ANAEROBIC DIGESTION OF FOOD WASTE

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MCCLURE
9/13/2018

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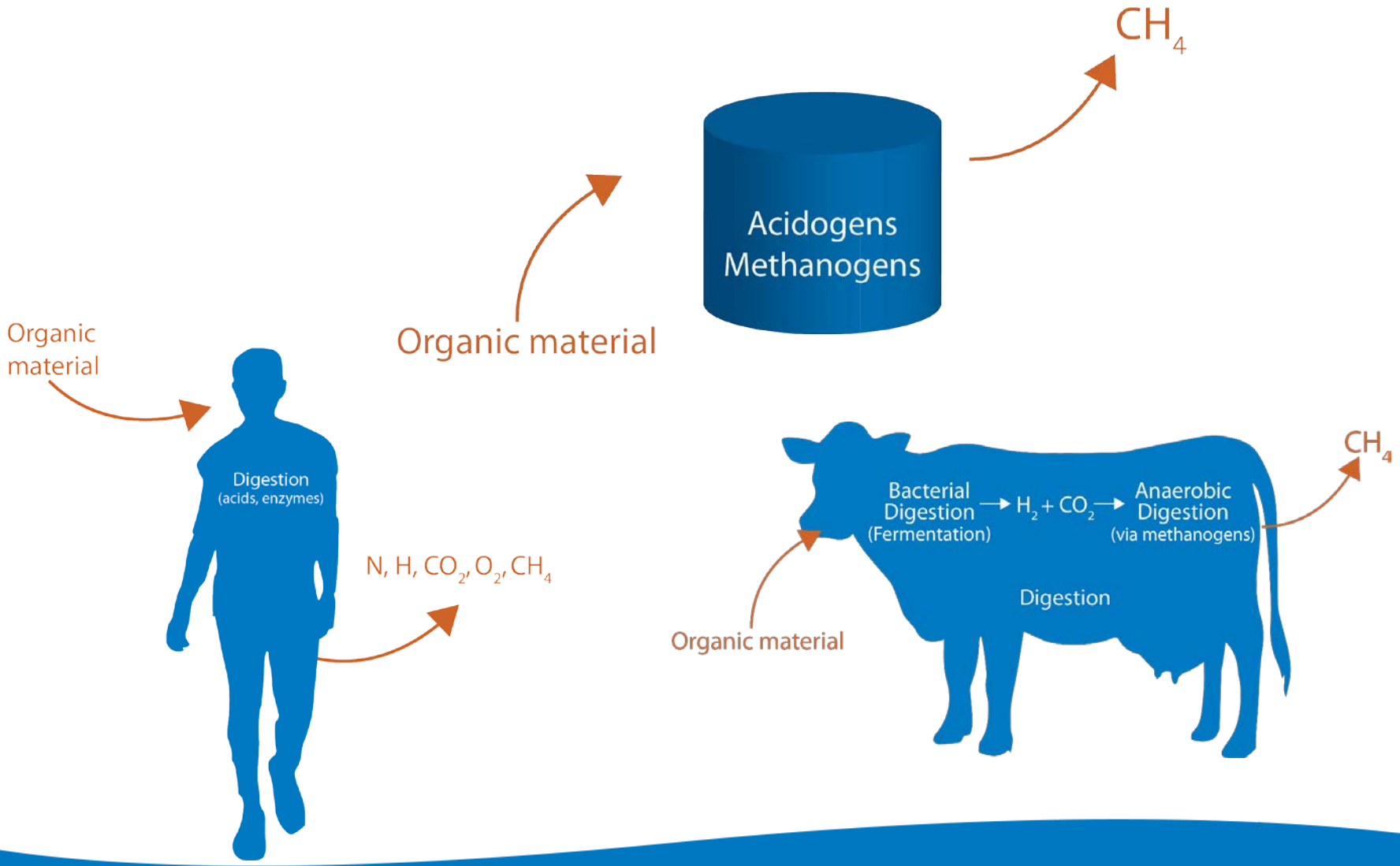
CH_4
Acidogens
Methanogens
Organic material
Organic material
Digestion
(acids, enzymes)
N, H, CO_2, O_2, CH_4
Bacterial
Digestion
(Fermentation)
$H_2 + CO_2$
Anaerobic
Digestion
(via methanogens)
CH_4
Digestion
Organic material

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FUEL UP ON FOOD WASTE

WATER ENVIRONMENT AND TECHNOLOGY (WE&T) – NOVEMBER 2017

- "Food waste is generated worldwide at a rate of about 0.3 kg (0.7 lb) per person per day."
- "More than 149 million Mg (164 million tons) of municipal solid waste was discarded in 2011, comprising approximately 21% food waste."
- "With its economic advantage, reduced emissions, and ability to decrease dependence on fossil fuels, the combination of food waste digestion and biogas purification would appear most beneficial."

