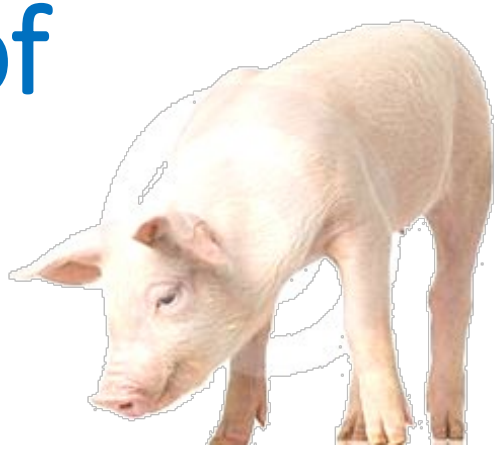
Modernisation of meat inspection of pigs by use of risk assessments - An evidence-based approach



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Meat inspection - historically

Aims of inspection

- To ensure food safety and wholesomeness of meat
  - Later: also to ensure animal health and welfare

Rules known since antiquity

- Often connected to religious rites

Germany: leading country in the past centuries

- *Trichinella* epidemics and identification of *Trichinella* =>
  - Renewed interest for meat inspection – requirement for trichinoscopy
- Dr. Robert von Ostertag's meat inspection act of year 1900
  - Led to a reduced incidence of bovine tuberculosis in humans

100 years later, time for an update

White paper about food safety, 1999

Introduced the concept of

1. Risk-based approach
2. Stable-to-Table line of thinking
3. Food Business Operator's responsibility

These three elements are basic principles for the General Food Law in EU

- EU Regulation 178/2001

The concept was addressed in the EU Meat Inspection Regulation 854/2004

- Which opened up for use of *risk assessments*, when considering to change meat inspection
  - From traditional to a more visual inspection
  - For young calves and finishing pigs, raised under controlled housing conditions

Risk assessments undertaken in Denmark

To illustrate what the effect would be of changing inspection

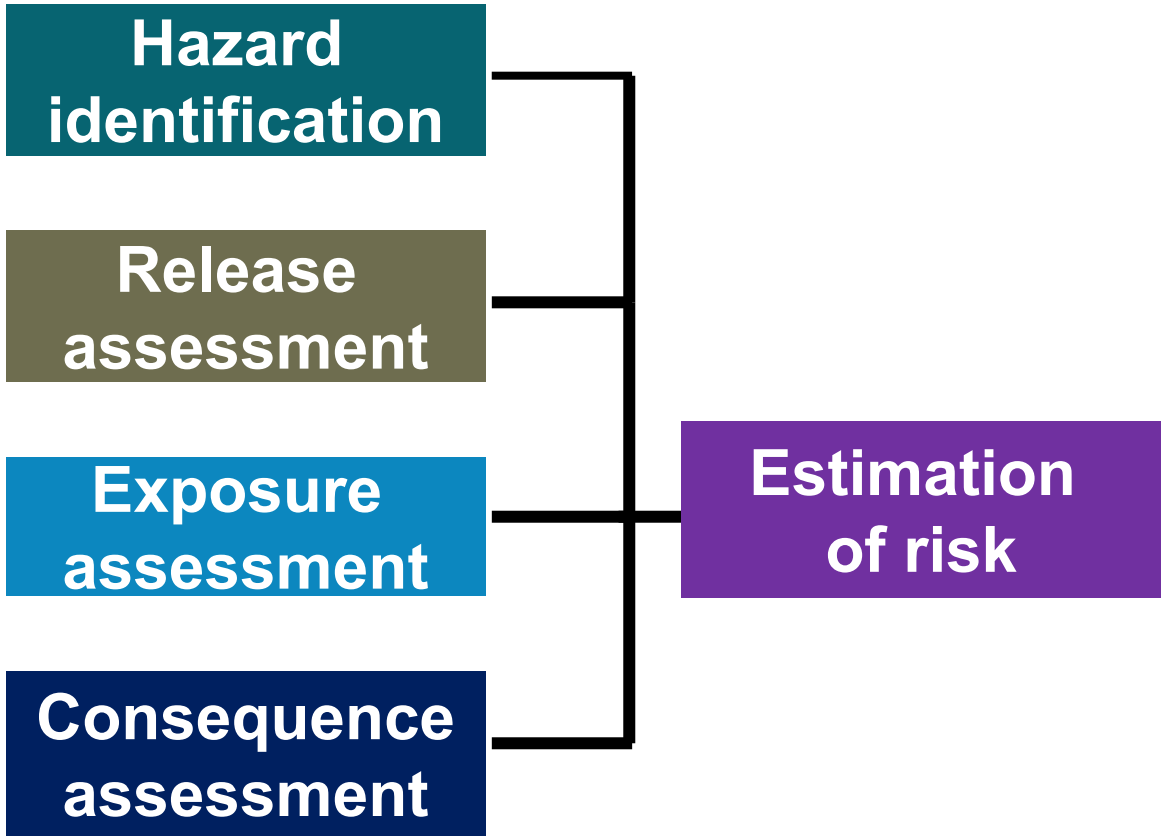
- Cut-by-cut, palpation-by-palpation
- OIE approach to risk assessment

