Match Maker/ Renewable Chemicals & Materials/ 16 Apr 2021

Microbial cetearyl alcohol for cosmetic & pharmaceutical applications

Lead Inventor: Dr Syed Shams Yazdani

Organization: ICGEB

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

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What is Cetearyl (Cetostearyl/Cetylstearyl) Alcohol ?

Synonyms:
- Cetostearyl alcohol
- Cetylstearyl alcohol
- C 16-C 18 alcohol

Mixture:
- Cetyl (C 16) alcohol or hexadecan-1-ol
- Stearyl (C 18) alcohol or octadecan-1-ol

Commercial mixtures:
- C16:C18 is 50:50 (most common)
- C16:C18 is 30:70
- C16:C18 is 70:30

Forms:
- White waxy solid
- Liquid

Usage and price:
- Used < 3-5% in formulation
- Wholesale > Rs 110-150/kg

Uses:
- Opacifying agents (ex shampoos)
- Emollient or moisturizer
- Emulsifier
- Viscosity agent/ thickener
- Lubricant

Industries:
- Food Industry
- Cosmetics Industry (skin creams/ lotions)
- Pharmaceutical Industry as excipient (not API)

By sources:
- Synthetic
- From animal sources
- From plant oils
- ***Microbial***

C16 alcohol at RT:
- Waxy white solid or flakes

Sources of C16 alcohol:
- Whales
- Palm oil, coconut oil

C18 alcohol at RT:
- White granules or flakes

Sources of C18 alcohol:
- Coconut & palm kernel oil

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Specs & Compositions: Commercial Cetearyl Alcohol

Parameter	Cetearyl Alcohol NF (70:30)	WILFAROL 1618 (50:50)	WILFAROL 1618 (30:70)
Specifications:			
• Acid value (mg KOH/g)		0.1 max	0.1 max
• Saponification value (mg KOH/g)		1.0 max	1.0 max
• Iodine value (% I2 absorbed)		1.0 max	1.0 max
• Hydroxyl value (mg KOH/g)		210-225	210-225
Composition:		**Most popular!**	
• Fatty alcohols		99% min	99% min
• C16	~ 70%	45-55%	22-32%
• C18	~ 30%	45-55%	66-76%
• C12, C14		3 max	3 max
• Others		3 max	3 max
• Moisture		0.1 max	0.3 max

Source: https://heess.all.biz/en/cetyl-stearyl-alcohol-5050-and-3070-g8266275

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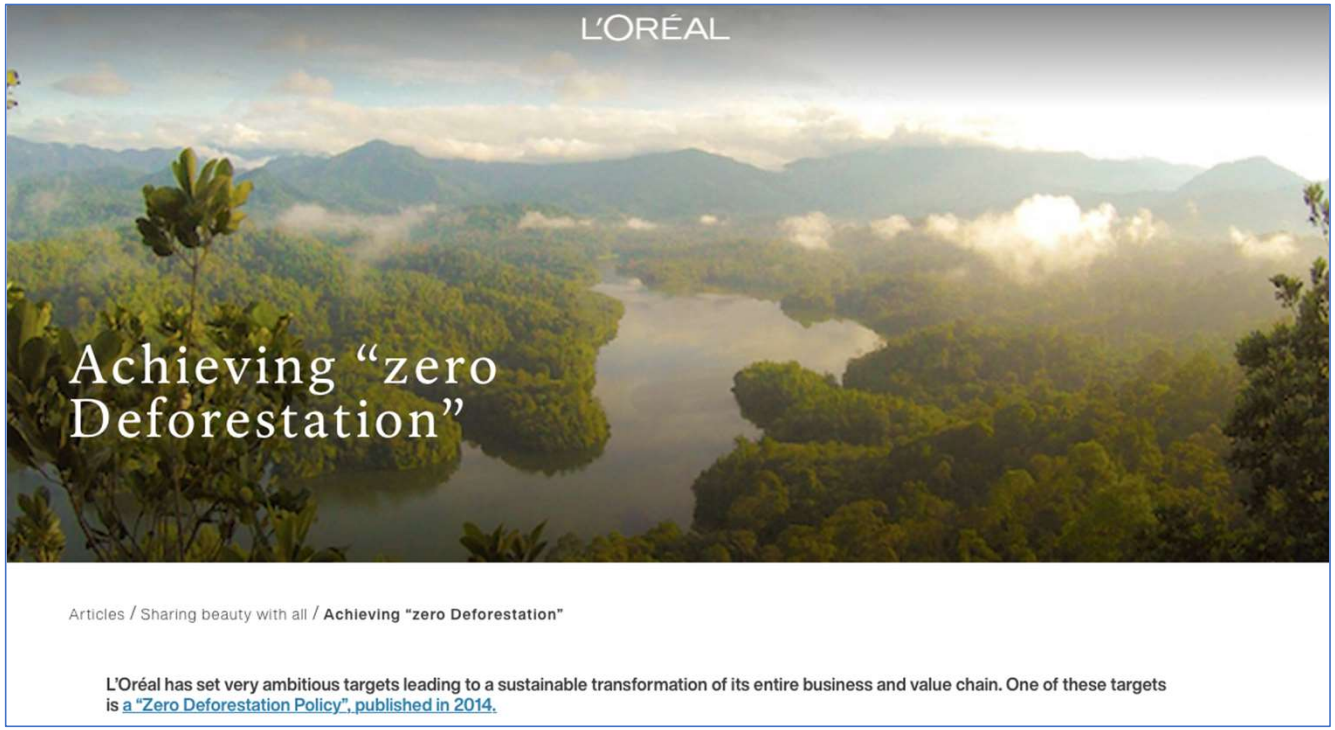
The Opportunity: Microbial Cetearyl Alcohol

