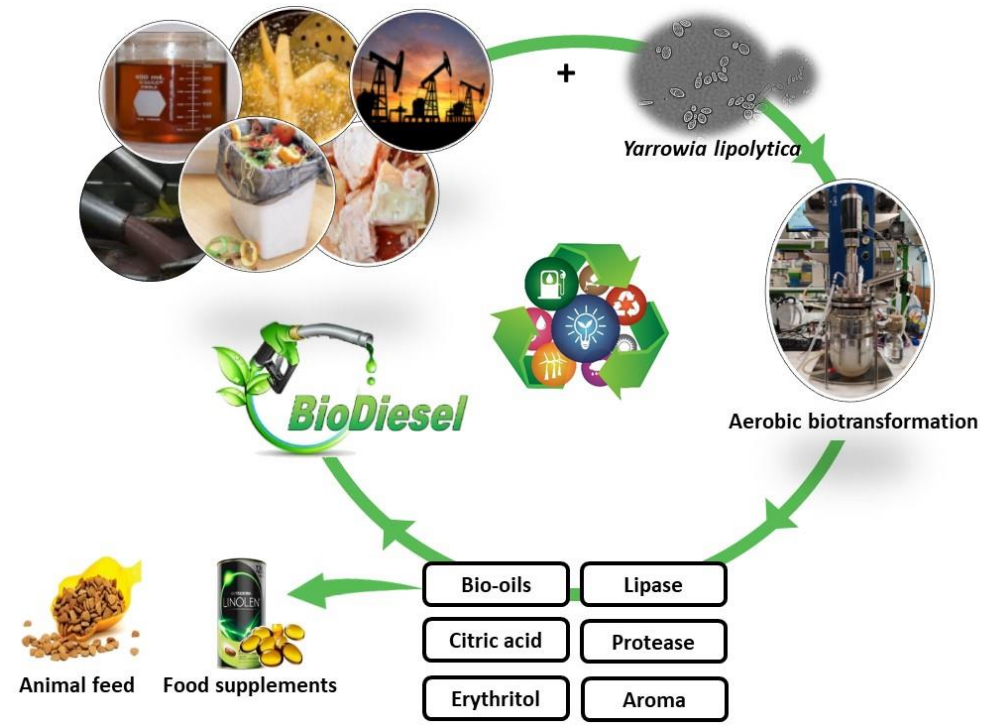


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# Sustainable bioprocesses based on *Yarrowia lipolytica*



**Marlene Lopes**

# Main features of *Yarrowia lipolytica*

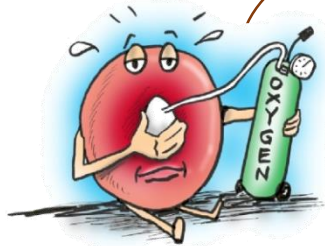
Species name:  
ability to  
hydrolyse lipids

Non-pathogenic  
with GRAS  
status

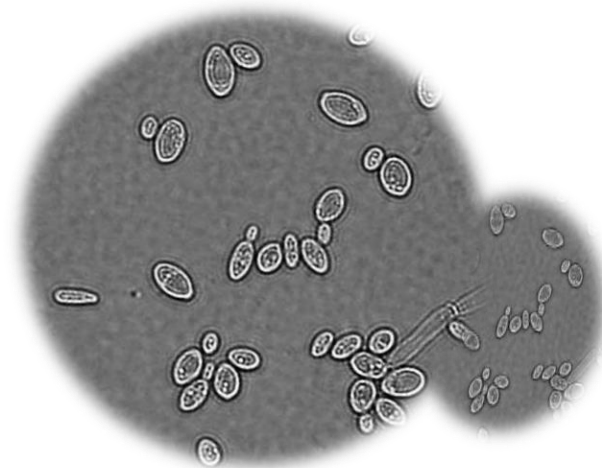
Oleaginous  
yeast

Yeast model for  
dimorphism  
studies

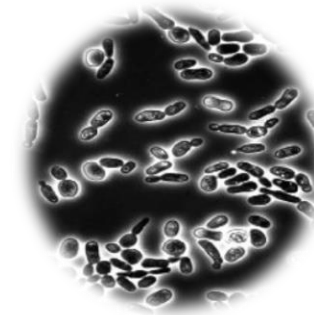
Strictly aerobic  
yeast



Isolated from dairy  
products, lipid-rich  
media, and marine or  
hypersaline  
environments



*Yarrowia lipolytica*



Yeast shape



Mycelium

CRITICAL REVIEWS IN BIOTECHNOLOGY  
2022, VOL. 42, NO. 2, 163–183  
<https://doi.org/10.1080/07388551.2021.1931016>

