

# Chemical Causes of Pig-house Odour

Linda Farmer,

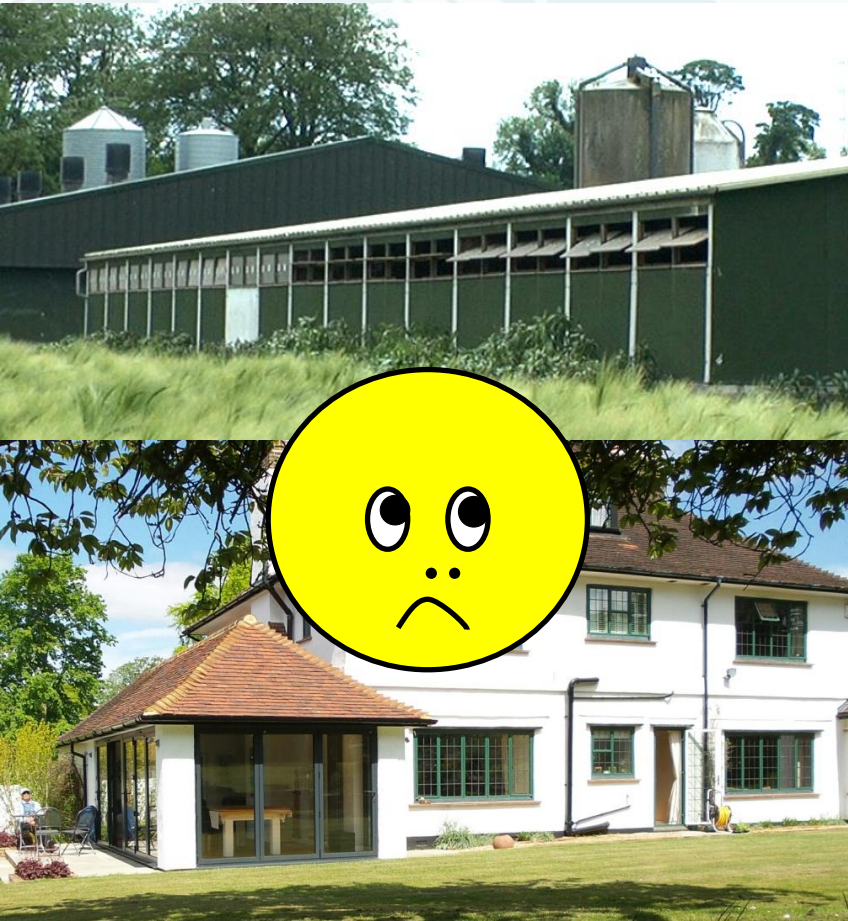
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# The problem with pig-houses is ....

## ... the neighbours!

- Tight legislative / environmental requirements
- Restrictions on industry development
- Ammonia cited as main culprit
- Review requested ...

