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Evaluation of a Silicone Rubber Sheet-Modified Traditional Matka for GhichaTasar Yarn Production

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Abstract
Ghicha tasar yarn production is traditionally carried out using the Matka method, which involves manual processing of softened tasar cocoons. The present study evaluated a modification of the traditional Matka by assembling a silicone rubber sheet on its working surface and compared its performance with the conventional method in terms of yarn and fabric properties. Pierced *Daba* bivoltine (BV) tropical tasar cocoons (*Antheraea mylitta* Drury) were softened using a non-peroxide chemical treatment followed by boiling and pressurised steaming. Ghicha yarn was produced manually from semi-moist cocoons using both methods. The yarns were subsequently used as weft, with reeled twisted tasar silk yarn as warp, to prepare fabric samples. Yarn and fabric properties were evaluated at the Textile Testing Laboratory, CSB-CSTRI, Bengaluru. The modified Matka-produced yarn recorded fewer winding breaks (16 breaks/30 min) and higher elongation (21%) than the conventional Matka-produced yarn (19 breaks/30 min and 12%, respectively). However, the conventional method yielded yarn with lower count variation (8.6%), higher breaking load (9.1 N) and higher tenacity (6.8 cN/tex), compared with 13.0%, 8.4 N and 5.7 cN/tex, respectively, for the modified method. Fabric evaluation showed that the fabric containing modified Matka-produced Ghicha yarn had higher mass per unit area, weft density, weft cover factor and elongation, along with lower overall stiffness. Conversely, the control fabric exhibited higher warp tearing strength and warp breaking load. The findings indicate that silicone rubber sheet modification of the traditional Matka influences the physical and mechanical characteristics of Ghicha yarn and the corresponding fabrics, with favourable differences in selected properties. The modified approach offers scope for further refinement and evaluation as an alternative method for Ghicha tasar yarn production.

Keywords: Antheraeamylitta, Ghicha, Matka, Silicone rubber sheet, Surface modification

1. Introduction

Silk is a natural protein fibre valued for its lustre, handle and textile versatility. It is utilised in the form of continuous filament yarn as well as spun yarn manufactured from short fibres and processing waste. Among the different varieties of Indian silk, tasar is an important non-mulberry silk that supports rural and forest-based livelihoods. Tropical tasar is primarily produced by the silkworm *Antheraea mylitta* Drury.

According to the production statistics of the Central Silk Board, the production of tasar raw silk in India was 1,586 metric tonnes during 2023–24 (Press Information Bureau, 2025) [1]. This figure represents the national tasar category and does not distinguish between tropical and oak tasar production. The scale of production highlights the importance of efficient utilisation of tasar cocoons and the fibre resources generated during subsequent processing.

Tasar silk processing generates fibre waste at different stages, including deflossing, reeling and basin operations. The Central Tasar Research and Training Institute (CTR&TI, 2024) [2] estimates that approximately 30–40% fibre waste is generated during silk processing. Based on the reported national tasar raw silk production of 1,586 metric tonnes in 2023–24, the publication estimates the generation of approximately 476–634 metric tonnes of tasar silk-waste fibre. These figures are institutional estimates and should not be interpreted as a universal cocoon-shell recovery ratio. The publication also highlights the potential utilisation of these fibre wastes for the production of spun yarns and fabrics.

Tasar silk waste is utilised for producing different categories of spun yarn, including Ghicha, Katia, Jhuri and Balkal. The type and characteristics of the raw material determine the category of yarn produced. The CTR&TI (2020) [3] reference book describes Ghicha as a spun yarn produced from degummed, unreelable tasar cocoons. In the traditional Matka method, fibres are manually drafted and rubbed against the back surface of an earthen pitcher to impart twist and cohesion to the fibre strand. The publication also describes other categories of tasar waste-based yarns and different spinning machines used for their production.

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Previous studies have investigated the quality characteristics of tasar silk yarn. Chattopadhyay *et al.* (1995) [4] examined the quality characteristics of commercially available tasar (tussah) silk yarn, providing information on its physical and mechanical properties. In addition, institutional publications have documented the traditional methods of tasar waste spinning, different spinning machines and the utilisation of various categories of fibre waste (CTR&TI, 2020, 2024) [3]. These publications provide a basis for understanding existing practices and the scope for further technological improvement in tasar waste-based yarn production.

The existing literature thus documents traditional methods of Ghicha yarn production, different spinning appliances, the quality characteristics of tasar yarn and the utilisation of tasar silk waste. However, there remains scope to investigate modifications to the conventional Matka-based Ghicha yarn production method, particularly with respect to the working surface and the resulting yarn characteristics.

