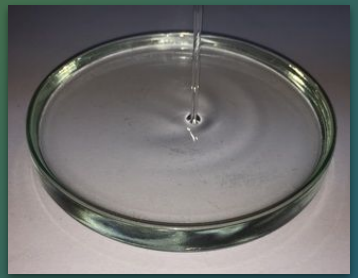
Technology Match Maker | Sustainable Ingredients for Skin & Personal Care | 12 Oct 2023

Sustainable Bioprocess For Production Of "Green" Paraffins



Lead Inventor: Dr Syed Shams Yazdani
Organization: ICGEB
TechEx.in Case Manager: Pradnya Aradhye (pradnya@venturecenter.co.in)

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Green Paraffins

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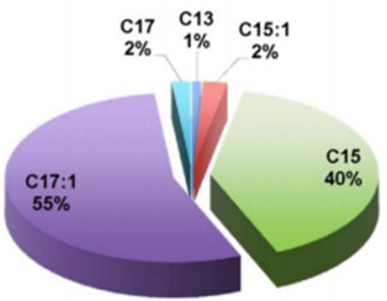
- Paraffins are alkanes or saturated hydrocarbons ranging from C10 to C38.
- Paraffins are mostly acquired from the distillation of petroleum which contain:
  - Polycyclic aromatic hydrocarbons (PAH) which are known to be strong carcinogens and skin irritants or sensitizers causing allergic reaction in human as well as animals.
  - Heavy metals, sulphides and other contaminants.
- Green Paraffins are highly pure C15 and C17 linear alkanes obtained by microbial biosynthesis.
  - Do not contain any branching or aromatics hydrocarbons,
  - Do not contain sulfur or ...nts.
- Green Paraffins are extremely safe for use in skin care.



Opportunity For Green Paraffins

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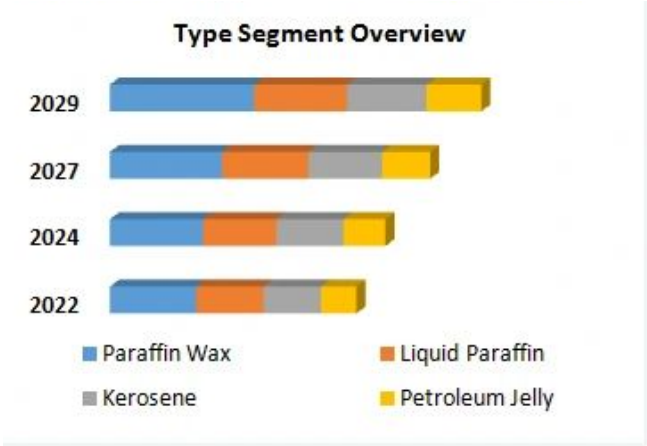
The global market for paraffins was valued at USD 6.44 B in 2022, and it is expected to reach USD 8.54 B by 2029 with a CAGR of 4.12% during the forecast period [1].



Market Prices[2]

- **Paraffin wax - Rs. 45-140 /kg**
- **Liquid Paraffins - Rs. 58-70/l**
- **Kerosene - Rs. 54-75/l**
- **Petroleum Jelly - Rs. 240-300/kg**

Who Should Be Interested?

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Who?	Why?
Manufacturers of blended raw materials for cosmetic, skin & personal care, pharma and food coatings that use paraffins	• Well-defined product composition and properties without any harmful contaminants; • New value proposition for customers • Sustainability as a competitive edge
Manufacturers of cosmetics, skin & personal care products	• New grade to meet needs of consumers • Source of competitive edge
Manufacturers of C15, C17 linear alkanes	• Add-on to existing market share and buyers • Source of competitive edge
Manufacturers of bio-synthesized value added chemicals	• New products and forays into new segments • Opportunity to disrupt markets & displace incumbents
Manufacturer of drop-in fuels - jet/aviation and diesel fuels	• New product as fuel additive • Source of competitive edge

About the Technology

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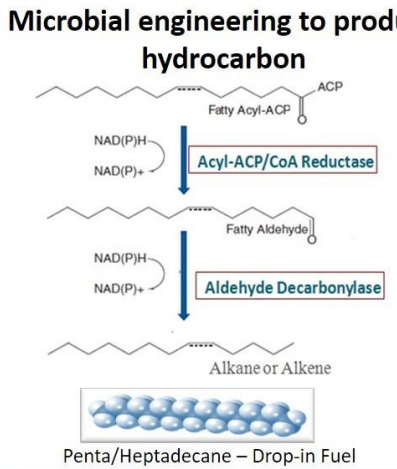
Process features:

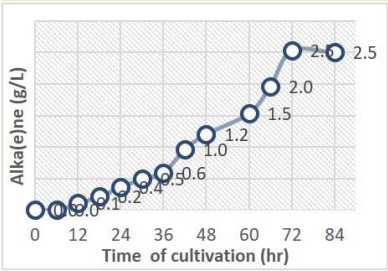
- ➔ **First successful demonstration of production of linear alkanes using bioengineered *E.coli*:**
  - ◆ **Novel method:** Synthesis of C15-C17 linear alkanes using fermentation technology and renewable materials.
  - ◆ **Carbon source:** Glucose Environmental friendly and sustainable.
  - ◆ **Ease of extraction:** Extracellular synthesis.
  - ◆ **Process output:** Uniform and consistent product quality.

