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# Sustainable Development of *Hibiscus Sabdariffa*- Indigenous Practices

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**Abstract:** ***Global trends towards sustainable development have brought to light natural, renewable, biodegradable raw materials, and bast fibres are amongst them. In the present study the current status of the cultivation process, harvesting and retting methods of Hibiscus Sabdariffa (mesta) are studied and documented along with its current uses and socio economic factors influencing the production of the crop. Retting is one of the main challenges confronted during the processing of the bast plants for the production of long fibre. Water retting is one of the traditional methods for separating the long bast fibres in which indigenous bacteria attack the gums and hemicelluloses, yielding much water pollution. Currently much interest has been focussed on the sustainable anaerobic microbial retting. The objective of this study was to investigate the effect of anaerobic microbial retting and water retting on the fibre yield, strength, fineness, colour and lustre, density and defects of mesta fibre (Hibiscus Sabdariffa). Mesta fibres were extracted using microbial retting (microbial consortium from CIRCOT) and water retting and their physical characteristics were investigated. The physical characteristics showed a significantly better fibre after treating it with microbial consortium compared to aerobic water retting in terms of its strength, fineness and density.***

**Keywords:** Hibiscus Sabdariffa, Mesta, Microbial Retting, properties, yield

## 1. Introduction

### Nomenclature

Mesta belongs to the family *Malvaceae* and genus *Hibiscus*. It is an annual erect shrub with red or green stem, practically unbranched or with branches at the base; stem is glabrous or slightly hairy with minute tubercles; leaves are serrate, lower leaves ovate and undivided, upper ones palmately 3-5 lobed; flowers are large yellow with dark crimson eye; epicalyx united at the base and adjoined to calyx. Calyx is dark red to purple; fleshy capsules are ovoid and pointed with numerous seeds (Wealth of India, 2001).

### Production and utilization

It is considered to be a native to Asia (India to Malaysia) or Tropical Africa. The plant is extensively grown in tropics like Africa, Brazil, Australia, Caribbean, Central America, India, Hawaii, Florida and Philippines as a kitchen garden crop. It is known by the names like Roselle, Rozelle, Sorrel, Red sorrel, Jamaica sorrel, Indian sorrel, Guinea sorrel, Sour-sour, Queensland jelly plant, Jelly okra, Lemon bush and Florida cranberry. In Indian languages it is known as Gongura, Lal ambari, Patwa (Hindi), Lal-mista, Chukar (Bengali), Lal-ambadi (Marathi), Yerra gogu (Telugu), Pulichchai kerai (Tamil), Pulachakiri, Pundibija (Kannada), Polechi, Pulichchai (Malayalam) and Chukiar (Assam) (Mahadevan et.al, 2009).

### Cultivation

Mesta is cultivated in an area of about 1.5 lakh hectare and the average national productivity of the crop is around 11q/ha. Although its productivity has increased two folds since independence, despite it face tough competition from cheaper synthetic fibres (Mungole & Chaturvedi 2011). It is one of the important bast fibre crops which stand next to jute in production. At the time of partition, India lost about 80% of total jute production area. The jute crop needs a particular set of climatic conditions, therefore, the cultivation of jute could not be extended beyond the states of West Bengal, Assam, Bihar, Orissa, and parts of U.P. and Tripura. As a result the production of jute fell below the requirement of mills. Mesta can, however, be grown even in those areas where jute is not grown under wider climatic and soil conditions with much less care. This helped the country to expand more area under mesta (Singh, D.P.).

## 2. Objectives of the Study

1) To document the sustainable cultivation process, the current harvesting and retting methods of Hibiscus Sabdariffa in the state of Maharashtra.
2) To study the socio cultural life of mesta cultivators from Maharashtra.
3) To extract and compare the properties of fibre using aerobic water and anaerobic microbial retting
4) To grade the Mesta fibre found in the state of Maharashtra and Andhra Pradesh
5) To identify the feasibility of spinning the mesta fibres as a novelty yarn and weaving the mesta yarn into fabric.

