



From yeast lipids to biodiesel:

***Rhodotorula graminis* Lipids Biosynthesis from renewable carbon sources for the production of biodiesel**

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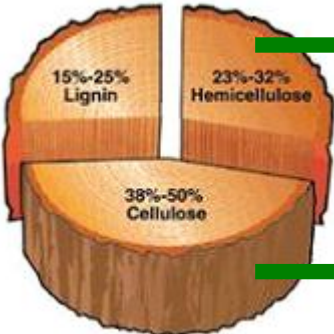
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Oleaginous yeasts fermentation

Saccharification



C5 sugar

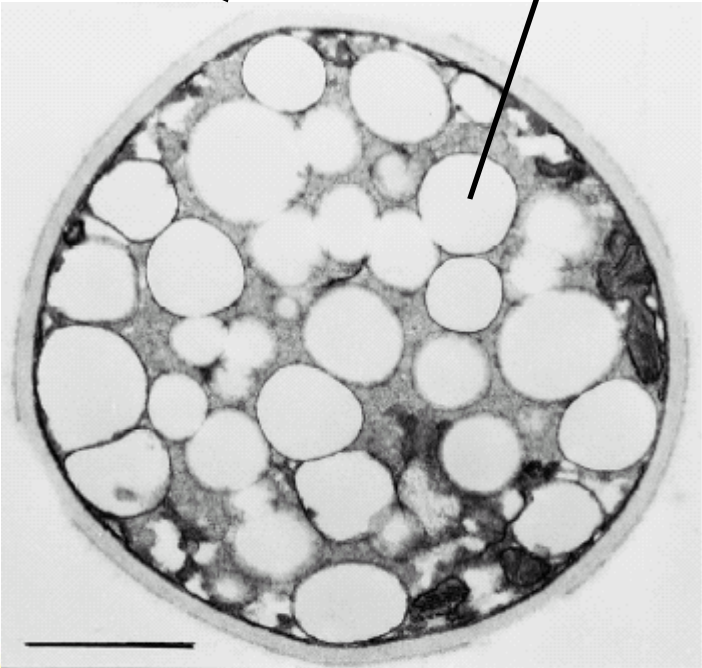
C6 sugar

Fermentation

MICROBIAL LIPIDS

Lignocellulosic biomass

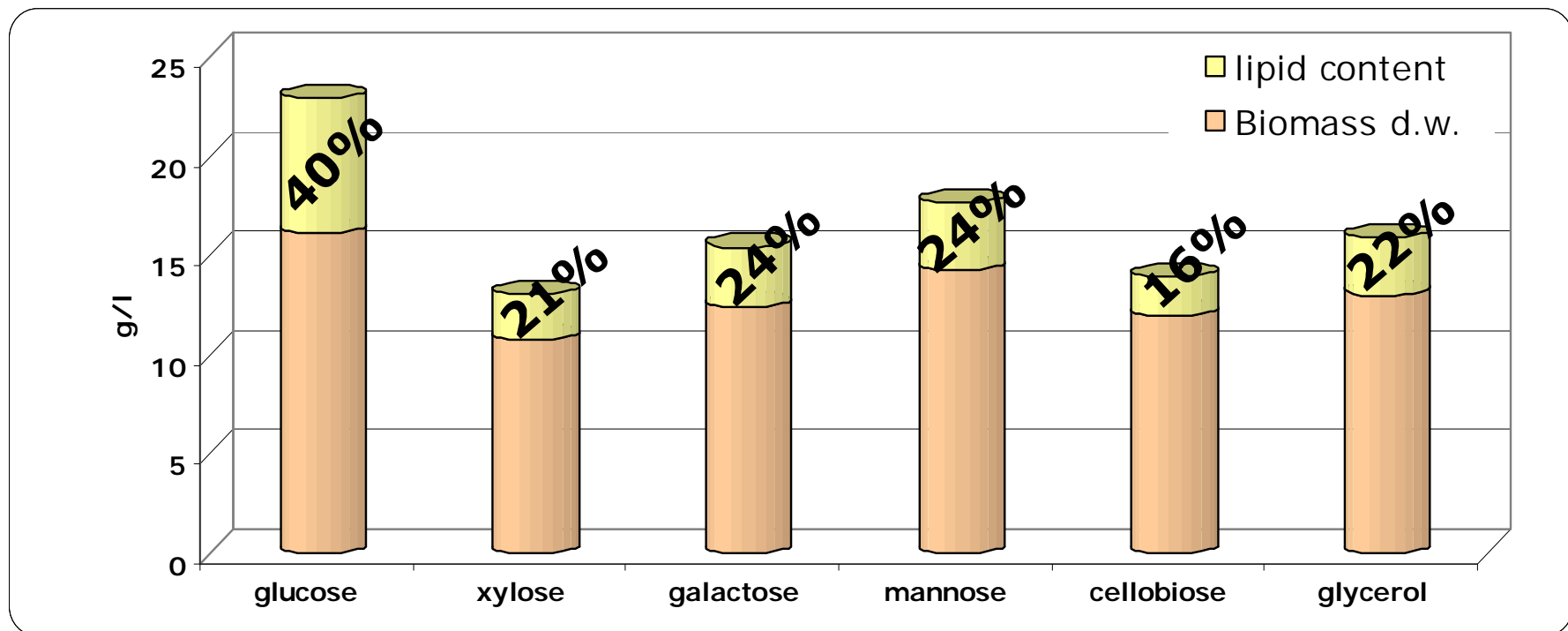
Oleaginous Yeasts
Can accumulate up 70% (dry weight) of tryglicerides inside the cell



