Supplementary Data to: Simultaneous Synergy in CH_4 Yield and Kinetics: Criteria For Selecting the Best Mixtures During Co-digestion of Wastewater and Manure from a Bovine Slaughterhouse.

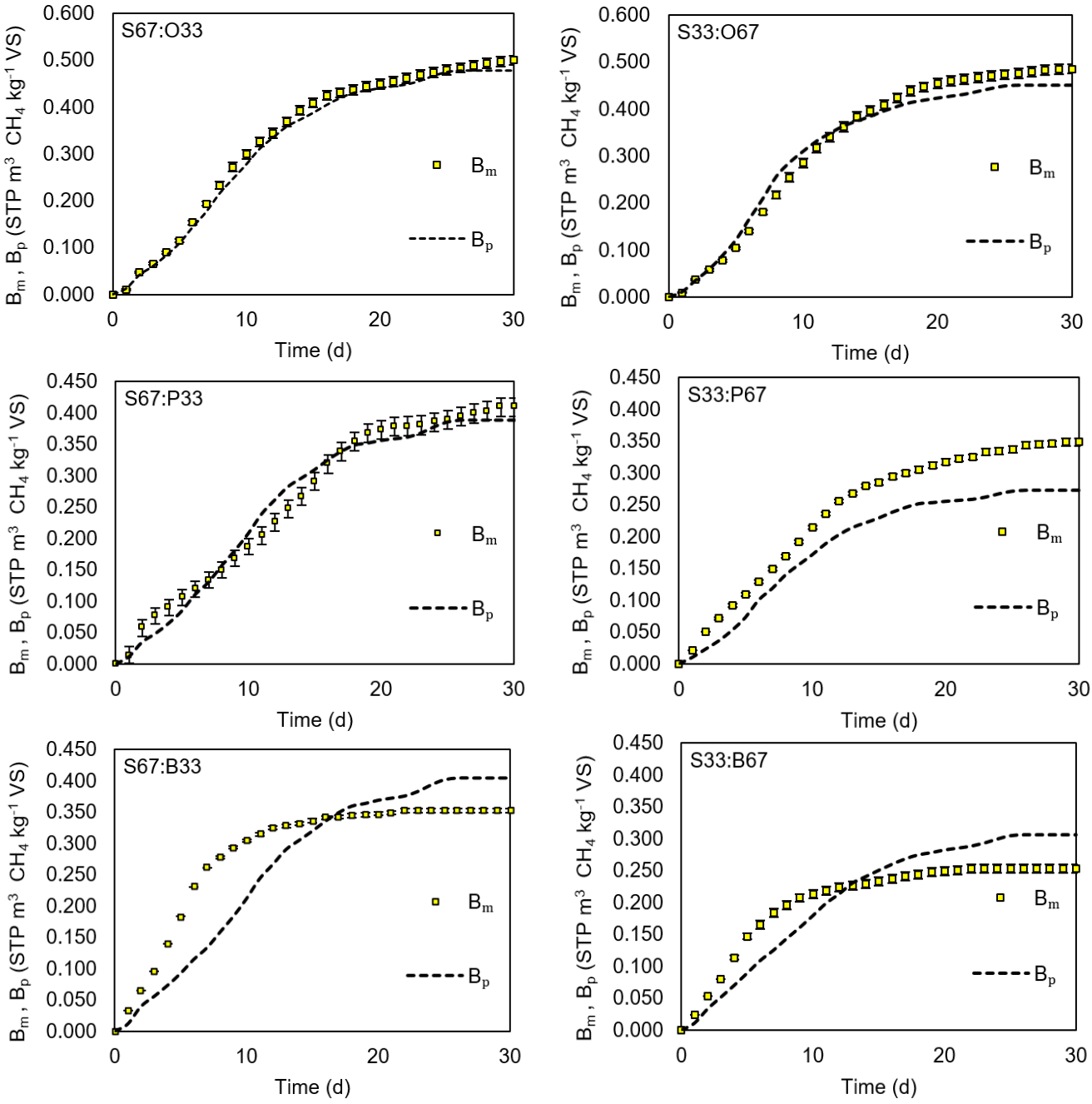
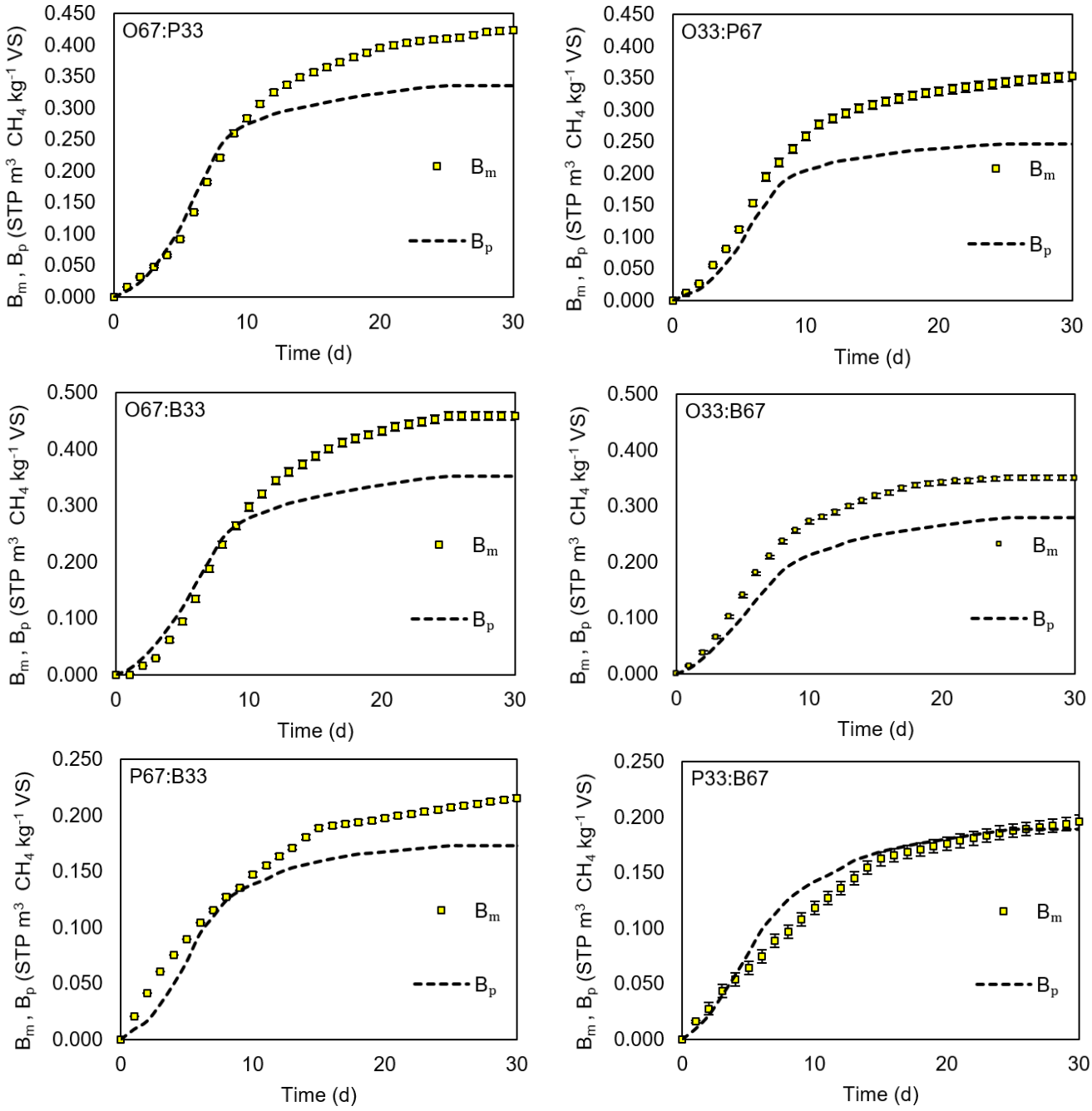


