



International Journal of Home Science

ISSN: 2395-7476
IJHS 2018; 4(1): 281-285
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www.homesciencejournal.com
Received: 08-11-2017
Accepted: 10-12-2017

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Nettle fiber: Himalayan wonder with extraordinary textile properties

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Abstract

Girardinia diversifolia, commonly known as the Himalayan Nettle is a naturally available wild shrub found abundantly in the foothills of Himalayas. According to the Centre for Sustainable Fashion, Himalayan Nettle is the longest fiber and is considered finer, stronger, and more elastic than linen. This new trend to use the Nettle fiber for textile purpose has been driven by concern over the environmental damage caused by the processing of synthetic fibers and fabrics. The morphological, physical, and mechanical characterization of *G. diversifolia* fibres in different research studies provide encouraging results, indicating a substantial superiority of Himalayan Nettle fibers compared to other common textile bast fibres. The development of this fiber would create work and income for many local populations and bring a durable and sustainable textile to market. This study aims to provide an unprecedented investigation and documentation on traditional extraction technique, processing and the units involved in production of Himalayan nettle fibres in Uttarakhand.

Keywords: fibers, *Giardinia diversifolia*, Himalayan Nettle

Introduction

Himalayan Nettle (*Girardinia diversifolia*), locally known as *bichu buti*, *Nilgiri*, *Kandali* and *Dolan* is a perennial plant possibly best known as a source of strong, light-weight, sustainable natural fibers. The shrub grows wild throughout the moist mountainous regions of India for e.g. Jammu & Kashmir, Sikkim, Arunachal Pradesh and Uttarakhand (Badoni and Ghosh, 2015) [3]. The Himalayan Nettle has been lately added to the list of possible commercial fibre producing plants having the advantage of being 100% sustainable. Documented information available so far reported that Nettle fibre has traditionally been made into cordage for string, ropes and fishing nets, and it is also spun into yarns and used to weave durable jackets, mats, bags and blankets. Not much scientific work has been carried out to explore the possibilities of Nettle fibre to develop textile grade products. Due to lack of knowledge and traditional production process of fiber extraction, quality products of commercial grades are not available. Traditionally it takes about 10 days to produce 1 kg hand spun Nettle yarn. Some NGOs in Uttarakhand are conducting income generating programmes, with training on better ways of processing, spinning and weaving Himalayan nettle. Various scholarly works have also been done on the other varieties of Nettle to study and improve its efficiency in the field of textiles. Stinging Nettle (*Urtica dioca*) is the variety on which most of the studies are based. Production of Himalayan Nettle fiber is still under infancy stage and needs constructive efforts to help this wondrous fiber to emerge from the wilderness and occupy its rightful place in the galaxy of textile. We can say that Nettle is very socially responsible plant i.e. it can provide income to millions through village –based work.

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Fig 1: Himalayan Nettle Plant (*Girardinia diversifolia*)

History of Nettle

The Nettle plant is best known as an abundant and perennial weed, but throughout history it has been used as a source of fibre in many parts of the world. This plant has been used in the middle hills of Nepal for centuries for extracting fibres and turning them into clothing, as well as sacks and bags for various uses around the home and farm. Burial shrouds made of Nettle fabrics have been discovered in Denmark, that date back to the Bronze Age (3000-2000 BC). Europeans and Native Americans used the fibers from Stinging Nettle to make sailcloth, sacking, cordage, and fishing nets. These fibers have also been used to produce cloth similar in feel and appearance to silky linen. During World War I, the German Empire, plagued by textile shortages, used Nettle fabric as a substitute for cotton. Captured German uniforms were found to be 85% Nettle fiber. At the beginning of the Second World War, a request by the British government was made for the collection of 100 tons of Nettle fiber, which were used for the extraction of green dye for camouflage. By drying and pounding the stalks of Nettle, it is possible to extract fibers that may be twisted into robe or used to produce cloth. The production of Nettle fabric began around the Late Bronze age and is reported to be quite similar to flax or hemp which could be made into a variety of textures, from silky and fine to coarse and thick (Jones, 1994). An added benefit to this fabric is that it could be bleached and dyed in the same way as cotton textiles. As early as the 16th and 17th centuries, Nettle fabric was the textile of choice for Scottish household linens. During much of the early 20th century, Germany made good use of Nettle fibers. Germans discovered that Nettle fiber, mixed with 10 percent cotton, made excellent underclothes, fabric, stockings, and tarps. Fishing nets during this time were also largely constructed from Nettle twine (Williams, 2013)^[16]. The Nettle fiber was also mentioned by Hans Christian Andersen in the fairy-tale of the princess and the 11 swans: 'the coats that they had to make for them before dawn was made of stinging Nettles'. (natuurlijkerwijs, 2016). The plant was also used for the production of paper.