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Why *Rhodotorula graminis* strain DBVPG 4620?

In shake flasks experiments *R. graminis* DBVPG 4620 showed a good growth on hexose and pentose sugars as well as glycerol. Lipids were accumulated both by using C6, C5 sugars and glycerol



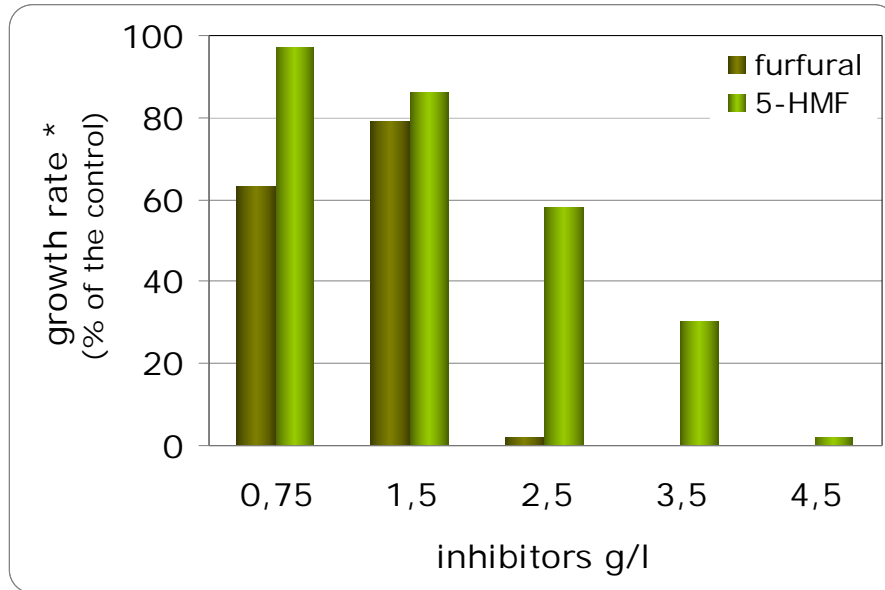
Growth on different carbon sources after 6 days in mineral medium, C-source 5%, pH 6, 30°C, 200 rpm



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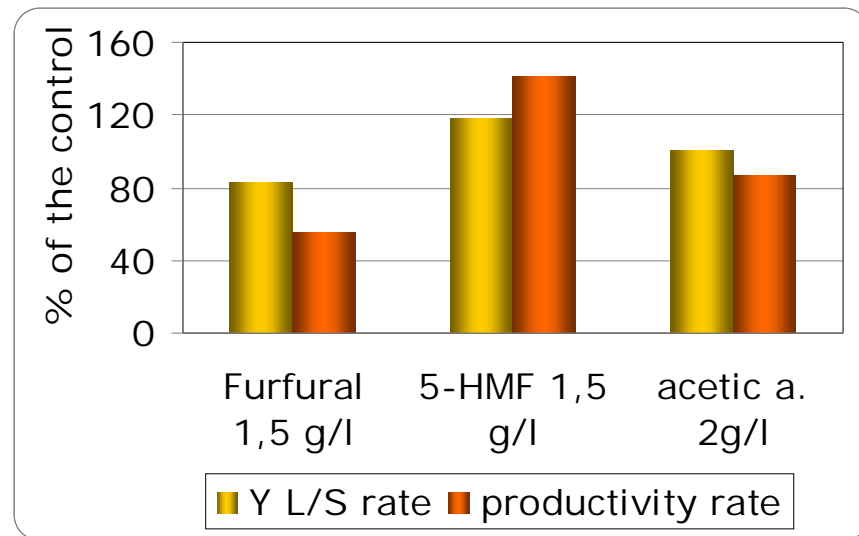
Inhibitors effect



