TechEx.in
Tech Transfer Hub

National Chemical Laboratory

Match Maker/ Renewable Chemicals & Materials/ 16 Apr 2021

Highly yield production of bacterial nano- cellulose useful for making medical and personal care products.

Lead Inventor: Dr Syed Dastager

Organization: CSIR-NCL, Pune

TechEx.in Case Manager: Pradnya Aradhye (pradnya@venturecenter.co.in)

TechEx.in is a Regional Tech Transfer Office supported by:

birac Ignite Innovate Incubate

nbm NATIONAL BIOPHARMA MISSION innovate in India for inclusiveness (i3)

VENTURE CENTER

Bacterial cellulose: the polymer with versatile applications

Multiferous applications

Sulaeva *et al.*,(2015). *Biotechnology advances*, *33*, 1547-1571

Exemplary startups and their products: Sheets & mats

AXCELON BIOPOLYMERS CORP

cass materials

BOWIL | BIOTECH

CELMAT FACE	CELMAT EYE	CELMAT WOUND
CELMAT FACE	CELMAT EYE	CELMAT WOUND
CELMAT FACE H	CELMAT EYE H	CELMAT WOUND H

The Opportunity

- Bacterial Nanocellulose has versatile properties. Have high liquid absorption activity, high degree of polymerization, higher specific surface area and higher mechanical properties as compared to plant cellulose
- Global "Bacterial Nanocellulose Market" size is expected to reach USD 201 million by 2026, from USD 191.9 million in 2020, at a CAGR of 4.3%% During 2020-2026
- BNC finds use as:
    - Cosmetics like creams, lotions
    - Textile Industry (Sports clothing, tents etc)
    - Biomed application (Wound dressing, implants, drug delivery etc)
    - Waste treatment (recycling of minerals and oils)
    - Mining (sponges to collect leaking oil, materials for absorbing toxins)
    - Food industry (edible cellulose)
    - Paper industry (special papers)
- Price realization is roughly USD 10/gm for bacterial cellulose sheet, USD 11/gm for bacterial cellulose slurry and USD 50/gm for bacterial cellulose freeze dried powder.
- Producers of BNC in world: Axcelon biopolymers, Granbio, CelluForce, American Process, Innventia AB, UPM-Kymmene, STORA ENSO, DAICEL FINECHEM, Nippon Paper Industries.

Who should be interested and why?

Who?	Why?
Producers of BNC	• Higher yield process for BNC
Manufacturers of cosmetic, medical products, pharmaceutical & skin contact applications utilizing BNC	• Process to produce BNC with high yield and at lower cost. Vertical integration.
Glycerol producers	• Value added product from glycerol
Startups developing new products from BNC	• Patent pending, novel process for BNC production as a competitive edge

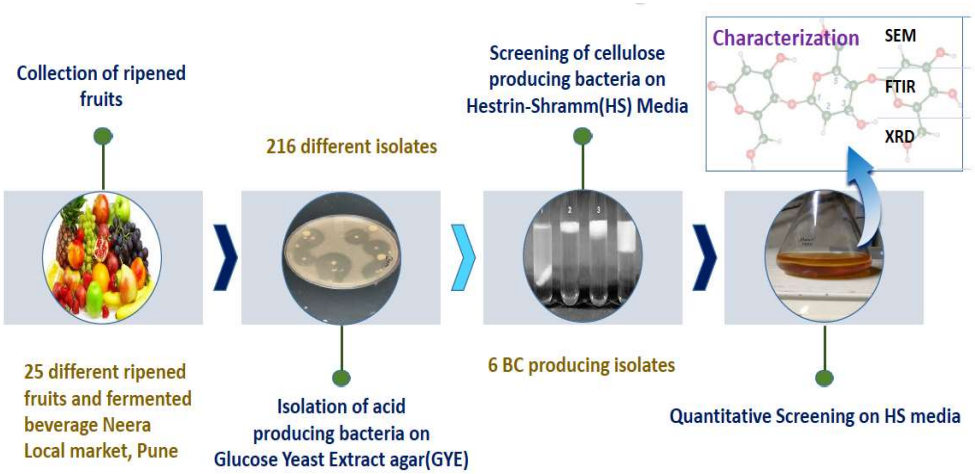
About the technology

Process features:

- Novel indigenous bacterial strain *Komagataeibacter rhaeticus PG2*
  - Highest ever reported BNC yielding (dry weight 8.7 g/L) organism ➔ High yielding process
  - Utilizes very low cost carbon source as feedstock ➔ Affordable and low cost Bacterial Nanocellulose
  - Static fermentation process

Product features:

- Enhanced water absorption ability (around 800%-1000%)
- Enhanced crystallinity index of resulting BNC
- Easy to harvest and Purest form of nanocellulose
- Produced in different shapes, gels, and foams



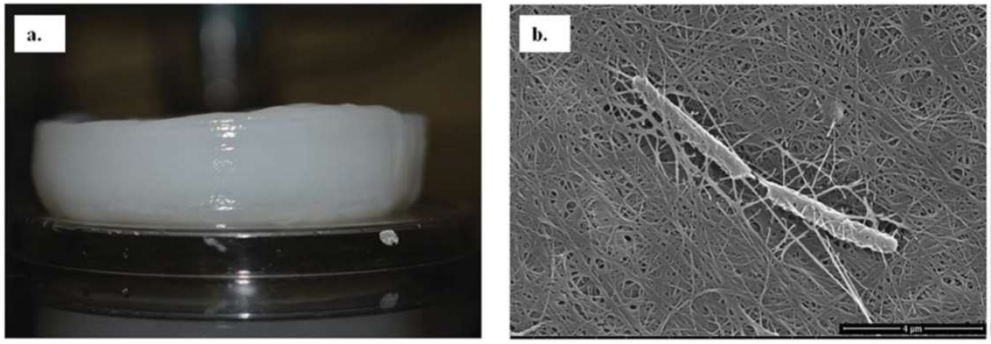
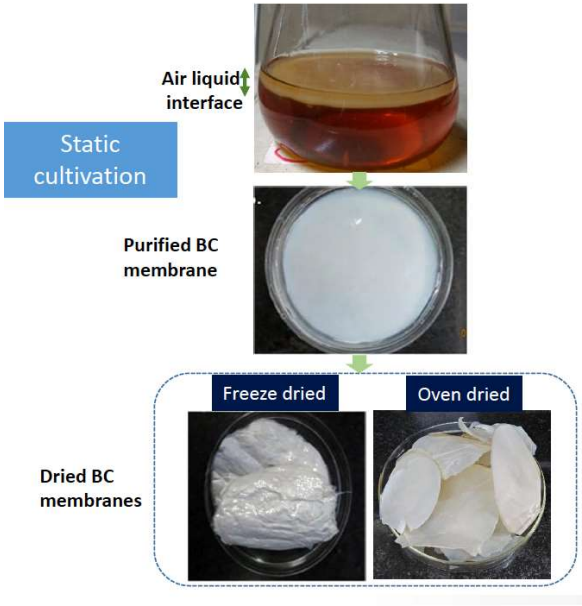


Fig. The pure wet BC membrane produced by the *K. rhaeticus* strain PG2 using glycerol as the carbon source after 15 days of incubation at 28 °C under static cultivation. (b) FE-SEM image of the bacterial cellulose membrane network with the entrapped cells.

Current status

Technology status:

- ❖ Demonstrated at 50 L static fermentative conditions scale
- ❖ Patent protected
- ❖ Samples available



Thorat, M. N., & Dastager, S. G. (2018). *RSC Advances*, *8*, 29797.