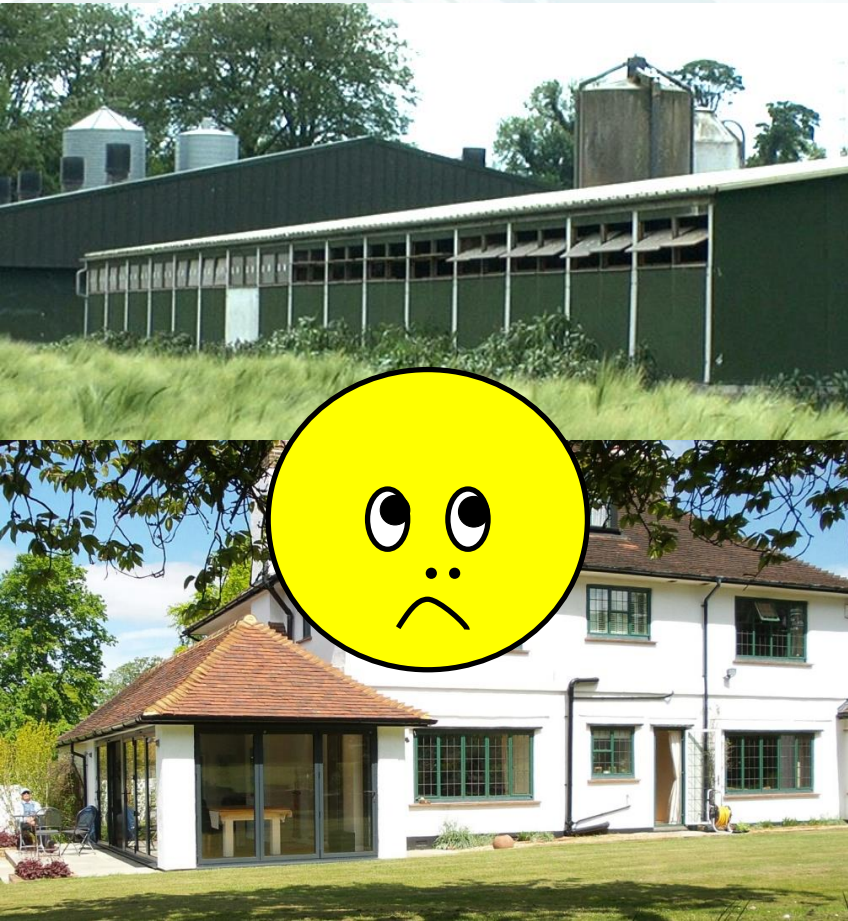


# The problem with pig-houses is ....

## ... the neighbours!

Review to ...

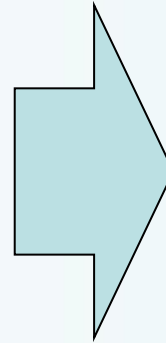
- list methods ... reduce the level of ammonia and odour emitted from pig houses
- provide an understanding of the factors and conditions creating ... odour in pig housing



# Odours from pig-houses

## Literature

- Number of papers = 89
- Number of compounds reported = 500
- Only some researchers give concentrations in air
- Compounds contributing to noxious odour not clear!



**Use Odour  
Activity Values**



# “Odour activity values”

- Usually used for flavour studies
- **Odour activity value (OAV) =**  
concentration / odour threshold
- **Odour threshold** = concentration in air at which 50% people detect an odour



# Method

- Collated data on concentrations in air
  - 136 compounds, 21 papers
  - Different analysis methods, sampling techniques
    - ‘Tedlar bag’ versus ‘thermal desorption’
- Inconsistent odour threshold data
  - Compiled “consistent” sets:
  - Devos et al. 1990 and Nagata 2003



# OAVs for main compounds, 21 papers

Group	Year of publication	Compound class																																																
		Acid				Alcohol		Aldehyde		Amine		Indole	Ketone		Phenol		S-containing			Terpe																														
		2-Methylpropanoic Ac	3-Methylbutanoic Ac	4-Methylpentanoic Ac	Acet	Buta	Doode	Hexa	Nona	Octa	Penta	Prop	1-De	1-Dc	3-Me	Acet	Buta	Hept	Hexa	Octa	Penta	2-Ar	Amm	Dime	Trim	3-Me	Indo	2,3-F	3-Hy	4-Etl	4-Me	Phen	Buty	Dietl	Dime	Dime	Dime	Ethyl mercaptan	Hydrogen sulphide	Isopropyl mercaptan	Methyl mercaptan	D-3-Carene								
Papers	Martensson et al	1999	8.3	109		66	563					169	27														1.9																							
	Zahn et al	2000																										8.6																						
	Ngwabi et al	2007		8		7	26						1.1				3.7									2.6	247																							
	Blunden et al	2005																																																
	Chemielowicz	2009																2.9																																
	Yao et al	2011	28	6106		9	1232																																											
	Van Huffel	2012	2.8	25		20	36		2.7																																									
	Hansen et al	2012				579	4643																																											
	Kim, Lee,	2007																																																
	Zahn et al	2000																																																
	Trabue et al	2006	3.6	79		28	162		0.8																																									
	Hobbs et al	1997	12	1919		196	2500																																											
	Blanes-Vidal	2009	1.1	18	1.1	7	53		8.2																																									
	Blanes-Vidal	2009	0.9	13	1.2	7	37		4.5																																									
	Feilberg et al	2010		73		29	175																																											
	Blanes-Vidal,	2009	0.7	39		60	2																																											
	Zahn et al	2000	6.3	132	1.3	9	274		9.1																																									
	Trabue et al	2006	4.3	95		38	191		1.0																																									
	Zahn et al	1997				35	1549	44	203	26	58	2208	102	120	38																																			
	Zahn et al	2001	20	297	5.3	18	868		37.9																																									
	Trabue et al	2008	0.8		2.5	3	28		0.6																																									
Parker et al	2013		11	115		30	112		1.1																																									
Schiffman et al	2001	2.8	194	0.2	5	324		1.4																																										
Hartung and Phillips	1994	7.4	148	2.1	13	468		3.4	0.2	10	219	9.2																																						

