Supplementary Materials

Trace Elements Enhance High-Straw Dry Anaerobic Digestion: Microbial Mechanisms of Acidification Suppression and Biogas-Yield Improvement

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Table

Table S1 The solution of trace elements.

Table S2 Community roles in microbial ecological networks under different treatments.

Table S1 The solution of trace elements.

$FeCl_2 \cdot 4H_2O$	13.65 g
$CoCl_2 \cdot 6H_2O$	1.62 g
$NiCl_2 \cdot 6H_2O$	3.24 g
Water	——
Total Volume	500 mL

Table S2 Community roles in microbial ecological networks under different treatments.

Group	species	Phylum	Zi	Pi	Role
Control group	unclassified_g__Methanosaeta	Methanomicrobia	0	0	Peripheral
	unclassified_g__Methanobacterium	Methanobacteria	0	0	Peripheral
	Methanosarcina_mazei	Methanomicrobia	0	0	Peripheral
	Methanosarcina_mazei	Methanomicrobia	0	0	Peripheral
	unclassified_o__Methanomicrobiales	Methanomicrobia	0	0	Peripheral
	Methanobacterium_sp._Maddingley_MBC34	Methanobacteria	0	0	Peripheral
	Methanospirillum_hungatei	Methanomicrobia	0	0	Peripheral
	Methanobacterium_petrolearium	Methanobacteria	-1	0	Peripheral
	unclassified_g__Methanosaeta	Methanomicrobia	0	0	Peripheral
	unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	0	0	Peripheral
	unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	0	0	Peripheral
	unclassified_g__Methanosaeta	Methanomicrobia	0	0	Peripheral
	unclassified_f__Methanobacteriaceae	Methanobacteria	0	0	Peripheral
	unclassified_g__Methanobacterium	Methanobacteria	0	0	Peripheral
	unclassified_f__Methanobacteriaceae	Methanobacteria	0	0	Peripheral
	unclassified_g__Methanosaeta	Methanomicrobia	0	0	Peripheral
	unclassified_g__Methanobacterium	Methanobacteria	0	0	Peripheral
	Methanobacterium_formicicum	Methanobacteria	0	0	Peripheral
	unclassified_c__Thermoplasmata	Thermoplasmata	0	0	Peripheral
	Methanospirillum_hungatei	Methanomicrobia	0	0	Peripheral
	unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	-1	0	Peripheral
	unclassified_g__Methanobacterium	Methanobacteria	0	0	Peripheral
	environmental_samples_g__Methanosaeta	Methanomicrobia	0	0	Peripheral
	Methanobacterium_formicicum	Methanobacteria	0	0	Peripheral
	unclassified_g__Methanobacterium	Methanobacteria	0	0	Peripheral
	unclassified_o__Methanomicrobiales	Methanomicrobia	0	0	Peripheral
	Methanobacterium_formicicum	Methanobacteria	0	0	Peripheral
	unclassified_c__Thermoplasmata	Thermoplasmata	0	0	Peripheral
	uncultured_Methanobacteriales_archaeon	Methanobacteria	0	0	Peripheral
	unclassified_g__Methanobacterium	Methanobacteria	0	0	Peripheral
	Methanosarcina_barkeri	Methanomicrobia	0	0	Peripheral
	unclassified_o__Methanomicrobiales	Methanomicrobia	0	0	Peripheral

