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S.47 Health and production diseases



Salmonella risk assessment in home-mixed feeds for pigs

Eric Royer

Ifip-institut du porc, France



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Home-mixing as a risk for *Salmonella* introduction in pig farms



■ Few information available

- Risk factors studies (Rossel et al, 2006; Vonnahme et al, 2006; Rajić et al, 2007)
- Scientific opinion on microbiological risks in feeds (EFSA, 2008)

- risk of introduction of *Salmonella* to livestock as a result of home-mixing of contaminated ingredients ?
- *“may be a significant under-recognised risk with home-mixing...”*
 - *“in some countries strict precautions to minimise contamination of commercial feed but far less control of materials for home-mixing”*
 - *“good storage facilities may be deficient in many situations such that contamination by rodents, wild birds, insects and development of condensation is poorly controlled”*
 - *“lack of heat treatment step ↔ no critical control point”*
 - *“less sophisticated facilities (including mobile equipment) & inferior quality control measures”*
- *“....some protective factors”*
 - *“risk can be mitigated by use of organic acids”*
 - *“bulk buying and prolonged storage of ingredients ↘ risk of contamination events”*

Home-mixing as a risk for *Salmonella* introduction in pig farms



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- Risk factors studies (Rossel et al, 2006; Vonnahme et al, 2006; Rajić et al, 2007)
- Scientific opinion on microbiological risk in feeds (EFSA, 2008)
 - conflicting risk factors and protective factors in home-mixed feed production
 - need for more information

■ Assessment study in France

- Surveys + analysis (n = 419)
- Evaluation in pig farms (n = 50)
 - Procedures and equipment
 - Raw material and feeds sampling

■ % of the pig feed market mixed on-farm

- GB → 43 % (Hazzledine et al, 2011)
- DK → 60 % (Challan-Belval, 2013)
- D → 40 % (Krüsken, 2008)
- F → 40 % (Martin- Houssart, 2007)

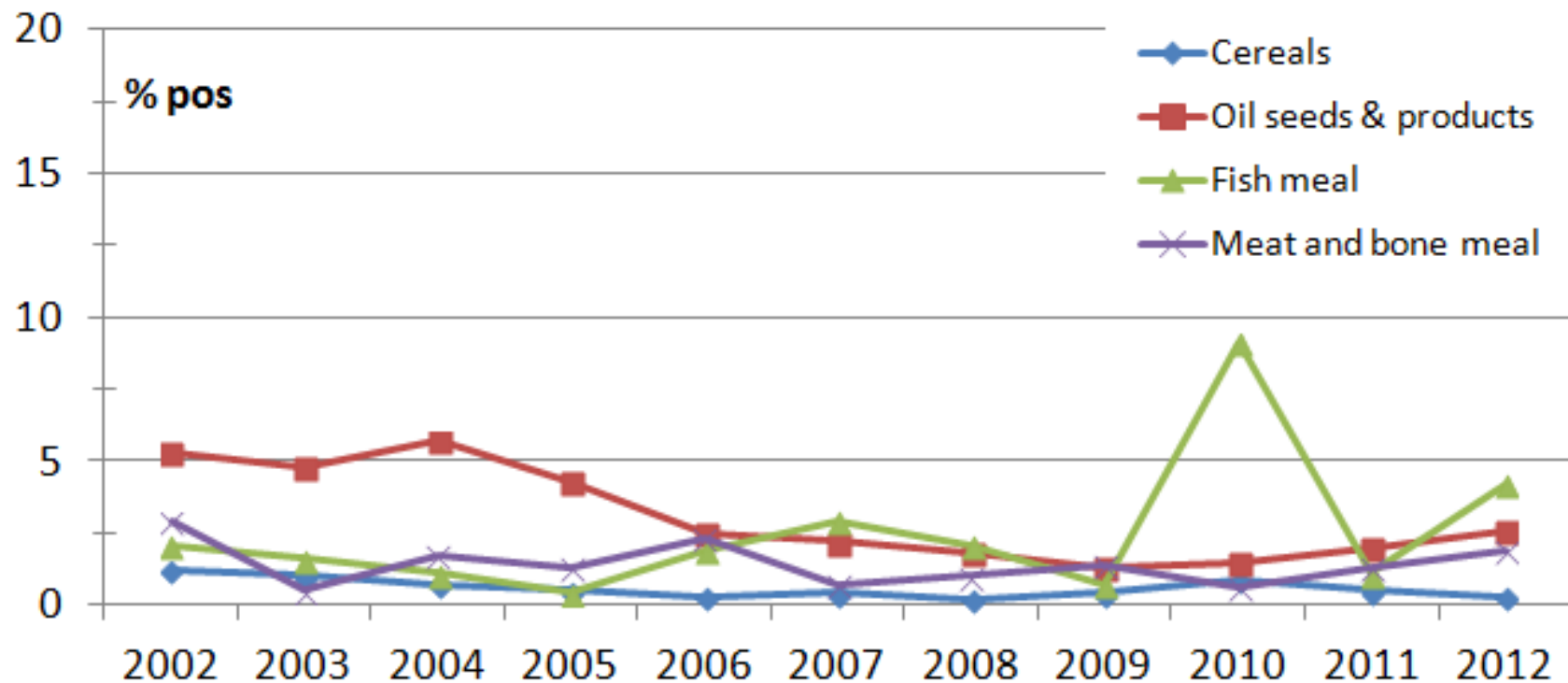
■ market analysis by Nutreco (H. de Wildt, 2013)