Up-to-date-in-country data used

- Danish meat inspection database
- Own collection of samples taken during inspection/slaughter
- Worldwide published literature
- Expert opinion, when needed

Collaboration

- Academia-Authority-Industry



Example: The heart

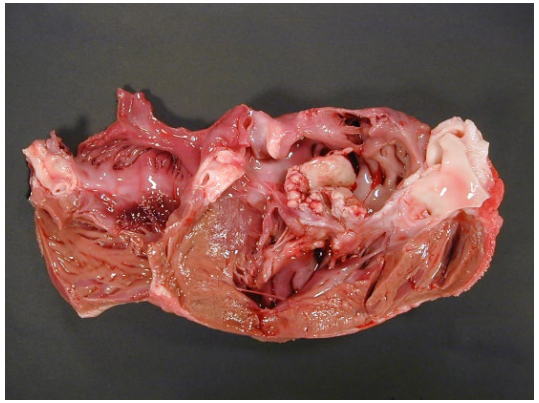


Photo: Henrik Elvang Jensen

What is the risk associated with abandoning routing incision allowing inspection of the inner side of the heart?

Endocarditis may be overlooked

- Prevalence of 0.01% in Danish finishing pigs

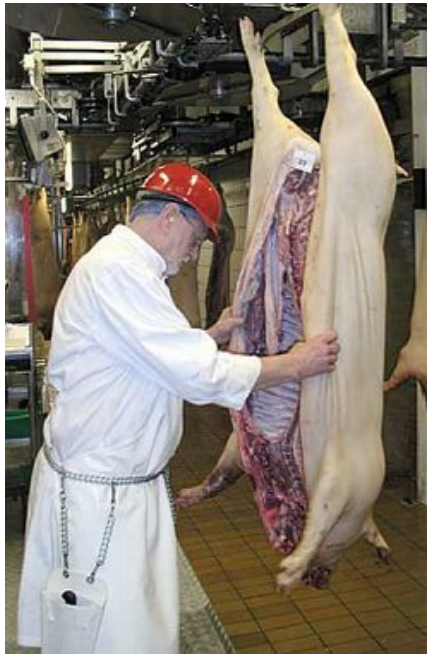
Hazard identification

- *Streptococcus suis* and *Erysipelothrix rhusiopathiae*
  - Considered occupational hazards that are not foodborne

Release/exposure/consequences

- Years' of focus on work safety → Not considered a problem among abattoir employees' union
- Statens Serum Institute's 3-year study on human meningitis:
  - 1 case (a farmer) caused by *S. suis*

Example: The heart, continued



Conclusion

- Presence of endocarditis *per se* does not render the meat unsafe for human consumption

If other lesions are found during inspection, indicative of systemic infection

- Such as abscesses that could be part of a septicaemia complex
- Then carcass should go to rework area and be subjected to traditional inspection

Handling of heart

- Danish solution: heart is opened by an abattoir employee
  - Condemned, if lesions are found
  - To reduce exposure of consumers to *S. suis* and *Erysipelothrix rhusiopathiae*

Process 2004-2009 – Danish risk assessments about swine inspection

EU Regulation 854/2004

- Opened up for use of risk assessments in indoor finishing pigs

Risk assessment for heart and mandibular lymph nodes, 2008

- **Concern:** Risk of overlooking tuberculosis and endocarditis

Risk assessment for intestinal lymph nodes, 2009

- **Concern:** Risk of overlooking disease only in intestines or their lymph nodes

Process 2013-2019 – Danish risk assessments about swine inspection

Risk assessment for lungs and liver, 2013

- **Concern:** Risk of overlooking embolic pneumonia caused by septicaemia, and liver abscesses

Microbiological burden of pigs with septicaemia, 2013

- **Concern:** Meat from pigs with septicaemia have high microbiological burden

De-boning of cases with lesions indicating prior septicaemia, 2014-19

- **Concern:** Osteo-myelitis could be overlooked, if carcass is not de-boned

Low quantitative number of *S. aureus* in pigs with lesions indicative of septicaemia

Table 2
Quantitative presence of *S. aureus* in various sites in each of 19 finisher pigs identified with embolic pneumonia during traditional meat inspection. carcasses (final judgement of the carcass and presence of ulcer).

