



## Supplementary materials

# From agricultural wastes to fermentation nutrients: a case study of 2,3-butanediol production

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**Table S1.** Production scenarios used for process design.

Production scenario	Media composition
Control	Mineral/elemental nutrients
Scenario I	5 g/L FSBC + organic N
Scenario II	5 g/L PLBC + organic N
Scenario III	75% ADE + 10 g/L FSBC
Scenario IV	75% ADE + 10 g/L FSBC + 12.5% organic N
Scenario V	75% ADE only

**Table S2.** Average glucose utilization per MT of 2,3-BD produced.

	Control	Scenario I	Scenario II	Scenario III	Scenario IV	Scenario V
Total Glucose consumed (MT/yr)	124,727	107,443	107,443	118,555	112,301	148,655
Total 2,3-BD produced (MT/yr)	41,000	41,000	41,000	41,000	41,000	41,000
Yield (MT 2,3-BD /MT glucose)	0.33	0.38	0.38	0.35	0.37	0.28
Glucose utilization (MT glucose / MT 2,3-BD)	3.03	2.63	2.63	2.86	2.70	3.57

**Table S3.** Production costs of different 2,3-BD production scenarios.

Production scenario	Conc. of 2,3- BD after fermentation (g/L)	Cost without distillation		Cost with distillation		Distillation Cost (\$/L) <sup>b</sup>
		\$/L	Fold ↓ in cost <sup>a</sup>	\$/L	Fold ↓ in cost <sup>a</sup>	
Control	32.5	5.96	-	8.38	-	2.42
Scenario I	38.7	2.91	2.05	4.14	2.03	1.23
Scenario II	41.9	2.63	2.27	3.73	2.24	1.11
Scenario III	22.4	2.70	2.21	4.63	1.81	1.94
Scenario IV	37.1	3.26	1.83	4.98	1.68	1.73
Scenario V	16.7	3.42	1.74	5.95	1.41	2.53

<sup>a</sup>Fold decrease in production cost of 2,3-BD relative to the control.

<sup>b</sup>Difference between the production costs of 2,3-BD with and without distillation.

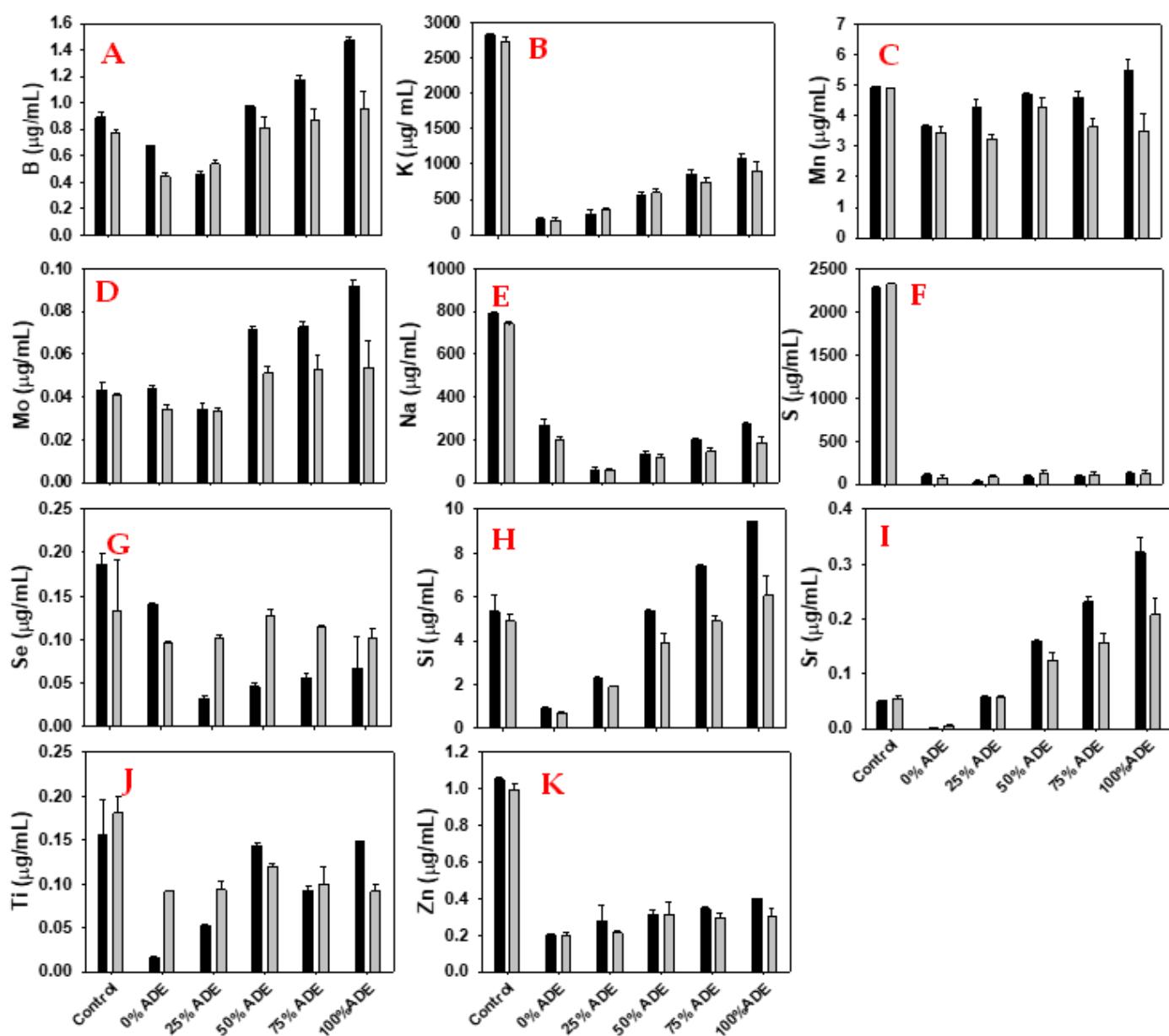
**Table S4.** Production cost parameters for 2,3-BD fermentation without distillation.