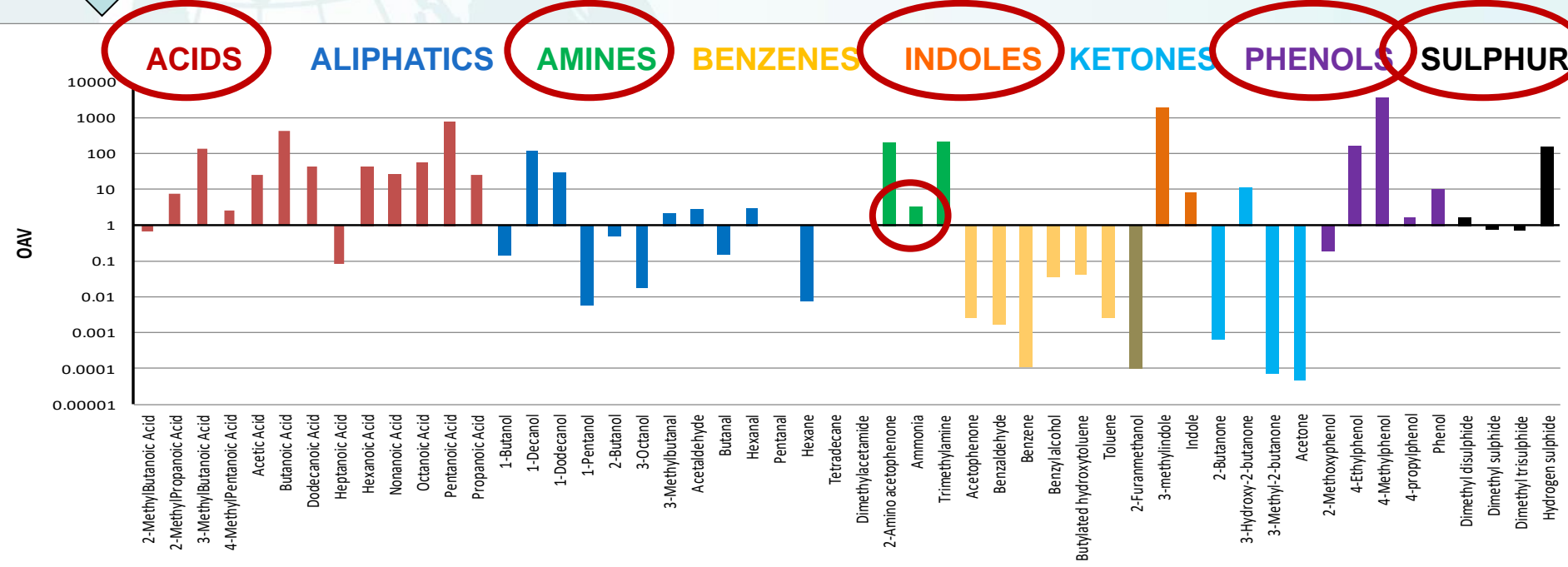
2.0	1-10
20.0	10-100
200.0	100-1000
2000.0	1000-10000
20000.0	10000+

