

# Genetic approaches for rearing entire males

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# Genetic background for entire males

- Two topics mainly related to boar taint
  - Understand genetic determinism of boar taint
  - Implement selection or new breeding technologies in nucleus populations to reduce boar taint risk
- Other traits to be explored
  - Damaging behaviour
  - Maternal/paternal fertility
  - Fatty acid composition

# Genetics of boar taint

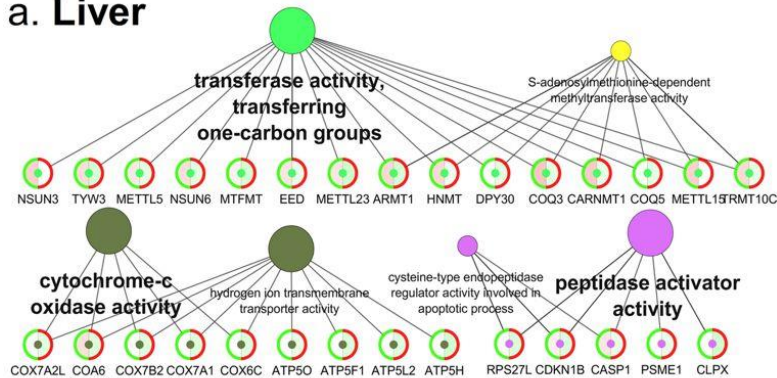
- Heritable traits
  - Androstenone  $h^2 \sim 0.6$
  - Skatole  $h^2 \sim 0.3$
  - Human Nose Score  $h^2 \sim 0.2$  (with qualified testers)
- Genetically related
  - Androstenone/skatole  $r_g \sim 0.4$
  - HNS/skatole  $r_g \sim 0.8$
  - HNS/Andostenone  $r_g \sim 0.6$



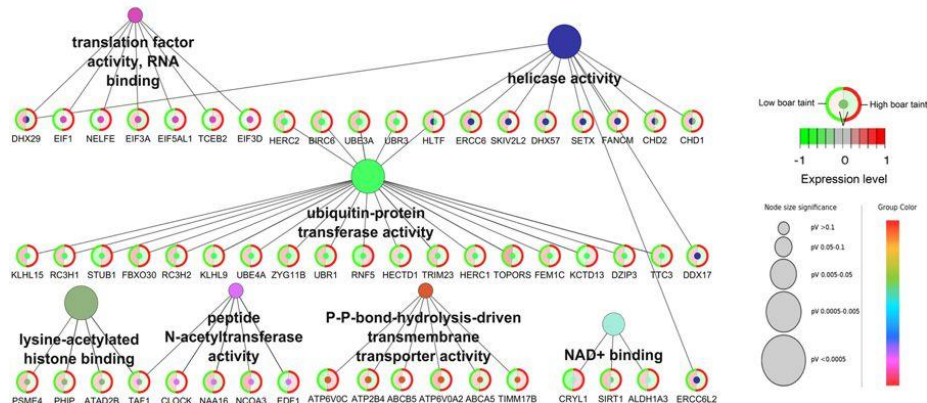
# Looking for candidate genes

- (« omics way ») Transcriptomic/expression studies (tissue specific)