Methanobacterium_sp._Maddingley_MBC34	Methanobacteria	0	0	Peripheral
unclassified_o__Methanomicrobiales	Methanomicrobia	0	0	Peripheral
uncultured_Methanobacteriales_archaeon	Methanobacteria	0	0	Peripheral
unclassified_o__Methanomicrobiales	Methanomicrobia	0	0	Peripheral
Methanoculleus_marisnigri	Methanomicrobia	0	0	Peripheral
Methanoculleus_marisnigri	Methanomicrobia	0	0	Peripheral
Methanoculleus_chikugoensis	Methanomicrobia	0	0	Peripheral
unclassified_g__Methanoculleus	Methanomicrobia	0	0	Peripheral
Methanofollis_ethanolicus	Methanomicrobia	0	0	Peripheral
unclassified_g__Methanoculleus	Methanomicrobia	0	0	Peripheral
unclassified_g__Methanolinea	Methanomicrobia	0	0	Peripheral
Methanoculleus_chikugoensis	Methanomicrobia	0	0	Peripheral
Methanoculleus_marisnigri	Methanomicrobia	0	0	Peripheral
Methanoculleus_chikugoensis	Methanomicrobia	0	0	Peripheral
unclassified_c__Thermoplasmata	Thermoplasmata	0	0	Peripheral
Methanoculleus_bourgensis	Methanomicrobia	0	0	Peripheral
unclassified_g__Methanobacterium	Methanobacteria	0	0	Peripheral
unclassified_o__Methanobacteriales	Methanobacteria	1	0	Peripheral
unclassified_g__Methanobacterium	Methanobacteria	0	0	Peripheral
unclassified_f__Methanobacteriaceae	Methanobacteria	0	0	Peripheral
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	0	0	Peripheral
unclassified_o__Methanomicrobiales	Methanomicrobia	0	0	Peripheral
Methanoculleus_bourgensis	Methanomicrobia	0	0	Peripheral
Methanosaeta_harundinacea	Methanomicrobia	0	0	Peripheral
Methanosaeta_harundinacea	Methanomicrobia	0	0	Peripheral
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	0	0	Peripheral
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	0	0	Peripheral
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	0	0	Peripheral
Methanobacterium_petrolearium	Methanobacteria	0	0	Peripheral
unclassified_g__Methanoculleus	Methanomicrobia	1	0	Peripheral
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	0	0	Peripheral
Methanoculleus_marisnigri	Methanomicrobia	0	0	Peripheral

	environmental_samples_g__Methanosaeta	Methanomicrobia	-1.414213562	0	Peripheral
	unclassified_f__Methanomicrobiaceae	Methanomicrobia	0	0	Peripheral
	unclassified_f__Methanomicrobiaceae	Methanomicrobia	0	0	Peripheral
	unclassified_g__Methanobacterium	Methanobacteria	0	0	Peripheral
	Methanoculleus_sp._S3Fa	Methanomicrobia	0	0	Peripheral
	unclassified_o__Methanomicrobiales	Methanomicrobia	0	0	Peripheral
	unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	1.414213562373095	0	Peripheral
	unclassified_g__Methanobacterium	Methanobacteria	0	0	Peripheral
	unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	0	0	Peripheral
	unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	0	0	Peripheral
	unclassified_g__Methanosaeta	Methanomicrobia	-1.200093761	0.64	Connectors
	unclassified_g__Methanobacterium	Methanobacteria	-1.577124465	0.7222222222	Connectors
	Methanobacterium_formicicum	Methanobacteria	-0.540061725	0.7160493843	Connectors
Treatment group	Methanospirillum_hungatei	Methanomicrobia	-1.423024947	0.72	Connectors
	unclassified_g__Methanoculleus	Methanomicrobia	-1.200093761	0.72	Connectors
	unclassified_g__Methanobacterium	Methanobacteria	-0.413150429	0.6419753099	Connectors
	unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	-0.991561031	0.6111111111	Peripherals
	unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	-0.548565031	0.5	Peripherals

Methanospirillum_hungatei	Methanomicrobia	-0.034285314	0.27777777778	Peripherals
Methanosaeta_harundinacea	Methanomicrobia	0.825064461	0.27777777778	Peripherals
unclassified_g__Methanobacterium	Methanobacteria	1.500117201	0.24489795 9	Peripherals
unclassified_g__Methanobacterium	Methanobacteria	-0.540061725	0.571428571	Peripherals
unclassified_o__Methanomicrobiales	Methanomicrobia	-0.540061725	0.32	Peripherals
unclassified_o__Methanomicrobiales	Methanomicrobia	1.08012345	0	Peripherals
unclassified_o__Methanomicrobiales	Methanomicrobia	-0.991561031	0.48	Peripherals
Methanobacterium_formicicum	Methanobacteria	1.08012345	0	Peripherals
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	1.08012345	0.24489795 9	Peripherals
Methanosarcina_mazei	Methanomicrobia	-1.569971632	0.48	Peripherals
Methanosarcina_mazei	Methanomicrobia	-1.350154312	0.56	Peripherals
Methanobacterium_petrolearium	Methanobacteria	0.743670773	0	Peripherals
unclassified_g__Methanobacterium	Methanobacteria	1.08012345	0.24489795 9	Peripherals
unclassified_f__Methanobacteriaceae	Methanobacteria	0.270030862	0	Peripherals
unclassified_o__Methanobacteriales	Methanobacteria	1.08012345	0	Peripherals
unclassified_g__Methanoculleus	Methanomicrobia	0.800326731	0.37037037	Peripherals