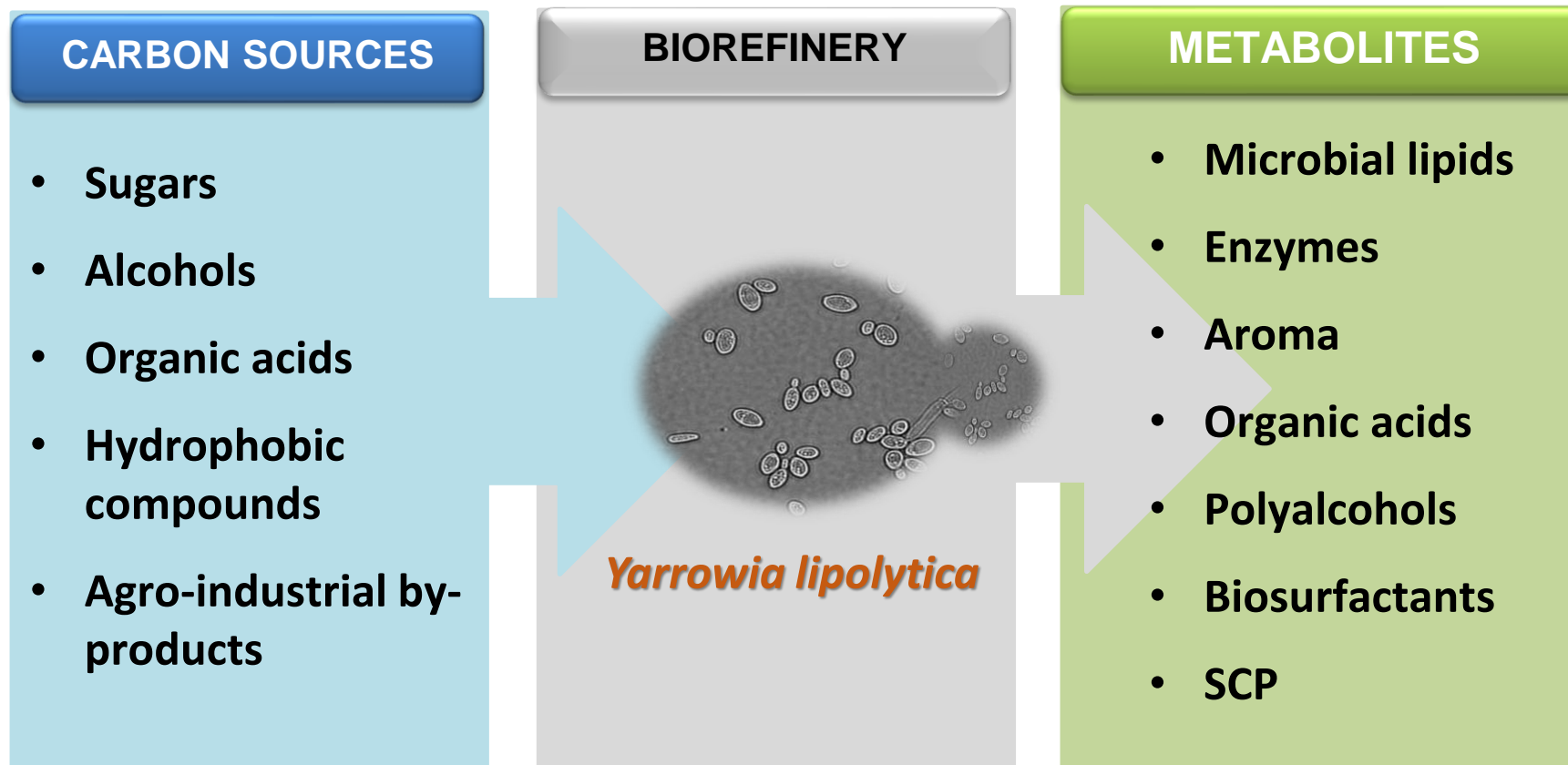
Taylor & Francis  
Taylor & Francis Group

REVIEW ARTICLE

Check for updates

*Yarrowia lipolytica* as a biorefinery platform for effluents and solid wastes valorization – challenges and opportunities