Thresholds: Nagata+

OAV > 1 = above threshold

# Results

## Main odours - Thermal desorption



Probable additive effects

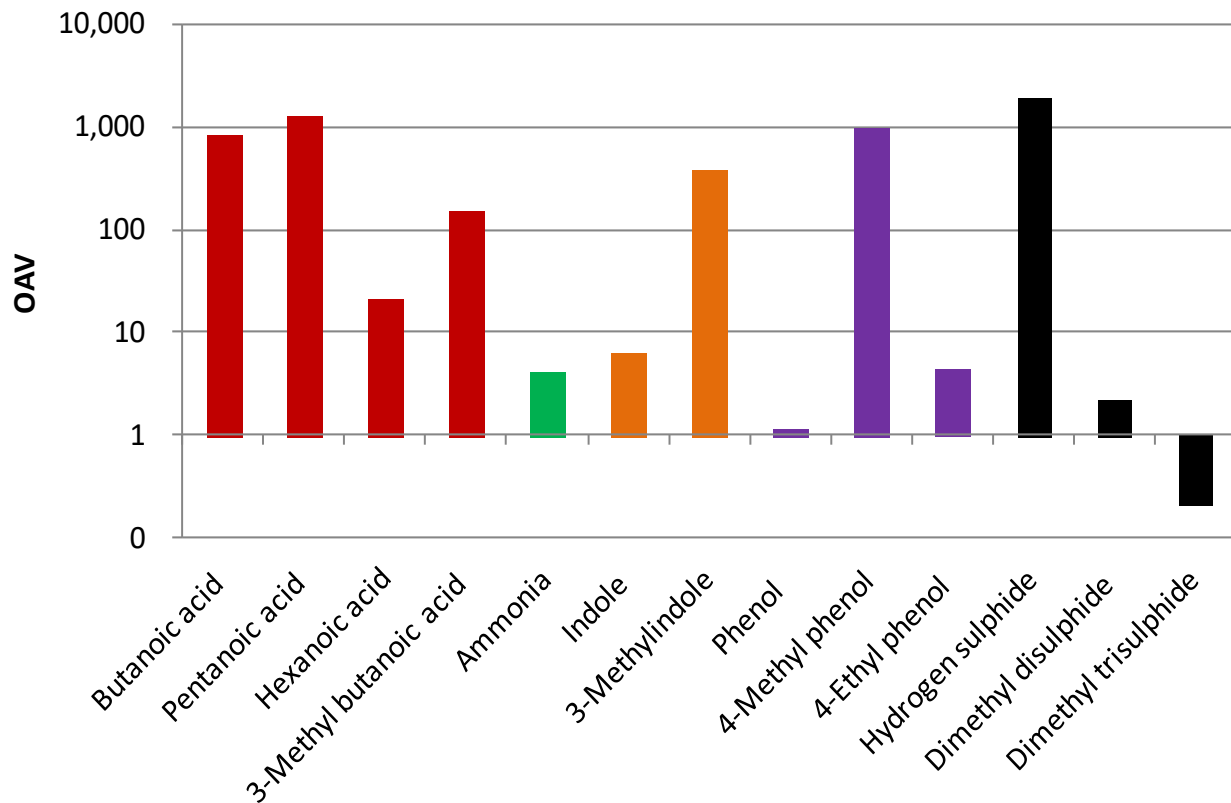




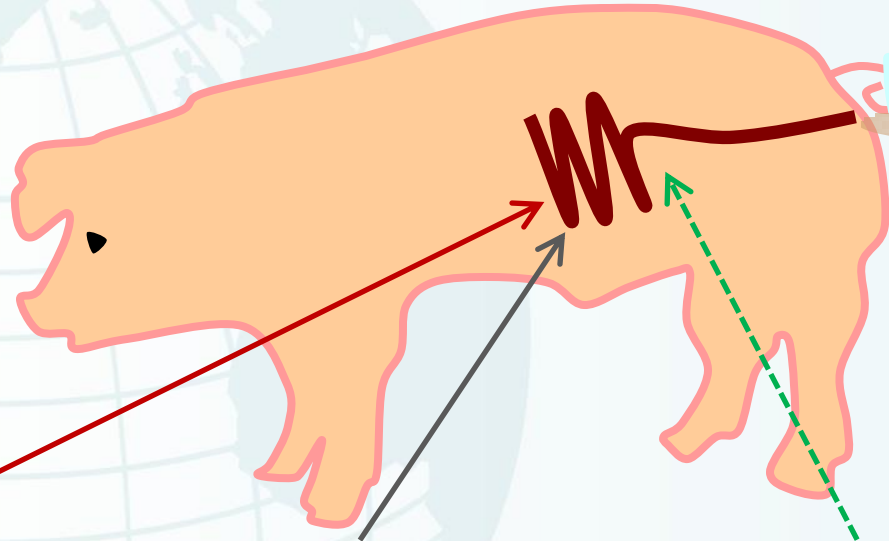
# AFBI analyses

## - main odorous compounds in pig houses

- OAVs high  
- as expected!
- Main odour compounds:
  - **Hydrogen sulphide**
  - **Acids**
  - **4-methylphenol (p-cresol)**
  - **3-methylindole (skatole)**



# Classes of odour compounds contributing to pig-house odour



## ACIDS

- from proteins and carbs
