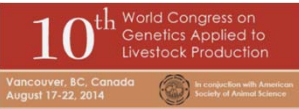


Potential Application of Genomics to Reduce Boar Taint Levels in Three Canadian Swine Breeds



J. Squires*, M. Jafarikia*[†], F. Schenkel*, S. Wyss[†], F. Fortin[‡], W. Van Berkel[§], R. de Wolde[#] and B. Sullivan[†]

*Centre for Genetic Improvement of Livestock, University of Guelph, Guelph, Ontario, Canada, [†]Canadian Centre for Swine Improvement, Ottawa, Ontario, Canada

[‡]Centre de développement du porc du Québec, Québec City, Québec, Canada; [§]Western Swine Testing Association, Lacombe, Alberta, Canada; [#]Ontario Swine Improvement, Innerkip, Ontario, Canada



INTRODUCTION

- Boar taint is caused by the accumulation of androstenone and skatole in fat tissues and emanates from intact male pig meat.
- Castration of young piglets is a common practice in preventing boar taint.
- Genetic selection to reduce boar taint offers an alternative solution to castration.

OBJECTIVE

- Investigate the possibility of reducing boar taint in fat tissues of swine using genetic markers.

MATERIALS & METHODS

- A total of 976 Duroc, 1128 Landrace and 1193 Yorkshire pigs were genotyped for 97 SNPs located in 40 genes.
- Fat samples on 644 Duroc, 837 Landrace, and 871 Yorkshire boars were collected at the slaughter plant or *via* biopsies (Baes *et al.* 2013. Animal: 714-720).
- Androstenone levels measured using enzyme-linked immunosorbent assay (ELISA) and skatole using high performance liquid chromatography (HPLC).

- Androstenone and skatole levels were skewed and thus log transformed prior to analysis.
- 80% of older boars were assigned to a training set and 20% of youngest pigs to the validation set.
- A two-step analysis was performed:
 - 1) SAS PROC GLM to adjust phenotypes for season, boar's age and weight.
 - 2) SAS PROC REG backward elimination to identify significant SNPs.

RESULTS

- **Marker frequency:** 61, 80 and 83 SNPs had MAF>0.05 for Duroc, Landrace and Yorkshire pigs, respectively.
- **Boar taint measures:** Duroc boars had the highest androstenone levels whereas higher skatole levels were found in Landrace and Yorkshire breeds.
- **Duroc pigs:** In the validation set, the number of unfavorable alleles were significantly correlated ($r=0.33$, $p<0.001$) with androstenone levels in fat.

Effectiveness of the markers in training sets

Breed	Duroc	Landrace	Yorkshire
Compound	Androstenone	Skatole	Skatole
Significant SNPs	14	23	12
Model R-square	22%	14%	14%

- The percentage of Duroc pigs with androstenone levels above the threshold were 20% and 76% for groups of animals with 10 and 15 or more unfavourable SNP alleles, respectively.
- **Landrace pigs:** In the validation set, the number of unfavorable alleles was significantly correlated ($r=0.23$, $p<0.01$) with skatole levels.
- **Yorkshire pigs:** No significant correlation between the number of unfavorable alleles and skatole levels were observed in validation set.
 - Only 11% of Yorkshire pigs had high levels of skatole. A larger sample size is recommended.

IMPLICATION & FUTURE WORK

- Markers assisted EBVs (MEBV) for boar taint can be calculated using genetic markers.
- MEBV for boar taint compounds can be included in sire and dam line selection indices.
- Possible negative impacts of markers on production traits should be investigated.
- Efficiency of markers must be validated in commercial pig populations.

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Figure 1: Frequency of 97 markers tested within each breed

