# UTILIZATION OF ECONOMIC POTENTIAL OF *LANTANA CAMARA*

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## Introduction

*Lantana camara* L. (Verbenaceae) is an obnoxious weed which has encroached upon a large expanse of lands in forests, pastures and grasslands, orchards and wastelands in many parts of the world and has imposed a great threat to land productivity, grazing livestock, biodiversity and consequently to the overall ecology (Sharma *et al.*, 1988; Pass, 1991). invading pasture lands and natural communities throughout the world. Literature reveals that till date number of approaches has been adopted for its effective management (Munir, 1996; Stirton, 1999). Control measures have included the use of chemical sprays and the deployment of biological control agents. Treatment of large Lantana infestations with herbicides is not economically feasible. Since each approach has inbuilt limitation e.g. high cost, impracticability, environmental safety, temporary relief etc., satisfactory approach is yet to be evolved.

Utilization of Lantana can be an effective method for managing the weed. Weed is a weed until it has no use, like bamboo about 200 years ago. It became a resource when people started using it. Owing to the presence of fibres, *L. camara* has exploitable potential to make value added products such as $\alpha$-cellulose and its derivatives, handmade paper, wood composites (which are good substitute of solid wood depending upon the end use) and furniture. This would be a practical proposition for effective and environment friendly management of the weed. Thus utilization-based management of Lantana would not only relieve the nation from its negative social and environmental effects by carbon locking but also promote the economic development. The above scenario reflects an immediate need to undertake sincere R&D efforts on making value added products from Lantana in order to utilize its economic potential.

## Physical properties

Lantana was collected from the field of FRI, Dehra Dun campus. The physical properties of the raw material were determined in terms of moisture content and bulk density.

| | |
|---|---|
| Moisture content (freshly felled, %) | 65.88 - 69.97 |
| Bulk density (kg/m$^3$) | 210.76 - 252.94 |

Knowledge of the chemical composition and anatomical features of any raw material is essential in terms of its utility for various purposes. These will determine the suitability of raw material for specific purposes in particular. Therefore it is very important to study the chemical composition and anatomical feature of raw material before making any useful product. The material was air dried and manually reduced to 2.5 - 5 cm chip size. The chips were stored in a polythene bags to avoid moisture loss.

## Proximate Chemical Analysis

Preliminary assessment about the quality and suitability of raw material for further processing was examined by its proximate chemical analysis in respect of hot water solubility, 1% NaOH solubility, alcohol benzene solubility, holocellulose, alpha cellulose, pentosans and klason lignin.

Chips were reduced to dust, dust passing through 40 mesh and retained on 60 mesh was taken for the studies. Table 1 shows the data on the proximate chemical composition of Lantana.

Hot water solubility (7.0 - 7.25%) correspond to some extent the presence of low molecular weight carbohydrates and water soluble extractives, whereas 1% caustic soda (NaOH) solubility is of importance in assessing the soundness of the material in respect of its decay. 1% NaOH solubility (18.0- 19.5 %) is within the limit as values ranging from 10-30% are normally considered adequate for further investigation. The alcohol benzene solubility (4.45 - 5.65%) gives indication of the amount of waxy resinous matter and certain other low molecular weight organic solvent soluble components. Holocellulose determination gives preliminary assessment of total fibrous component of the raw material which constitutes nearly three fourth of the fibrous material. Holocellulose include(s) alkali resistant cellulose as well as water-soluble and alkali soluble hemicellulose. Higher amount of holocellulose indicates better the yield of the product. The holocellulose content of Lantana (65.89 - 66.30 %) is lower than Eucalyptus (72 - 75%0) but higher than bagasse and rice straw (58 - 60%). Alpha cellulose (55.92 - 56.34%) alkali resistant portion of holocellulose indicates pure cellulose content whereas pentosan is an indicator of hemicelluose which is water and alkali soluble fraction. Klason lignin is an indication of lignin present in wood. Lantana contains 26.32 - 27.54% lignin which is in the range of hardwoods (25 - 30%). The amount of lignin present in raw material decides the quantity of chemical consumption and the yield of the product.

**Table 1**

*Proximate Chemical Analysis of Lantana camara*

| | |
|---|---|
| Hot Water solubility (%) | 7.0 - 7.25 |
| 1% NaOH solubility (%) | 18.0-19.5 |
| Alcohol Benzene solubility (%) | 4.45-5.65 |
| Holocellulose (%) | 65.89 – 66.30 |
| Alpha cellulose (%) | 55.92 – 56.34 |
| Pentosans (%) | 13.0-14.23 |
| Lignin (Klason) (%) | 26.32 – 27.54 |

## Anatomy and fibre morphology

The morphology of fibres plays a very important role on the structural properties of the product. The development of the properties were influenced by the fibre length, fibre diameter, Lumen diameter, and wall thickness and Runkel ratio, Length/width ratio (L/D) and shape factor determines fibre coarseness. The anatomical studies are reported in Table 2. Standard laboratory procedures were followed for estimation of fibre characteristics.