- large intestine
- manure
- anaerobic

## PHENOLS , INDOLES

- intestine
- microbial fermentation
- tyrosine and phenylalanine
- tryptophan

## AMMONIA & AMINES

- urea, urine
- manure
- less from intestine

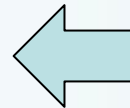
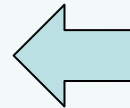
## S COMPOUNDS

- in manure
- anaerobic bacteria



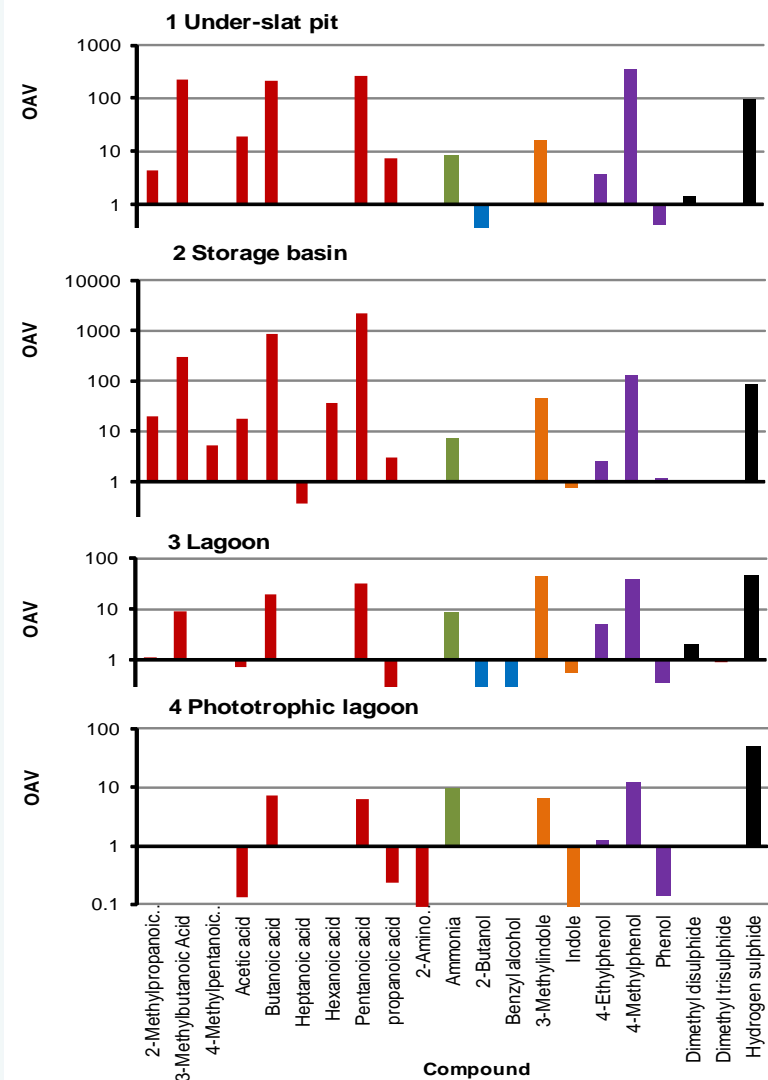
# Which factors affect the impact of odour compounds?