		Numbers of bacteria (CFU) per sample[a]						
Pig no.	Final judgement	Lung	Muscle	Heart	Liver	Kidney	Spleen	Joint
1	De-boning	>200	3	0	1	28	0	0
2	Condemnation	0	2	8	0	0	0	0
3	Condemnation	0	N/a	0	0	0	0	0
4	De-boning	>200	0	~150	87	44	0	0
5	De-boning	0	0	2	0	115	N/a	0
6	De-boning	>200	8	1	0	10	~50	~100
7	De-boning	0	1	0	0	~50	2	0
8	De-boning	>200	5	0	0	0	0	0
9	De-boning	>200	0	0	0	0	0	0
10	De-boning	0	0	0	0	0	0	N/a
11	De-boning	0	0	0	0	0	0	0
12	De-boning	~50	0	0	0	0	0	0
13	De-boning	>200	0	36	0	0	0	0
14	De-boning	>200	0	15	0	0	0	0
15	De-boning	>200	0	5	0	0	0	0
16	Condemnation	0	0	0	0	0	0	0
17	De-boning	0	0	15	0	0	N/a	0
18	De-boning	0	0	0	8	0	N/a	N/a
19	De-boning	>150	3	0	10	0	0	21

N/a.: Data not available.
[a] Per sample represents a swap sample from lung, heart and joint and a tissue sample of approx. 1 g from muscle, liver, kidney and spleen. See S
explanation.

Kruse et al., 2015. Int. J. Food Microbiol.

Suspicion of septicaemia

Presence of lesions indicative of septicaemia needs careful evaluation

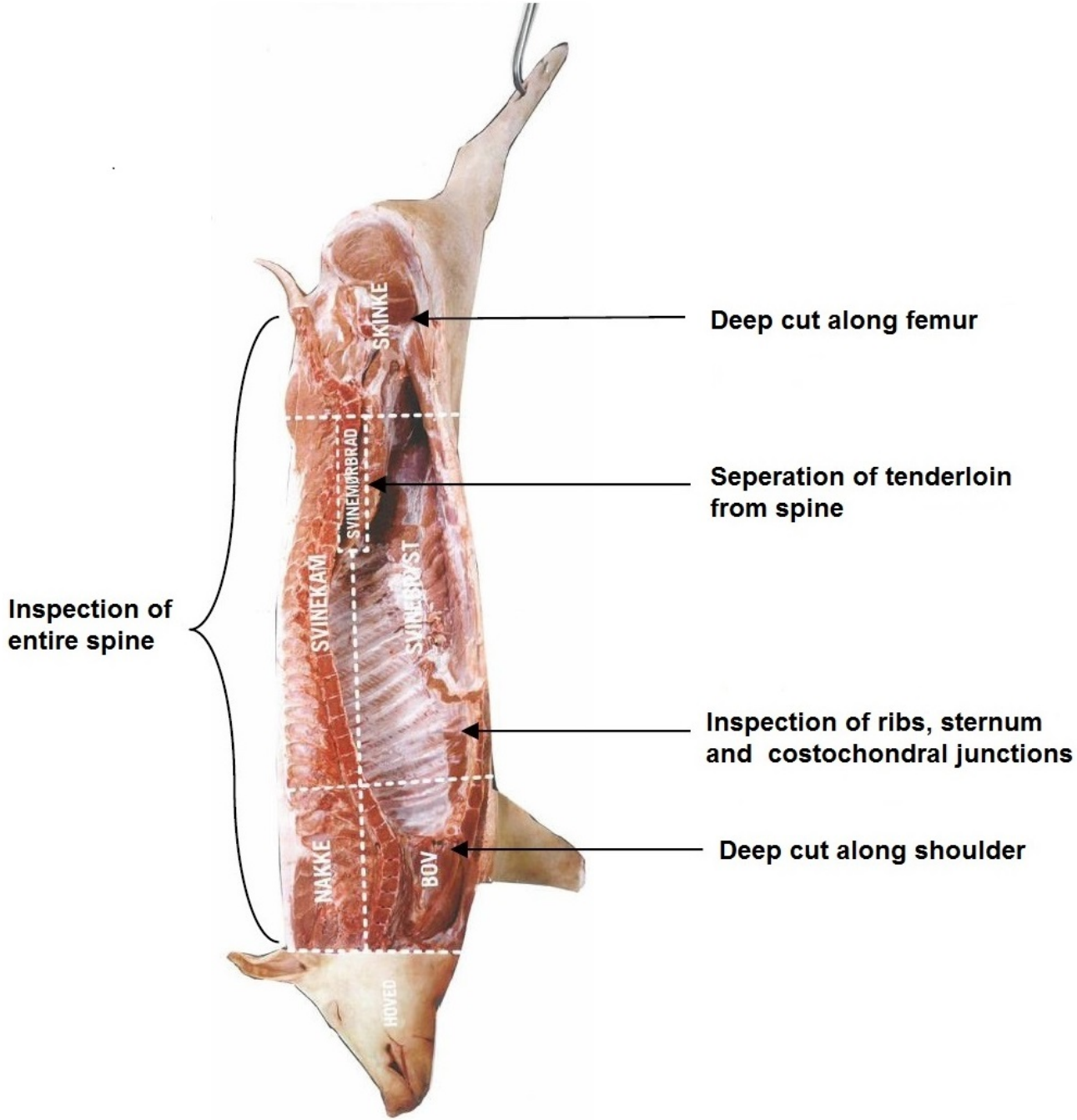
- In Denmark, so-called “pyaemia” investigation undertaken in the rework area