Availability of Nettle (*Girardinia diversifolia*)

The Giant Himalayan Nettle grows at altitudes between 1200 - 3000 metres. It is a grass species and can attain a height of up to 12 to 18 feet in height. The plant has been generally found in broad leaf forest, having a high leaf litter fall. It is perennial and insect resistance crop. Uttarakhand has been recognized as one Indian state which has potential for Nettle

fibre development. Through initial surveys conducted by Uttarakhand Bamboo and Fibre Development Board and some other NGOs e.g. *Himmothan* Society for resource quantification in three blocks of *Chamoli* district of Uttarakhand, it was estimated that a total of seven hundred and seventy square kilometer area has naturally growing Nettle (Himalayan Nettle, *Girardinia diversifolia*), which can provide 24704.26 tons raw dried fibre annually (Lepcha, Bahti and Kumar, 2009)^[11].

Properties of Himalayan Nettle

Despite its armoured exterior, the fibers inside are surprisingly ideal for textile production. The fibers are pliable and have a good length to be spun into yarn. Its length is greater than any other plant fibre known to man, which increases spinning options and, hence, fabric possibilities. The final woven fabric is similar to linen- but much stronger (it's strength increases when wet) and a bit stiffer, making it ideal for more structured garments. It has great resistance to wrinkling and reputedly antimicrobial, antibacterial and fire retardant (Lanzilao, 2015)^[10]. Himalayan Nettle has a unique property that makes it an ideal clothing material for both winters and summers, the fibers of the plant are actually hollow as such they can accumulate air inside thus creating a natural insulation. In order to create clothing material for summers the yarn length can be twisted closing the hollow core and reducing insulation. In winter with low twist the hollow fiber remains open maintaining a constant temperature (SWICOFIL, 2015)^[18].

Structure of Nettle

The fibres are located in a wide ring in the outer part of the stem, not in bundles but as single fibre cells separated by parenchyma cells. In cross-section the fibre cells are polygonal or roundish in shape, with a wide lumen and relatively thin walls (Lanzilao, 2015)^[10].

The fibre content of the stem is 3.5–13.2% on a dry weight basis. In studies in Indo-China in the 1940s, the bark of *Girardinia diversifolia* yielded 61% fibre. Bark strips contained 16% moisture, 38% cellulose, 8% hemicelluloses, 8% lignin and 7% ash. After degumming, the fibre contained 11% moisture, 67% cellulose, 8% hemicelluloses, 4% lignin and 3% ash. Indian fibre has been recorded as containing 7% moisture, 90% cellulose and 1.5% ash (Plant Use, 2017). The fibre is comparable to ramie fibre, but contains more gums, which, however, are removed easily.

