

Supplementary Material

Trajectory-level dynamic validation of a phase-structured grey-box model for consolidated bioprocessing using literature-derived ethanol trajectories

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This supplement summarizes the source-data inventory underlying the literature-derived ethanol trajectory compilation used for series-level curation and dynamic modeling. The counts reported here describe the broader source compilation prior to the analytical filtering steps reported in the main manuscript.

Table S1: Source-data inventory for the literature-derived ethanol trajectory compilation.

Metric	Value
Observation rows in source compilation	311
Distinct nonblank trajectory identifiers	56
Unique literature sources	17
Unique biomass or feedstock labels	23
Median timepoints per identified series	2
Residence-time range (h)	0–675

Table S2: Source-data coverage of literature-derived ethanol observations ($n = 311$), aggregated by biomass or feedstock and literature source.

Biomass or feedstock	Observations	Distinct series	Literature source
Alkali extracted deshelled corn cobs (AECC)	7	3	Artificial symbiosis for acetone-butanol-ethanol (ABE) fermentation from alkali extracted deshelled corn cobs by co-culture of <i>Clostridium beijerinckii</i> and <i>Clostridium cellulovorans</i>
Avicel	6	1	High Ethanol Titters from Cellulose by Using Metabolically Engineered Thermophilic, Anaerobic Microbes
Avicel (2% w/v)	4	2	Chung et al. (2015) engineered <i>C. bescii</i> at 75°C (Biotechnol Biofuels 8:163; 10.1186/s13068-015-0346-4)
Avicel (crystalline cellulose)	16	2	Single-step ethanol production from lignocellulose using novel extremely thermophilic bacteria
Avicel (microcrystalline cellulose)	7	1	Consolidated bioprocessing of lignocellulose by a microbial consortium
Avicel (microcrystalline cellulose)	10	5	Minnaar & den Haan (2023) engineered <i>S. cerevisiae</i> isolates for CBP (Appl Microbiol Biotechnol 107:7013–7028; 10.1007/s00253-023-12729-4)
Avicel (microcrystalline cellulose)	14	2	Xiong et al. 2018 Biotechnol Bioeng (DOI:10.1002/bit.26590)
Bread & pasta fraction (BP; 7.5% dw/v)	4	2	Gupte et al. (2024) OFMSW→bioethanol CBP with amylolytic yeast ER T12.7 (Energy Convers Manage 302:118105; 10.1016/j.enconman.2024.118105)
Carboxymethylcellulose (CMC)	9	1	Producing bioethanol from cellulosic hydrolyzate via co-immobilized cultivation strategy

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Biomass or feedstock	Observations	Distinct series	Literature source
Cellobiose (5 g/L) + AFEX-CS water extract (WE)	10	5	Jin et al. (2012) CBP of AFEX-pretreated corn stover at high solids (Biotechnol Bioeng 109:1929–1936; DOI:10.1002/bit.24458)
Cellulose (0.5% w/v in CT-FUD)	24	2	Wang et al. 2019 Frontiers in Microbiology 10:2035 (doi:10.3389/fmicb.2019.02035)
Cellulose (feed)	2	1	EPFL_TH9200 thesis (Continuous CBP)
Cellulosic hydrolyzate (as in Liu 2012 Fig.7)	22	1	Producing bioethanol from cellulosic hydrolyzate via co-immobilized cultivation strategy
Dilute acid pretreated wheat straw (washed solids + xylose)	13	1	Consolidated bioprocessing of lignocellulose by a microbial consortium
Dilute acid pretreated wheat straw slurry (whole slurry)	13	1	Consolidated bioprocessing of lignocellulose by a microbial consortium
Discolored rice (DR; 10% dw/v)	4	2	Gupte et al. (2024) OFMSW→bioethanol CBP with amyolytic yeast ER T12.7 (Energy Convers Manage 302:118105; 10.1016/j.enconman.2024.118105)
Enriched OFMSW (OFMSW + 15% w/w BP; 7.5% dw/v)	4	2	Gupte et al. (2024) OFMSW→bioethanol CBP with amyolytic yeast ER T12.7 (Energy Convers Manage 302:118105; 10.1016/j.enconman.2024.118105)
Enriched OFMSW + DR (17.5% dw/v total)	4	2	Gupte et al. (2024) OFMSW→bioethanol CBP with amyolytic yeast ER T12.7 (Energy Convers Manage 302:118105; 10.1016/j.enconman.2024.118105)
Mixed lignocellulosics (R. communis + S. spontaneum + S. officinarum tops)	8	1	Althuri et al. (2017) PCBP mixed lignocellulosics (Biortech 2017.08.140)
OFMSW (organic fraction municipal solid waste; Este, Italy; 7.5% dw/v)	4	2	Gupte et al. (2024) OFMSW→bioethanol CBP with amyolytic yeast ER T12.7 (Energy Convers Manage 302:118105; 10.1016/j.enconman.2024.118105)
Solka Floc	70	8	One-pot bioethanol production from cellulose by co-culture of Acremonium cellulolyticus and Saccharomyces cerevisiae
Switchgrass (2% w/v; untreated)	4	2	Chung et al. (2015) engineered C. bescii at 75°C (Biotechnol Biofuels 8:163; 10.1186/s13068-015-0346-4)
Unwashed pretreated poplar	20	2	Single-step ethanol production from lignocellulose using novel extremely thermophilic bacteria
cellobiose (1% w/v)	4	2	Chung et al. (2015) engineered C. bescii at 75°C (Biotechnol Biofuels 8:163; 10.1186/s13068-015-0346-4)
α -cellulose	20	2	Consortia-mediated bioprocessing of cellulose to ethanol with a symbiotic Clostridium phytofermentans/yeast co-culture
α -cellulose	7	1	Direct ethanol production from cellulose by consortium of Trichoderma reesei and Candida molischiana
	1	0	Restiawaty et al. (2023) Lignocellulosic bioethanol production using Neurospora intermedia in consolidated bioprocessing (CBP) system. Biofuels. DOI:10.1080/17597269.2022.2137948

Note. Observation counts correspond to source-compilation rows. Distinct series counts are based on nonblank trajectory identifiers within each biomass–source grouping. These source-data summaries precede the series-level curation and trimming reported in the main manuscript.