Selection strategies against boar taint in a Swiss sire line

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Objective

Incorporate selection against boar taint into a breeding program

To do this, we need a reliable and repeatable target trait…

- Boar taint compounds measured in carcasses of half / full sibs or in live selection candidates
- Human nose scores (HNS) in carcasses of half and/or full sibs

Biopsy Information

- Biopsy of neck fat of live selection candidates
- Boar taint compounds (androstenone, skatol and indole) measured in small sample of liquid fat
- $h^2 = 0.30 – 0.60$
- Reproducability = 0.98

Baes *et al*., 2013

Human Nose Score

- Carcass fat samples heated with a hot iron to release the smell normally experienced during cooking
- Score from 0 (no odour) to 4 (strong boar taint) by trained expert panel
- $h^2 = 0.12 – 0.19$
- Reproducability = 0.29

Windig *et al*., 2012

Scenarios

- **1- Current breeding program (on-farm test of male candidates + station testing of sibs)**
- **2- Chemical compounds of boar taint**
  - **a)** field biopsy-based performance testing of 1,200 live boars
  - **b)** genomic scenario (GEBVs)
  - **c)** biopsy-based performance testing + genomic scenario
- **3- Human nose score (HNS)**
  - **a)** HNS of 4 full sibs and 76 half sibs (1 or 2 trained persons) on station
  - **b)** genomic scenario (GEBVs)

Haberland *et al*., submitted

Accuracy of GEBVs

$$r_{\hat{Q}} = \sqrt{\frac{Nr^2}{Nr^2 + M_e}}$$

(Daetwyler *et al*. 2010)

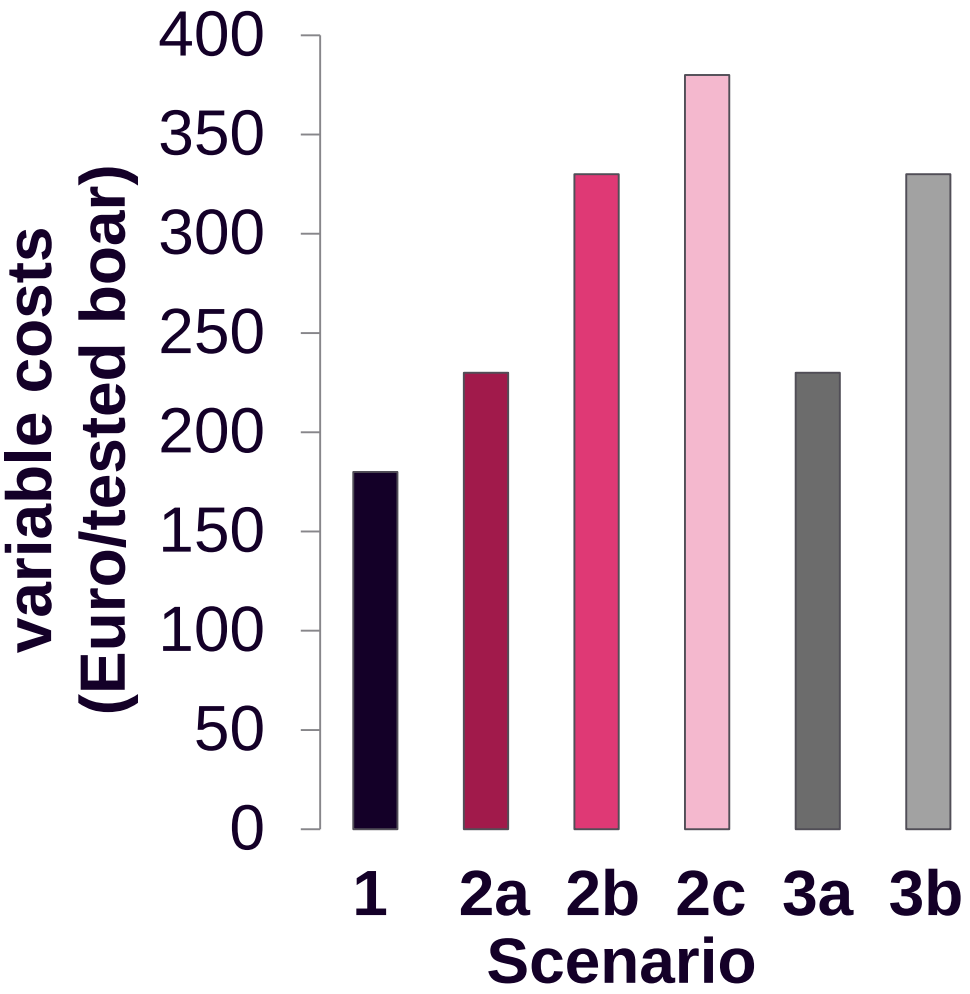
N = Number of animals in reference (1,000)

r^2 = Reliability of conventional BVs of animals in reference

M_e = Number of independently segregating QTL
(H1,000, Goddard *et al*., 2011)

➔Accuracy is multiplied by q=0.9 (Dekkers, 2007) and is equal to **0.52 (assumed for both scenarios)**.

Variable costs



- No selection for boar taint (1)
- Biopsy-based performance testing (2a)
- Genomic info (boar taint components, 2b)
- Combined biopsy-based performance testing + genomic info (2c)
- Station test for HNS (3a)
- Genomic info (HNS, 3b)