The present study was undertaken to investigate a modified arrangement of the traditional Matka by mounting a silicone rubber sheet on its working surface. The concept was inspired by the surface characteristics of Thigh reeled silk yarn and was explored as an alternative approach to Ghicha yarn production. The study compares the physical and mechanical properties of yarn produced using the conventional and modified Matka arrangements. It further evaluates fabrics woven using the respective Ghicha yarns as weft, with reeled tasar yarn used as warp. The study is intended to provide an experimental basis for assessing the suitability of the modified Matka arrangement for producing Ghicha tasar yarn.

2. Materials and Methods

2.1. Materials

A total of 800 pierced *Daba* bivoltine (BV) tropical tasar cocoons (*Antheraea mylitta* Drury) were obtained from the stock maintained at the Post Cocoon Technology (PCT) Section of the Central Tasar Research and Training Institute (CSB-CTRTI), Ranchi. Laboratory-grade sodium carbonate (Na_2CO_3) and sodium bicarbonate ($NaHCO_3$) were used for cocoon softening at concentrations of 5 g/L each. The chemicals were used to prepare the non-peroxide softening solution. An earthen Matka (traditional spinning pot) and a silicone rubber sheet measuring 2 × 2 ft with a thickness of 2 mm were procured from the local market in Ranchi for the yarn production experiments.

2.2. Cocoon softening

The pierced tasar cocoons were softened using a non-peroxide chemical treatment involving sodium carbonate and sodium bicarbonate, each at a concentration of 5 g/L, following the procedure described by Khan *et al.* (2019) [5].

For each replication, 80 cocoons were treated using approximately 3 L of the prepared solution. The quantity of water was selected to ensure adequate immersion of the cocoons during treatment. The cocoons were first boiled in the solution for 15 minutes under atmospheric pressure. Subsequently, they were placed on a perforated plate inside a pressure cooker, above the cooking solution, and subjected to pressurised steaming for another 15 minutes. The softened cocoons were then used for Ghicha yarn production.

2.3. Production of Ghicha tasar yarn

Two methods of Ghicha yarn production were evaluated:

- Traditional Matka method (GN): Ghicha yarn was produced using the conventional earthen Matka without any surface modification.
- Modified Matka method (GSR): The working surface of the Matka was covered with a silicone rubber sheet before yarn production.

In both methods, yarn was produced manually from semi-moist, softened cocoons processing one cocoon at a time. For each method, 80 cocoons were used per replication, with five replications conducted. The yarn produced and the residual waste generated during the process were collected separately. The collected yarn and residual waste were dried in a hot-air oven at 105 ± 3 °C before further handling.

2.4. Fabric preparation

Two fabric samples, each measuring 3 m in length, were woven on a handloom at the PCT Section of CSB-CTRTI, Ranchi. Reeled twisted tasar silk yarn was used as the warp material, while the Ghicha yarn produced through the two experimental methods was used as the weft material.

The fabric samples were coded as follows:

- GN*R: Fabric woven using traditional Matka-produced Ghicha yarn as weft.
- GSR*R: Fabric woven using silicone rubber sheet-modified Matka-produced Ghicha yarn as weft.

Thus, the effect of the two Ghicha yarn production methods was examined through the physical and mechanical properties of the corresponding woven fabrics.

2.5. Conditioning of samples

Before laboratory testing, the yarn and fabric samples were conditioned for 24 hours at a temperature of 27 ± 2 °C and relative humidity of 65 ± 2%.

2.6. Testing and evaluation

The yarn and fabric samples were tested at the Textile Testing Laboratory (Grade A), Central Silk Technological Research Institute (CSB-CSTRI), Bengaluru. The tests were conducted to evaluate the physical and mechanical characteristics of the yarns and the corresponding fabrics.

2.6.1. Yarn testing

The yarn samples were evaluated for linear density, count variation, winding breaks, breaking load, tenacity, elongation, moisture content and moisture regain. The test methods and conditions reported by the laboratory are presented in Table 1.

Table 1. Test methods and conditions used for evaluation of Ghicha yarn

Parameter	Test method/standard	Test conditions
Linear density (yarn count)	ASTM D1907-12	Test length: 22.6 m; number of observations: 20
Count variation (CV %)	Calculated from linear density observations	Based on 20 observations
Winding breaks	Laboratory test	Number of breaks recorded over 30 minutes
Breaking load	IS 1670	Gauge length: 500 mm; number of observations: 20
Tenacity	IS 1670	Determined from breaking load and linear density
Elongation	IS 1670	Gauge length: 500 mm; number of observations: 20
Moisture content	IS 15090 (Part 3):2019	As per the specified test method
Moisture regain	IS 15090 (Part 3):2019	As per the specified test method

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2.6.2. Fabric testing

The woven fabric samples were evaluated for width, mass per unit area, thread density, yarn count, tearing strength, stiffness, tensile properties, cover factor, twist, water repellency, thickness and absorbency. The corresponding test standards and methods are given in Table 2.

