



Using Poultry-derived Biochar as Litter Amendment to Control Ammonia Emission

Hong Li¹, Mingxin Guo², Jonathan Moyle³

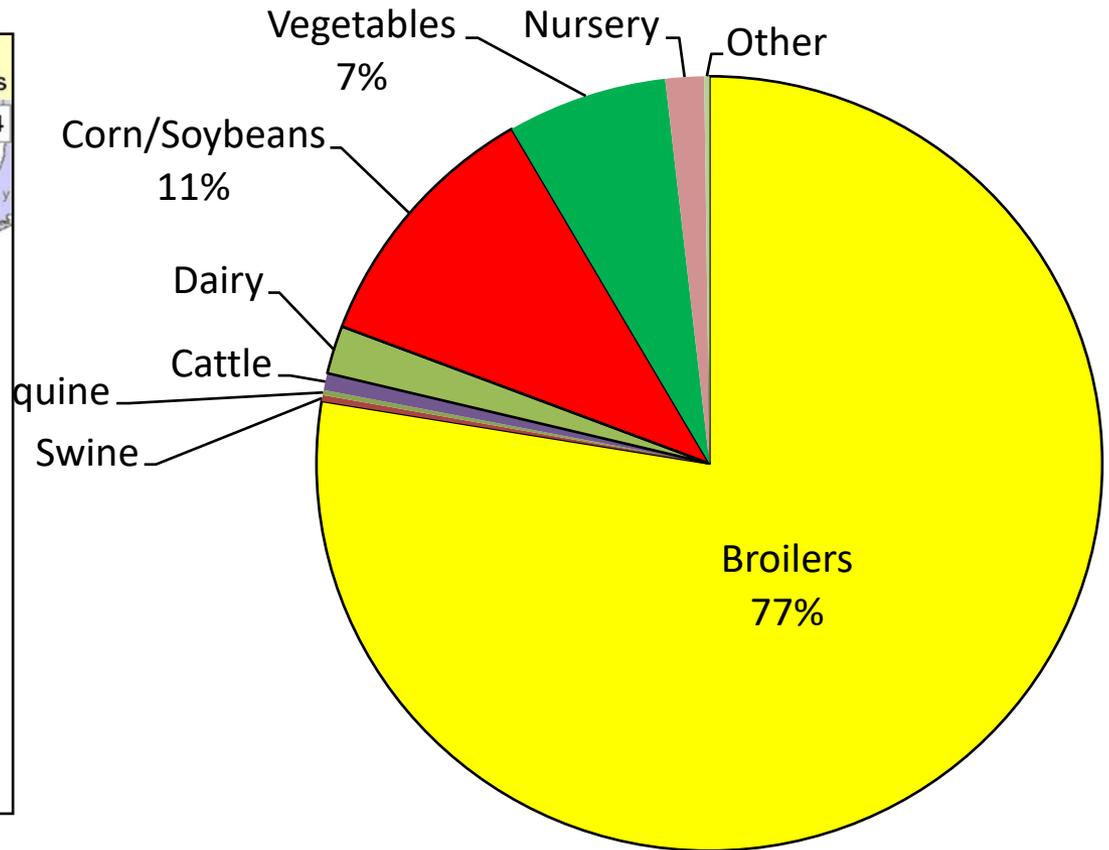
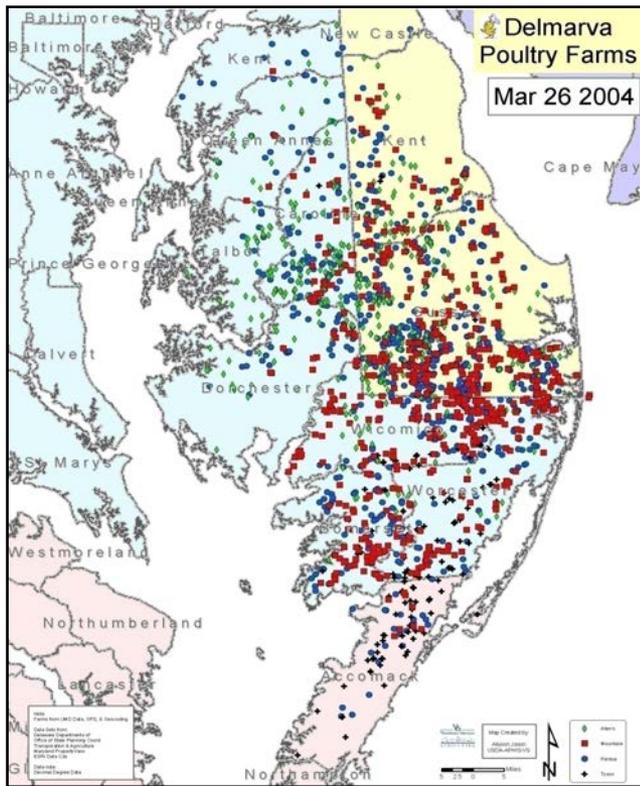
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Delmarva Poultry





