Livestock Center Oberschleissheim
Ludwig-Maximilians-University Munich
M. Bernau, P.V. Kremer, E. Tholen, S. Müller, E. Pappenberger, P. Gruen, E. Lauterbach, A.M. Scholz

New lean meat formulas for progeny testing of intact boars

- developed by using MRI and DXA

motivation

- in Germany: lean meat content for stationary performance testing is evaluated based on the "*Bonner Formula*" (after 2004)

dependent variable	intercept	slope	independent variable
Bonner Formula	59.704	- 0.147	back fat area [cm^2]
(2004)		+ 0.222	loin eye area [cm^2]
Lean Meat %		- 1.744	back fat lumbar [cm]
		- 1.175	back fat middle [cm]
		- 0.809	back fat withers [cm]
		- 0.378	side fat [cm]
		- 1.801	fat depth *"B"* [cm]

motivation

- in Germany: lean meat content for stationary performance testing is evaluated based on the "*Bonner Formula*" (after 2004)

- dealing with boar fattening occurs the question:
  Is it necessary to adapt this Formula to boars for the use in stationary performance testing?

animals & methods

animals

- 61 left boar half carcasses
- 3 performance testing stations in Germany
- genetic: Pi x LW-GL (n=41)
  Pi x LW-Leicoma-GL (n=20)
- full carcass weight Ø 85 kg and Ø 95 kg

animals & methods

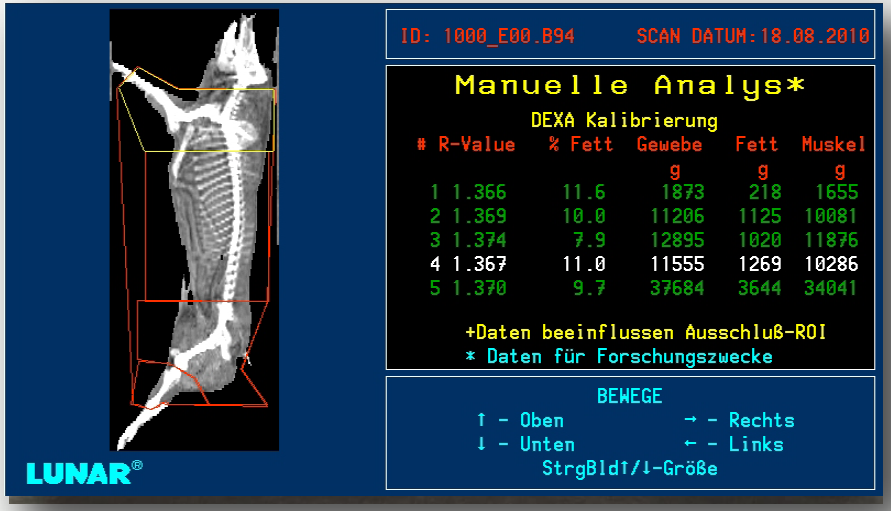
Dualenergy-X-ray-Absorptiometry (DXA)

= quantitative analysis method

- suitable to evaluate body composition

- GE Lunar DPX IQ
- mode: whole body adult normal

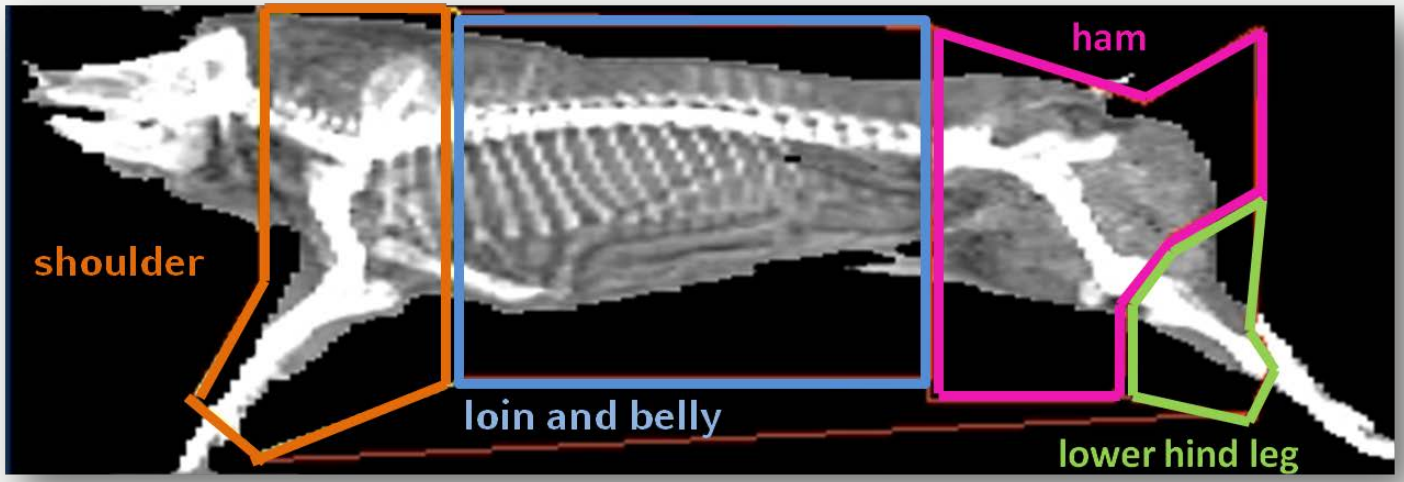
- DXA lean tissue (g; %)
- DXA fat tissue (g; %)
- DXA bone mineral content (g; %)



