

Natural Resins and Gums

based

Technologies of ICAR-NISA



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Lac Production Technologies

1. Lac cultivation on Kusum

Cultivation of *kusmi* lac on Kusum tree is an age old practice. Additionally, lac is a cash crop. The Institute has developed the scientific method for growing *kusmi* lac cultivation on Kusum tree. The technique delivers a capital growth rate of 352% a year. Technology has been spread among farmers. Currently, lac grower's from nine states adopted this technology.

2. Package of practices for broodlac production on Palas

It's been done for ages to grow *rangeeni* lac on Palas trees. Lac is also a cash crop. On Palas, the Institute has developed a scientific method for growing *rangeeni* lac. Over the old system of lac cultivation, capital growth of 194 and 171 percent can be expected by implementing these measures. Technology has been spread among farmers. Farmers have been exposed to technology. Nine states currently cultivate it.

3. Technology for *rangeeni* lac production on Palas and Ber

It's been done for ages to grow *rangeeni* lac on Palas trees. Lac is also a profitable crop. A systematic technique to grow *rangeeni* lac on Palas in conjunction with Ber has been devised by the Institute. For the production of sticklac and broodlac, respectively, using Palas and Ber trees in a 5:1 ratio can result in annual capital growth rates of 169%. In the farmer's field, the technique has been tried out and shown to work. Technology has been spread among farmers.

4. Production of *rangeeni* lac on Ber

Summer *rangeeni* crops typically have a cycle from October/November to June/July. Summer time lac crop continuation is harmful to both the lac insect and the host. Collection of immature crop (*Ari* lac) in April or May is preferable because it can bring in some revenue for the farmers. Technology has been spread among farmers.

5. *Kusmi* lac production on Kusum and Ber in alteration

Kusum tree is a very excellent host tree for quality lac production. However, not all farmers have Kusum trees, although many also have Ber trees. Kusum trees can produce lac in both the summer and the winter. Ber trees are unable to produce brood in the summer due to defoliation in the summer season. In order to continue lac cultivation when a farmer only has a small number of Kusum trees and a comparatively large number of ber trees, this new system was developed. Technology has been spread among farmers.

6. Early *kusmi* breed cultivation on *Flemingia semialata*

Due to its quick growth, soft shoots, and appropriateness for intensive lac cultivation, *Flemingia semialata* has shown significant potential for lac production. This plant is especially helpful to farmers who are interested in lac cultivation but do not have access to lac-host trees. Compared to normal practice, a 40%+ increase in farmer revenue is ensured. The developed technology has been put to the test on farmer's fields. Due to the simplicity with which it is to carry out lac cultivating operations, farmers have adopted it.

7. Late *kusmi* breed cultivation on Ber

Ber is also one of the fastest growing lac-host among the tree species which also responds to pruning quite well. Because it can be used for both strains of the lac insect, it is the growers' favorite host for lac cultivation. Early *kusmi* lac genotypes that were infected on Ber trees caused the lac crop to be harvested in December or January. This practice has been shown to be incompatible with the host's physiology and pruning response. As a result, the Institute has successfully developed a technique for the March-April maturation of *Kusmi* late variety on Ber. Without impacting plant growth, this method demonstrated higher performance and sustainable production.

8. *Kusmi* lac production on fruit varieties of Ber

Different Ber varieties that are well-known for their edible fruits were assessed for winter *kusmi* lac production in order to lower the risk of lac crop failure and to maximize the benefits of fruits. With an average broodlac yield ratio of 8.8 (output/input ratio) among the 24 fruit varieties of Ber, Maharwali emerged as the best fruit variety for winter *kusmi* lac. Banarasi Pebandi, with a mean broodlac output/input ratio of 8.4, came in second. Thornless, Katha, and Seb x Gola F1 varieties have been found to have potential for this crop. These Ber types produced noticeably more broodlac than CAZRI Gola (7.4), the most popular fruit ber variety that is susceptible to lac culture, which was used as the experiment's control.

9. *Kusmi* lac production on Palas var. *Swadi*

The Swadi Palas (*Butea monosperma*) is a variant of the common Palas. It grows significantly more quickly than common Palas and can support *kusmi* lac instead of *rangeeni* strain. As a result, it is significant in the context of lac farming in Jharkhand's generally less fertile soils. Pruning-cum-lac harvesting of *kusmi* broodlac (*aghani* crop) from Swadi Palas should be done from mid-January to mid-February instead of an immature harvest in December, following to the correct scientific pruning timing intervention.

