Biogas Production from Poultry Hydrolysate

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INTRODUCTION

- Ambient alkaline hydrolysis (AMAHY) is a mortality management tool that uses ambient temperature and pressure to solubilize mortalities in alkaline solution.
- Management of caustic hydrolysate is a challenge.
- Anaerobic digestion is a microbiological process that converts organic substrates into methane-rich biogas, a renewable form of energy for use in heating, electrical generation, or transportation.

OBJECTIVES

1) Investigate efficacy of poultry mortality hydrolysate neutralization strategies.
2) Determine biochemical methane potential of hydrolysates produced using potassium hydroxide (KOH) or sodium hydroxide (NaOH).
3) Assess phytotoxicity of digestate after anaerobic digestion at different dilution rates.

METHODOLOGY

- Poultry mortality hydrolysates produced using either KOH or NaOH.
- Hydrolysates partially neutralized by titration with hydrochloric acid (HCl), sparging with waste carbon dioxide (CO_2), or mixing with corn silage. pH and electrical conductivity (EC) determined after serial dilution (**Table 1**).
- Neutralized hydrolysates or non-neutralized control hydrolysate was mixed with anaerobic inoculum (3:1, w/w) and used as substrate for a biochemical methane potential assay operated at 38 °C for 21 days. Methane volume was continuously measured through liquid displacement and buoyancy using an AMPTS II BioProcess flow cell array (**Figure 1**).
- Phytotoxicity of liquid digestate remaining after anaerobic digestion was estimated using tomato seeds. Digestate was used to wet filter paper and tomato seeds were placed on top within a petri dish, which was sealed and incubated at room temperature in the dark for 10 d. Seed germination and root elongation were measured daily to determine Germination Index (**Figure 2**).

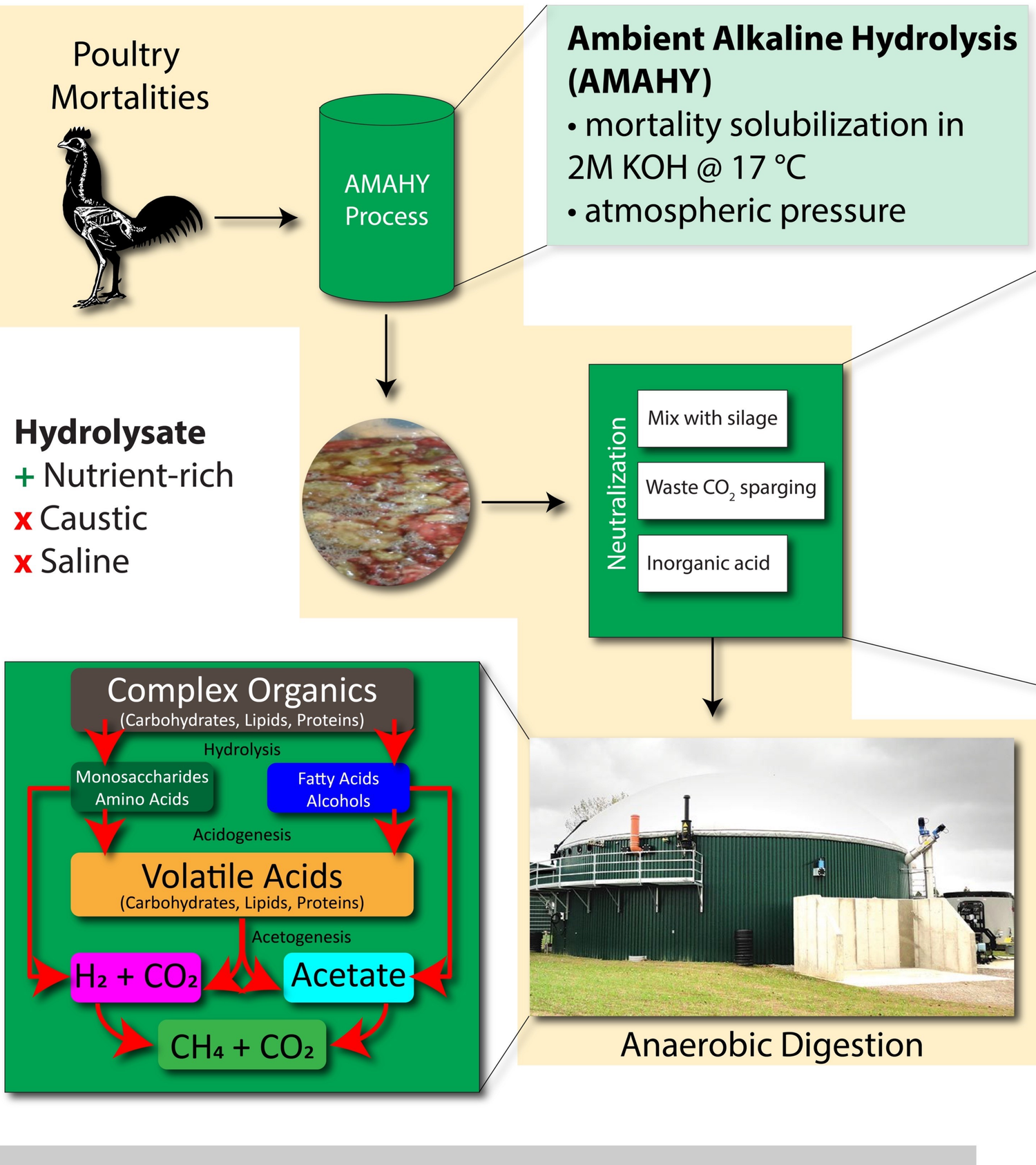

Table 1. Electrical conductivity (EC; mS cm^{-1}) and pH values of poultry mortality hydrolysate derived from potassium hydroxide (KOH) and sodium hydroxide (NaOH) according to neutralization treatment and dilution level.

