yarn type significantly influenced fabric performance.

MATERIALS AND METHODS

White jute fibre of Grade 2 quality and acrylic fibre were obtained from the National Institute of Research on Jute and Allied Fibres (NIRJAFT), Calcutta. Five jute–acrylic blended yarns were prepared in different blend ratios (10:90, 20:80, 30:70, 40:60, and 50:50), along with 100 per cent jute and 100 per cent acrylic yarns. These yarns were converted into plain knitted fabrics using a 9-inch diameter circular knitting machine without a dial at the TTTS Jute Extension Centre, Ludhiana, Punjab. The fibres were analysed for mean fibre length, fineness as per ASTM D1769-67, and tensile characteristics. Yarn properties such as count (ASTM D1059-87), twist, and tensile strength were evaluated following ASTM D2256-66. All experimental testing was performed at the Textile Institute of Textile and Sciences (TIT&S), Bhiwani, in accordance with standard testing procedures. A subjective assessment was conducted with the participation of 30 subject-matter experts to evaluate consumer preference and acceptability of the developed fabric samples. For determining fabric suitability for various applications, respondents ranked the samples according to their preference. The most preferred fabric was assigned a score of 7, followed by scores of 6, 5, 4, 3, 2, and 1 for the least preferred fabric. Mean preference scores were computed to quantify overall consumer acceptance.

RESULTS AND DISCUSSION

The results in Table 1 show clear differences between jute and acrylic fibers. Jute fibers are coarser and longer, with a fineness of 1.8 tex and an average length of 200 mm. Acrylic fibers, on the other hand, are finer and shorter but show better mechanical performance. They have higher tenacity (40 g/tex) and much higher breaking elongation (21.8%) compared to jute. The very low elongation of jute fibers (1.1%) indicates that they are stiff and less stretchable. Overall, jute fibers are more rigid, while acrylic fibers are stronger and more flexible, making them suitable for different end-use applications.

Table 2 presents the yarn blend compositions, ranging from 100% acrylic (Yarn A) to 100% jute (Yarn G). Yarns B to F contain increasing jute content from 10% to 50% with a corresponding decrease in acrylic fiber, enabling evaluation of the effect of jute proportion on yarn properties. The jute–acrylic blended yarns listed in Table 2 are shown in Figure 1.

It is evident from Table 3 that clear trends are observed in the yarn properties with increasing jute content. The yarn count increases, indicating the formation of coarser yarns as the proportion of jute increases. Figure 2 shows the effect of blend composition on yarn count. Single yarn breaking strength, breaking elongation, and tenacity show a gradual decrease with higher jute content, which can be attributed to the coarser, stiffer nature of jute fiber and its lower strength and extensibility compared to acrylic fiber. As a result, acrylic-rich yarns exhibit better strength and flexibility, while jute-rich yarns become weaker and less extensible. However, the twist values do not follow a consistent trend.

Fabrics were then made from the yarn blends. As shown in Table 4, consumer preference indicated that blends with higher acrylic content were favored for apparel items such as sweaters, scarves, mufflers, woollen blouses, woollen shirts/phirans, woollen gowns, slex, socks, undershirts, and shawls. With jute content above 30%, preference shifted from apparel to home furnishings like blankets, carpets, and rugs. Considering both subjective evaluation and laboratory tests, the 20:80 and 30:70 jute–acrylic blends exhibited the best overall appearance and performance. These blends were particularly suitable for sweaters, scarves, mufflers, slex, shawls, and socks due to their warmth, lustre, texture, and aesthetic appeal, making them ideal for hosiery applications. Blending jute with acrylic provides an economical alternative to wool, offering consumers new fashionable options. Moreover, increased use of jute promotes sustainable manufacturing and contributes to environmental and ecological balance.

