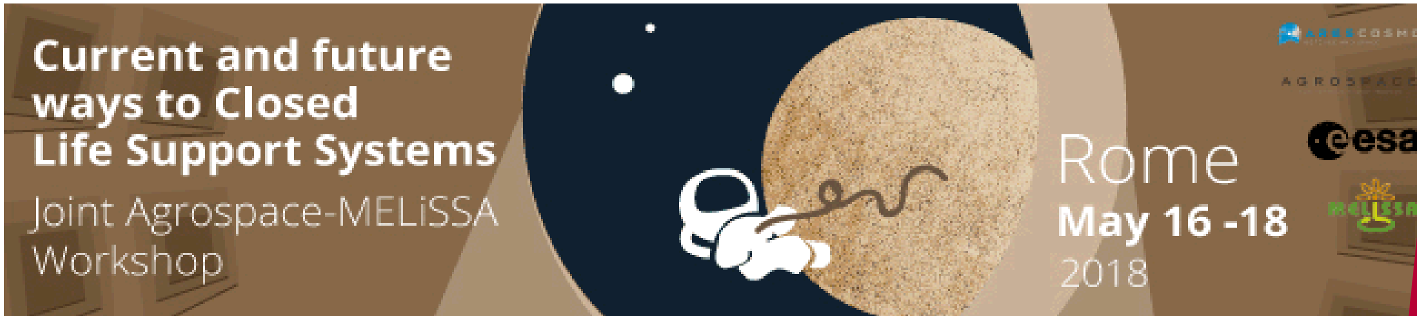


UMONS
Université de Mons

ProtMic

Polyhydroxyalkanoate production by *Rhodospirillum rubrum* S1H :

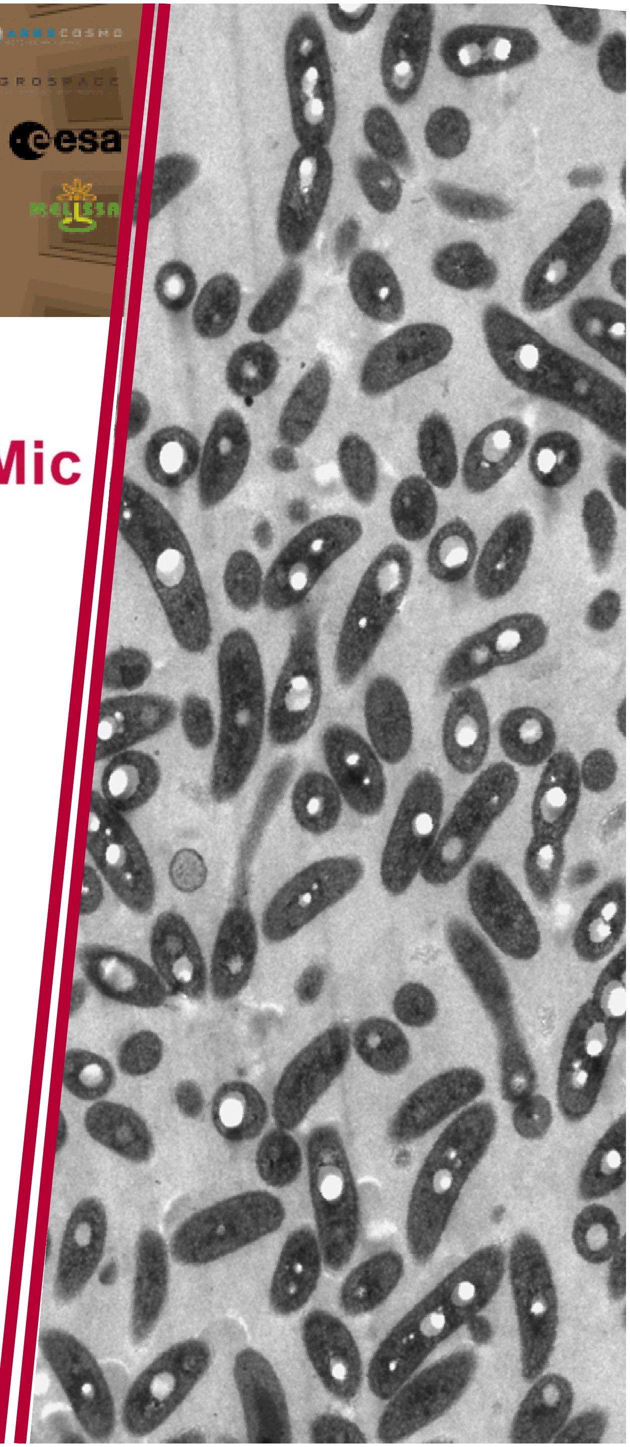
Carbon source and light intensity impact

biosciences
UMONS RESEARCH INSTITUTE
FOR BIOSCIENCES

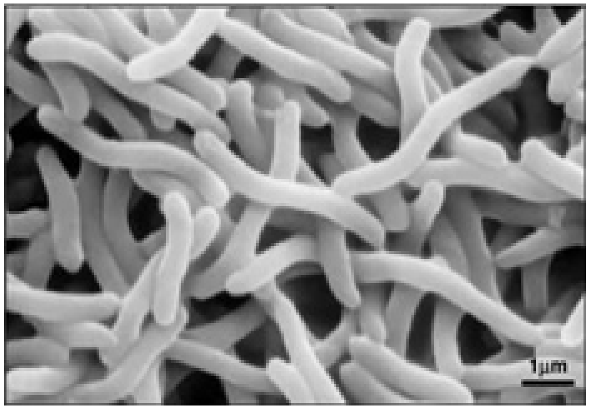
MELiSSA

fnrs
FREEDOM TO RESEARCH

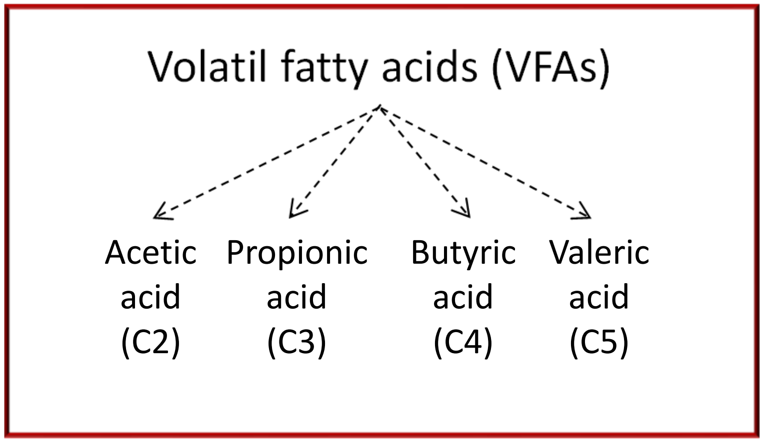
Guillaume Bayon-Vicente



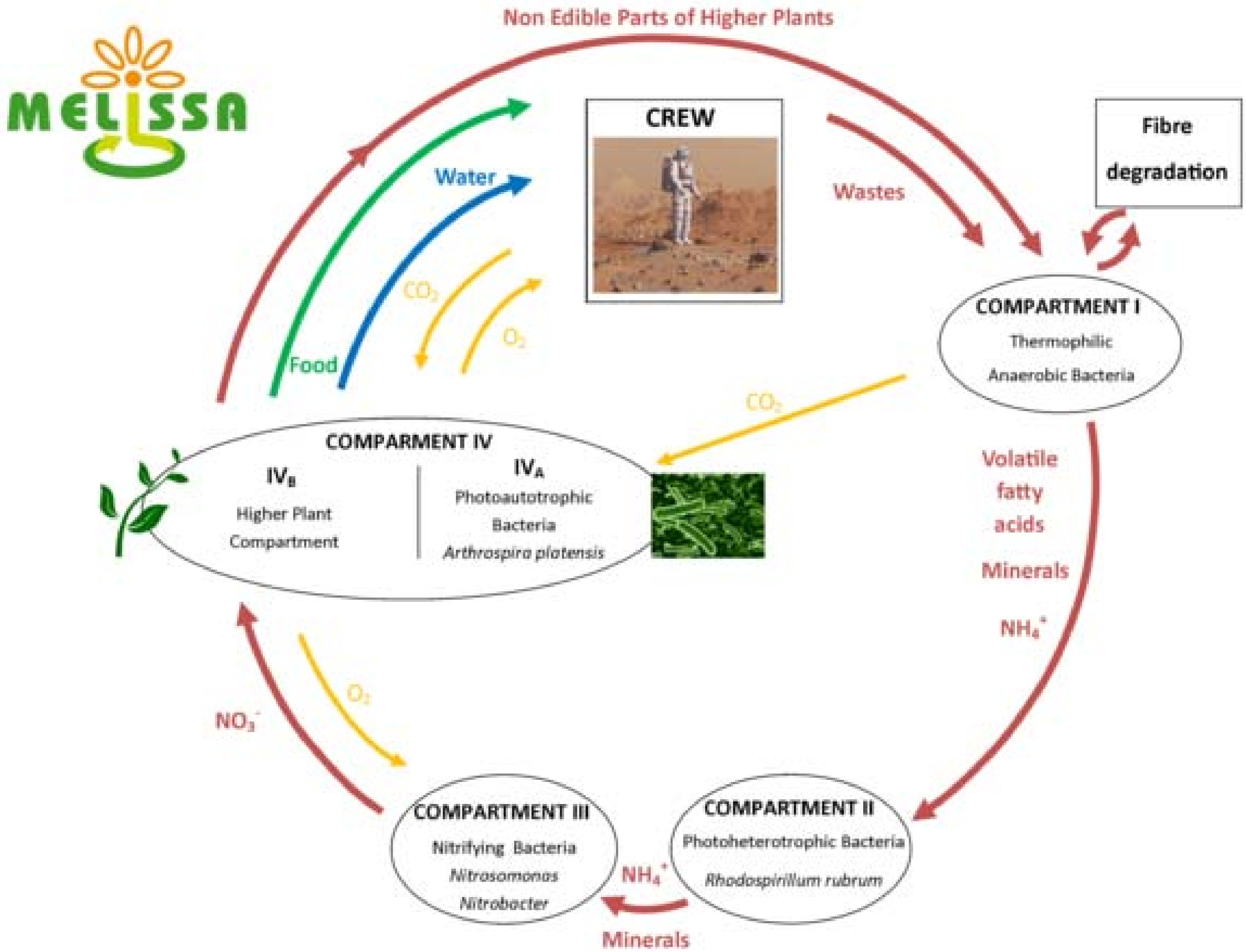
Rhodospirillum rubrum



- ✓ High metabolic versatility (chimioheterotrophy, photoautotrophy or photoheterotrophy)
- ✓ Assimilation of a wide range of carbon source