Marlene Lopes, Sílvia M. Miranda, Ana R. Costa, Ana S. Pereira and Isabel Belo



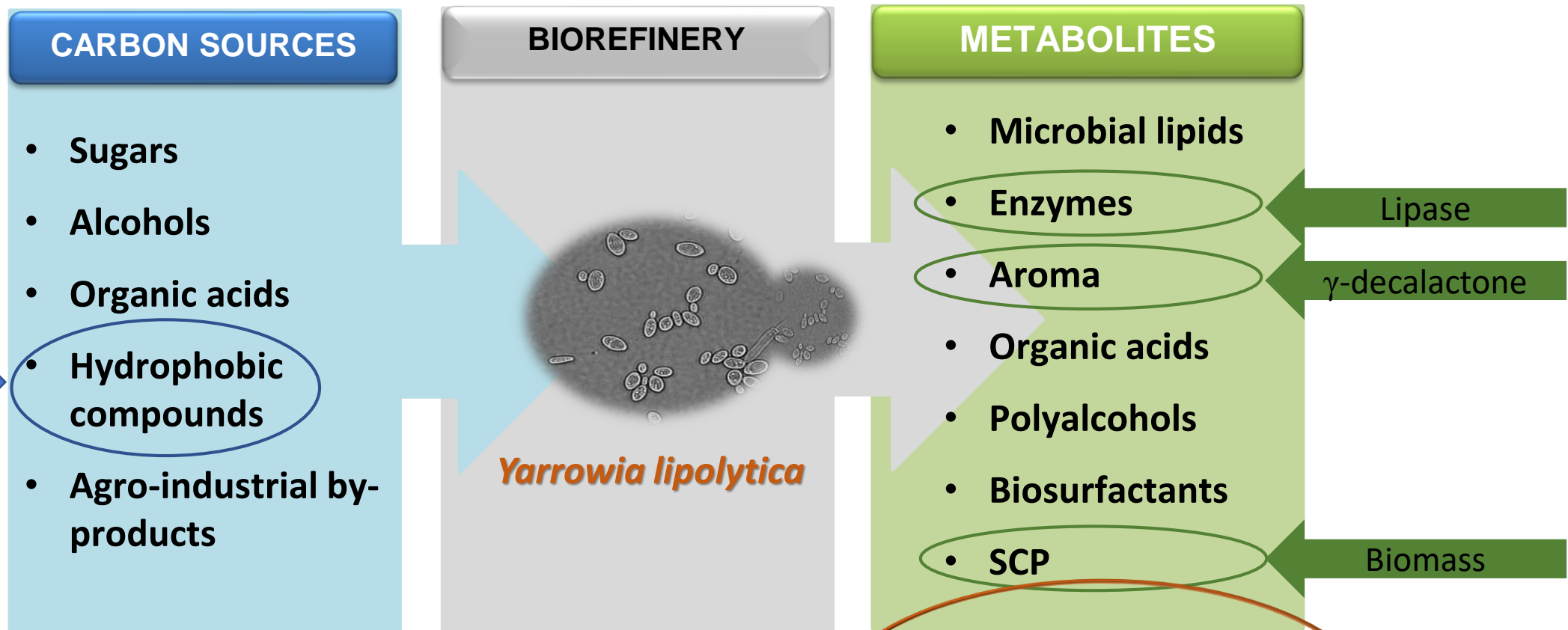
CRITICAL REVIEWS IN BIOTECHNOLOGY  
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Taylor & Francis  
Taylor & Francis Group

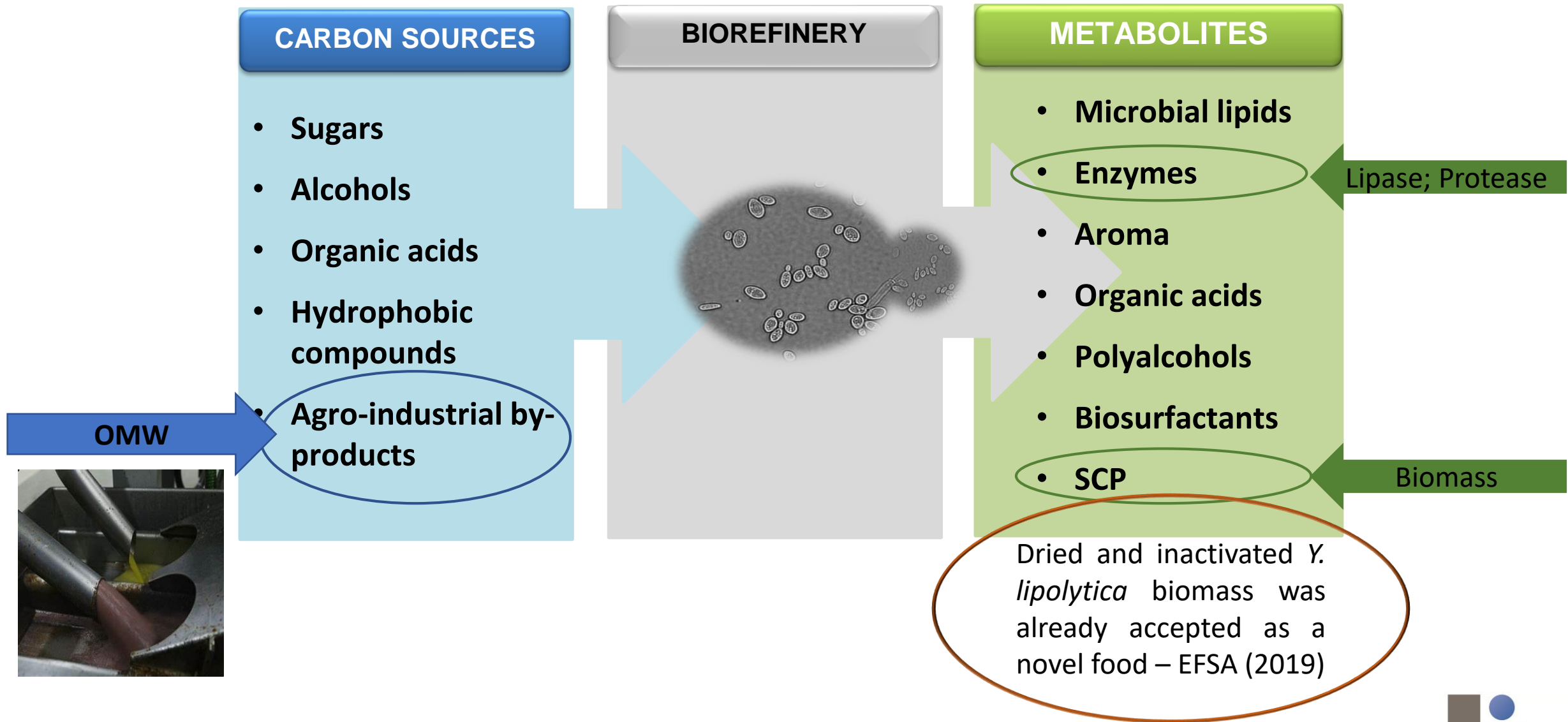
REVIEW ARTICLE [Check for updates](#)