- Individual papers on different factors
- Applied OAVs
- Effect of
  - Age group of pigs
  - (Distance downwind)
  - Type of slurry tank
  - Covering slurry tanks
  - Pig diets



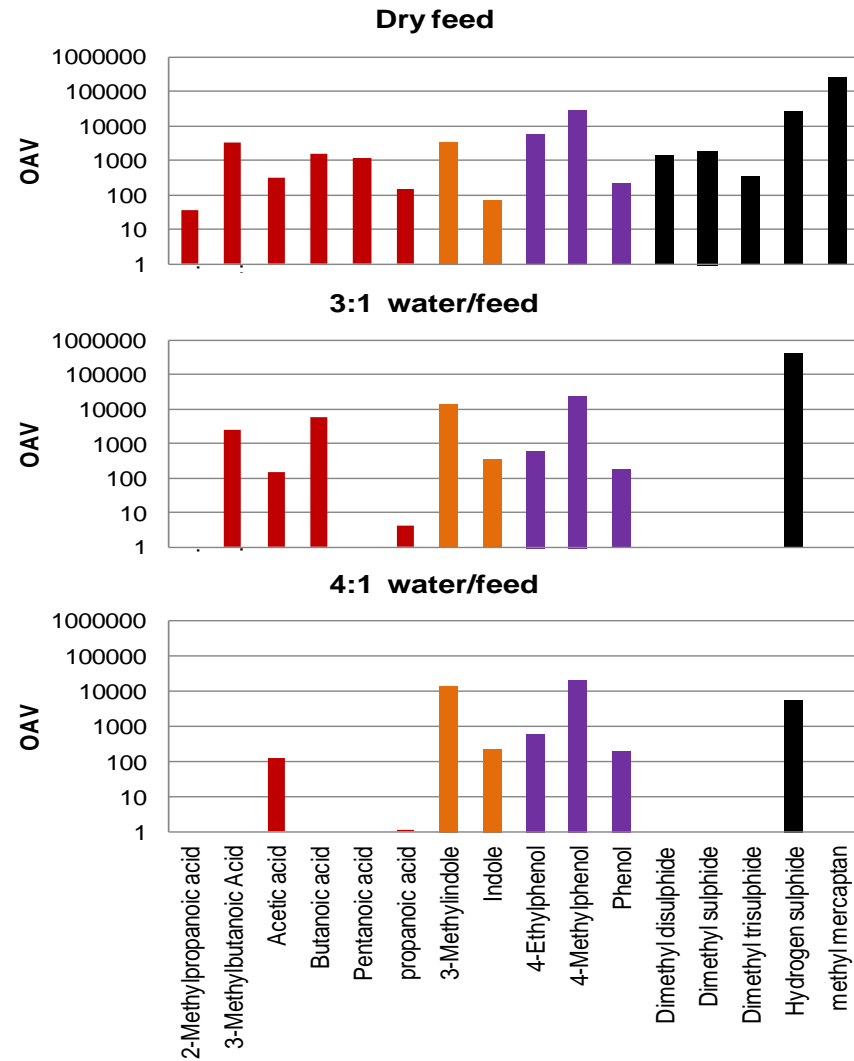
# Effect of Type of slurry tank

- **Acids** and **phenols** decreased in lagoons
- **Ammonia**, **skatole** and **S-compounds** not much decreased



# Effect of Type of diet

- Most acids (**red**) and S compounds (**black**) decreased with liquid diets
- Phenols (**purple**) and skatole/indoles (**orange**) were not decreased



# Gaps in knowledge

- Combination abatement treatments
- Compound classes important for downwind odour
  - Few analyses and few compounds measured
- Impact of diet on gut microflora
  - ... and odour formation
  - Fat content?
- Effect on off-flavours in meat?