Growth in shake flasks with furfural and 5-HMF

The inhibitory action of these compounds decreases after 90 hours of cultivation. In particular, 5-HMF seemed to exert a positive effect increasing yield and productivity

Inhibitors effects after 90 hours



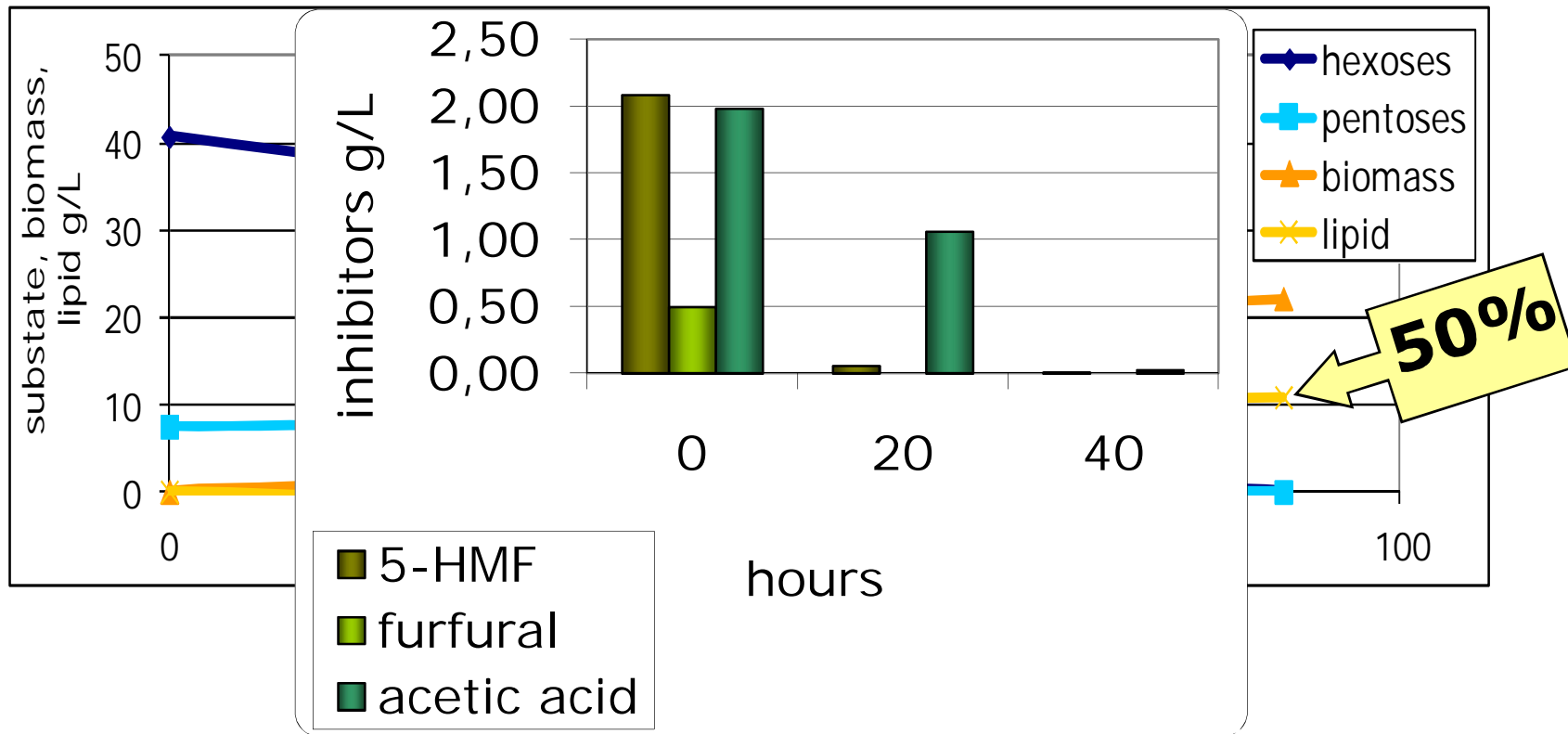
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1-liter Batch fermentation on "Synthetic hydrolysate"

- Medium composition*:

Glucose 26.2 g/L, Xylose 6 g/L, Mannose 13.1 g/L, Galactose 3.1 g/L,
 L-Arabinose 1.5 g/L + Acetic acid 2.2 g/L, Furfural 0.5 g/L, 5-HMF 2.1 g/L



* T. Modig, J. R. M. Almeida, M. F. Gorwa-Grauslund, G. Lidén: "Variability of the response of *Saccharomyces cerevisiae* strains to lignocellulose hydrolysate"; Biotechnol. Bioeng. (2008), vol. 100 (3), 423-429.



