

Tuesday the 11th of November 2025

Unilever Presentation Slides and Notes

Slide 1:

Craig Jones
Technical Programme Leader,
Biotechnology & Biosourcing,
Unilever R&D

THAT'S HOW IT WORKS!
I'VE PERFECTLY DUPLICATED THE PROCESS!

Aston 11/11/2025

**Supergen Annual Meeting Aston, Birmingham
Tuesday the 11th of November 2025**

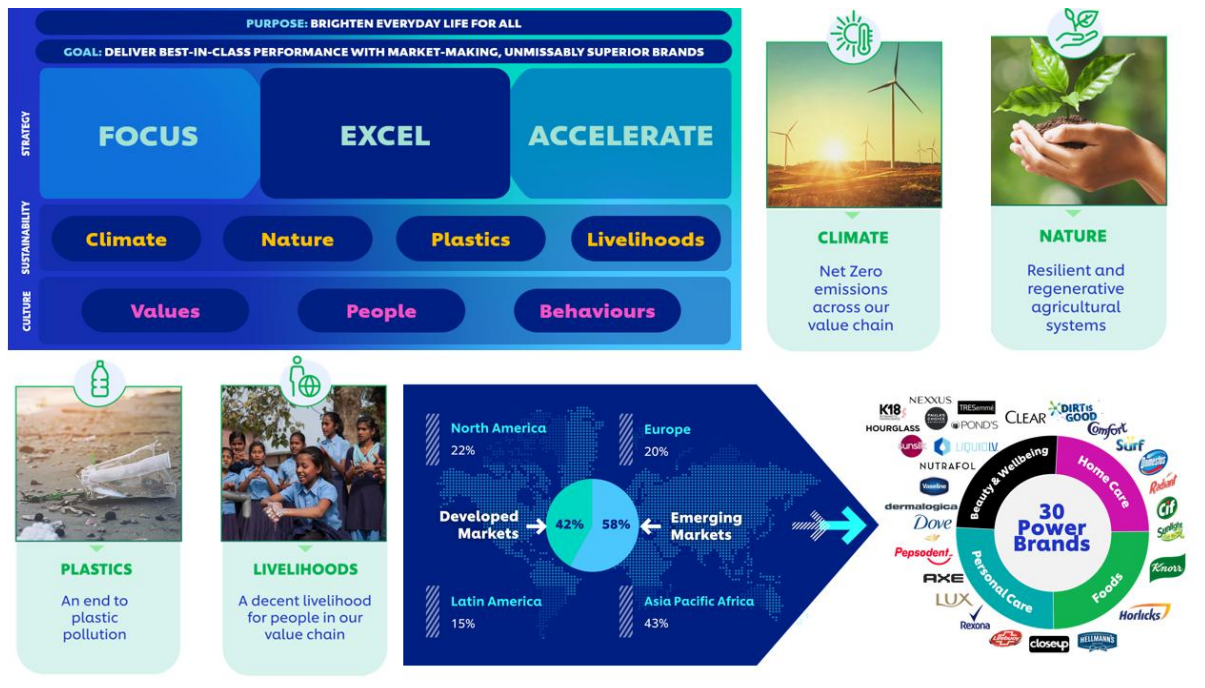


**Harnessing Biology as an enabler
for Future Ingredients**

"Superior Performance, Sustainably Sourced"

- Good afternoon, I'm Craig Jones, Technical Programme Leader for Biotechnology & Biosourcing at Unilever R&D.
- Today I'll share how Unilever has/is harnessing biology to create future-fit ingredients that deliver superior performance while being sustainably sourced.
- This aligns with our ambition to meet consumer needs and planetary boundaries.

Slide 2:



“Unilever is a global consumer goods company with over 400 brands, serving 3.4 billion people daily across 190 countries. Our mission is to make sustainable living commonplace. We embed purpose into every brand and business decision—driving innovation that’s better for people and the planet.”

Nature

Goal: Regenerate and protect natural and agricultural ecosystems.

Actions: Deforestation-free sourcing; Regenerative agriculture to improve soil health, biodiversity, and water security; Partnerships with NGOs, governments, and suppliers to restore ecosystems.

Climate

Goal: Achieve net zero emissions across the value chain.

Actions: Transition to renewable energy and low-carbon ingredients; Embed climate metrics into product innovation and sourcing; Advocate for systemic change through policy engagement.

Plastics

Goal: End plastic pollution through reduction, circulation, and collaboration.