# Conclusions

- Acids, sulphur compounds, indoles, phenols and amines contribute to pig-house odour
  - Ammonia is not the most important
- No single treatment appears to reduce all odour compound classes
  - BUT some treatments reduce some odour compounds
- Could help to devise new combined strategies for abatement





(a) Uncovered slurry at start of expt

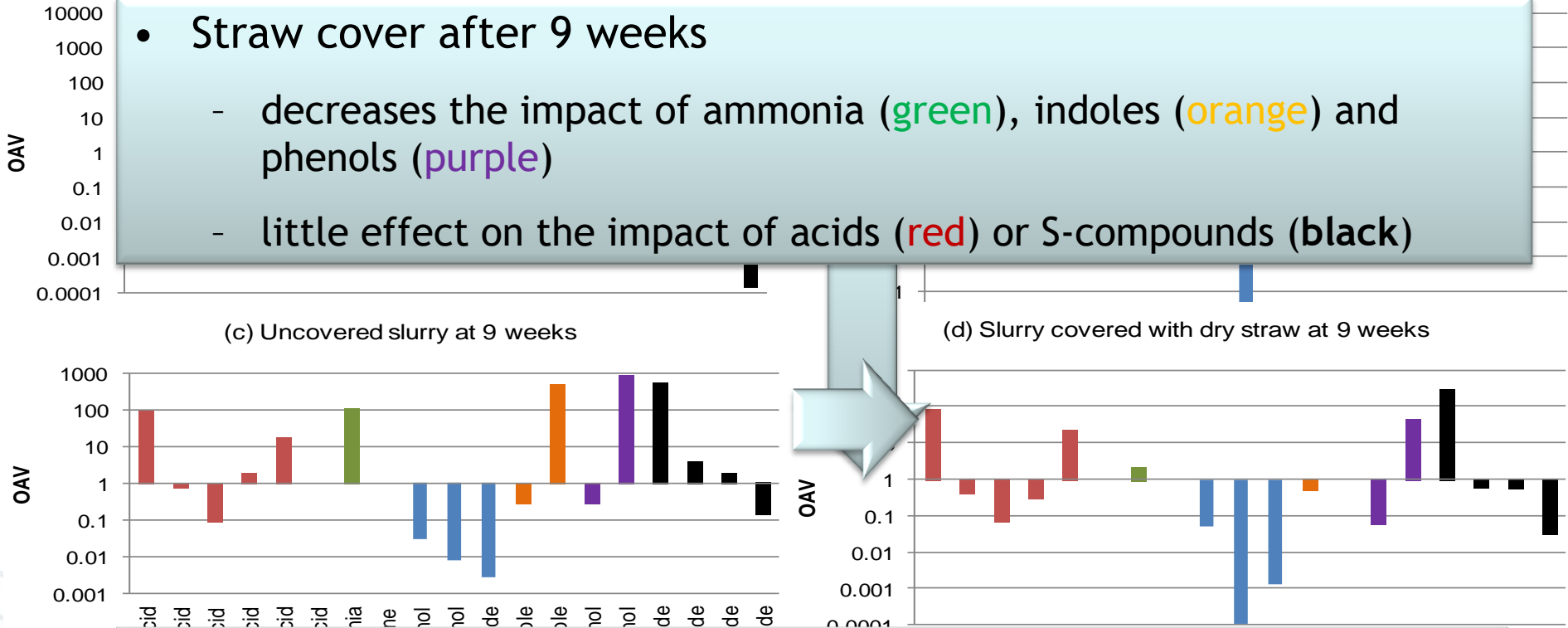
(b) Covered slurry at start of expt

### • Straw cover after 9 weeks

- decreases the impact of ammonia (green), indoles (orange) and phenols (purple)
- little effect on the impact of acids (red) or S-compounds (black)

