

The genetic background of goat milk oligosaccharide content

R. Gonzalez-Prendes, R. Crooijmans, B. Dibbitts, K. Laport, S. Breunig, P. Keijzer, L. Pellis, Henk Bovenhuis



Milk sampling team



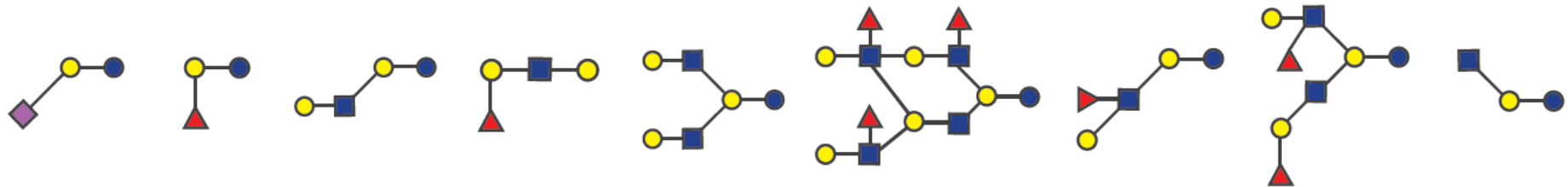
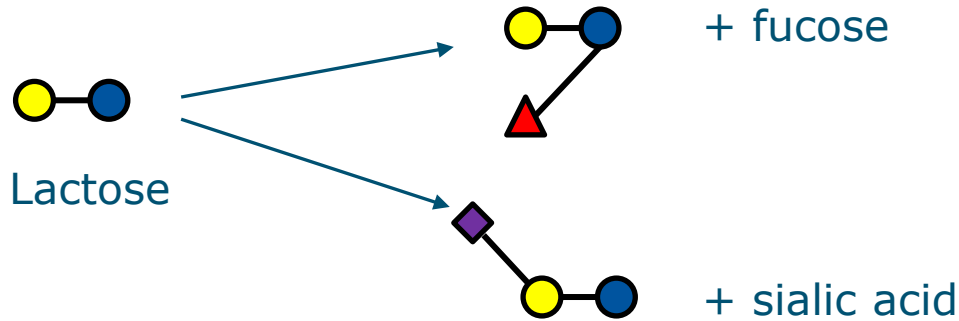
Infant formula

Introduction

- Milk is the only food for a newborn mammal.
- Primary function of milk: transfer resources from the mother to her offspring.