**Table 2**

*Fibre Morphology of Lantana camara*

| | |
|---|---|
| Fibre Length (μ) | |
| Min. | 684.0 |
| Max. | 1134.20 |
| Avg | 912.0 |
| Fibre Diameter (μ) | 22.0 |
| Lumen Diameter (μ) | 16.0 |
| Wall Thickness (μ) | 3.06 |
| Runkel Ratio | 0.43 |
| Length/width (L/D) | 0.68 |
| Shape Factor | 0.36 |

Fibre length affects the sheet formation or uniformity of fibre distribution. The average fibre length of Lantana (min 684μ, max 1134.2μ) is 912μ. This indicates that lantana has shorter fibre length than Eucalypts (1190μ). The shorter the fibres, the closer and more uniform will be the sheet formation. Fibre length also affects other physical properties such as the strength and rigidity and especially tearing strength, which is directly proportion to fibre length. Fibre diameter primarily affects the fibre flexibility. More the fibre diameter the more flexible is the fibre. Thin walled fibres produce a dense, more evenly formed sheet in contrast to thick walled fibres, which remain stiff and give bulky, coarse textured paper. The wall thickness of Lantana fibre is 3.06μ. The runkel ratio (0.43) is the ratio between wall thickness and lumen diameter, which is within the limit, as values ranging from 0.25 to 1.5 are normally considered adequate from strength point of view.

**Management of Lantana by utilization**

*Lantana camara* is of potential economic value as it contains appreciable quantity of cellulosic fibres but has never been exploited commercially. Preliminary studies conducted at FRI, Dehra Dun have shown that fibre of Lantana has excellent strength properties and suggested it as a suitable raw material for papermaking. In addition to this α-cellulose can also be extracted from Lantana that can be converted through chemical modification into a number of commercially viable products (e.g. quaternary ammonium, methylated, hydroxypropylmethylated derivatives) to be used by pulp and paper, ore, sugar, textile and a large number of other industries besides making composites and furniture from Lantana. The various approaches are discussed in the following paragraphs.

**Handmade paper**

In recent years, the customer taste has drifted from the hackneyed past grades to some thing unusual and distinctly novel. Thus, more and more emphasis has been laid on the production of high grade and specialty papers and paperboards. Handmade paper units can profitably make these papers, which are in great demand In the prevailing situation hand made paper industry in the decentralized sector can play a vital role because of its low capital investment, high employment potential and minimum gestation period. This industry can produce different grades of paper by utilizing, local available weeds, agriculture residues, secondary fibres, forest wastes by adopting intermediate technology, besides reducing the import bill and providing gainful employment to rural masses

Realizing the above facts, potential is seen in making handmade paper from Lantana fibre alone and or in blended form and therefore, the same is proposed is to be given high priority

### $\alpha$-Cellulose and its derivative

Cellulose has been popularly used as a material for centuries in all kinds of practical applications. Alpha cellulose is a chemically refined bleached pulp composed of more than 90% pure cellulose fibre. This pulp has special properties, such as a high level of brightness and uniform molecular weight distribution. It is used to make products that include rayon, cellulose acetate, textile fibres, cellophane, photographic film and various chemical additives. Chemical modified cellulose find applications in various areas such as pharmacy, cosmetics, food, oil drilling, paper, paints, textiles, construction and adhesives.

There has been an increasing importance of cellulose rich biomass from various sources as chemical feedstock, since these materials consist of cellulose, hemicellulose and lignin containing many functional groups susceptible for chemical derivatization reactions. A careful survey of literature reveals that cellulose continues to be a source of raw material for modifications into products particularly cellulose ethers having different properties to meet mankind's basic needs and for industrial applications (Barkalow and Young, 1985; Vieira *et al*., 2002). There lies abundant scope in derivatization of $\alpha$-cellulose obtained from Lantana for scientific curiosity as well as possibilities for value addition and industrial applications. Thus, extraction of $\alpha$-cellulose from Lantana and its derivatization to make useful products e.g. cellulose ethers such as carboxymethycellulose, methylcellulose, quaternised ammonium salts and hydroxypropylmethyl cellulose is of immense importance.