Actions: Halve virgin plastic use; Make all packaging recyclable, reusable, or compostable; Support global treaties and circular economy initiatives.

Livelihoods

Goal: Ensure decent livelihoods across the global value chain.

Actions: Promote living wages and fair working conditions; Support smallholder farmers and local communities; Invest in skills, equity, and resilience.

Slide 3:



Key science & technology platforms

with wide applications

Microbiome

- Probiotics with new benefits for Home Care
- Biome-enhancing Beauty & Personal Care
- Biome-boosting food ingredients



Biotechnology

- Bio-based 'Rhamnotech' superior cleaning
- Plant-based proteins for Foods
- High-value skin care for Prestige Beauty



Next Gen Materials

- 'GlutaGlow' 10x vit C skin antioxidant
- 'Pro-S' fast acting laundry care
- 'Pro-ceramides' 24hr skin barrier repair



- **We're building on microbiome science and biotechnology to unlock new benefits: Probiotics** for Home Care.

Biome-enhancing ingredients in Beauty & Personal Care.

Bio-based cleaning via "Rhamnotech".

Plant proteins and prestige skincare.

Our Next Gen Materials include:

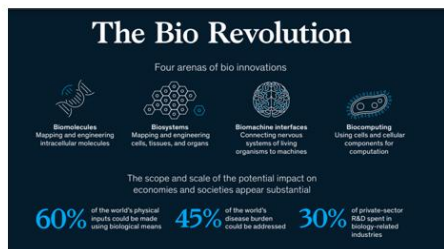
GlutaGlow – a potent antioxidant (Vaseline brand helps with reducing darker skin spots).

Pro-S – fast-acting laundry care (materials for 'Quick wash'. Aimed at malodour counteraction)

Pro-ceramides – long-lasting skin barrier repair (used in deodorants for example to aid skin healing after shaving by encouraging natural ceramide production).

Slide 4:

Our starting position



Talk will highlight the following strategy for bio-material innovation

1. Sustainability Without Compromise

Unilever is committed to delivering **superior product performance with lower environmental impact**. This means rethinking ingredients, formats, and packaging to align with our Climate, Nature, Plastics, and Livelihoods goals.

Unilever is addressing this through **deep/strategic partnerships**—from scaling **biosurfactants with Evonik**, to developing **energy cane with Nuseed**, and accelerating formulation science with the **University of Liverpool**.

2. Regulatory & Reputational Risk Management

With increasing scrutiny on ingredients, emissions, and sourcing, Unilever embeds **regulatory foresight, safety, and transparency** into innovation from the start.

We work with **academic partners** to advance **LCA and TEA methodologies (must be considered very early in the innovation process)** and collaborate with **industry alliances** and policymakers to shape a regulatory environment that supports sustainable innovation.

If there is one take out from the Aston meeting it is:

Partnerships are central to how we scale responsibly, innovate sustainably, and build trust.

Our journey began with a clear ambition: to move from fossil-based to bio-based ingredients. We've built foundational capabilities in strain engineering, fermentation, and formulation.

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Slide 5:

CASE STUDY 1-Rhamnolipids



Rhamnolipids are a great example of nature's fine-tuning.

Originally discovered decades ago (1949), we've now unlocked their potential for superior cleaning performance.

This case study shows how biology can outperform synthetic surfactants
How Unilever through partnerships went from laboratory scale rhamnolipid to commercial scale and deployed in hand dishwash liquids.

Nature produces rhamnolipid surfactants primarily as a microbial strategy for survival, competition, and adaptation in complex environments.

Rhamnolipids are produced mainly by bacteria such as *Pseudomonas aeruginosa*. These molecules help the bacteria:

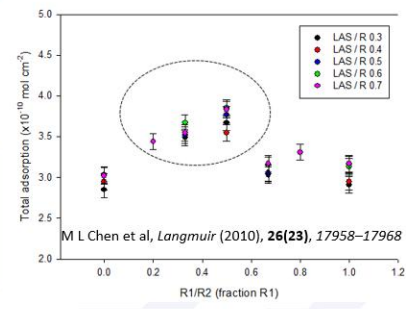
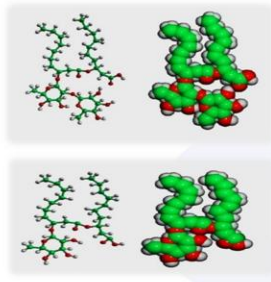
- Disrupt competitors' cell membranes (they're mildly antimicrobial).
- Aid in colonization by creating biofilms that protect against predators and antibiotics.
- Compete for limited nutrients like hydrocarbons or lipids by emulsifying them for easier uptake.