## 3. Methodology

As the study has both documentation and experimentation it was conducted in three parts:

**Part I**

1) For objective 1, the seeds of Hibiscus Sabdariffa were planted in the pot at the researcher's place. Its growth was monitored from the sowing till the fruiting stage. Various photographs were taken to record different stages of the plant and the observations are mentioned below:

2) Multiple field visits to various villages where the crop grows was planned. The sample size comprised of 10 families who are currently growing mesta in their farm. The interview schedule and participatory observation techniques was undertaken. The data was collected with the help of interview coupled with observation method. The schedule consisted of closed and open ended questions. The questions dealt with demographic details, current cultivation process, present harvesting methods, retting methods, versatility of the crop and their socio-cultural life. Purposive sampling method was adopted for selection of the sample. A multi visit, interview method was implemented along with photographic and video documentation for the collection of authentic data.
3) To get the complete and authentic information about the cultivation process, harvesting and retting methods a pilot study was conducted. To study the current scenario of Mesta in Maharashtra multiple field visits to three villages were planned. The sample size comprised of ten families; three from Kacheri Sawonga village, four from Khekranala village near Nagpur and three from Ambhora village near Wardha(Maharashtra).

**Part II**

A pilot study on different retting methods was conducted in CIRCOT and ICT Mumbai. The dried stem of Mesta was sourced from the Khekranala, Maharashtra. Different types of retting methods employed for the extraction of the fibre are as follows:

1) Water retting- A bundle of 10 sticks was tied together and immersed in the tap water under room temperature.
   a) Material to liquor ratio- 1:25
   b) Room Temp- 32 degree Celsius
   c) Ph of water- 6.98
   d) Duration- 15-20 days

2) Enzymatic/Microbial retting- One kilogram of cattle dung was mixed with 1 ltr of tap water and 3 ltrs of sea water. To this 100 ml of digested slurry was added as a source of inoculum. This mixture acts as a microbial consortium. The consortium continuously produces biogas. Both anaerobic and aerobic micro-organisms were found to be present in the microbial consortium. It is maintained in a 10 ltr capacity bottle. The stem of Hibiscus Sabdariffa was immersed in the stabilised microbial consortium for 2, 3, 4, 5, 6 days, 1 week, and 2 week. The retting tank was covered and sealed from the water tunnel to prevent the entry of air. The gas produced escaped from the air trap as there was always a positive pressure inside the digester.

**Part III**

**Grading of Mesta Fibre**

The BIS grading of mesta envisages a score card system of grading that aims at eliminating personal bias as far as possible. Six physical parameters i.e., strength, root content, defects, fineness, colour and density of mesta fibres are assessed for sorting out the fibre into six different grades. Relative weightage is given to each physical parameter by standard scoring system and the grade of fibre is determined by total score of six parameters. Scores for the mesta can be taken as guidance for determining the quality or grade of the fibre which will further justify the commercial value of the same.

## 4. Results and Discussion

**Part I**

The Mesta grown at researchers place grows at a limited height of about 2-3 ft as compared to the mesta grown on farmers' field which grows upto a height of about 6-7ft farmer's field. There were significant observations made while growing the plant at home as compared to the growth of the plant at field. Below are the observations made:

a) One in five seeds becomes active and shows a good growth.
b) The plant is resistant to drought but ruins in water logged condition.
c) It is not infested by any moth or worm
d) The height of the plant remains redundant as compare to land.
e) The fruiting begins after 3 – 4 months of sowing the seed.
f) The height of the plant increases till 4$^{th}$ month and after that the growth stops.
g) The bark of the plant was very thin in diameter as compared to the commercial crop grown in farms.
h) The fibre doesn't mature properly in the pot and hence the yield is very poor.
i) The growth of the plant is largely dependent on the climatic conditions for eg. Excessive rains can hamper the crop.
j) The fruit is sour and can be substituted for tamarind like flavour in food.
k) The leaves of the plant are also edible.

**a) Sowing and cultivation:** Cultivation of *Hibiscus Sabdariffa* was being carried out in most organic and efficient way. Seeds of *Hibiscus Sabdariffa* were sown by broadcasting/ line sowing method with the onset of monsoon in the 1st or 2nd week of July, and the same is also mentioned in the Natural Fibres- Handbook with cultivation and uses by NIIR and Vegetable Fibres by Kirby R.H. that the planting should be done at the commencement of rainy season. While sowing the moisture level of the soil was maintained around 20-30% and seeds were sown at a depth of 2-3 cms for good germination. The spacing between the seeds was maintained for proper growth of the plant. For manure, organic fertilizers in the form of compost were being used. It was prepared from cow dung, cow's urine, gram flour, jaggery, soil. The mixture of this is applied on the field at regular intervals as compost. Weeding, thinning and hoeing were the three major inter-cultural operations attempted in mesta crop. The growth in case of sabdariffa is low in the initial stages but picks up in the later stages. (Agarwal & Dedhia, 2014)