*Yarrowia lipolytica* as a biorefinery platform for effluents and solid wastes valorization – challenges and opportunities

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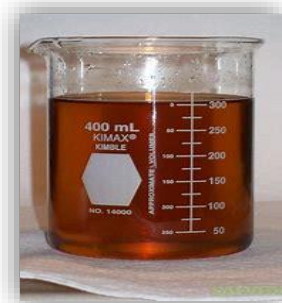
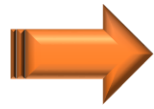
Dried and inactivated *Y. lipolytica* biomass was already accepted as a novel food – EFSA (2019)



# Metabolites production from Crude Glycerol

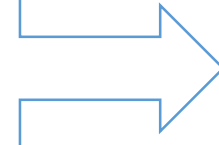


Biodiesel



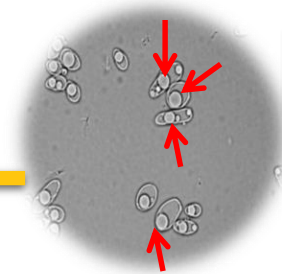
Crude glycerol

Modulation of operational conditions



Metabolites	Conditions
Citric acid	↑ C/N ratio
Erythritol	↑ Salt

Feedstock



38 %

**Microbial lipids**  
C16 to C18 fatty acids  
Similar to vegetable oils

## Main advantages of *Y. lipolytica*

- Crude glycerol without purification and degreasing
- Consumes methanol
- No inhibition of impurities and high glycerol concentration ( $40 \text{ g}\cdot\text{L}^{-1}$ )

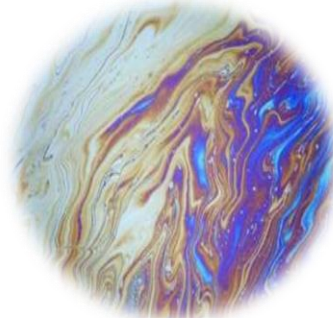
# Metabolites production from oily by-products



Animal Fat (Lard)

