Changing from recording ultimate pH to drip loss when improving breeding programs for quality traits in pigs

EAAP 2008,

Vilnius, Lithuania

August 2008

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Title of research programme:
"Programme for improved meat and fat quality in pigs through genetics and nutrition"

- ✓ This project is a cooperation between Department of Animal Science UMB, Felleskjøpet Feed Development, Norwegian Meat Research Centre and Norsvin
- ✓ The programme is running 2005-2008

- ✓ Background for this project:
  - ✓ There are four breeds of pork in Norway, and we run breeding programs for Landrace and Duroc
  - ✓ The Norsvin Landrace is one of the leanest and most efficient breeds in the world, and Duroc is special for its high level of intramuscular fat
  - ✓ Both breeds have a high response in lean meat percentage which affect eating, nutritional and technological quality

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Purpose for the PhD-project

- ✓ To find methods for cheaper large scale measurements of meat and fat quality traits
- ✓ To find inheritance and genetic correlations for pH, drip loss, colour, IMF, fat colour, moister content in fat and fatty acid composition
- ✓ To include new quality traits in the genetic evaluation programs for Norsvin Landrace and Norsvin Duroc

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Aims for this presentation

- ✓ The objective of this study was to estimate genetic parameters of drip loss and pH for Norsvin Landrase and Duroc
- ✓ Drip loss was measured in the glycolytic loin muscle *Longissimus dorsi* (LD), last rib
- ✓ pH was measured in LD, last rib, the glycolytic ham muscle *Gluteus medius* (GM) and the oxidative ham muscle *Gluteus profundus* (GP)

LOIN

Longissimus dorsi

HAM

Gluteus medius

Gluteus profundus

Foto: Porcine Myology. Available: http://porcine.unl.edu

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Background

- Norsvin has **two breeds**:
  - **Norsvin Landrace** is now bred as a dam line, but was earlier bred as a combined line. The breed is one of the leanest and most efficient breeds in the world
  - **Norsvin Duroc** is bred as a sire line. The breed is special for its high level of intramuscular fat