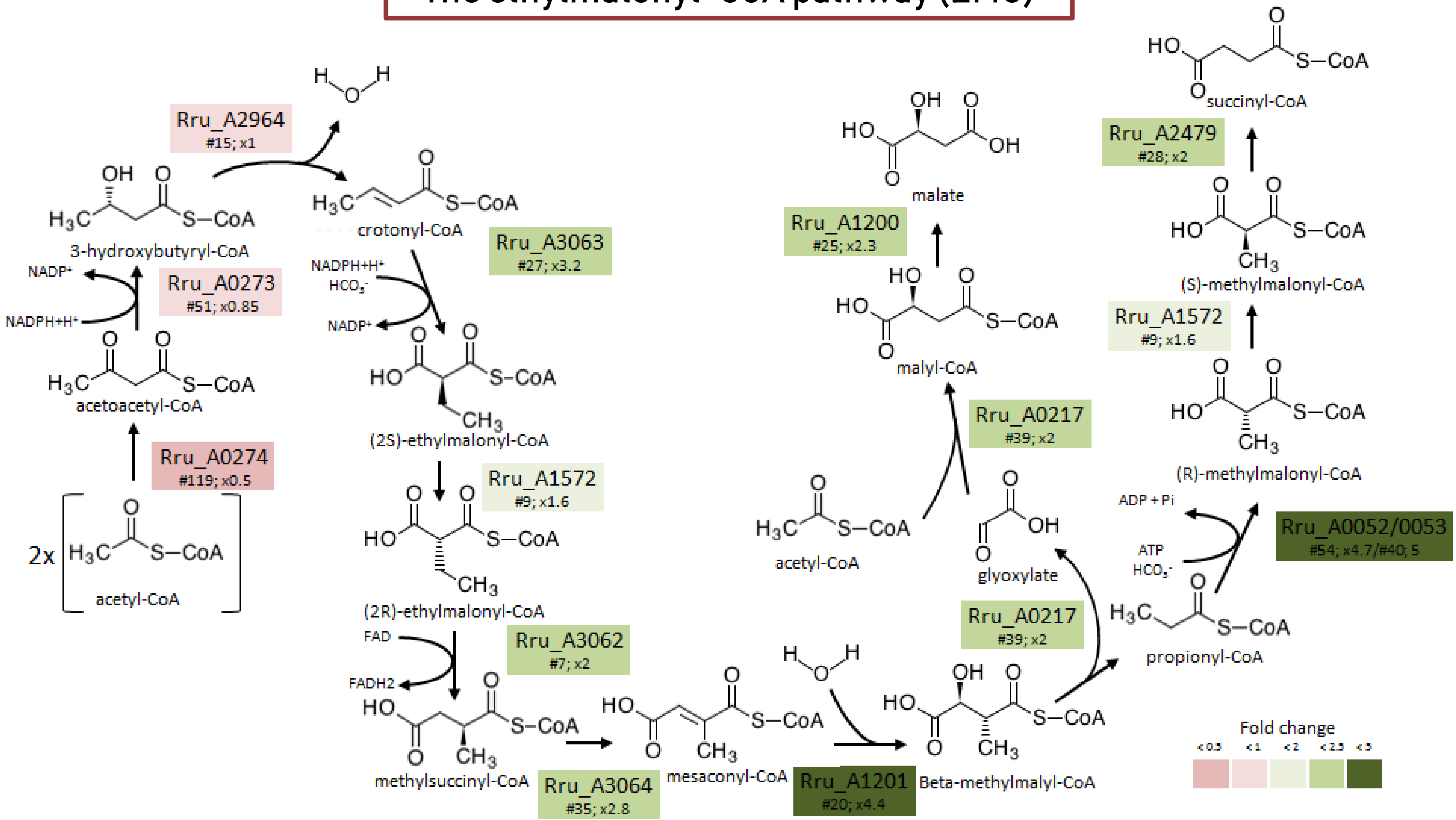


Implication in MELiSSA loop



Implication in MELiSSA loop

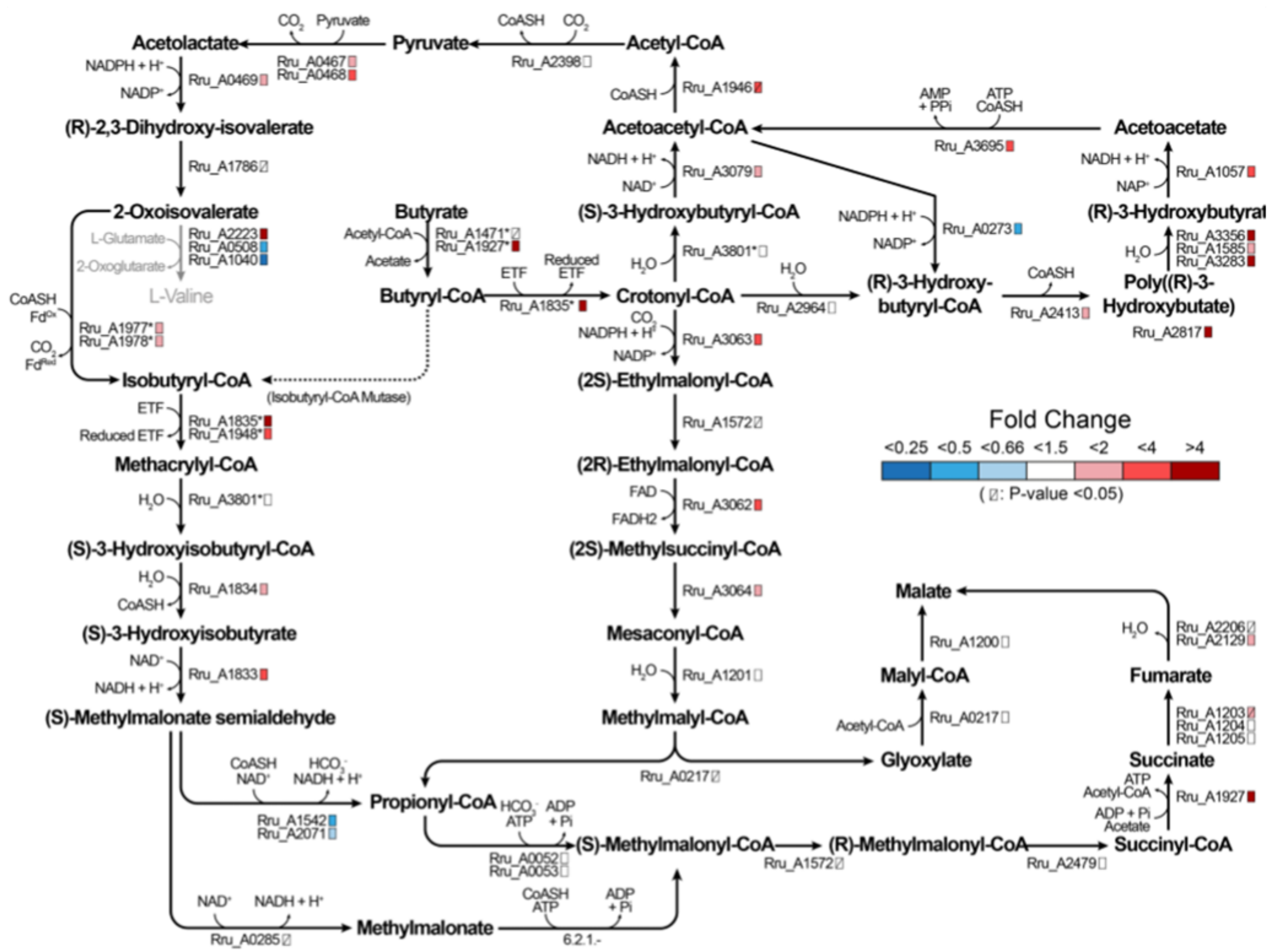
The ethylmalonyl-CoA pathway (EMC)



Leroy, B., De Meur, Q., Moulin, C., Wegria, G., & Wattiez, R. (2015). New insight into the photoheterotrophic growth of the isocytrate lyase-lacking purple bacterium *Rhodospirillum rubrum* on acetate. *Microbiology (Reading, England)*, *161*, 1061–72.