Rhamnolipids are biosurfactants, meaning they reduce surface and interfacial tension. This allows bacteria to access hydrophobic carbon sources (e.g., oils, waxes, hydrocarbons) that would otherwise be insoluble in water. By increasing the surface area of oil droplets, they make nutrients more bioavailable — acting like a microbial detergent. **Mild.**

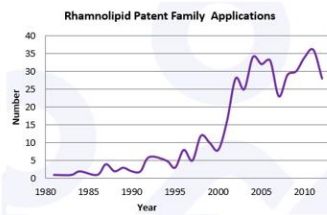
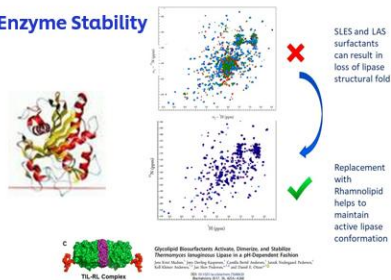
Slide 6

Rhamnolipid Targeted Materials-Superiority

Rhamnolipid producers	
Pseudomonas:	<i>P. aeruginosa</i> , <i>P. chlororaphis</i> , <i>P. putida</i> , <i>P. fluorescens</i> , <i>Pseudomonas</i> sp. GRP(3), <i>Pseudomonas nitroreducens</i> TSB.MJ10
Burkholderia:	<i>B. Thailandensis</i> , <i>B. Plantarii</i> , <i>B. Pseudomallei</i> , <i>B. kururiensis</i>
Other Gram negatives:	<i>Pseudoxanthomonas</i> sp. PNK-04, <i>Acinetobacter calcoaceticus</i> , <i>Enterobacter hormaechei</i> , <i>E. asburiae</i> , <i>Serratia rubidaea</i>
Gram positives:	<i>Tetragenococcus koreensis</i> , <i>Renibacterium salmonarum</i> 27BN, <i>Bacillus subtilis</i>



Enzyme Stability



- **Rhamnolipids offer targeted performance advantages**, with superior adsorption properties compared to conventional surfactants like LAS and SLES.
 - **Diverse microbial sources** (e.g. *Pseudomonas*, *Burkholderia*, Gram-negative and Gram-positive bacteria) enable tailored rhamnolipid production.
 - **Patent activity has increased steadily**, indicating growing interest and innovation in rhamnolipid applications.
 - **Enhanced enzyme stability** is achieved with rhamnolipids, maintaining lipase structure better than traditional surfactants.
- Would you like these adapted for a technical audience or simplified for a broader stakeholder presentation?

Rhamnolipids They're biodegradable, mild, and effective – ideal for Home and Personal Care. offer excellent enzyme stability and targeted material properties. Supported by peer-reviewed data and internal studies.

Core Message:

Blending surfactants (like LAS and R-type molecules) leads to **better adsorption** on surfaces, which is crucial for cleaning performance.

Nature tends to use **blends rather than single molecules**, and this principle can be applied to product formulation.

Graph Insight:

The graph plots **total adsorption** (in units of $(10^{-6}) \text{ mol/cm}^2$) against the **fraction of R1 in the R1/R2 blend**.

Different LAS/R ratios (0.3 to 0.7) are compared, showing how varying the blend affects adsorption. This suggests there is an **optimal ratio** for maximizing surface interaction.

Molecular Structures:

The molecular images reinforce the idea that **structural diversity in surfactants** contributes to performance.

The caption “Defining the right combination for performance” supports the idea that **rational design of blends** is key.

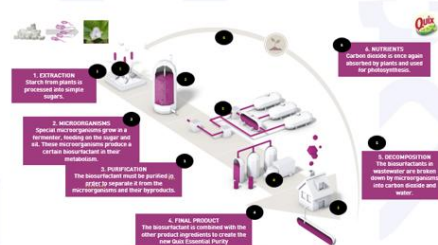
Scientific Backing:

Langmuir journal articles by M.L. Chen et al. provide **peer-reviewed evidence** supporting the claims.