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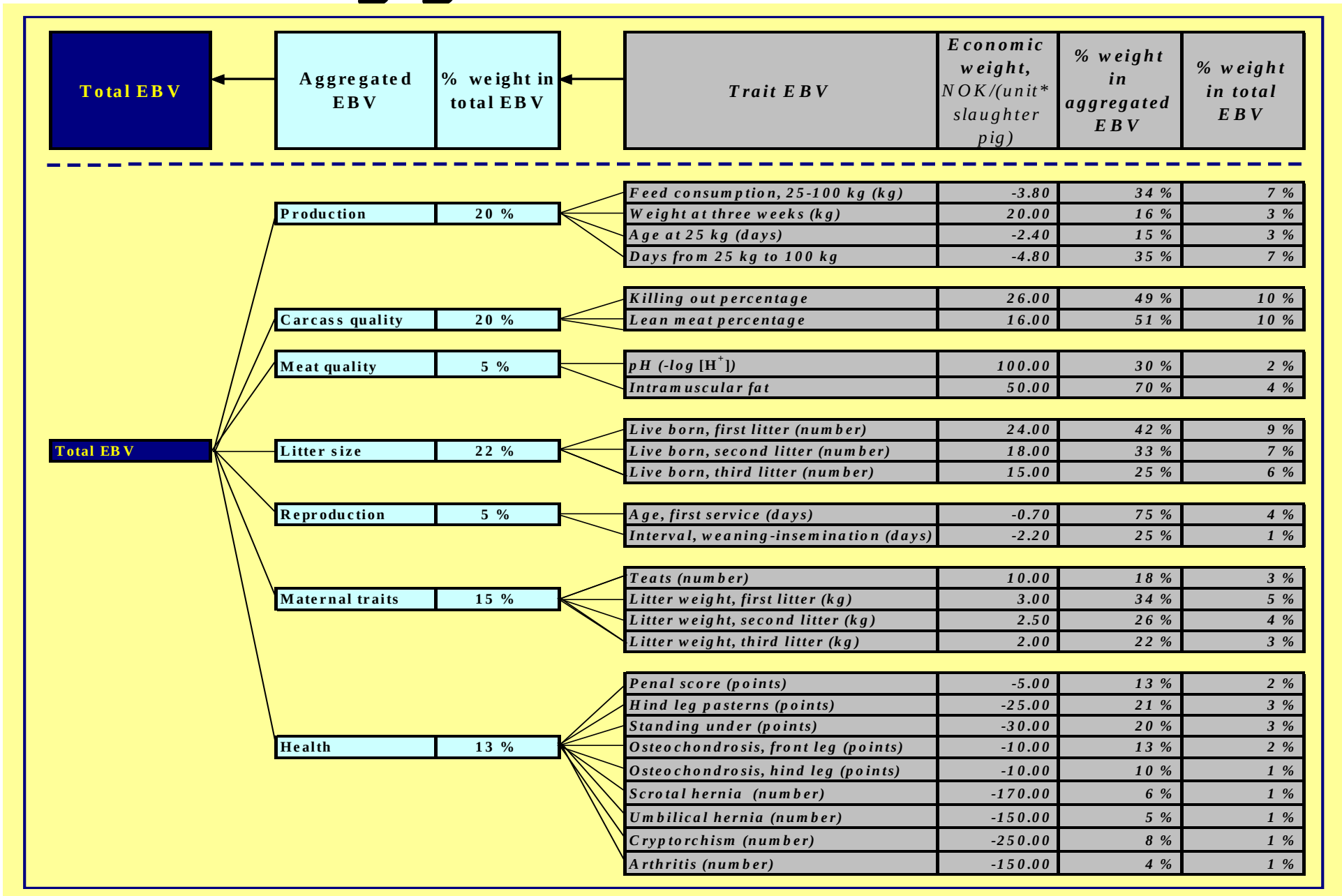
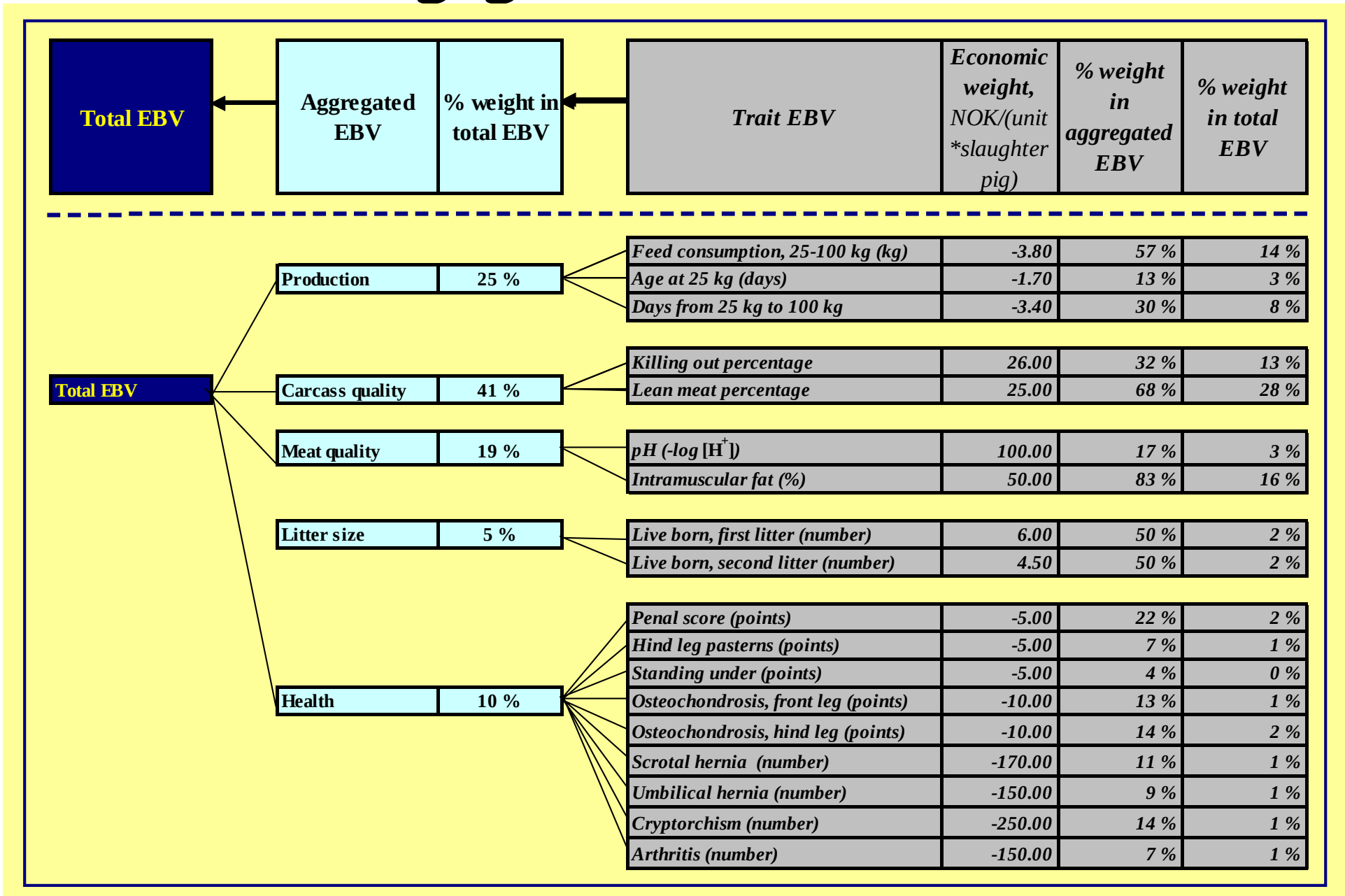
Breeding goal, Norsvin Landrace