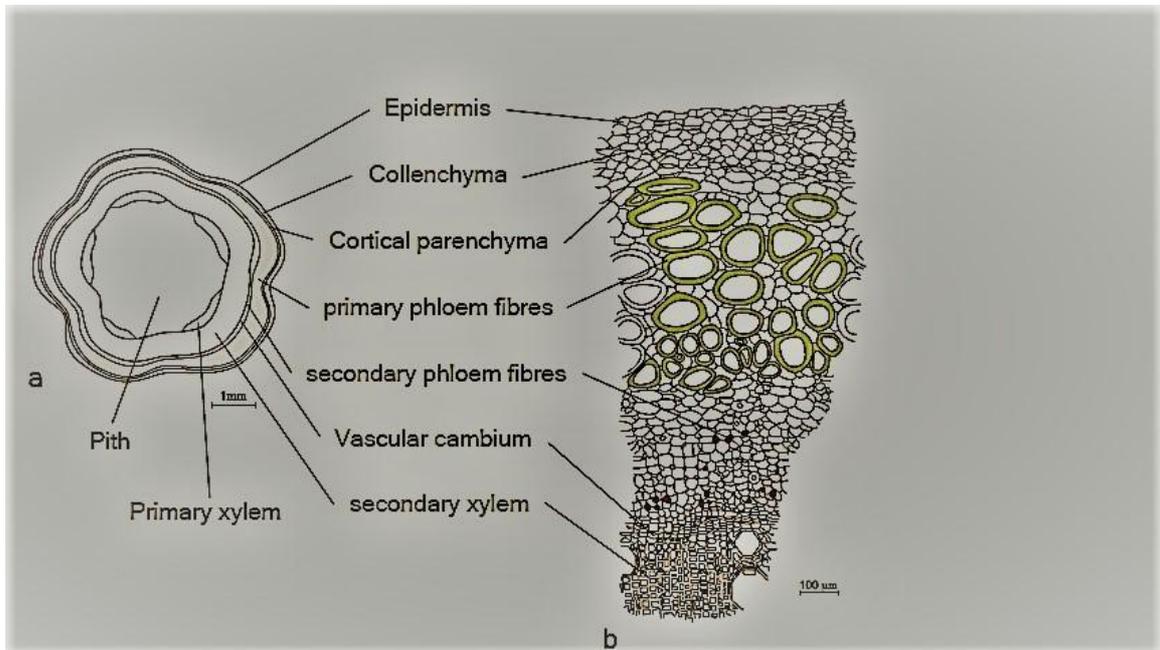


Fig 2: (a) Schematic stem section, (b) section of a *G. diversifolia* stem segment

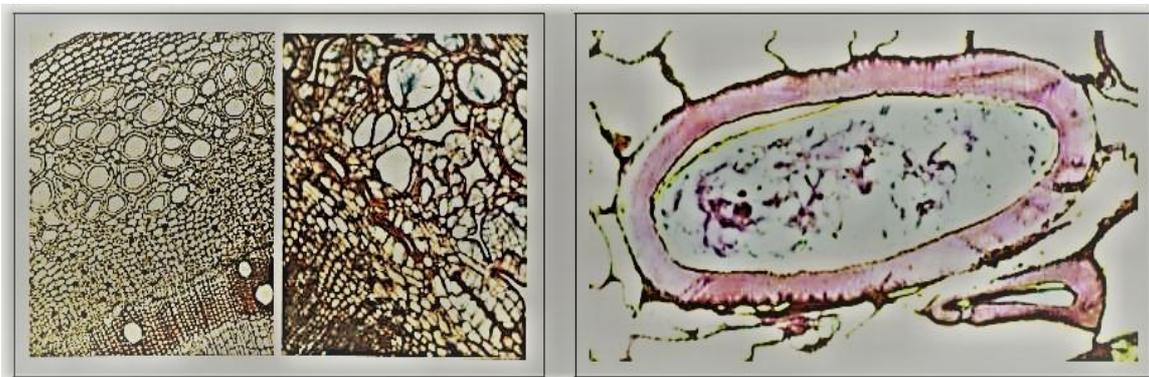


Fig 3: Section of *Girardinia diversifolia* stem extracts: the fibre cells with large lumens

