Data on the effect of co-fermentation of maize and leguminous crops on biogas production, methane production and methane content in biogas

Authors

Antonín Kintl [1], Igor Huňady [1], Julie Sobotková [1], Tomáš Vítěz [2], Martin Brtnický [3], Karel Vejražka [1], Jakub Elbl [1,4*]

Affiliations

[1] Agricultural Research, Ltd., Zahradní 400/1, 66441 Troubsko, Czech Republic; kintl@vupt.cz, hunady@vupt.cz, sobotkova@vupt.cz, vejrazka@vupt.cz

[2] Department of Agricultural, Food and Environmental Engineering, Faculty of AgriSciences, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic; tomas.vitez@mendelu.cz

[3] Department of Agrochemistry, Soil Science, Microbiology and Plant Nutrition, Faculty of AgriSciences, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic; martin.brtnicky@seznam.cz

[4] Department of Agrosystems and Bioclimatology, Faculty of AgriSciences, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic jakub.elbl@mendelu.cz

Corresponding author's email address and Twitter handle

*jakub.elbl@mendelu.cz, Tel.: +420 545 133 086

Table 1: Overview of individual silage substrates and their acronyms Percentage of maize and leguminous in the substrate and its average density

Silage	Acronym	Percentage of Maize in silage	Percentage of legumes in silage	Average density of silage in DM (kg/m^3)
Maize	MA	100	0	173.9
Maize + White sweet clover	MA+WSC	70	30	166.6
Maize + White lupin	MA+LU	70	30	150.2
Maize + Fodder vetch	MA+VE	70	30	168

Table 2: Average content of VS (%TS), NDF, ADF, CF, starch, cellulose, hemicellulose, CP, lipids and ADL (%DM) in the prepared silages.

VARIANT	DM (%)	VS (%TS)	NDF	ADF	CF	STARCH	ASH	CELLULOSIS	HEMI-CELLULOSIS	CP	LIPIDS	ADL
MA	33.70	95.87	32.65	20.41	15.19	15.57	3.95	19.49	12.95	10.34	2.25	0.36
MA+LU	30.53	95.00	33.25	22.42	15.91	34.99	4.25	23.42	11.04	12.31	3.38	0.6
MA+VE	32.20	94.62	30.17	21.78	16.44	19.24	5.22	20.13	13.14	13.44	2.86	0.99
MA+WSC	32.46	95.09	39.23	26.62	22.22	29.33	3.98	27.87	12.37	9.03	2.75	0.32

Legend to Table 2: Mean of measured values (n = 3). All parameters were recalculated to sample dry weight (DM). MA – Maize, WSC – White sweet clover, LU – White lupin, VE – Fodder vetch. VS (volatile solids) NDF (Neutral Detergent Fibre), ADF (Acid Detergent Fibre), CF (Crude Fibre), CP (crude protein), ADL (Acid Detergent Lignin).

Table 3: Biogas during 21 days of the experiment (average values for every day of measurement, n = 3 for one measurement, ± SD).

Day of sampling	Biogas cumulative (m3/kgVS)							
	MA		MA+LU		MA+VE		MA+WSC	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
1	0.176060	0.004253	0.177326	0.002850	0.180931	0.002254	0.145483	0.002035
2	0.345953	0.002450	0.357232	0.002350	0.367521	0.005638	0.309844	0.003701
3	0.466238	0.011500	0.486861	0.004408	0.491411	0.003805	0.421481	0.002222
4	0.545272	0.004327	0.593742	0.004680	0.568578	0.004019	0.513039	0.004185
5	0.581582	0.002986	0.649182	0.002300	0.608268	0.002809	0.577608	0.003042
6	0.603262	0.001886	0.699730	0.002753	0.640347	0.001622	0.604487	0.002508
7	0.605342	0.002201	0.736565	0.002757	0.647462	0.002181	0.630821	0.002100
8	0.602575	0.001501	0.772595	0.001809	0.648680	0.002453	0.656299	0.002951
9	0.608310	0.001500	0.805412	0.002651	0.659133	0.002003	0.673267	0.002350
10	0.608767	0.001553	0.837356	0.002671	0.658843	0.003187	0.680978	0.002644
11	0.609243	0.001126	0.867895	0.003046	0.666441	0.003127	0.689156	0.002605
12	0.616252	0.002556	0.888085	0.002467	0.673571	0.003100	0.694067	0.002802
13	0.622895	0.003120	0.910824	0.003118	0.676955	0.002211	0.693729	0.003829
14	0.631310	0.001554	0.931975	0.004854	0.684204	0.003874	0.694163	0.003455
15	0.636358	0.003010	0.946380	0.005470	0.692504	0.003459	0.699863	0.004571
16	0.640246	0.001204	0.955533	0.006600	0.701670	0.003549	0.699387	0.006143
17	0.642287	0.001408	0.969705	0.008774	0.707749	0.002439	0.696744	0.005647
18	0.640859	0.002085	0.982526	0.007766	0.713883	0.001714	0.706819	0.006203
19	0.638498	0.002649	0.994880	0.006896	0.720517	0.001027	0.712708	0.011901
20	0.635037	0.002725	1.000001	0.012159	0.726918	0.002410	0.715697	0.014069
21	0.631323	0.004017	1.025896	0.028969	0.730861	0.003401	0.718208	0.014553

Legend to Table 3: MA = Maize, MA+LU = Maize+White Lupin, MA+VE = Maize+Vetch, MA+WSC = Maize+White Sweet Clover

Table 4: Methane yield during 21 days of the experiment (average values for every day of measurement, n = 3 for one measurement, ± SD).