Implication in MELiSSA loop

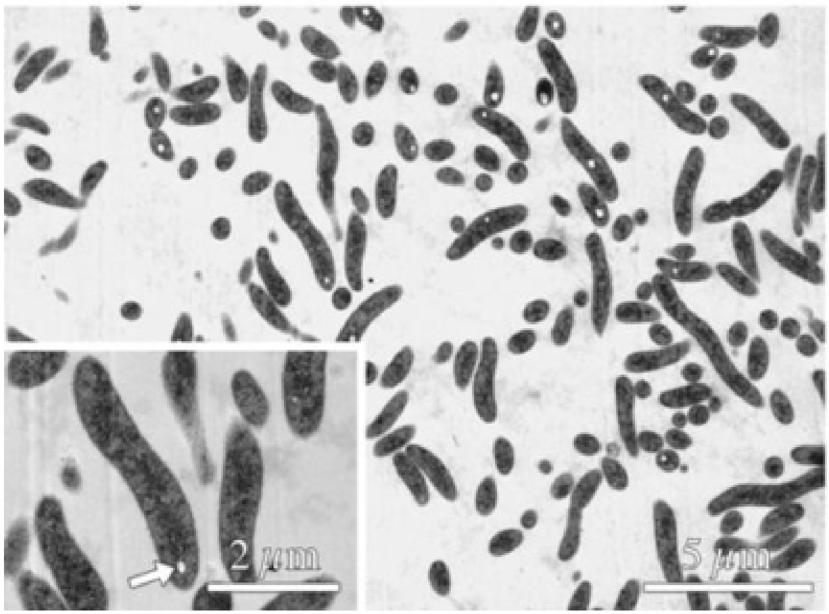
Hypothetical pathway



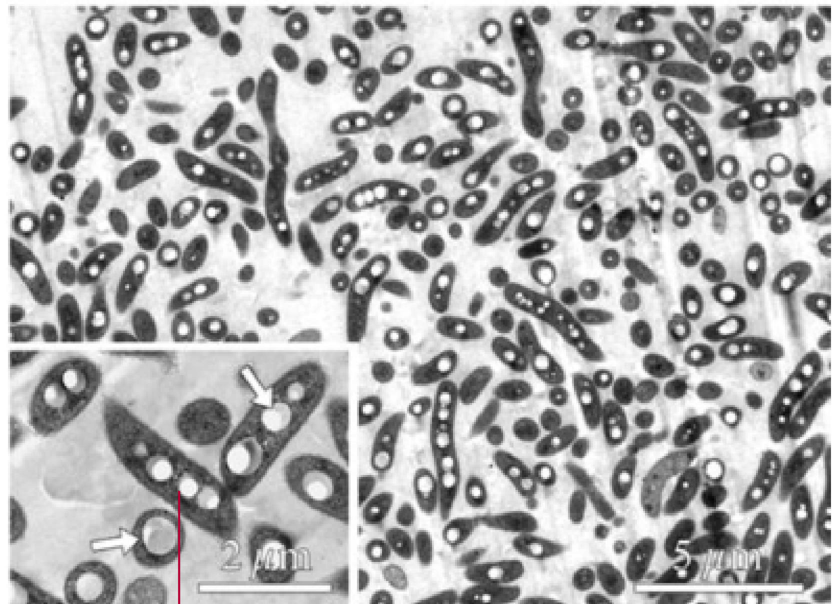
New perspectives on butyrate assimilation in *Rhodospirillum rubrum* S1H under photoheterotrophic conditions. De Meur Q., Leroy B., Wattiez R.. In preparation for publication in Microbiology.

Outcome of MELiSSA project collaboration

Succinate



Acetate

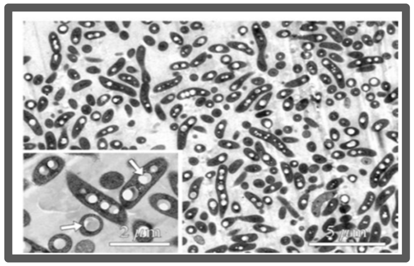


Polyhydroxyalkanoates (PHA)

Leroy, B., De Meur, Q., Moulin, C., Wegria, G., & Wattiez, R. (2015). New insight into the photoheterotrophic growth of the isocytrate lyase-lacking purple bacterium *Rhodospirillum rubrum* on acetate. *Microbiology (Reading, England)*, *161*, 1061–72.

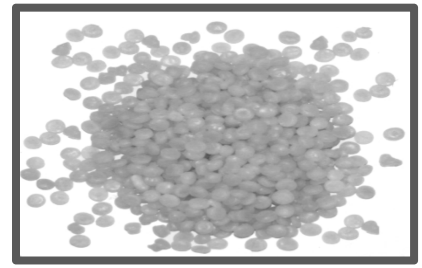
PHA a promising solution ?

Pros

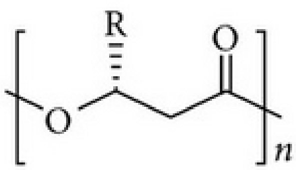


Bio-based

Biodegradable

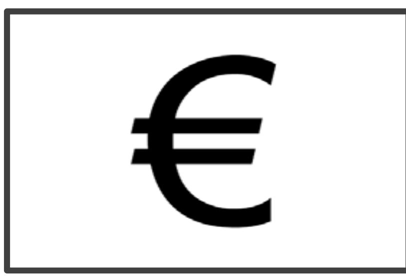


Broad range of application

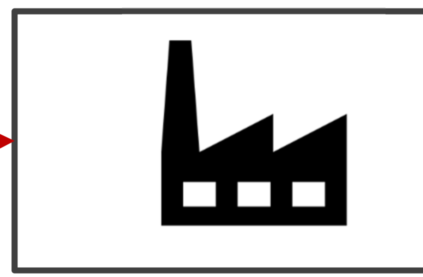


Poly(3-hydroxyalkanoates) [PHA]

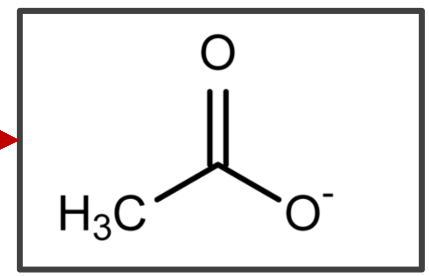
Limits



Final price

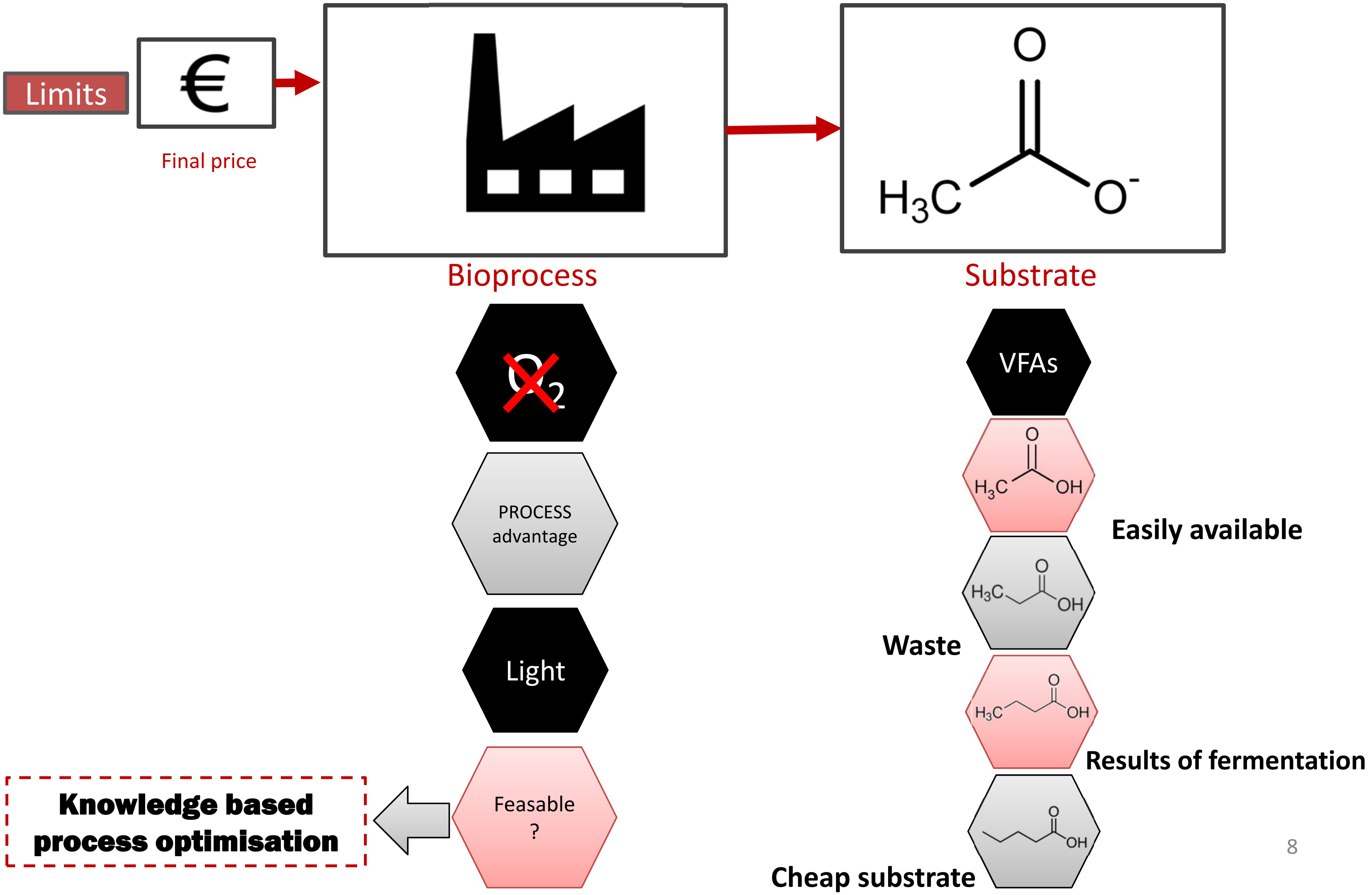


Bioprocess



Substrate

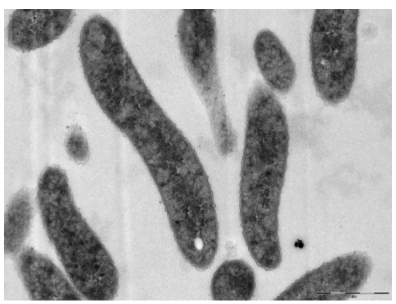
How to reduce production cost ?



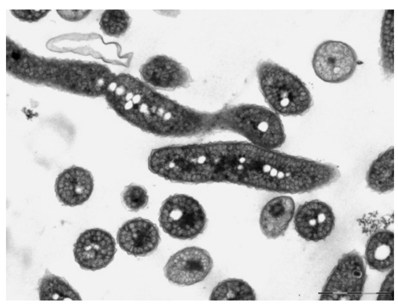
What are PHAs ?