  Acute cases → Total condemnation

  Chronic cases → De-boning

Lesions probably caused by a tail bite, which occurred months earlier

- In many case, lesions are in healing
- Deboning will ensure that osteomyelitis cases will be detected
  - Hereby abscesses are removed



Study of septicaemia in finishing pigs, 2013-14

Study at Tican Abattoir during 2 weeks in 2013

- Table shows location of abscesses in 102 carcasses
- Detected during pyaemia investigation

Location	Number	Distribution (%)
Thoracic cavity	50	42.0
Lumbal spine	21	17.6
Thoracic spine	17	14.3
Foreleg	14	11.8
Hindleg	10	8.4
Other[a]	5	4.2
Total	119	100.0

[a] Tail bone, pelvis, jaw, neck, lungs.

Main part of abscesses found in the thoracic cavity

Bækbo et al., 2015. Food Control

Study of septicaemia in finishing pigs, 2013-14

The 102 finisher pigs sent for de-boning - All accepted afterwards

One abscess found during de-boning (not related to septicaemia complex)

- Most (83%) muscle samples sterile, but abscesses only 6% sterile
- Positive samples: mostly known pig pathogens and environmental bacteria
    - *Streptococcus* sp., *Pasteurella* sp., *Trueperella pyogenes, Aeromonas* spp., *Ralstonia Pickettii* (judged as contaminant)

***S. aureus* judged as only potential human patogen (toxin production)**

- No association between presence of bacteria in muscle and abscess (P = 0.86), neither for the specific findings of *S. aureus* (P = 1)

Subesquent data from 6 other abattoirs evaluated

- Less effcient in finding all abscesses during the pyaemia investigation
    - Some absceses overlooked