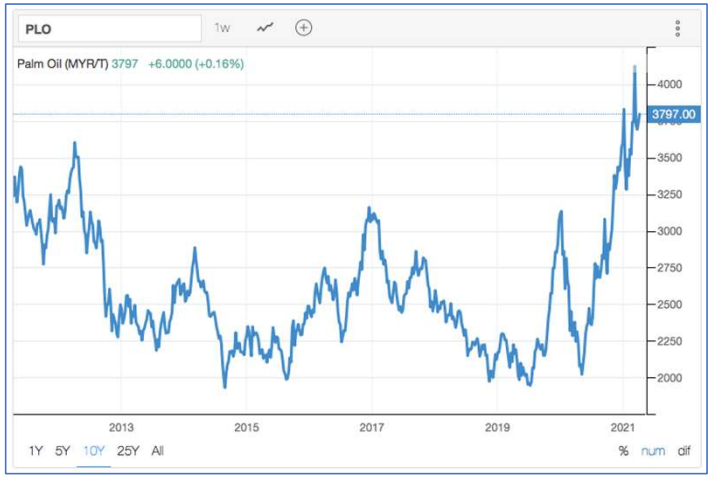
- Cetearyl alcohol is a well known and accepted ingredient in cosmetics and personal care, pharmaceuticals and food industries with an established market demand and a stable industry landscape (with end-product manufacturers and raw material suppliers). Wholesale price realization of cetearyl alcohol is a minimum of Rs 110-150/kg and go up to Rs 5000/kg

- The key drivers for ***microbial production of Cetearyl alcohol*** are:
  - Desire to reduce plant sources like palm oil to ***reduce deforestation*** and loss of tree cover; Position this as a value for customers especially in the specialty cosmetics and personal care space where customers place a premium on environmental sustainability and natural products.
  - Desire to avoid animal sources or synthetic sources
  - Desire to reduce risks of price fluctuations related to palm oil trading dynamics
  - Desire to get the Cetearyl Alcohol in a clean, ***environmentally safe process*** without use of harmful chemicals or heavy metals as catalysts.

The mega trends



Zero Forestation Policy of L'OREAL
https://www.loreal.com/en/articles/sharing-beauty-with-all/achieving-zero-deforestation/



Price fluctuation in Palm Oil prices
https://tradingeconomics.com/commodity/palm-oil

A common ingredient found in hundreds of everyday beauty products is devastating the environment.

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Who should be interested and why?