- Accumulation inside granules
- Granules formed by phasins
- Another nutrient (N, S, P) is limiting
- Stock of energy, electron and carbon

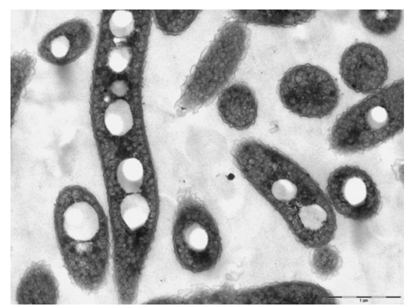
Succinic acid



Butyric acid

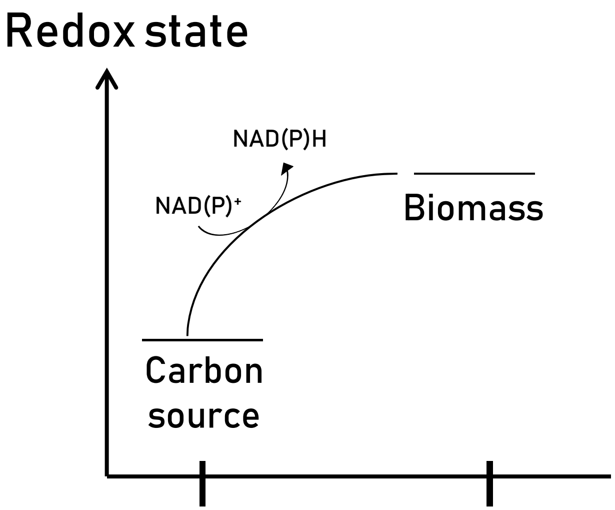


Acetic acid

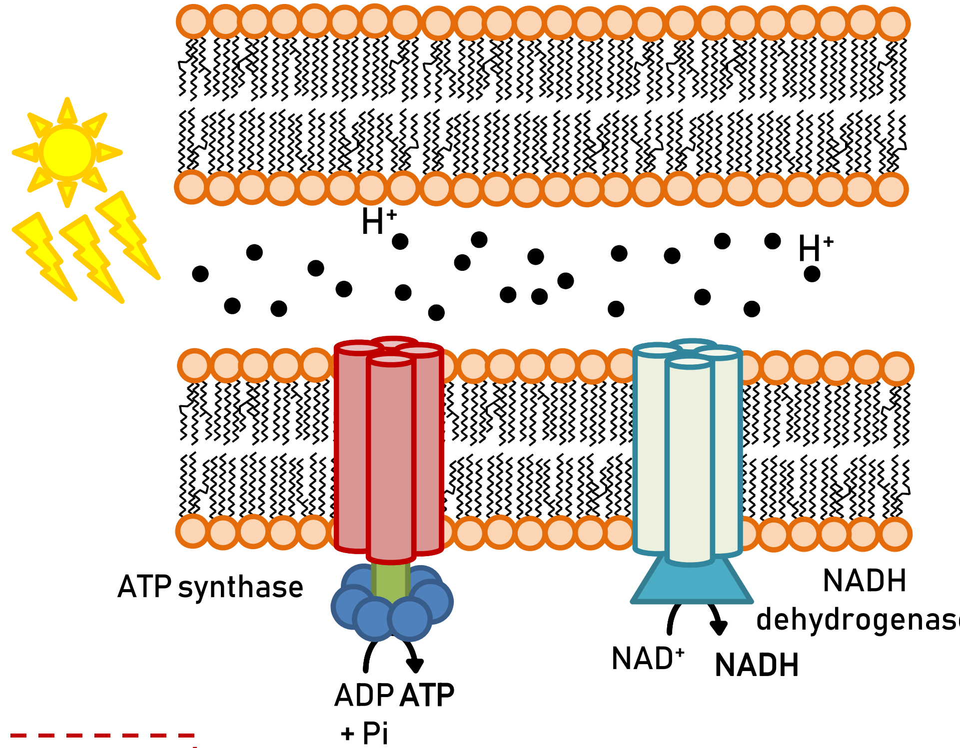


What drives the PHA accumulation ?