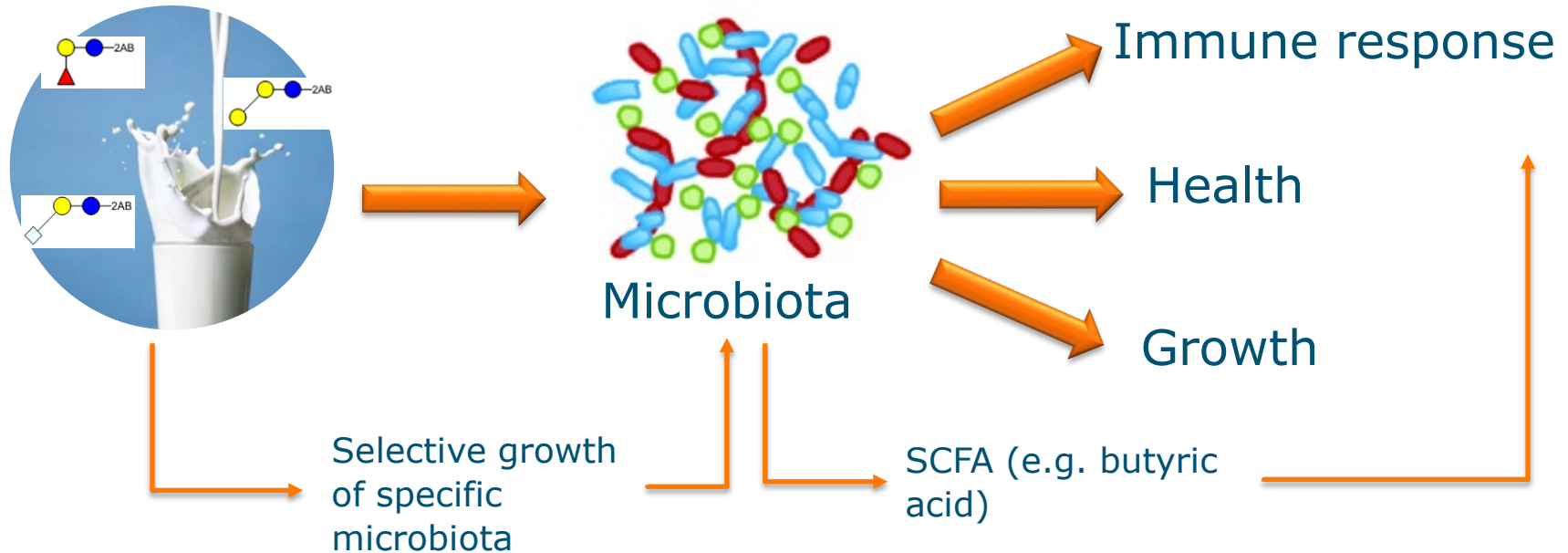
Introduction - oligosaccharides

- Milk oligosaccharides (or glycans) are a combination of lactose and different monosaccharides



Introduction - oligosaccharides

- Milk oligosaccharides are (mainly) indigestible. What is their role??



Aim

Investigate the genetic background of goat milk oligosaccharide (gMOS) content

- Heritability of gMOS
- GWAS for gMOS



Material and Methods

- 996 dairy goats - synthetic population (e.g. Dutch White goats, Saanen, Alpine)
- 18 Farms in the Netherlands
- Morning milk sample – gMOS analysed at commercial lab (Eurofins)
- Blood sample - GGP Goat 70K array. After filtering ~48k SNP genotypes used

Material and Methods

Statistical model:

- Farm (fixed or random)
- Parity (2 classes: 1, >1)
- Lactation stage (5 classes)
- Age by parity (co-variable)
- Genetic effect – Genomic relationship matrix (SNP effect)