Haberland *et al*., submitted

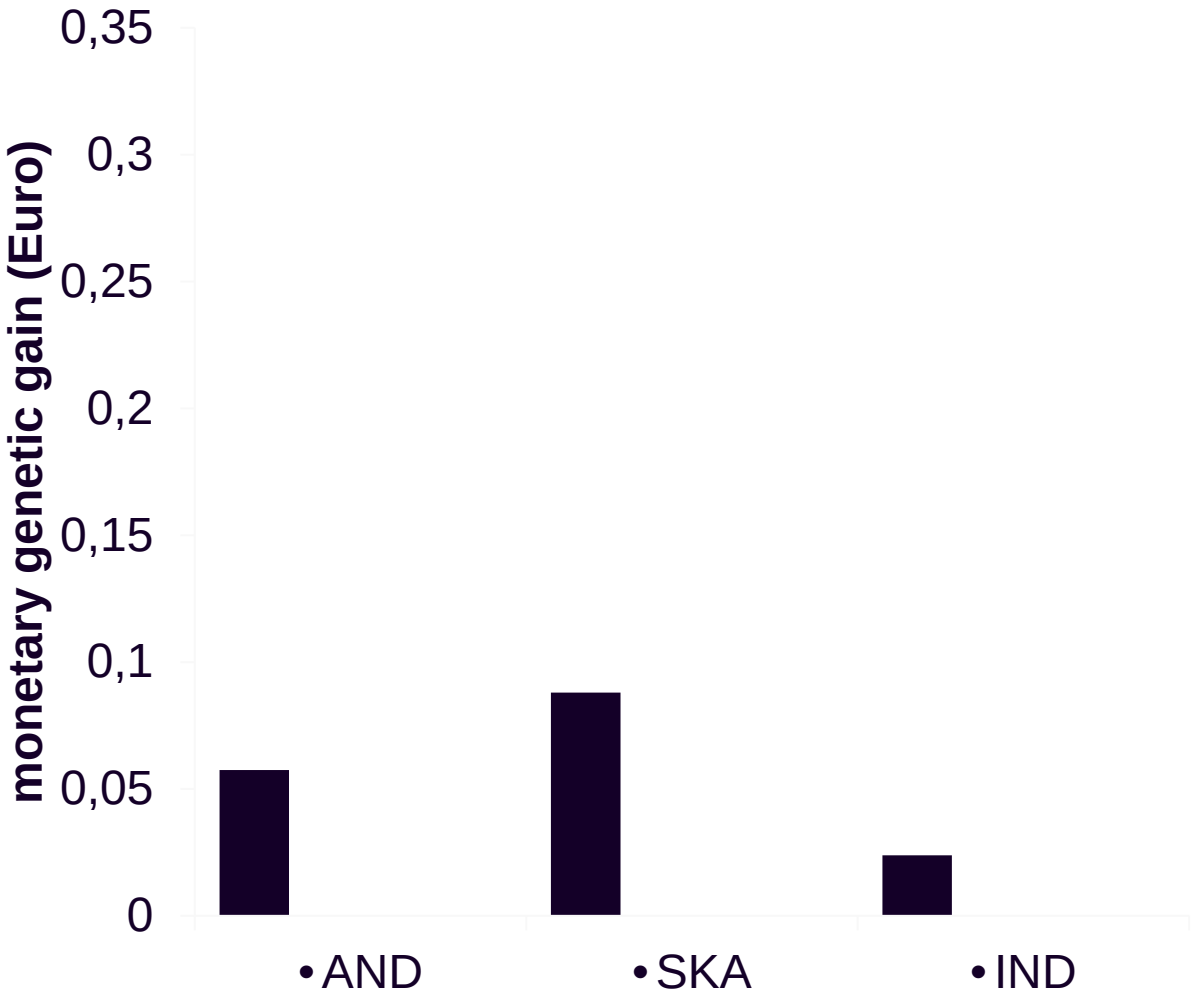
Economic weights

	Percentage of genetic variance of boar taint in the overall breeding goal		
	5%	10%	20%
Androstenone	-2.74	-4.02	-6.14
Skatol	-1.69	-2.48	-3.79
Indole	-0.99	-1.46	-2.23
HNS	-2.93	-	-