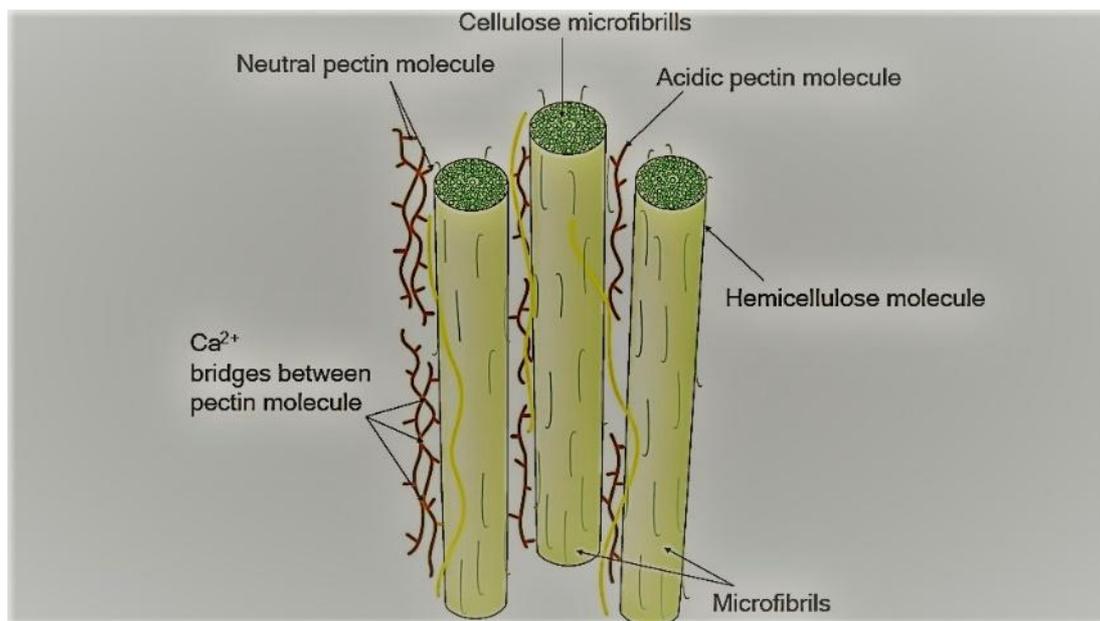


Fig 4: Structure of bast fibres in nettle stem

Traditional Extraction Process Of Himalayan Nettle

Nettles are ready to harvest for fiber in August when the plants are tall, seeds are forming, and the new growth begins to come up from the root zone. The leaves are beginning to

wilt and yellow but there is still a lot of water in the stem. At this time of year it is easy to get stung by the nettles. The stem needs to be cut first and the cut should be near the ground. Gloves are required to be worn during this process. The

leaves are then removed from the stalks. The stems are left to dry for a day, this makes the stems flexible and easier to split later that day. The stems are squeezed flat until it splits. The pith is broken and levered off by bending stick over a finger. The woody pith is separated gently. The inner part of the stem that makes the fiber is then boiled in water. After boiling they are taken and washed in tap water, which removes whatever outer layer is left. After washing it is rubbed in mud called *Kamedu Mitti*. Without this clay the raw fiber would not separate into the strings needed for spinning. It is then left to dry in the sun, after drying it in the sun the fiber is ready to be weaved. Village women perform the spinning by hand and onto a stick, often while on the move. The fibre is then woven into delicate shawls and scarves using a traditional backstrap loom. Nettle stalks do not achieve the quality required for fibre processing in the first year of cultivation; also the stalks

are too thin and branched. A cutter bar can be used for harvesting, or alternatively the same harvesting chain of flax or hemp. Harvesting can start from the second year and can be carried out also according to the final destination of the crop. For fibre production harvest can be carried out between July and August. Fibre of stinging nettle is similar to all the other herbaceous stalk fibres, as hemp or kenaf. The fibre processing, industrially, can follow same procedures used e.g. for hemp or flax, i.e. biological retting, mechanical or physico-chemical methods. Apical part of the plant is richer in fibre so this part is used for textile. Some experiences anyway revealed that nettle stalks are prone to over-retting (decrease of fibre quality). Good degree of separation between fibers and shives was obtained by mechanical scutching applied on stalks stored for 1 year, probably resulting from natural retting processes occurring during the storage (Himmotthan, 2013).