Who?	Why?
Manufacturers of cosmetic, personal care, pharmaceutical (lotions, creams), food products that use cetearyl alcohol	• New value proposition for customers • Source of competitive edge
Manufacturers of cetyl and stearyl alcohol	• New grades of cetearyl alcohol to meet needs of buyers • Source of competitive edge
Manufacturers of bio-synthesized value added chemicals	• New products and forays into new markets • Opportunity for startups to disrupt markets & displace incumbents

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About the technology

Process features:

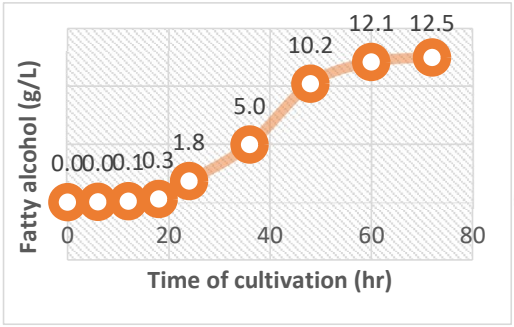
- **Bioengineered *E.coli* for production of CA**
  - Novel method for synthesis of cetearyl alcohol using fermentation technology ➔ Renewable source
  - Carbon source: Glucose ➔ Environmental friendly and sustainable
  - Extracellular synthesis of cetearyl alcohol ➔ Ease of extraction
  - Uniform and consistent product quality ➔ Highly pure CA

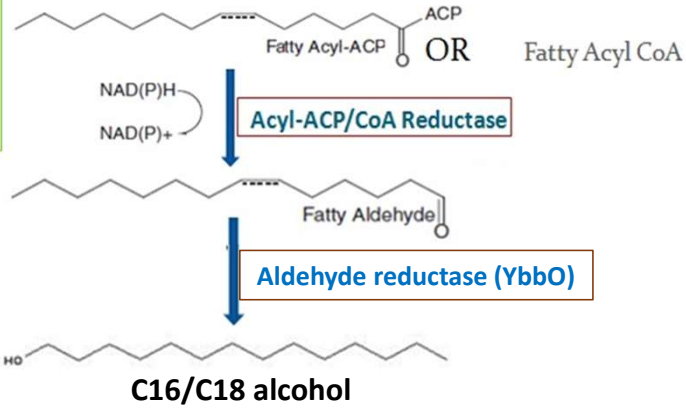
Product features

- Highly (99%) pure form of Cetearyl alcohol
- By products -- minimal

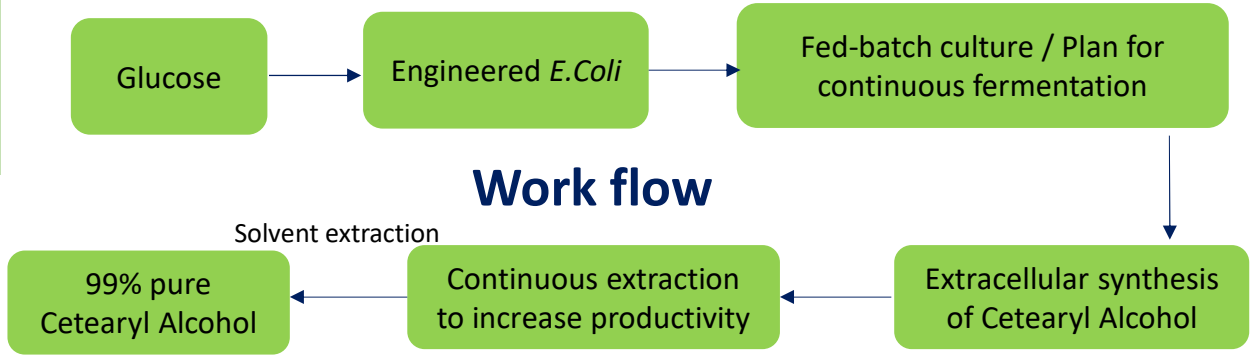
Microbial engineering to produce alcohol

- **3 gene addition and 8 deletions carried out for alcohol production**
- **Engineered bacteria produced >12 g/L cetaryl alcohol**