Figure S1. Experimental (B_m) and predictive (B_p) accumulative CH_4 production of AcoD of slaughterhouse wastewater streams and bovine manure. The synergistic effects of AcoD can be observed when comparing B_m and B_p curves. The letter represents the waste stream (S: slaughter wastewater; O: offal wastewater; P: paunch wastewater; B: bovine manure) and the number its %VS in the mixture.



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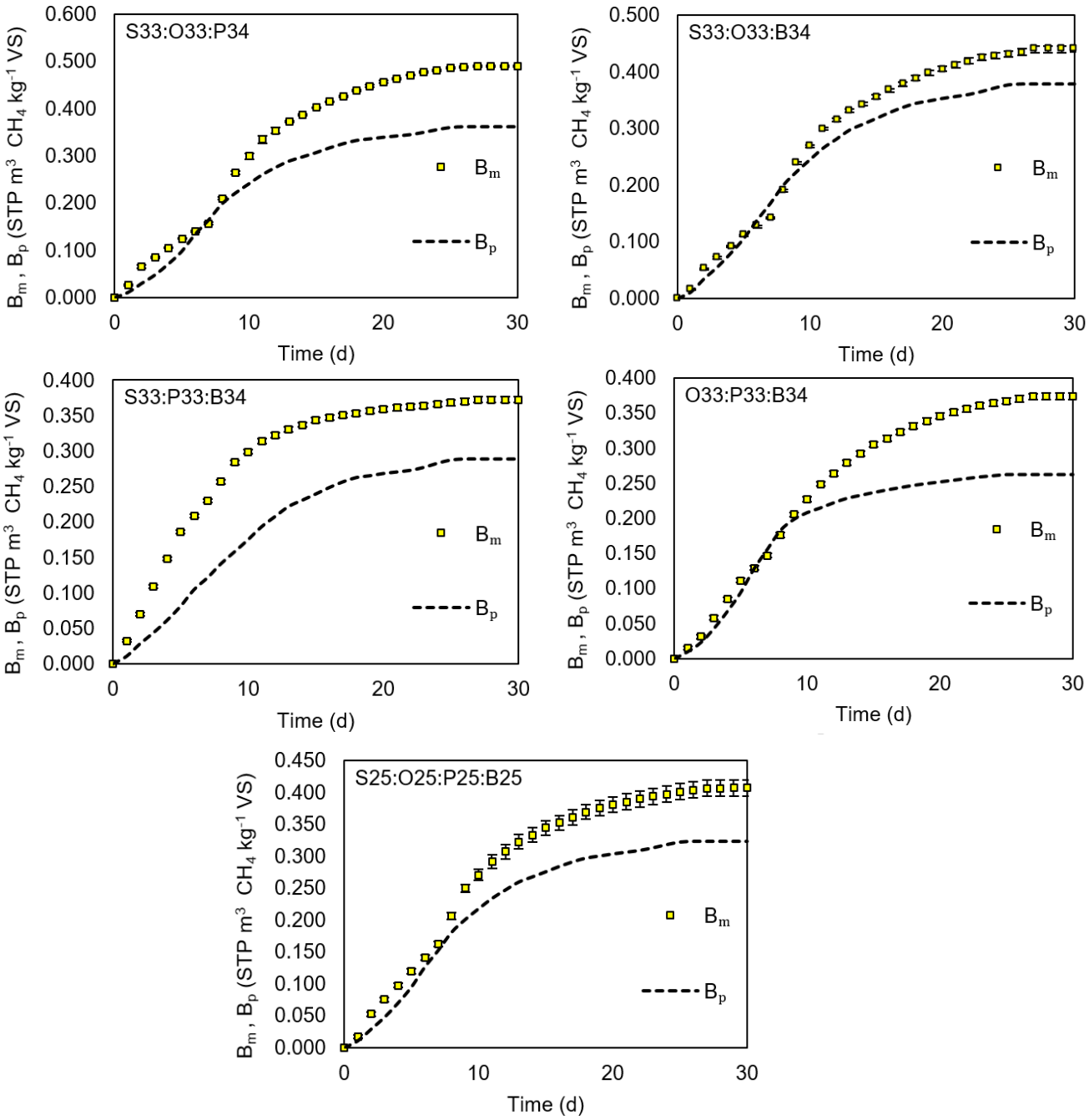