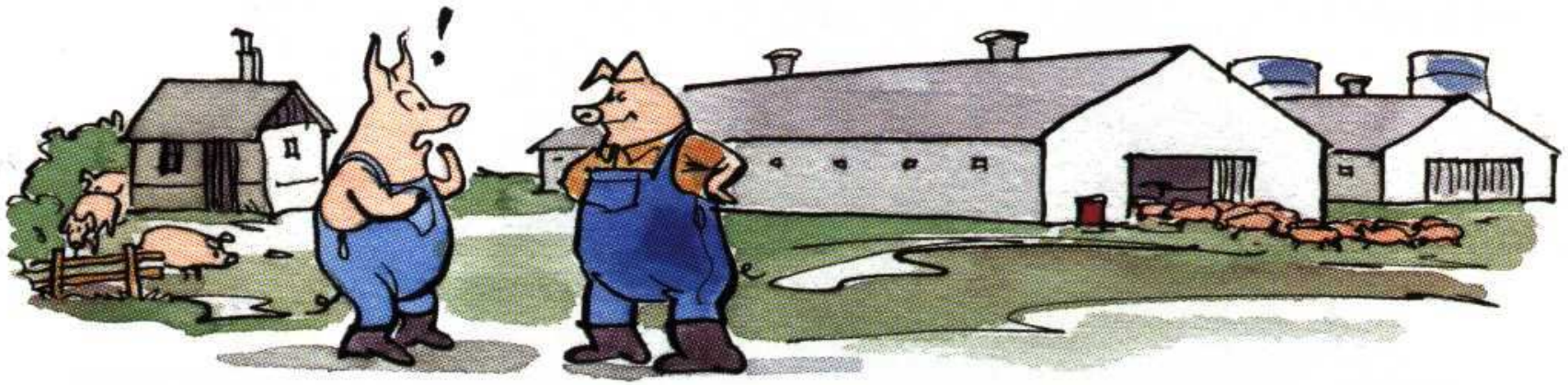


Breeding goal, Norsvin Duroc



Testing on boars

- ✓ Records on meat- and fat quality for Norsvin Landrace and Duroc will be collected from our new test station for boars, 3500 animals annually
- ✓ The Loin are send to a partial dissection line, at Animalia (Norwegian Meat Research Center)