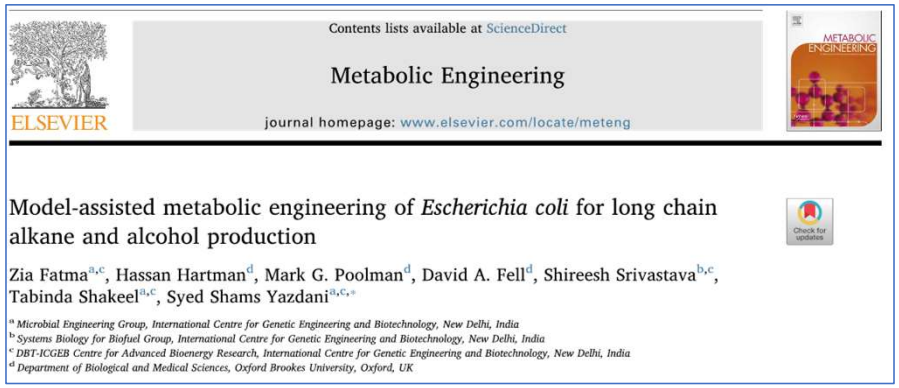


Work flow



- **Expected yield: 10-15%**
- **> 85% Cetearyl Alcohol**
- **Current OD: 30/40; expected to be increased to 200.**

Illustrative Cetearyl alcohol compositions demonstrated



Contents lists available at ScienceDirect

Metabolic Engineering

journal homepage: www.elsevier.com/locate/meteng

Model-assisted metabolic engineering of *Escherichia coli* for long chain alkane and alcohol production

Zia Fatma[a,c], Hassan Hartman[d], Mark G. Poolman[d], David A. Fell[d], Shireesh Srivastava[b,c], Tabinda Shakeel[a,c], Syed Shams Yazdani[a,c,*]

[a] Microbial Engineering Group, International Centre for Genetic Engineering and Biotechnology, New Delhi, India
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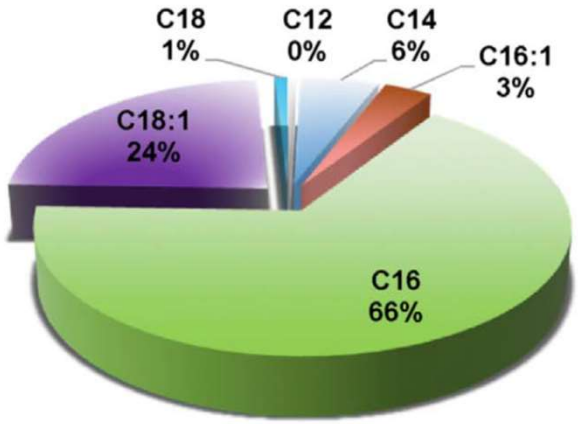
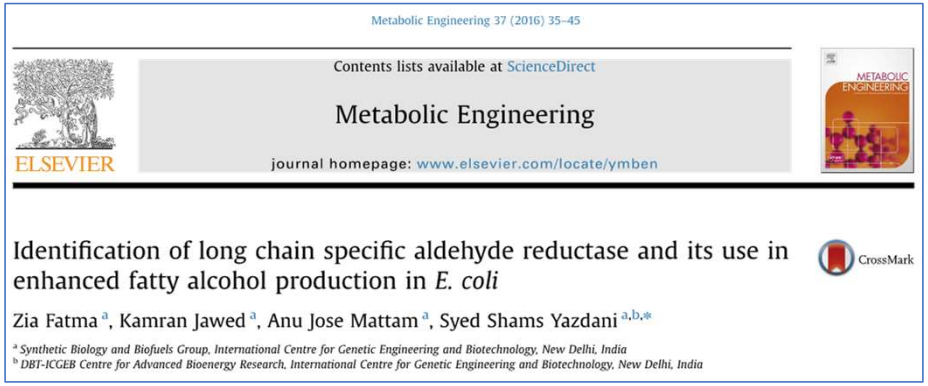
[c] DBT-ICGEB Centre for Advanced Bioenergy Research, International Centre for Genetic Engineering and Biotechnology, New Delhi, India
[d] Department of Biological and Medical Sciences, Oxford Brookes University, Oxford, UK