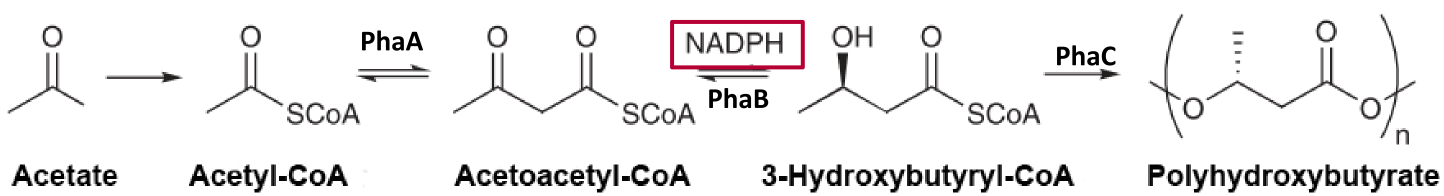
Use of reduced carbon sources



Photoreduction of NAD+

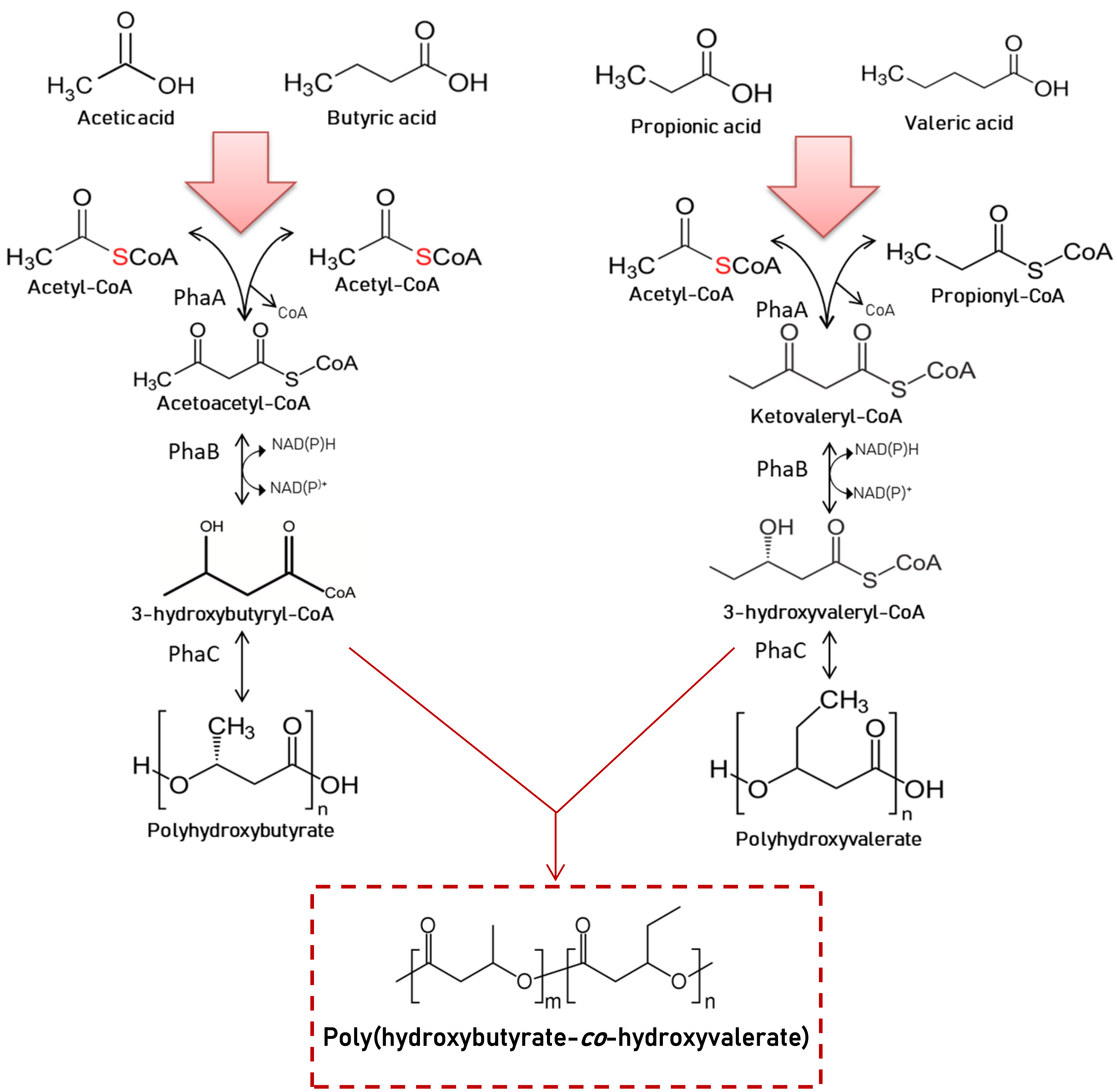


Electron sink

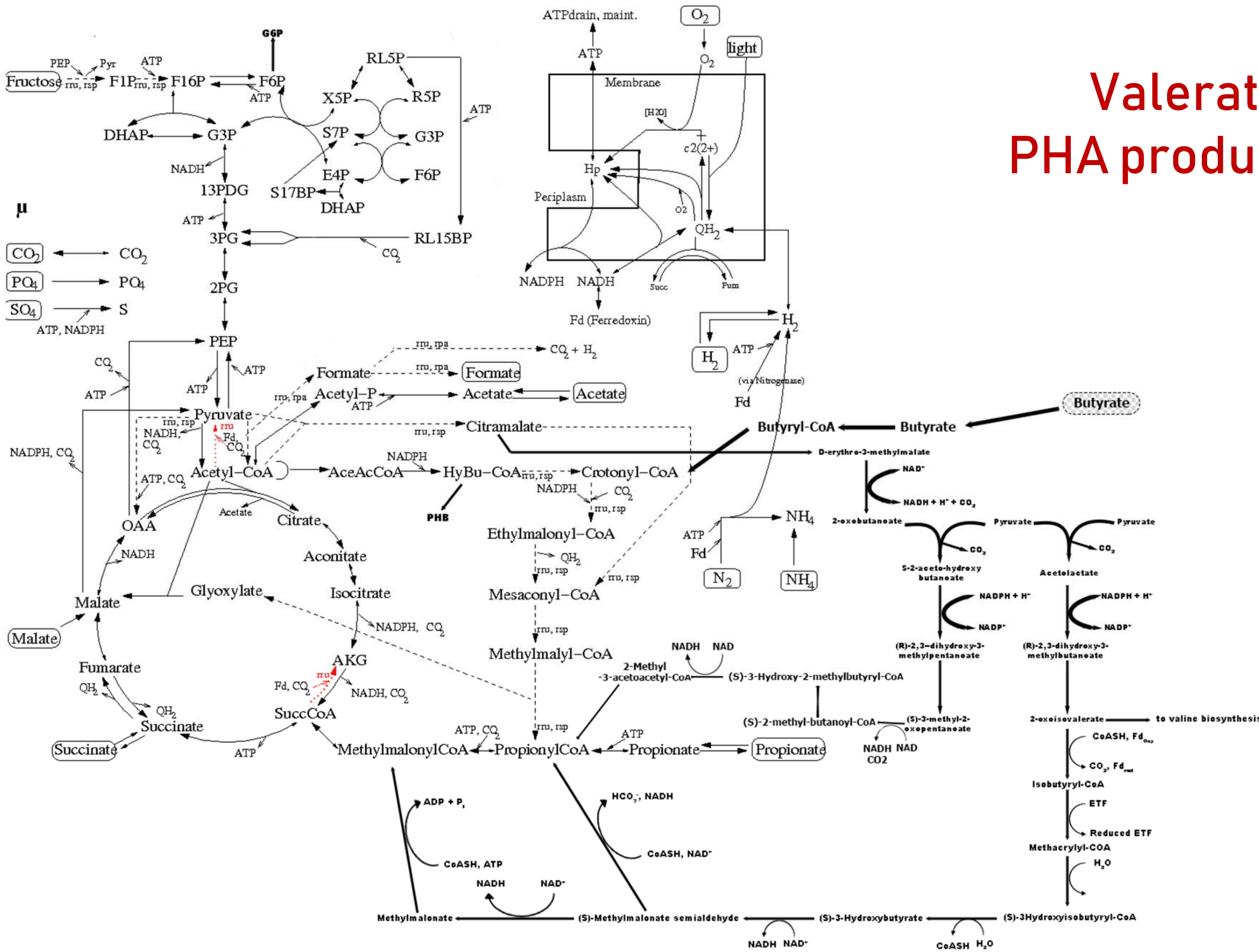


Bond-Watts, B. B., Bellerose, R. J., & Chang, M. C. Y. (2011). Enzyme mechanism as a kinetic control element for designing synthetic biofuel pathways. *Nature Chemical Biology*, *7*(april), 222–7.

What drives the PHA composition ?



Rhodospirillum rubrum metabolism

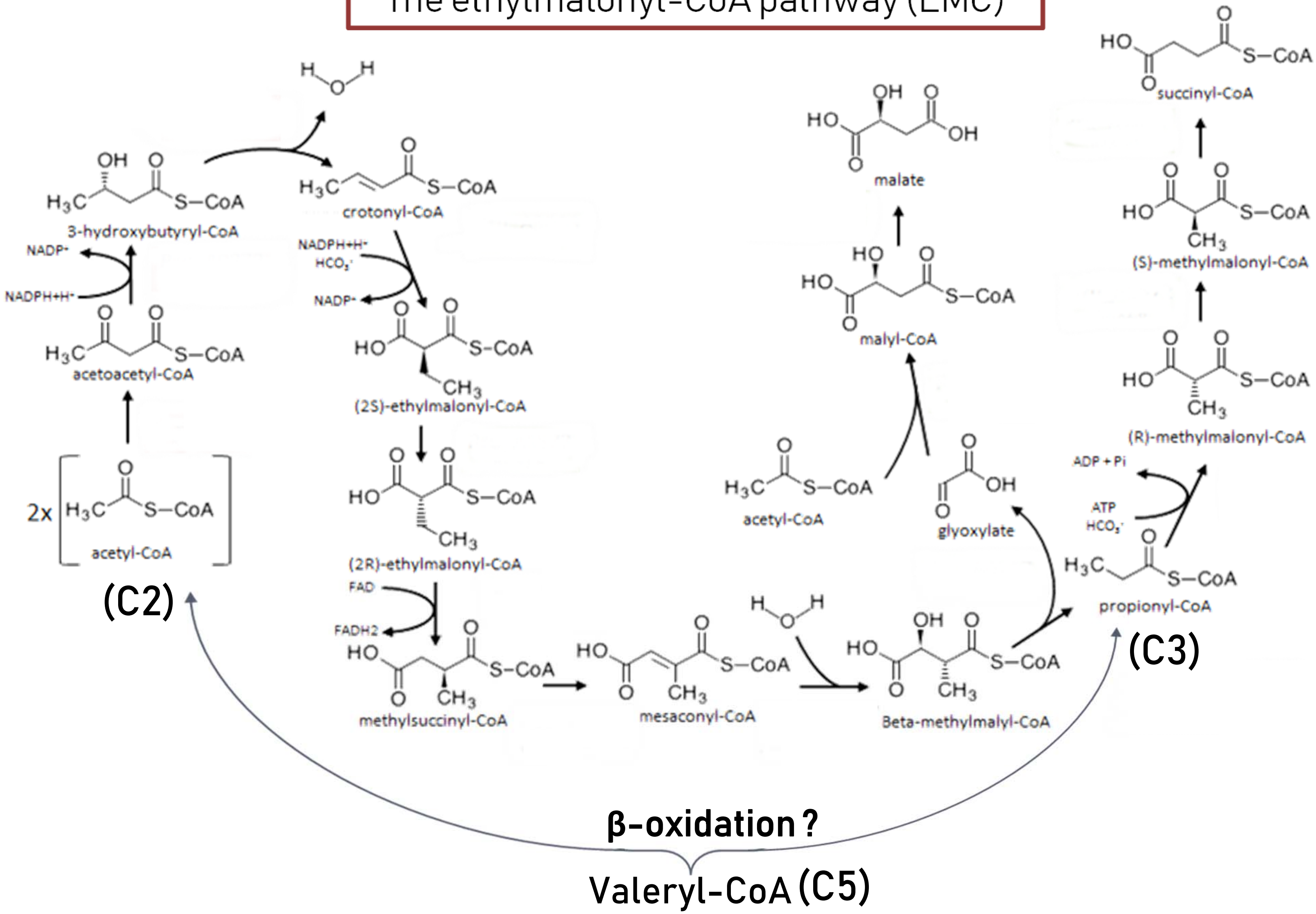


Valerate ?

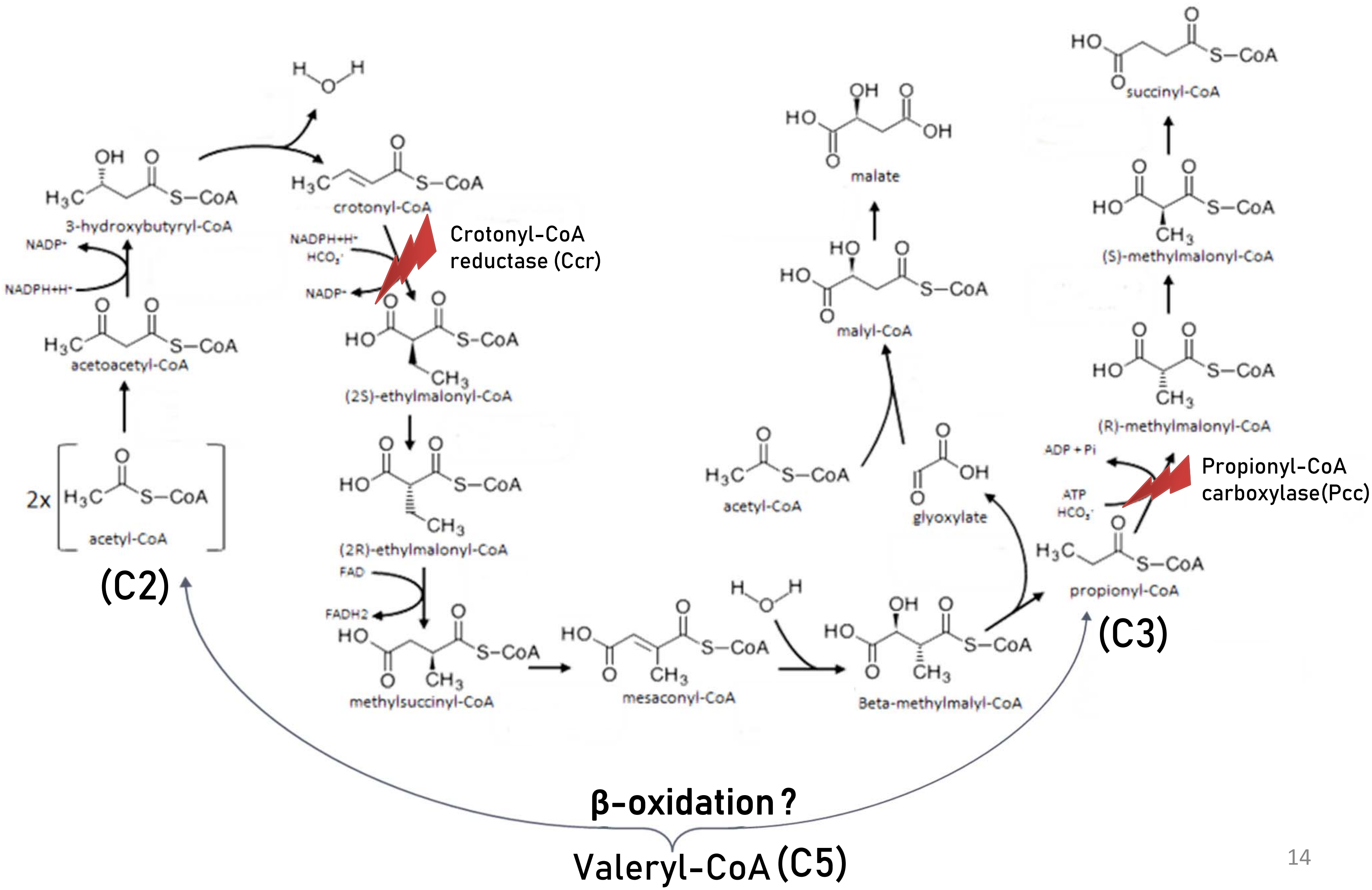
PHA production ?