Day of sampling	Methane cumulative (m^3/kg_{VS})							
	MA		MA+LU		MA+VE		MA+WSC	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
1	0.021882	0.001001	0.021674	0.000901	0.062363	0.000850	0.044822	0.000910
2	0.088469	0.001201	0.080435	0.000863	0.136737	0.000755	0.131153	0.000935
3	0.147838	0.001265	0.134458	0.001105	0.197275	0.001093	0.205148	0.000905
4	0.189370	0.001679	0.168599	0.001411	0.237218	0.001151	0.266545	0.001602
5	0.208120	0.001651	0.184552	0.001350	0.256157	0.001402	0.311347	0.001802
6	0.218814	0.001895	0.204778	0.001407	0.270052	0.001702	0.329086	0.001507
7	0.219953	0.001803	0.211941	0.001503	0.273328	0.002104	0.345563	0.001761
8	0.220267	0.001950	0.216064	0.001504	0.274228	0.003013	0.360800	0.001453
9	0.221722	0.001809	0.225874	0.001601	0.278652	0.002414	0.371014	0.001607
10	0.222033	0.001986	0.227589	0.001607	0.277131	0.001573	0.371414	0.002255
11	0.222200	0.002117	0.234788	0.001753	0.280078	0.001767	0.375742	0.002540
12	0.225863	0.002115	0.241130	0.001791	0.284074	0.001836	0.378729	0.002484
13	0.229552	0.002145	0.247607	0.001807	0.286708	0.001697	0.378195	0.002170
14	0.233516	0.001896	0.252740	0.001689	0.290606	0.001844	0.377931	0.002239
15	0.235775	0.001773	0.257616	0.001242	0.294743	0.001650	0.378571	0.002117
16	0.238000	0.002022	0.261783	0.001613	0.298869	0.001355	0.378605	0.002175
17	0.240066	0.001321	0.267150	0.002057	0.304080	0.001430	0.378671	0.002289
18	0.240099	0.001277	0.267283	0.002070	0.304280	0.001630	0.380404	0.002587
19	0.240132	0.001235	0.267283	0.002070	0.304380	0.001781	0.382938	0.002537
20	0.240132	0.001235	0.270258	0.002053	0.307277	0.002278	0.382973	0.002589
21	0.240133	0.001234	0.272463	0.002001	0.309174	0.002469	0.383008	0.002576

Legend to Table 4: MA = Maize, MA+LU = Maize+White Lupin, MA+VE = Maize+Vetch, MA+WSC = Maize+White Sweet Clover

Table 5: Methane content during 21 days of the experiment (average values for every day of measurement, n = 3 for one measurement, ± SD).

Day of sampling	Methane content (%)							
	MA		MA+LU		MA+VE		MA+WSC	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
1	12.424152	0.267913	12.219552	0.311523	34.475148	0.899313	30.818943	1.041131
2	25.571857	0.166395	22.515861	0.100012	37.212898	0.757047	42.330549	0.226614
3	31.725978	1.052357	27.617415	0.028913	40.147251	0.530639	48.673267	0.070645
4	34.729254	0.042130	28.398444	0.460714	41.723719	0.497142	51.958078	0.734403
5	35.784737	0.104106	28.429071	0.308667	42.113786	0.423930	53.904898	0.594117
6	36.271487	0.214820	29.266113	0.315362	42.173438	0.370785	54.441905	0.474908
7	36.334943	0.181008	28.775046	0.311974	42.216417	0.466839	54.780965	0.460543
8	36.553903	0.240541	27.966386	0.260056	42.276284	0.618577	54.974987	0.026846
9	36.448513	0.218840	28.045117	0.290952	42.276581	0.493454	55.106377	0.051462
10	36.472257	0.233588	27.180102	0.278479	42.063736	0.282546	54.540957	0.159651
11	36.471195	0.287832	27.053279	0.295061	42.025863	0.168312	54.521751	0.192823
12	36.650736	0.224343	27.152174	0.267719	42.174140	0.135668	54.566357	0.161243
13	36.854180	0.529766	27.185663	0.291268	42.352408	0.145400	54.516334	0.130811
14	36.989675	0.386377	27.119822	0.309237	42.473821	0.221035	54.444022	0.125907
15	37.052037	0.443124	27.222251	0.284349	42.562077	0.186929	54.093510	0.416012
16	37.173711	0.380740	27.398070	0.339280	42.594167	0.142528	54.136040	0.479928
17	37.377140	0.287560	27.552120	0.436408	42.964443	0.157147	54.349974	0.345540
18	37.465641	0.275972	27.205747	0.407541	42.623153	0.171874	53.821721	0.563832
19	37.609342	0.242198	26.866174	0.177284	42.244509	0.187449	53.736998	0.678122
20	37.814095	0.181640	27.027899	0.321750	42.271872	0.409659	53.520822	0.829850
21	38.036989	0.173363	26.568943	0.552826	42.304308	0.533550	53.339900	0.907643

Legend to Table 5: MA = Maize, MA+LU = Maize+White Lupin, MA+VE = Maize+Vetch, MA+WSC = Maize+White Sweet Clover