AUTEX 2022 Conference Proceedings 978-83-66741-75-1 

**DOI: 10.34658/9788366741751.119**

# HIMALAYAN NETTLE: A PROMISING FIBRE ON THE RISE

**Ana Santiago[1(*)], Cláudia Pinheiro[1], Nuno Belino[1]**

[1] University of Beira Interior (UBI), Faculty of Engineering, Department of Science and Textile Technology, Convento de Santo António, 6201-001 Covilhã, Portugal

[(*)] *Email:* ana.santiago@ubi.pt

## ABSTRACT

The nettle is widely known as an "unloved" plant due to its unpleasant and even painful texture when incorrectly handled. However, it has very interesting therapeutic properties and stands out for its high sustainability, from cultivation, extraction, and fibre processing to the development of a long-lasting end-product with unique characteristics.

With this paper we sought to demonstrate the growing relevance of the nettle fibre for the fashion industry, mainly their spinnability properties. For this purpose, a hand spun Himalayan nettle yarn (588,24 Tex) was bought and it were studied. A woven fabric with different wool/nettle compositions was produced and their main properties analysed. Our findings proved that due to the irregularity of the acquired yarn, it is not possible to obtain scientific statements concerning the properties of nettle yarn. However, this is a work in progress, which aims for more promising results.

## KEYWORDS

Nettle fibre, Wool, Hand Spun Yarn, Woven fabric, Himalayan Nettle.

## INTRODUCTION

The historiography of nettle dates back to the Bronze Age, when it was used for clothing. Harwood & Edom [1] state that the most accurate evidence of the use of this fibre dates to 900 to 750 BC, with samples of nettle fabric discovered in the tomb of Danish Voldtofte in Denmark, which had been used to wrap the mortal remains. This fibre was used in Britain in about 1860 to produce strong and durable clothing. However, with the arrival of new and cheaper materials, its use fell into disuse [1].

The nettle amongst several species in its family is known for the uncomfortable contact it causes when its leaves, which contain small hairs/spikes, touch the skin. Due to this factor, the name nettle derives from the Anglo-Saxon "noedl" (needle) and the Latin term "urtica" (to burn) [2].

This cellulose fibre is part of the Urticacea family, which contains about 46 species, hailing from various geographical areas of the world, with their respective characteristics, both in composition and morphology [3].

## MATERIALS AND METHODS

The yarn was purchased from Apple Oak Fibre Works, Ireland. It is a hand spun yarn, (Figure 1), obtained from the Himalayan Nettle (*Girardinia diversifolia*) (Figure 2) [4]. This species is resistant to various insects and usually grows at heights between 1200 and 3000 metres, reaching heights up to 1.5 metres [5].

**Figure 1. Hand Spun Nettle Yarn.**

**Figure 2. Himalayan Nettle Himalayan Wild Fibers [6].**

The company through which the nettle fibre was obtained explained that the process of extraction of nettle fibre is very similar to that of flax, consisting of harvesting and removing the leaves from the plant and then decomposing the stems in a mixture of water and ash. A scheme of the extraction process can be observed in Figure 3.

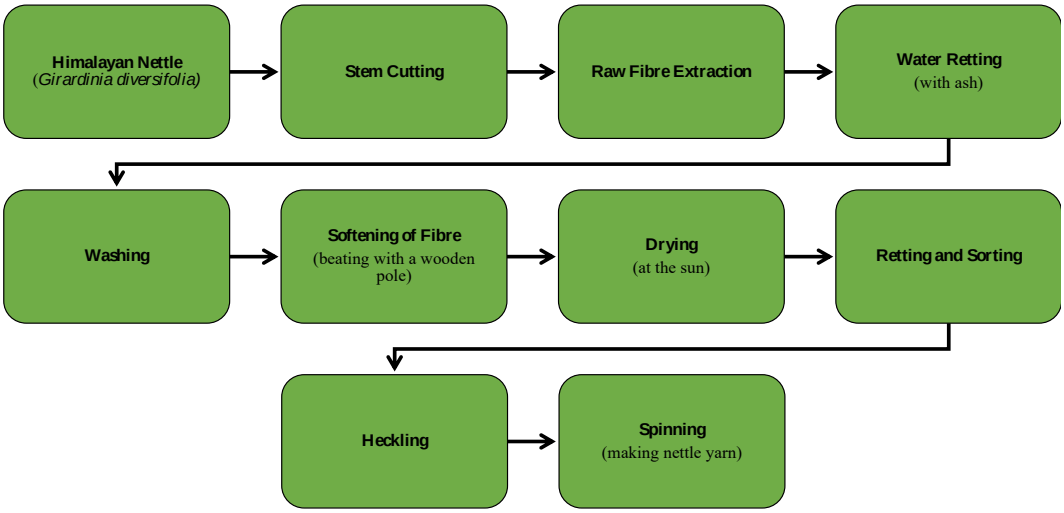



**Figure 3. Extraction and processing of nettle yarn [7–9].**

## RESULTS AND DISCUSSION

The main properties of nettle yarn were assessed through tensile strength and evenness tests. Additionally, we also tried to characterize the morphology of the nettle fibre through Scanning Electron Microscopy (SEM) (Table 1) and its Elemental Chemical Characterization (EDX) was carried out (Table 2).

