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Post harvesting processing of linseed stalks at RSV College of Agriculture and Research Station Bemetara, Chhattisgarh

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Abstract
This study presents an overview of the innovative post-harvesting processing techniques for linseed stalks conducted at the RSV College of Agriculture and Research Station in Bemetara District, Chhattisgarh. With the increasing production of linseed (*Linum usitatissimum*) in the region, the focus has shifted towards utilizing not only the seeds but also the biomass of the stalks traditionally considered agricultural waste. The research aim to explore sustainable processing methods that enhance the value of linseed stalks. Various techniques including mechanical processing, fiber extraction, and bio-composite manufacturing were examined. The research entailed both laboratory experiments and field trials, assessing the quality of extracted fibers and their applications in biodegradable products. Results indicated that linseed stalks can be processed to obtain high quality lignocelluloses fibers with potential use in textiles, bio-degradable packaging and insulation materials. The study further highlighted the economic benefits of utilizing these stalks, contributing to a circular economy in agriculture by reducing waste and providing farmers with additional income sources.

Keywords: Linseed stalks, post harvest processing, fiber extraction

Introduction
Chhattisgarh is blessed with required climatic diversity for our traditional crop i.e. linseed. Chhattisgarh is one of the important linseed growing states of India, which account 27.10 thousand hectares area and 7.90 thousand metric tonnes production. Linseed has been cultivated in the state from very earlier times. Chhattisgarh region is divided into 3 agro-climatic zones viz., Chhattisgarh plains, Northern Hill region and Baster Plateau. Linseed is grown in many districts of the state but major linseed growing districts are Rajnandgaon, Durg, Bilaspur, Kabirdham, Raipur, Dhamtari, Sarguja, Kanker and Raigarh. In Chhattisgarh linseed is grown as a winter crop mostly in sub-marginal land under rainfed (63%) and utera (25%) i.e. para cropping conditions.

Indira Gandhi Krishi Vishwavidyalaya, Raipur has been working since 1967-68 relentlessly for enhanced production and value addition of linseed. In Chhattisgarh IGKV holds around 2025 linseed germplasm accessions till date. These accessions having variability for all the important traits like seed colour, plant height, seed yield, oil yield, values additions traits, resistance to diseases and pest etc. We have also yellow seeded accessions as well, which is known for its golden yellow seed colour and buttery taste and is demanded for edible & confectionary market. To strengthern our state's traditional linseed crop various projects are also being carried out in the institute to boost & exploit different aspects of the crops. AICRP on linseed, wide hybridization and DBT Network project on linseed are the major projects to be named.

Flax type linseed varieties are generally of tall stature in comparison to seed type linseed varieties (> 90 cm). Also, the branching habit of flax type linseed is different as it has fewer secondary branches and erects plant type. Flax fibre is extracted from the blast or skin of the stem of flax plant. Flax fibres are arranged in the form of thin filaments, grouped in longitudinal slender bundles distributed circularly around a central wooden cylinder. Due to the combination of high mechanical performances and plant-based origin, flax fibres are interesting reinforcement for environmentally friendly composite materials.

Flax fibres have been used as textile raw material, composing cords and weaving yarn and later on more fashionable garments or high-quality fabric upholstery. Selection of good quality seeds in an important aspect for flax fibre production. Varietal improvement work on tropical flax type is in progress since last ten years at IGKV.

Materials and Methods

Method of making linen from linseed stalk is given below as flow chart:

- Collection of linseed wastes from farmer's field
- Threshing
- Cutting of linseed branches
- Bundling
- Retting
- Drying
- Bundling
- Storage
- Fibre extraction
- Cleaning of fibre
- Carding
- Spinning of yarn
- Looming practices
- Bleaching
- Dyeing
- Washing
- Drying
- Hot Rolling
- Fold and Packing

Methodology of Linen Production from Linseed Stalk

Fig 1: Linseed Crop

Threshing: it is carried out to remove capsules of the Linseed to get seeds detached from stalk waste.

Fig 2: During threshing operation in thresher machine

Branching Cutting: Branches and roots if any, are cut and separated so that it will not deteriorates the quality of fibre.

Fig 3: During the Branch Cutting in the cutter machine

Retting of Stalks: There are two ways of retting the stalks. One is natural retting through water and the other is chemical retting. In present project common practice was natural through water. This natural retting process is carried out in the pit filled with normal water or in channels running with water. In this channel/pit small bundles of stalks are dipped in water and pressed with heavy weight of concrete/stone to avoid floating. Bundles are allowed to be dipped in water for 4 to 7 days during summer season. After retting bundles are washed with fresh water and spread for sun drying for 2-3 days.

Fig 4: During the Retting operation

Fibre Extraction: Fibre is extracted from rotten stalks by using crushing machine. This process is also called as hackling. This machine is self-designed by university.

Machine is occupied with two pairs of serrated roller, Rotten stalks are processed 2-4 rounds for complete crushing.

Fig 5: During the Fibre Extraction operation

Cleaning of Fibre: Fibre is cleaned by the use of combing machine. This process is also called as scotching. In this process crushed stalks are striked of the woody parts from the fibre. About 10-15 % fibre are obtained by this process. This machine is also self-designed by university. This machine has two flyer rollers which rotate opposite to each other so the stalks fed in between roller gets striked of.