Based on the above facts, and in the context of our present work on the chemical modification of polysaccharides (Sharma *et al.*, 2002, 2003, 2003a, 2003b, 2003c, 2003d, 2004), $\alpha$-cellulose (average DP 430; purity 94.3%; brightness 81.0%) was isolated from *Lantana camara*. It was further modified to prepare carboxymethyl cellulose (CMC) by carboxymethylation reaction. The conditions optimized were viz: concentration of aqueous NaOH 3.24 mol/AGU, 20% (w/v); concentration of MCA 2.05 mol/AGU; carboxymethylation time 3.5 hrs and temperature 55°C with isopropyl alcohol as the solvent medium. Na-CMC of viscosity 600 cps (1% solution) and 7500 cps (2% solution) having a DS of 1.22 was prepared. The starting material can be obtained easily from abundantly available *Lantana camara*. *Lantana camara*, therefore, seems to be a potential feedstock for producing water soluble Na-CMC for a variety of applications paving thereby a way for management of this obnoxious weed by its utilization into products of commercial importance.

### Composites

Composites are good substitute of solid wood depending upon the end use. Composite products have become popular for various purposes such as interior decoration, furnishing and as building materials. With the emergence of concern for the conservation of forest resources, the utilization of waste lignocellulosic material in the composites have assumed greater importance as an alternative of valuable wood material.

The work carried out at FRI, Dehra Dun reveals that boards can be produced from inferior variety of wood (Singh and Negi, 2001; Singh *et al.*, 1995; Shukla and Bhatnagar, 1993), which have no commercial utility or from wood wastes from sawmills, plywood plants, other wood based industries and other waste lignocellulosic materials Thus, preparation of composites from Lantana are being an unexploited lignocellulosic raw material of commercial interest.

### Preservation of Lantana products

The destructured reconstituted Lantana wood/wood products as prepared by phenol-formaldehyde glues will resist the attack of decay agencies due to presence of phenolic resin but the other products have to be tested for their natural durability against insects and termites and the effect of ecofriendly wood preservatives like borax: boric acid, copper resinate and copper napthates would need optimization of the preservative doses and treatment schedules.

The treatment with preservative will help in enhancing the life of the Lantana products 3-4 times, thus affecting carbon locking for better environment.

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## SUMMARY

**Utilization of *Lantana camara* can be an effective method for managing the weed. It is of potential economic value as it contains appreciable quantity of cellulosic fibres, have excellent strength properties, but till date not been exploited commercially. Owing to the presence of fibres, *L. camara* has potential to be utilized for making value added products such as α-cellulose and its derivatives, hand made paper, wood composites (which are good substitute of solid wood depending upon the end use) and furniture. Preliminary studies conducted have shown that *Lantana camara* contains ~66 % holocellulose and ~27% lignin. The average fibre length is 912μ with fibre diameter ~22μ. α-Cellulose was isolated from *L. camara* with product yield ~40%, brightness ~80% at ~95% purity having negligible ash content. α-Cellulose isolated from *L. camara* was derivatized to prepare water soluble carboxymethyl cellulose (CMC) having DS of 1.22, viscosity 600 cps (1% solution) and 7500 cps (2% solution).**

### *लैण्टाना कैमारा* की आर्थिक संभावनाओं को काम में लगाना

पी०एल० सोनी, संजय नैथाणी, पी०के० गुप्त, अमित भट्ट व ऋतु खुल्लर

## सारांष

*लैण्टाना कैमारा* को किसी काम में उपयोग करना इस खरपतवार का प्रबन्ध करने का प्रभावकारी तरीका सिद्ध हो सकता है। यह संभावित आर्थिक महत्व वाली है क्योंकि इसमें कोशाधु रेशे की काफी मात्रा होती है जिसकी अत्युत्तम शक्ति विशेषताएं हैं परन्तु अभी तक इसका व्यापारिक समुपयोजन नहीं किया गया है। रेशा होने के कारण *लै० कैमारा* में मूल्य वर्धन करते उत्पाद जैसे कि एल्फा–सेलुलोज और उससे व्युत्पन्न पदार्थ, हाथ से बनाया जाने वाला कागज, काष्ठ के संग्रथित भाग (जो अन्तिम उपयोग पर निर्भर करते हुए ठोस लकड़ी का अच्छा बदल सिद्ध हो सकते हैं) और उपस्कर (= फर्निचर) के लिए उपयोग किए जाने की संभावनाएं हैं। प्रारम्भिक

अध्ययनों ने दिखाया है कि *लैण्टाना कैमारा* में ~ 66% होलोसेल्यूलोज (सर्वकोशाधु) और ~ 27% लिग्निन होता है। इसकी औसत रेशा लम्बाई 912 μ तथा रेशा व्यास ~ 22 μ है। *लै० कैमारा* से पृथक किए एल्फा–सेलुलोज की चमक ~ 80% ~ 95% शुद्धता पर मिली जिसमें राख तत्व नगण्य था। *लै० कैमारा* से पृथक्कृत एल्फा–सेलुलोज को जलविलेय कार्बोक्सीमिथाइल सेलुलोज बनाने को निष्पन्न किया गया जिसकी DS 1.22, गाढता 600 cps (1% विलयन) और 7500 cps (2% विलयन) थी।

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