Fiber Type	Fineness (tex)	Average Fiber Length (mm)	Tenacity (g/tex)	Breaking Elongation (%)
Jute	1.8	200	28	1.1
Acrylic	0.33	100	40	21.8

Table 1- Analysis of fiber properties

Yarn Code	Blend Composition (%)	
	Jute Fibre (%)	Acrylic Fibre (%)
A	0	100
B	10	90
C	20	80
D	30	70
E	40	60
F	50	50
G	100	0

Table 2- Blend composition of yarn

A= 100% Acrylic
B= Jute Acrylic (10:90)
C= Jute Acrylic (20:80)
D= Jute: Acrylic (30:70)
E= Jute: Acrylic (40:60)
F =Jute Acrylic (50:50)
G= 100% Jute

Figure 1- Yarns

Sample Code	Yarn J/A	Yarn Count (tex)	Twist (tpi)	Single Yarn Breaking Strength (g)	Breaking Elongation (%)	Tenacity (g/tex)
A	0:100	100	5.64	1510	28.1	15.1
B	10:90	110	6.25	1397	25.0	12.7
C	20:80	120	5.48	1344	22.7	11.2
D	30:70	125	5.04	1287	20.1	10.3
E	40:60	125	4.45	1187	11.9	9.5
F	50:50	130	3.72	1066	7.2	8.2
G	100:0	140	4.45	966	2.0	6.9

Table 3- Analysis of yarn properties

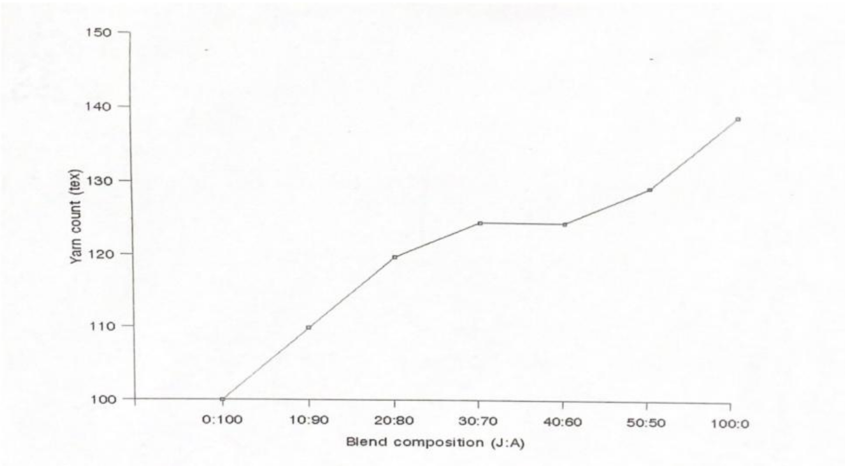

Figure 2- Effect of Blend Composition on Yarn Count

Items	A	B	C	D	E	F	G
Sweater	7.0	6.6	6.2	4.6	2.4	2.5	1.0
Scarf	7.0	6.8	6.5	4.5	4.2	2.0	1.0
Muffler	7.0	6.8	6.5	4.5	4.2	2.5	1.0
Jacket	7.0	5.0	6.2	5.5	6.0	5.1	2.0
Woolen shirt/ Phiran	7.0	6.6	6.2	5.8	5.1	2.0	1.0
Woolen blouse	7.0	6.6	2.0	2.6	2.2	1.0	1.0
Woolen gown	7.0	6.6	6.0	5.7	4.5	1.0	1.0
Slex	7.0	6.5	6.5	4.0	2.5	1.0	1.0
Socks	7.0	6.8	6.0	4.2	4.2	1.0	1.0
Undershirt	7.0	4.0	1.0	1.0	1.0	1.0	1.0
Shawl	7.0	6.8	4.8	4.8	4.5	1.0	1.0
Carpet	1.0	1.0	1.0	1.0	1.0	6.0	5.7
Rugs	1.0	1.0	1.0	1.0	1.0	6.0	7.0
Blankets	1.0	1.0	1.0	1.0	1.0	7.0	1.0
Curtains	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Sofa Cover	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cushion Cover	1.0	1.0	1.0	1.0	1.0	1.0	2.0