C16: 69%
C18: 25%
C12, C14: 6%



Metabolic Engineering 37 (2016) 35–45

Contents lists available at ScienceDirect

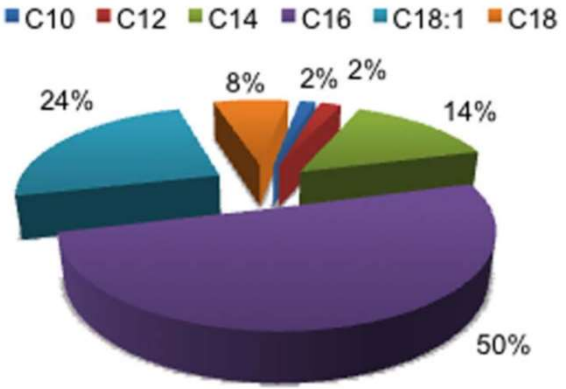
Metabolic Engineering

journal homepage: www.elsevier.com/locate/ymben

Identification of long chain specific aldehyde reductase and its use in enhanced fatty alcohol production in *E. coli*

Zia Fatma [a], Kamran Jawed [a], Anu Jose Mattam [a], Syed Shams Yazdani [a,b,*]

[a] Synthetic Biology and Biofuels Group, International Centre for Genetic Engineering and Biotechnology, New Delhi, India
[b] DBT-ICGEB Centre for Advanced Bioenergy Research, International Centre for Genetic Engineering and Biotechnology, New Delhi, India



C16: 47%
C18: 45%
C12, C14: 8%

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Current status

Technology status:

- Demonstrated at lab scale; 5 L fermenter
- Patent protected

Patents:

- Priority document: 4260/DEL/2015 (23 Dec 2015)
- Coverage: IN
- Status: FER Response Submitted (Application Pending)

Publications:

- Identification of long chain specific aldehyde reductase and its use in enhanced fatty alcohol production in *E. coli*. Zia Fatma, Kamran Jawed , Anu Jose Mattam , Syed Shams Yazdani, Metab Eng 37 (2016), 35-45.
- 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

Team & organization

Lead Scientist: Dr Syed Shams Yazdani

- **Coordinator** of the DBT-ICGEB Centre for Advanced Bioenegry 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:
  - **10** Indian patents filed **, 3 granted** US patents, **1 granted** China patent; **More than 60** publications in biofuels, fatty alcohols from non-crude carbon source.
  - Team strength: 58
  - Well equipped labs and analytical facilities
    - 20 L fermenter facility for validation
    - Mass Spectrometer
    - Multi vessel fermentation system
    - HPLC and Gas chromatography
  - Industry Project /Tech transfer
    - Project undertaken with various oil companies
    - Enzyme based technology Transferred and scaled-up

Next Steps

- The team has developed the background science, demonstrated lab scale processes and proof-of-concept. The team understands 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 and process of interest.
  - 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 interested in tapping scientist capabilities as an expert/ consultant.
- Startup founders who leverage the core capability to identify many more market opportunities in a) cosmetics & personal care products segment, b) synthetic biology companies

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A Centre of excellence for research, training and technology transfer to industry in the field of biotechnology to promote sustainable global development
Developing Knowledge

DBT-ICGEB

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innovate in India for inclusiveness (i3)

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References> Market data

1. http://www.thegoodscentscompany.com/data/rw1298331.html
2. https://www.openpr.com/news/2104626/cetearyl-alcohol-market-2020-global-market-size-share
3. https://www.maximizemarketresearch.com/market-report/global-cetearyl-alcohol-market/86165/
4. https://www.researchandmarkets.com/reports/4514895/global-cetyl-stearyl-alcohol-market-trends
5. https://www.marketdataforecast.com/market-reports/asia-pacific-cetyl-stearyl-alcohol-market
6. https://www.persistencemarketresearch.com/market-research/cetostearyl-alcohol-market.asp
7. https://www.acme-hardesty.com/product/ahcohol-1618-cetyl-stearylcetearyl-alcohol/
8. https://acmehardesty.wpengine.com/wp-content/uploads/AHCOHOL-1618-TA-Spec-Pastilles.pdf
9. https://www.wilmar-international.com/oleochemicals/products/personal-care/detail/cetyl-stearyl-alcohol-(50-50)
10. https://heess.all.biz/en/cetyl-stearyl-alcohol-5050-and-3070-g8266275