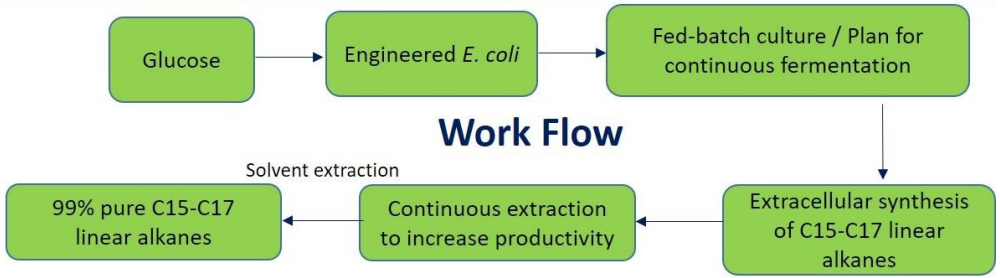
Product features:

- ➔ **Highly pure (99%) form of "green" Paraffins:**
  - ◆ >95% C15-C17 linear alkanes
  - ◆ Minimal by products
- ➔ **Current Yield:** 2.5-3 g/l
  - ◆ Expected yield 2-5% during continuous processing.
- ➔ **Current OD:** 120
  - ◆ Expected to be increased to 200.



- 3 gene addition and 6 deletions carried out for hydrocarbon production
- Engineered bacteria produced ~3 g/l alkane





Current Status

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Technology Status:

- **Demonstrated at Lab Scale 5L fermenter.**

IP Status:

- **Knowhow**

Publications:

★ Model-assisted metabolic engineering of Escherichia coli for long chain alkane and alcohol production. Zia Fatma, Hassan Hartman, Mark G Poolman, David A Fell, Shireesh Srivastava, Tabinda Shakeel, Syed Shams Yazdani, Meab Eng 46(2018), 1-12.

★ Microbial engineering to produce fatty alcohols and alkanes. Ashima Sharma and Syed Shams Yazdani, Journal of Industrial Microbiology and Biotechnology, 2021, 0, 1–18 DOI: 10.1093/jimb/kuab011

Team & Organisation

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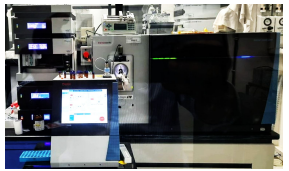
Lead Scientist:
Dr Syed Shams Yazdani

★ **Coordinator** of the DBT-ICGEB Centre for Advanced Bioenergy Research, ICGEB, Delhi.
★ **Group Leader**, Microbial Engineering Group, ICGEB, Delhi
★ **Expertise:** Microbial Engineering, Synthetic Biology, Biofuels

★ **Established under UNIDO in 1983, the ICGEB** is a unique, autonomous, Intergovernmental Organisation, with biotech labs in Italy, India, and South Africa.
★ **DBT-ICGEB Centre for Advanced Bioenergy Research** was established in March 2012.
★ **Key assets and strengths of Dr Shams lab:**
- 15 total patents filed, 3 granted US patents, 1 granted China patent, 3 granted in India; More than 100 publications in biofuels, fatty alcohols from non-crude carbon source.
- **Team strength:** 20
- **Well equipped labs and analytical facilities:**
  - 20 L fermenter facility for validation
  - Robotic liquid handling System - Tecan
  - Multi vessel fermentation system
  - HPLC and Gas chromatography,
  - Mass Spectrometer - Orbitrap Fusion Lumos
- **Industry Project /Tech transfer:**
  - Project undertaken with various oil companies;
  - Enzyme based technology Transferred and scaled-up



Next Steps

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- The team has developed the background science and demonstrated lab scale processes as a proof of concept. Further work on stability of the strain and titre are ongoing.
- The team has expertise as to how the process can be modified to get desired products.
- The next phase will be to work closely with industry partners to:
  - Define techno commercial specifications for the product.
  - Optimize process to meet industry requirements
- Scale up, further optimization to meet end customer needs, testing, and certifications.

Seeking:

- **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.**
- **Industry/ Startups interested in tapping scientist capabilities as an expert/ consultant.**

For More Information Contact:

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References

- Slide 1: https://www.unicornpetroleum.net/liquid-paraffin-5848953.html
- Slide 2: Image: Model-assisted metabolic engineering of Escherichia coli for long chain alkane and alcohol production. Zia Fatma, Hassan Hartman, Mark G Poolman, David A Fell, Shireesh Srivastava, Tabinda Shakeel, Syed Shams Yazdani, Meab Eng 46(2018), 1-12.
- Slide 3: [1] https://www.maximizemarketresearch.com/market-report/global-paraffin-market/29394/
- Slide 3: [2] https://indiamart.com