Table 2. Test methods and standards used for evaluation of Ghicha tasar fabrics

Parameter	Test method/standard
Fabric width	IS 1954:1990
Fabric mass per unit area	IS 1964:2001, Method A
Threads in cloth (ends and picks per inch)	IS 1963:1981 (RA 2004), Method A
Yarn count	IS 3442:1980
Tearing strength	IS 6489:1993
Stiffness	ASTM D1388-96, Option A (Cantilever test)
Tensile strength and elongation	IS 1969 (Part 1):2010
Cover factor	--
Twist	IS 832:1985
Water repellency	IS 390:1975
Fabric thickness	IS 7702:1975
Absorbency	AATCC 79-2010, Option A

For tensile testing, the laboratory used a 50 mm constant-rate-of-traverse (CRT) test arrangement, a gauge length of 200 mm and a testing speed of 200 mm/min, with five observations for each sample. The twist test was conducted using a 250 mm gauge length and the untwist-and-retwist (UT&RT) method, at a tension of 0.5 g/tex, using a motorised twist tester.

2.7. Comparative evaluation

The laboratory test results were compiled and compared to examine differences in the physical and mechanical properties of yarns produced by the traditional and modified Matka methods. The corresponding fabric properties were also compared to assess the characteristics of fabrics woven using the two types of Ghicha yarn. The results are presented descriptively, with emphasis on the observed differences between the samples. No inferential statistical analysis was undertaken.

3. Results and Discussion

3.1. Physical and Mechanical Properties of Ghicha Tasar Yarn

The physical and mechanical properties of Ghicha yarn produced using the traditional Matka method (GN) and the silicone rubber sheet-modified Matka method (GSR) were evaluated at the Textile Testing Laboratory, CSB-CSTRI, Bengaluru. The test results are presented in Table 3.

Table 3. Physical and mechanical properties of Ghicha tasar yarn produced by two methods

Parameter	Unit	Modified Matka (GSR)	Traditional Matka (GN)
Yarn count	Nm	8.3s	8.0s
Count CV	%	13.0	8.6
Winding breaks	Breaks/30 min	16	19
Breaking load	N	8.4	9.1
Tenacity	cN/tex	5.7	6.8
Elongation	%	21	12
Moisture content	%	8.9	9.0
Moisture regain	%	9.7	10.8

3.1.1. Yarn count and count variation

The yarn count recorded for the modified Matka-produced Ghicha yarn (GSR) was 8.3s, compared with 8.0s for the traditional Matka-produced yarn (GN). The count variation (CV) was 13.0% for GSR and 8.6% for GN. Thus, although the yarn count values were relatively close, the traditional method produced yarn with lower count variation, indicating comparatively better uniformity in linear density. The higher CV observed in GSR suggests greater variation in yarn thickness along the tested length.

The difference in count variation indicates that the silicone rubber sheet modification did not improve yarn uniformity under the experimental conditions. Further refinement of the modified surface and yarn-forming technique may be required to achieve more consistent yarn characteristics.

3.1.2. Winding performance

The number of winding breaks recorded during the 30-minute test was 16 for GSR and 19 for GN. The modified Matka yarn therefore showed fewer winding breaks than the traditional Matka yarn. This represents a reduction of approximately 15.8% in the observed number of breaks.

The lower number of winding breaks suggests comparatively better continuity during winding of the modified Matka-produced yarn. However, winding performance is influenced by several yarn characteristics, including thickness variation, surface irregularity and yarn cohesion. The present results indicate a favourable difference in winding breaks, although further trials would be required to establish the consistency of this observation.

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3.1.3. Tensile properties

The breaking load and tenacity of GSR yarn were 8.4 N and 5.7 cN/tex, respectively, whereas the corresponding values for GN yarn were 9.1 N and 6.8 cN/tex. The traditional Matka-produced yarn therefore exhibited higher breaking load and tenacity.

In contrast, the elongation at break was higher for GSR yarn (21%) than for GN yarn (12%). This indicates that the modified Matka-produced yarn showed greater extension before breaking, despite having lower breaking load and tenacity. The results therefore suggest a difference in the tensile behaviour of the two yarn samples: GN exhibited higher resistance to tensile loading, while GSR exhibited greater elongation.