10. Lac cultivation on *Calliandra calothyrsus*

Both the strains of the lac insect *Kerria lacca* were shown to grow well on *C. calothyrsus*. All four crops during the crop cycle had a broodlac ratio of 3 to 4 times. Wood from *C. calothyrsus* can be used for fuel, and the leaves can be used as green fodder. Due to its bushy growth and ability to maintain both strains of *K. lacca*, *C. calothyrsus* is becoming more and more popular among lac farmers.

11. Disease and Pest Management during lac production

Prophylactic fungicide spraying has a good impact on lac production. Only one fungicide, carbendazim, has been tried out for this purpose thus far. Fewer other fungicides were tested for alternative uses against sooty mold since repeated use of a single pesticide can lead to the disease developing resistance. Two fungicides, Kavach (chlorothalonil) at 1 g/liter water and Cantaf (hexaconazole) at 0.5 ml/liter water, are particularly efficient against sooty mold. In the winter crop of *kusmi* lac, three sprays of these fungicides at 60, 90, and 120 days after lac inoculation or 90, 105, and 120 days provided an economically greater yield. Hexaconazole usage resulted in a 38–56% yield increase over control. The similar range was 18–47% for chlorothalonil.

12. Early detection of parasitoid infestation in lac crop

Tachardiaephagus tachardiae and *Aprostocetus purpureus* are the two most significant parasitoids of lac insects. For parasitoids to be controlled, early parasitoid infection diagnosis is crucial. For the detection of these two significant parasitoids in lac insects, a PCR (polymerase chain reaction) based method has been devised. In comparison to host dissection and caging, the procedure was found to be effective with samples of infected lac insects gathered from the field. It was able to distinguish infected lac insects from the uninfected ones at a relatively early stage of infection. The technique is extremely sensitive and specific.

13. Management of Soil Fertility for *kusmi* lac production

When host trees in continuous *kusmi* lac farming aren't supplied nutrients on a regular basis, it leads to their mortality and poor health. Technology increases lac output while reducing host mortality. As a result, Ber can produce more lac yield sustainably, and higher incomes will boost the farmers ability to support itself. Increased lac production can be secured with the use of fertilizer application. Additionally, the health of the trees is unchanged.

14. Management of Soil Fertility for *rangeeni* lac production

In upland locations with an abundance of Palas trees, the level of soil potassium that is available is very low. Previous research has shown that potassium application at a rate of 150 g per tree can boost *kusmi* lac production on Ber throughout the winter season. Higher potassium application rates for the *rangeeni* lac crop on Palas were found to corroborate the same conclusion. A monsoon-period application of 1000 g K_2O per tree on rings made at 60% of the canopy diameter increases *rangeeni* lac yield by 3.0-3.9 times compared to control.

15. Technique for quick raising of Ber plantation

The majority of Jharkhand's soils have an acidic character, with pH values ranging from 4.5 to 5.5. Plants cannot grow their roots in such an environment. Additionally, the majority of soil nutrients continue to be in less accessible form. Through the use of technologies developed by the Institute, plantations can be produced for lac production in five years with the administration of nitrogen, phosphate, and potassium at 100-170-80 g per plant. Basal diameter was obtained by fertilization at the aforementioned rate and duration, which was roughly twice as large as the control. At a lesser dose, i.e. 50-85-40 g/plant, the plant yields diameter 1.25 times more than the control at the end of five years.

16. Weed control in *Flemingia semialata* for *kusmi* lac Production

Farmers who want to develop lac in conjunction with agricultural crops or who don't have access to traditional lac hosts might consider winter-season *kusmi* lac cultivation on *F. semialata*. Without affecting lac production, the institute standardized the use of herbicides in lac farming operations. Effective weed control requires only one application of glyphosate at a rate of 1.0 kg a.i./ha in the plantation seven to ten days before lac insect inoculation. Glyphosate treatment has a weed control efficiency of 89%, which is comparable to hand weeding.

17. Nursery raising of lac host-plants

Kusum tree germination rates can range from 2 to 66%. Evaluation of the causes of poor germination is necessary, and the distribution of variables should be optimized for the optimal germination. It is advised to gather enough seed for nursery raising during the first week of July. For the best germination rate and seedling growth, seed should be chosen between 0.8 and 1.1 g. It is advised to heat-treat dry seed at 50°C + 20°C for 3-6 hours for successful germination. The PGPR should be inoculated in a liming environment. To improve germination, it is advised to inoculate seed with *Azotobacter* and Vascular Arbuscular Mycorrhizae (VAM) before sowing.