**b) Harvesting:** It is generally done after the six months of sowing and it is very important aspect in a bast fibre crop. Harvesting is done by cutting the plant close to the ground with the help of a sickle. After the harvesting, the plants are sorted out according to the thickness of stems. This is followed by bundling of plants in convenient sizes of 20-25 inches in diameter. These bundles are kept standing- in the field for two or three days for shedding of seeds (Agarwal & Dedhia, 2014)

**c) Retting and fibre extraction:** The stems were retted in water in the same way as jute is retted i.e. by beat and jerk

extraction method. The stems were immersed in stagnant water for 15-20 days so that the fibre loosens and can be easily taken out. The outer sheath of the stem was removed manually from hand. Then it was washed thoroughly in clean water to get rid of all the impurities. The fibres separated and due to their length it was needed to tie them in the form of a knot while cleaning. The cleaning process was carried out by beating the fibre(tied in the form of a knot) against the hard rock/stone. The fibres were then hanged vertically on the wire and dried in the sun. Similarly the same procedure is also mentioned in the Handbook with cultivation and uses by NIIR and Vegetable Fibres by Kirby R.H.

**d) Socio economic factors:** The respondents clarified that the cultivation process was being carried out by the entire family except for children. They have planted Sabdariffa from last 2-3 yrs. The age of the farmers ranged around 40-45 yrs and only the older generation is into farming. Younger generation had no inclination to pursue and continue with the traditional farming practiced by the family. One of the farmers conversed in the vernacular language and the other two conversed in hindi. They stayed in their own cemented house. Two farmers belonged to a joint family and only one farmer belonged to a nuclear family. The children in the family were motivated by the parents to study further and would take up a good job rather than being involved in the farming because of poor returns which farmers are getting irrespective of their hard work. Farming is the main source of income for all the farmers(Agarwal & Dedhia, 2014).

## 5. Determination of the yield of fibre

The yield of the fibre was also recorded and the extraction percentages were calculated

**Table 3:** Influence of retting method on the yield of the fibre

| | | Initial Weight (gms) | No. of days kept for retting | Weight of retted and dried fibre(gms) | Recovery % |
|---|---|---|---|---|---|
| Water Retting | Fresh Harvested stalks | 5000 | 16 | 327 | 6.54 |
| | Dried Stalks | 5000 | 21 | 296.5 | 5.93 |
| Microbial Retting | Fresh Harvested stalks | 5000 | 11 | 355.7 | 7.10 |
| | Dried Stalks | 5000 | 16 | 285.2 | 5.70 |

Freshly harvested mesta stalks processed by anaerobic microbial retting yielded more fibres as compared to the aerobic water retting. Quantity of the fibres extracted from the dried stalks of mesta by microbial retting was also more in contrast to the water retting. From the view point of the physical properties fibres extracted by microbial retting possess better strength, fineness, density and uniformity as compared to the fibres extracted from water retting. Moreover the fibres extracted from the fresh harvested stalks of mesta prove to be better for textile application in comparison to the conventionally used fibres extracted from the dried stalks. So overall microbial retting is a good method to extract the fibres with respect to the yield and quality of the fibre without causing overdue damage to the environment and moving towards sustainability. The current worldwide interest in using environmentally benign fibres makes it urgent to seek the processes of bast fibres which can overcome the challenges of traditional processes

## 6. Determination of the properties of retted mesta fibre

Retted kenaf fibre was tested on Fibre bundle strength tester for the tensile strength, airflow fineness tester for fineness, colour and lustre meter and bulk density meter. To avoid the bias all the samples were subjected twice for readings and the average was taken as the final reading. The instruments used for testing are developed by NIRJAFT for the jute or similar fibre testing. Strength of the fibre- To test the strength of the fibre Fibre Bundle Strength Tester was used. The test length of 5 cm is adopted as standard and its tenacity is expressed n gm/tex.

Fineness - Airflow fineness tester developed by NIRJAFT measures fineness of fibre on the principle of measuring specific surface of a constant mass of fibre. The instrument comprises of a device by which air is sucked through a sample of fibre plug at a constant pressure and the rate flow is measured. The rate of flow is dependent on the fineness of fibres.

Colour and lustre – It is a kind of a reflectance photometer, which measures the brightness and lustre of the fibre sample in terms of diffused and specular reflectance using photoelectric cell.

Density – Fibre bundle of fixed weight (40gms) and length (10cms) is held between the plates of bulk density meter and compressed by a fixed load (10kg) hanged from the bottom of the device. The bulk density is then calculated by dividing the mass by the volume under compression.

Defects – Defective portions are cut from a bundle of mesta fibre reeds and weighed. The weight is expressed as percentage of total weight of the reed bundle give a measure of defects.