Haberland *et al*., submitted

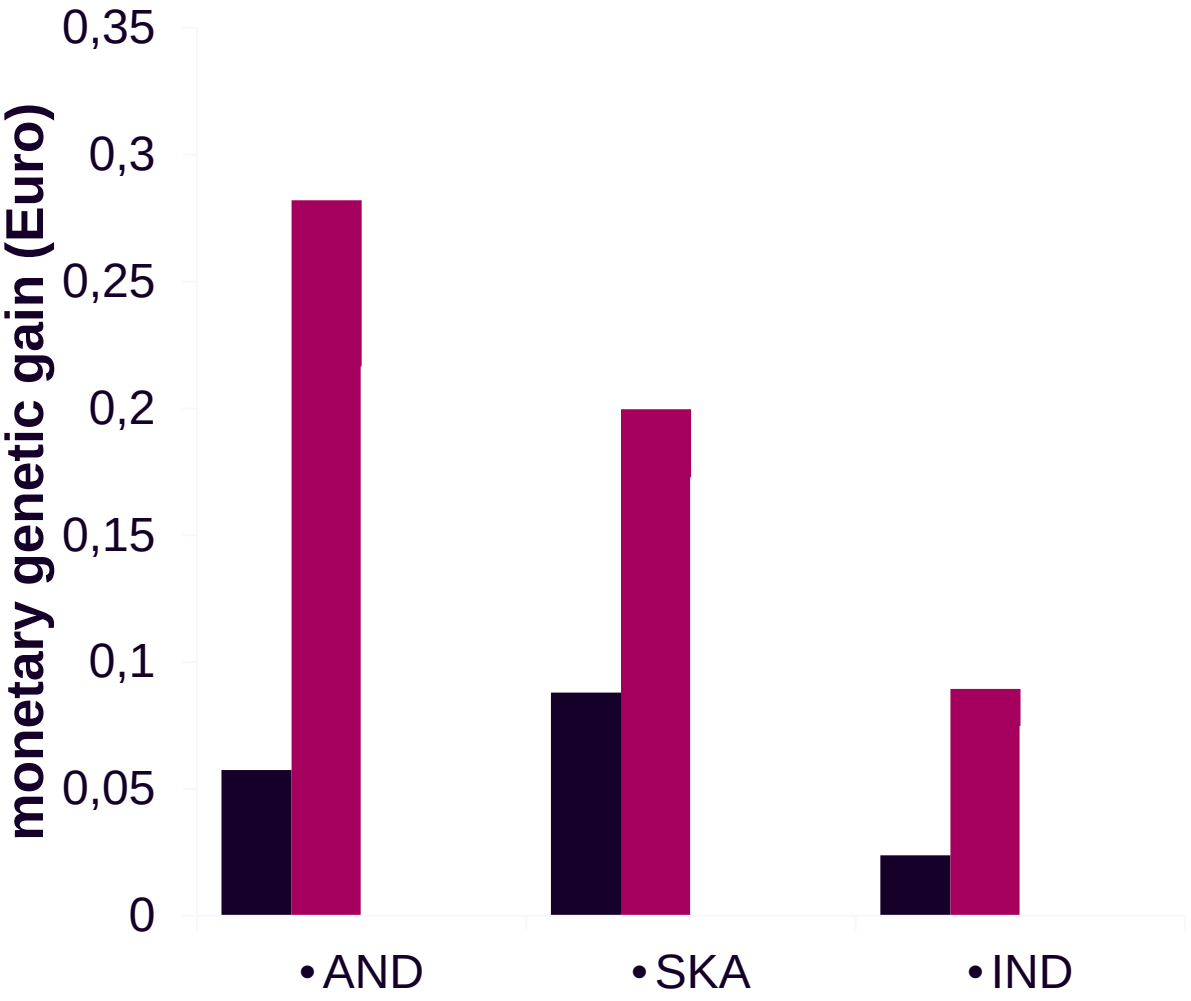
Annual gain

- No selection for boar taint (1)



Haberland *et al*., submitted

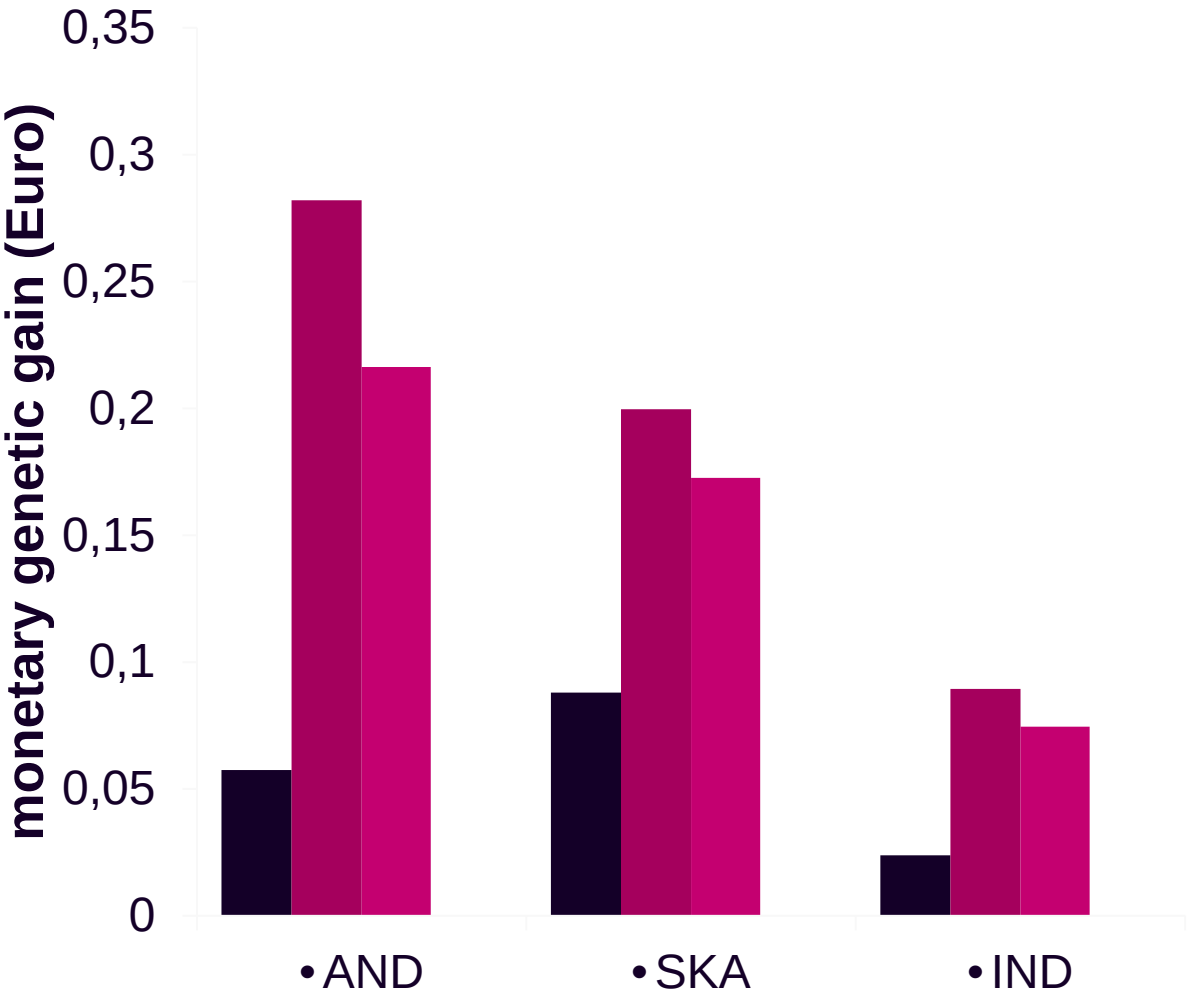
Annual gain



- No selection for boar taint (1)
- Biopsy-based performance testing (2a)