Percentage of total operating cost	Control	Scenario I	Scenario II	Scenario III	Scenario IV	Scenario V
Raw Materials (%)	56.6	67.2	67.2	71.7	58.6	70.8
Labor-dependent (%)	0.4	0.8	0.8	0.8	0.7	0.7
Facility-dependent (%)	31.9	23.3	22.8	20.8	30.2	21.3
Laboratory/QC/QA (%)	0.1	0.1	0.1	0.1	0.1	0.1
Utilities (%)	11.1	8.6	9.0	6.5	10.4	7.1
Total operating cost (%)	100.0	100.0	100.0	100.0	100.0	100.0
Total operating cost (x10 <sup>6</sup> \$)	247.6	122.9	113.7	112.9	134.2	143.2

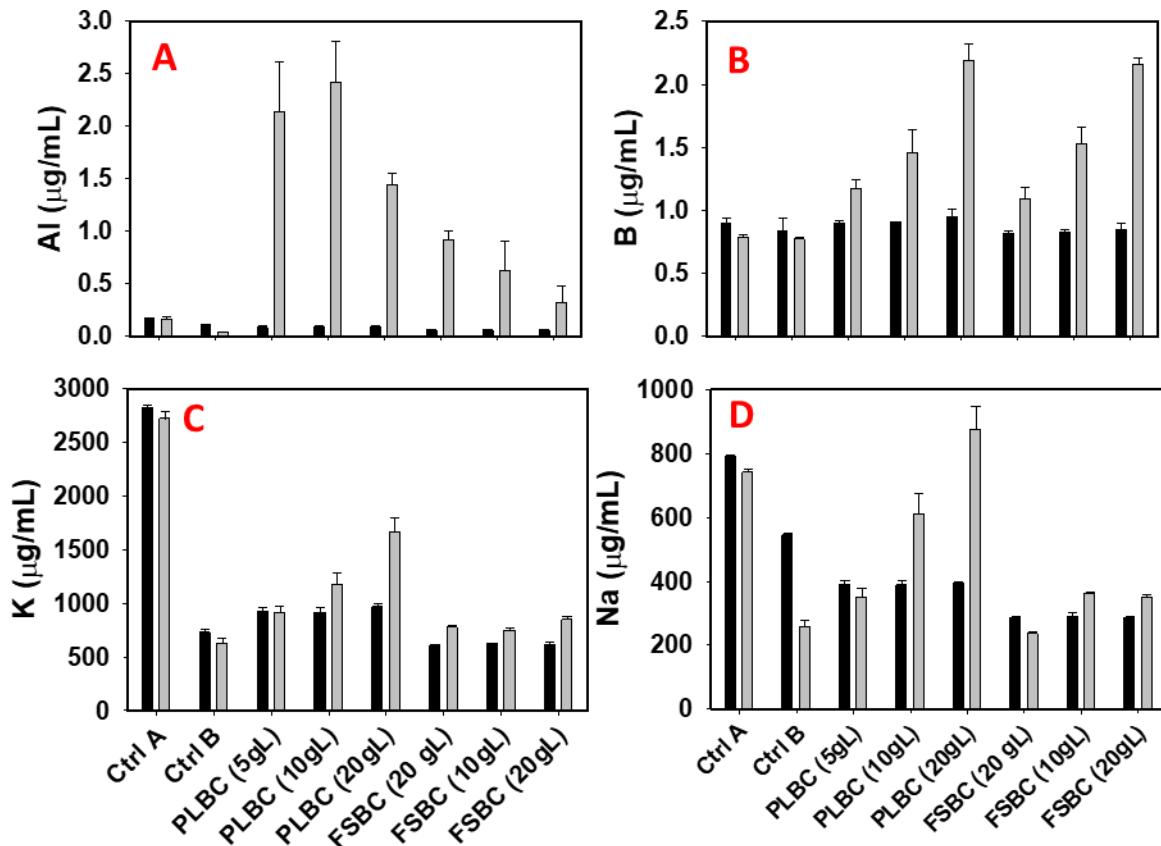
**Table S5.** Production cost parameters for 2,3-BD fermentation with distillation.

Percentage of total operating cost	Control	Scenario I	Scenario II	Scenario III	Scenario IV	Scenario V
Raw Materials (%)	37.5	47.6	47.9	42.5	38.4	41.7
Labor-dependent (%)	0.3	0.6	0.6	0.5	0.5	0.4
Facility-dependent (%)	22.8	16.6	16.3	12.2	19.8	12.3
*Facility-dependent (distillation) (%)	30.3	26.9	28.0	35.3	34.1	35.8
Laboratory/QC/QA (%)	0.0	0.1	0.1	0.1	0.1	0.1
Utilities (%)	7.9	6.1	6.4	3.8	6.8	4.1
Utilities (distillation) (%)	1.2	2.1	0.6	5.5	0.4	5.6
Total operating cost (%)	100.0	100.0	100.0	100.0	100.0	100.0
Total operating cost (x10 <sup>6</sup> \$)	346.1	173.0	159.1	192.3	205.0	247.5

\* Facility dependent costs (distillation) are the additional facility dependent costs associated with the distillation process.



**Figure S1.** The concentrations of boron, potassium, manganese, molybdenum, sodium, sulfur, selenium, silicon, strontium, titanium, and zinc in ADE cultures of *P. polymyxa* at 0 h (black color) and end of fermentation (gray color). Control medium contains all the required nutrients, minerals, and buffers necessary for optimal growth and 2,3-BD production. The treatment contains 0%, 25%, 50%, 75% and 100% dilutions of ADE.



**Figure S2.** The concentrations of aluminum, boron, potassium, and sodium in the Ctrl A, Ctrl B, 5 g/L PLBC, 10 g/L PLBC, 20 g/L FSBC, 5 g/L FSBC, 10 g/L FSBC and 20 g/L FSBC cultures of *P. polymyxa* at 0 h (black color) and end of fermentation (gray color). Ctrl A medium contains all the required nutrients, minerals, and buffers necessary for optimal growth and 2,3-BD production, whereas Ctrl B contains 5 g/L yeast extract, 3.5 g/L tryptone, and trace element solution.