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INSTITUT DE RECHERCHE
ET DE DÉVELOPPEMENT
EN AGROENVIRONNEMENT

STRATEGIES TO IMPROVE INDOOR CONDITIONS IN AVIARY LAYING HENS PRODUCTION SYSTEMS

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I. INTRODUCTION

2007 : Humane Society International – Canada :

Confined laying hens awareness campaign with Canadian municipalities

Transition from conventional systems to alternative systems (enriched cages, cage-free)

2007

2015

Conventional systems banned in Québec

2021

2036

Complete transition

CHALLENGES
TRANSITION TO ALTERNATIVE SYSTEMS

Parameters	Systems		
	1	2	3
Welfare	++	+	-
Workers health	-	+	++
Air quality			
• [NH_3, dust, bio -aerosols]	±	+	++
Egg quality	±	++	++

1 = Cage-free
2 = Enriched-cages
3 = Conventional cages

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AIR QUALITY

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OBJECTIVE

To select and evaluate practices or techniques to improve air quality, welfare and workers health in cage-free production systems of Québec

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LITERATURE REVIEW

Practices and techniques to improve air quality (NH_3, dust, and bio-aerosols):

- Ventilation
- Type of litter
- Litter management
- Type of feed and diet
- Litter amendments
- Electrostatic precipitation
- Water or vegetal oil sprinkling
- Heating floor

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Practices and techniques selected:

1. Litter amendment
2. Heating floor
3. Oil-emulsion sprinkling
4. Decreasing of litter surface area

DECISION SUPPORT GRID

- Technical
- Economic
- Agronomic
- Social and health
- Environment
- Use of Resources

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METHODOLOGY

Laboratory-scale assessment:

1. Litter amendment
2. Heating floor
3. Oil-emulsions sprinkling

- 80 g of litter
- $[NH_3]$

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EVALUATION -EXPERIMENTAL FARM

- IRDA, Deschambault-Quebec
- 12 independent rooms
- Single-level aviaries
- 12 Laying hens (Lohmann LSL-Lite)
- Animal density was 1115 cm^2 per hen
- 2 lots of 8 weeks
- 3 treatments + Ctrl x 3 replicas

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EVALUATION -EXPERIMENTAL FARM

Treatments

L-17% = Decreasing of litter surface area

HF+OES = Heating floor + Oil-emulsion sprinkling

AD+OES = Biochar + Oil-emulsion sprinkling

OES = Oil-emulsion sprinkling

Ctrl = Traditional aviary system without any treatment

Parameters evaluated

- **Performance of the production system**: weight gain, water and feed consumption, laying rate
- **Air quality** : GHGs, NH_3, $PM_{2.5}$, PM_{10}, *bio-aerosols*
- **Eggs quality**: % of clean eggs, cracked or broken eggs
- **Welfare**: behavior, health and body condition
- **Physicochemical characteristics of the litter** : dry matter, organic matter, pH, Nt, N-NH_4, P, K, Ca, Mg

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EVALUATION -COMMERCIAL FARMS