Haberland *et al*., submitted

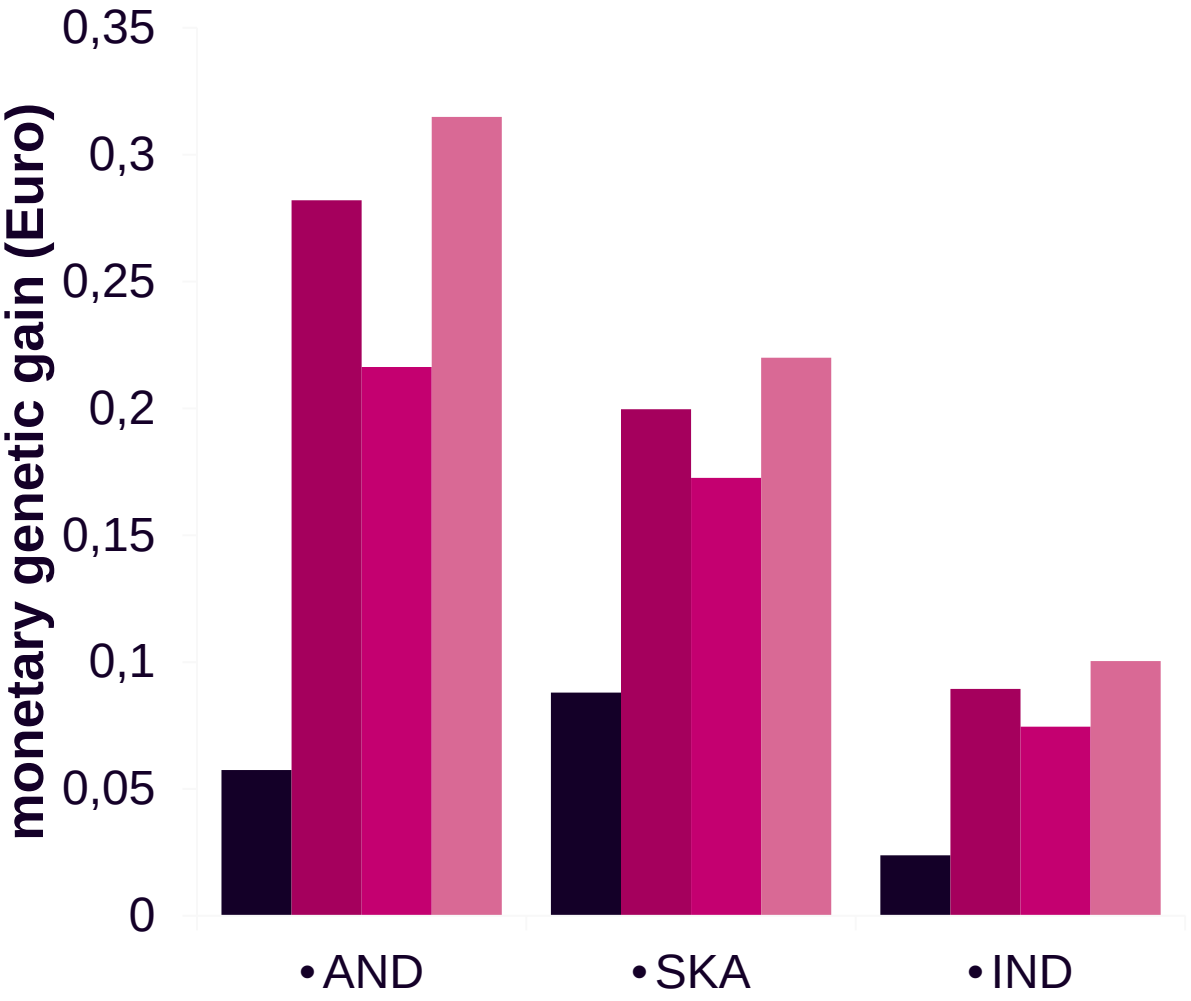
Annual gain



- No selection for boar taint (1)
- Biopsy-based performance testing (2a)
- Genomic scenario (2b)

Haberland *et al*., submitted

Annual gain



- No selection for boar taint (1)
- Biopsy-based performance testing (2a)
- Genomic scenario (2b)
- Combined biopsy-based performance testing + genomic selection (2c)