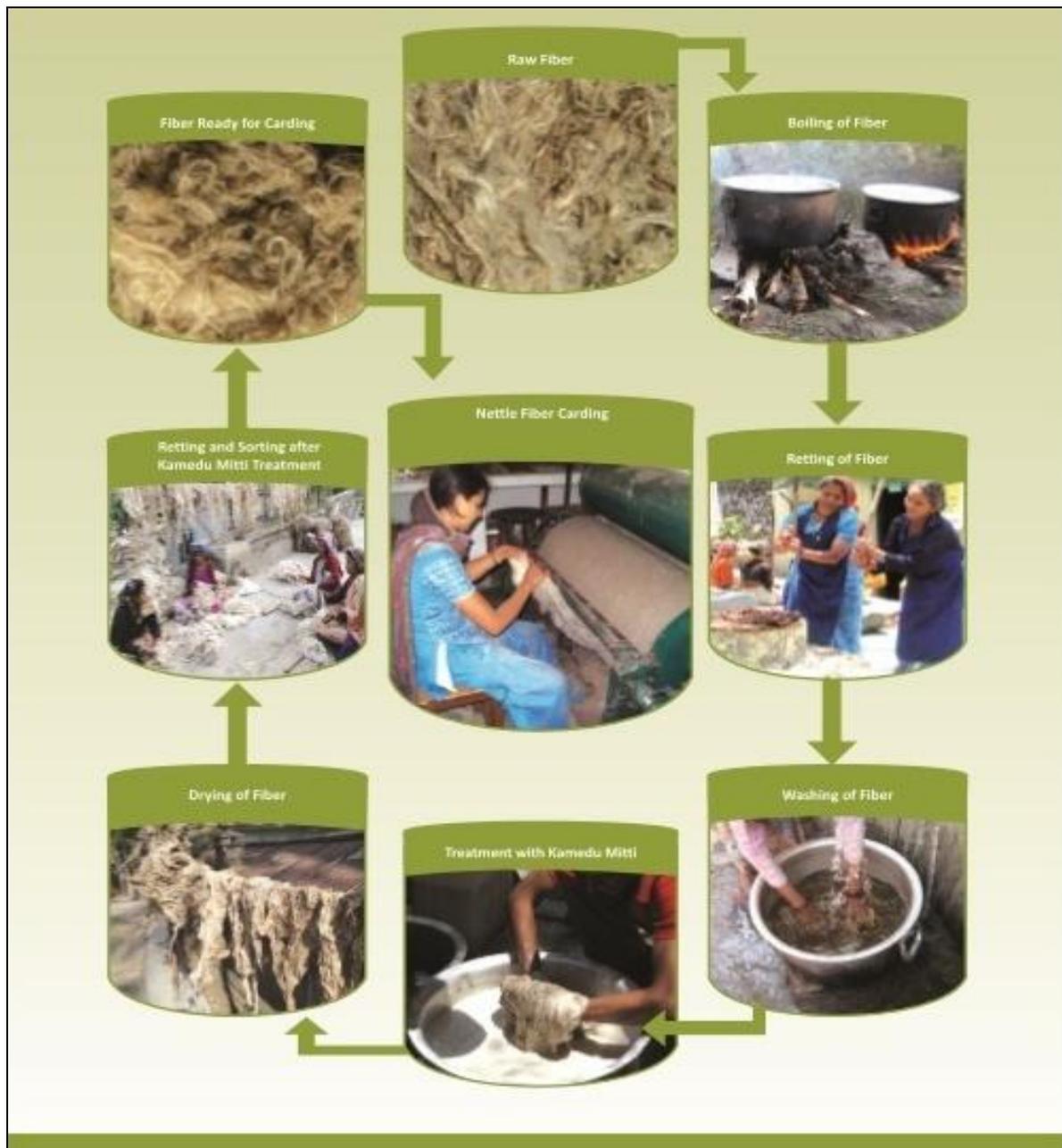


Fig 2: Extraction process of Himalayan Nettle (Source: www.himmotthan.in)

Existing Applications of Nettle

The bast fibre is used in tropical Africa for making sewing thread, twine and rope. In Kenya it has been grown in demonstration projects aiming at producing fibre, paper and

insecticide from the plant. In India and Nepal the bast fibre is traditionally made into cordage for strings, ropes and fishing nets, and woven into cloth for bags, sacks, jackets, porters' headbands and mats, vests, shawls and a range of other

articles aimed at tourist and export markets.

In Nepal, the plant is a source of livestock feed, bedding material, fuel and a blue dye.

Conclusion

The Himalayan Nettle fiber is at growing stage in Uttarakhand. Only traditional extraction process is known to the local community. As a result the fiber extracted and processed is of not very good quality to turn it into textile products. A lot of work needs to be done towards the development of this eco-friendly fiber. Research can be done towards the current status of Nettle fiber in Uttarakhand and how the quality can be improved so that it can give a real competition to the other fibers in trend.

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