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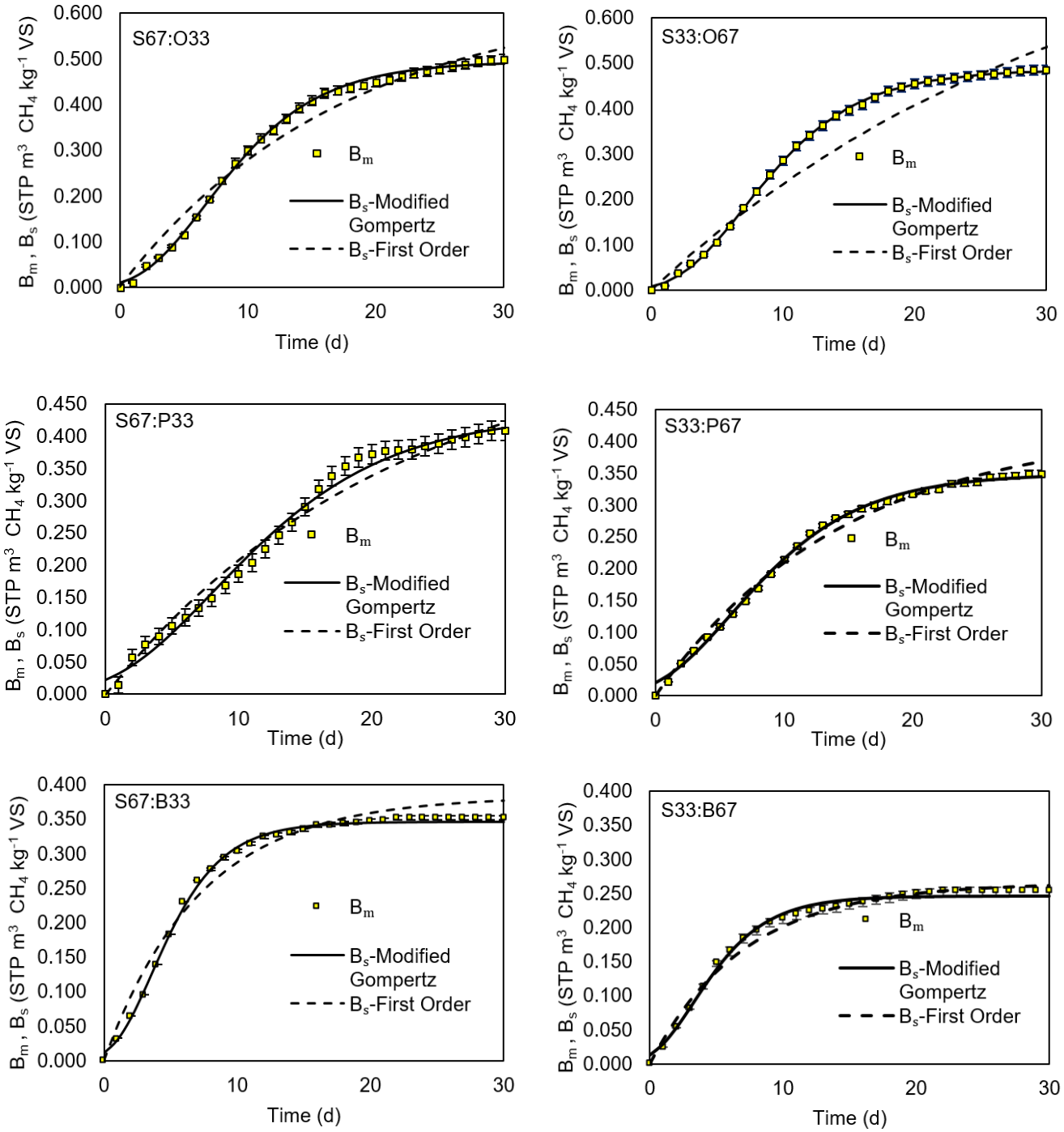
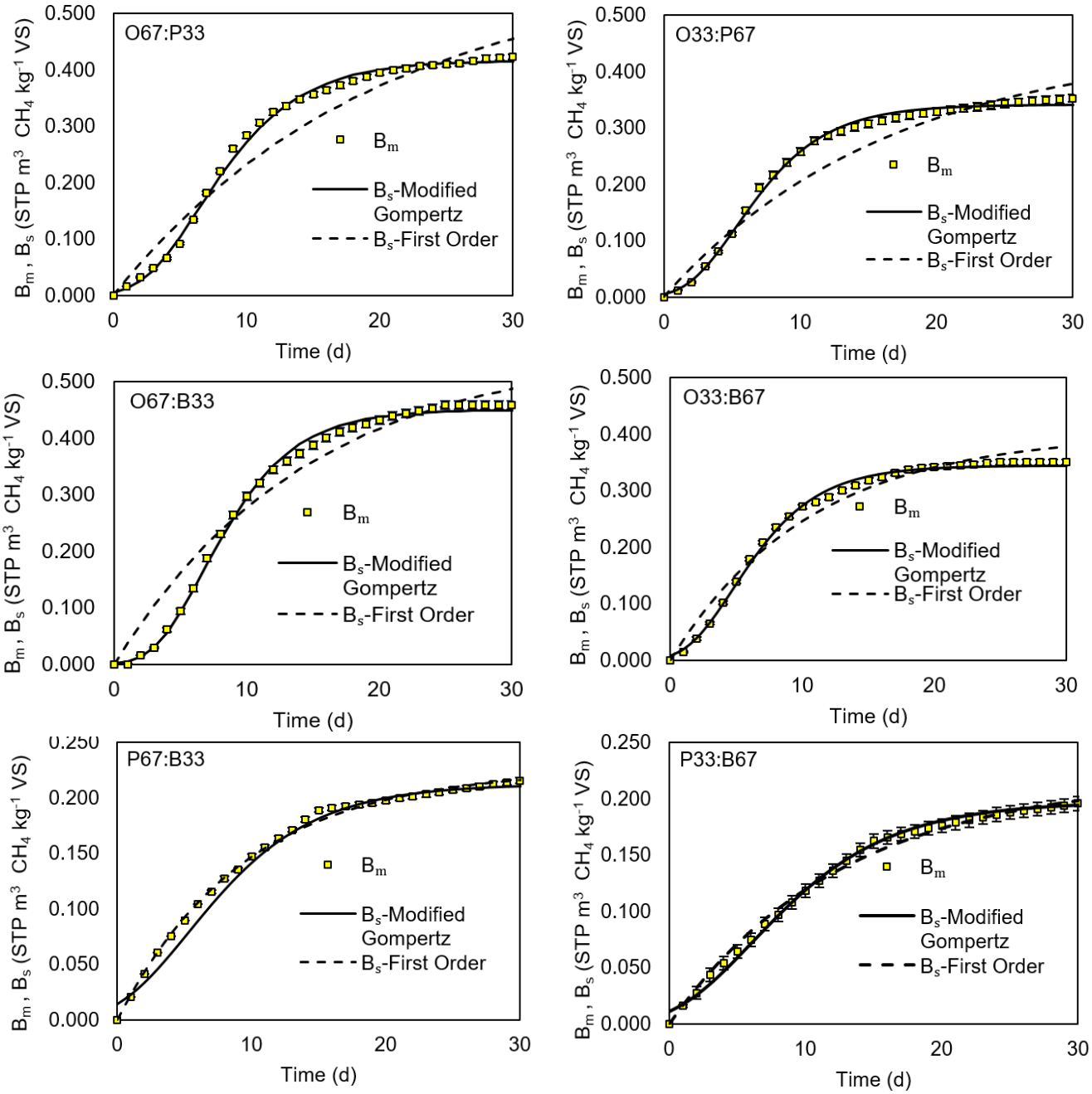