(c) Uncovered slurry at 9 weeks

(d) Slurry covered with dry straw at 9 weeks



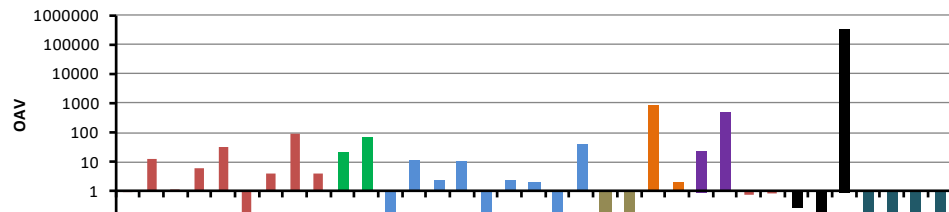
### • The compounds important for odour change over 9 weeks.

- Trimethylamine (green) becomes less important
- Sulphur compounds (black) and phenols (purple) increase

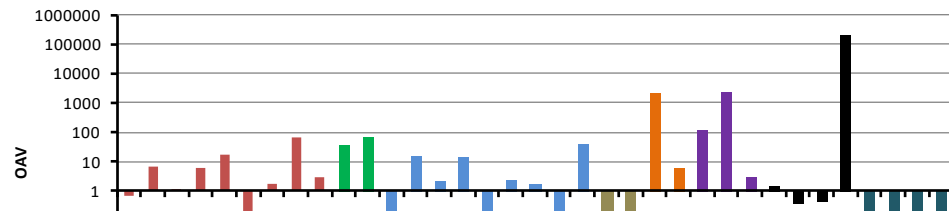
# Effect of Age group of pigs

- Not much effect

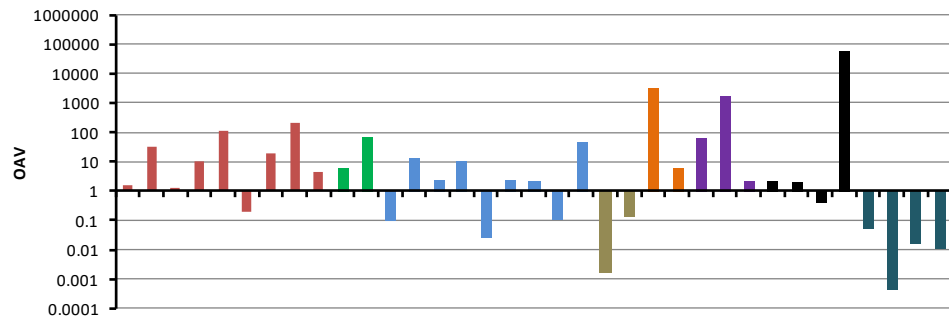
Farrowing Sows



Finishing Pigs



Weaning Pigs



2-Methylpropanoic acid  
 3-Methylbutanoic acid  
 4-Methylpentanoic acid  
 Acetic acid  
 Butanoic acid  
 Heptanoic acid  
 Hexanoic acid  
 Pentanoic acid  
 Propanoic acid  
 Ammonia  
 Trimethylamine  
 1-Butanol  
 2,3-Butanedione  
 3-Hydroxy-2-butanone  
 3-Methylbutanal  
 Butylacetate  
 Heptanal  
 Hexanal  
 Nonanal  
 Octanal  
 Acetophenone  
 Toluene  
 3-Methylindole  
 Indole  
 4-Ethylphenol  
 4-Methylphenol  
 Phenol  
 Dimethyldisulphide  
 Dimethylsulphide  
 Dimethyltrisulphide  
 Hydrogensulphide  
 alpha-Pinene  
 D-3-Carene  
 D-Limonene  
 Pyridine