

Effect of straw bedding in pig housing on emissions of greenhouse gases

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Animal welfare



Straw in pig husbandry

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- Cost,
- Labour,
- Hygiene
- Incompatibility with manure drainage systems

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- Physical comfort
- Thermal comfort
- Exploration,
- Foraging,
- Rooting
- Chewing
- Nesting
- Maternal behaviour

Another potential -: Environmental issues

Agricultural emissions: focus of the Netherlands

Focus for straw systems:

- NH_3
- N_2O
- CH_4
- Odour
- Particulate Matter (PM10 and PM2.5)

Deep litter

- Mixture of litter and slurry
- High C/N ratio
- Anaerobic as well as aerobic conditions
- Methanogenesis = CH_4
- Nitrification/denitrification = NH_3 , N_2O , (NO , N_2)



Literature review

Fatteners (n=13):

■ NH ₃	3.0-16.2	g/d per pig
■ CH ₄	2.5-13.4	g/d per pig
■ N ₂ O	0.03-11.3	g/d per pig

Sows (n=1)

■ NH ₃	6.7-8.7	g/d per pig
■ CH ₄	39	g/d per pig
■ N ₂ O	0.5	g/d per pig

Key factors affecting emissions

	CH ₄	N ₂ O	NH ₃
Animal-related factors			
Age/Live weight	+	+	+
Amount and composition of feed	+	+	+
Water use	0	0	-

Key factors affecting emissions

	CH ₄	N ₂ O	NH ₃
Environment-relating factors			
Housing configuration	+/-	+/-	+/-
Air velocity	0	0	+
Temperature inside	+	+	+
Temperature outside	+	+	+

Key factors affecting emissions

Factors related to slurry/litter mixture	CH ₄	N ₂ O	NH ₃
C/N ratio	+	+	-
O ₂ concentration	-	+/-	+
Surface area	0	0	+
Maturity of litter/slurry mixture	+	+	0
Optimal pH	7	6	+
Temperature of the slurry/litter	+	+	+
NH ₄ ⁺ concentration	-	+	+
Volatile Solids concentration	+	0	0
Drymatter	-	0	0

Litter and slurry: complex ecosystem

Litter management affects key factors

Type of litter	Sawdust, wood shavings, straw
Amount of litter	50–1000 g/d per pig
Depth of the litter bed	0–70 cm
Additives	Yes or no
Addition of fresh litter	None to weekly
Litter mixing	None, two or three times a week
Litter removal	partly; completely; daily; weekly; monthly; yearly
Littered surface area	40–100% of total living area
Location of litter	Resting, feeding or excretion area

Nitrous oxide

- C/N ratio and N_2O not well correlated
- Higher emissions with woodshavings and sawdust
- ws and sd contain more lignine and hemicellulose
- Straw contains more cellulose
- Cellulose is more biodegradable
- Biodegradability > C/N ratio

Methane

- CH₄ from Digestive tract: endogene CH₄:
 - regular diets: 3-4 g/d
 - Fibrous diets (250 g/kg) up to 10 g/d
- CH₄ from Slurry
- Slurry based systems fatteners: 2.5-30 g/d
- Litter based systems within this range
- No substantial CH₄ production in litter/slurry??

Methane

- Anaerobic bed
- Deep litter systems dairy: ca 1000 g/d CH₄ per cow
- Sows root, cows don't
- CH₄ in aerated top layer >> CO₂

Conclusions

- N_2O and CH_4 from littered systems variable
- N_2O is lower with straw
- CH_4 is oxidised in rooted top layer
- With good litter management emissions of greenhouse gases can be limited

Thank you for your attention