Slide 7

Moving to scale up - considerations

- Pathogens pose problems
 - Containment
 - Regulatory issues
 - Heterologous host essential
- High yield critical for economical production
 - Metabolic engineering to increase flux through the rhamnolipid biosynthetic pathway is necessary
- Foam control vital especially as yield increases
- DSP is a big factor
 - What is the minimum purity/concentration
- Safety and Regulatory Hurdles
- LCA and scale up location



Slovenska Lupca
Slovakia

Scaling biological ingredients isn't trivial:

Pathogen control, regulatory hurdles, and foam management are key. We use heterologous hosts and metabolic engineering to boost yield.

In synthetic biology, a **heterologous host** refers to an organism—often a well-characterized, easy-to-manipulate microbe like *E. coli*, *Saccharomyces cerevisiae* (yeast), or other chassis—that is used to express genes or biosynthetic pathways that originate from a **different organism**.

The challenge has always been production – now we can do it economically and sustainably.

“**Evonik** partnered Unilever to scale rhamnolipids. Importantly, we embedded **safety** and **regulatory** foresight early, using **LCA** and **TEA** to ensure responsible innovation.”

Slovenska Lupca in Slovakia is our scale-up site.

Slide 8

In market

....SUPERIOR PERFORMANCE, SUSTAINABLY SOURCED

.....BENEFITS AND A PULL FROM CONSUMER /

Quix **NEW Quix ESSENTIAL PURITY**

I am comfortable with the cleaning and degreasing of my current dishwash, but I feel that nowadays they have unnecessary chemicals. It would be ideal to have a dishwasher that only has what it takes to clean my dishes.

Introducing **NEW Quix Essential Purity**, new formulation plant-based.
Contains a **100% biodegradable, renewable and natural cleaning agent.**

NEW Quix Essential Purity hard on grease, and dermatologic tested for irritation and allergies.

NEW Quix ESSENTIAL PURITY
With a 100% biodegradable, renewable and natural cleaning agent.

Mineral salts and green tea

....GOOD FOR ME, GOOD FOR PLANET.



These ingredients are now in market, delivering superior performance with sustainable sourcing.

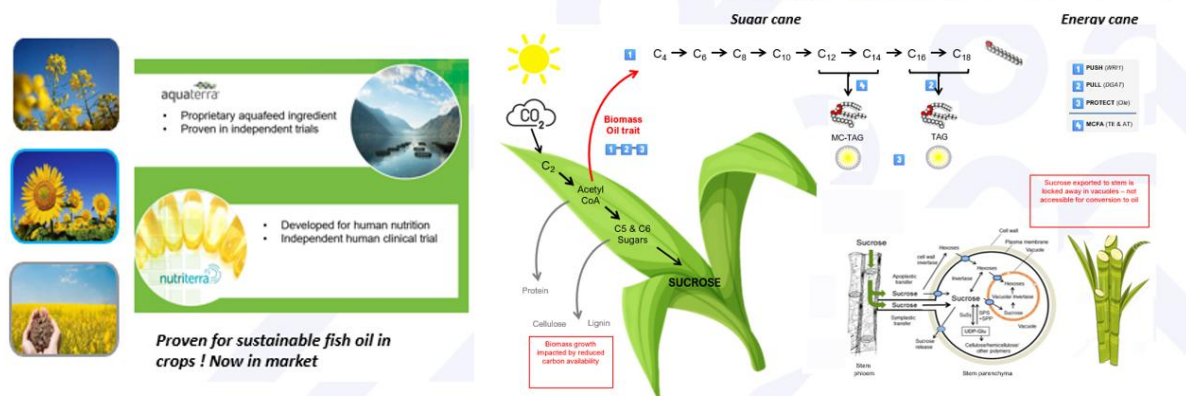
Consumers are responding positively – they want products that are good for me, good for the planet.

Slide 9

Repeating the Model New partnership to investigate alternative raw materials in cleansing products

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Multi-million partnership with Nufarm to use biotechnology to cultivate optimised crop



The success of our biotechnology-driven ingredient development, like rhamnolipids, is not a one-off. We're actively repeating the model across other platforms.

A prime example is our strategic partnership with Nuseed, the seed technologies arm of Nufarm. Together, we're developing biomass oil from energy cane and forage sorghum—crops optimized to produce oil not just from seeds, but from the entire plant: leaves, stems, and all.

This is a breakthrough in sustainable sourcing. Traditional plant oils come from seeds or fruits, but biomass oil uses the whole plant, increasing yield and reducing waste.