18. Integrated Lac Farming System with *Flemingia semialata*

Different *Flemingia semialata* (semialata) intercropping models with vegetable crops have been established for both the summer and winter seasons. Semialata was grown in paired rows, with a spacing of 3 m between the two paired rows, 75 cm between rows, and a distance of 1 m between plants for intercropping. Between two rows of semialata that were paired off, the intercrops were grown. Through economic research, viable intercropping models for each season were created. While the other elements, such as vegetables and other crops, can help to ensure nutritional security, the lac integrated cropping system (LICS) under semialata can contribute to economic security from lac. Farmers receive the developed technologies to use land resources as efficiently and sustainably as possible.

Lac Processing and Product Technologies

1. Small Scale Lac Processing Unit

Lac growers sell sticklac immediately after scraping at throwaway prices due to associated storage problems. To address this, the Institute has developed Small Scale Lac Processing Unit (Capacity-100 kg/day).

- Value addition through primary processing of lac, i.e., making seedlac (semirefined product) at the village level, was accompanied by better storability like grains in bags.
- The technology has been licenced to three firms and more than 100 such units (total installed capacity 3,000 tons/year) have been sold by these firms across the country.

2. Integrated Small Lac Processing Unit

The unit operations of primary processing of seedlac were integrated for development of small compact unit for reducing labour requirement and drudgery by the Institute as Integrated Lac Processing Unit (Capacity-100 kg/day).

- Minimum water requirement and potential to obtain good quality lac dye from the wash water are its few advantages for primary lac processing.
- The technology is under process of commercialization.

3. Lac Wood Varnish

Traditional lac-based varnish used by polisher using shellac is not heat proof which was reason for development of water and heat proof varnish for wooden surface.

- The developed varnish is eco-friendly, non-toxic, imparting fine finish and possesses qualities like hardness, gloss, heat, and water thus possess desirable features/characteristics of a modern wood lacquer.
- The technology has been transferred to different interested entrepreneurs/persons.

4. Lac based non-spirit Wood Varnish

Lac based non-spirit varnish has been developed for polishing wooden surfaces due to spirit licensing and procurement problems.

- The developed varnish is natural, thin, water and heat resistant and retains texture. It quickly dries, saves labour & time, minimizes sticking of dust particles & permits quick recoats.
- The technology has been transferred to different interested entrepreneurs/persons.

5. Multipurpose Lac based Varnish / Lac Glaze

Metal objects/ artifacts requires periodic cleaning of the oxidative coating by rubbing/polishing formulation. Plastic, rexin, leather, painted artworks, murals, and rubber can also be restored/glazed by lac based varnish.

- Application of this provides sheen on the above surfaces, which remains unaffected for 2-3 years.
- The technology has been transferred to different interested entrepreneurs/persons.

6. Aqueous Lac Varnishes for Earthenware and Bamboo

Lac is insoluble in water and due to its acidic nature, it dissolves in water in the presence of alkalis, forming a salt. The aqueous lac varnishes have been treated with cross-linking agent to improve their properties.

- The varnish is water based and eco-friendly, do not lose shininess and does not whiten when it encounters water and can be used for coating of earthenware and bamboo.
- The technology has been transferred to different interested entrepreneurs/persons.

7. Lac based Natural Nail Polish

Due to increased interest in use of natural materials particularly in foods and cosmetics, lac based natural nail polish was developed by ICAR-NISA based on lac resin.

- The developed nail polish provides very glossy, hard, smooth and durable finish on nails.
- It is quick drying and non-hazardous to health and conforms to the BIS standards (IS: 9245:1994).

8. Lac Dye based Natural Alta

Alta is an important cosmetic used by Indian woman to decorate their feet especially during marriages and festivals. IINRG-LDA-91 (Orange colored) and IINRG-LDA-94 (Deep red colored) natural Alta formulations were developed from lac dye and other skin friendly ingredients unlike their synthetic counterparts.

- It is herbal, easy to remove and safer as compared to synthetic azo dyes.
- The technology has been transferred to one NGO Khandadhar Horti-Agricultural and Forest Producers Development Cooperative Ltd., Sundargarh, Odisha

9. Lac based Water Thinnable Interior Paint

- Lac-based water-thinnable paint has been developed by modifying lac with suitable synthetic resin for cementitious surfaces.
- It has excellent resistance towards water, acid and alkali and a shelf-life of four years on interior walls.

10. Lac based Multi-Colour Dental Plates

Dental plate was developed naturally based on Lac products, eco-friendly used resin lac in place of synthetic resin.

- Shellac based dental plates have good heat stability, colour stability, solubility, resistance to climate changes, strength, plates softening, mouldability.
- The technology has been transferred to one entrepreneur M/s M.D.M. Corporation, Delhi.

