

Table S1. Statistical models for butyric acid conversion and yields of propane and CO₂ under compressed air atmosphere

Models	Statistics	Response		
		Conversion	Propane	CO ₂
Linear	R ²	0.68	0.28	0.81
	R ² -adj.	0.65	0.22	0.79
	R ² -pred.	0.56	0.1	0.74
	SD	15.8	14	4.01
Linear Square	R ²	0.93	0.90	0.95
	R ² -adj.	0.94	0.88	0.94
	R ² -pred.	0.92	0.85	0.93
	SD	6.4	5.4	2.06
Full quadratic	R ²	0.96	0.90	0.98
	R ² -adj.	0.96	0.88	0.97
	R ² -pred.	0.95	0.85	0.94
	SD	4.9	5.4	1.5
Cubic	R ²	0.99	0.97	0.95
	R ² -adj.	0.98	0.97	0.94
	R ² -pred.	0.98	0.95	0.91
	SD	2.8	2.63	2.2

Table S2. Statistical models for butyric acid conversion and yields of propane and CO₂ under hydrogen gas atmosphere

Models	Statistics	Response		
		Conversion	Propane	CO ₂
Linear	R ²	0.86	0.48	0.61
	R ² -adj.	0.84	0.44	0.58
	R ² -pred.	0.80	0.26	0.47
	Sdv.	9.9	9.1	5.4
Linear Square	R ²	0.97	0.97	0.95
	R ² -adj.	0.96	0.96	0.93
	R ² -pred.	0.95	0.96	0.91
	Sdv.	4.8	2.3	2.1
Full quadratic	R ²	0.99	0.98	0.98
	R ² -adj.	0.99	0.97	0.97
	R ² -pred.	0.98	0.96	0.95
	Sdv.	2.3	1.7	1.3
Cubic	R ²	0.98	0.98	0.97
	R ² -adj.	0.98	0.97	0.97
	R ² -pred.	0.97	0.97	0.96
	Sdv.	3.3	1.7	1.4

Table S3. ANOVA results for the models for butyric acid conversion and yields of propane and CO₂ under compressed air atmosphere

Response	Factors	DF	Mean of Square	F-value	P-Value
Conversion	Block	2	495.38	-	
	Model	2	5230.2	55.1	0.0001
	A	1	8307.5	87.52	0.0007
	A ²	1	2209.3	23.27	0.0001
	Residual	10	94.9	-	-
	Lack of fit	5	189.7	1422.9	0.0001
	Pure error	5	0.13	-	-
	Total	14	-	-	-
Propane	Block	2	73.64		-
	Model	2	1229.97	19.12	0.0004
	A	1	1236.9	19.23	0.0014
	A ²	1	1239.3	19.26	0.0014
	Residual	10	64.3	-	0.03
	Lack of fit	5	128.7	-	0.0001
	Pure error	5	0.0013	-	
	Total	14	-	-	-
CO ₂	Block	2	227.34	-	
	Model	3	616.7	122.1	0.0001
	A	1	0.038	0.007	0.9
	A ²	1	249.3	49.3	0.0001
	A ³	1	125.49	24.8	0.0008
	Residual	9	5.06	-	-
	Lack of fit	4	11.18	72.29	0.0001
	Pure error	5	0.155	-	-
	Total	14	-	-	-

Table S4. ANOVA results for the models for butyric acid conversion and yields of propane and CO₂ under hydrogen gas atmosphere

Response	Factors	DF	Mean of Square	F-value	P-Value
Conversion	Model	4	1904.77	348.64	0.0001
	A	1	1144.74	209.53	0.0001
	A ²	1	167.89	30.73	0.0005
	A ³	1	118.21	21.64	0.0016
	A ⁴	1	54.66	10	0.0133
	Residual	8	5.46	-	-
	Lack of fit	3	14.32	96.77	0.0001
	Pure error	5	0.1480	-	-
	Total	12	-	-	-
Propane	Model	3	584.84	189.91	0.0001
	A	1	192.48	62.50	0.0001
	A ²	1	851.72	276.57	0.0001
	A ³	1	22.25	7.23	0.0249
	Residual	9	3.08	-	-
	Lack of fit	4	6.93	4156.16	0.0001
	Pure error	5	0.0017	-	-
	Total	12	-	-	-
CO ₂	Model	3	271.74	129.24	0.0001
	A	1	143.98	68.48	0.0001
	A ²	1	264.35	125.73	0.0001
	A ³	1	27.38	13.02	0.0057
	Residual	9	2.1	-	-
	Lack of fit	4	4.72	708.36	0.0001
	Pure error	5	0.0067	-	-
	Total	12	-	-	-