These findings indicate that the silicone rubber sheet modification was associated with changes in the tensile characteristics of the resulting yarn. The higher elongation of GSR may be relevant for applications where yarn extensibility is an important consideration; however, its lower tenacity should also be taken into account.

3.1.4. Moisture characteristics

The moisture content of the two yarn samples was almost identical, with values of 8.9% for GSR and 9.0% for GN. Moisture regain was 9.7% for GSR and 10.8% for GN. The small difference in moisture content indicates comparable moisture levels in the tested samples, while the traditional Matka-produced yarn showed higher moisture regain.

Overall, the yarn test results indicate that the modified Matka method was associated with fewer winding breaks and higher elongation, whereas the traditional method showed lower count variation, higher breaking load and higher tenacity. Moisture content was nearly identical in both samples.

3.2. Physical and mechanical properties of Ghicha tasar fabrics

Two fabric samples were prepared using reeled twisted tasar silk yarn as warp and Ghicha yarn produced by the two methods as weft. The fabric containing GSR yarn was coded GSRR, while the fabric containing GN yarn was coded GNR. The test results obtained from CSB-CSTRI, Bengaluru, are presented in Table 4.

3.2.1. Fabric construction and physical properties

Both fabric samples had the same width of 105.5 cm and the same warp density of 60 ends per inch. However, the weft density was 24 picks per inch for GSRR and 22 picks per inch for GNR. The mass per unit area was 152.2 g/m^2 for GSRR, compared with 148.5 g/m^2 for GNR.

The weft yarn count was 5.5s in GSRR and 7.9s in GNR. The higher pick density and mass per unit area of GSRR indicate differences in fabric construction between the two samples. The fabric containing modified Matka-produced yarn also exhibited a higher weft cover factor (13.2) than the control fabric (10.1). Consequently, the overall cover factor was higher for GSRR (19.1) than for GN*R (17.2).

The differences in fabric construction, particularly weft density and weft yarn count, should be considered when interpreting the subsequent mechanical properties, as these parameters can influence fabric performance.

Table 4. Physical and mechanical properties of fabrics woven using Ghicha yarn produced by two methods

Parameter	Unit	GSR*R	GN*R
Fabric construction and physical properties			
Width	cm	105.5	105.5
Mass per unit area	g/m^2	152.2	148.5
Ends per inch	No.	60	60
Picks per inch	No.	24	22
Warp yarn count	Denier	183.6	181.8
Weft yarn count	Nm	5.5s	7.9s
Tearing strength			
Warp	g	7,603	8,499
Weft	g	9,293	9,037
Stiffness (Cantilever test)			
Warp	mg-cm	770.0	749.7
Weft	mg-cm	1,788.3	2,462.4
Overall	mg-cm	1,173.4	1,358.7
Tensile properties			
Breaking load – warp	kg	45.3	77.5
Breaking load – weft	kg	49.5	52.2
Elongation – warp	%	38.5	35.9
Elongation – weft	%	25.2	21.8
Cover factor			
Warp	—	11.2	11.1
Weft	—	13.2	10.1
Fabric	—	19.1	17.2
Twist characteristics of warp yarn			
Twist	TPM	473	474
Twist CV	%	5.9	8.7
Direction/ply	—	Z/Single	Z/Single
Other properties			
Water repellency	Rating	0	0
Thickness	mm	0.76	0.70
Absorbency	Seconds	20	18

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3.2.2. Tearing strength

The warp-direction tearing strength was 7,603 g for GSRR and 8,499 g for GNR. In the weft direction, the corresponding values were 9,293 g and 9,037 g, respectively.

Thus, GNR showed higher tearing strength in the warp direction, whereas GSRR showed a slightly higher value in the weft direction. The difference in weft tearing strength was relatively small. These results indicate that the two fabrics exhibited different directional responses to tearing, rather than a consistent advantage for either sample.

3.2.3. Fabric stiffness

The stiffness values obtained through the Cantilever test were 770.0 mg-cm and 749.7 mg-cm in the warp direction for GSRR and GNR, respectively. In the weft direction, the values were 1,788.3 mg-cm for GSRR and 2,462.4 mg-cm for GNR. The overall stiffness values were 1,173.4 mg-cm and 1,358.7 mg-cm, respectively.

The modified Matka-based fabric exhibited lower weft and overall stiffness than the control fabric, while the warp stiffness values were relatively close. The lower overall stiffness of GSR*R suggests that this fabric was comparatively more flexible. The difference was more pronounced in the weft direction, which contained the experimental Ghicha yarn.