Valeric acid assimilation - Hypothesis

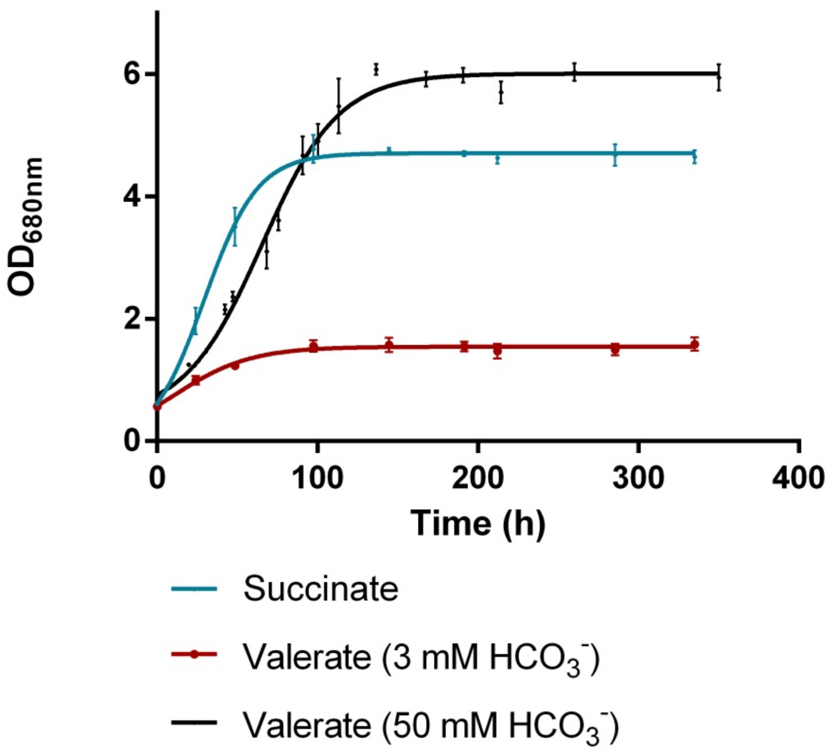
The ethylmalonyl-CoA pathway (EMC)

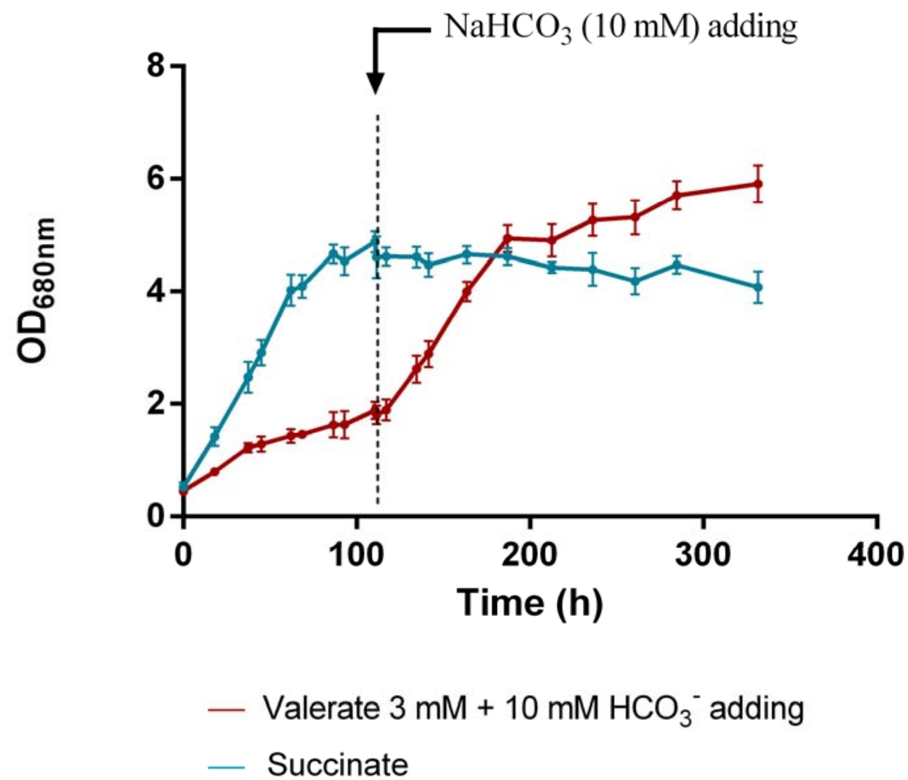


Valeric acid assimilation

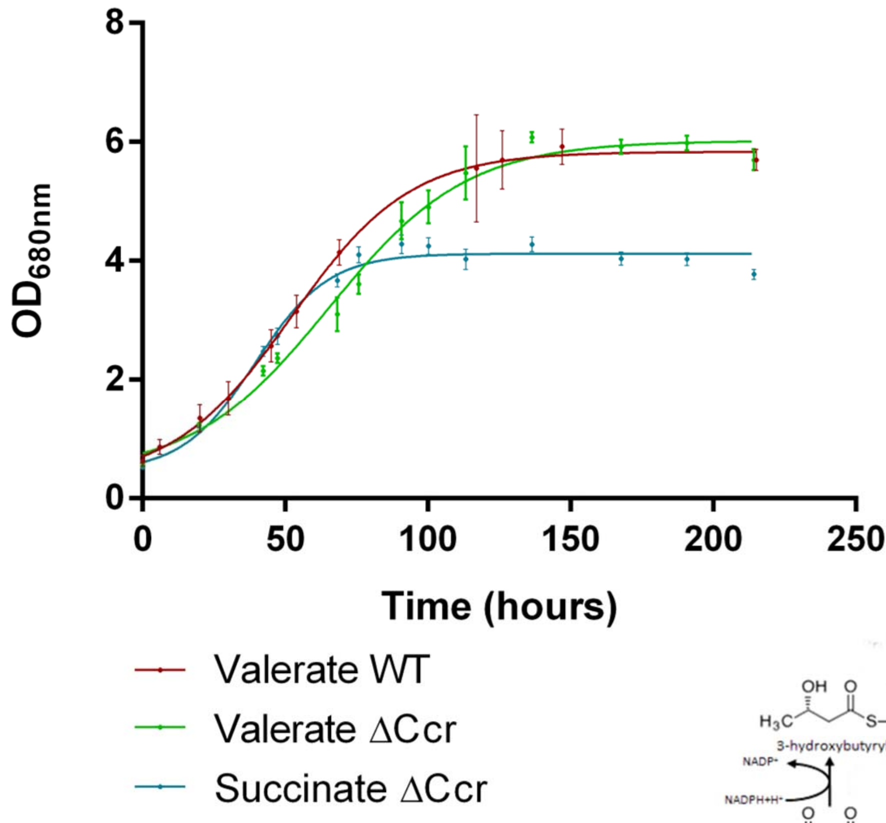


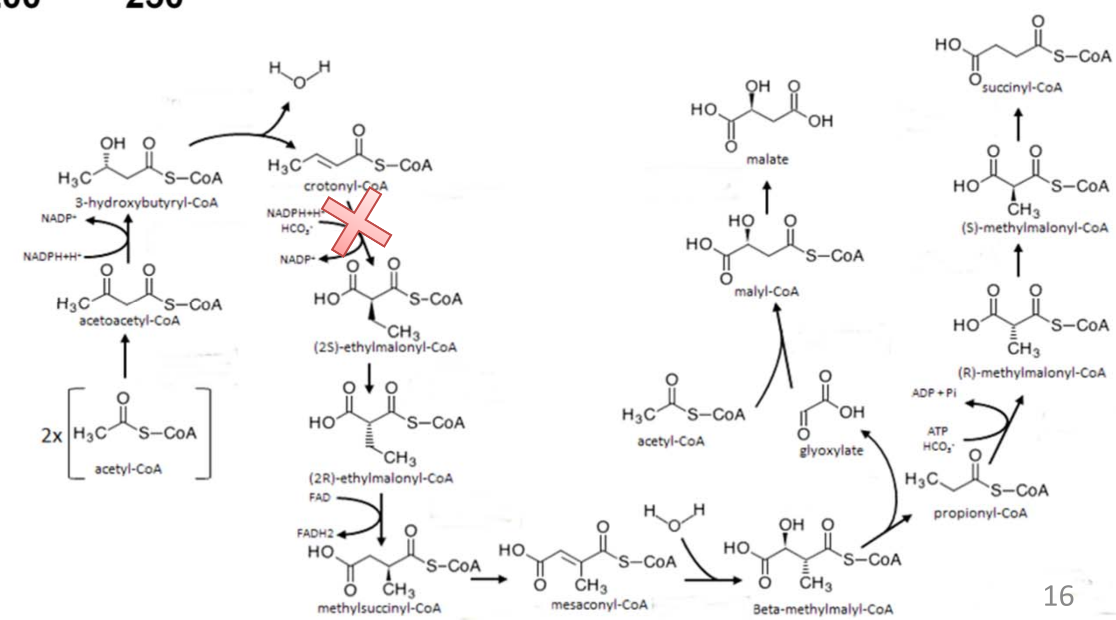
Valeric acid assimilation – First characterisation