Poultry Litter

- Concerns about poultry litter (PL) are multifaceted
 - Excessive nutrient and emission sources (i.e. NH_3)
- Alternative use of PL as biochar to control NH_3
 - Pyrolysis of PL
 - PL biochar as litter amendment
 - Derived from PL
 - Acidified with H_2SO_4



Objectives

1. Evaluate and delineate the efficacy of PL-derived biochar compared to other litter amendment on NH_3 emission.
2. Conduct verification tests in environmentally controlled emission chambers on bird health, production performance, and air quality and emissions.



Materials and Methods



Objective 1

- PL biochar produced by 400°C slow pyrolysis of pelletized PL
- PL biochar acidified by soaking in 6M H₂SO₄ at 1:1 w/w solid/solution ratio for 1 h at room temperature
- PL biochar dried at 105°C



Objective 1

- Air emission vessels
 - Each vessel (19 L)contained 2 kg litter
 - NH_3 concentration was measured by a photoacoustic analyzer with auto air sampling system
 - The biochar or PLT was applied on litter surface





Objective 1

- NH_3 reduction test
 - Experiment 1: Acidified PL biochar vs. PLTTM with 20% MC litter
 - Two PLT dosages (100 and 200 lb/1000ft²)
 - Three biochar dosages (50, 100, and 200 lb/1000ft²)
 - Experiment 2: different MC (35% vs. 40%)
 - Biochar only (200 lb/1000ft²)
 - Combination (100 lb/1000ft² biochar + 100 lb/1000ft² PLTTM)