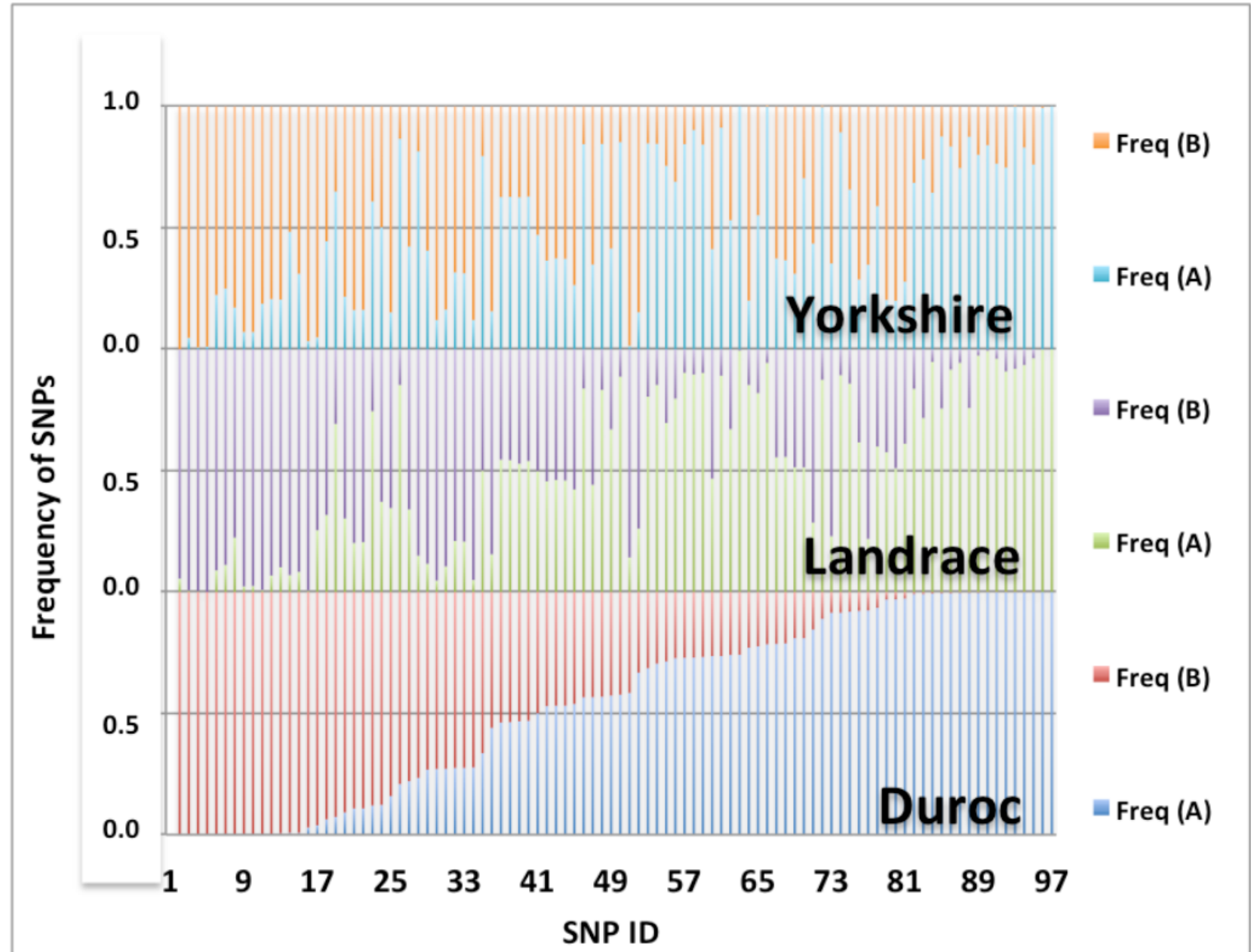
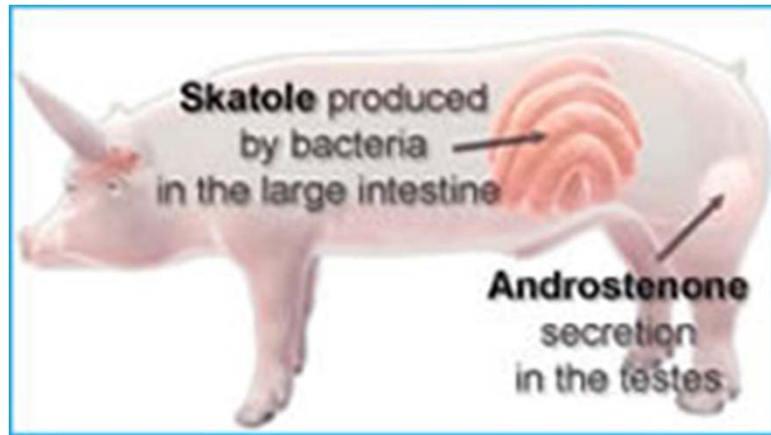