11. Shellac Gasket Compound

Gasket Shellac cement compound is a product used to fix in position all kinds of gasket in between two metallic parts of internal combustion engine in the automobile industry.

- The Gasket shellac compound is a viscous, homogeneous solution of shellac and other cheap additive in organic solvents.
- The technology has been transferred to different interested entrepreneurs/persons.

12. Herbal Gulal from Palas Flower

The base material of herbal gulal was made from the ground petals of the palas flower as an alternative to synthetic Holi colours.

- The developed herbal gulal is completely safe, organic, smooth, free-flowing, attractive and with food grade ingredients.
- Herbal palas gulal is non-toxic, eye and skin friendly.
- The technology has been transferred to one entrepreneur.

13. Lac based Fruit Coating Formulation for Kinnow

Lac based fruit coating formulation for kinnow has been developed based on natural resin lac for better gloss, firmness to the kinnow fruits and enhancing shelf life.

- It is natural, non-toxic composition of lac-based formulation that gives improved appearance, less moisture loss, reduced postharvest decay and longer shelf-life.
- The technology has been transferred to one firm M/s Gupta Brother (Shellac) Bundu, Ranchi.

14. Lac based Fruit Coating Formulation for Pomegranate

Lac-resin based formulation has been developed and optimized for post harvest treatment of pomegranate for extending self life.

- Formulation is based on natural resin lac, which is a eco-friendly material and toxicologically safe.
- Can be applied immediately after harvesting for extending shelf life without moisture loss.

15. Lac based Coating Formulation for Seed Spices

Lac-resin based coating formulation has been developed for post-harvest treatment of seed spices like coriander and cumin for extending self life.

- Formulation is based on natural resin lac and toxicologically safe ingredients, aqueous based; easy drying with good improves cosmetic appearance.
- Completely odorless formulation with enhanced storage life of six months and retention of natural flavors.

16. Lac based Coating Formulation for Ginger

Coating formulation for ginger has been developed at ICAR-NISA, Ranchi to address the problem of rapid moisture loss in ginger after harvesting, a serious issue which needed to be addressed.

- Coating and post harvest studies were conducted on ginger for three consecutive seasons and it was observed that formulation was effective in controlling moisture loss.
- It is cost effective and convenient and has exhibited performance in retaining moisture in ginger.
- Its efficacy has been successfully evaluated and formulation is toxicologically safe.

17. Lac based Coating Formulation for Vegetables

Fresh Coat series of coating formulation have been developed at ICAR-NISA, Ranchi to address the problem of extensive post harvest losses in the horticulture sector.

- Coating of this formulation is effective in controlling moisture loss & toxicologically safe.
- It is cost effective and convenient and has exhibited remarkable performance in extending shelf life of vegetables like brinjal, capsicum, tomato and pointed gourd.

18. Utilization of Gummy Mass (GM) – An industrial effluent from Aleuritic acid

Gummy mass (GM) a by-product of lac industry involve in making of aleuritic acid which can be used in coating materials, gasket cement compound and biocomposite board.

- The products showed satisfactory results in coating formulations and was also used in preparation of cementing composition and adhesive.
- Technology has been transferred to different interested entrepreneurs/persons.

19. Coating formulation for Paper Packaging Materials

Coating formulations were developed at the institute for paper packaging materials for the packaging of food items.

- The formulations has high tensile strength, elastic modulus and toughness, elongation and hydrophobicity.

20. Coating formulation for Clayware

Lac based coating formulation for Clayware has been developed which can be applied on clayware items like cup, plate, glass for improving its cosmetic appearance and making it water and heat proof.

- The product provides very good shine, water resistant and easy to apply and enables multiple reuse.
- The technology has been transferred to firm M/s Founder Re-energy King solution, Gujarat in 2018 for its commercial production through licensing for five years.

21. Coating formulation for Green Garbage Bags

The coating formulation was developed for making biodegradable garbage bags from newspapers.

- The formulation developed showed an increase in tensile strength elongation, toughness and water impermeability.

22. Lac Wax Policosanol based Plant Growth Regulator

The lac wax policosanol based plant growth regulator formulation (PGR) has been developed by the institute from by-product lac wax of lac industry.

- Lac wax policosanol was tested as PGR in wheat and fenugreek crops and showed promising results.

23. Process of making Aleuritic acid

Aleuritic acid (9,10,16-Trihydroxyhexadeca-noic acid) is a major constituent acid of lac resin and is estimated to be present in the lac resin up to extent of 35% and has demand and export potential in the fields of perfumery and pharmaceuticals.