- *“Home-mixing farmers and integrators are the fastest growing segments in Europe”*
- *“Compound feed industry in the future will only remain strong in countries where:*
 - *Farmers make purchase decisions on feed*
 - *Farmers have relatively poor access to raw materials”*

Salmonella risk in feedingstuffs ?

■ Reports of EU *Salmonella* monitoring plans

- ↘ % positive findings
- Positive oil seed meals : 5 % → 3 %
- low occurrence of *S. typhimurium* & *S. enteritidis*



Results : ingredients sources of French pig farms

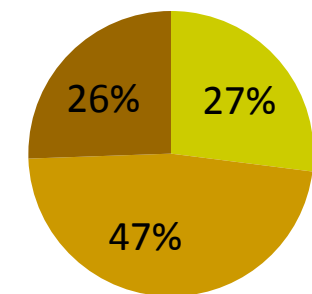
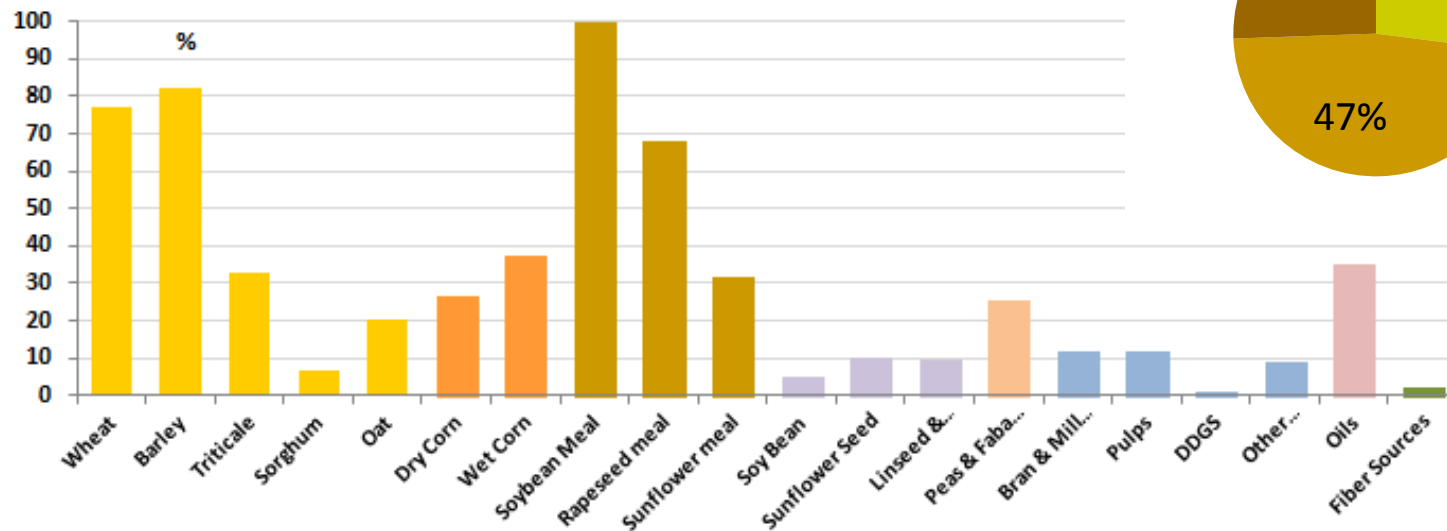
■ Feed materials used by home-mixers

■ Average farm

- 6 compound feeds or more
- 6 raw materials or more
- Cereals = 75 % of materials
- 73 % of farms = 2 or 3 oil seed meals
- Purchases = 66 % of needs