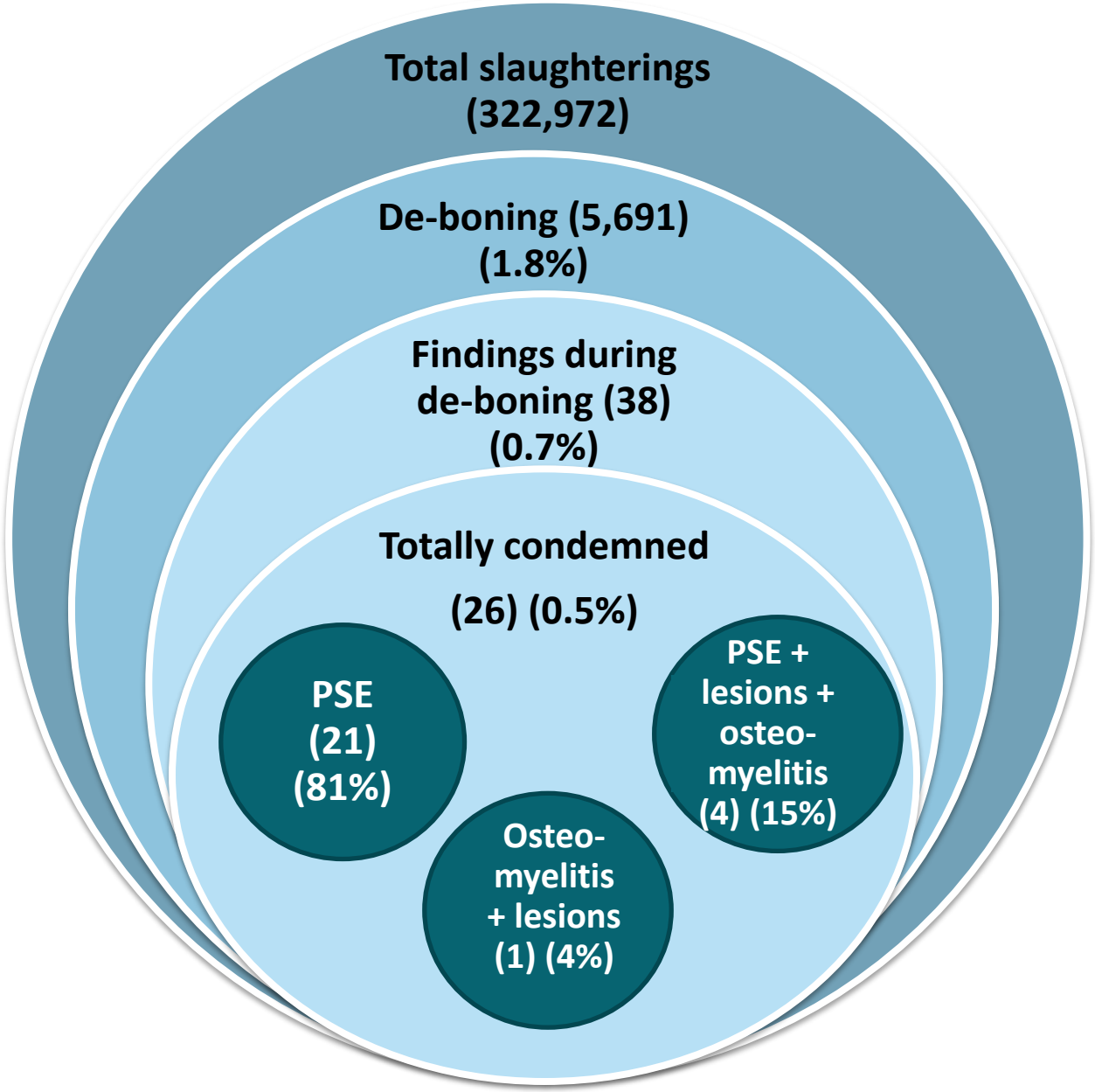
Prior septicaemia in sows

Sows are destined for de-boning

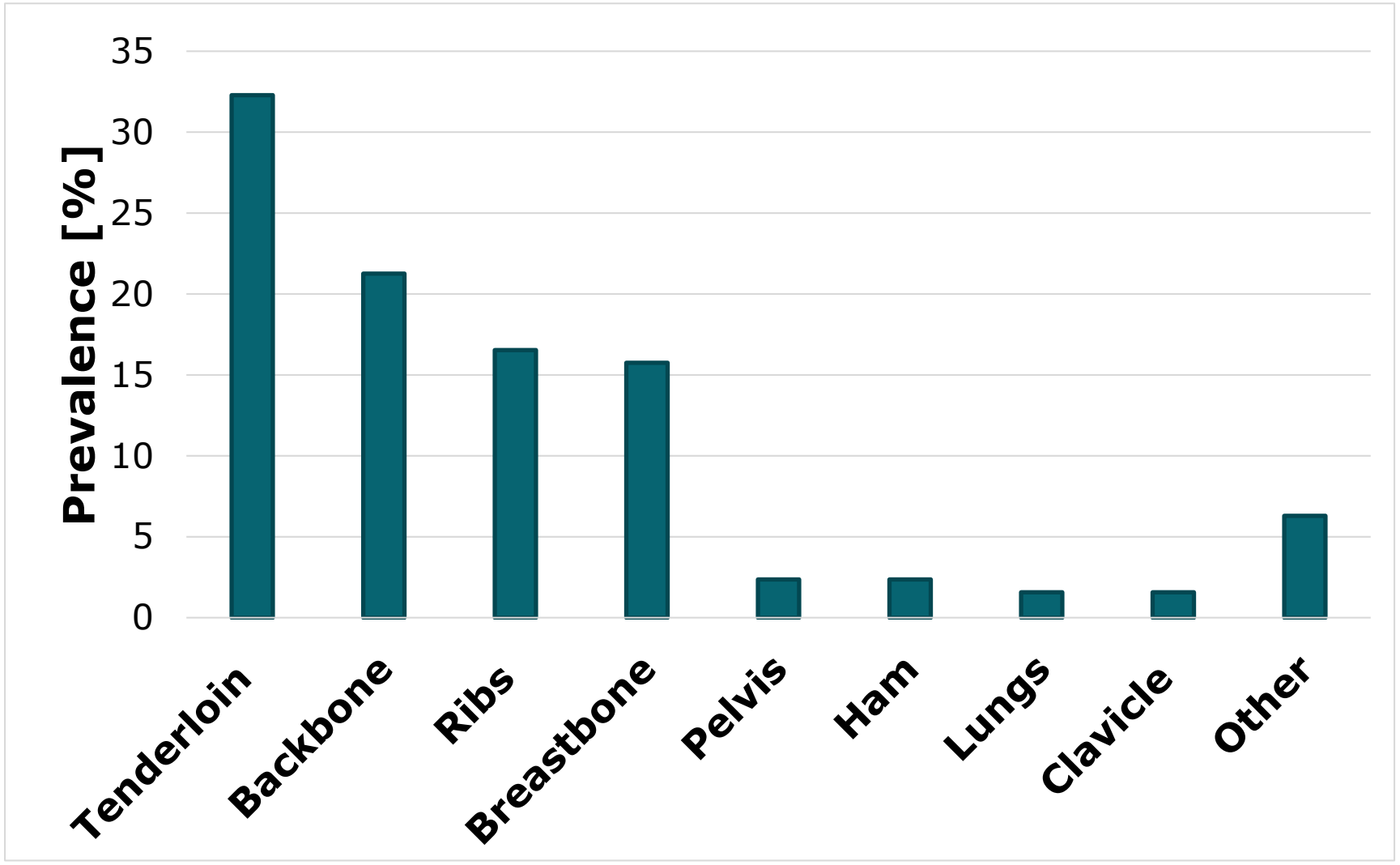
- If lesions are found, indicating septicaemia
  - As for finishing pigs

Data from 14 months from Skærbæk Sow Abattoir

- Very few abscesses escape detection during the pyaemia investigation
- Only 5 cases out of 322,972 condemned due to septicaemia
- According to Pedersen et al., Fleischwirtschaft International (2017)



Locations of 127 abscesses in 105 sows/ boars



- The tenderloin is the most common location in sows/boars
- Not the same in finishing pigs, where the thoracic cavity is the most common location