**Table 1. Scanning Electron Microscopy (SEM).**

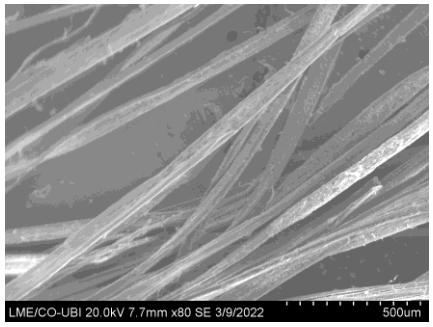
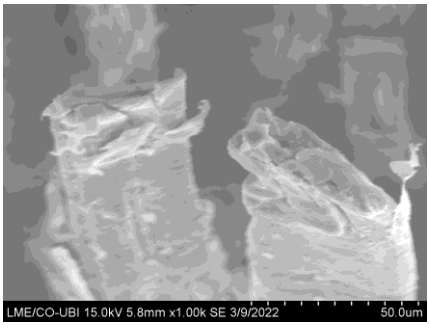
| Longitudinal Micrography | Cross-sectional Micrography |
|---|---|
|  |  |

**Table 2. Energy Dispersive X-Ray Analysis (EDX).**

| Element | Atomic Number | Norm C (wt.%) | Atom. C (at.%) |
|---|---|---|---|
| Carbon | 6 | 41.70 | 49.06 |
| Oxygen | 8 | 52.75 | 47.73 |
| Sodium | 11 | 0.41 | 0.26 |
| Magnesium | 12 | 0.40 | 0.24 |
| Aluminium | 13 | 2.12 | 1.14 |
| Silicon | 14 | 2.00 | 1.03 |
| Potassium | 19 | 1.04 | 0.39 |
| Iron | 26 | 0.58 | 0.15 |

The linear yarn density was determined using the gravimetric method. Thus, 5 samples of 0.5 meters were cut and weighed on the Mettler H51AR scale. After weighing the samples, we were able to calculate the linear yarn density, which value is 588.24 Tex.

The fineness of the fibres was estimated through visualization in the Projectina (Heerbrugg - Optical Precision Instruments). The approximated fineness of the cross section of the fibres was found to be ranging between 11.6 μm and 24 μm, with an average of 19 μm.

The yarn tensile strength was also tested, 10 tests were performed with samples of 0.5 meters each, in the Adamel Lhomargy DY35 dynamometer. Table 3 presents the results obtained.

**Table 3. Tensile strength of nettle yarn.**

| Statistics (10 tests) | Minimum | Maximum | Average | Standard Deviation |
|---|---|---|---|---|
| Strength (cN/tex) | 3.14 | 5.90 | 4.38 | 0.8654 |
| Elongation (%) | 3.17 | 8.164 | 5.825 | 1.522 |
| Energy (J) | 0.134 | 0.4563 | 0.2801 | 0.1001 |

The evaluation of the yarn evenness was performed on the USTER TESTER 3 with a test speed of 25 meters in one minute. The results obtained can be observed in Table 4.

**Table 4. Evenness (Tests USTER TESTER 3 – 25m/min).**

| | |
|---|---|
| Evenness - Um (%) | 28.55 |
| CVm (%) | 36.23 |
| Thin Points (-50%) | 131 |
| Thick Points (+50%) | 59 |
| Neps (+200%) | 54 |

Based on this yarn, four taffeta samples were produced, using a handloom, with different compositions of wool/nettle. In the following tables (Tables 5, 6 and 7) the characteristics of the yarns used as well as the fabric samples produced can be analysed.