Figure S2. Experimental (B_m) and simulated (B_s) accumulative CH_4 production of AcoD of slaughterhouse wastewater streams and bovine manure. The letter represents the waste stream (S: slaughter wastewater; O: offal wastewater; P: paunch wastewater; B: bovine manure) and the number its %VS in the mixture.



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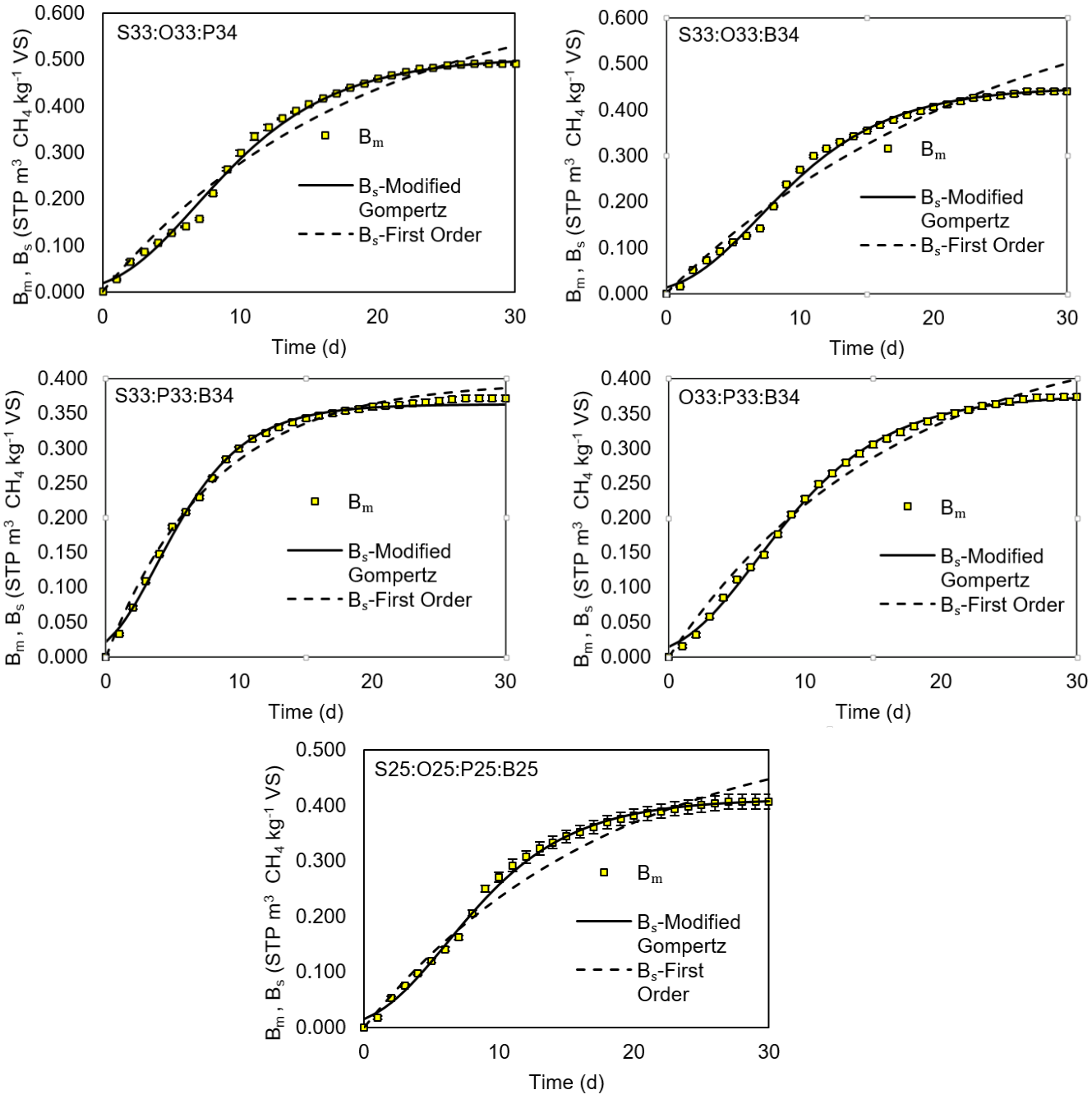