Patents:

- ❖ Priority document: IN201911024544 (20 Jun 2019)
- ❖ Coverage: IN

Publications:

- ❖ A New TBAF Complex, Highly Stable, Facile and Selective Source for Nucleophilic Fluorination: Applications in Batch and Flow Chemistry. Madhukar S. Said,Nilesh S. Khonde,Meghana N. Thorat, Ranjit S. Atapalkar, Amol A. Kulkarni,Jayant Gajbhiye,and Syed G. Dastager. Asian J. Org. Chem. 2020, 9, 1022– 1026
- ❖ High yield production of cellulose by a Komagataeibacter rhaeticus PG2 strain isolated from pomegranate as a new host. Meghana N. Thorat and Syed G. Dastager. RSC Adv., 2018, 8, 29797–29805

Team and Organization

Lead Scientist: Dr Syed Dastager
Principal Scientist, CSIR-NCL

Research Experience: China, Brazil, Germany, Australia

Young International Scientist (CAS)
CSIR Raman Research Fellow
INSA-Indo-Australia EMCR Fellowship

Expertise: Bacterial systematics, Environmental-Microbiology, Plant-Microbe Interaction, Microbial molecules

Students trained: 4 Ph.D. awarded and **8** Ph.D ongoing, **16**- M.Tech students trained.

Council of Scientific and Industrial Research
National Chemical Laboratory

- NCL is a constituent lab of the CSIR, India
- Publicly funded non-profit R&D lab & DSIR recognized SIRO => R&D project sponsors can claim tax benefits; Eligible for CSR support
- Track record of technology transfer and working with industry; attractive models of engagement and flexible terms for IP

- Key assets and strengths of Dr Dastager's lab
  - Strength of the team: **8+**
  - **10** Indian patents filed, **120+** publications
  - Well equipped labs and analytical facilities
    - Static fermentation capacity of 100 L
    - DX Genetic Analyzer
    - RT-PCR (Thermocycler)
    - High end instrument availability: XRD, FE-SEM, TGA, FTIR and NMR
    - Sponsored projects:
    - Consultancy:
    - Co-development:

Next Steps

- The NCL group has demonstrated BNC production at 50 liter scale. Samples are available in the form of wet films and sheets. The NCL team shall be happy to collaborate with industry partners/ startups developing end-use applications.

- The next steps will be to identify commercially attractive end-use applications and carry out experiments to demonstrate the value of BNC in those applications. In particular, applications which leverage the following properties will be more interesting:
    - Bio-synthesized ➔ High purity
    - Nanostructured ➔ high surface to volume ratio of fibers
    - Biodegradable ➔ Will disappear inside body or in waste
    - Hydrophilic ➔ absorbs water

Seeking:

- Startup entrepreneurs with medical products expertise interested in spin-out R&D into a startup
- Industrial partners interested in technology licensing
- Industrial partners interested in sponsoring further technology advancement and scale-up
- Industrial partners interested in raising 3rd party funds for a collaborative project.

TechEx.in
Tech Transfer Hub

National Chemical Laboratory

For more information, contact:

Pradnya Aradhye
pradnya@venturecenter.co.in
+91-88050-09010

TechEx.in is a Regional Tech Transfer Office supported by:

birac
Ignite Innovate Incubate

nbm
NATIONAL BIOPHARMA MISSION
innovate in India for inclusiveness (i3)

VENTURE CENTER

References> Market data

1. https://medium.com/@anshulpa1994/microbial-and-bacterial-cellulose-market-growth-2019-2024-b149bfba3bab
2. https://www.startus-insights.com/innovators-guide/discover-6-materials-startups-you-should-watch-in-2021/
3. https://onlinelibrary.wiley.com/doi/10.1002/pi.5882
4. https://nanollose.com/media/australia-company-keen-on-fabrics-made-from-microbial-cellulose-derived-from-coconut-waste/
5. https://www.celluloselab.com/price/CelluloseLab%20Product%20Price%20List%202020.htm
6. https://bioesque.com/pages/why-bio-cellulose