Enzymatic Degumming: Novel routes to increase oil yields

Jorge Moreno

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Firstly…
Who is dsm-firmenich?

Joining forces: DSM and Firmenich

Our roots may go back well over a century, but we're always looking forward, too

Experts in fragrance, taste, texture, and nutrition

Bringing together the best of both market leading companies

Accelerating innovation

Groundbreaking products and solutions that reshape markets

A history of discovery

150 years of research, and scientific brilliance with 16,000 patents

A partner in progress, from concept to commercialization

Bringing customers' ideas to life and delighting end consumers

A global group with European roots

A Swiss-Dutch global group, proudly listed on Euronext Amsterdam

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Two iconic names, one foundational purpose

dsm-firmenich: we bring progress to life We're a trusted partner to global companies operating in high-growth and resilient markets. We're innovators in nutrition, health, and beauty

~30,000
passionate, talented, and diverse people in our global team

150+ years
of combined scientific discovery and innovation heritage

€12+ bn
combined revenue

Taste, Texture & Health: A global group with regional roots

39
Production sites

44
Application labs

13
R&D centers

Ingredients Processing

Ingredients for processors that deliver higher yields, maximize output while reducing losses, and enable performance your customers care about.

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Ingredients Processing

Enzymes that make the difference in processing and beyond.

Fruits processing
- Increase yield
- Increase capacity
- Reduce downtime
- Minimize waste
- Suitable for Organic

Sugar processing
- High yield invert sugar without chemicals
- Improved sweetness
- Reduced crystallization.
- Suitable for Organic

Oils & Fats processing
- Increase oil yield
- Lower operation cost
- Reduced chemical usage
- Reach phosphorous specs

Protein processing
- Increase protein content & yield
- Higher solubility
- modified functionality e.g. texture & foam

Wine processing
- Increase yield
- Extract flavors and color
- Increase filtration, reduce waste

Egg processing
- Optimize production
- Reduce costs of egg-yolk processing
- Boost shelf-life and thermal stability

Fermentation processing
- Release nutrients with phytase
- Shorten fermentation times (incr. capacity)
- Offer foam control

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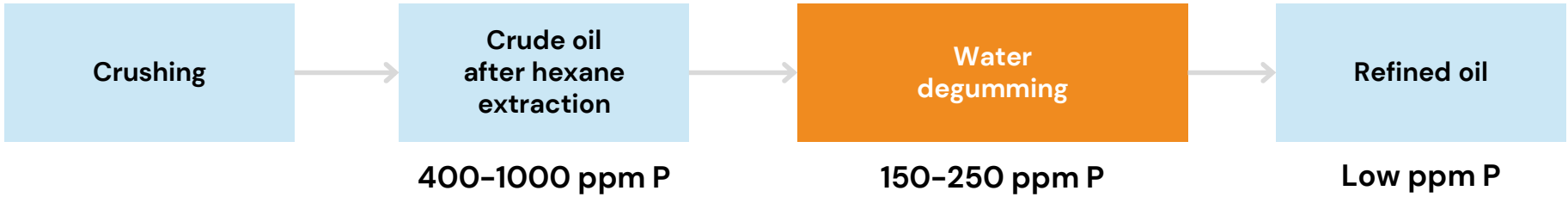
Now….
What about enzymes for degumming?