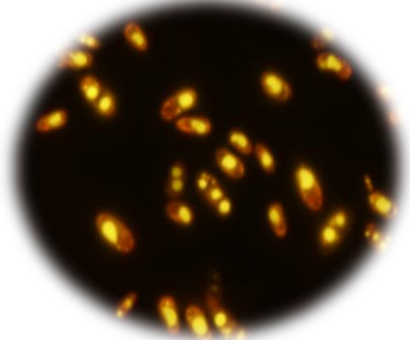


Waste cooking oils



Hydrocarbon-rich effluents

## Microbial lipids



Rich in MUFA and PUFA <sup>3</sup> <sup>6</sup>



Animal feed



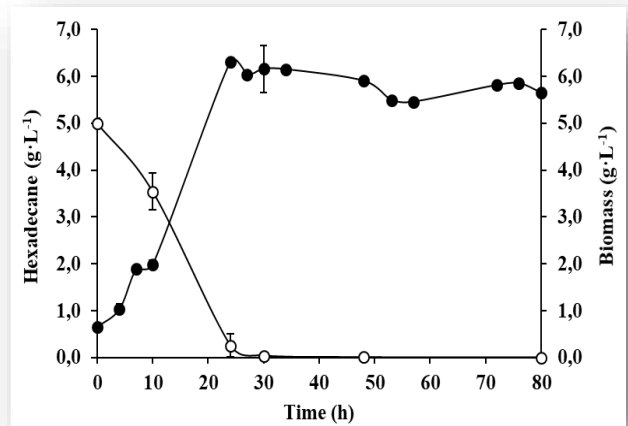
Food supplements



Cocoa butter

## Other metabolites

- Lipase
- Citric acid



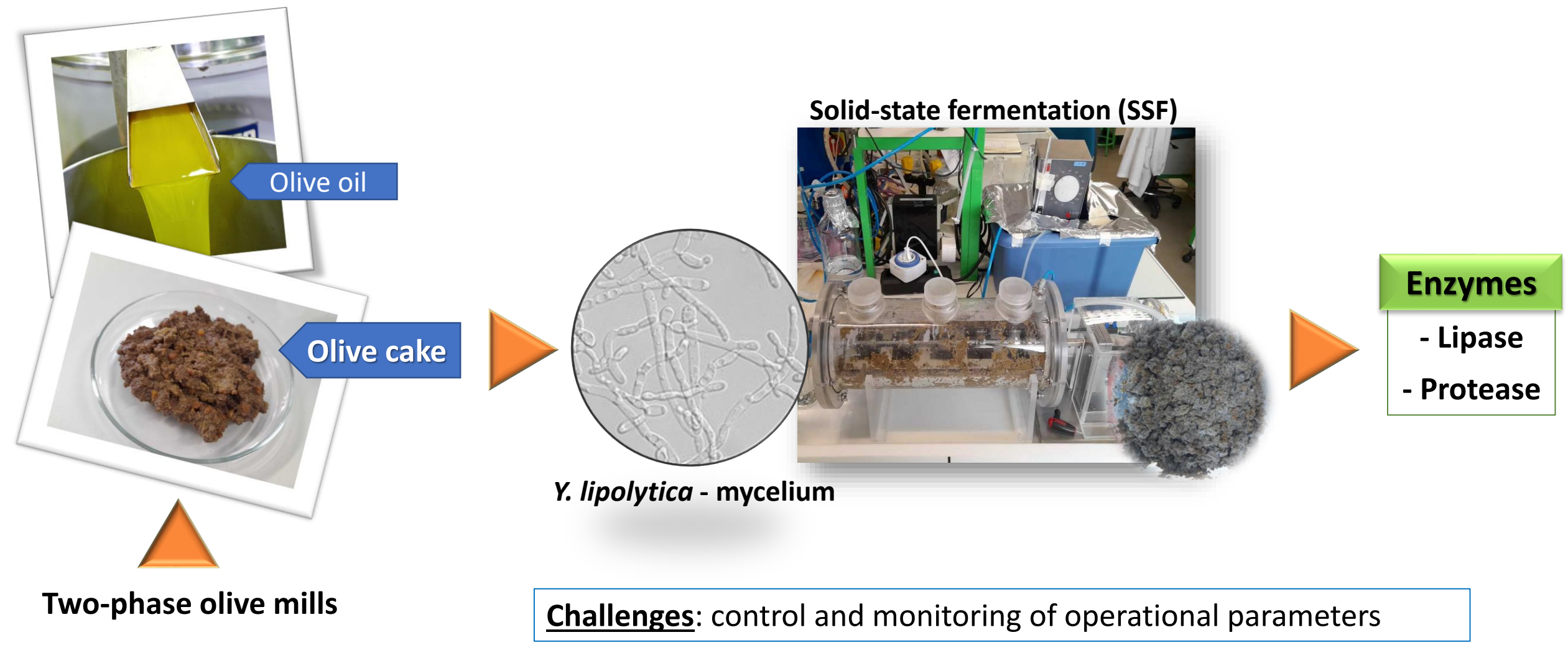
Consumption of 5 g·L<sup>-1</sup> hexadecane in 24 h



C16-C18 fatty acids



Biodiesel



Two-phase olive mills

Olive oil

Olive cake

Solid-state fermentation (SSF)