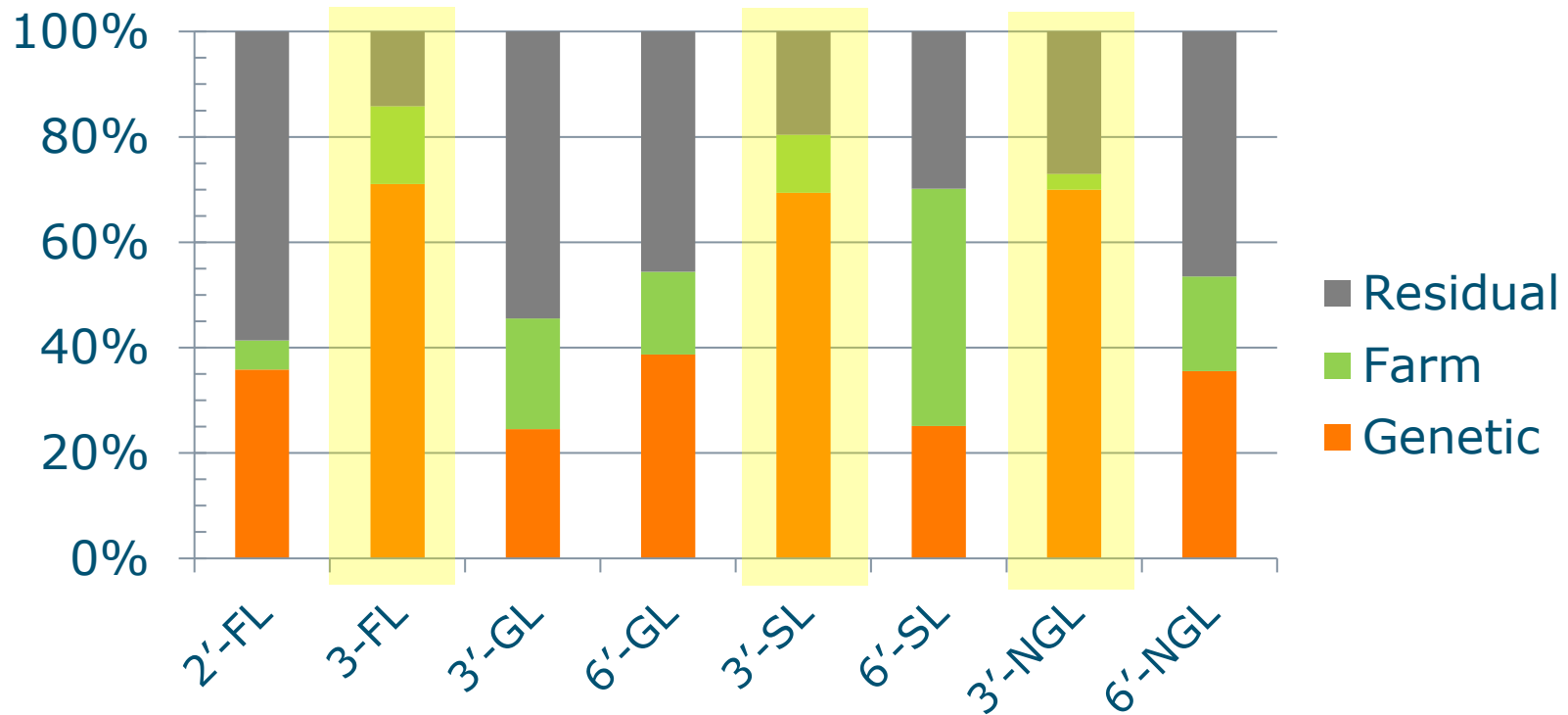
Results – gMOS content

gMOS	
	2'-FL
	3-FL
	3'-GL
	6'-GL
	3'-SL
	6'-SL
	3'-NGL
	6'-NGL

Results – gMOS content

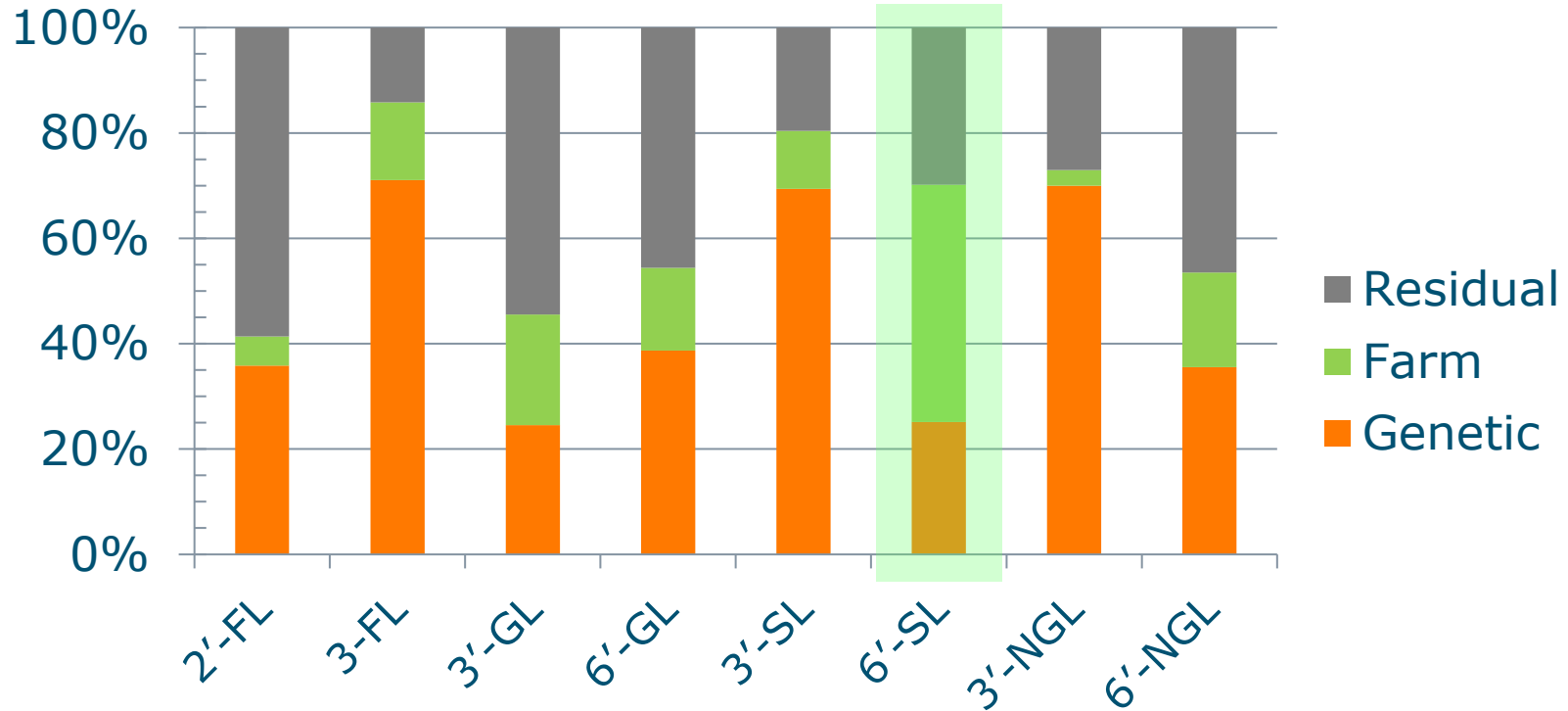
	gMOS	Average (mg/kg)		CV(%)
	2'-FL	2.0		164
	3-FL	1.9		47
	3'-GL	12.5		41
	6'-GL	8.6		64
	3'-SL	17.3		78
	6'-SL	15.9		132
	3'-NGL	32.1		45
	6'-NGL	16.4		91