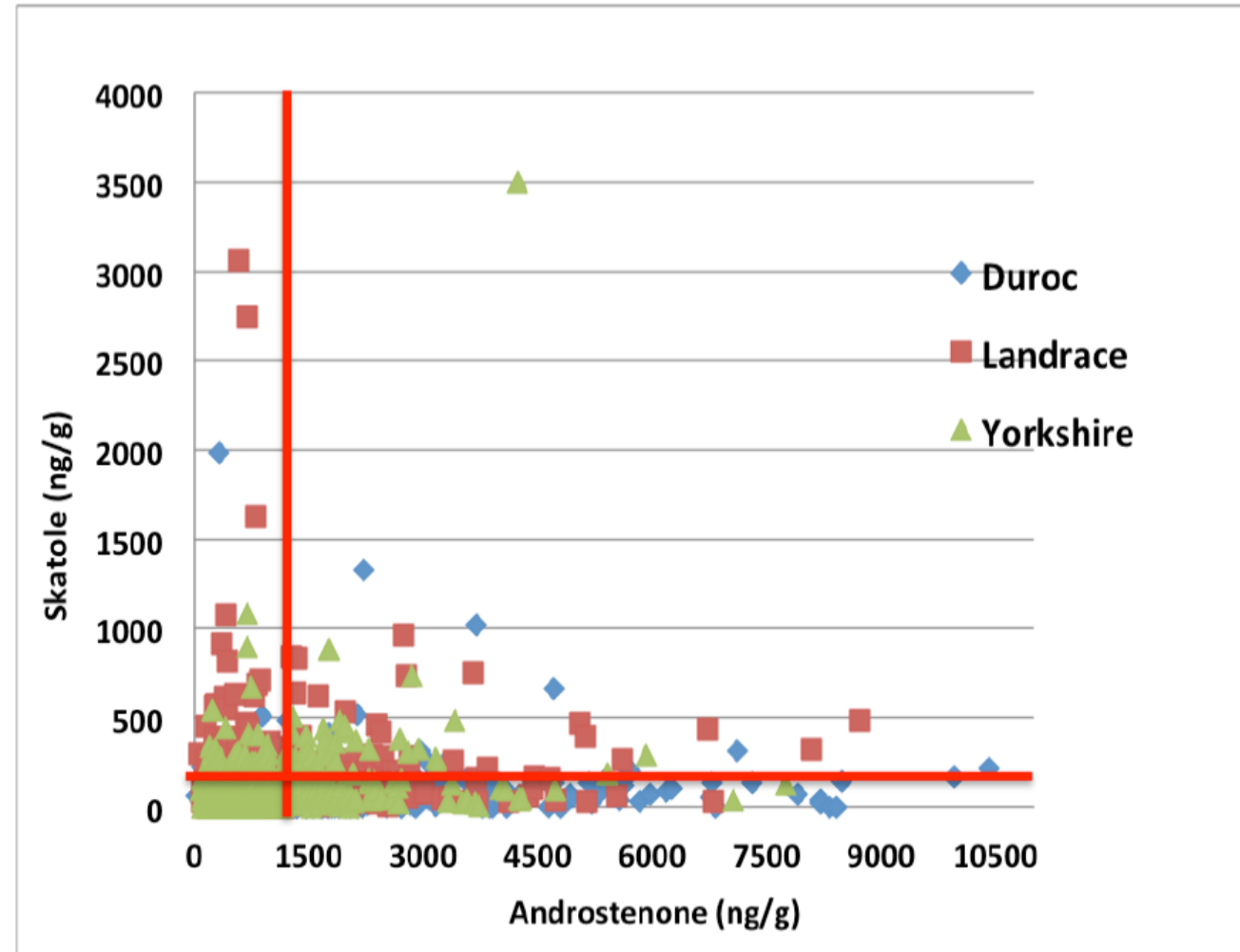