3.2.4. Tensile properties

The breaking load of GSRR was 45.3 kg in the warp direction and 49.5 kg in the weft direction. For GNR, the corresponding values were 77.5 kg and 52.2 kg. The control fabric therefore exhibited a substantially higher warp breaking load, while the weft breaking loads were comparatively close.

The elongation values were higher for GSRR in both directions. In the warp direction, elongation was 38.5% for GSRR and 35.9% for GN*R. In the weft direction, the values were 25.2% and 21.8%, respectively.

The results indicate that GSR*R exhibited higher elongation but lower breaking load, particularly in the warp direction. Since the warp yarn was reeled twisted tasar silk yarn in both fabrics, the difference in warp tensile performance should not be attributed directly to the Ghicha yarn production method. Differences in fabric construction and sample characteristics may also have contributed to the observed variation.

3.2.5. Cover Factor

The warp cover factors of the two fabrics were nearly identical, with values of 11.2 for GSRR and 11.1 for GNR. However, the weft cover factor was higher in GSRR (13.2) than in GNR (10.1). The overall cover factor was also higher in GSRR (19.1) than in GNR (17.2).

The higher weft and overall cover factors of GSR*R are consistent with its higher pick density and indicate a comparatively greater weftwise coverage of the fabric structure.

3.2.6. Twist characteristics

The twist level of the warp yarn was 473 TPM for GSRR and 474 TPM for GNR. Both samples had *Z*-direction single yarn in the warp. The twist CV was 5.9% for GSRR and 8.7% for GNR. The laboratory report recorded no twist in the weft yarn for either sample.

The nearly identical warp twist values indicate comparable twist levels in the warp yarns used for both fabrics. The lower twist CV recorded for GSR*R indicates lower variation in the measured warp twist values. As the warp material was common to both fabric samples, this parameter does not directly establish an effect of the Ghicha yarn production method.

3.2.7. Water repellency, thickness and absorbency

Both fabric samples received a water repellency rating of 0. The thickness of GSRR was 0.76 mm, compared with 0.70 mm for GNR. The absorbency time was 20 seconds for GSRR and 18 seconds for GNR.

The GSR*R fabric was therefore slightly thicker and required a longer time for the absorbency test. However, the water repellency rating was identical for both samples. These findings indicate differences in thickness and absorbency response, while no difference was observed in the reported water repellency rating.

3.3. Overall comparative assessment

The comparative evaluation of Ghicha yarn and the corresponding fabrics revealed differences in several physical and mechanical properties between the traditional and modified Matka methods.

At the yarn level, the modified Matka method showed fewer winding breaks and higher elongation, while the traditional Matka method produced yarn with lower count variation, higher breaking load and higher tenacity. The moisture content of the two yarn samples was nearly identical.

At the fabric level, GSRR exhibited higher mass per unit area, weft density, weft cover factor, overall cover factor, elongation and thickness. It also showed lower overall stiffness and slightly higher weft tearing strength. In contrast, GNR exhibited higher warp tearing strength and substantially higher warp breaking load. The two fabrics had identical width, warp density and water repellency rating.

The results demonstrate that the silicone rubber sheet-modified Matka method was associated with changes in the physical and mechanical characteristics of the resulting Ghicha yarn and fabrics. The modified method showed favourable differences in selected properties, particularly winding breaks, yarn elongation and fabric flexibility. However, the higher count variation and lower yarn tenacity indicate that further refinement is necessary to improve yarn uniformity and strength.

The findings provide an initial assessment of the modified Matka approach for Ghicha tasar yarn production. Further experimentation with optimisation of the silicone rubber surface, yarn formation parameters and fabric construction would be useful to establish the consistency and practical applicability of the modified method.

4. Conclusion

The present study evaluated a silicone rubber sheet-modified traditional Matka for Ghicha tasar yarn production and compared its performance with the conventional method. The modified Matka-produced yarn exhibited fewer winding breaks (16 versus 19 breaks/30 min) and higher elongation (21% versus 12%). However, the conventional method produced yarn with lower count variation and higher breaking load and tenacity.

At the fabric level, the fabric containing modified Matka-produced Ghicha yarn showed higher weft cover factor and elongation, along with lower overall stiffness. Conversely, the control fabric exhibited higher warp tearing strength and warp breaking load. These findings indicate that the silicone rubber sheet modification influenced selected physical and mechanical properties of the yarn and fabrics, without demonstrating an overall superiority of the modified method.

The modified Matka offers potential as an alternative approach to Ghicha tasar yarn production. Further refinement of the silicone rubber surface and yarn formation process, followed by validation under practical production conditions, is required to establish its consistency and applicability.

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