Criteria	Landfilling	Incineration	Composting	Co-Digesting	Hog and Fish Feed	Pyrolysis	Gasification
Established technology	x	x	x	x	x		
Limited operator input	x	x	x	x	x		
Renewable Energy Generation	x	x		x		x	x
Produces valuable end product			x	x	x		
Low land requirement		x	x	x	x	x	x
Good public acceptance			x	x	x		
Treat large volumes	x	x	x	x		x	x
Scalable and portable			x	x			

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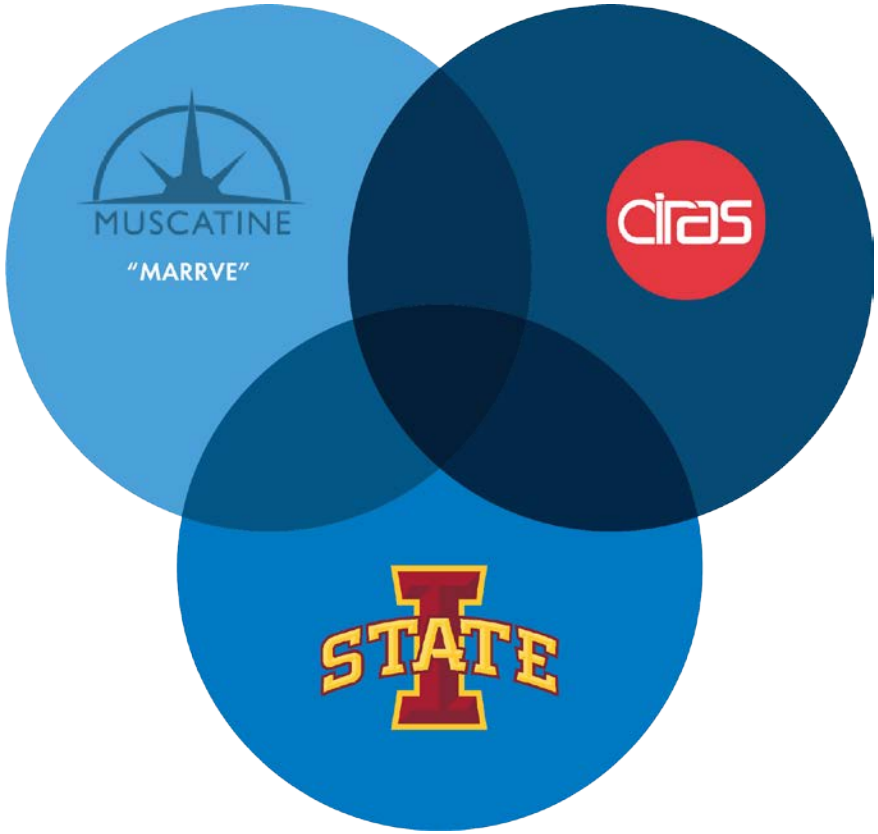
FOOD WASTE ANAEROBIC DIGESTION IN MUSCATINE WATER POLLUTION CONTROL PLANT



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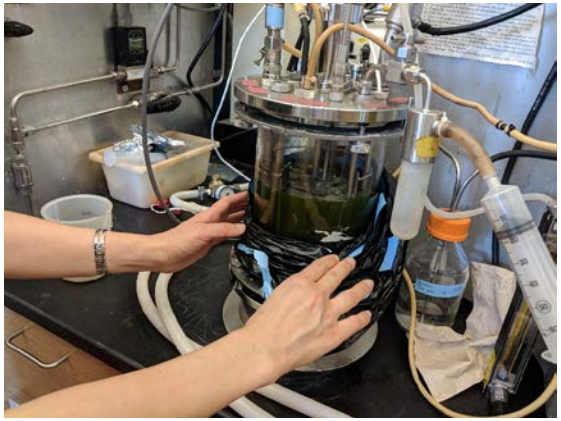
FOOD WASTE	Kraft Sauce
	HyVee Mix
	Purina Pet Food
FOOD/ FAT/OIL/ GREASE (FOG)	W. Liberty Food
	Kraft Deli
	Tyson Meat
	Kraft DAF
INDUSTRIAL	GPC G Starch
	GPC G Starch
	GPC Spent C



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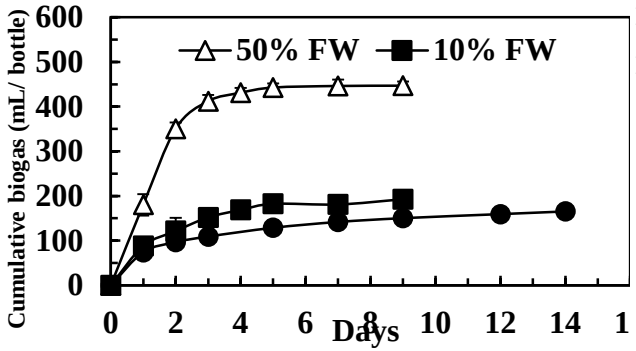
FOOD WASTE