## a. Liver

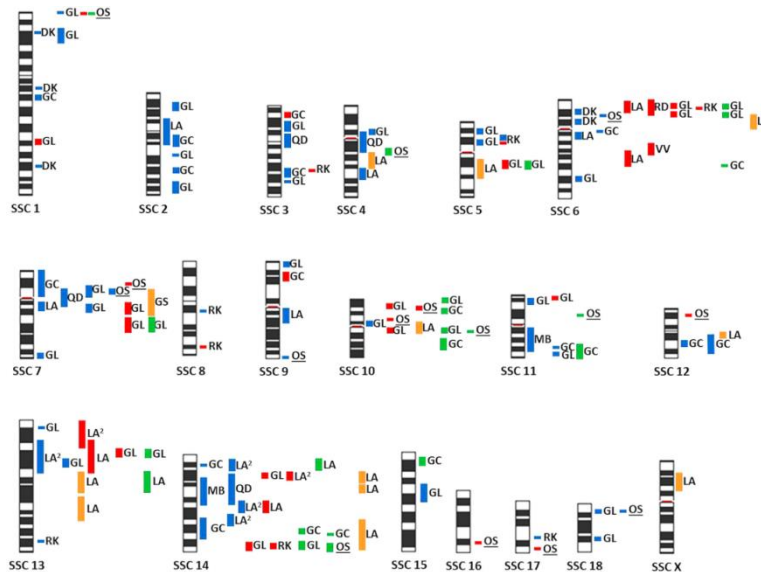


## b. Testis



# Looking for genes: QTL

- Quantitative trait loci approach



GS = Grindflek et al. 2001  
 LA = Lee et al. 2004  
 QD = Quintanilla et al. 2003  
 VV = Varona et al. 2005  
 MD = Marklund et al. 2008  
 DK = Duijvesteijn et al. 2010  
 GL = Grindflek et al. 2011  
 RD = Ramos et al. 2011  
 GC = Gregersen et al. 2012  
 RK = Rowe et al. 2014  
 OS = Own study

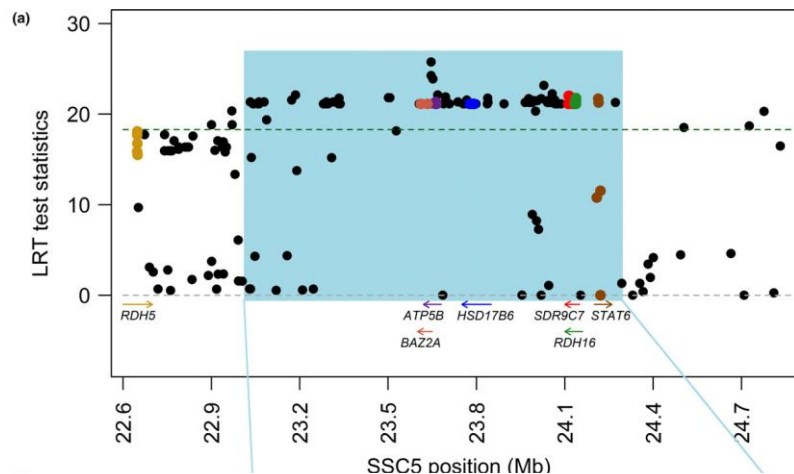
■ Androstrenone  
■ Skatole  
■ Indole  
■ subjective boar or pork odor in fat or meat

Große-Brinkhaus et al. 2015

- Improved by density of SNP microarrays/whole genome sequence data

# Looking for mutations

- Knowing the gene (QTL) is not enough
- Need to determine causal mutations
  - access to high quality pig genome sequence
  - gene annotation