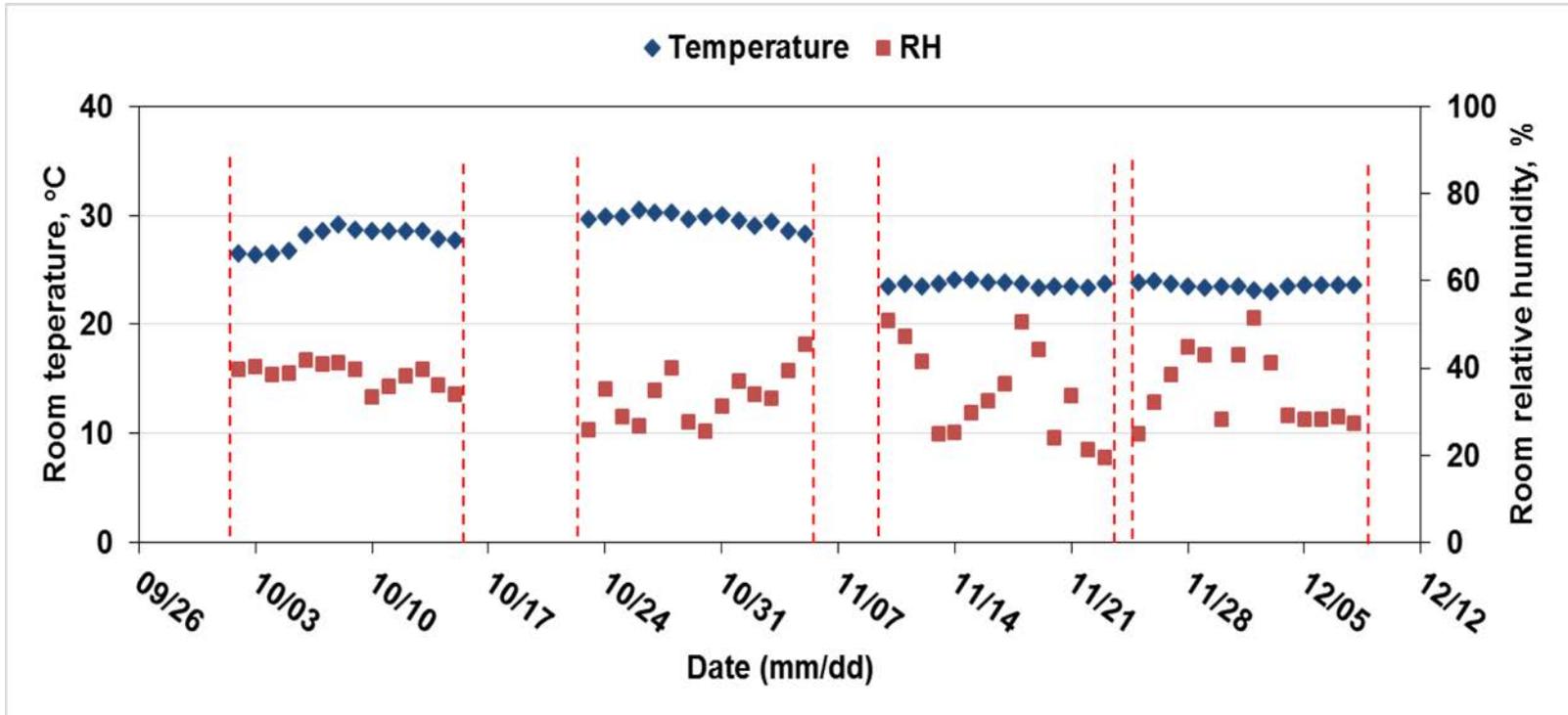
* PLTTM is sodium bisulfate, which is a standard litter amendment for broilers

* Each experiment had two trials