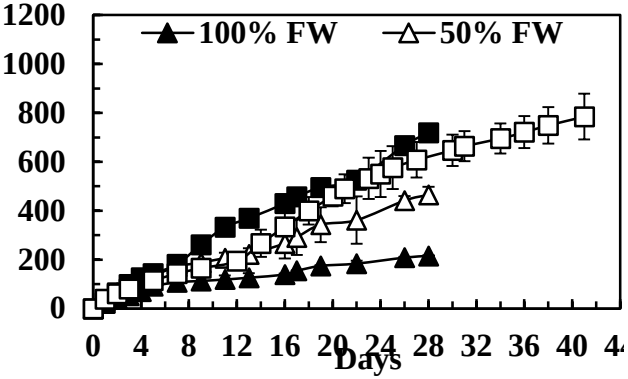
Purina Pet Food



Day	Methane content					
	50% FW		10% FW		1% FW	
	%	mL/bottle	%	mL/bottle	%	mL/bottle
5	0.0	0.0	0.2	0.37	5.5	7.1
7	0.2	0.9	0.2	0.36	18.4	26.1
9	0.6	2.7	0.2	0.37	16.9±4.3	25.4
12	-	-	-	-	24.5±0.9	39.0
14	-	-	-	-	23.8±1.5	39.3

FAT/OIL/GREASE

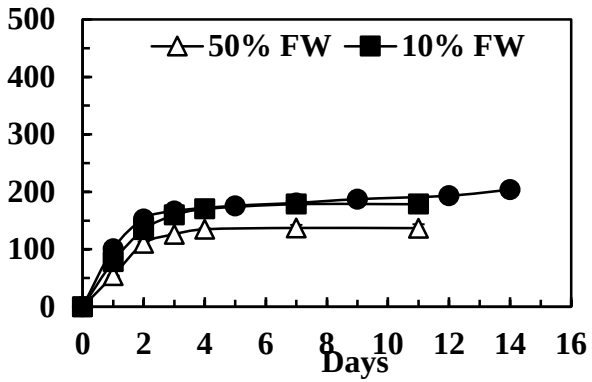
Kraft Heinz DAF



Day	Methane content							
	100% FW		50% FW		10% FW		5% FW	
	%	mL/bottle	%	mL/bottle	%	mL/bottle	%	mL/bottle
5	7.3	6.8	17.3	23.2	27.3	39.3	30.4	35
7	20.7±0.1	22.4	25.3±2.0	43.5	37.4±4.4	67.7	26.5	38.2
12	22.5±0.1	28.6	29.4±6.8	65.3	54. ±3.9	200.0	36.1±9.6	70.4
17	36.7±4.8	56.9	41.8±5.3	122.1	54.9±1.4	251.4	-	-
22	44.7±0.8	82.7	55.1±4.8	199.5	62.3±1.1	327.7	57.0±3.5	303.8
26	49.1±0.9	102.6	57.6±2.9	254.6	63.6±0.8	424.2	-	-
28	48.3±2.9	104.3	56.1±5.0	260.9	64.9±0.2	466.6	64.7±3.3	394.0
30	-	-	-	-	-	-	66.7±2.6	432.2
36	-	-	-	-	-	-	67.1±0.5	484.5
41	-	-	-	-	-	-	69.9±2.3	548.7

INDUSTRIAL

GPC Starch



Day	Methane content					
	50% FW		10% FW		1% FW	
	%	mL/bottle	%	mL/bottle	%	mL/bottle
4	0.2	0.3	0.2	0.3	-	-
7	0.3	0.4	0.2	0.4	4.6	8.3
11	0.3±0.3	0.4	1.7±1.8	3.0	-	-
12	-	-	-	-	12.9±0.1	24.9
14	-	-	-	-	16.9±4.0	34.5