Energy cane is already known for its high biomass, drought resistance, and soil protection benefits. Now, with advanced biotechnology, we're engineering it to produce valuable oils for use in our home care, beauty, and personal care products

Leaf Oil Biomass Trait enables plant cells to produce and store **more oil droplets**, shifting their function from carbohydrate (CHO) factories to **oil-rich cells**.

This trait has been successfully applied to crops like **sunflower and sugarcane**, with real-world products: **aquaterra**® – a sustainable aquafeed ingredient, validated in independent trials. **nutriterra**® – a nutritional oil for humans, supported by clinical studies.

This partnership supports our ambition to reach net zero emissions by 2039, by reducing reliance on petrochemical-based ingredients and building a more resilient, diverse supply chain.

It's a clear example of how agriculture and consumer goods can intersect to create transformational sustainability impact.

Addendum:

Photosynthetic Conversion Pathway:

Plants absorb **CO₂ and sunlight**, converting them into **C2 (acetyl-CoA), C5 & C6 sugars**, and ultimately **sucrose**.

This process is **limited by carbon availability**, which affects biomass yield.

Chemical Pathway for Oil Production:

A top diagram shows a **carbon chain elongation pathway** from **C4 to C18**, with key genetic interventions:

PUSH (WRI1) – boosts carbon flux into oil biosynthesis.

PULL (DGAT) – enhances triacylglycerol (TAG) formation.

PROTECT (Ole1) – stabilizes oil production.

MCFA (TES & AT) – introduces medium-chain fatty acids.

Molecular Targets:

Molecules labelled **MC-TAG and TAG** represent different types of oils or energy-rich compounds being produced.

What is the future of ingredient manufacturing?

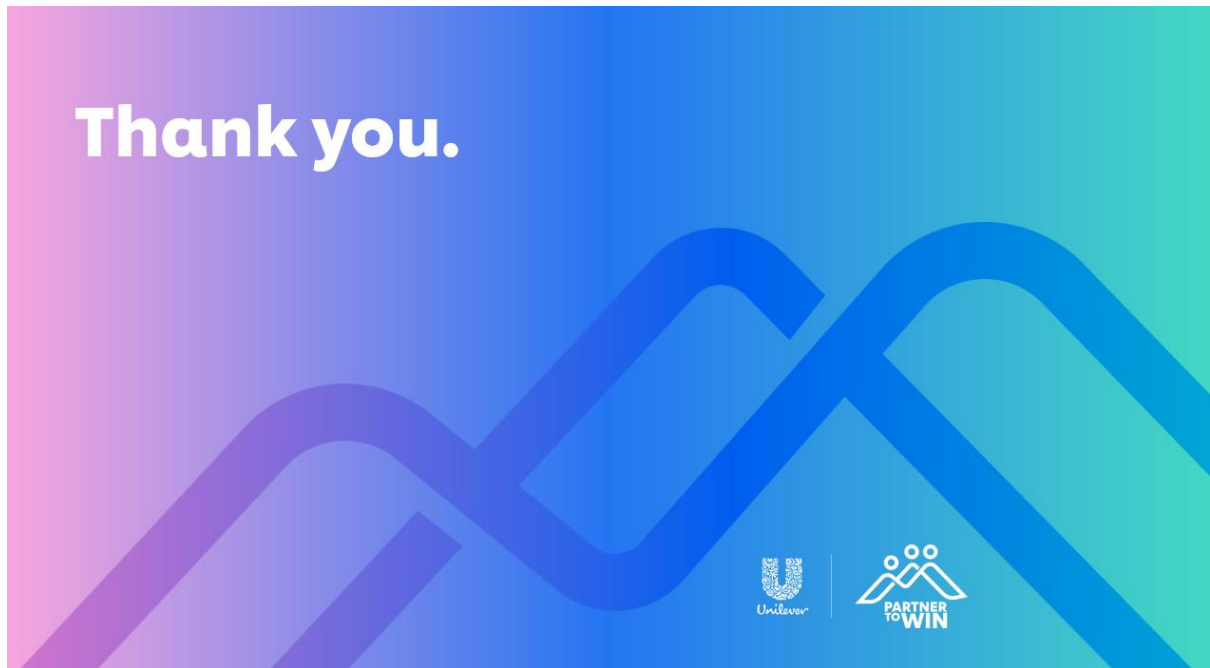


Our R&D focus is on linking structure to functionality.

We're exploring full valorisation of feedstocks, regional sourcing, and hybrid bio-chemical processing.

The future is not just about technology – it's about systems thinking and local impact.

Slide 11



Thank you for your time.

I'm happy to take any questions.