Pedersen et al., 2017. Fleischwirtschaft International

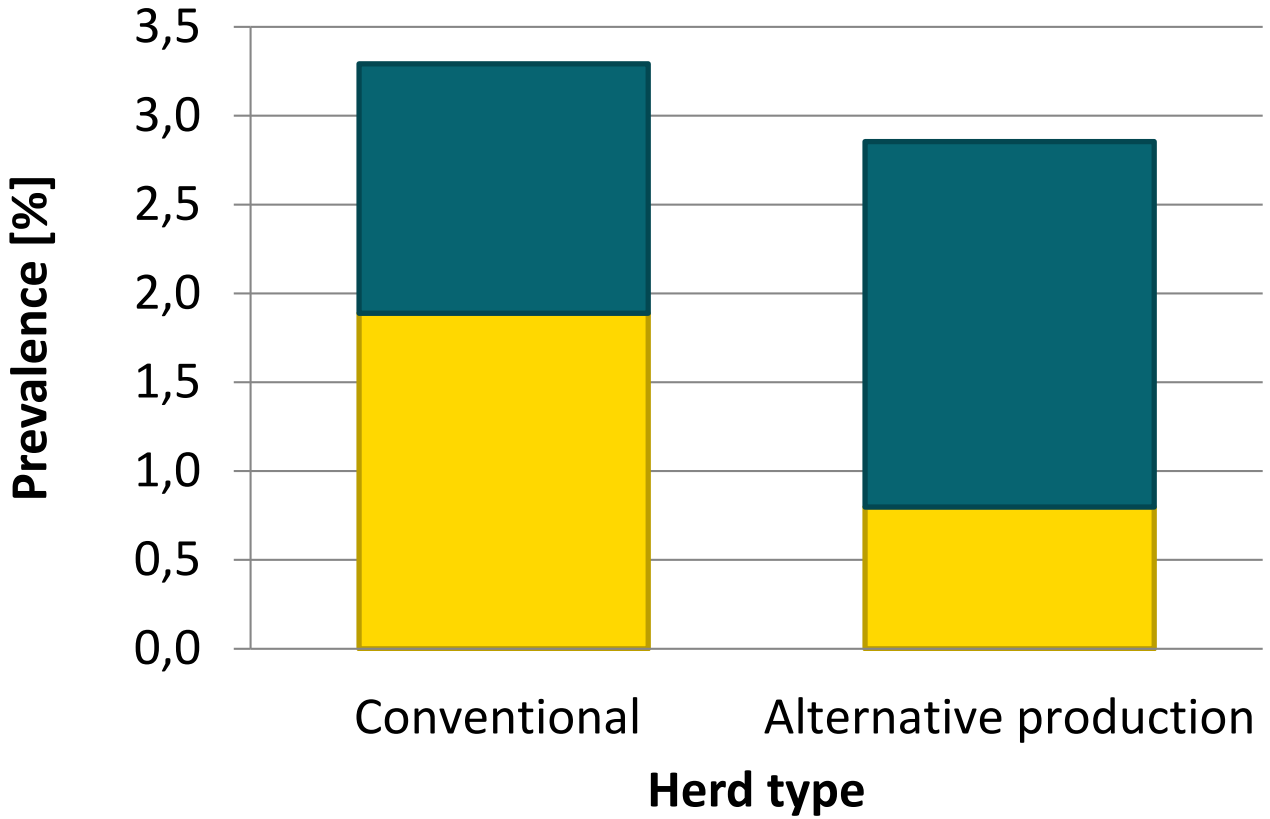
Difference between conventional and alternative raised sows

Research question:

- Does prevalence of de–boning and total condemnation of sows differ according to production system?
- Abattoir data (Jan. 2014–Mar. 2015)
- Divided into sows raised in:
  - Conventional or alternative system

Result:

- Conventional sows with septicaemia are less likely to be totally condemned than similar sows from alternative production
- Could be related to low AM-use in alternative production



Pedersen et al. 2017 Fleischwirtschaft International

Process in Denmark – collaboration across parties

Review process in place

- Risk assessments are developed by the livestock and meat industry in collaboration with University of Copenhagen with Master or Ph.D. students on board
  - Assessments are presented to the veterinary authorities
- The veterinary authorities send the assessment to the Danish Technical University (DTU)
  - For objective, external review
  - Any concern raised by DTU will then be addressed

Case: Changing handling of de-boning of carcasses with lesions indicative of prior septicaemia

- Risk assessments accepted, but implementation study was judged as required

Studies of implementation of alternative handling of prior septicaemia cases, 2017-19

Study objective: find alternatives to de-boning of chronic cases

- Studies done separately in sows and finishers
- Showed that some abscesses were overlooked in specific areas

Action/New legislation in Denmark (finishers: 2018, sows/boars: 2019)

- Pyaemia investigation updated + targeted cutting described for own control
- Own control used by abattoirs => will result in lower costs because 1) no need for de-boning, 3) higher value of meat, and 3) no category 2 animal by-products

Results of risk assessments – in general

Finishing pig have few lesions of importance to food safety

- Seriously ill pigs are euthanised and are hence not delivered to the abattoir
- The body is clearing itself after an infection
- Very low count of bacteria in muscles – bacteria also found in healthy controls

In most cases, lesions are macroscopically observable

- Except from endocarditis and small abscesses in lymph nodes
- Embolia in lungs may be overlooked, if few and only located deep in the tissue

Bacteria involved are usually not foodborne, but considered occupational hazards

- May cause infections in existing wounds in humans
- Lungs not considered edible tissue in Denmark

Experienced gained - gradually

The approach led to a gradual implementation of visual-only inspection

For indoor finishing pigs, routine incisions/palpation was abandoned

1. Mandibular lymph nodes
2. Heart
3. Intestinal lymph nodes
4. Lungs

} Unless data/findings during AM/PM indicate a need for additional inspection

Experience gained regarding how to modify the slaughter line

- Enabling inspection of plucks hanging over intestines
- Mirrors and lights to ensure documentation