Figure 2: Distribution of androstenone and skatole in sampled pigs



www.boartaint.com



The horizontal and vertical red lines specify the consumer acceptable level of 200 ng/g and 1000 ng/g for skatole and androstenone, respectively.

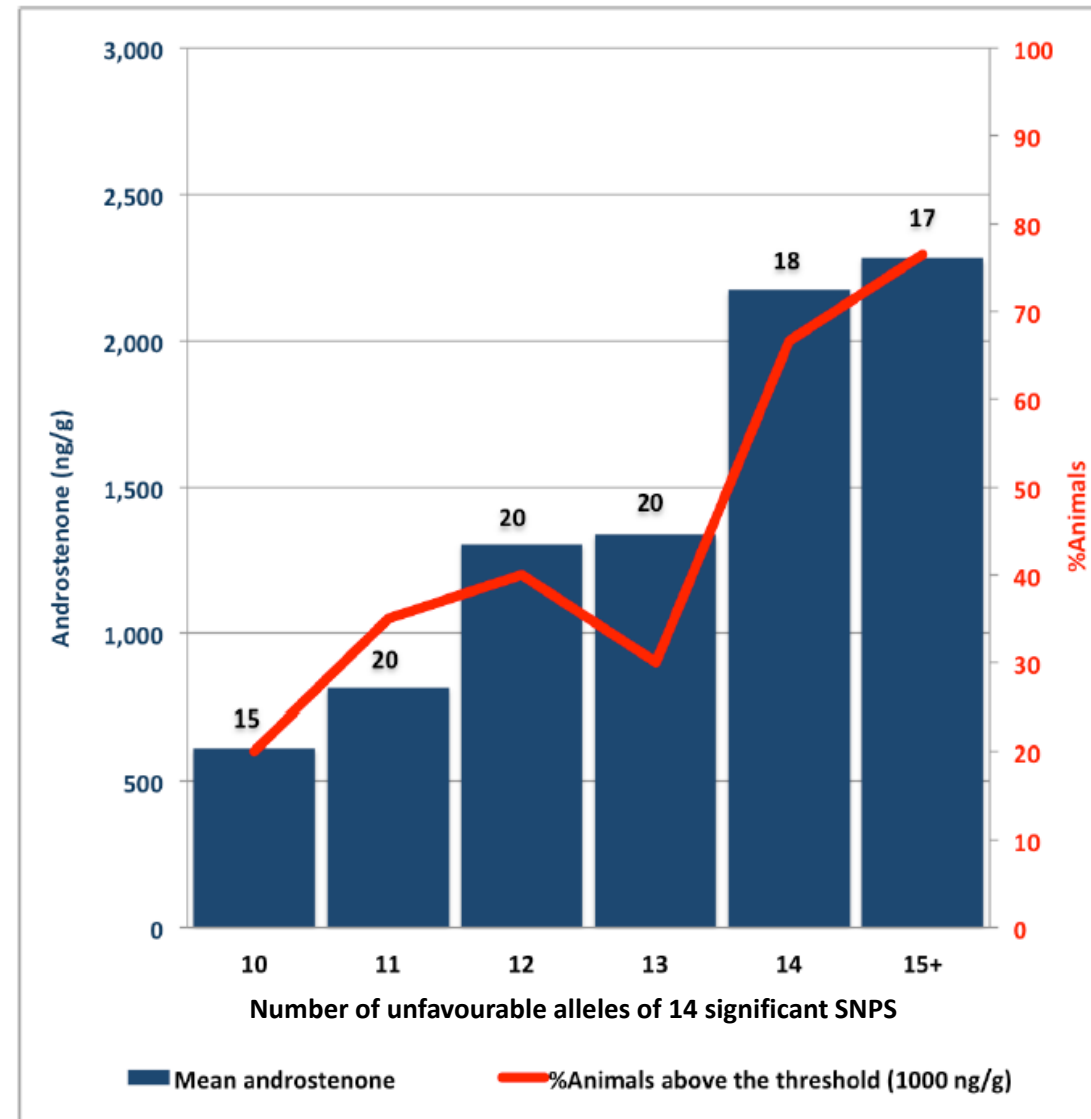
Table 1. Descriptive statistics on androstenone and skatole levels in Canadian boars*

Boar taint compound	Breed		
	Duroc	Landrace	Yorkshire
<i>Androstenone (ng/g)</i>			
Number of animals	627	768	805
Mean	1,650	954	840
Range	35-18,820	65-13,748	75-7,470
%Unacceptable	51	27	24
<i>Skatole (ng/g)</i>			
Number of animals	606	725	755
Mean	70	124	94
Range	0-1,986	0-3,062	0-3,502
%Unacceptable	5	15	11

* Statistics based on all the sampled boars before excluding light weight and very old or heavy individuals.