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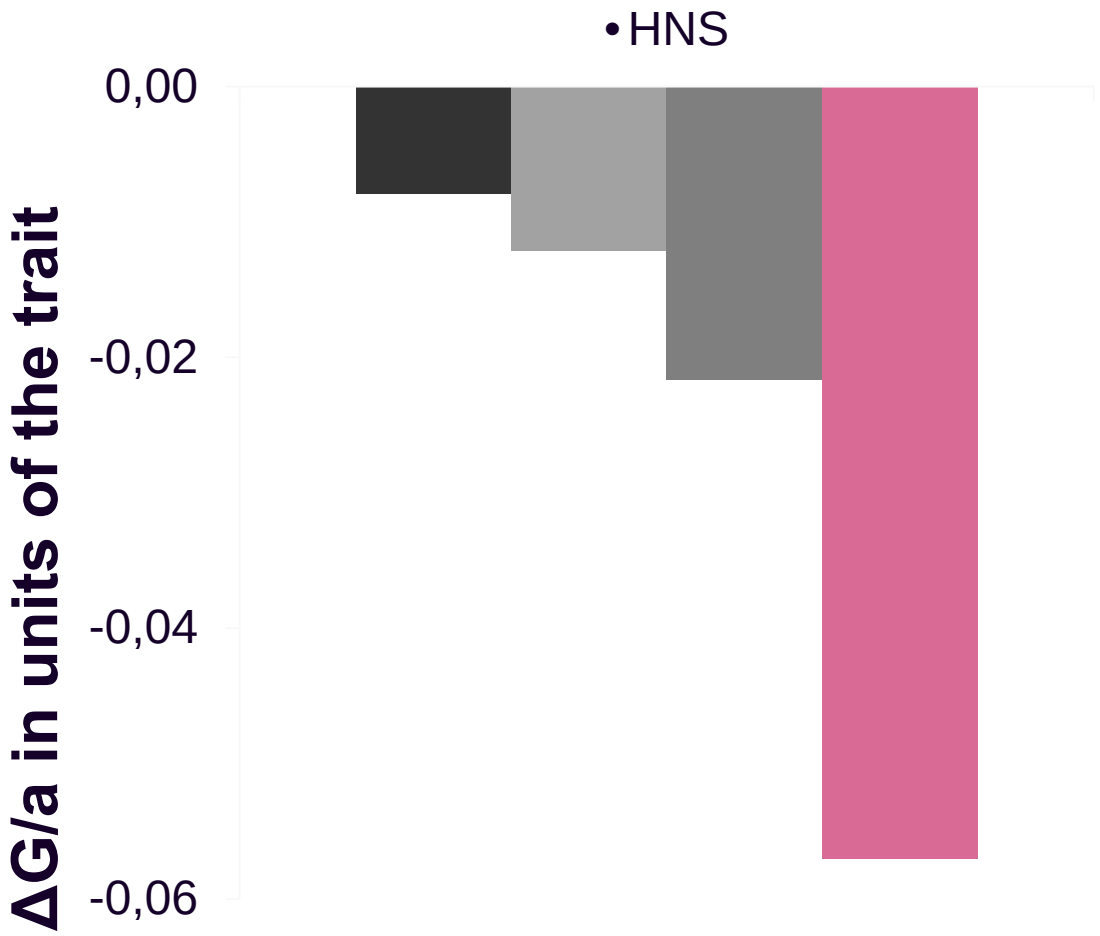
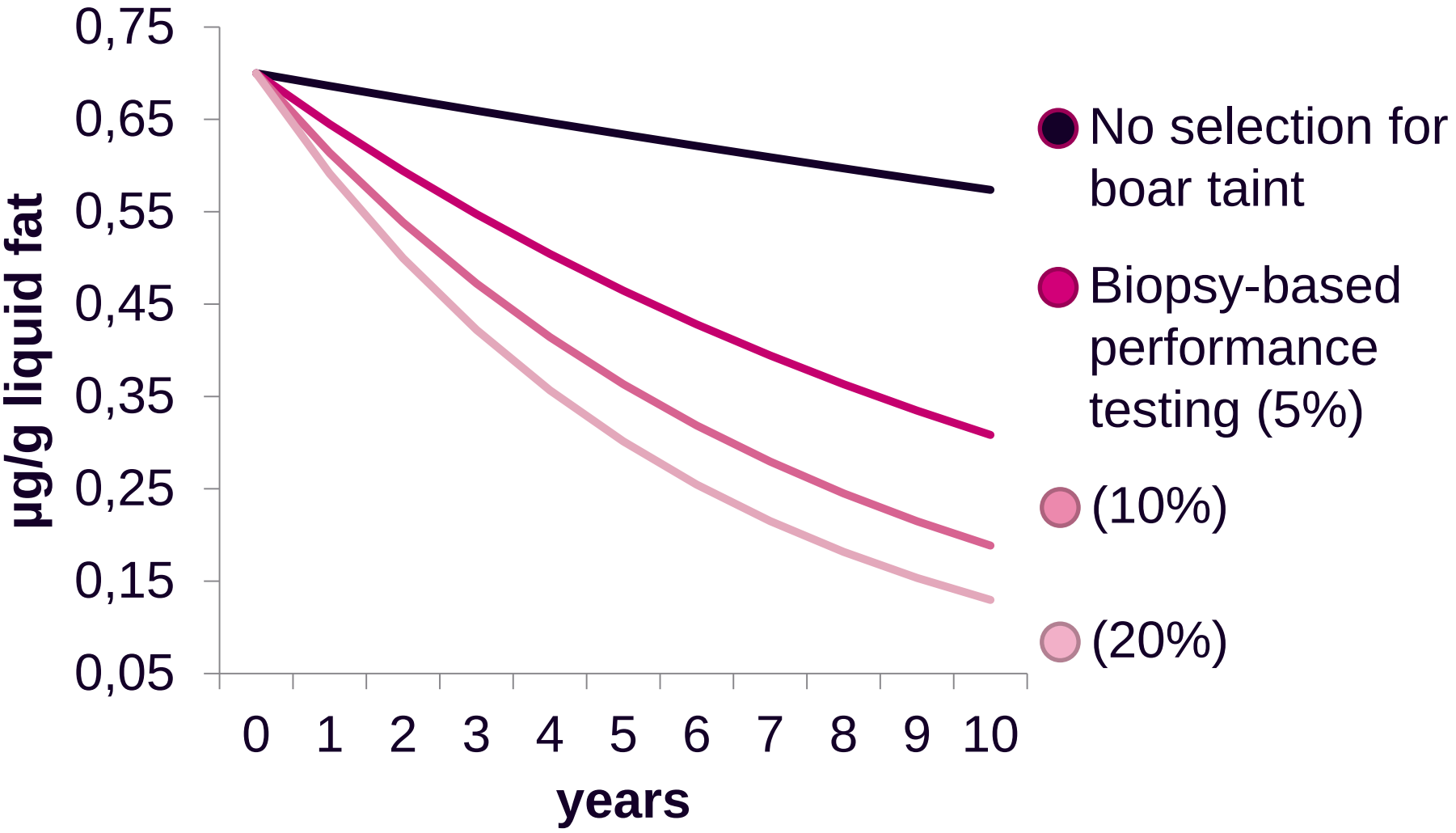
Annual genetic gain



- Selection against HNS (3a,1 person)
- Selection against HNS (3a, 2 persons)
- Genomic scenario (3b)
- Biopsy-based performance testing (2a)

Haberland *et al*., submitted

Expected Trend: Androstenone



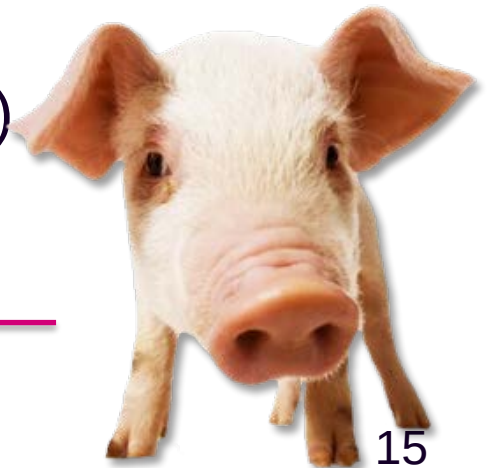
Haberland *et al*., submitted

Summary & Outlook

- Need cost-effective, repeatable trait for early identification of low-risk boars
- Average boar taint compound levels (and therefore also HNSs) decline without direct selection
- Average boar taint compound levels can be reduced more quickly by selecting against boar taint
- Biopsy-based performance testing most efficient

Further research

- Long term effects? Fertility? (Strathe et al.)
- How to process tainted carcasses?