unclassified_o__Methanomicrobiales	Methanomicrobia	-0.548565031	0.32	Peripherals
unclassified_g__Methanosaeta	Methanomicrobia	-0.548565031	0.32	Peripherals
unclassified_f__Methanobacteriaceae	Methanobacteria	0.994274119	0	Peripherals
Methanobacterium_sp._Maddingley_MBC34	Methanobacteria	-0.540061725	0.5	Peripherals
environmental_samples_g__Methanosaeta	Methanomicrobia	0.270030862	0.27777778	Peripherals
Methanobacterium_sp._Maddingley_MBC34	Methanobacteria	0.270030862	0	Peripherals
unclassified_g__Methanobacterium	Methanobacteria	-1.569971632	0.611111111	Peripherals
unclassified_g__Methanobacterium	Methanobacteria	0.165260172	0.27777778	Peripherals
unclassified_f__Methanomicrobiaceae	Methanomicrobia	0.743670773	0	Peripherals
unclassified_g__Methanosaeta	Methanomicrobia	-0.158113883	0.32	Peripherals
Methanosarcina_barkeri	Methanomicrobia	-0.158113883	0.32	Peripherals
unclassified_c__Thermoplasmata	Thermoplasmata	-0.158113883	0.32	Peripherals
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	1.739252713	0.345679012	Peripherals
environmental_samples_g__Methanosaeta	Methanomicrobia	1.106797181	0.375	Peripherals
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	0.165260172	0.46875	Peripherals

Methanoculleus_marisnigri	Methanomicrobia	-2.160246899	0.48	Peripherals
Methanofollis_ethanolicus	Methanomicrobia	0.800326731	0.3456790122	Peripherals
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	-1.062844748	0.4897959188	Peripherals
unclassified_c__Thermoplasmata	Thermoplasmata	-0.158113883	0.5	Peripherals
unclassified_g__Methanosaeta	Methanomicrobia	0.165260172	0	Peripherals
uncultured_Methanobacteriales_archaeon	Methanobacteria	0.165260172	0	Peripherals
uncultured_Methanobacteriales_archaeon	Methanobacteria	0.743670773	0.2448979599	Peripherals
unclassified_o__Methanomicrobiales	Methanomicrobia	0.743670773	0.375	Peripherals
unclassified_f__Methanomicrobiaceae	Methanomicrobia	1.900491975	0	Peripherals
unclassified_f__Methanobacteriaceae	Methanobacteria	0.15001172	0.32	Peripherals
Methanosaeta_harundinacea	Methanomicrobia	0.15001172	0.32	Peripherals
unclassified_o__Methanomicrobiales	Methanomicrobia	0.825064461	0.4489795972	Peripherals
unclassified_g__Methanobacterium	Methanobacteria	0.15001172	0.32	Peripherals
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	1.508553836	0	Peripherals
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	1.508553836	0	Peripherals
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	1.508553836	0	Peripherals
Methanobacterium_formicicum	Methanobacteria	-0.540061725	0.32	Peripherals

Methanoculleus_bourgensis	Methanomicrobia	-1.257656291	0.44897959 2	Peripherals
unclassified_c__Thermoplasmata	Thermoplasmata	-0.790569415	0.56	Peripherals
Methanoculleus_chikugoensis	Methanomicrobia	1.829318242	0.42975206 6	Peripherals
unclassified_g__Methanoculleus	Methanomicrobia	-0.22866478	0.49382716	Peripherals
Methanoculleus_marisnigri	Methanomicrobia	-1.257656291	0.27777777 8	Peripherals
Methanoculleus_chikugoensis	Methanomicrobia	-0.22866478	0.24489795 9	Peripherals
Methanoculleus_marisnigri	Methanomicrobia	-0.22866478	0.40625	Peripherals
Methanoculleus_chikugoensis	Methanomicrobia	-0.22866478	0.24489795 9	Peripherals
unclassified_g__Methanolinea	Methanomicrobia	-0.548565031	0.44444444 4	Peripherals
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	0.479994402	0	Peripherals
Methanoculleus_bourgensis	Methanomicrobia	-1.200093761	0.40816326 5	Peripherals
unclassified_g__Methanobacterium	Methanobacteria	-0.034285314	0	Peripherals
unclassified_p__Euryarchaeota	unclassified_Euryarchaeota	-1.062844748	0.48	Peripherals
Methanobacterium_petrolearium	Methanobacteria	-0.034285314	0	Peripherals