→ steady flow of raw materials and transports

■ Frequency of use



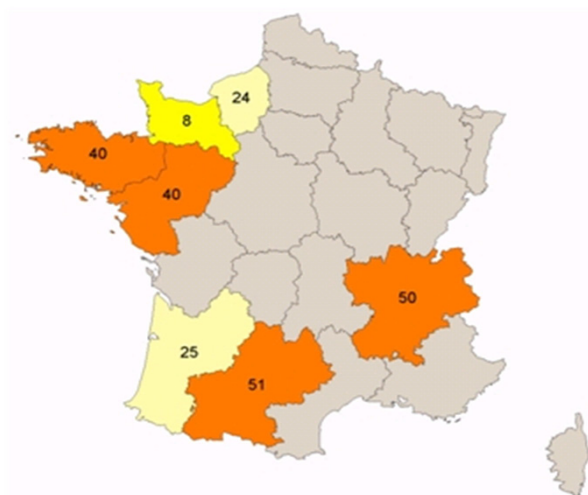
Number of oil seed meals

- 1
- 2
- 3

Results : *Salmonella* contamination of feedingstuffs and home-produced pig feeds

■ Survey

- 50 home-mixing facilities
- 154 raw materials & 84 mixed feeds
- Analysis in 100 g of sample



Samples origin

■ Results

Feed materials	N	Findings
Wheat	28	0
Corn (dry or wet)	14	0
Barley, rye, sorghum, triticale	30	0
Soybean meal	34	1
Rapeseed meal	18	1
Sunflower meal	7	0
Whey	5	0
Other liquid byproducts	9	0
Bread, biscuits	5	1
Others : soybeans, bran, dry byproducts	4	0
Total	154	3

Mixed feeds	N	Findings
Sow	32	1
Piglet	16	0
Fattening pig	36	0
Total	84	1

■ Controls operated in farms with positive samples

Farm	Cereals	Oil seed meals	By-products	Feeds	Ratio
D			whey, brewer's yeast, <u>bread</u> , whey + bread, yoghurt	pig & sow protein complementary feeds	1/7
AA	triticale, barley	soybean meal, rapeseed meal		fattening pig, <u>gestating sow</u>	1/6
AB	wheat	<u>soybean meal</u> , rapeseed meal		fattening pig, gestating sow	1/5
AS	barley	soybean meal, <u>rapeseed meal</u>		gestating sow	1/4

■ Serovars

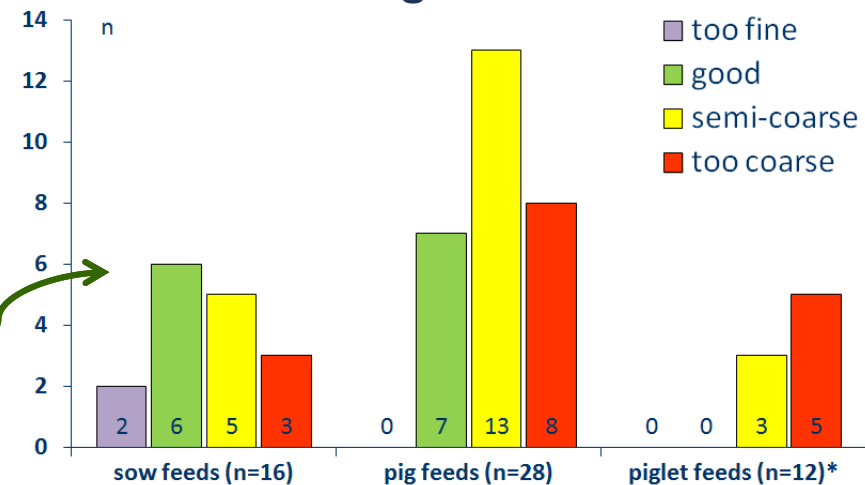
- Farm D : *Salmonella enterica* subsp. *enterica* ser . VENEZIANA
- Farm AA : *Salmonella enterica* subsp. ARIZONAE ser S.IIIa 48 :z4,z23.
- Farm AB : *Salmonella enterica* subsp. *enterica* ser CERRO
- Farm AS : *Salmonella enterica* subsp. *enterica* ser MBANDAKA

■ Particle size analysis of home-mixed feeds

■ Fineness of meal feeds ASAE method -10 sieves

Feeds	n	Median diameter (mm)
Post-weaning phase 2	8	0.65 ± 0.10
Growing-finishing	28	0.66 ± 0.08
Sows	16	0.71 ± 0.11