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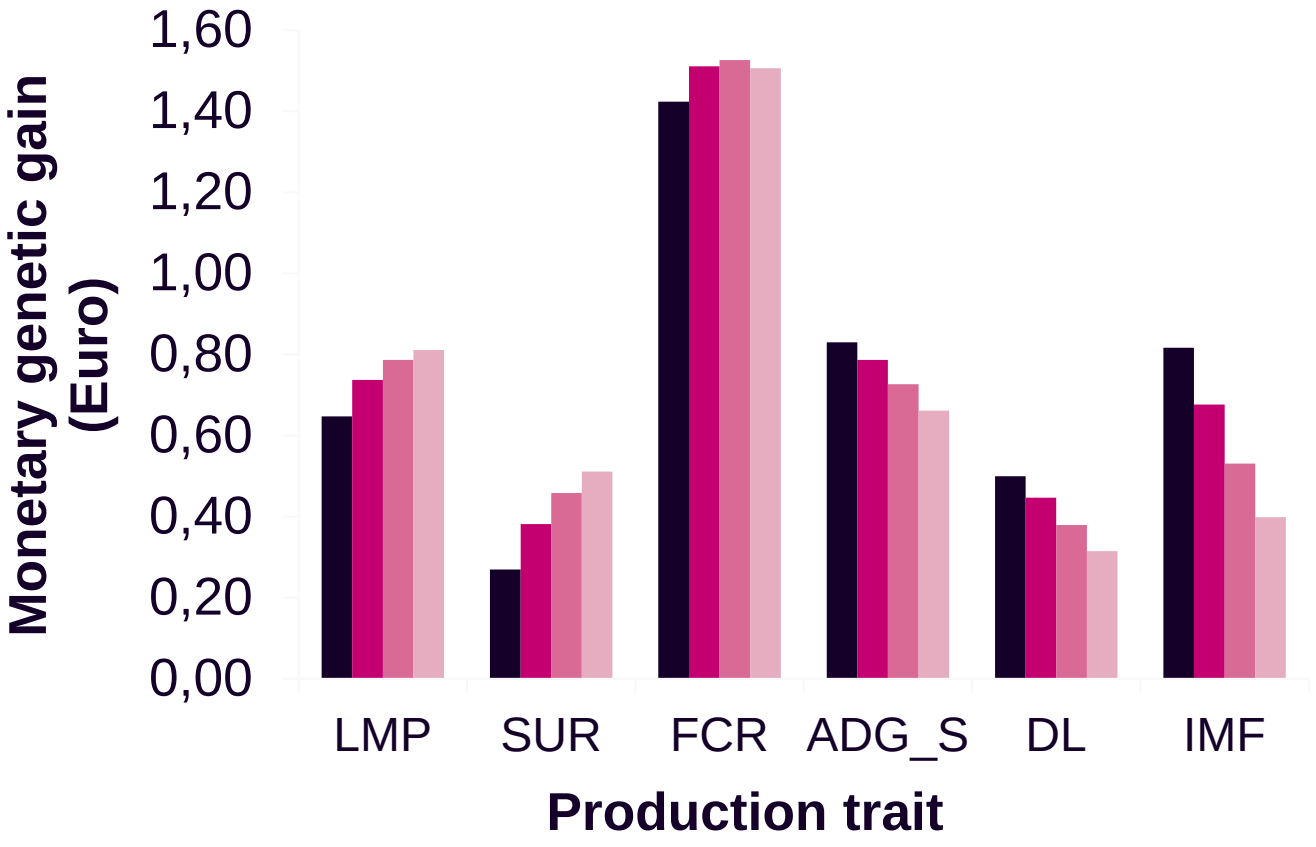
Selected production traits