Results – Variance components



Large fraction of the variation in gMOS content is due to genetics.

Results – Variance components



Differences between Farm are relevant.

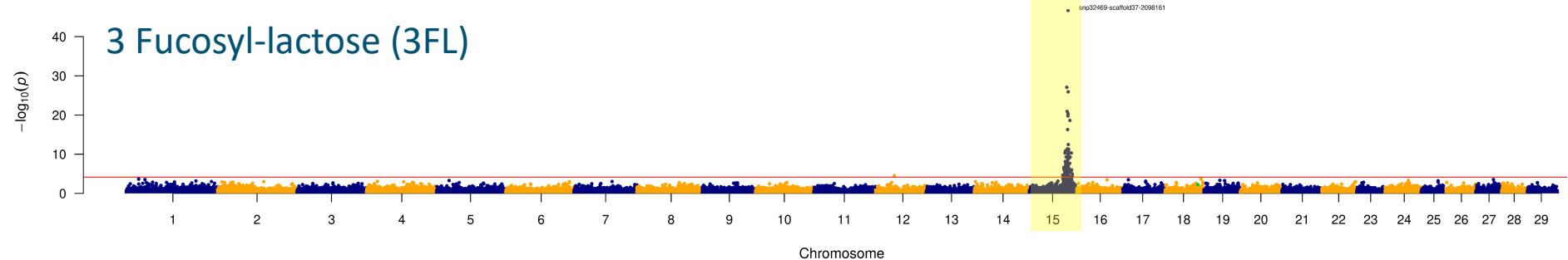
Results - GWAS

2' Fucosyl-lactose (2'FL)