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Importance of WHC

(Water holding capacity)

- ✓ Content and distribution of water influence the properties of the meat (firmness, juiciness, appearance etc)
- ✓ Loss of water as drip:
  - ✓ Weight of product and therefore financial value is affected
  - ✓ Waste of animal protein
  - ✓ Technological properties are influenced
  - ✓ Appearance and consumers appeal of the meat is affected

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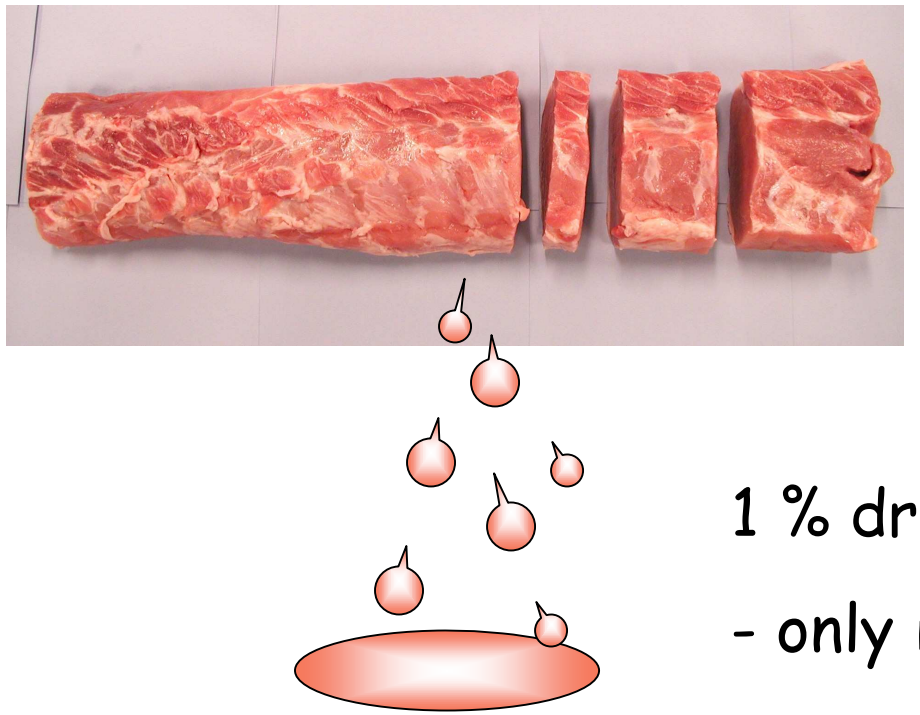
Monetary loss per % drip loss in Norway