■ Classification according home-mixing recommendations

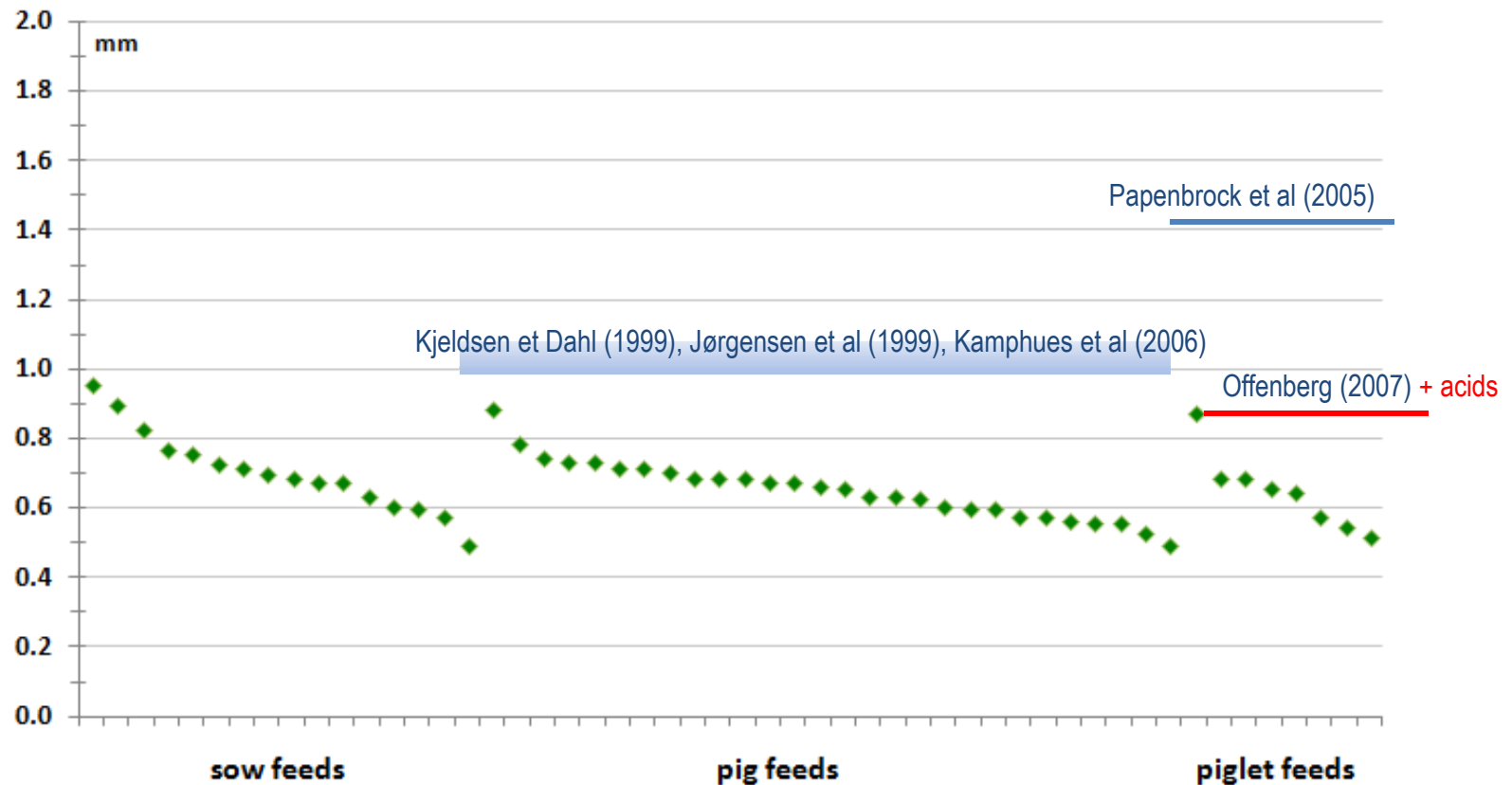


■ Favorable effect of coarse grinding

- ↘ stomach survival of Salmonella (Mikkelsen et al, 2004)
 - ↗ pH gradient & ↗ lactobacilli (Bullerman et al, 2012)
 - finely ground pelleted feed ↘ pH gradient (Hansen et al, 2003; Moessler et al, 2010, 2012)

Discussion : Effect of coarse grinding by home-mixers ?

■ Comparison to studies with effects on *S.* prevalence



■ Other studies : size not mentioned, wet sieving, roller mills

■ No direct effect of fineness of home mixed feeds ?

