Behaviour, health and performance of piglets exposed to atmospheric ammonia P4.9

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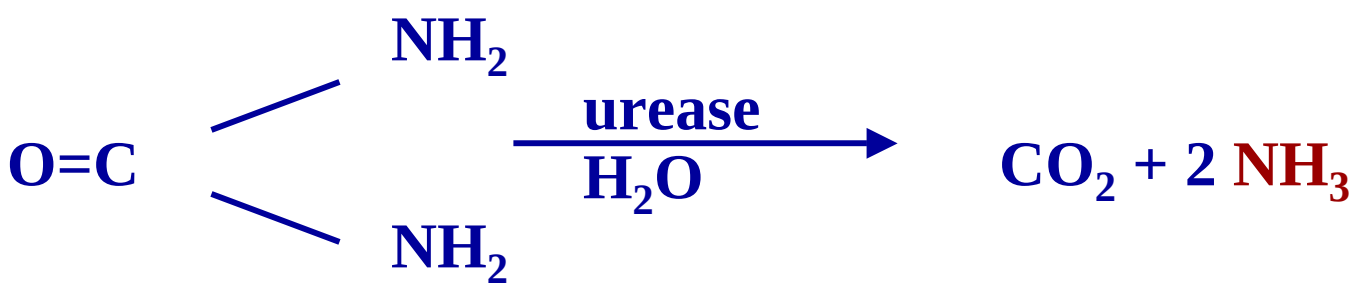
Content

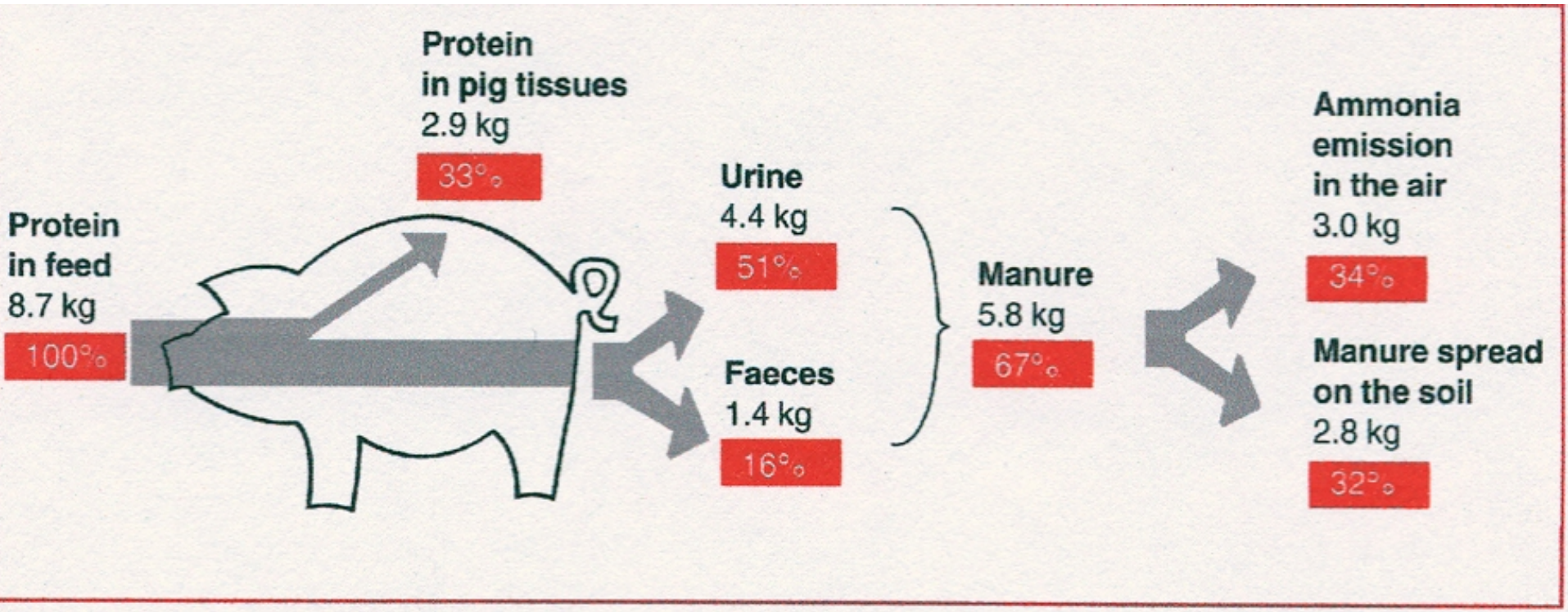
- Source of NH_3 - emissions from pig farming
- Impact of ammonia on pig health & welfare
- Objective; Material & methods
- Results
- Conclusions & outlook

Ammonia - formation

- **Source:**
  - **Microbial degradation (enzyme: urease) of faeces and urine**
  - 

  - **N in urine:**
    mainly from urea (mammals)
  - **N in faeces:**
    unmetabolised feed protein, endogenous protein, nucleic acid (microorganisms)

N – utilisation in pigs



IPPC – BAT, 2003

Ammonia – properties and effects on pig health and performance

- Colourless, intense smell, corrosive gas
- Clinical & behavioural signs from experimental exposure:

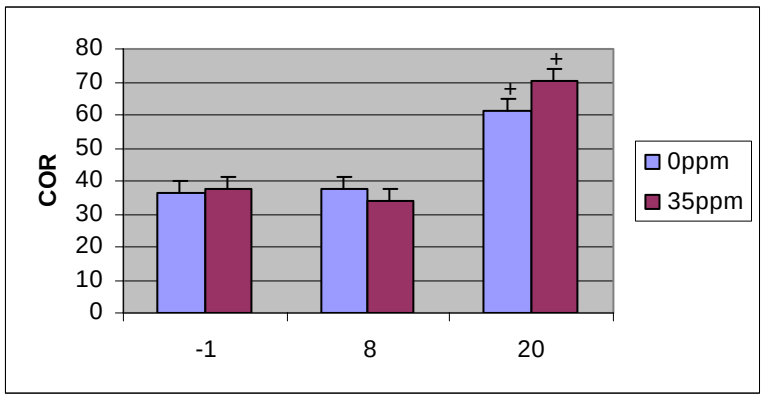
> 20 ppm	Predisposition for respiratory diseases ? Aversion to polluted air in a choice test
> 30 ppm	Mucosal inflammation ?
> 50 ppm	Effects on immune function ? Reduced performance
> 100 ppm	Reduced daily gain Respiratory problems
> 200 ppm	Mortality increase, cramps, severe respiratory problems

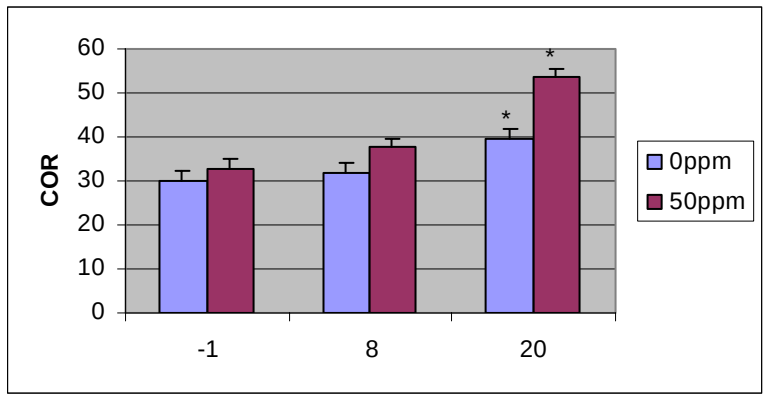
Objective: Ammonia (35 and 50 ppm) & effects on Piglet Welfare, Health & Performance

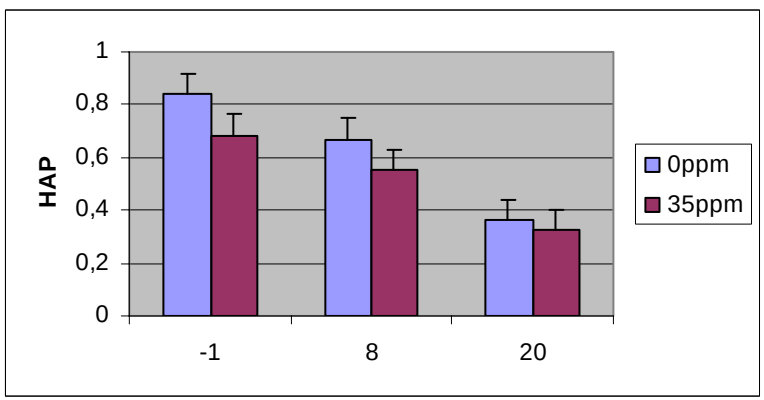
Material & methods

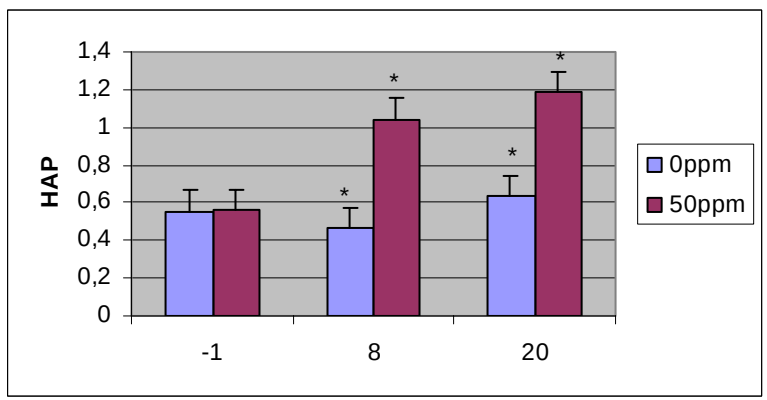
- **4 groups of 24 piglets in 2 identical environmental chambers within pens of 4 pigs respectively**
- **Exposure for 20 d to 35 vs. 0 ppm (control) and 50 vs. 0 ppm of atmospheric ammonia**
- **Performance (BW, DMI, ADG & F:G) haematological (blood cells), metabolic parameters (BUN, glucose, lactate, ammonia), cortisol & haptoglobin measured on d -1, 8 & 20**
- **Behaviour (posture, feeding & aggression) recorded on d 3 & 19 for 12 h**
- **Statistics: PROC MIXED and PROC GLM in SAS**