1,5 million slaughter pigs / year

10 million kg of boneless loin

price: 139 NOK/kg

1 % drip loss = ca. 14 million NOK/year

- only in case of loin -

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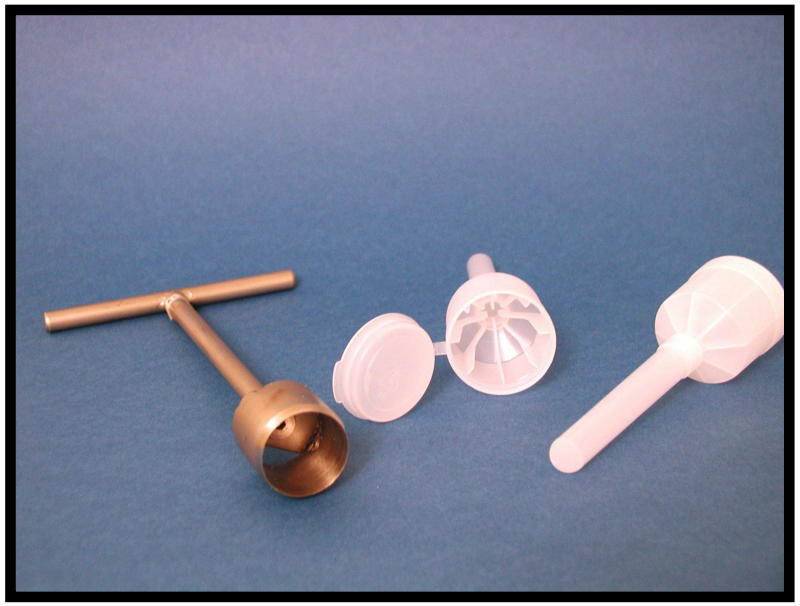
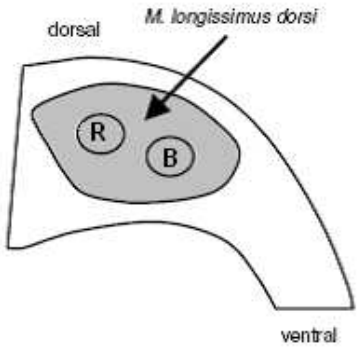
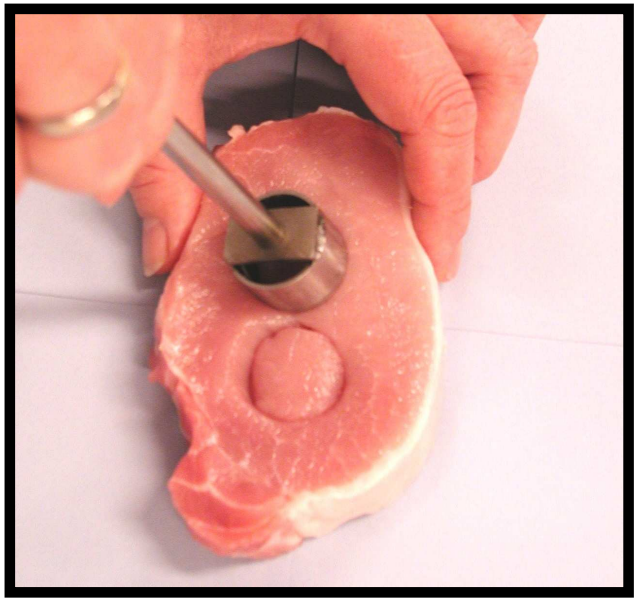
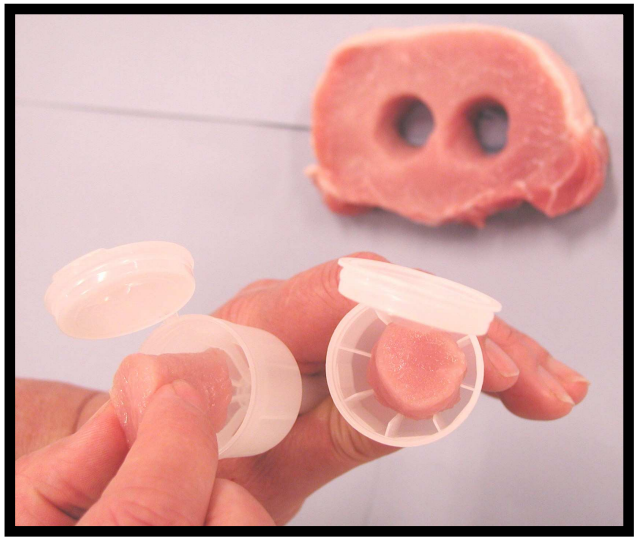
EZ-DripLoss

Developed at Danish Meat Research Institute









Photos: Danish Meat Research Institute

A special cylinder knife and special containers secure the same treatment of all samples