and each trial lasted for 14 days.



Results (Objective 1)

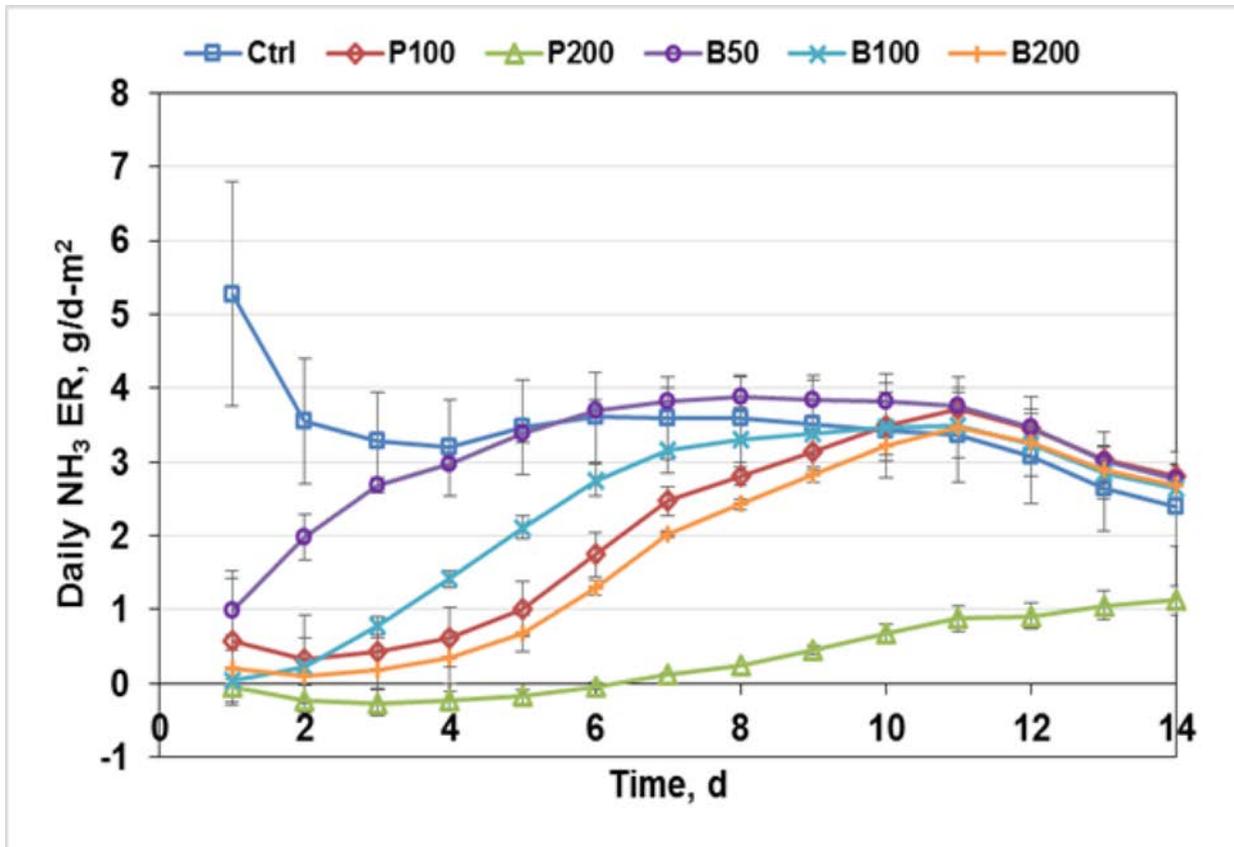
- Environmental room air temperature and RH