animals & methods

Dualenergy-X-ray-Absorptiometry (DXA)

two dimensional classification of the carcass into 4 parts



From each part:

- DXA lean tissue (g; %)
- DXA fat tissue (g; %)
- DXA bone mineral content (g; %)

animals & methods

Magnetic Resonance Imaging (MRI)

= imaging method

- Siemens Magnetom Open (0.2 Tesla)
- sequence:

TR 700 ms
TE 8 ms
18 slices
7 mm thickness
0.7 mm distance
=> 13.86 cm

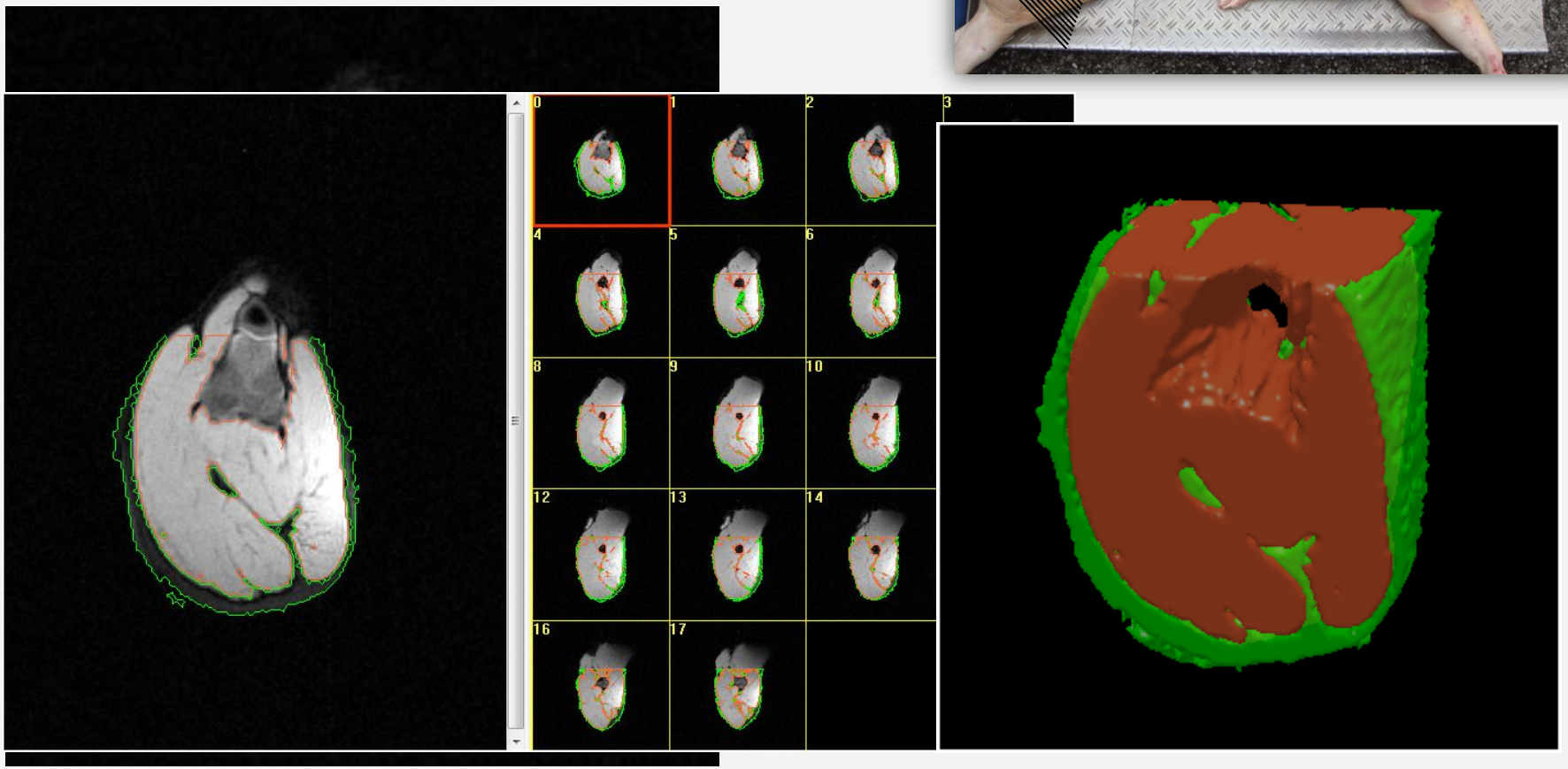
ham loin caudal thorax shoulder

=> axial direction

image evaluation

- semi-automatic evaluation with Able 3D Doctor Software®
- differentiation between muscle and fat tissue
- single slices and whole sequence
- bone tissue was removed manual

image evaluation - ham



MRI regions volume [cm^3]

ham	loin	caudal thorax	shoulder
ham_M	loin_M	Th_M	shoulder_totalVol
ham_F	loin_F	Th_F	shoulder_M
	loin_3/4_M	Th_ML	shoulder_F
	loin_3/4_F	Th_BF	shoulder_2/3_totalVol
		Th_3/4_M	shoulder_2/3_M
		Th_3/4_F	shoulder_2/3_F
		Th_1/2_M	
		Th_1/2_F	

reference

„gold standard“: dissection

- 20 right boar half carcasses