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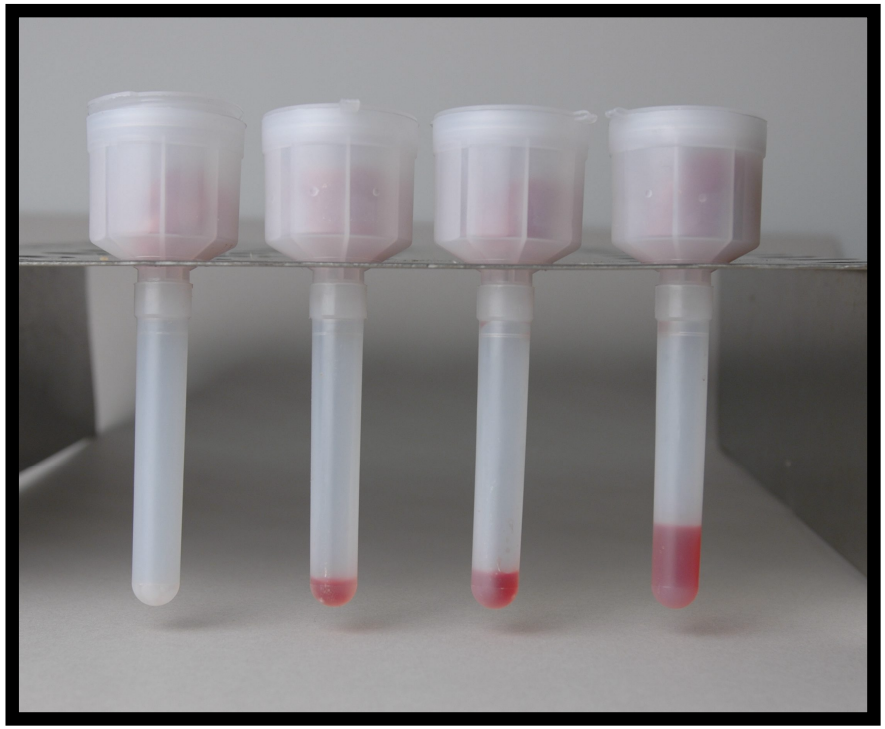
EZ-DripLoss continued



After 24 hours, the meat juice is weighted. A bar-code scanner and a weight connected to a computer make the job simple and the data quality good