Results (Objective 1)

- Expt. 1 – Daily NH_3 emission rate (ER)

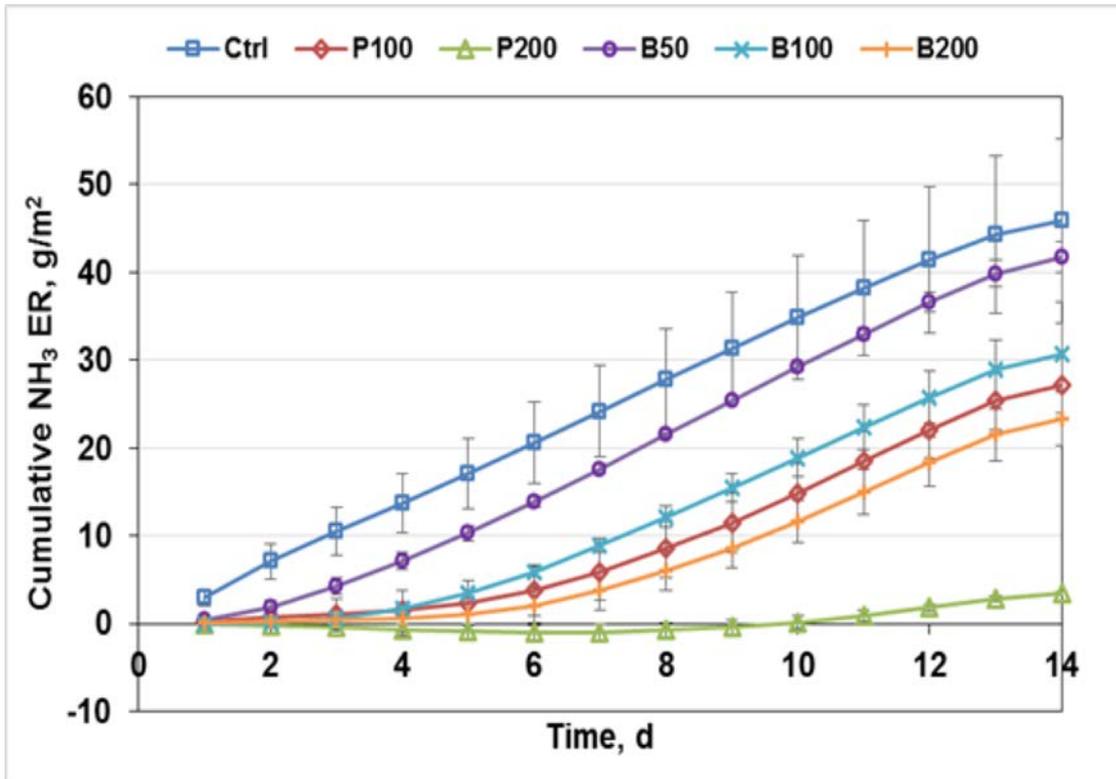


Ctrl = no additive
P100 = 100 lb/1000ft² PLT
P200 = 200 lb/1000ft² PLT
B50 = 50 lb/1000ft² Biochar
B100 = 100 lb/1000ft² Biochar
B200 = 200 lb/1000ft² Biochar



Results

Expt. 1 – Cumulative NH₃ ER



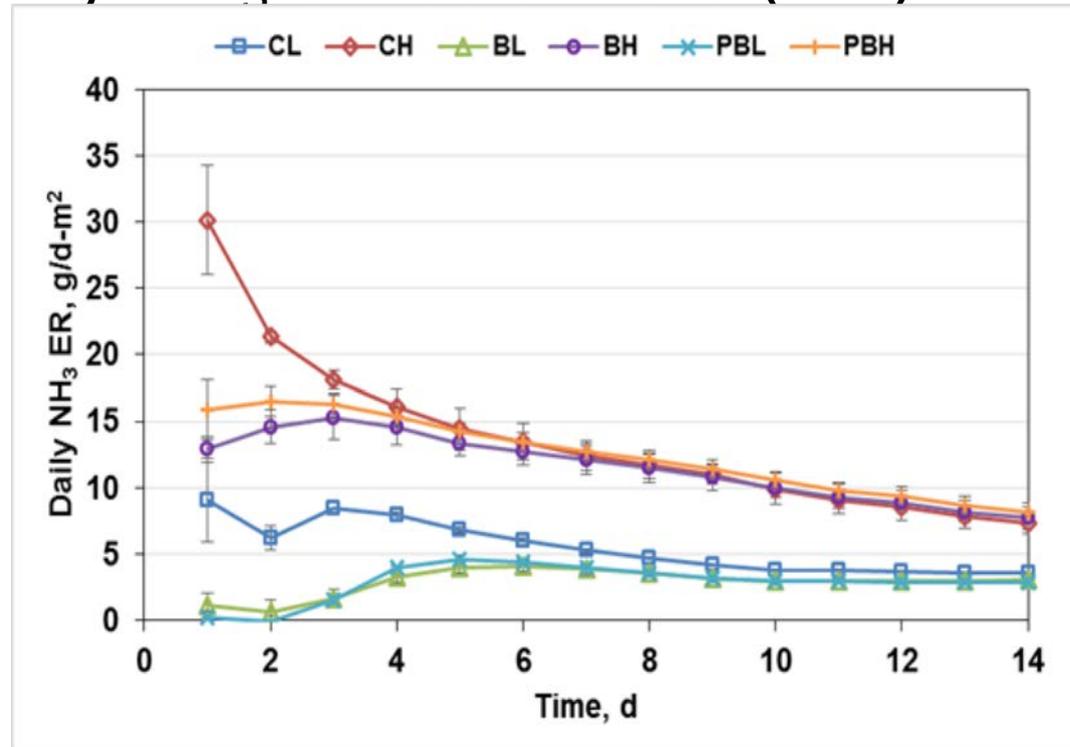
Ctrl = no additive
P100 = 100 lb/1000ft² PLT
P200 = 200 lb/1000ft² PLT
B50 = 50 lb/1000ft² Biochar
B100 = 100 lb/1000ft² Biochar
B200 = 200 lb/1000ft² Biochar

A twice amount acidified PL biochar is need to achieve the similar performance on NH₃ emission reduction of broiler litter with PLT



Results (Objective 1)

- Expt. 2 – Daily NH_3 emission rate (ER)