From Soybean to oil: typical process

Water and Acid Degumming



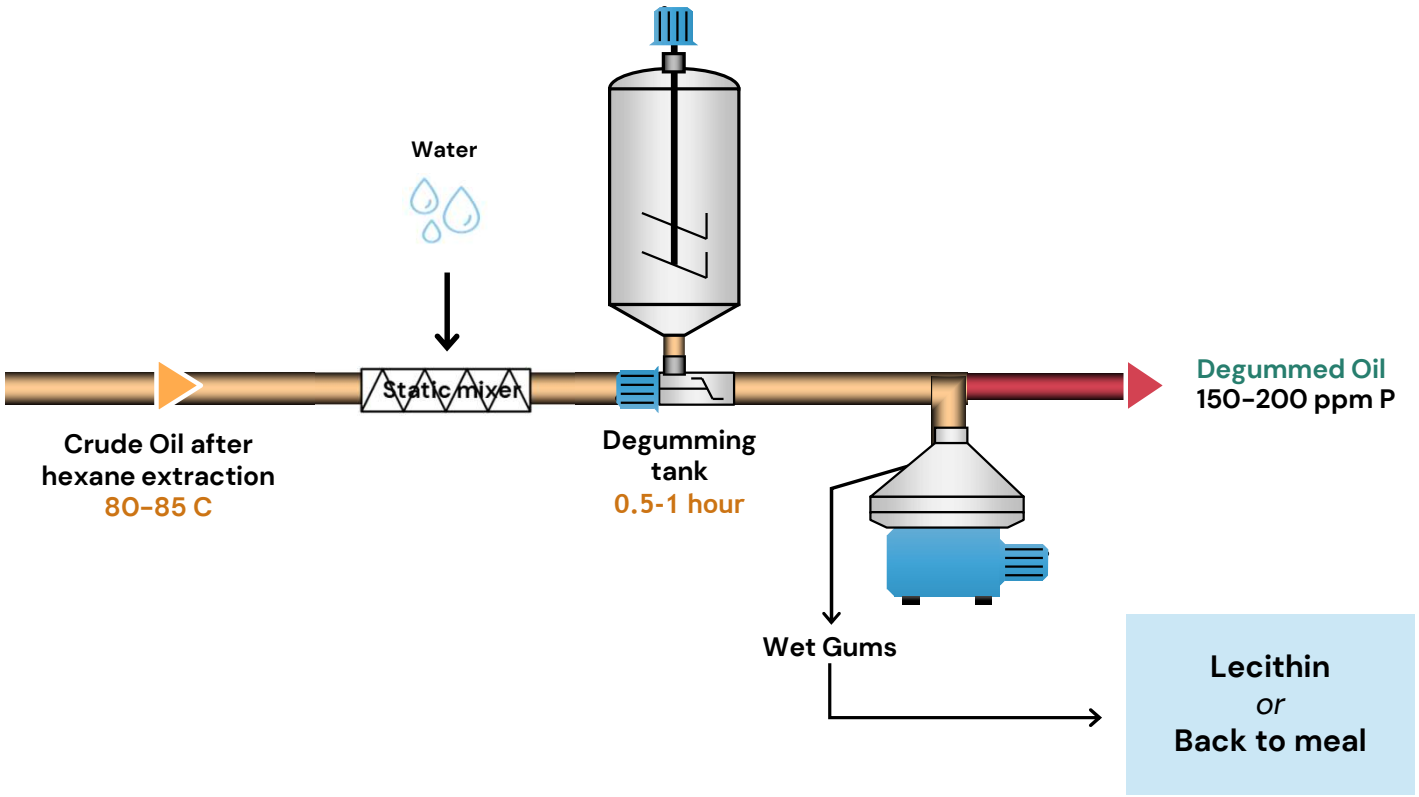
In Water degumming…

- Oil quality will play a big role in degumming efficiency
- Non-hydratable Phosphorous (NHP), will not be removed
- **Oil losses in gums.**

P = phosphorous

Conventional water degumming plant process

Soybean degumming sites



What are enzymes?

- Molecules that work as catalyst by cleaving onto substrates and modify them, producing different products.
- **Phospholipases** are enzymes which target specifically phosphorous in the form of phospholipids.

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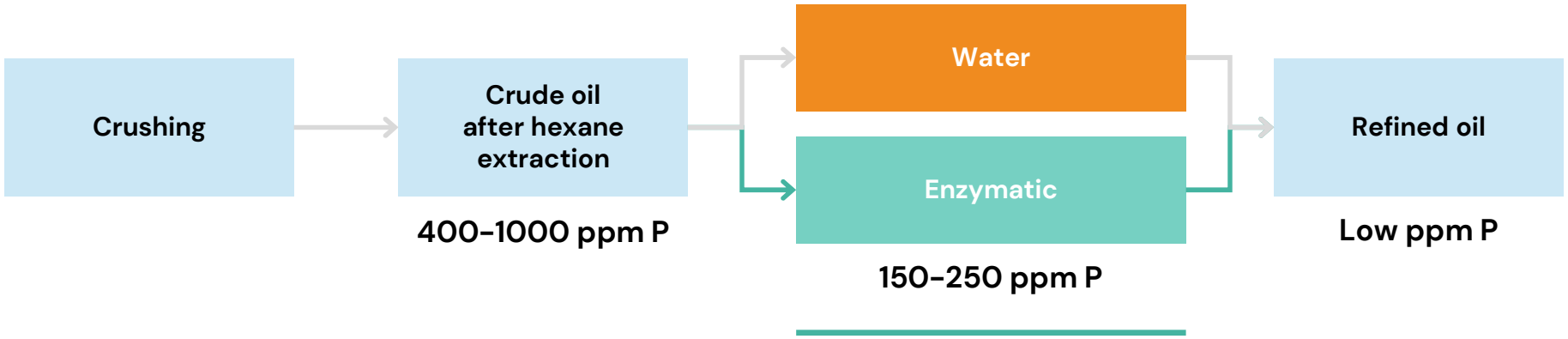
Purifine® 3G

Purifine® LM

Purifine® PLA1

Yield Increase at degumming step

What does enzymes can bring in?