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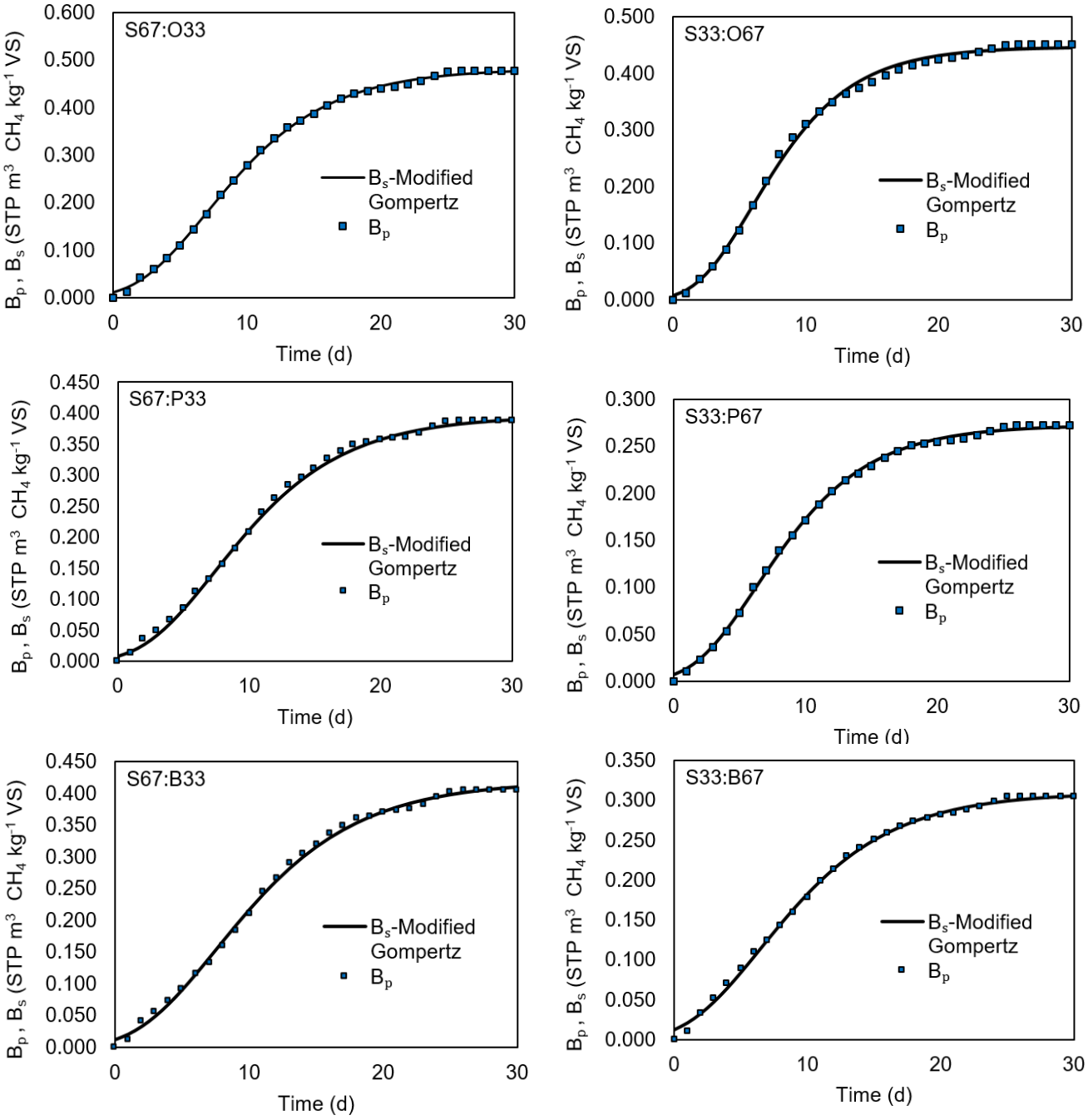
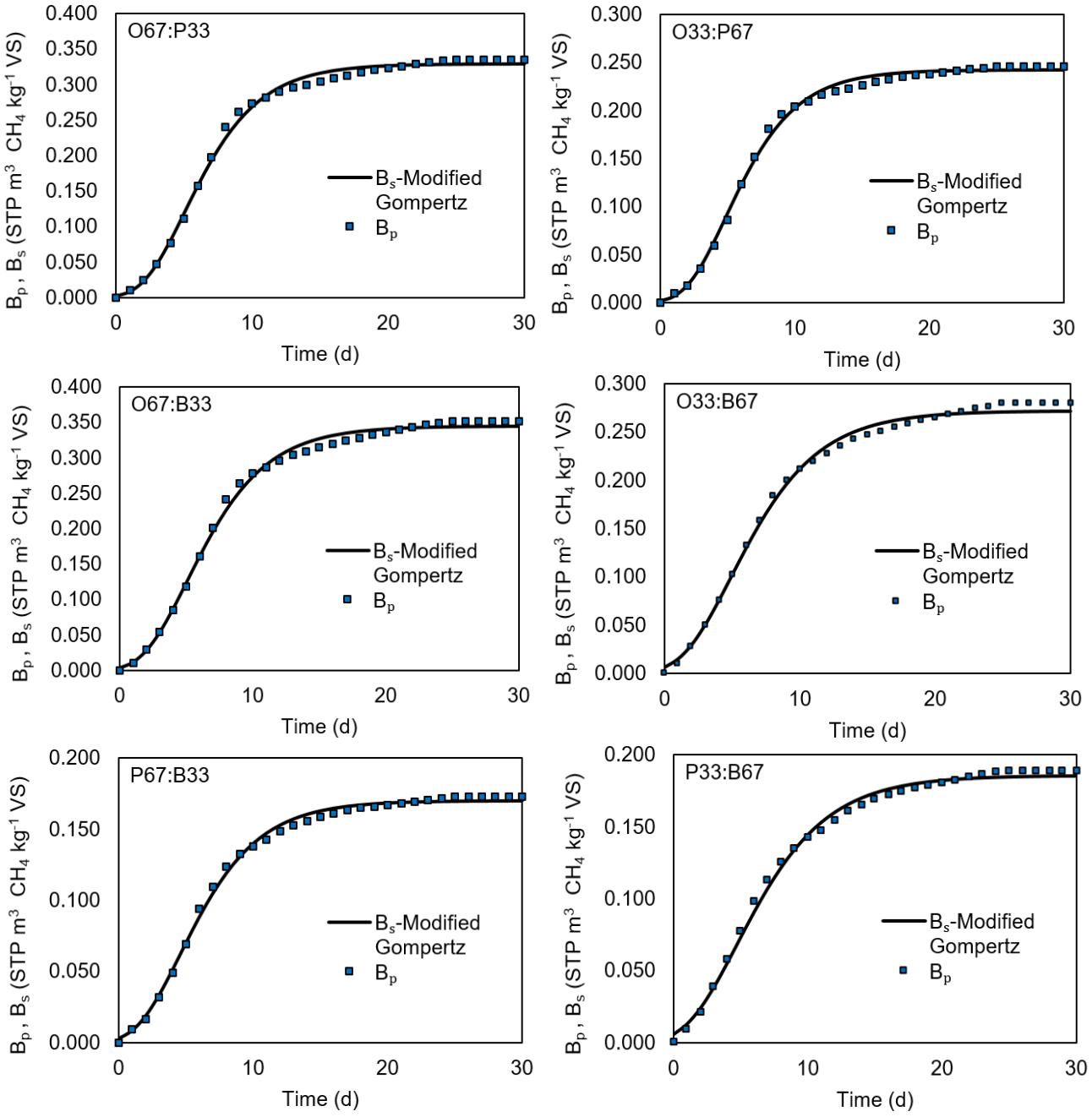