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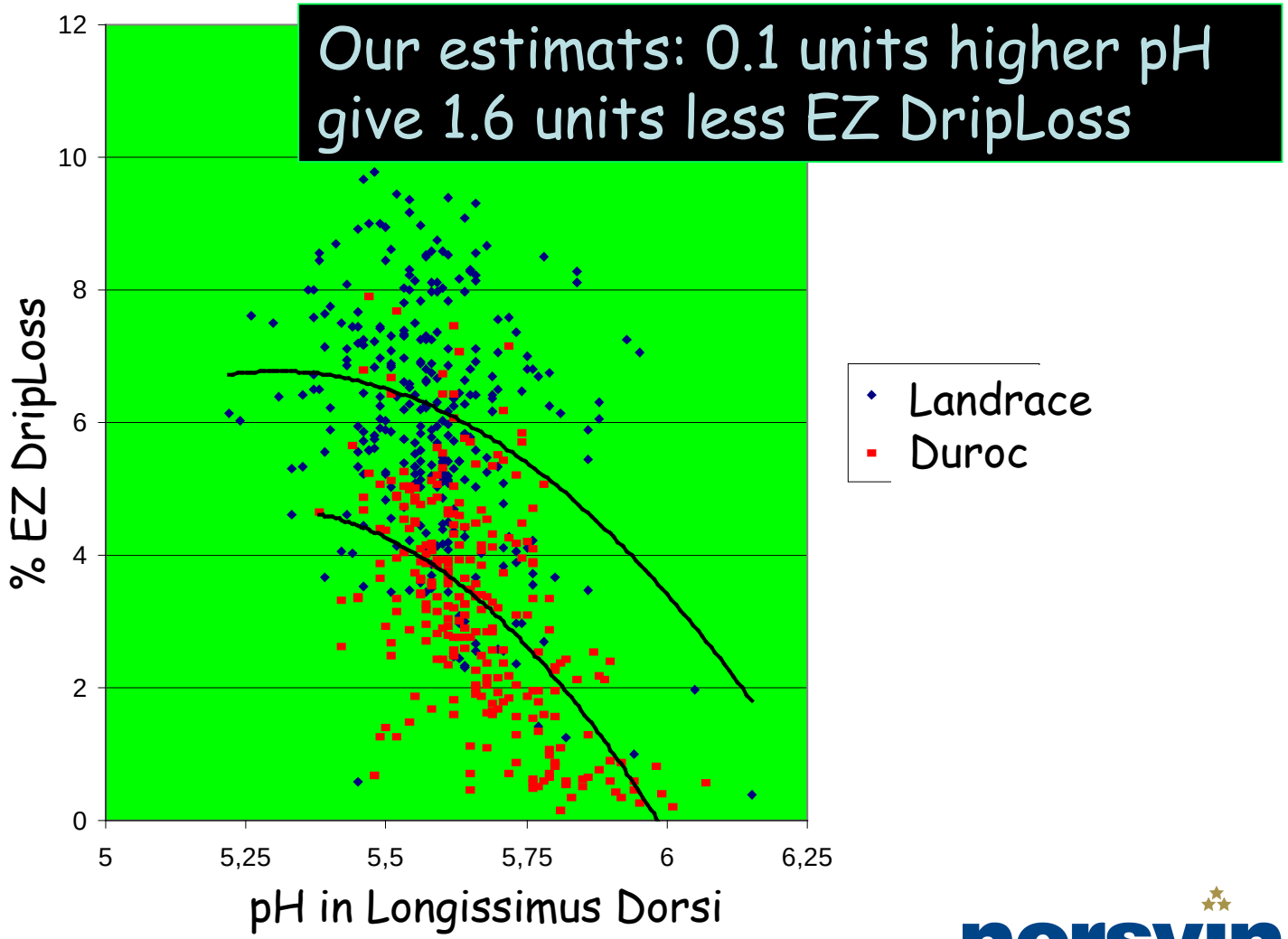
EZ-DripLoss and pH in LD



Iso-electric point at pH 5,4 - 5,6 with lowest WHC

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Theory: Drip loss and pH

- ✓ The isoelectric point of proteins is the point where the numbers of positive and negative charges are the same or the net charge is zero
- ✓ The isoelectric point of meat occurs at a pH of about 5.4 - 5.6
- ✓ After normal rigor mortis development meat has a pH of about 5.5, and therefore has the lowest WHC possible
- ✓ If the meat pH is increased and the isoelectric point of the proteins is decreased, WHC will be drastically increased

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Model for EZ-DripLoss

Model: EZ-DripLoss = sex + slaughter day + time to drip

F F FR

+ age carcass + age carcass^2 + age carcass^3 + animal + e

FR 1st degree FR 2nd degree FR 3rd degree R R

Same model for both breeds: All p-values < 0.05

Landrace: R^2 = .27
Duroc: R^2 = .44

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Did you know that pH in carcass increase again?

- ✓ For all muscles pH decrease first 24 h post mortem
- ✓ **But the pH increase from day 2 to 9 !**
- ✓ pH for Landrace increase from 5.5 to 5.6 and Duroc from 5.6 to 5.7
- ✓ This effect improves the water holding capacity with 1.5 - 2 percent for Duroc and Landrace
- ✓ The decreased drip loss was not an effect of the amount of evaporation or drip from the carcass, since the content of water in the longissimus muscle was stable
- ✓ The reason for this is the denaturation and enzymatic hydrolysis of the muscle proteins giving an increased concentration of nitrogen compounds, which have a buffering effect on the pH

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Genetic parameters for EZ-DripLoss and pH

Landrace	N = 3 448	N = 16 263	N = 16 263	N = 16 263
	EZ-DripLoss LD	pH LD	pH GM	pH GP
EZ-DripLoss LD	**0,26**			
pH LD	-0,68	**0,17**		
pH GM	-0,52	0,81	**0,11**	
pH GP	-0,07	0,29	0,54	**0,19**