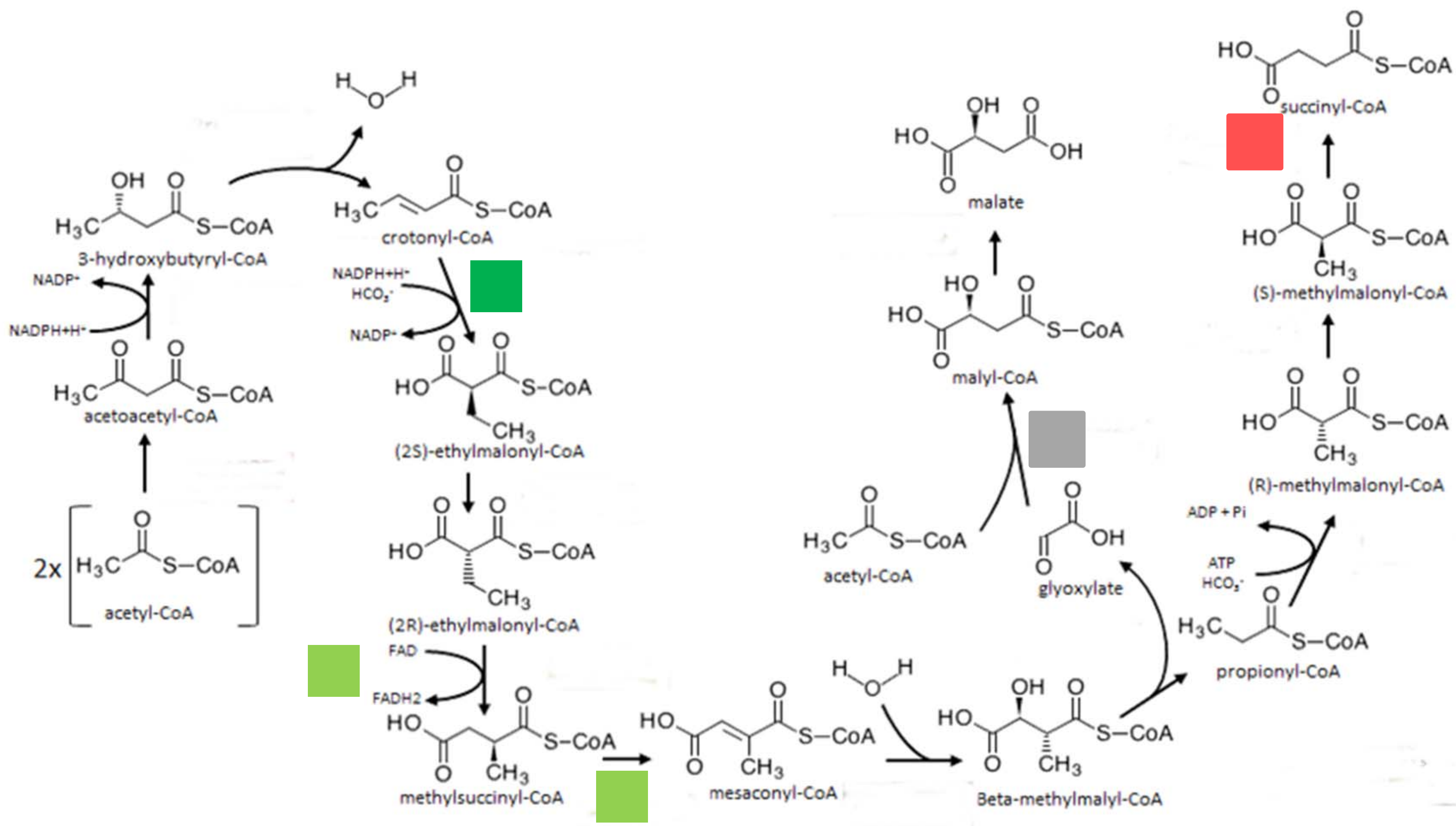
Valeric acid assimilation





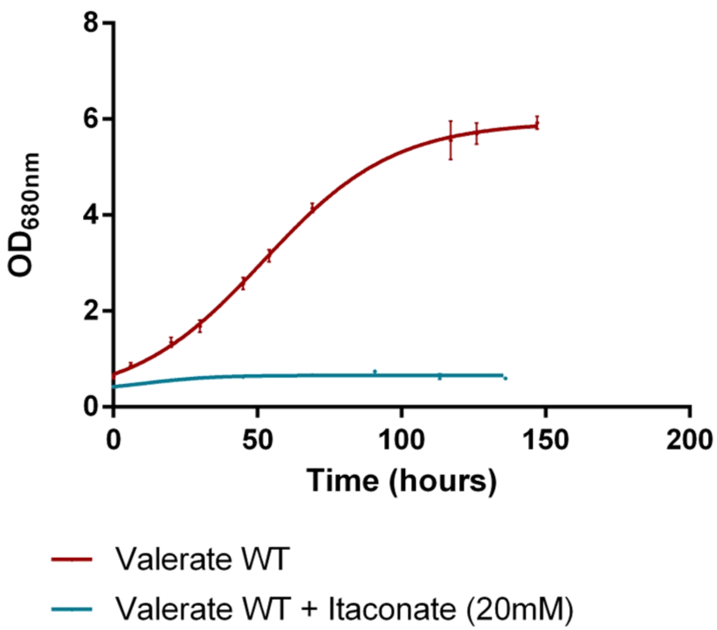
Valeric acid assimilation – Pathway used

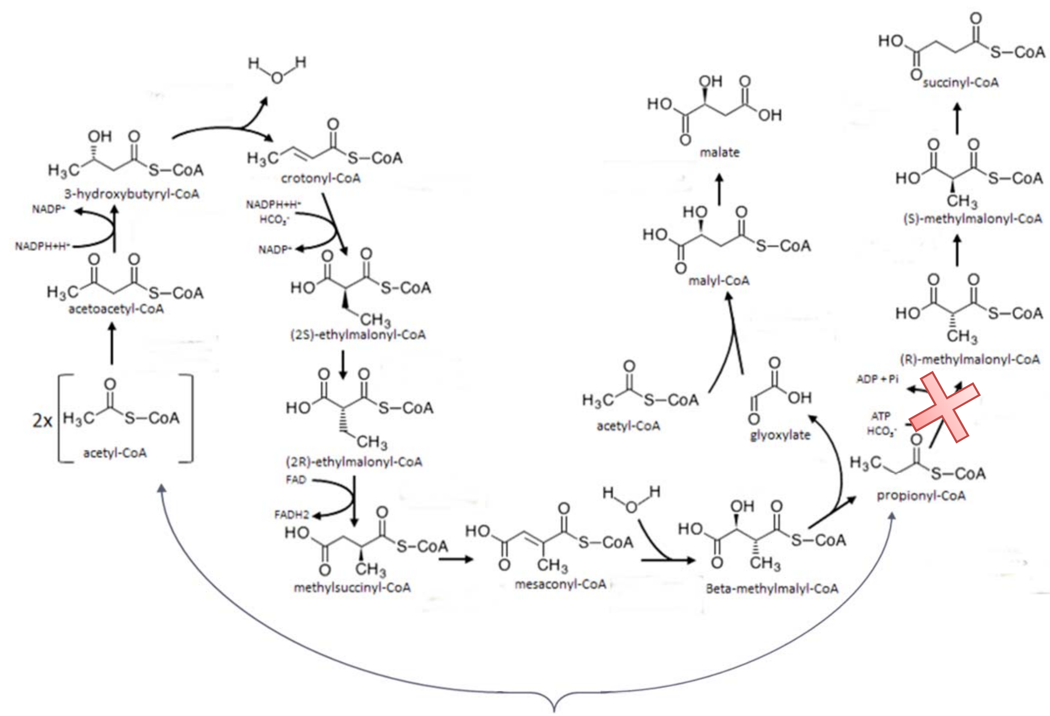
	Peak name	Enzymes	RefSeq Locus Tag	p-value	Fold change Val/Succ	Identified peptides
EMC pathway	Q2RPT7	Crotonyl-CoA reductase	Rru_A3063	0.00012	6.35020217	26
	Q2RPT8	Methylmalonyl-CoA mutase	Rru_A3062	0.05	1.648625809	9
	Q2RPT6	Isovaleryl-CoA dehydrogenase	Rru_A3064	0.01151	2.527293212	42
	Q2RXX3	Citrate lyase	Rru_A0217	0.03587	0.849474298	25
	Q2RRG6	Methylmalonyl-CoA mutase	Rru_A2479	0.01698	0.596213911	37



Valeric acid assimilation – Pathway used

Use of itaconic acid

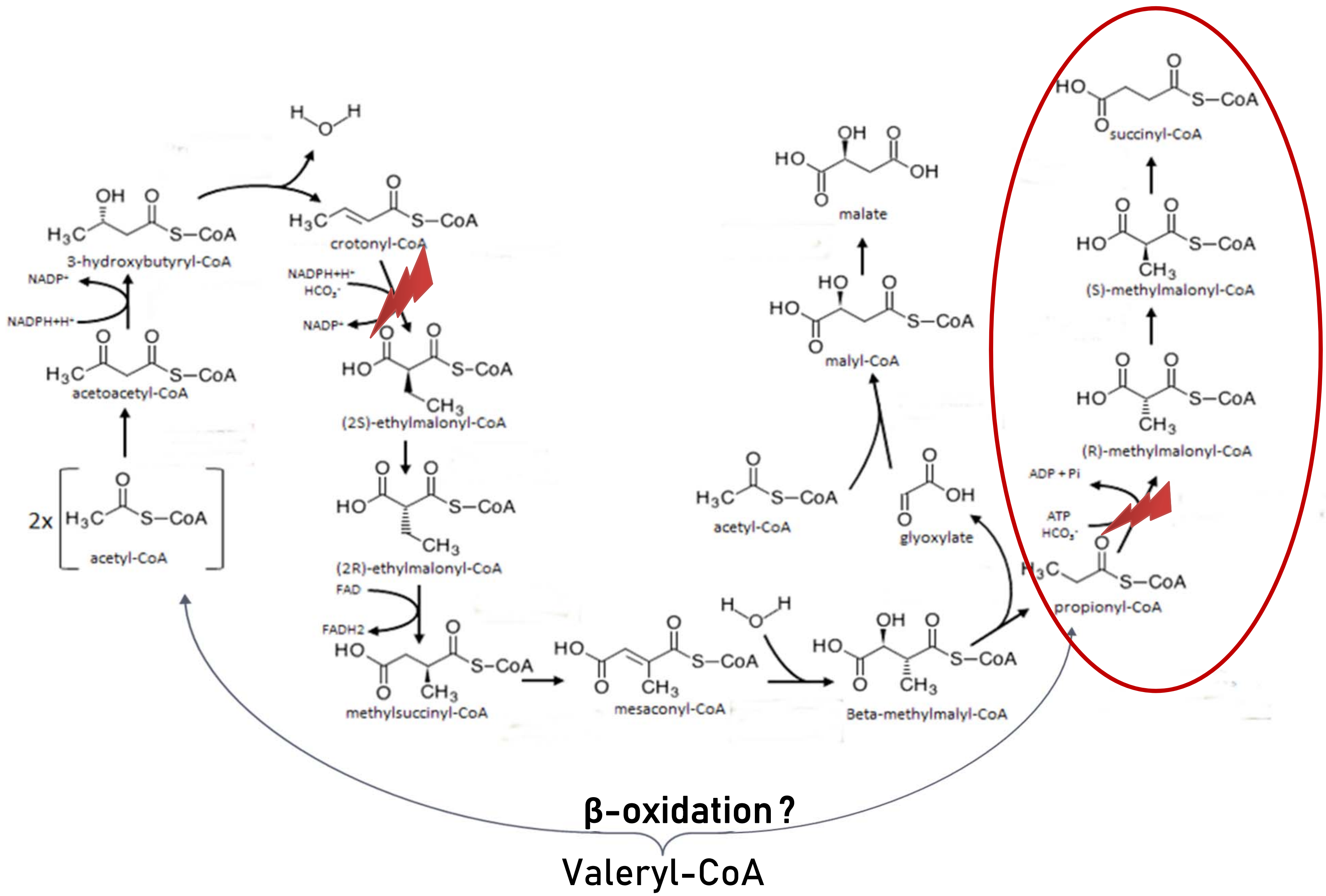




β-oxidation ?