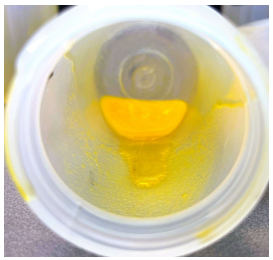
Enzymatic degumming benefits

- Clean process & less chemical usage
- **Yield increase up to 2%***
- Work with different oil qualities
- Low-CAPEX solution available
- Proven and worldwide used technology

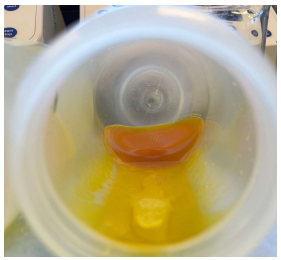
P= phosphorous

How does enzymatic degumming work?

Water Degumming



Enzymatic Degumming



Phospholipase cuts the phospholipid molecule changing the gum structure, releasing trapped oil.

Non-enzyme Enzyme

Less gum volume = more oil released

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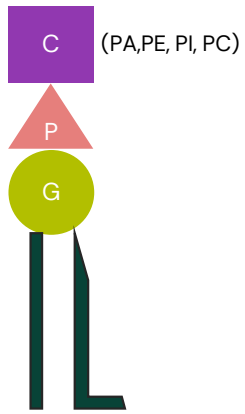
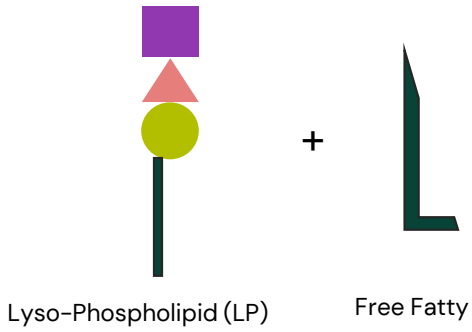
But…why does the gum change?



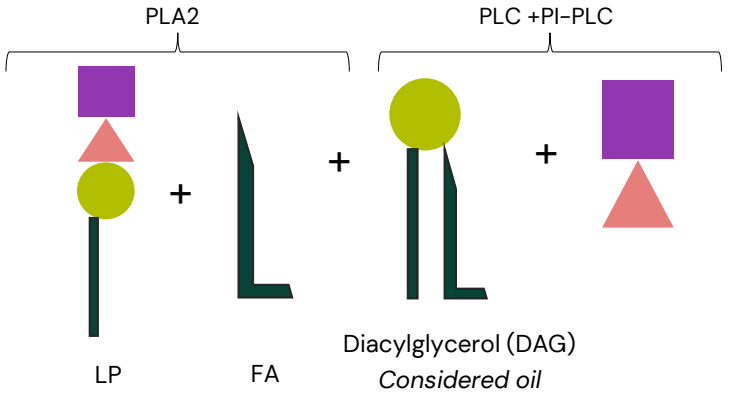
Phospholipid (P)

Purifine® LM
PLA2- type enzyme



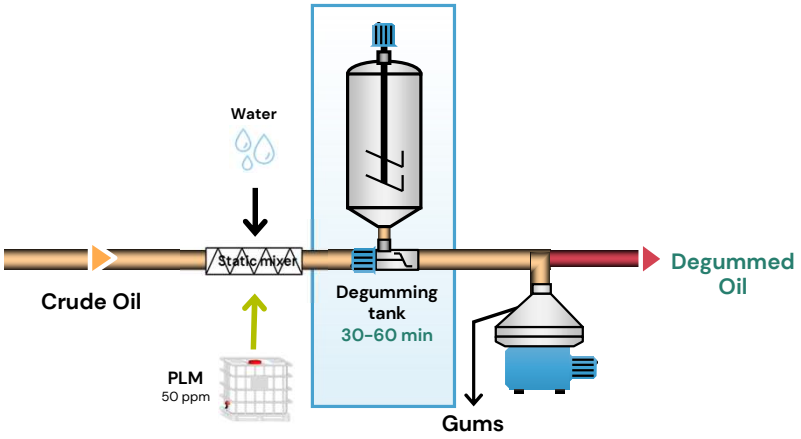
Purifine® LM modifies P to lyso-P, changing the structure of the gum, decreasing oil in gum.