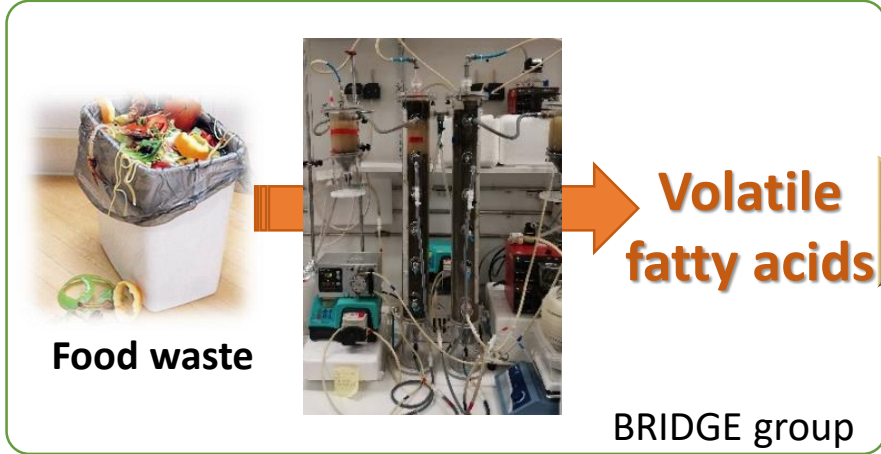
*Y. lipolytica* - mycelium

Enzymes  
- Lipase  
- Protease

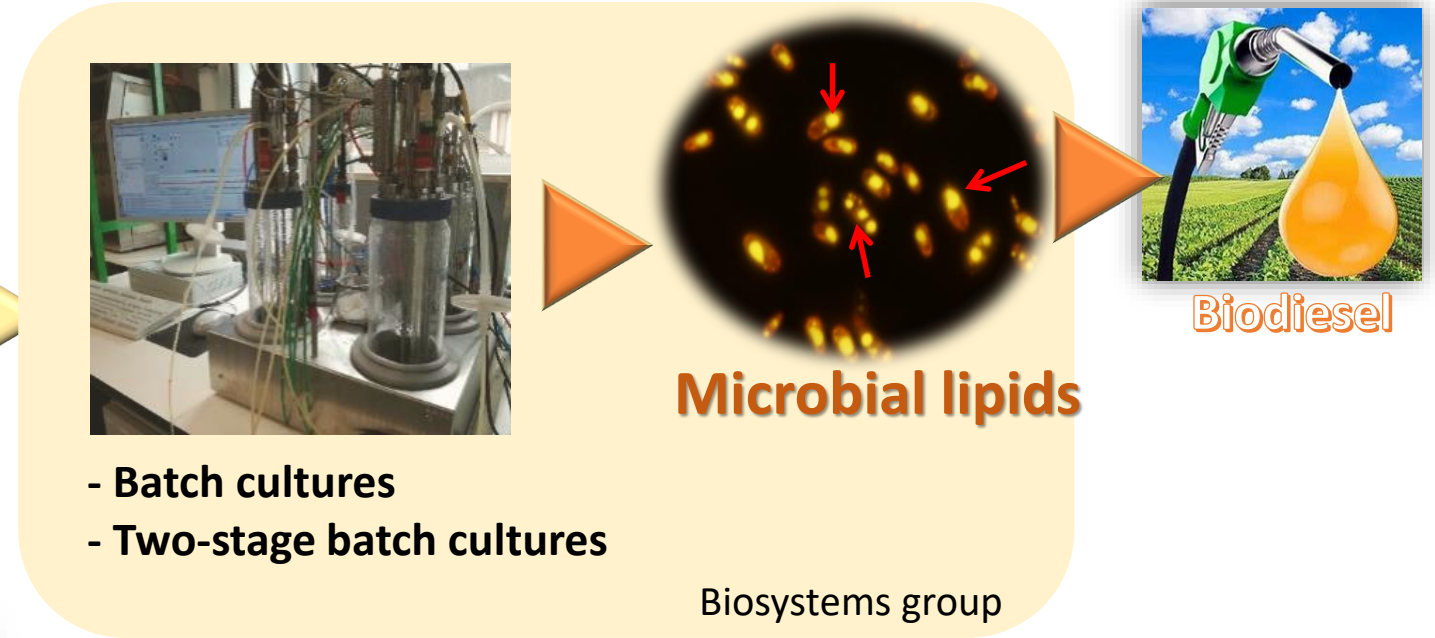
Challenges: control and monitoring of operational parameters



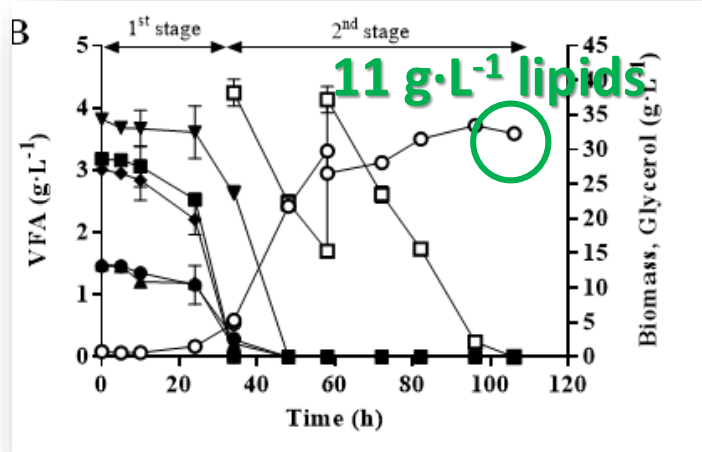
## Anaerobic fermentation



## Aerobic production of microbial oils



- Batch cultures
- Two-stage batch cultures



Two-stage batch culture

- *Y. lipolytica* consumes high VFA concentrations (18 g·L<sup>-1</sup>) in 2 days
- No inhibition of cell growth by the high salinity of VFA-fermented medium

# Metabolites production from Lignocellulosic biomass

## Lignocellulosic biomass

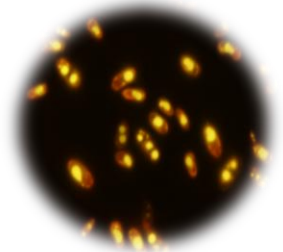


- Olive tree pruning
- Eucalyptus bark

## Pre-treatments

- Fermentable sugars
- **Possible inhibitors:** acetic acid, furfural, 5-HMF, formic acid, phenolic compounds