■ Distribution as meal vs pellets

■ Benefits of meal in

- Risk factors studies (Vonnahme et al, 2006 ; Rajić et al, 2007 ; Corrége et al, 2009)
- Some experimental studies (Jørgensen et al, 1999; Dahl et al, 1999), but not consistent with (Kjærsgaard et al, 2001; Jørgensen et al, 2003)

■ Pellets → neutral mucines ↗ adhesion of Salmonella in intestine (Hedemann et al, 2005 ; Betscher et al, 2010)

■ Liquid feeding

- ↘ salmonella in risk factors studies (Dahl et al, 2000 ; Kranker et al, 2001 ; Fablet et al, 2003; Lo Fo Wong et al, 2004; Farzan et al, 2006; Corrége et al, 2009)
- Lactobacilli in liquid distribution systems (Royer et al, 2004)
- CCM, liquid by-products

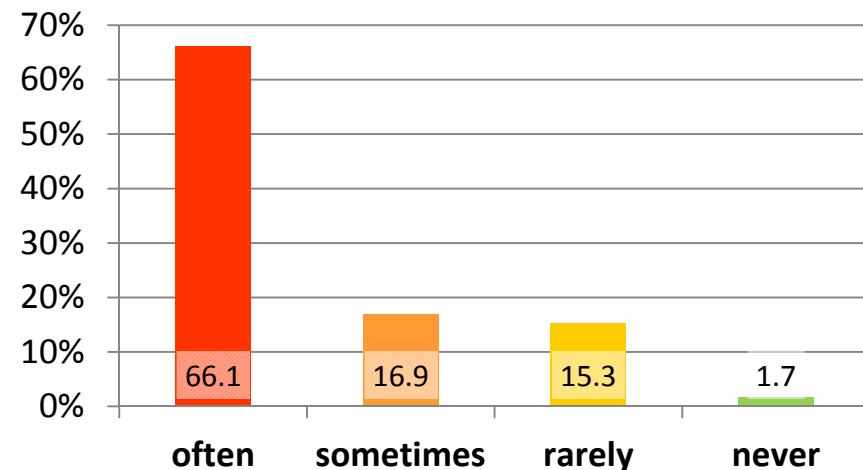
■ Implementation of main biosecurity measures

Implementation rate	< 50 %	50 - 80 %	> 80 %
Raw ingredient and feed storages	Raw materials out of rodents and birds	Measures against insects	Measures against rodents
	Coverage of storage bins	Cleaning of feed storage	Frequent cleaning of ingredients units
	Birds in building		Mixed feeds out of rodents and birds
Equipments and process	Footbath for mixing unit	Grain cleaner	Separation of home-mixing and pig units
	Records of cleanings	Frequent removal of dust	Coverage and grid on reception pit
	Knowledge of Salmonella status	Complete emptying of feed mixer	Frequent cleaning of reception pit
		Sampling of feeds	Frequent cleaning of manufacturing unit
		Pets not allowed in units	Cleaning of liquid feeding system

■ Prevention against rodent and pest infestations

	implementation %
absence of rodent around the building	62
prevention against rodents	97
prevention against insects	87
pets not allowed in the area	48

■ Birds in storage & mixing building



■ Control campaign in Denmark (Danish Food Authority, 2011)

■ 17 home-mixing pig herds

- 9 farms ← imported highly contaminated HP soymeal (including Typhimurium)

Salmonella analysis of feed materials	N	Findings
Scratch samples in storage and feed line	55	0
Soybean & rapeseed meals	7	1 (S cubana)
Home mixed feeds	2	0
Purchased compound feeds	2	1 (S typhimurium)

■ serology of meat juices samples

- only 1 farm ↗ after contaminated soymeal: doubtful ← previous problems

■ overall hygiene evaluation

- 3 farms with unsanitary conditions : rats or pests, leaks in barns, dust, transport equipment ↔ feeds + risk materials
- others : slight remarks on emptying & cleaning frequency , traceability

'home-produced feed does not appear to increase the risk'

■ Cross contamination with herds

- *Salmonella* presence on cattle, pigs, poultry herds → storage & mixing area ?
 - Birds, rodents, pets, insects ?
 - Milling facility closed to main livestock buildings ?
 - Tractors used in the mill and around the farm ?
- Contribution of contaminated feed to cycle of infection on farm ?

■ Future research

- Status of feed manufactured on farm : major risk or indicator of general contamination ? (EFSA, 2008)
- More epidemiological work to evaluate risk factors, 'gut health' aspects and protective factors

- Risk of transmission of *Salmonella* from home-mixed feeds to pigs seems generally restrained,
 - moderate prevalence in feed materials and compound feeds
 - dominant serotypes
 - meal or coarse meal + liquid feeding → a lower risk
- Effective compliance with good practices should reduce the risk of *Salmonella* contamination in pig farms manufacturing their own feed.

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Thank you for your attention



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