Dimethyl carbonate and Switchable Anionic Surfactants: two effective tools for the extraction of polyhydroxyalkanoates from microbial biomass

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Table 1. PHA yield (wt%, calculated gravimetrically on microbial biomass weight basis) and recovery (%, calculated as $\dfrac{PHA\ yield\ *\ PHA\ purity}{PHA\ amount\ in\ the\ microbial\ cells}$) obtained under various conditions.

Treatment	Biomass source	PHA type	Temperature (°C)	Time (h)	PHA yield (wt%)	PHA recovery (%)
CH_2Cl_2	Freeze dried	P(3HB)	50	4	73±1	98±3
DMC	Freeze dried	P(3HB)	90	1	64±2	87±2
DMC	Freeze dried	P(3HB)	90	2	64±3	86±4
DMC	Freeze dried	P(3HB)	90	3	63±3	85±4
DMC	Freeze dried	P(3HB)	90	4	65±4	88±6
DMC	Freeze dried	P(3HB)	50	4	8±1	11±1
DEC	Freeze dried	P(3HB)	90	4	4±1	6±1
PC	Freeze dried	P(3HB)	90	4	3±0.2	4±1
PC	Freeze dried	P(3HB)	140	4	70±6	95±8
AcOEt	Freeze dried	P(3HB)	80	4	3±1	5±1
DMC	Slurry (50 g L^{-1})	P(3HB)	90	1	62±5	85±6
DMC	Slurry (50 g L^{-1})	P(3HB)	90	2	64±2	86±3
DMC	Slurry (50 g L^{-1})	P(3HB)	90	3	70±3	94±4
DMC	Slurry (50 g L^{-1})	P(3HB)	90	4	69±2	93±3
DMC	Slurry (100 g L^{-1})	P(3HB)	90	1	68±4	92±6
DEC	Slurry (50 g L^{-1})	P(3HB)	90	1	13±4	17±5
AcOEt	Slurry (50 g L^{-1})	P(3HB)	80	1	3±1	4±0.1
DMC	Freeze dried	P(3HB-*co*-3HV)	90	1	46±3	84±5
DMC	Slurry (50 g L^{-1})	P(3HB-*co*-3HV)	90	1	47±1	87±1
DMC	Freeze dried	P(3HB-*co*-4HB)	90	1	56±1	88±1
DMC	Slurry (50 g L^{-1})	P(3HB-*co*-4HB)	90	1	61±5	95±8
NH$_4$-laurate 200 wt%	Slurry (17 g L^{-1})	P(3HB)	90	3	77±3	102±6
NH$_4$-laurate 100 wt%	Slurry (25 g L^{-1})	P(3HB)	90	3	78±3	84±3
NH$_4$-laurate 50 wt%	Slurry (50 g L^{-1})	P(3HB)	90	3	76±3	93±14
NH$_4$-laurate 20 wt%	Slurry (100 g L^{-1})	P(3HB)	90	3	79±1	86±8
NH$_4$OH (0.1 N)	Slurry (17 g L^{-1})	P(3HB)	90	3	79±2	74±15
SDS 200wt%	Slurry (17 g L^{-1})	P(3HB)	90	3	75±1	100±2

FT-IR analysis. A Thermo Nicolet (Thermo Fisher Scientific, Waltham, MA, USA), Avatar 370 was used. The measurements were performed in transmission mode in the range 4.000-400 cm^{-1}, at a spectral resolution of 4 cm^{-1}, by using KBr. A dedicated software, OMNIC™ (Thermo Fisher Scientific, Waltham, MA, USA), was applied for the manipulation of the spectra.