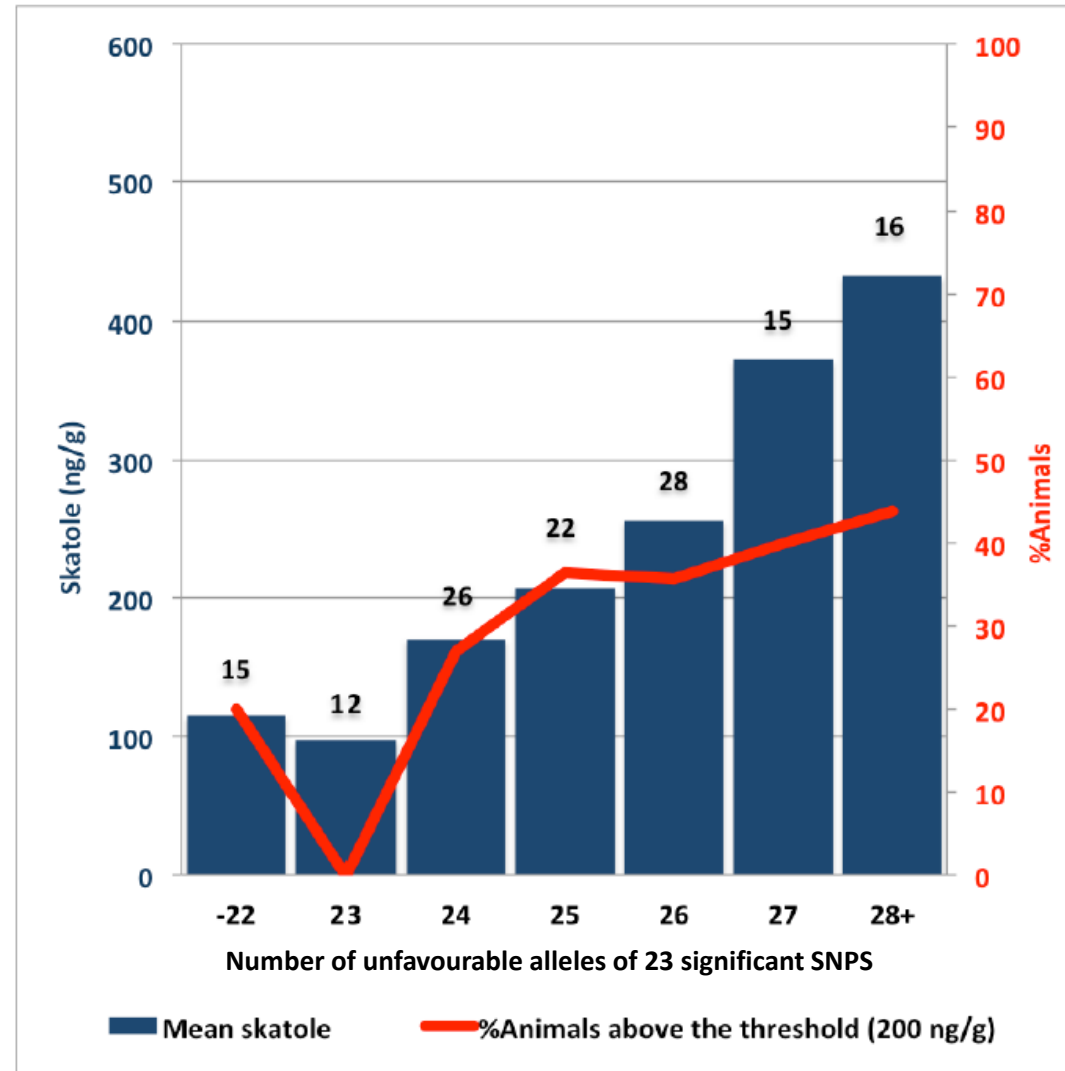
Figure 3. Relationship between number of unfavorable alleles of selected SNPs and levels of androstenone in the Duroc validation group



Number of animals in each group is shown on top of each bar. The 15+ group includes 9, 6 and 2 animals that were found to have 15, 16 and 17 unfavourable alleles, respectively



Figure 4. Relationship between number of unfavorable alleles of selected SNPs and levels of skatole in the Landrace validation group



Number of animals in each group is shown on top of each bar. The -22 group includes 4 and 11 animals with 21 and 22 unfavorable alleles, respectively. The 28+ group includes 10, 4 and 2 animals that had 28, 29 and 30 unfavorable alleles, respectively.

Effectiveness of the markers in training sets

Breed	Duroc	Landrace	Yorkshire
Compound	Androstenone	Skatole	Skatole
Significant SNPs	14	23	12
Model R-square	22%	14%	14%