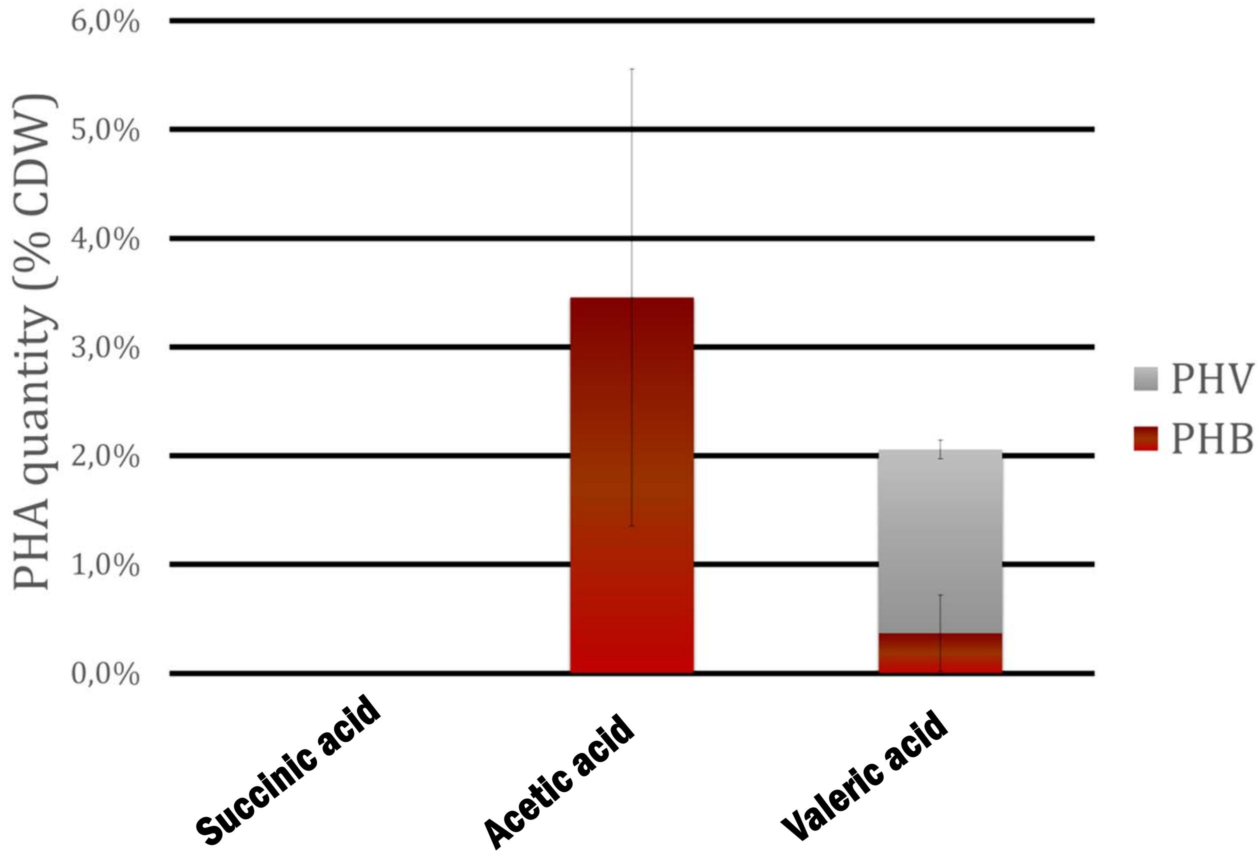
Valeryl-CoA

Valeric acid assimilation – Pathway used

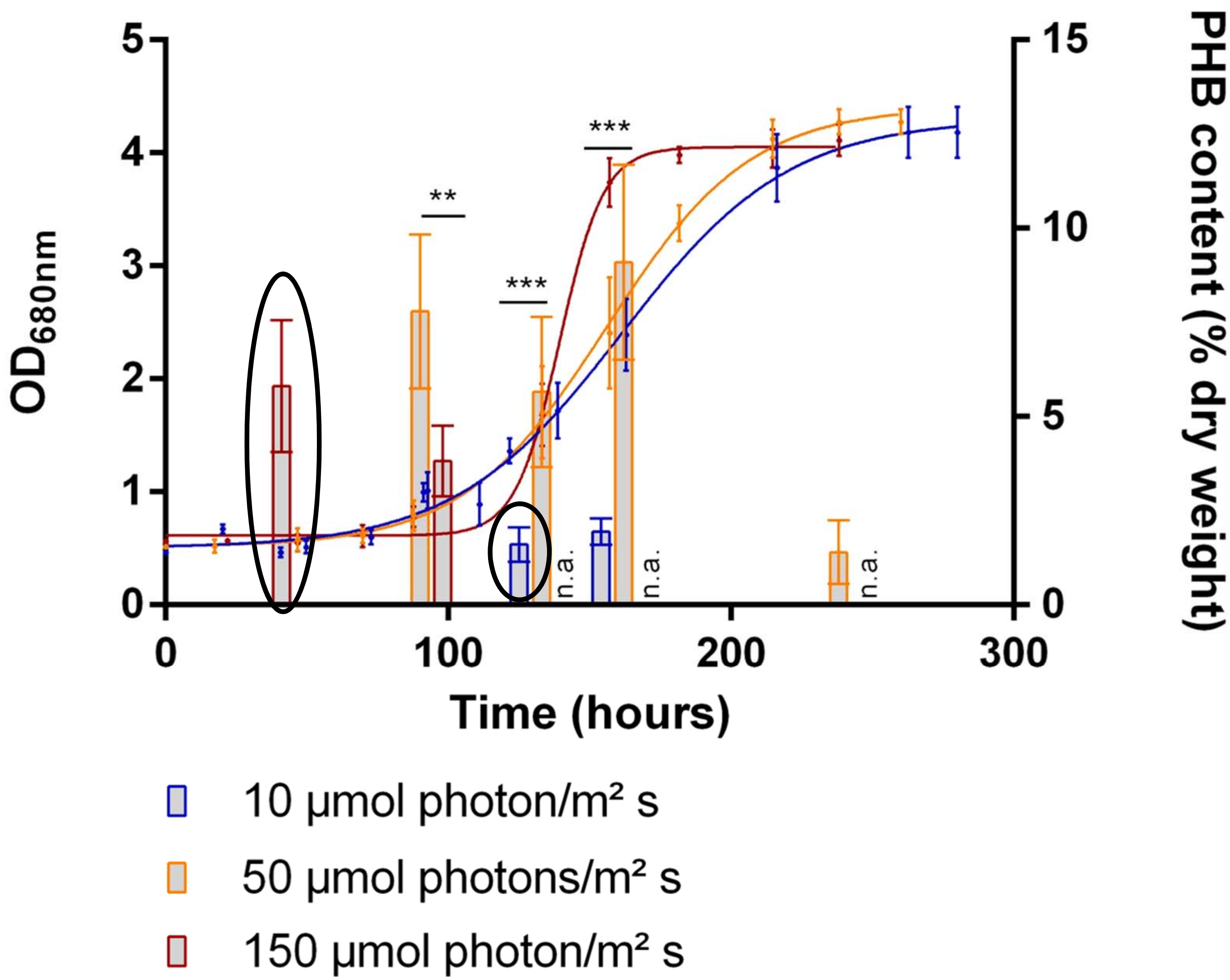


Valeric acid assimilation – P(HB-*co*-HV) production

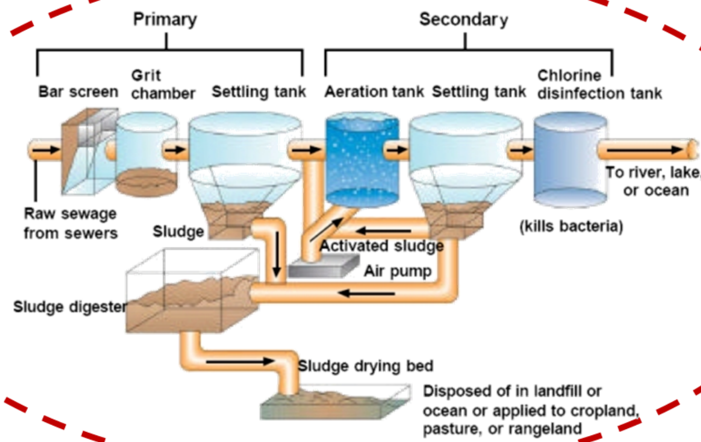
	Peak name	Enzymes	RefSeq Locus Tag	p-value	Fold change Val/Succ	Identified peptides
PHA production	Q2RNZ5	Polyhydroxyalkanoate depolymerase	Rru_A3356	0.00414	0.581772011	3
	Q2RQI1	Phasin	Rru_A2817	0.00038	48.24069362	24
	Q2RP67	Phasin	Rru_A3283	0.02786	2.056047044	80



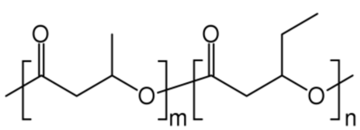
Impact of light intensity on PHB production in presence of acetic acid



Industrial project goals



PHASYN project
(ARC project)

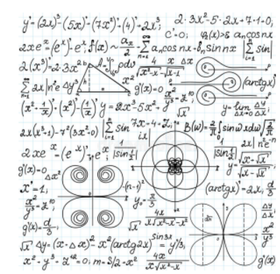


HBHBHBHVHVHV or HBHVHBHVHBHV

Physico-chemical properties

Additivated PHA

Optimise PHA producing culture condition



Modelisation PHA/culture condition

Thank you for your attention