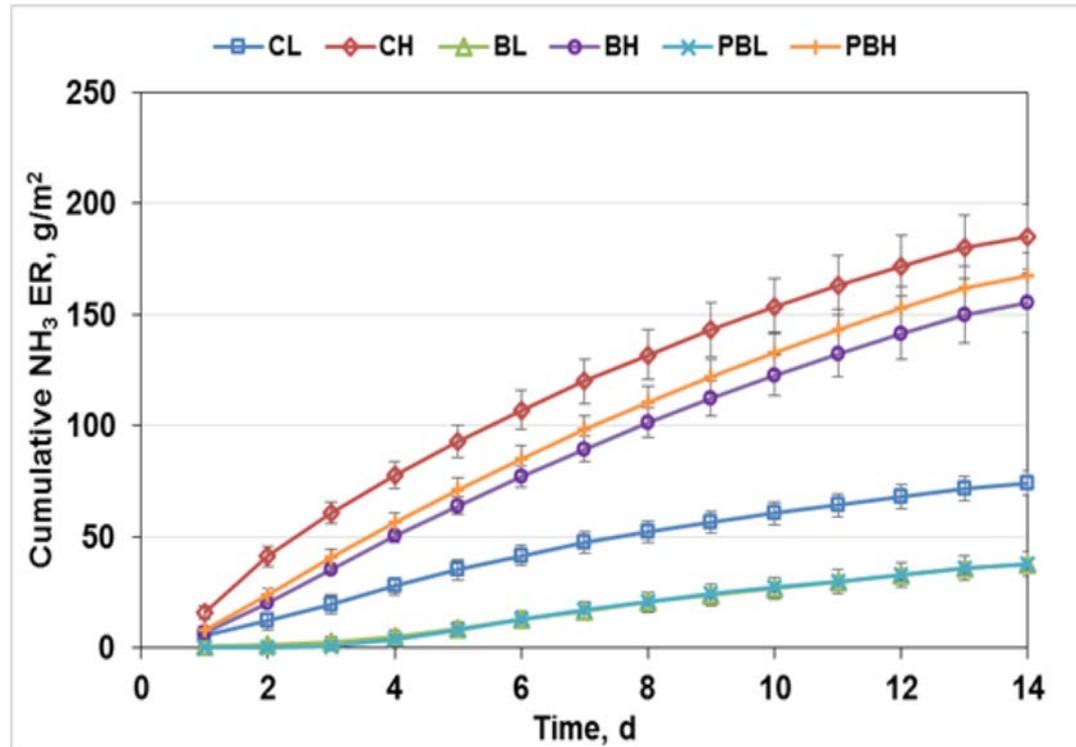


CL = no additive, 35 % MC
CH = no additive, 40 % MC
BL = 200 lb/1000ft² biochar, 35 % MC
BH = 200 lb/1000ft² biochar, 40 % MC
PBL = 100 lb/1000ft² biochar +50 lb/1000ft² PLT, 35 % MC
PBH = 100 lb/1000ft² biochar +50 lb/1000ft² PLT, 40 % MC



Results (Experiment 1)

■ Expt. 2 – Cumulative NH₃ ER



CL = no additive, 35 % MC
CH = no additive, 40 % MC
BL = 200 lb/1000ft² biochar, 35 % MC
BH = 200 lb/1000ft² biochar, 40 % MC
PBL = 100 lb/1000ft² biochar +50 lb/1000ft² PLT, 35 % MC
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Results (Objective 1)

- Expt. 1 – NH₃ ER reduction rate (%)

