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Fibre quality characterization of water-retted Indian linseed (*Linum usitatissimum* var. RLC 92)

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ABSTRACT

Flax and linseed bast fibres are gaining renewed attention as sustainable raw materials for textile and composite applications, yet quantitative physical-property data for Indian dual-purpose linseed genotypes remain limited compared with dedicated fibre flax cultivars. This study reports the physical and mechanical properties of bast fibre extracted, through water retting and mechanical scutching hackling, from the dual-purpose Indian linseed variety RLC 92. Fibre fineness, length, bundle strength, and diameter were determined using standard textile testing methods. The extracted fibre exhibited an average fineness of 55.50 denier (CV 14.53%), a fibre length of 282.36 mm (ASTM D5103; CV 31.38%, range 125.0–533.0 mm), a bundle tenacity of 70.38 g/tex with 2.0% elongation and a breaking load of 4575 gf (ASTM D1445; CV of breaking load 22.16%), and a diameter of 63.23 μ m (CV 76.98%). These properties are discussed in relation to previously reported physical and mechanical characteristics of flax and linseed bast fibre. The results confirm that water-retted Indian linseed fibre possesses fineness, strength, and length characteristics adequate for further textile processing, such as blending with cotton for yarn spinning.

Keywords: Linseed, *Linum usitatissimum*, Fibre fineness, Fibre length, Bundle strength, Fibre diameter, Bast fibre characterization

1. Introduction

Fibre fineness, length, bundle strength, and diameter are widely regarded as the key processing properties that determine the suitability of extracted bast fibre for textile spinning, yarn production, or composite reinforcement (Norton *et al.*, 2006) [1]. These properties are influenced jointly by the genotype of the plant, the agronomic conditions under which it is grown, and the retting and mechanical extraction method used to isolate the fibre from the stem (Norton *et al.*, 2006; Goudenhooff *et al.*, 2019) [2, 1]. While the physical and mechanical properties of dedicated fibre-flax have been extensively characterised, comparatively little quantitative data exist for the bast fibre obtained from Indian dual-purpose linseed genotypes, which are cultivated mainly for oil but whose straw represents a potentially valuable, currently under-utilised by-product (Husain *et al.*, 2009) [3].

The present study characterises the physical and mechanical properties of textile-grade fibre extracted from the dual-purpose linseed variety RLC 92 through water retting and mechanical scutching–hackling, and situates these results within the range of values reported for flax and linseed bast fibre in the wider literature.

2. Materials and methods

2.1 Fibre source

The fibre characterised in this study was obtained from dual-purpose linseed (variety RLC 92) straw processed by seven-day water retting, sun drying, mechanical scutching, and manual hackling, as detailed in a companion process study on the extraction and yield of this fibre. The clean, hackled long-line fibre fraction was used for the physical and mechanical property testing reported here.

2.2 Testing methods

Fibre fineness was assessed by an in-house method and expressed in denier, using a torsion balance following sample preparation and dye marking. Fibre length was measured in accordance with ASTM D5103 using a black plate and calibrated ruler. Bundle fibre strength and elongation were determined in accordance with ASTM D1445 using a Stelometer. Fibre diameter was determined by a microscopic method. All tests were carried out at the Northern India Textile Research Association (NITRA), Ghaziabad. Mean values and coefficients of variation (CV %) were computed from the test replications using Microsoft Excel.

**Figure 1.** Linseed Plant**Figure 2.** Flax Fiber

3. Results

3.1 Fibre fineness

The average fineness of the extracted fibre, assessed by the in-house denier method, was 55.50 denier, with a coefficient of variation of 14.53% (Table 1).

Table 1. Fibre fineness (in-house method)

S. No.	Property	Value
1	Average fineness of fibre (denier)	55.50
2	CV% of denier	14.53

3.2 Fibre length

Fibre length, measured according to ASTM D5103, averaged 282.36 mm, with a coefficient of variation of 31.38%. The minimum and maximum fibre lengths recorded were 125.0 mm and 533.0 mm, respectively (Table 2).

Table 2. Fibre length (ASTM D5103)

S. No.	Property	Value
1	Fibre length (mm)	282.36
2	CV%	31.38
3	Minimum fibre length (mm)	125.0
4	Maximum fibre length (mm)	533.0

3.3 Bundle fibre strength

Bundle fibre strength, tested according to ASTM D1445, gave a tenacity of 70.38 g/tex, a mean breaking load of 4575 gf, a coefficient of variation of breaking load of 22.16%, and an elongation of 2.0% (Table 3).

Table 3. Bundle fibre strength (ASTM D1445)

S. No.	Property	Value
1	Tenacity (g/tex)	70.38
2	Breaking load (gf)	4575
3	CV of breaking load (%)	22.16
4	Elongation (%)	2.0

3.4 Fibre diameter

Fibre diameter, determined by the microscopic method, averaged 63.23 μm , with a coefficient variation of 76.98% (Table 4).