Table 4- Suitability of blends for different uses: Consumers preference

CONCLUSION

The study demonstrates distinct differences between jute and acrylic fibers and their impact on blended yarn properties. Jute fibers are coarser, longer, and stiffer, with low elongation, while acrylic fibers are finer, stronger, and more flexible. As the proportion of jute in jute–acrylic blends increases, the resulting yarns become coarser, with higher yarn counts but reduced breaking strength, elongation, and tenacity. Acrylic-rich blends offer superior strength and flexibility, whereas jute-rich blends are stiffer and less extensible. These findings indicate that the fiber composition can be tailored to achieve specific yarn characteristics, making acrylic-dominant blends suitable for applications requiring strength and elasticity, while jute-rich blends may be better suited for coarser, more rigid textile products. Subjective evaluation revealed that as the proportion of jute in the blends increased, consumer preference shifted from apparel toward blankets, carpets, and rugs. When jute content exceeded 30%, the popularity of blends for clothing declined, while their acceptance for home textiles like blankets, carpets, and rugs increased. Based on both laboratory tests and subjective assessments, the blends with jute-acrylic ratios of 20:80 and 30:70 were identified as the most suitable. These blends were considered ideal for making sweaters, scarves, mufflers, jackets, woolen shirts or phirans, woolen gowns, slex, socks, and shawls due to their warmth, lustre, texture, and overall aesthetic appeal. Therefore, jute-acrylic blends in the ratios 20:80 and 30:70 were recommended for hosiery products as alternative to wool.

REFERENCES

1. American Society for Testing and Materials. (1967). American standard for textiles: Standard test methods (ASTM D.1769-67; ASTM D.2256-66; ASTM D.1059-872). ASTM.
2. Bajaj, P., & Kumari, S. (1987). Developments in acrylic fibres. Man Made Textiles in India, 30(5), 211.
3. Booth, J. E. (1968). Principles of testing. Butterworth.
4. Chaudhary, A., & Das, A. (1991). Blending of jute fibre with natural and synthetic fibres. Indian Textile Journal, 101(3), 122.
5. Dr.Nurul. (2022). Preparation of yarn by blending of etherified jute fibre with natural and synthetic fibre. European Journal of Applied Sciences, 10(1), 544–549. https://doi.org/10.14738/aivp.101.11758
6. Khambra, K., & Deepak, D. (2007). A study on jute-acrylic knitted blends. Annals of Biology, 23(1), 81–82.
7. Parikh, J., & Aiyer, H. (1980). Potential for blended fabrics. Man Made Textiles in India, 23(1), 21–30.
8. Prem, V., & Kansal, H. (1993). Jute decorative textiles: Good prospects foreseen. Clothesline, 8, 110.
9. Sengupta, S., & Debnath, S. (2012). Studies on jute-based ternary blended yarns. Indian Journal of Fibre & Textile Research, 37(3), 217–223.

10. Shahid, M. A., Okyay, N., & Babaarslan, O. (2024). A Comparative Analysis of Denim Fabric Performances from Cotton/Polyester Blended Rigid and Stretched Yarns. Fibers, 12(10), 86. https://doi.org/10.3390/fib12100086
11. Shahid, Md. A., Mahabubuzzaman, A. K. M., Ahmed, F., & Ali, A. (2016). Investigation of the Physical Properties of Jute Blended Yarn Using a Novel Approach in Spinning Process. Journal of Textile Science and Technology, 02(01), 1–6. https://doi.org/10.4236/jtst.2016.21001
12. Sharma, P. N., & Mishra, S. (1984). Acrylic fibres. Indian Textile Journal, 95(11), 44–45.
13. Vasantha, G., & Jacob, M. (1993). Blending of jute with polypropylene and acrylic. Indian Textile Journal, 103(3), 28–31.