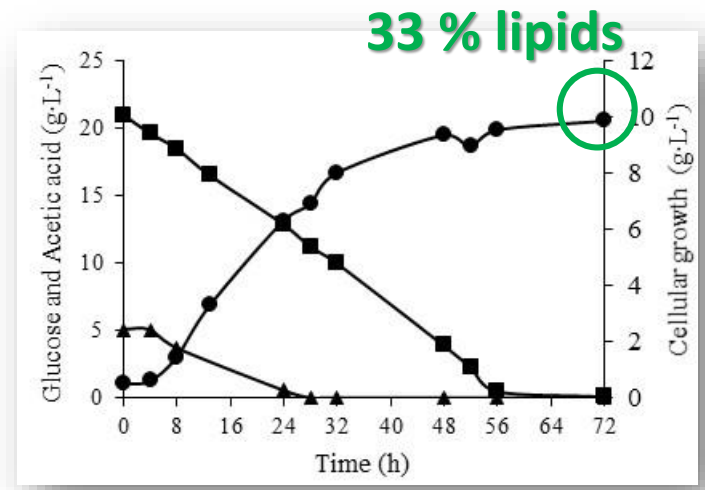
## Metabolites



**Microbial lipids**  
C14 to C18 fatty acids



- Enzymes
- Organic acids

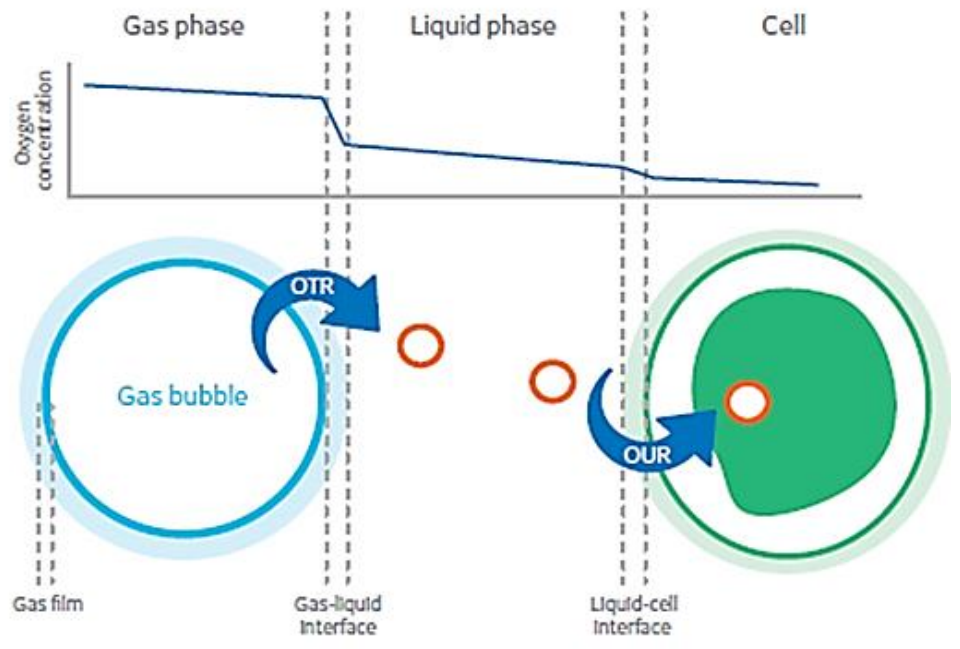
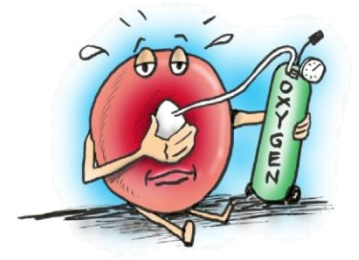


Synthetic medium

- *Y. lipolytica* W29 was not inhibited by the compounds formed during pre-treatments
- Complete consumption of glucose (58 h) and acetic acid (24 h)