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R. graminis DBVPG 4620: Lipid composition

	saturated fatty acids		unsaturated fatty acids			
	16:0	18:0	18:1	18:2	18:3	22:1
Palm oil ^[4]	36	2	50	8		
Soybean oil ^[4]	11	4	23	54	8	
Sunflower oil ^[4]	7	5	19	68		
Hi oleic rapessed oil ^[5]	4	1	60	21	13	
Hi erucic rapeseed oil ^[5]	3	1	13	14	10	51
<i>R.graminis</i> oil	13-22	4-7	40-60	15-23	2-6	

Rhodotorula oil characteristics suggest the possibility of using it to replace vegetable oils in “green diesel” synthesis. Green diesel is a renewable hydrocarbon fuel, fully compatible with current automotive engines, produced by Ecofining[®] process, developed by eni/UOP.

Table adapted from: J. Van Gerpen et al.: “Biodiesel Production Technology”, 2004, National Renewable Energy Laboratory subcontractor report NREL/SR-510-36244, available on line at: www.nrel.gov/docs/fy04osti/36244.pdf



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Thank you!

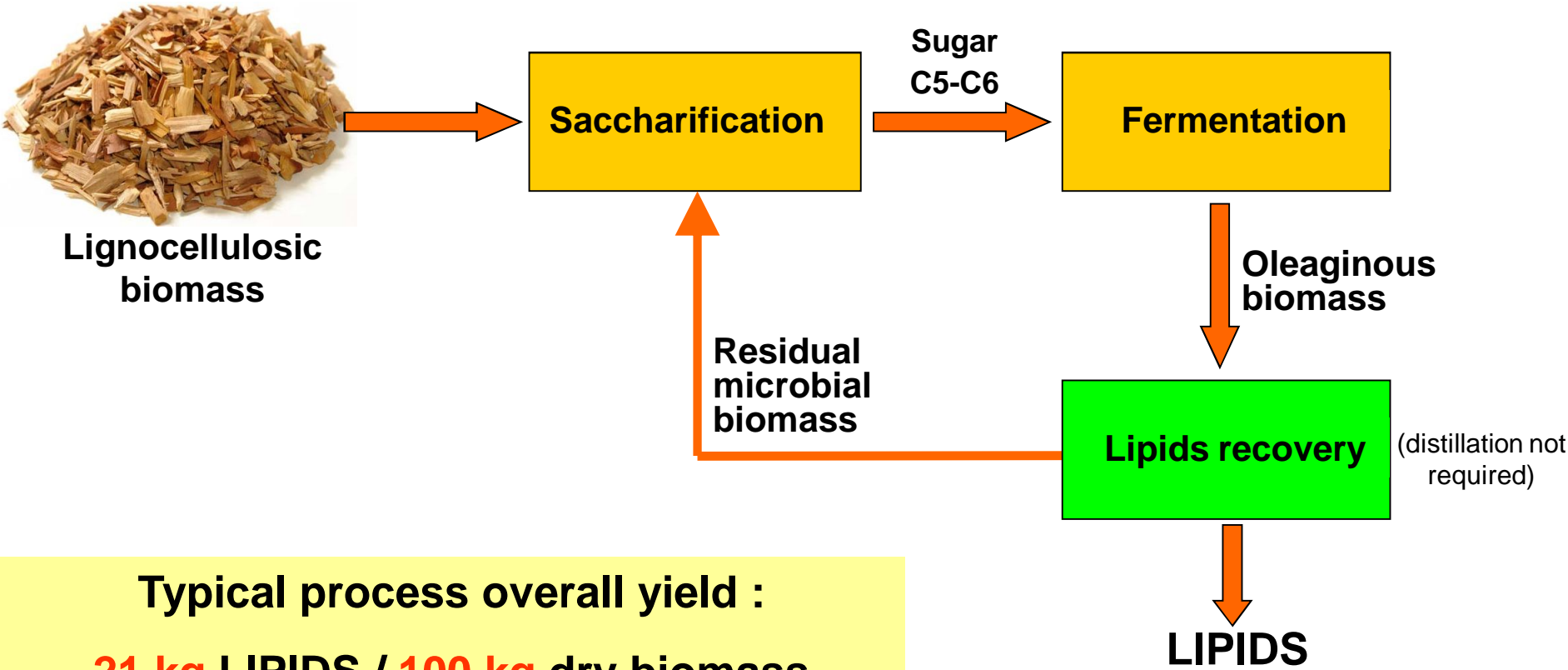
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Oleaginous yeasts fermentation



Typical process overall yield :
21 kg LIPIDS / 100 kg dry biomass

Process under development by ENI



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