Purifine® 3G
Enzyme cocktail

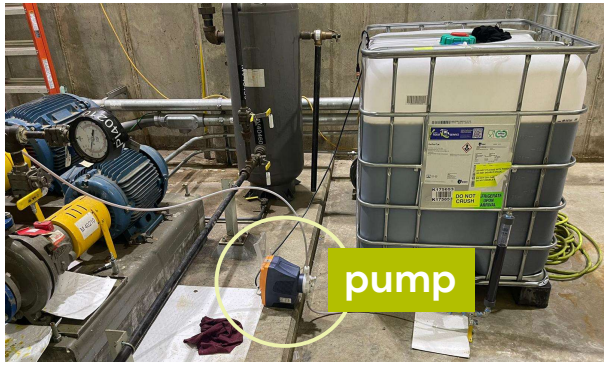


PLC- enzyme type produces DAG contributing to the oil yield increase and PLA2 modifies the structure of the gum, decreasing oil in gum.

Purifine® LM- No CAPEX, up to 1% yield increase



Process needs	Benefits
• Reaction tank of 30-60 min • Mixer in front of the reaction tank	• Neutral oil-yield increase: Up to 1% • AI% increases ~10% (dry) • FFA increase: ~0.2% • P level no change observed vs water degumming • Metal level no change observed vs water degumming



Process parameters:

- Temperature required: **75-85C**
- pH required: **Neutral**
- Dosage: **50 ppm**
- Retention time: **30-60 min**

This enzyme produces lyso-gums.
The rheology and structure differ from lecithin.
Current customers implementing this solution feed the lyso-gums to the meal.

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Gross numbers after Purifine® LM plant trial

Brazilian Soybeans

+0.5–0.6%

Extra oil yield gain by using Purifine® LM with **their worst** quality oil.

+450 kEUR

Annual revenue

USA Soybeans

+0.8%

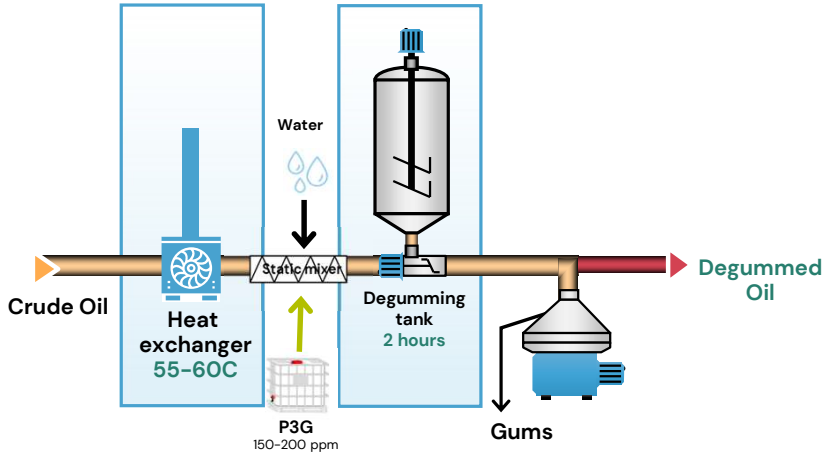
Extra oil yield gain by using Purifine® LM

+990 kEUR

Annual revenue

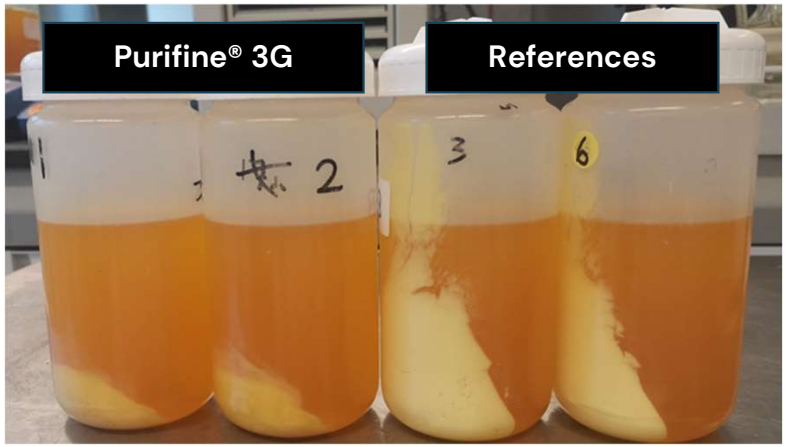
Disclaimer: Oil yield gain results are oil quality dependent.
The data shown is specific of a plant trial and cannot be extrapolated for other assessments.