independent sample

- independent sample of 33 boars
- of a 4th performance station
- used to validate the calculated formulas

statistics

- multiple regression analyses (SAS 9.3)
  stepwise and backward
- $p < 0.05$
- weight was not independent variable
- 3 data sets were used (DXA, MRI and MRI & DXA)

statistic data evaluation I

1. dissection data (n=20) used for calculating a lean meat content based on dissection (**LM_D**)

2. relation between LM_D and data sets (**LM_D_DXA**, **LM_D_MRI**, **LM_D_MRI/DXA**)

results I - relation between LM_D and the three data sets (n=20)

formula	dependent variable	independent variable	R^2	$\sqrt{MSE}$ [%]
DXA	LM_D _DXA	DXA_shoulder_lean tissue [g] DXA_ham_fat tissue [g] DXA_ham_lean tissue [g]	0.91	0.82
MRI	LM_D _MRI	MRI_Th_1/2_M [cm^3] MRI_Th_BF [cm^3] MRI_ham_M [cm^3]	0.88	0.90
MRI & DXA	LM_D _MRI/DXA	DXA_shoulder_lean tissue [g] DXA_ham_lean tissue [g] MRI_Th_BF [cm^3]	0.95	0.61

statistic data evaluation II

3. calculating the LM_D_DXA, LM_D_MRI, LM_D_MRI/DXA for all 61 evaluated boars (**LM_DXA, LM_MRI, LM_MRI/DXA**)