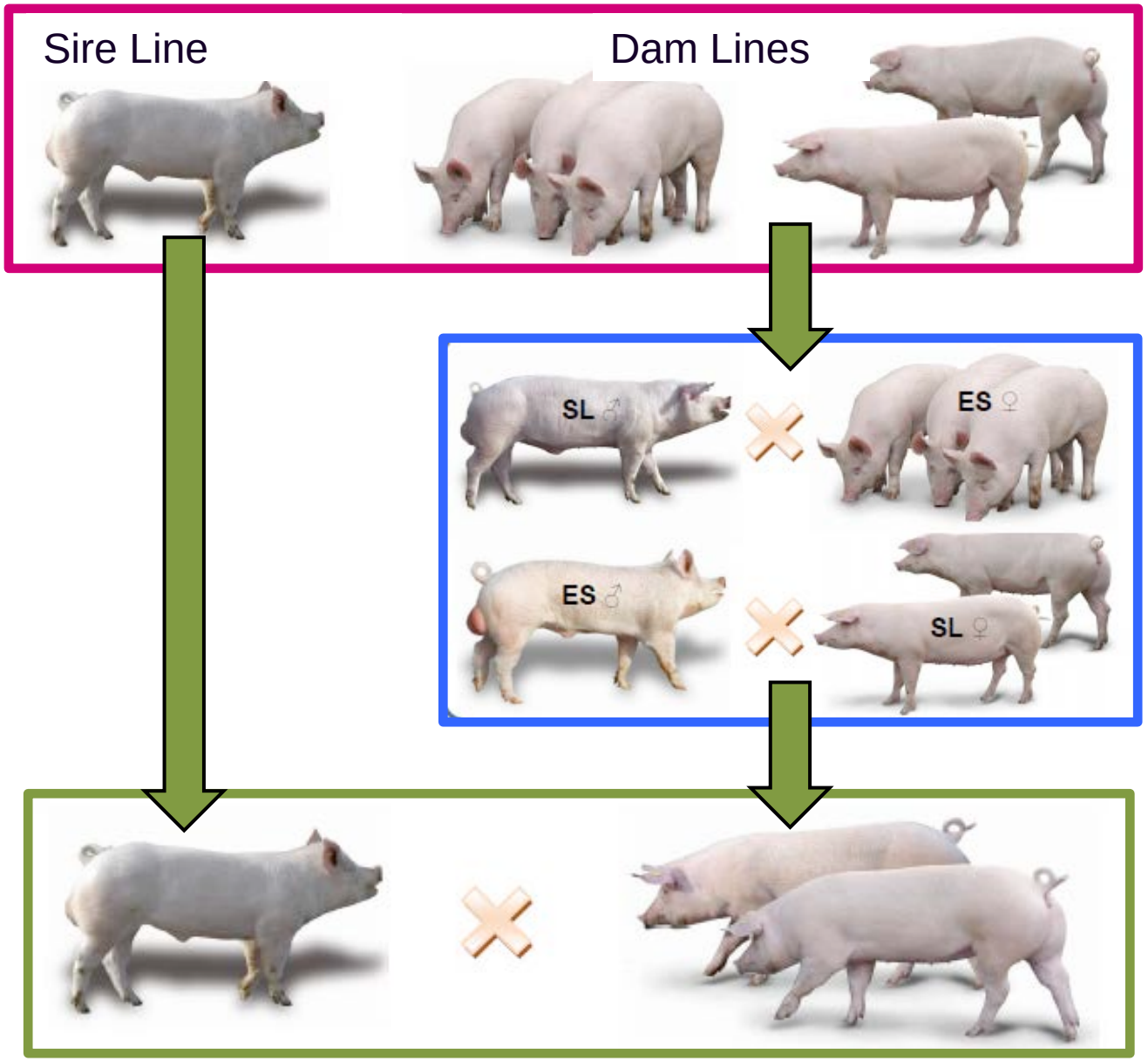


- No selection for boar taint
- Biopsy-based performance testing (2a, 5%)
- (2a, 10%)
- (2a, 20%)

LMP= lean meat percentage
SUR = surface area
FCR = feed conversion ratio
ADG_S = averagy daily gain (on station)
DL = drip loss
IMF = intramuscular fat

Haberland *et al*., submitted

Trait	h^2	σ_P	unit
Average daily gain (ADG, station test)	0.27	85.33	g/day
Feed conversion ratio (FCR)	0.35	0.16	kg/kg
Intra-muscular fat (IMF)	0.60	0.53	%
Drip loss (DL)	0.30	1.71	%
Lean meat percentage (LMP)	0.34	2.45	%
Androstenone (AND)	0.45	0.90	ln(µg/g)
Skatole (SKA)	0.49	0.53	ln(µg/g)
Indole (IND)	0.55	0.34	ln(µg/g)
Human nose score (HNS)	0.12	0.95	score