Purifine® 3G- Up to 2.5% oil yield increase.



CAPEX needs	Benefits
• Heat exchanger to reduce temp to 55-60 °C • Static mixer in front of the reaction tank • Reaction tank with 2 hours of retention time	• Neutral oil-yield increase: Up to 2.5%* • FFA increase: 0.1-0.3% • P level no change observed vs water degumming • Metal level no change observed vs water degumming

Less gum volume = more oil released



Process parameters:

- Temperature required: **55-60C**
- pH required: **Neutral** (caustic optional)
- Dosage: **150-200 ppm**
- Retention time: **2 hours**

* Oil quality dependent

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Gross numbers after Purifine® 3G plant trial

Brazilian Soybeans

+2.0%

Extra oil yield gain by using Purifine® 3G or in other words **22.4 kg/ton of extra oil**

+2.7 M EUR

Annual revenue

Disclaimer: Oil yield gain results are oil quality dependent.
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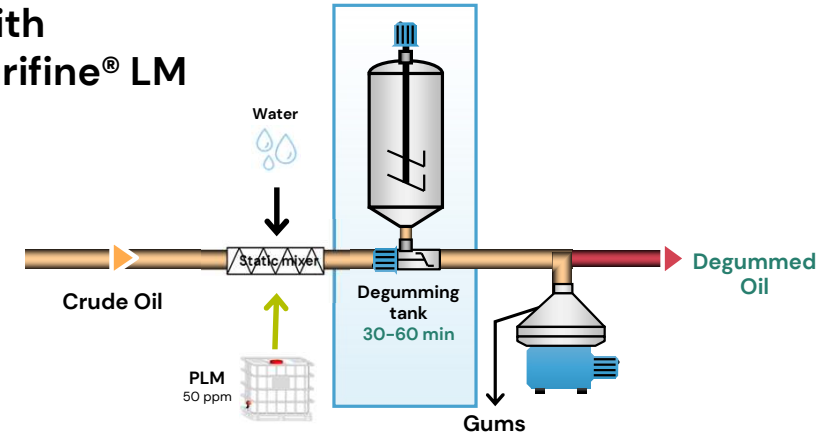
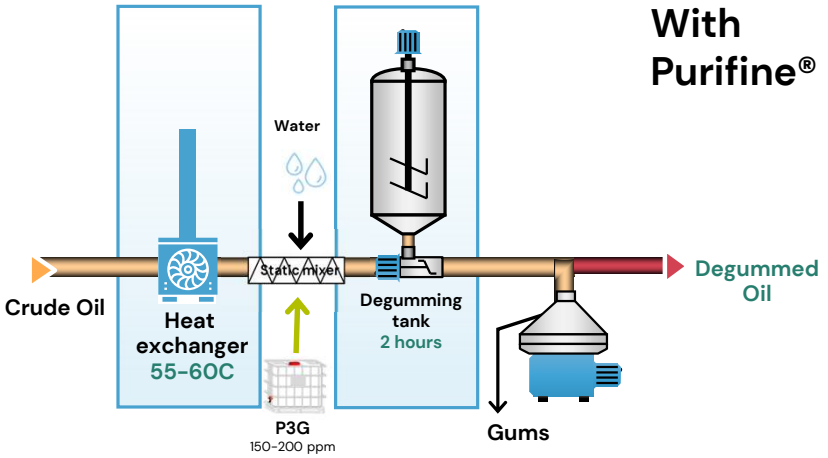
Purifine® LM & 3G- Novel routes to increase oil yields

With Purifine® LM



- Fast adoption
- No Capex
- Up to 1% yield increase

With Purifine® 3G



- Capex to maximize oil yield output
- Up to 2.5% yield increase
- Industry track record performance

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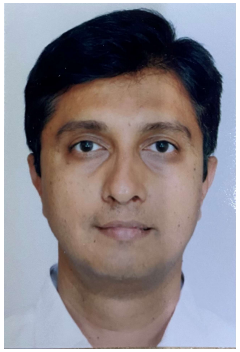
We are here to help you to increase your oil yield by adopting enzymatic degumming. We are open to discuss your process and oil to get on board with this technology.

Jorge Moreno
Product Application Expert &
Technical Service Manager EMEA



Vinay Inamdar
Senior Account Manager

We bring progress to life

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