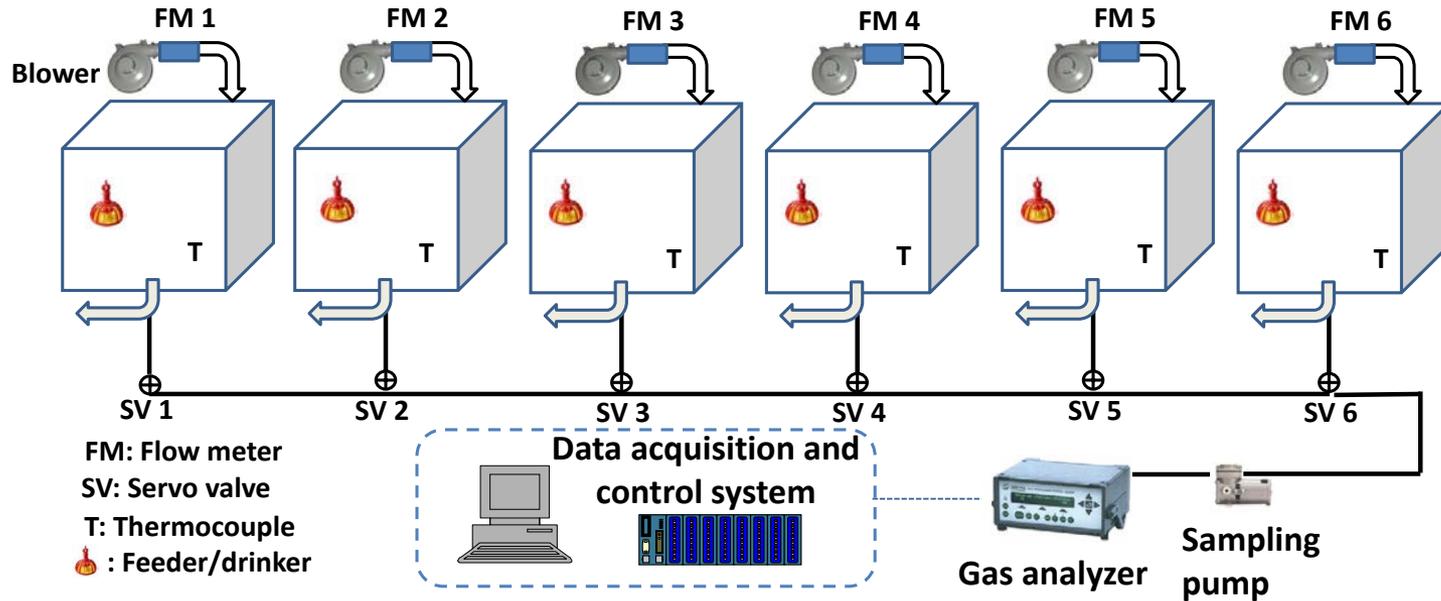
	35% MC	45% MC
PL biochar	45.6 ± 3.2	20.2 ± 4.0
PL biochar + PLT	40.9 ± 2.8	18.0 ± 3.1



Objective 2

- **Emission Chambers (EC) System**
 - Six environmentally controlled chambers
 - 6 Ross 708s (female) per chamber
 - Standard commercial diet
 - Air flow rate: 1 to 4 cfm/bird
 - Acidified PL Biochar vs. PLT
 - 976 and 488 g/m² (200 and 100 lb/1000ft²)
 - Ammonia emission
 - Production performance and health
 - Feed conversion, growth rate
 - Necropsy and histopathological analysis

Objective 2



- Density: 0.95 ft²/bird (11.3 bird/m²)
- Interval: 5 min per chamber
- Grow-out: 6 wks