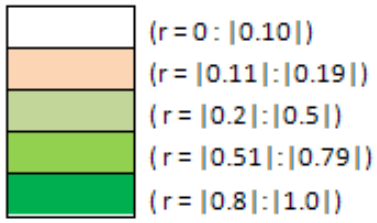


Nucleus

Multiplication

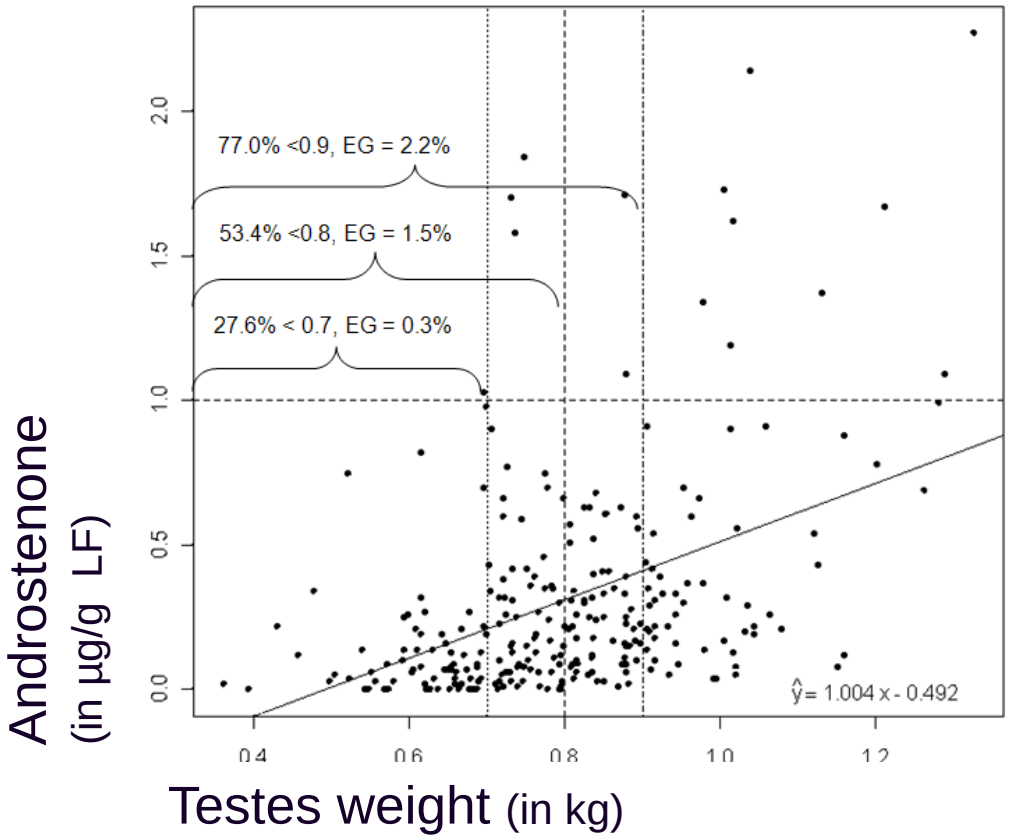
Production

	Mikrowelle (Basel)		Heisses Wasser Methodik (Labor Sempach)				Mikrowelle Methodik (Labor Sempach)					Ebergeruchs-komponenten (ALP)			Transformierte Ebergeruchs-komponenten			
	AKP	CB_SH	HW_G	HW_A	HW_S	HW_I	MW_G	MW_A	MW_S	MW_I	GewH	And	Ska	Ind	LNAnd	LNSka	LNInd	CoMore
Amtliche Kochprobe *(AKP)*	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.02	0.09	0.03	0.02	0.12	0.02
CB_Schlachthaus *(CB_SH)*	0.36	1.00	0.00	0.00	0.28	0.04	0.00	0.00	0.00	0.03	0.00	0.00	0.70	0.63	0.09	0.26	0.08	0.48
HW_Gesamt *(HW_G)*	0.24	0.18	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
HW_Androstenon *(HW_A)*	0.25	0.19	0.79	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.09	0.00	0.28	0.01	1.00
HW_Skatol *(HW_S)*	0.14	0.07	0.79	0.42	1.00	0.00	0.00	0.00	0.00	0.00	0.19	0.01	0.00	0.00	0.02	0.00	0.01	0.00
HW_Indol *(HW_I)*	0.20	0.12	0.76	0.35	0.74	1.00	0.00	0.00	0.04	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.02	0.00
MW_Gesamt *(MW_G)*	0.27	0.22	0.34	0.30	0.22	0.23	1.00	0.00	0.00	0.00	0.01	0.00	0.02	0.03	0.01	0.01	0.07	0.12
MW_Androstenon *(MW_A)*	0.24	0.24	0.39	0.32	0.22	0.28	0.79	1.00	0.00	0.00	0.03	0.00	0.16	0.08	0.00	0.12	0.06	0.92
MW_Skatol *(MW_S)*	0.18	0.17	0.22	0.18	0.19	0.12	0.85	0.50	1.00	0.00	0.04	0.00	0.01	0.02	0.03	0.00	0.05	0.01
MW_Indol *(MW_I)*	0.25	0.13	0.24	0.21	0.19	0.20	0.85	0.47	0.76	1.00	0.07	0.01	0.02	0.09	0.20	0.04	0.18	0.00
HodenGewicht *(GewH)*	0.12	0.21	0.22	0.24	0.08	0.07	0.16	0.13	0.12	0.11	1.00	0.00	0.02	0.00	0.00	0.00	0.00	0.10
Androstenon *(And)*	0.22	0.31	0.39	0.45	0.16	0.24	0.29	0.31	0.24	0.17	0.42	1.00	0.00	0.00	0.00	0.00	0.00	0.14
Skatol *(Ska)*	0.15	0.02	0.26	0.06	0.34	0.37	0.14	0.08	0.15	0.14	0.14	0.28	1.00	0.00	0.00	0.00	0.00	0.00
Indol *(Ind)*	0.10	0.03	0.22	0.10	0.25	0.27	0.13	0.11	0.14	0.10	0.18	0.33	0.87	1.00	0.00	0.00	0.00	0.02
LNAndrostenon *(LNAnd)*	0.13	0.10	0.31	0.33	0.14	0.17	0.16	0.20	0.13	0.08	0.42	0.59	0.20	0.23	1.00	0.00	0.00	0.33
LNSkatol *(LNSka)*	0.15	0.07	0.18	0.07	0.24	0.20	0.16	0.09	0.19	0.13	0.19	0.30	0.48	0.39	0.36	1.00	0.00	0.04
LNIndol *(LNInd)*	0.09	0.10	0.17	0.16	0.15	0.14	0.11	0.11	0.12	0.08	0.22	0.33	0.42	0.63	0.36	0.41	1.00	0.63
CoMore	-0.14	0.04	0.14	0.00	0.20	0.23	0.09	0.01	0.15	0.18	-0.10	-0.09	0.19	0.14	-0.06	-0.12	-0.03	1.00



(Pearson Korrelationen)

Number of animals which could be excluded from a sensoric test using testes weight as a boar taint indicator



Indirect traits for boar taint?

-Testes weight alone explained 17.5% of the variance in androstenone

-Other autoFOM values…? (shoulder size, etc.?)

Estimate testes size (weight) automatically?

The Biopsy Device

Geverink et al (1999) described behavioural and physiological responses of pigs (n=10, 23 weeks of age) biopsied (muscle tissue):

-70% of the pigs vocalized when the biopsy was taken

- all pigs flinched in response to the biopsy in that study.

In contrast, animals in our study showed very little pain response when biopsied.

- slightly thinner needle which minimized the invasiveness of sampling

- strength of the compression spring

- biopsy of fat and not muscle (less pain, less bleeding)

Irie and Sakimoto (1992) adjusted the length of the biopsy needle to the thickness of the back fat based on ultrasonic measurements to avoid reaching muscle tissue. This measure was not taken in our study for practical reasons. Instead, the biopsy device was held at a 35° angle to the body of the pig to ensure maximal fat and minimal muscle sampling.

Selection Index

The number of traits in the breeding goal must be chosen carefully, because increasing the number of traits decreases the amount of genetic progress per trait.
With regards to boar taint, reducing the off-odour (HNS) of heated pork is the objective.
Estimated breeding values (EBVs) for androstenone, skatole, indole or other compounds can be weighted accordingly to model individual contributions to the aggregate breeding objective (in this case, HNS).
A method such as that presented by Schneeberger *et al*. (1992) could be used to calculate appropriate weights for EBVs.
Using this method, weights depend only on genetic variances and covariances among the individual boar taint components and the HNS, and on the economic values of these traits.