Carding: This is the heart of the spinning process. Cleaned fibre is feed to carding machine. Main function of carding machine is opening of fibre up to single strand apart from cleaning up to some extent. Output of this machine is sliver from fibre which is continuous input for spinning process either charkha or rotor spinning mahine. This machine is modified according to linseed fibre parametes. Sliver is collected in the can as shown in the image.

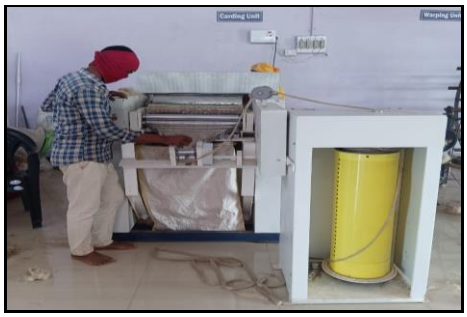

Fig 6: During the Carding Machine

Spinning of Yarn: Spinning of yarn is done either by using charkha or rotor spinning machine.

Paddle Charkha: This charkha is traditional one which is known as Bagheshwari Charkha. There is no need of electricity to run this charkha and it is operated manually. It is very much usual for villages located in remote areas. These are means of employment for rural women. Women can spin 150-200 g yarn per day. Yarn spun is of khadi type. Limitation of this charkha is that only coarser yarn can be spun. This is a paddle operated charkha where option of different twist direction either ‘s’ or ‘z’ in the yarn. This charkha is useful for spinning of other fibres as well i.e. silk,cotton, woolen etc.

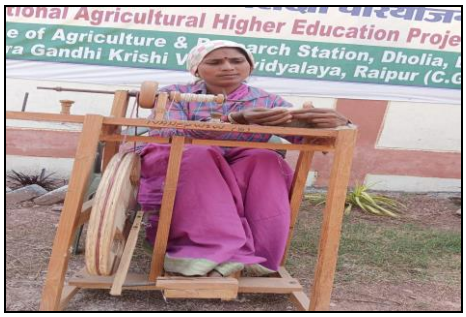

Fig 7: Paddle Charkha

Rotor spinning or Open End Spinning Machine : This is a fully digital machine. Yarn twist per inch (TPI), twist direction count (Thickness) of yarn, speed of machine is directly controlled by panel. This is laboratory model machine having four heads operated by single person. Production of the yarn depends upon the spun count of yarn.

Fig 8: Spinning Machine

Looming Practices: It consists of following process

Warping: Warping refers to the process of arranging yarns or threads lengthwise on a loom. During warping, parallel threads are wound onto a beam in preparation for the weaving process. This step ensures that the threads are properly aligned and tensioned before weaving.

Warping consists following parts:

1. **Creel:** it is wooden frame holding package of yarn i.e. bobbin, cones or cheeses according desired number of ends in the warp. Creel capacity may be differed from 240-1200.
2. **Drum:** This is made by iron or wooden, which circumference is 5 meters. The warp sheet yarn wind up over this drum, the rotation of drum depends on required length of warp.

Weavers Beam: This beam is also made by either steel or wooden with iron flange. Warp sheet is transferred to this beam, here ensures that the threads are properly aligned and tensioned before weaving. Warp is a sheet of ends yarn. An iron drum winds up sheet of yarn according to required length. Creel holds the bobbin from which yarn with drawl passes through reed for making shed leasing. 120 number ends make a series of number of section winds according reed of the loom and width of the fabric required.

Fig 9: Warping Process

Pirn Winding : The weft yarn wind on a plastic rod like structure called pirn which crosses the warp back and forth in order to create fabric on a loom and thus weaving occur.

Fig 10: Pirn Winding

Weaving: Weaving is done using frame loom. Weaving is a process of intersection or crossing back and forth of warps and weft in different fashion. A loom consists of different motions to perform weaving. Three primary motion firs treadling is for making two layers of shed, after that picking up of the weft to insert the pick in the shed. Last is beating up of the last pick to fell on the cloth then woven cloth is taking in the cloth beam. A women can weave 8-10 meters per day investing eight hours for weaving process.

Fig 11: Frame Loom

Bleaching: It is a process to remove the natural and artificial impurities in fabrics to obtain clear white finished fabric or in preparation for dyeing and finishing. Bleaching is carried out using hydrogen peroxide (H_2O_2) at boiling temperature.

Dyeing: It is a process of colouring fibre, yarns or fabrics with either natural or synthetic dyes. Natural dyes are extracted from natural sources. In this project we have mostly used natural dyes for environmental concern. In natural dyeing process a mordant is required for fixing the dye molecules. Natural dyes are soaked in water for 1-2 days and then boiled. Fabric is dipped in the mordant and heated to boiling temperature. Then content is then transferred in vessel containing dye and continued dyeing for next sixty minutes at boiling temperature.

Conclusion

The post harvest processing of linseed fiber at IGKV, RSV College of Agriculture and Research Station Bemetara, Chhattisgarh state has demonstrated the importance of adopting systematic practices to enhance fiber quality and yield. The processing methods implemented have effectively reduced impurities and maximized the extraction of high quality linseed fiber which is crucial for various industries application. Through careful retting, drying and mechanical treatment, we have observed that the resultant fiber exhibits increased tensile strength and improved marketability. The integration of modern processing techniques alongside traditional methods has a comprehensive approach to fiber processing, leading to better economic outcomes for local farmers and contributing to sustainable agricultural practices in the region.

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