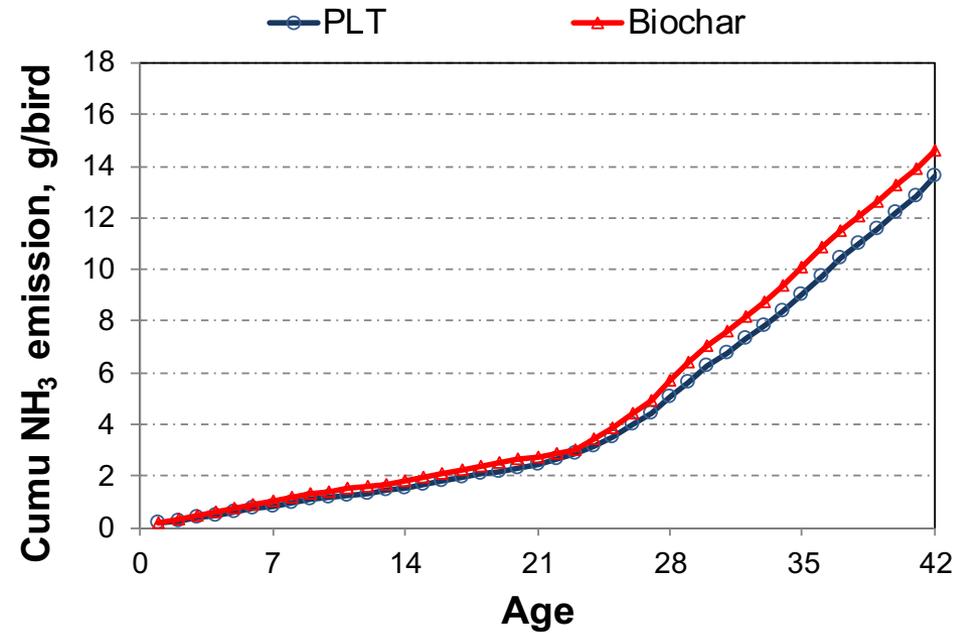
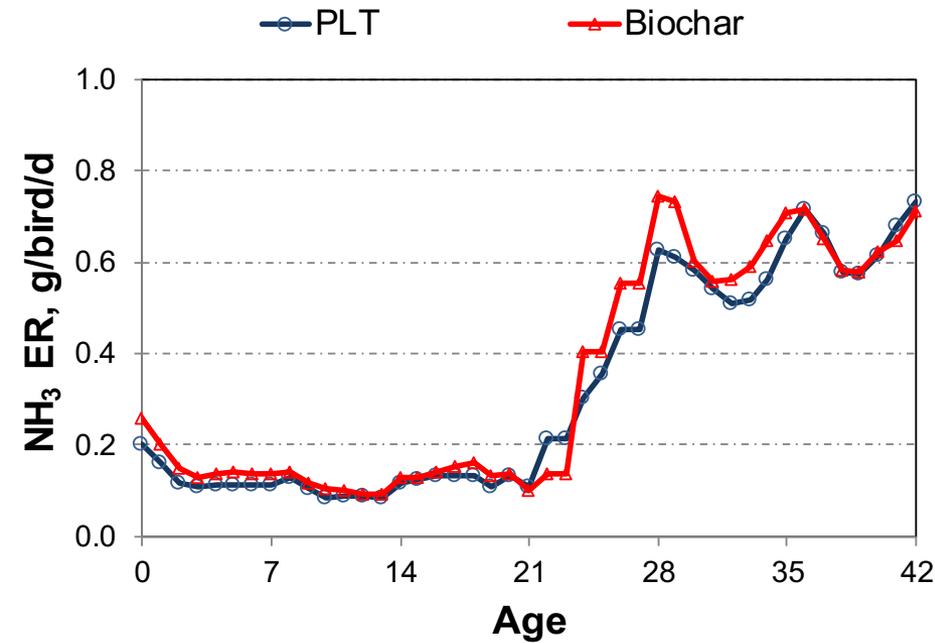
Objective 2





Results (Objective 2)

(N=3)





Results (Objective 2)

(N=3)

	PLT	Biochar
Body weight, g/bird	2909 ± 146	2951 ± 41
FCR	1.90 ± 0.13	1.88 ± 0.06
NH ₃ emission, g/bird	13.6 ± 0.81	14.6 ± 0.49



Results (Objective 2)

Necropsy

- Parameters: Trachea, eyes, oral ulcers, paws, breast blisters, bone quality, air sacs, livers, hocks, lungs, intestines & gizzards
- Across Flocks
 - No oral ulcers and breast blisters
 - Good bones, air sacs, organs upon observation
 - Acidified PL biochar did not have negative impact





Conclusions

- Acidified PL biochar could be used to control NH_3 from broilers without negatively impact on production performance and health;
- Increased acidified PL biochar application rate could achieve the similar performance of PLT on NH_3 emission reduction from broiler litter;
- PL biochar with 200 lb/1000ft² of application rate reduced 45.6 % and 20.2 % NH_3 emission from broiler litter at high and low MC (40% vs. 35 %).



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