Table 4. Fibre diameter (microscopic method)

S. No.	Property	Value
1	Diameter of fibre (μm)	63.23
2	CV% of diameter	76.98

4. Discussion

The fineness value obtained (55.50 denier, CV 14.53%) indicates a moderately fine, reasonably uniform technical fibre bundle. Fineness in bast fibres is known to be influenced jointly by cultivar and growing-season conditions, with drier growing seasons and favourable agronomic management generally producing finer, more uniform fibre (Norton *et al.*, 2006) [1]; the present value is consistent with fibre of adequate fineness for blending applications.

The relatively high coefficient of variation observed for fibre length (31.38%) reflects the inherent heterogeneity of technical bast fibre, which is composed of bundles of elementary fibres of unequal length rather than a single continuous filament (Angulu & Gusovius, 2024) [4]. The average length of 282.36 mm, and the wide spread between the minimum (125.0 mm) and maximum (533.0 mm) values, are of a similar order of magnitude to the weighted average fibre lengths of 100–550 mm reported for retted and non-retted flax fibre fractions, with retted fibre consistently showing greater average length than non-retted fibre (Nair *et al.*, 2013) [5]. This spread is also consistent

with the expectation that hackling separates the fibre population into a long-line fraction and a shorter tow fraction rather than a single uniform length class (Manian *et al.*, 2021) [6].

The measured tenacity (70.38 g/tex) and low elongation (2.0%) are characteristic of bast fibre as a stiff, high-strength material with limited extensibility. Retting quality has been shown to directly affect these mechanical properties, with the breaking force of properly retted fibre exceeding that of non-retted fibre, since adequate removal of pectic and non-cellulosic binding material through retting improves rather than weakens tensile performance (Nair *et al.*, 2013) [5]. The comparatively low elongation obtained here is consistent with a well-retted, low-extensibility fibre suitable for spinning.

The measured average diameter of 63.23 µm is substantially larger than the elementary (single-cell) flax fibre diameter of approximately 20 µm commonly reported in the composite-reinforcement literature (Goudenhooft *et al.*, 2019) [2], indicating that the present measurement reflects a technical fibre bundle comprising several elementary fibres bound together, rather than an individual ultimate fibre cell. The very high coefficient of variation for diameter (76.98%), compared with the markedly lower CV for fineness (14.53%), is consistent with this interpretation: technical bundles vary considerably in the number of elementary fibres they contain along their length, whereas fineness, expressed on a linear-density basis, averages out much of this bundle-to-bundle variability (Goudenhooft *et al.*, 2019; Angulu *et al.*, 2024) [4, 2].

Taken together, the fineness, length, and strength characteristics obtained for RLC 92 fibre in this study fall within ranges reported as suitable for spinning bast fibre either alone or in blends with other fibres such as cotton (Martin *et al.*, 2014), supporting the potential of this under-utilised Indian linseed genotype as a textile fibre resource.

5. Conclusion

The bast fibre extracted from dual-purpose Indian linseed (RLC 92) through water retting and mechanical scutching–hackling exhibited a fineness of 55.50 denier, a length of 282.36 mm, a bundle tenacity of 70.38 g/tex with 2.0% elongation, and a diameter of 63.23 µm. These values are broadly comparable with previously reported physical and mechanical properties of flax and linseed bast fibre, confirming that

the extracted fibre possesses fineness, strength, and length characteristics adequate for further textile processing. The findings support the potential of this under-utilised Indian linseed genotype as a viable raw material for blended yarn spinning and other textile applications.

References

1. Norton AJ, Bennett SJ, Hughes M, Dimmock JPRE, Wright D, Newman G, Edwards-Jones G. Determining the physical properties of flax fibre for industrial applications: the influence of agronomic practice. *Annals of Applied Biology*. 2006;149(1):15-25.
2. Goudenhooft C, Bourmaud A, Baley C. Flax (*Linum usitatissimum* L.) fibers for composite reinforcement: exploring the link between plant growth, cell walls development, and fiber properties. *Frontiers in Plant Science*. 2019;10:411.
3. Husain K, Malik YP, Srivastava RL, Pandey R. Production technology and industrial uses of dual purpose linseed (*Linum usitatissimum*): An overview. *Indian Journal of Agronomy*. 2009;54(4):374-379.
4. Angulu M, Gusovius HJ. Retting of bast fiber crops like hemp and flax—a review for classification of procedures. *Fibers*. 2024;12(3):28.
5. Raveendran Nair G, Singh A, Zimniewska M, Raghavan V. Comparative evaluation of physical and structural properties of water retted and non-retted flax fibers. *Fibers*. 2013;1(3):59-69.
6. Manian AP, Cordin M, Pham T. Extraction of cellulose fibers from flax and hemp: a review. *Cellulose*. 2021;28(13):8275-8294.
7. Sipponen MH, Laakso S, Baumberger S. Impact of ball milling on maize (*Zea mays* L.) stem structural components and on enzymatic hydrolysis of carbohydrates. *Industrial Crops and Products*. 2014;61:130-136.

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