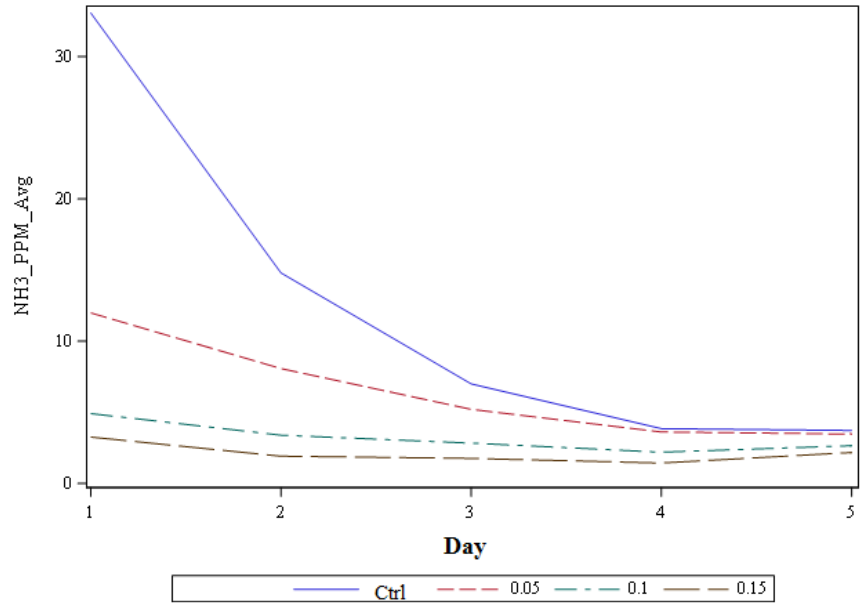
Parameters evaluated

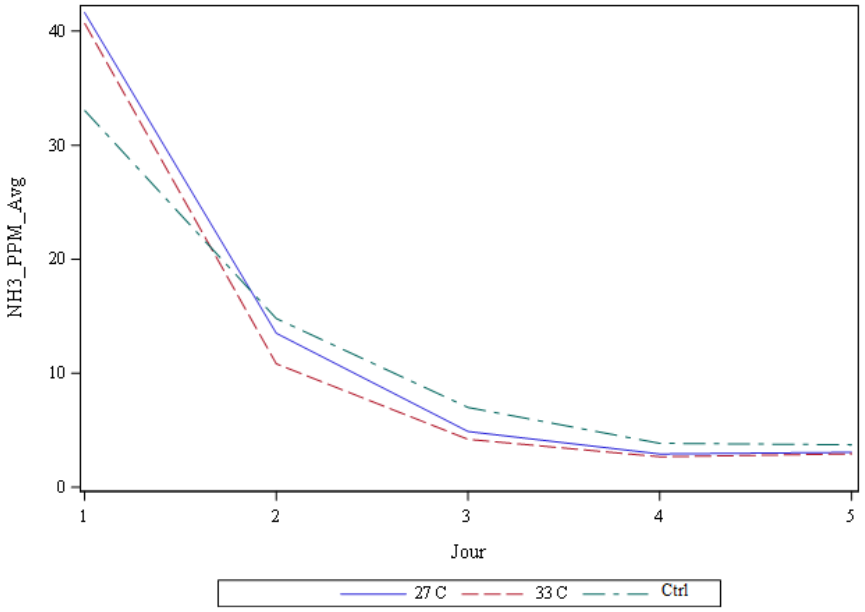
- **Air quality** : GHGs, NH_3, $PM_{2.5}$, PM_{10}, *bio-aerosols*
- **Physicochemical characteristics of the litter** : dry matter, organic matter, pH, Nt, $N\text{-}NH_4$, P, K, Ca, Mg

RESULTS:

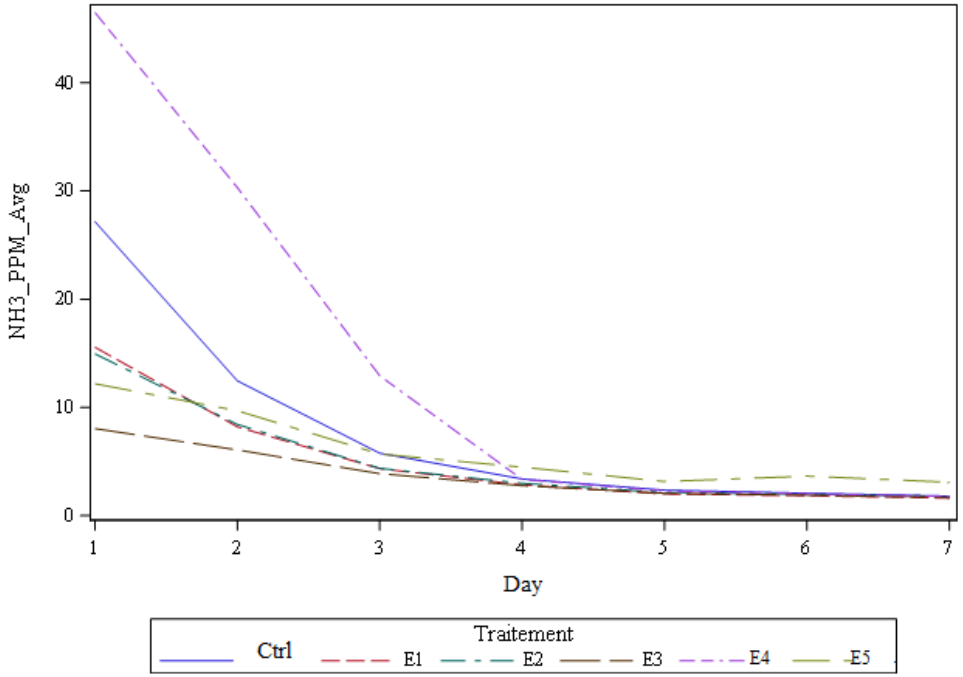
LABORATORY-SCALE ASSESSMENT

Biochar 5%, 10%, 15%





Heating floor (27 and 33°C)



Oil-acid-emulsions

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RESULTS:

EXPERIMENTAL FARM

NH_3 and GHGs emissions

Effect	DDL num.	Value F	Pr > F	Value F	Pr > F	Value F	Pr > F	Value F	Pr > F
		CH_4		CO_2		N_2O		NH_3	
Treatment	3	2,70	0,14	0.35	0,79	0,51	0,68	1,53	0,33
Week	7	18,46	<0,01	35.65	<0,01	9,32	<0,01	3,48	0,01
Week*trt	21	1,18	0,36	1.04	0,43	0,91	0,59	0,68	0,82

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RESULTS:

EXPERIMENTAL FARM

Dust reduction (%)

Treatment	Lot 1			Lot 2		
	PMT	PM10	PM4	PMT	PM10	PM4
L-17%	77,6	75,1	73,7	60,2	54,5	50,9
HF+OES	**97,9**	**98,3**	**97,3**	**95,0**	**94,7**	**91,6**
AD+OES	92,4	94,3	91,9	89,1	89,9	86,9
OES	ND	ND	ND	83,7	83,7	82,6

L-17% = Decreasing of litter surface area

HF+OES = Heating floor + Oil-emulsion sprinkling

AD+OES = Biochar + Oil-emulsion sprinkling

OES = Oil-emulsion sprinkling

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Performance of the production system

EXPERIMENTAL FARM

Parameter/Treatment	Ctrl	T-17%	HF+OES	AD+OES	OES
Initial weight (g)	1438	1440	1440	1438	ND[a]
Weight in the end of Lot 1(g)	1635	1632	**1671**	**1669**	ND[a]
Weight in the end of Lot 2(g)	1711	1728	**1745**	**1759**	1747
Water consumption L1(ml/day)	186	**166**	188	191	ND
Water consumption L2(ml/day)	200	**183**	200	216	204
Feed consumption Lot 1 (g)	1289	1333	1283	1281	ND
Feed consumption Lot 2 (g)	1375	1401	1407	1388	1369
Egg production Lot 1	12	12	12	12	ND
Egg production Lot 2	12	12	12	12	12
% proper eggs Lot 1	81	79	83	**77**	ND
% proper eggs Lot 2	86	86	88	**82**	**82**

RESULTS: COMMERCIAL FARM

HF+OES = Heating floor + Oil-emulsion sprinkling

CONCLUSIONS

Selection of techniques to improve:

- Air quality (NH_3 , dust and bioaerosols concentration)
- Welfare, workers health, and the performance of the production system

The best scenario:

- Oil emulsion sprinkling combined with litter absorbent or heating floor was proven efficient to reduce aerosolized particle concentrations and NH_3
- **Feasibility of the implementation :**
- Technical and economic study in progress

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ACKNOWLEDGMENT

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THANKS!

QUESTIONS?