		KOH				NaOH			
Parameter		Dilution Level							
Neutralization Treatment		10^0	10^{-1}	10^{-2}	10^{-3}	10^0	10^{-1}	10^{-2}	10^{-3}
SN[a]	pH	8.95	7.91	7.51	6.55	10.04	10.06	9.55	7.72
	EC	30.73	14.92	1.90	0.22	31.51	13.47	1.55	0.17
HN[b]	pH	6.94	7.12	6.8	6.8	7.13	7.51	7.26	6.58
	EC	138.90	17.48	2.02	0.23	121.30	17.61	2.25	0.25
CN[c]	pH	9.08	9.31	9.28	9.08	9.43	9.39	9.02	9.19
	EC	77.00	12.63	1.52	0.18	49.16	9.47	1.17	0.12
NDH[d]	pH	13.99	12.95	12.14	10.8	13.06	12.36	12.09	11.22
	EC	244.55	27.48	3.53	0.36	274.47	27.38	4.58	0.41

[a] SN: silage neutralized hydrolysate
[b] HN: hydrochloric acid neutralized hydrolysate
[c] CN: carbon dioxide neutralized hydrolysate
[d] NDH: non-neutralized hydrolysate

Figure 1. Cumulative methane production (A) and methane potential (B) of poultry mortality hydrolysate produced using potassium hydroxide (KOH) and then neutralized with either hydrocholoric acid (HCl), carbon dioxide (CO_2), silage, or non-neutralized.

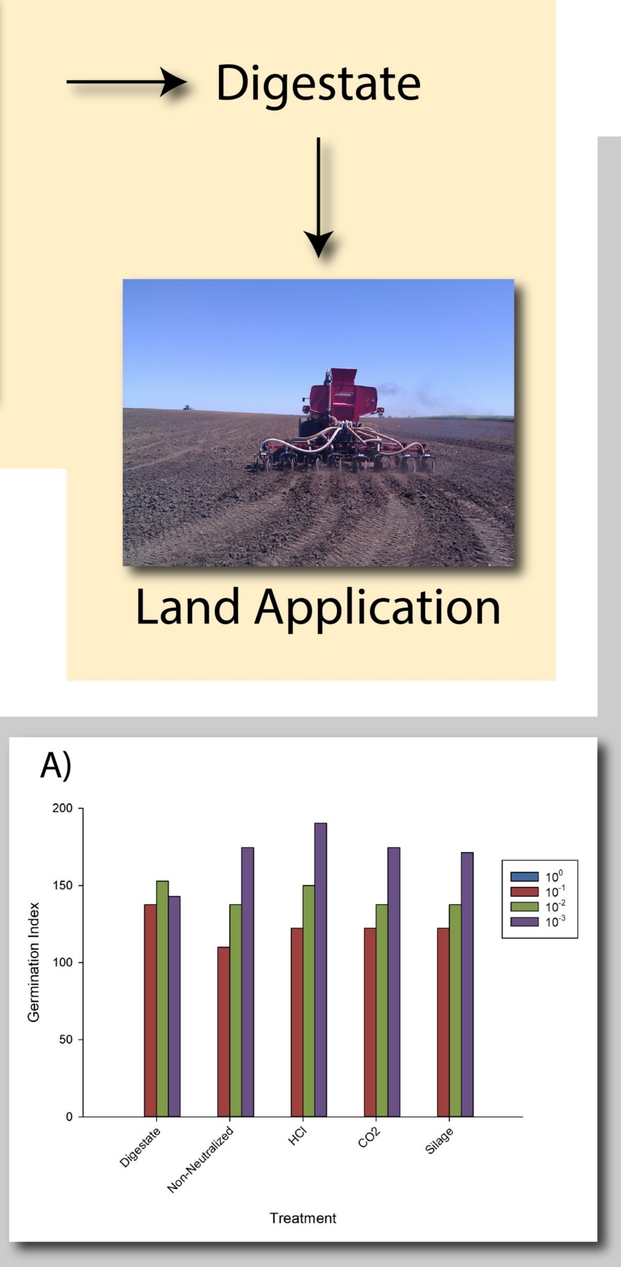

Figure 2. Germination index (A) for tomato seeds incubated with anaerobic digestate (control), non-neutralized poultry hydrolysate, or poultry hydrolysate neutralized with either hydrochloric acid (HCl), carbon dioxide (CO_2), or silage at 4 different serial diluion levels. Photographs of tomato seed germination (B) and root elongation after exposure to poultry hydrolysate neutralized with silage at different serial dilutions.

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