Duroc	N = 2 086	N = 7 323	N = 7 323	N = 7 323
	EZ-DripLoss LD	pH LD	pH GM	pH GP
EZ-DripLoss LD	**0,27**			
pH LD	-0,91	**0,26**		
pH GM	-0,65	0,81	**0,22**	
pH GP	-0,49	0,23	0,09	**0,38**

A multi-trait AI-REML animal model - DMU software

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Selection for DripLoss

- ✓ Indirect selection on pH is estimated to be 44% and 11% less efficient than direct selection on EZ-DripLoss for Landrace and Duroc, respectively
- ✓ EZ-DripLoss and pH are both measured at the partial dissection line
- ✓ EZ-DripLoss is suitable for large-scale data recording
- ✓ Due to the high economy value of EZ-DripLoss, changing from pH to EZ-DripLoss is profitable, especially for Landrace

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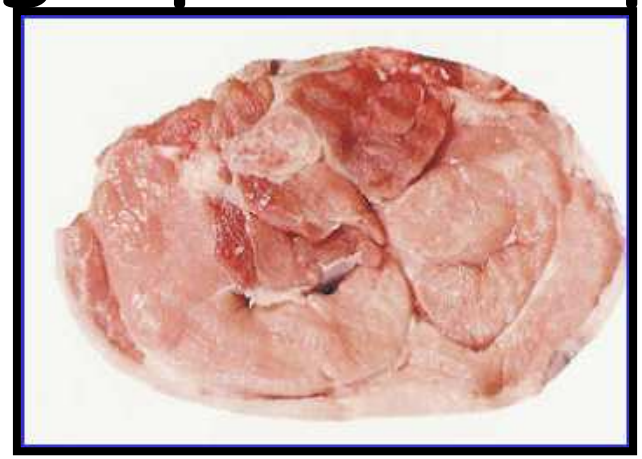
Can high pH be a problem ?

Low pH, PSE
(pale, soft, exudative)



Normal quality

- ✓ Increased pH in glycolytic muscles gives correlated response in oxidative muscles
- ✓ If pH in LD increase with .10 units, the estimated increasing of pH in GP was of .06 units
- ✓ High pH meat has reduced shelf-life
- ✓ For smoked-cured ham, to high pH in oxidative muscles can give bone-taint

High pH, DFD (dark, firm, dry)

Norsvin's approach

- ✓ New test station, capacity *~3500 animals annually*
  - ✓ recording of e.g. ADG, FCR and CT-scanning off-test
- ✓ Loins from all slaughtered boars are sent to a partial dissection line to get data on meat- and fat quality, including drip loss and pH, *>3000 animals annually*
- ✓ **Drip loss will be included in the breeding goal!**

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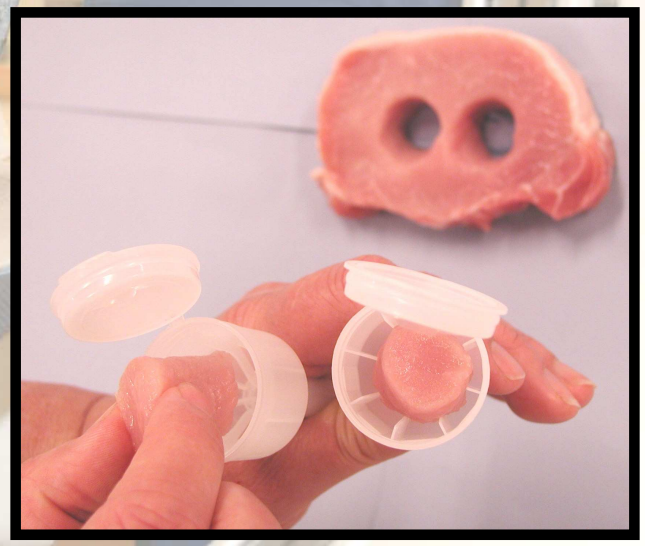
Thank you for your attention !



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