Figure S3. Predictive (B_p) accumulative CH_4 production of AcoD of slaughterhouse wastewater streams and bovine manure with the Modified Gompertz model fit. The letter represents the waste stream (S: slaughter wastewater; O: offal wastewater; P: paunch wastewater; B: bovine manure) and the number its %VS in the mixture.



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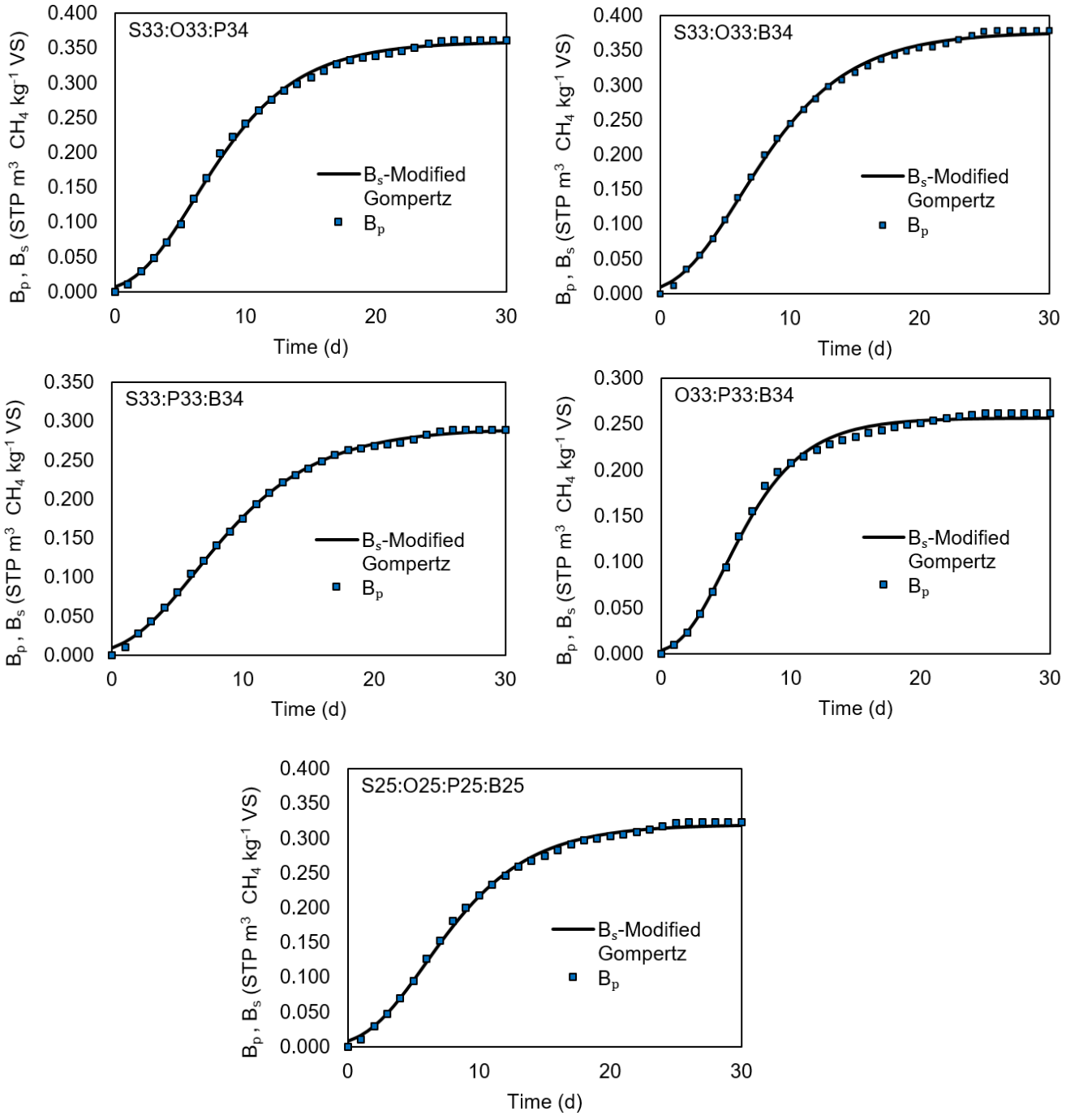

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Table S1. Summary of NH_3 calculation data.