Moreover, studies of septicaemia cases provided evidence regarding microbiological burden and more cost-effective ways of handling, depending upon stage of infection

Risk communication

Judged as very important to communicate

- Risk assessments written in English
- Scientific papers published in various journals
  - Placed on website of Danish Agric. & Food Council
  - http://lf.dk/aktuelt/publikationer/svinekod

Presentations given, and discussions taken

- At scientific meetings and arrangements for people involved in meat inspection

Dialogue with important trade partners

- To obtain acceptance of equivalence
- Very important for a country, which is exporting a high proportion of its pig meat

Discussion – EFSA Opinion from 2011

Identified the hazards, which should be covered by meat inspection of swine

- *Salmonella*, *Yersinia*, *Trichinella* and *Toxoplasma*
- EFSA concluded that traditional meat inspection in swine could safely be replaced by visual-only inspection
  - Without jeopardizing food safety, animal health or animal welfare

Hazard identification should be updated regularly

- Hepatitis E virus? - Relevant hazard?
- Residues of antimicrobials in meat – Relevant hazard?

Septicaemia was not covered in the EFSA Opinion

- Therefore, we did the work ourselves ☺
- Similar studies are currently undertaken in Portugal

Discussion – New EU Regulation not fully complied with

In June 2014, new EU Meat Inspection Regulation came into force

- Stipulating that meat inspection of all swine should be visual-only
  - Irrespective of age or production system
- Unless food chain information (FCI) or info from AM or PM indicate otherwise
  - Hence, FCI system is a requirement for visual-only inspection

However, countries outside the EU did not allow this

- Creating a difficult situation for pig meat exporting Member States
- This has delayed the implementation in some countries
- In Denmark, outdoor raised pigs as well as sows and boars slaughtered at the export-oriented abattoirs are still inspected in the traditional way

Discussion - continued

Development of national risk assessments in parallel with EFSA

- May be seen as complimentary work addressing specific needs in Member State
  - EFSA Opinion 2011 not considered as sufficiently detailed for trade partners
    - When negotiating acceptance of equivalence
    - Here, in-country-up-to-date risk assessments may be needed

Next question in Denmark is to look at same issues in bovines

- Beginning with update of microbiological testing methodology
  - Used when certain lesions involving prior septicaemia are found
  - Will involve detailed study of microbiological burden of animals/carcasses

Discussion - continued

EFSA recommended development of meat safety assurance systems

- With focus on the hazards that make humans and animals fall ill

Private standards in place

- Listing different requirements - among others for meat safety

RIBMINS Cost Action network 2019-2024

- Will bring together academia, authorities and stakeholders
- To look further into development of feasible meat safety assurance systems

Challenge: Food Chain Information

- Usefulnes: how, where and when?
- For- and backward feeding of information

Conclusion

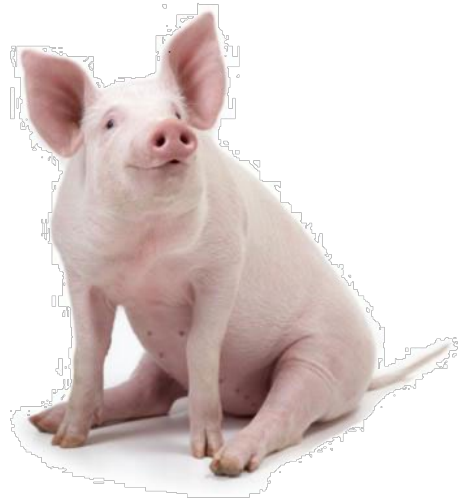
Risk assessment

- An effective tool and a constructive process, involving evidence and people
- Publishing in English is necessary
- Dialogue with different stakeholders is needed
- External review system: safe structure, but patience required

Approach made it possible to implement changes gradually

- As acceptance of equivalence was obtained from importing trade countries
- People involved in meat inspection became accustomed to visual-only inspection
- System modified step-by-step to ensure continued detection of important lesions
  - For food safety, animal health, and animal welfare

→ **Confidence in the Danish inspection system has been maintained**



For your interest:
RIBMINS Cost Action Network 2019-2024

Open inaugural workshop about risk-based meat inspection and integrated meat safety assurance

- Monday 26 August 2019 in Berlin
- Held in relation to the Safepork Conference
- Find more information on: www.safepork-conference.com

Thank you for your attention

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