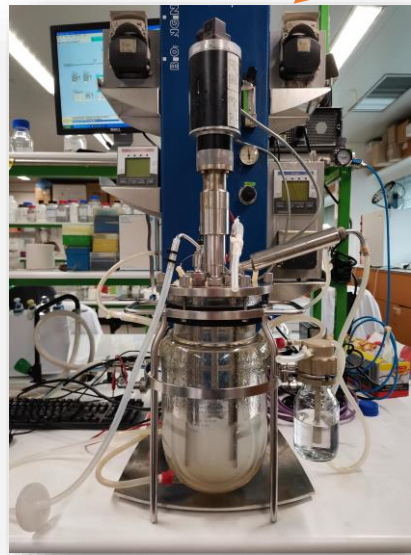


# Oxygen transfer rate (OTR) in bioreactors



$$OTR = k_L a \cdot (C^* - C_L)$$

↑ OTR ↑ Productivity



Stirred-tank

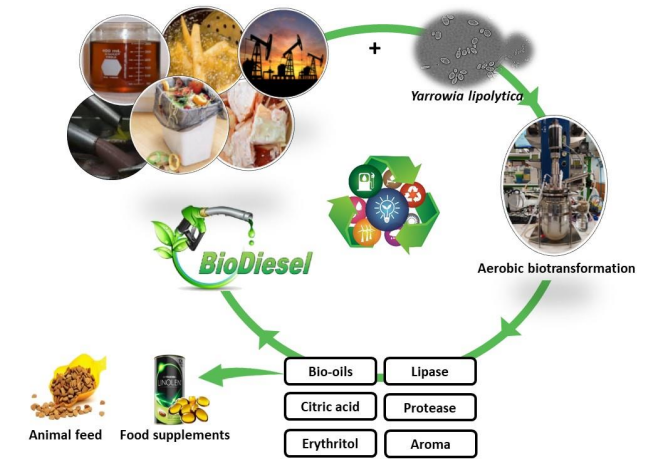


Air-lift



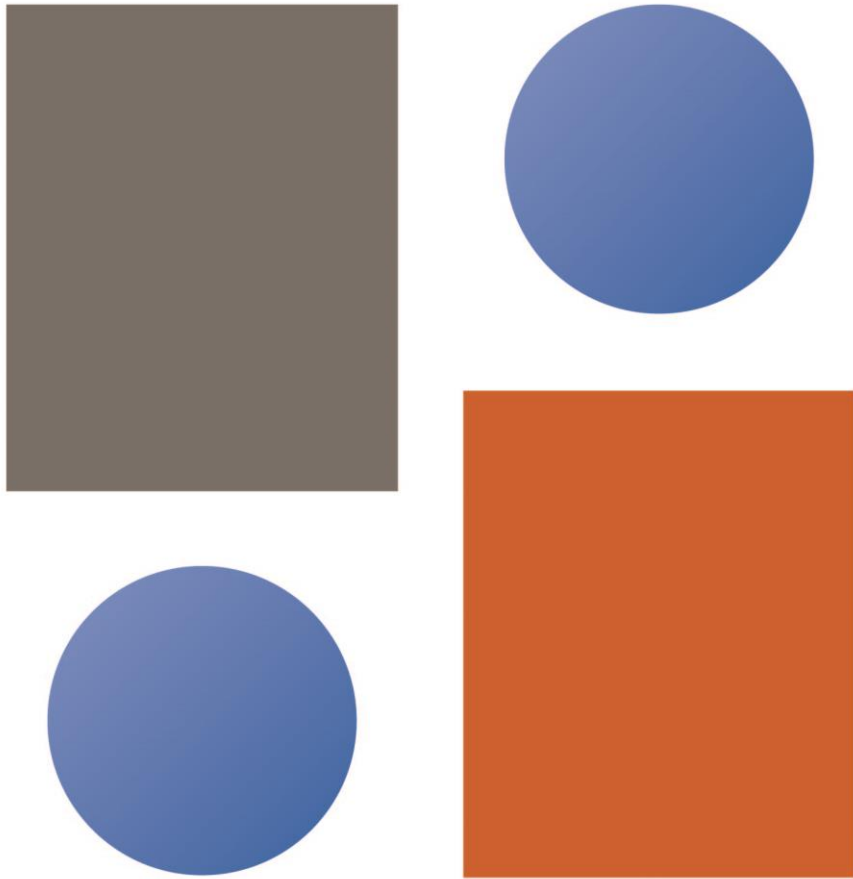
Pressurized

# Sustainable bioprocesses based on *Yarrowia lipolytica*



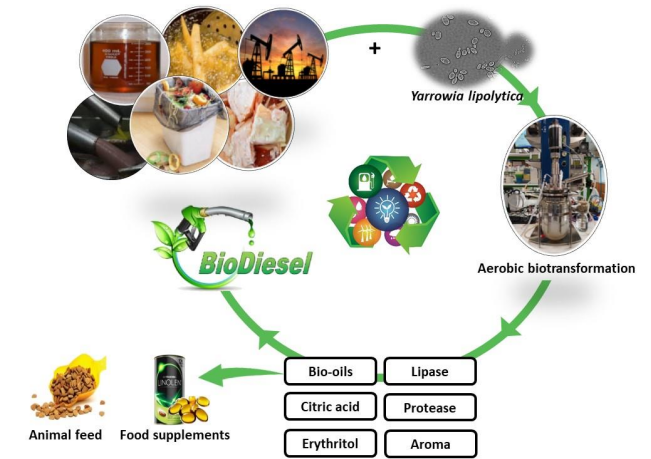
## Potential for innovation and collaboration

- *Online measurement of metabolites, especially intracellular lipids*



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# Sustainable bioprocesses based on *Yarrowia lipolytica*



*Thank you for your attention!*

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