- The Institute has developed process of making aleuritic acid from seedlac with 15% yield which is suitable for its commercial production.
- A total 23 firms/entrepreneurs were given this technology in 20 no. programme organized during last 10 years 2012-23

24. Process of making Bleached Lac

Bleached shellac is a non-toxic, edible lac product and used widely in different industries. The Institute has developed the process of manufacturing bleached lac for its commercial production.

- A pilot plant has been established at the Institute for process refinement, training and demonstration (with an yield of 75-80% by weight of seedlac).
- It has very good qualities like adhesiveness, binding, hardening, gloss and is odorless and as per BIS requirement (IS 17:1973).
- A total 50 firms/entrepreneurs/beneficiaries were given know-how in 12 no. programme organized during last 10 years 2012-23.

25. Process of making Dewaxed Decolourised Lac

Dewaxed decolourised lac is manufactured by removal of colouring matter *erythrolaccin* in solvent process and classified under category of Machine-made shellac. DDL is used in pharmaceutical and food industries for coating formulations and cosmetics.

- Dewaxed decolourised lac developed has good acid value, flow and life qualities as per BIS requirement.
- A total 8 firms/entrepreneurs/ beneficiaries were given this know-how in 7 no. programme organized during last 10 years 2012-23.

26. Process of making Lac Dye

Lac dye, a by-product of lac industry, is lost in the effluent during washing of sticklac in primary processing of lac which also contains water-soluble lac dye (laccic acid).

- A process has been developed for recovery of lac dye from effluent wash water of primary processing for its commercial production with average yield of 0.25% by wt. of sticklac.
- A total 39 firms/entrepreneurs/ beneficiaries were given this know-how in 9 no. programme organized during last 10 years 2012-23.

27. Process of making Isoambrettolide

Isoambrettolide, a geometrical and positional isomer of natural ambrettolide, is a very attractive substrate as an alternative musk resource which is obtained industrially from aleuritic acid, a major constituent acid of lac.

- Process know-how for production of isoambrettolide from aleuritic acid involving unsaturation reaction followed by cyclization and distillation steps, has been developed by Institute.
- The technology has been transferred to different firms for its commercial production through Institute training/know-how transfer programme.

28. Natural Adhesive for making Bio-Degradable Food Container

Different lac based natural adhesive formulations have been developed by the institute for making biodegradable food containers using coconut shell powder and jute.

- Bowls were prepared using the formulations and found to be good in respect of strength, flexibility, and aesthetic appeal.
- The technology of natural adhesive formulations were developed for making biodegradable food containers and have been transferred to AGROPAK Pvt. Ltd. Bengaluru, Karnataka in June 2023 through licensing for five years for its commercial production.

Plant Gum based Technologies

1. Process for preparation of cold water soluble Tamarind Seed Gum

Tamarind seed gum or tamarind gum (TG) does not dissolve in water at room temperature and only forms a clear solution on heating or boiling in water. As this process is energy and time consuming, the cold water insolubility of the TG has been a barrier to its application in many industries.

- About 70-75% yield of purified gum is achieved as compared to 20-25% in earlier reported method along with removal of impurities.
- Purified gum can be used in food, pharmaceuticals, paper, textile and other industries with ease.

2. Guar Gum based Super Absorbent Hydrogel

Guar gum based super absorbent hydrogel has been developed by synthesizing semi-synthetic cross-linked materials from guar gum to address the concern of low nutrient use efficiency and severe water deficit in agriculture.

- The synthesized hydrogel was confirmed to be highly porous & biodegradable with half-life period of 77 days.

3. Guar Gum Derivatives

Guar gum associated limitations like lack of clarity and free flowing properties, fall in viscosity, low thermal stability and turbidity on prolong stay etc were overcome by modification and derivatization of guar gum.

- Methods have been standardized for synthesizing three guar gum derivatives namely Carboxymethyl Guar (anionic), Hydroxypropyl derivative of guar gum (non-ionic) and Cationic derivative of guar gum using semi dry and non-aqueous method which involves minimal use of non-toxic organic solvent and eco-friendly.
- The developed method of preparation of derivatives are simple, economic and consistent and perfected to lab scale.

4. Dietary Fibre from Guar and Arabic gum

Dietary fibre was isolated from gum Arabic by using enzymatic means for obtaining safer, non-toxic and edible product with low calorific value.

- Methods have been standardized for isolation of dietary fibre from guar and gum Arabic using enzymatic method.
- The isolated dietary fibre from guar (PHGG) and gum Arabic may serve as potential prebiotics.



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