**Table 4:** Physical properties of mesta fibre

| *S. No.* | *Properties* | *Water Retting* | | *Anaerobic Microbial Retting* | |
|---|---|---|---|---|---|
| | | *Dried stalks* | *Fresh Stalks* | *Dried Stalks* | *Fresh Stalks* |
| 1 | Strength (gm/tex) | 20.8 | 23.9 | 24.1 | 24.8 |
| 2 | Fineness (tex) | 2.8 | 2.9 | 2.9 | 3.0 |
| 3 | Density (gm/cc) | .45 | .46 | .46 | .47 |
| 4 | Colour and lustre | Fair Average | Good | Good | Good |
| 5 | Defects Weight (%) | 2 | 1.5 | 2 | 1.5 |

Table No. 4 indicates that on comparison between the dried stalks and fresh stalks, fresh stalks of mesta gave the better results in terms of all the parameters. This could be due to the

water content present in the stalks during harvesting. The water retention after harvesting is higher which accelerates the process of retting i.e. loosening of the fibres and produces good quality of fibre. While there were not major differences noted between the fresh stalks retted by aerobic water retting and anaerobic microbial retting except for the strength of the fibre and the time taken for the extraction.

## 7. Grading of the Mesta fibre found in Maharashtra and Andhra Pradesh

The quality of Mesta can be easily judged by the scoring scheme and the grade in which it falls will decide the end use of the yarn. Six physical parameters i.e., strength, defects, root content, colour, fineness and density are assessed for sorting out the fibres into six different grades. $M_1$ is considered as very good quality whereas $M_6$ consist of all the mesta fibres which do not conform to any grade like $M_2$, $M_3$, $M_4$ and $M_5$ but they are of commercial importance. Instrumental method is mostly used to determine the grade of the fibre to avoid any personal bias.

**Table 5:** Scoring Scheme for Mesta fibre found in Andhra Pradesh and Maharashtra

| *State* | *Grade* | *Strength* | *Defects* | *Root Content* | *Colour* | *Fineness* | *Density* | *Total Score* |
|---|---|---|---|---|---|---|---|---|
| Andhra Pradesh | $M_{2(Good)}$ | 17 | 5 | 27 | 11 | 5 | 2 | 67 |
| Maharashtra | $M_{3(Fairly\ good)}$ | 17 | 5 | 22 | 7 | 5 | 2 | 58 |

The Mesta fibre grown in Andhra Pradesh is of better quality than the fibre grown in Maharashtra. This could be due to many reasons like improper retting of the stems, unsuitable ways of extraction of the fibre or stage of harvesting. Though it is called a multipurpose crop its area in India is going down. Its cultivation is restricted to a fewer places in India. If proper grading system is implied in the industry it will enhance the value of the crop

## 8. Conclusion

The above research was carried out to study the current scenario of *Hibiscus Sabdariffa* in the state of Maharashtra in India. The present cultivation methods, harvesting process, retting process, method of fibre extraction, uses and versatility of *Hibiscus Sabdariffa* was studied and documented. The farmers were using the most economical and organic ways to grow a healthy crop. There was no addition of external chemical fertilizer which adds value to the fibre. The growth is largely dependent on the climatic conditions as it is a rainfed crop. The process of harvesting and retting the crop is still traditional. There is a felt need to intervene in this sector. With the establishment of some food industries it is gaining popularity as raw material which can be used to make jam, jellies etc. The fibre of *Hibiscus Sabdariffa* was also used to develop various products like ropes, cordages, furniture and there is a lot of scope for the fibre to be utilized in the textiles sector as well.

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The grade of the mesta fibre found in Andhra Pradesh is better than the grades of the fibre found in Maharashtra. But this doesn't mean that the grade of the fibre remains same for every season and every crop. The grades can be improved by improving the way of cultivating the crop, retting the stem, harvesting the crop. By this low grade of mesta can be improved by -2 grades thereby ensuring high return to the farmer and the industry is also benefitted by the availability of the fibre of superior quality.

As a diversified and value added mesta product, besides the conventional yarn and fabric, technical textile has immense future in this sector and could drive its growth. For instance, it could find its application in various sectors of technical textile like agrotech, sporttech, meditech etc. The present trends in several user sectors of the textile industry in many industrialised countries indicate the use of conventional textiles has reached a static level. The manufacture of conventional textiles has become expensive, competitive and often unviable and many companies are switching over to value added technical textiles with the capability to meet functional needs for precision applications. It has become an integral part of human life and has a very bright future ahead.

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