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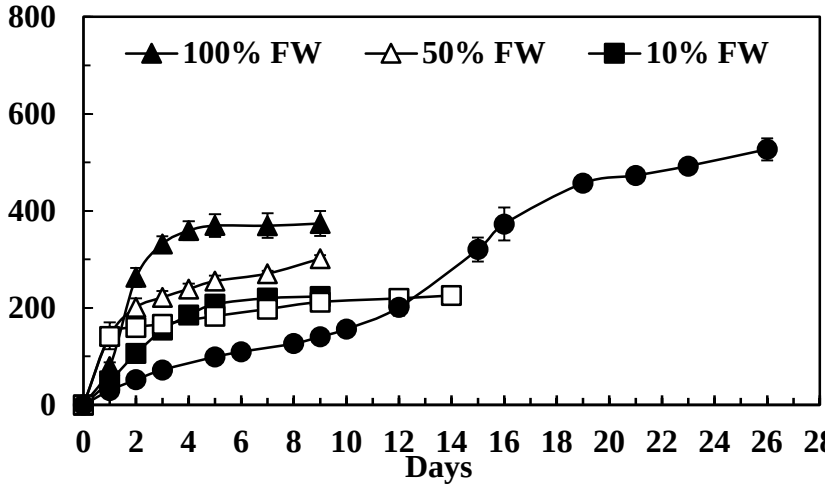
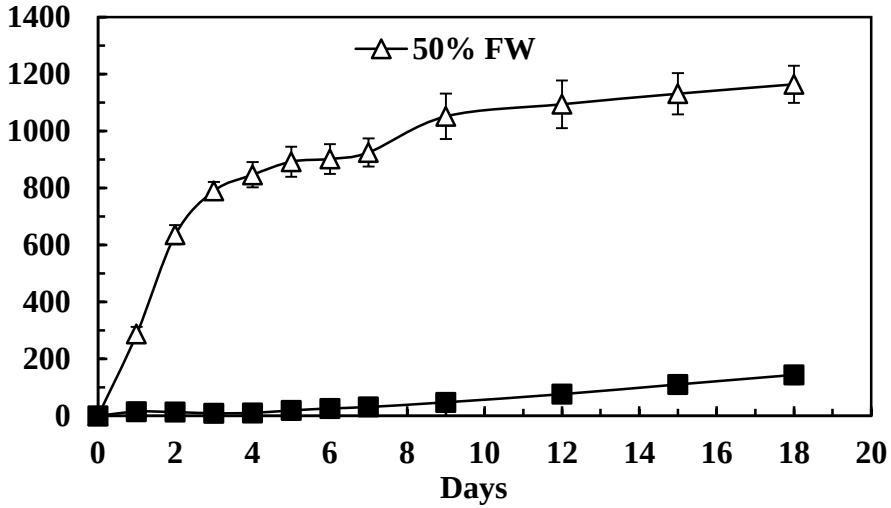
FOOD WASTE





No pH Adjust						
Day	**50% FW**		**10% FW**		**1% FW**	
	%	mL/bottle	%	mL/bottle	%	mL/bottle
5	0.1	0.26	7.9	16.43	30.4±1.3	30.1
7	0.1	0.27	10.5	23.1	-	-
9	0.1	0.3	12.3	27.55	34.1±0.7	48.08
12	-	-	-	-	49.7±3.2	100.39
14	-	-	-	-	-	-
21	-	-	-	-	62.7±1.5	296.57

pH Adjusted to 7.3				
Day	**50% FW**		**10% FW**	
	%	mL/bottle	%	mL/bottle
6	19.5	175.9	75.1	19.5
7	6.2±5.9	57.4	35.6±0.4	11
9	28.3±3.8	297.7	89.2±0.5	42.8
12	24.2±2.0	264.7	89.5±1.8	68
15	22.9±2.6	259	91.8±0.5	101
18	19.5±4.8	227	90.3±1.8	130

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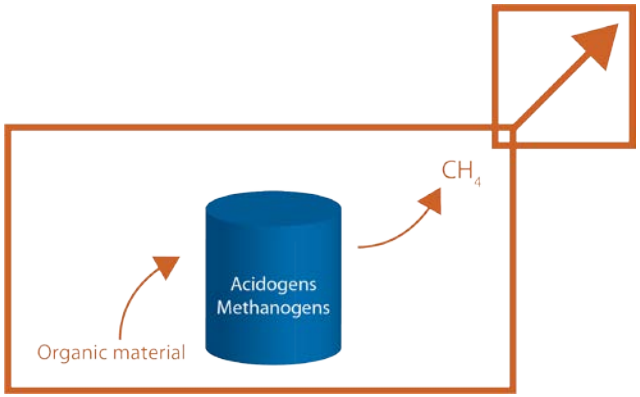
NEXT STEPS

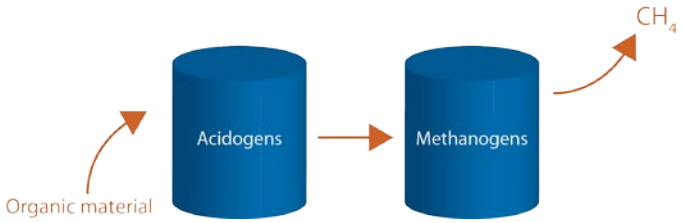
Scale up testing



Single phase

vs.

Multi phase



Best "recipe" for each metro

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THANK YOU!

Questions/comments/discussions

John Lee

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