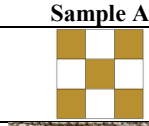
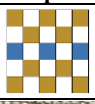
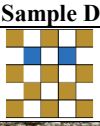
**Table 5. Properties of Nettle and Wool Yarn.**

| | Twist | Ply | Nm | Tex |
|---|---|---|---|---|
| **Nettle Thread (Weft)** | Z | 1 | 1.70 | 588.24 |
| **Wool Yarn 1 (Weft)** | S | 1 | 4.42 | 226.24 |
| **Wool Yarn 2 (Warp)** | S | 1 | 6.92 | 144.51 |

**Table 6. Properties of the fabric samples.**

| | Fabric Composition | | Density | | Weight ($g/m^2$) | Ligament |
|---|---|---|---|---|---|---|
| | Warp | Weft | Warp | Weft | | |
| **Sample A** | 100% Wool 2 | 100% Nettle | 6 | 7 | 493.36 | Taffeta |
| **Sample B** | 100% Wool 2 | 50% Nettle + 50% Wool 1 | 7 | 7 | 396.64 | |
| **Sample C** | 100% Wool 2 | 66% Nettle + 34% Wool 1 | 6 | 7 | 417.26 | $\frac{1}{1}A_1$ |
| **Sample D** | 100% Wool 2 | 75% Nettle + 25% Wool 1 | 6 | 7 | 509.30 | |

**Table 7. Weave Pattern of samples - Weft ( Nettle Yarn Wool Yarn).**

| Sample A | Sample B | Sample C | Sample D |
|---|---|---|---|
|  |  |  |  |
|  |  |  |  |

It can also be verified that the values of the sample's surface density present different and inconsistent values, due to the high irregularity of nettle yarn used in the weft of the samples.

## CONCLUSION

This article is the starting research of a PhD thesis that seeks to promote the use of nettle fibre in the development of a more sustainable fashion industry. The first tests, carried out with 100% hand spun nettle yarn, allowed an initial evaluation of the thermophysiological properties of the fabric produced with 100% wool warp and with several wool/nettle compositions to the weft, as well as a primary evaluation of its surface properties. However, due to the high irregularity of the acquired yarn, it is not possible to obtain valid scientific conclusions.

It is also important to mention that, despite the extraction process of nettle fibre being a complex and lengthy process, its cultivation, production and mass production present an increasing trend, standing out as an alternative natural fibre to the use of other cellulosic fibres with a major environmental impact.

## REFERENCES

[1] Harwood J., Edom G., *Nettle fibre: Its prospects, uses and problems in historical perspective*, Textile History, 2012, vol. 43, no 1, pp.107–119. doi: 10.1179/174329512X13284471321244

[2] Kregiel D., Pawlikowska E., Antolak H., *Urtica spp.: Ordinary plants with extraordinary properties*, Molecules 2018, vol. 23, no 7, pp. 1–21. doi: 10.3390/molecules23071664

[3] Debnath S., *Great Potential of Stinging Nettle for Sustainable Textile and Fashion* [in:] Gardetti M.A., Muthu S.S. (Eds.), *Handbook of Sustainable Luxury Textiles and* Fashion, 2015, Vol. 1, pp. 43–58, doi: 10.1007/978-981-287-633-1

[4] Singh G., Uprety Y., Subedee B., Chaudhary R.P., *Allo: The Himalayan Giant Nettle* [in:] Pullanikkatil D., Shackleton C.M. (Eds.), *Poverty Reduction Trough Non-Timber Forest Products - Personal Stories*, 2019, pp. 115–118, doi: 10.1007/978-3-319-75580-9_18

[5] Adhikari L., Shrestha A.J., Dorji T., Lemke E., Subedee B.R., *Transforming the Lives of Mountain Women Through the Himalayan Nettle Value Chain: A Case Study from Darchula, Far West Nepal*, Mountain Research and Development, 2018, vol. 38, no 1, pp. 4–13, doi: 10.1659/MRD- JOURNAL-D-17-00074.1

[6] Textile Fiber from the Himalayas, *Himalayan Wild Fibers, Himalayan - Wildly Natural*, online, https://www.himalayanwildfibers.com [access: 25.03.2022]

[7] Bacci L., Di Lonardo S., Albanese L., Mastromei G., Perito B., *Effect of different extraction methods on fiber quality of nettle (Urtica dioica L.)*, Textile Research Journal 2011, vol. 81, no 8, pp. 827–837, doi: 10.1177/0040517510391698

[8] Di Virgilio N., Papazoglou E.G., Jankauskiene Z., Di Lonardo S., Praczyk M., Wielgusz K., *The potential of stinging nettle (Urtica dioica L.) as a crop with multiple uses*, Industrial Crops and Products 2015, vol. 68, pp. 42–49, doi: 10.1016/j.indcrop.2014.08.012

[9] Mudoi M.P., Sinha S., Parthasarthy V., *Polymer composite material with nettle fiber reinforcement: A review*, Bioresource Technology Reports 2021, vol. 16, no 100860, doi: 10.1016/j.biteb.2021.100860