Figure 1. FT-IR spectra of various P(3HB) achieved with DMC-extraction of microbial slurry, NH$_4$-laurate (200 wt%) and NH$_4$OH (0.1N) dissolution of NPCM, in comparison with commercial P(3HB)
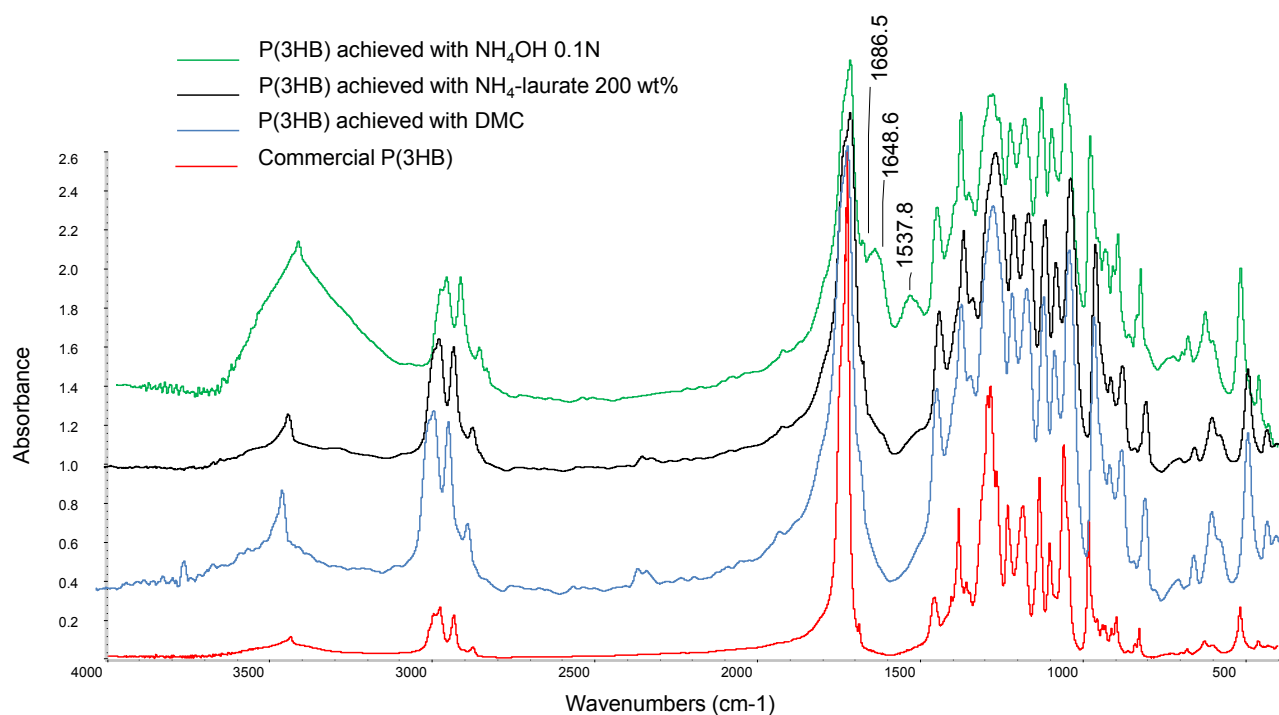

Table 2. Bacterial, yeast and fungal strains screened in this study for their ability to use DMC as carbon source, and related defined media.

Strain	Trait of interest	Medium	Reference or Source
C. necator DSM 545	PHA-producer	DSMZ81	DSMZ
Delftia acidovorans DSM 39	PHA-producer	DSMZ81	DSMZ
Hydrogenophaga pseudoflava DSM 1034	PHA-producer	Minimal medium [1]	DSMZ
Pseudomonas sp. DSM 1749	PHA-producer	DSMZ81	DSMZ
Bacillus farraginis LF3	H$_2$-producer	DSMZ81	[2]
Brevibacillus sp LF12	H$_2$-producer	DSMZ81	[2]
Paenibacillus sp LF82	H$_2$-producer	DSMZ81	[2]
Enterococcus faecium ST209GB	Bacteriocins-producer	M9	[3]
E. faecium ST711GB	Bacteriocins-producer	M9	[3]
Candida glabrata LF83	Wine yeast strain	YNB (Yeast	Dafnae Department

		Nitrogen Base)	(University of Padova)
Issatchenkia orientalis LF15	Wine yeast strain	YNB (Yeast Nitrogen Base)	Dafnae Department (University of Padova)
Hanseniaspora uvarum LF4	Wine yeast strain	YNB (Yeast Nitrogen Base)	Dafnae Department (University of Padova)
Saccharomyces cerevisiae 27P	Industrial bioethanol strain	YNB (Yeast Nitrogen Base)	[4]
S. cerevisiae Fm17	Industrial bioethanol strain	YNB (Yeast Nitrogen Base)	[5]
S. cerevisiae DSM 70049	Ethanol producer	YNB (Yeast Nitrogen Base)	DSMZ
Saccharomycodes ludwigii DSM 70551	Ethanol producer	YNB (Yeast Nitrogen Base)	DSMZ
Biscognauxia mediterranea	Enzymes-producer	Minimal medium [6]	TESAF department (University of Padova)
Pleurotus ostreatus	Enzymes-producer	Minimal medium [6]	TESAF department (University of Padova)
Schizzophilium comune	Enzymes-producer	Minimal medium [6]	TESAF department (University of Padova)
Trametes versicolor	Enzymes-producer	Minimal medium [6]	TESAF department (University of Padova)
Lepiota procera	Enzymes-producer	Minimal medium [6]	TESAF department (University of Padova)
Ganoderma appianatum	Enzymes-producer	Minimal medium [6]	TESAF department (University of Padova)

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