



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

Green Technology For Biosynthesis Of Cetearyl Alcohol



Lead Inventor: Dr Syed Shams Yazdani
Organization: ICGEB

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

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Cetearyl Alcohol

- ❖ **Cetearyl alcohol is a blend of long chain fatty alcohols used as **thickener, texture enhancer and emulsion stabiliser** in skin lotions and creams.**
 - **A blend of cetyl ($C_{16}H_{33}OH$) alcohol and stearyl ($C_{18}H_{37}OH$) alcohol in ratios 30:70, 50:50 or 70:30 mixtures.**
 - **Commonly sold as **white waxy solid** at room temperature.**
 - **Important ingredient found in hundreds of everyday beauty and hygiene products.**
- ❖ **Cetearyl alcohol is a USFDA permitted ingredient for use in cosmetics, food and pharma **products labeled “alcohol-free”**.**
 - **Safe and non-toxic.**
 - **Does not dry or irritate skin or scalp like other alcohols.**
 - **Used in food industry as flavouring agent, for adding lettering and pictures in sweets and gums.**
- ❖ **Sources of Cetearyl alcohol**
 - **Palm Oil is the most commonly used raw material.**
 - **Other plant sources include coconut, corn, soy etc.**
 - **Laboratory synthesis and animal sources such as Whale oil.**



Need for Microbial Cetearyl Alcohol

The key drivers for microbial production of Cetearyl alcohol are:

- ❖ Current trends of moving towards sustainable technologies that doesn't depend on non-renewable sources or single crop plantation products such as palm oil.
- ❖ Desire to reduce risks of price fluctuations related to raw material sourcing.



- ❖ Need for sustainably produced ingredients from clean, environmentally safe processes without use of harmful chemicals or heavy metals as catalysts.
- ❖ Value proposition that appeals to the growing base of "conscious consumers".



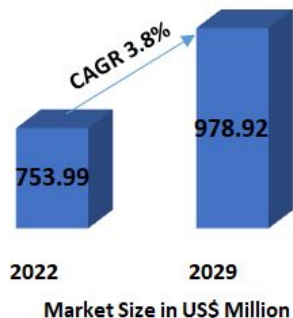
- ❖ Mitigate adverse impacts of deforestation on biodiversity, tropical forest covers as well as global climate changes.
- ❖ Avoid animal sources or minimise synthetic ingredients in everyday products.



Market Opportunity

Global market size of cetearyl alcohol was valued at USD 0.75B in 2022 and is expected to grow at CAGR of 3.8% reaching USD 0.98B by 2029 [1].

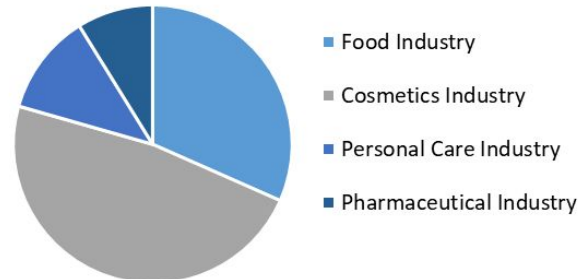
Global Cetearyl Alcohol Market



Key Players

Kerax Limited	Surfachem Group Ltd
Labthink International	P&G Chemicals
Intertek	BASF
Polymer Solutions	Lansdowne Chemicals
Avomeen Analytical Services	Mistral Industrial Chemicals
Bureau Veritas SA	Niram Chemicals
Aromantic Ltd	VVF LLC
Eurofins Scientific SE	
Trulux Pty Ltd	

Global Cetearyl Alcohol Market, by End User 2022 (%)



- ❑ **Cosmetic industry leading end user.**
- ❑ **Quantity used in Cosmetics 0.5-10%.**
- ❑ **Cetearyl Alcohol Price:**
 - ❑ **Wholesale ~ Rs.97-150/ 1 kg^[2]**
 - ❑ **Plant derived ingredient for cosmetics ~ Rs. 100-250/ 100g^[3]**

Who Should Be Interested?

Who?	Why?
Manufacturers of cosmetic, personal care, food products, pharmaceuticals.	<ul style="list-style-type: none">● New value proposition for customers● Sustainability as competitive edge
Manufacturers of Cetearyl alcohol, Cetyl alcohol and Stearyl alcohols	<ul style="list-style-type: none">● Green and sustainable technology for production● New grades of Cetearyl alcohol to meet needs of buyers● Source of competitive edge
Manufacturers of bio-synthesized value added chemicals	<ul style="list-style-type: none">● New products and forays into new markets● Opportunity for startups to disrupt markets & displace incumbents
Manufacturers of chemical and biotech-based ingredients	<ul style="list-style-type: none">● New value proposition for customers● Source of competitive edge
Manufacturer of drop-in fuels - jet/aviation and diesel fuels	<ul style="list-style-type: none">● New product as fuel additive● Sustainability as competitive edge

About the Technology

Process features:

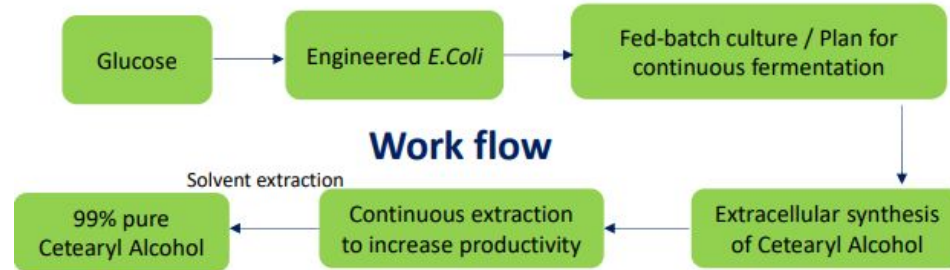
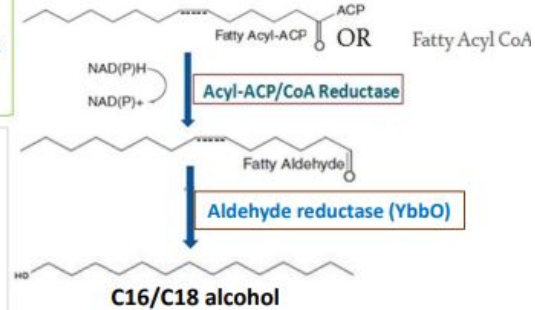
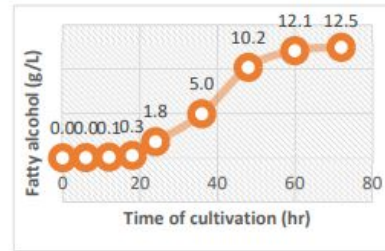
- **First demonstration of a new pathway for production of cetearyl alcohol:**
 - ◆ **Novel method:** Synthesis of cetearyl alcohol using bioengineered E.coli fermentation technology and renewable materials.
 - ◆ **Carbon source:** Glucose Environmental friendly and sustainable.
 - ◆ **Ease of extraction:** Extracellular synthesis of cetearyl alcohol.
 - ◆ **Process output:** Uniform and consistent product quality.

Product features:

- **Highly (99%) pure form of Cetearyl alcohol**
 - ◆ >85% Cetearyl Alcohol
 - ◆ Minimal by products
- **Current Yield:** 12.5 g/l
 - ◆ Expected yield 10-15% during continuous processing.
- **Current OD:** > 120
 - ◆ Expected to be increased to 200.

Microbial engineering to produce alcohol

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



Illustrative Product Compositions Demonstrated

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

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,b,c}, Hassan Hartman^d, Mark G. Poolman^d, David A. Fell^d, Shireesh Srivastava^{b,c}, Tabinda Shakeel^{a,c}, Syed Shams Yazdani^{a,b,c,*}

^a Microbial Engineering Group, International Centre for Genetic Engineering and Biotechnology, New Delhi, India
^b Systems Biology for Biofuel Group, International Centre for Genetic Engineering and Biotechnology, New Delhi, India
^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

Metabolic Engineering 37 (2016) 35–45

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

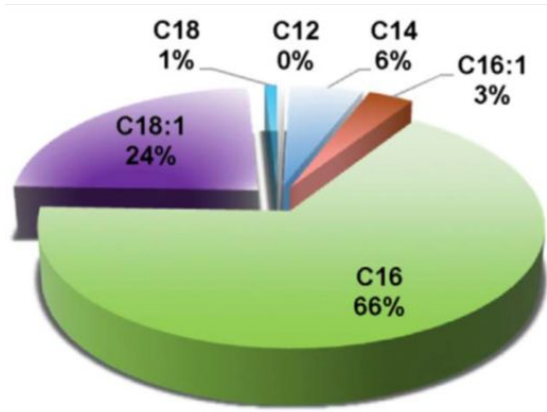
Metabolic Engineering

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

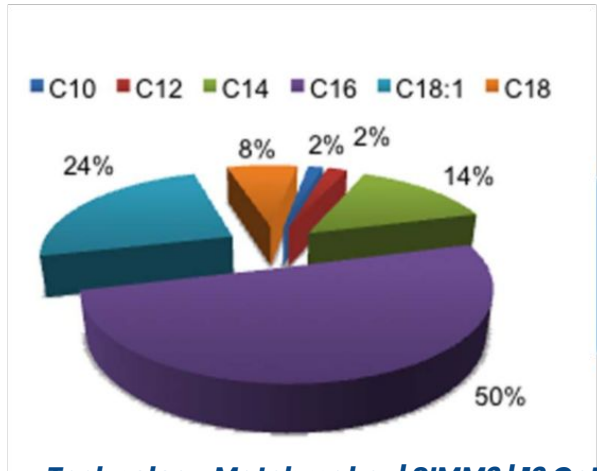
Identification of long chain specific aldehyde reductase and its use in enhanced fatty alcohol production in *E. coli*

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



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

Current Status

Technology Status:

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

IP Status:

- ❖ **Patent filed: METHOD FOR ENHANCED FATTY ALCOHOL PRODUCTION IN E. COLI.**

Patents:

- ★ Priority Date: 23.12.2015
- ★ Coverage: India
- ★ Status: Granted

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.

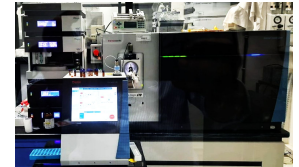


Team & Organisation



Lead Scientist:
Dr Syed Shams Yazdani

- ★ **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



- ★ **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



Next Steps

- ❑ The team has developed the background science and demonstrated lab scale processes as a proof of concept.
- ❑ 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://heess.all.biz/en/cetyl-stearyl-alcohol-5050-and-3070-g8266275>
- Slide 2: <https://pubchem.ncbi.nlm.nih.gov/compound/Cetostearyl-alcohol#section=2D-Structure>
- Slide 4: [1] <https://www.maximizemarketresearch.com/market-report/global-cetearyl-alcohol-market/86165/>
- Slide 4: [2] <https://indiamart.com>
- Slide 4: [3] <https://amazon.in>
- Slide 7: 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.
- Slide 7: 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.