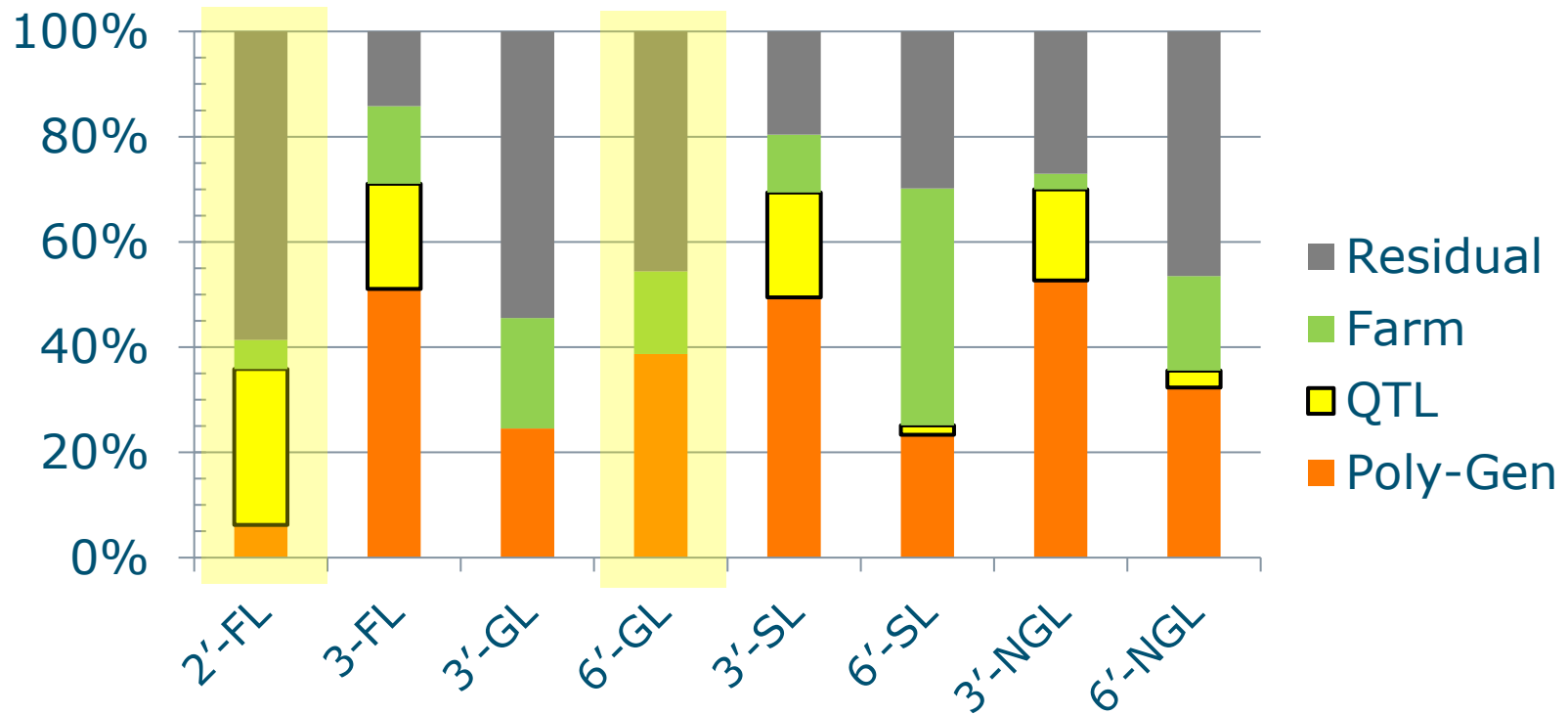


Significant associations between 5 gMOS and SNPs located in 6 genomic regions

3 Fucosyl-lactose (3FL)



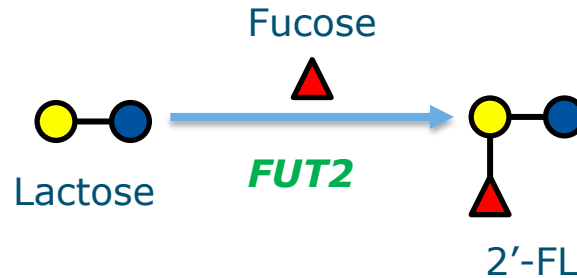
Results – Variance explained by QTL



Major genes affect.

Discussion

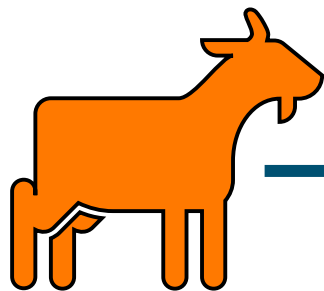
- Similar like in humans milk oligosaccharide content is strongly affected by genes with major effects: “secretors” versus “non-secretors”



- Significant genomic regions enriched with genes functionally related with oligosaccharide metabolism.
- Fine mapping using full sequence data. Improved goat reference genome.

Discussion

- First study to show large effect of “Farm” on milk oligosaccharide content. Effect of feed??
 - Liu et al (2019) – dairy cattle: “So increasing milk OS through diet manipulation is unlikely to be a feasible option.”



Differences in gMOS content

- Genetics – major genes
- Farm