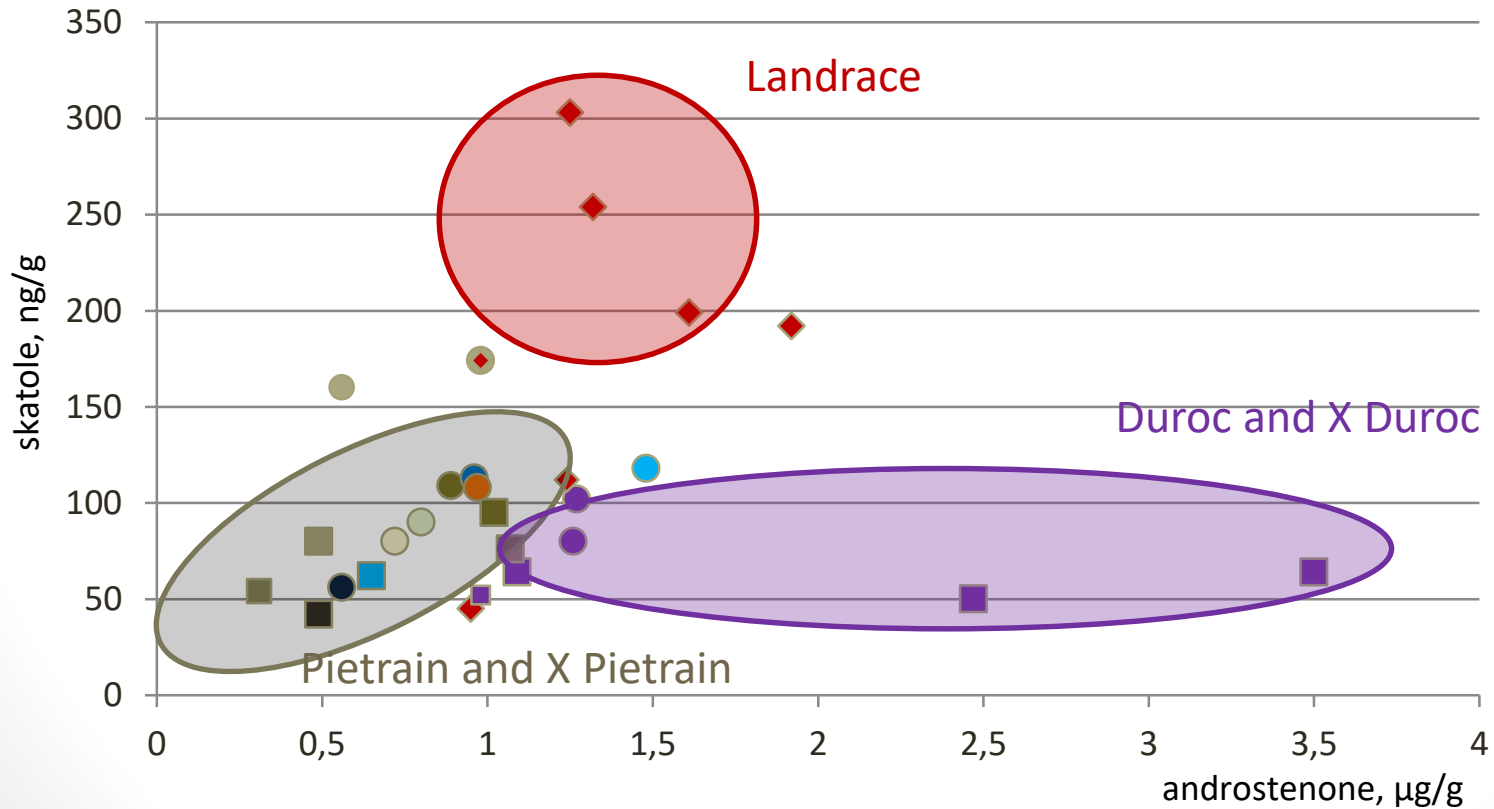


Van Son et al. 2017

> no clear proof of causal mutations influencing boar taint, up to now

# Selection: Use of existing variation

- Some breeds are more at risk
  - Dam vs Sire lines
  - Local breeds



From litterature



# Selection: Use of existing variation

- Implement selection
  - Direct (A/S) = Switzerland but abandoned
  - Direct (A/S): Low boar taint AI-boars, regional importance
  - (In)direct (HNS) = Topigs-Norsvin, efficient in sire lines
  - Indirect (estradiol) = mainly for androstenone
  - Post selection AI-boars ( $\neq$ selection)
- Need for Performance testing and breeding objectives
  - HNS > qualification of testers
  - A and S > cost
  - Weighting of A and S and HNS-Scores: Non linear approach

# Use of QTL/genetic markers

- Haplotype-based strategy (after QTL location)
  - Ex : haplotype on SSC6 associated with a lower level on androstenone
- Selected SNP based strategy
  - SNP in candidate genes
  - Ex : Canada (103 SNP in candidate genes, high and low boar taint sires, no difference observed between their progeny)
- Benefit from genomic data (Genomic Selection)
  - similar accuracy in comparison to conventional EBV but possibly cheaper
  - no improvement of GS-accuracy by pooling SNP-data of different breeds
    - improved marker density or using sequence data might help

# Use of causal mutation

- For the moment none clearly identified
- Induce mutations
  - Genome editing (but in EU : Gene Edited Organisms = GMO)
  - Ex : Hendrix > impact on pubertal development
  - Still to be demonstrated

# Relation with other traits

- Selection has to be balanced
  - Production traits > no adversory effects expected
  - Meat quality traits > limited effect expected except IMF and/or fatty acid composition
  - Reproduction traits > uncertain (positive/neural/unfavourable ?)
    - breed/line specific !
  - Behavioural traits > scarcely known (but unfavourable)
- Impact of genome editing
  - To be evaluated

# Conclusion

- Genetic has a high potential for dealing with problems arising by entire male breeding
  - Focus on boar taint risk
  - More studies are needed on
    - damaging behaviour
    - Processing quality (fatty acid composition)
- Conventional/GS strategies have already been implemented with some success at least for boar taint
- New opportunities in the future at the genome level (sequence, annotation, editing)
- Effort to be put on phenotyping
  - Boar taint measurement/prediction
  - Behaviour