Chronic effect of 35 and 50 ppm ammonia on serum cortisol- und haptoglobin concentrations of piglets









Chronic influence of 35 ppm ammonia on behaviour (12 h on d 19) of piglets (20 d, LSQ means)

	Treatment			
Measure	**35 ppm**	**0 ppm**	**SEM***	**P-value**
Number of replicates (pens)	**6**	**6**	**-**	**-**
Number of animals	**24**	**24**	**-**	**-**
Upright	**23.23**	**22.82**	**2.20**	**0.45**
Lying	**76.77**	**77.18**	**2.20**	**0.45**
Feeding	**7.76**	**8.03**	**0.94**	**0.059**
Aggression	**0.65**	**0.32**	**0.35**	**0.52**

*** Pooled standard error**

Chronic influence of 35 ppm ammonia on performance of piglets (20 d, LSQ means)

Item	Treatment		SEM*	P-value
	35ppm	0ppm		
Number of pigs	24	24	-	-
Number of pens	6	6	-	-
Initial BW, kg	10.2	9.7	0.57	0.57
BW at d 20, kg	19.4	19.1	0.84	0.82
ADG, kg/d	0.48	0.50	0.019	0.68
DMI, kg/d	0.39	0.44	0.019	0.096

* Pooled standard error

Chronic influence of 50 ppm ammonia on performance of piglets (20 d, LSQ means)

	Treatment			
Item	50 ppm	0 ppm	SEM*	P-value
Number of pigs	24	24	-	-
Number of pens	6	6	-	-
Initial BW, kg	7.5	7.5	0.32	0.96
BW at d 20, kg	12.2	13	0.45	0.22
ADG, kg/d	0.26	0.29	0.022	0.25
DMI, kg/d	0.66	0.70	0.022	0.30

* Pooled standard error

Haematological parameters 35 ppm NH_3

	Treatment			
Item	35ppm	0ppm	SEM*	P-value
Number of pigs	6	6	-	-
Ammomia, ug/dL	25.67	47.00	8.67	0.0948
BUN, mg/dL	6.17	7.00	1.22	0.63
Glucose, mg/dL	95.67	92.67	2.70	0.44
Lactate, mg/dL	63.50	69.08	13.63	0.78
WBC, thousand/uL	21.75	9.78	1.98	0.0003
RBC, million/uL	7.03	7.28	0.31	0.57
Hemoglobin, g/dL	10.90	11.55	0.43	0.30
Hematocrit, %	34.50	35.83	1.84	0.61
MCV[b], fL	49.50	49.33	1.92	0.95
MCH[b], pg	15.6	15.92	0.46	0.63
MCHC[b], g/dL	31.58	32.22	1.18	0.71
Neutrophils, /uL	3,408.17	3,029.37	963.98	0.78
Lymphocytes, /uL	11,014.00	6,228.25	956.85	0.0018
Monocytes, /uL	1116.26	515.37	155.11	0.0114

Haematological parameters 50 ppm NH_3

Item	Treatment		SEM*	P-value
	50ppm	0ppm		
Number of pigs	6	6	-	-
Ammonia, ug/dL	112.28	94.52	19.33	0.52
BUN, mg/dL	9.34	10.09	5.22	0.92
Glucose, mg/dL	89.27	95.84	5.48	0.41
Lactate, mg/dL	61.58	47.68	7.97	0.23
WBC, thousand/uL	20.75	15.64	4.60	0.44
RBC, million/uL	6.65	7.07	0.27	0.31
Hemoglobin, g/dL	9.20	10.34	0.64	0.24
Hematocrit, %	28.78	32.57	2.83	0.36
MCV[b], fL	42.28	46.53	2.10	0.17
MCH[b], pg	13.63	14.70	0.49	0.14
MCHC[b], g/dL	32.61	31.61	1.02	0.50
Neutrophils, /uL	4,459.92	4,306.71	663.80	0.87
Lymphocytes, /uL	13,764.00	10,138.00	2,702.23	0.36
Monocytes, /uL	1,145.96	1,132.27	438.57	0.98

Summary of results

- **Increased haptoglobin ($P<0.05$) to 50 ppm NH_3**
- **Increased cortisol ($P<0.05$) to 35 and 50 ppm NH_3**
- **Increased total WBC, lymphocytes and monocytes ($P<0.05$), trend for decreased DMI and reduced feeding behaviour (<0.1) to 35 ppm NH_3**

Interpretation and outlook

- **Exposure to atmospheric ammonia elicits systemic inflammatory and stress responses**
- **Performance seems to be less affected**
- **Effects on histopathology of the respiratory system needs to be analysed in detail**
- **Other studies indicate that the effects of ammonia in combination with other aversive factors (dust, microorganisms and temperature stress) are more severe**
- **Recommendations on maximum tolerable concentrations (recommendations range between 10 and 50 ppm) should be based on epidemiological field data as combination effects are relevant**