Mixture[a]	Final NH_4^+ (mg L^{-1})	Final pH	I[b] (mol L^{-1})	γ_1[c]	Final NH_3 (mg L^{-1})
S100	244.01	7.80	0.0095	0.90	21.82
O100	86.28	7.92	0.0035	0.94	10.62
P100	99.78	7.71	0.0038	0.94	7.48
B100	213.44	7.38	0.0079	0.91	7.24
S67:O33	175.23	7.80	0.0068	0.92	15.89
S67:P33	184.83	7.80	0.0072	0.92	16.73
S67:B33	137.70	8.07	0.0058	0.92	23.73
S33:O67	126.32	7.93	0.0051	0.93	15.71
S33:P67	150.53	7.66	0.0057	0.92	9.91
S33:B67	154.86	7.99	0.0063	0.92	22.01
O67:P33	86.67	7.83	0.0034	0.94	8.64
O67:B33	83.76	7.71	0.0032	0.94	6.32
O33:P67	99.06	7.66	0.0038	0.94	6.62
O33:B67	122.13	7.76	0.0047	0.93	10.22
P67:B33	171.45	7.63	0.0065	0.92	10.48
P33:B67	214.64	7.44	0.0080	0.91	8.37
S33:O33:P34	118.35	7.13	0.0043	0.93	2.30
S33:P33:B34	182.59	7.32	0.0067	0.92	5.43
S33:O33:B34	133.89	7.05	0.0049	0.93	2.16
O33:P33:B34	108.02	7.06	0.0039	0.94	1.79
S25:O25:P25:B25	132.94	7.27	0.0049	0.93	3.56

a. The letter represents the waste stream (S: slaughter wastewater; O: offal wastewater; P: paunch wastewater; B: bovine manure) and the number its %VS in the mixture.

b. I: ionic strength.

c. γ_1: activity coefficient

Table S2. Standard error of the estimated parameters for the first-order model and the modified Gompertz model.

Mixture[a]	Standard Error First-Order model[b]		Standard Error Modified Gompertz model[b]		
	P (m^3 CH_4 kg^{-1} VS)	k_h (d^{-1})	P (m^3 CH_4 kg^{-1} VS)	λ (d)	R_{max} (m^3 CH_4 kg^{-1} VS d^{-1})
S100	15.7%	21.1%	1.3%	7.1%	2.4%
O100	6.4%	13.3%	0.7%	5.1%	2.9%
P100	3.6%	10.8%	0.5%	5.9%	2.9%
B100	5.3%	10.1%	1.4%	9.2%	3.3%
S67:O33	5.9%	10.8%	0.7%	6.5%	2.0%
S67:P33	5.7%	9.8%	1.7%	46.3%	3.6%
S67:B33	3.5%	8.0%	*0.6%*	*11.6%*	*2.1%*
S33:O67	17.9%	24.0%	0.9%	3.2%	1.9%
S33:P67	3.4%	6.0%	1.0%	41.4%	1.8%
S33:B67	1.8%	4.8%	*0.8%*	*43.4%*	*3.4%*
O67:P33	9.7%	16.3%	0.8%	4.6%	2.4%
O67:B33	5.8%	12.2%	1.0%	2.5%	2.3%
O33:P67	8.3%	14.7%	0.6%	3.4%	1.9%
O33:B67	4.2%	9.4%	0.7%	8.9%	2.4%
P67:B33	0.7%	1.7%	*0.8%*	*20.9%*	*2.6%*
P33:B67	1.2%	2.9%	*0.7%*	*26.6%*	*1.8%*
S33:O33:P34	6.2%	11.6%	0.8%	12.2%	2.4%
S33:P33:B34	1.7%	4.3%	0.7%	70.5%	2.3%
S33:O33:B34	12.7%	17.4%	2.3%	13.3%	3.5%
O33:P33:B34	4.4%	7.9%	0.6%	10.2%	1.6%
S25:O25:P25:B25	6.8%	10.2%	1.5%	15.6%	2.9%

a. The letter represents the waste stream (S: slaughter wastewater; O: offal wastewater; P: paunch wastewater; B: bovine manure) and the number its %VS in the mixture.

b. P: maximum specific CH_4 yield; k_h: apparent hydrolysis rate coefficient; λ: Lag-phase; R_{max}: Maximum specific CH_4 production rate.

Table S3. Energetic evaluation for the mono-digestion scenario.

Waste[a]	Flow ($m^3\ d^{-1}$)	BMP Assay Duration (d)	λ (d)	HRT Estimated (d)	Digester Volume (m^3)	Electrical Energy Potential (kWh $month^{-1}$)	Thermal Energy Potential (kWh $month^{-1}$)
SWW	4.5	29	2.2	26.8	161.8	1,310.18	4,192.58
OWW	11.2	25	2.0	23.0	341.9	3,898.71	12,475.89
PWW	13.9	21	1.8	19.2	356.8	2,576.33	8,244.25
BM	0.8	28	1.1	26.9	27.6	1,834.55	5,870.57
Total					888.1	9,619.78	30,783.29

a. SWW: slaughter wastewater; OWW: offal wastewater; PWW: paunch wastewater; BM: bovine manure.

Table S4. Economic evaluation for electrical energy generation in the mono-digestion scenario.

Year	Operative Labour (US$)	Electricity Generator Maintenance (US$)	Electricity Savings (US$)	Saving in Waste Management (US$)	Benefits (US$)	Cash Flow (US$)
0	0	0	0	0	-90,892.89	-90,892.89
1	4,379.93	1,710.78	13,210.22	14,233.50	21,353.01	-69,539.88
2	4,548.56	1,710.78	13,718.81	14,781.49	22,240.96	-47,298.92
3	4,723.67	1,710.78	14,246.98	15,350.58	23,163.11	-24,135.81
4	4,905.54	1,710.78	14,795.49	15,941.57	24,120.75	-15.06
5	5,094.40	1,710.78	15,365.12	16,555.33	25,115.26	25,100.20
6	5,290.53	1,710.78	15,956.68	17,192.71	26,148.07	51,248.27
7	5,494.22	1,710.78	16,571.01	17,854.62	27,220.63	78,468.90
8	5,705.75	1,710.78	17,208.99	18,542.03	28,334.49	106,803.39
9	5,925.42	1,710.78	17,871.54	19,255.90	29,491.23	136,294.62
10	6,153.55	1,710.78	18,559.59	19,997.25	30,692.51	166,987.14
					PBP[a] (years)	5
					NPV[a] (US$)	56,962.88
					IRR[a] (%)	23.28

a. PBP: payback period; NPV: net present value; IRR: internal rate of return.