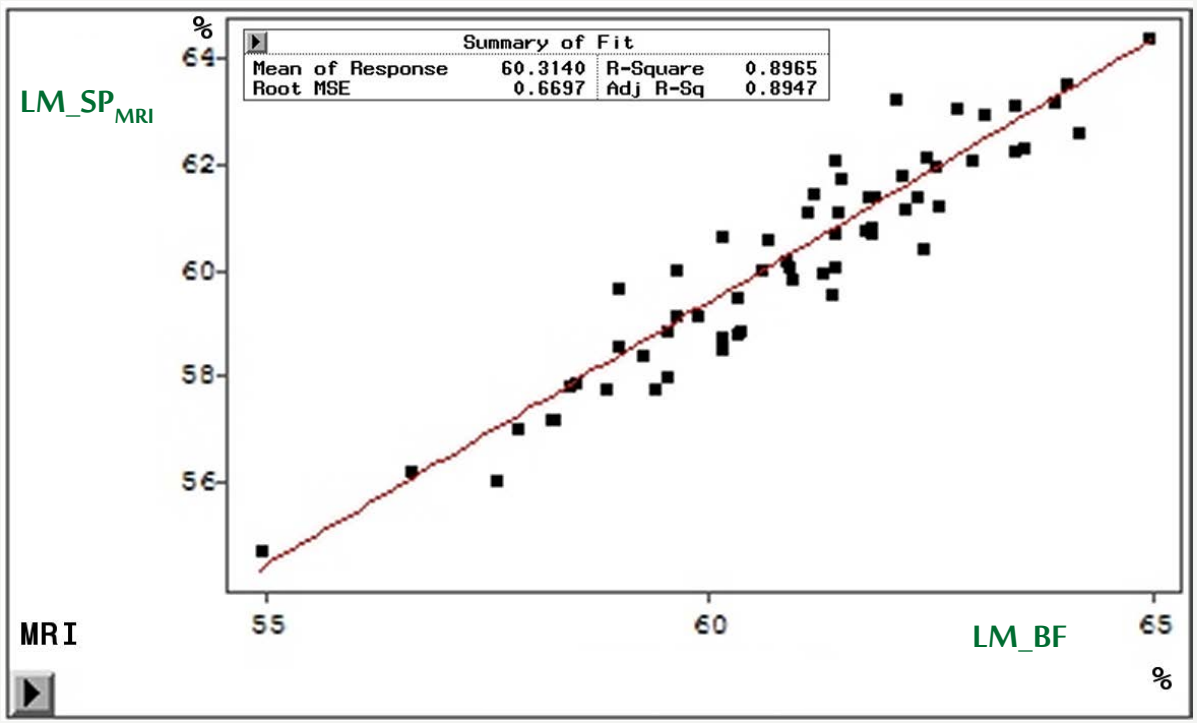
4. calculating the LM_DXA, LM_MRI, LM_MRI/DXA for all 61 evaluated boars using the slaughter performance data (**LM_SP_{DXA}, LM_SP_{MRI}, $LM\_SP_{MRI/DXA}$**)

results II – evaluation of the LM_D by performance data (n=61)

formula	dependent variable	independent variable	R^2	$\sqrt{MSE}$ [%]
DXA	LM_SP_{DXA}	loin eye area [cm^2] backfat loin [cm] side fat [cm]	0.49	1.60
MRI	LM_SP_{MRI}	loin eye area [cm^2] backfat middle [cm] *Speckmaß B* [cm]	0.76	1.2
MRI & DXA	$LM\_SP_{MRI/DXA}$	loin eye area [cm^2] backfat loin [cm] *Speckmaß B* [cm]	0.55	1.44

results

LM evaluated by "Bonner Formula" (**LM_BF**) and
LM evaluated by "Schleissheimer Formula" (**LM_SP_{MRI}**)



$R^2 = 0.90$

$\sqrt{MSE} = 0.67\ \%$

statistic data evaluation III

5. an independent performance data sample of 33 boars was used to validate the new formulas (LM_SP_{DXA}, LM_SP_{MRI}, $LM\_SP_{MRI/DXA}$)

results III

5. an independent performance data sample of 33 boars was used to validate the new formulas (LM_SP_{DXA}, LM_SP_{MRI}, $LM\_SP_{MRI/DXA}$)

dependent variable	intercept	slope	independent variable	R^2	$\sqrt{MSE}$ [%]
LM_BF	11.1008	+ 0.8183	LM_SP_{DXA}	0.78	0.76
LM_BF	7.2679	+ 0.8681	LM_SP_{MRI}	0.86	0.61
LM_BF	- 8.6247	+ 1.1444	$LM\_SP_{MRI/DXA}$	0.87	0.59

LM_BF = Lean meat calculated using the Bonner Formula

conclusions

1. *Bonner Formula* is suitable for boar carcasses
   but: acquisition of 7 variables necessary

2. *Schleissheimer Formula* comparable exact
   only **3** variables necessary

3. new variables necessary ?
   to evaluate boar carcasses exactly
   (shoulder region or ham)

Thank you ...

universitätbonn
Rheinische Friedrich-Wilhelms-Universität Bonn

EN-Z-EMA

...for your attention !