Table S5. Economic evaluation for thermal energy generation in the mono-digestion scenario.

Year	Operative Labour (US$)	Gas Natural Savings ($US)	Saving in Waste Management ($US)	Benefits (US$)	Cash Flow (US$)
0	0.00	0.00	0.00	-85,252.89	-85,252.89
1	4,379.93	10,001.13	14,233.50	19,854.71	-65,398.18
2	4,548.56	10,386.18	14,781.49	20,619.11	-44,779.07
3	4,723.67	10,786.05	15,350.58	21,412.95	-23,366.13
4	4,905.54	11,201.31	15,941.57	22,237.35	-1,128.78
5	5,094.40	11,632.56	16,555.33	23,093.48	21,964.71
6	5,290.53	12,080.41	17,192.71	23,982.58	45,947.29
7	5,494.22	12,545.51	17,854.62	24,905.91	70,853.20
8	5,705.75	13,028.51	18,542.03	25,864.79	96,717.99
9	5,925.42	13,530.11	19,255.90	26,860.58	123,578.58
10	6,153.55	14,051.02	19,997.25	27,894.72	151,473.29
				PBP[a] (years)	5
				NPV[a] (US$)	50,894.00
				IRR[a] (%)	22.77

a. PBP: payback period; NPV: net present value; IRR: internal rate of return.

Table S6. Energetic evaluation for the AcoD scenario.

Mixture[a]	Flow (m^3 d^{-1})	BMP Assay Duration (d)	λ (d)	HRT Estimated (d)	Digester Volume (m^3)	Electrical Energy Potential (kWh $month^{-1}$)	Thermal Energy Potential (kWh $month^{-1}$)
S33:O33:P34	3.5	26	1.1	24.9	117.6	1,356.15	4,339.69
S33:P33:B34	2.5	18	0.2	17.8	59.3	991.90	3,174.07
S25:O25:P25:B25	2.8	26	0.9	25.1	94.3	1,173.92	3,756.55
O33:P67	11.2	23	1.7	21.3	318.8	3,933.23	12,586.32
O33:B67	5.0	21	1.2	19.8	133.0	3,738.51	11,963.23
P100	5.3	21	1.8	19.2	135.5	978.54	3,131.31
Total					858.5	12,172.25	38,951.19

a. The letter represents the waste stream (S: slaughter wastewater; O: offal wastewater; P: paunch wastewater; B: bovine manure) and the number its %VS in the mixture.

The synergistic mixtures S67:O33 and S33:P67 was not evaluated since SWW has the lowest flow and was totally included in ternary mixtures. Likewise, due to PWW has the highest flow, there is a remnant, which should be mono-digested.

Table S7. Economic evaluation for electrical energy generation in the AcoD scenario.

Year	Operative Labour (US$)	Electricity Generator Maintenance (US$)	Electricity Savings (US$)	Saving in Waste Management ($US)	Benefits (US$)	Cash Flow (US$)
0	0.00	0.00	0.00	0.00	-88,053.05	-88,053.05
1	4,379.93	2,164.71	16,715.35	14,233.50	24,404.21	-63,648.84
2	4,548.56	2,164.71	17,358.90	14,781.49	25,427.12	-38,221.72
3	4,723.67	2,164.71	18,027.21	15,350.58	26,489.40	-11,732.32
4	4,905.54	2,164.71	18,721.26	15,941.57	27,592.59	15,860.27
5	5,094.40	2,164.71	19,442.03	16,555.33	28,738.24	44,598.51
6	5,290.53	2,164.71	20,190.55	17,192.71	29,928.01	74,526.52
7	5,494.22	2,164.71	20,967.88	17,854.62	31,163.58	105,690.10
8	5,705.75	2,164.71	21,775.15	18,542.03	32,446.72	138,136.81
9	5,925.42	2,164.71	22,613.49	19,255.90	33,779.26	171,916.07
10	6,153.55	2,164.71	23,484.11	19,997.25	35,163.10	207,079.17
					PBP[a] (years)	4
					NPV[a] (US$)	79,675.98
					IRR[a] (%)	28.48

a. PBP: payback period; NPV: net present value; IRR: internal rate of return.

Table S8. Economic evaluation for thermal energy generation in the AcoD scenario.

Year	Operative Labour (US$)	Gas Natural Savings (US$)	Saving in Waste Management (US$)	Benefits (US$)	Cash Flow (US$)
0	0.00	0.00	0.00	-82,413.05	-82,413.05
1	4,379.93	12,654.79	14,233.50	22,508.36	-59,904.69
2	4,548.56	13,142.00	14,781.49	23,374.93	-36,529.76
3	4,723.67	13,647.96	15,350.58	24,274.87	-12,254.89
4	4,905.54	14,173.41	15,941.57	25,209.45	12,954.56
5	5,094.40	14,719.09	16,555.33	26,180.01	39,134.57
6	5,290.53	15,285.77	17,192.71	27,187.94	66,322.51
7	5,494.22	15,874.27	17,854.62	28,234.68	94,557.19
8	5,705.75	16,485.43	18,542.03	29,321.71	123,878.91
9	5,925.42	17,120.12	19,255.90	30,450.60	154,329.51
10	6,153.55	17,779.25	19,997.25	31,622.95	185,952.46
				PBP[a] (years)	4
				NPV[a] (US$)	70,636.35
				IRR[a] (%)	27.71

a. PBP: payback period; NPV: net present value; IRR: internal rate of return.