

Research Hypothesis

Fat

Protein

Carbohydrate

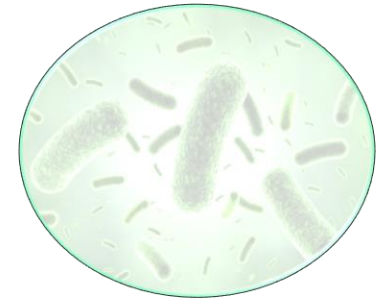


Lipolysis

Proteolysis

Glycolysis

Manufacture *Ripening*



Cheese volatile organic compounds (VOCs)

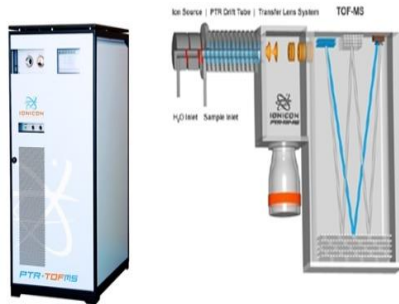


Cheese flavour



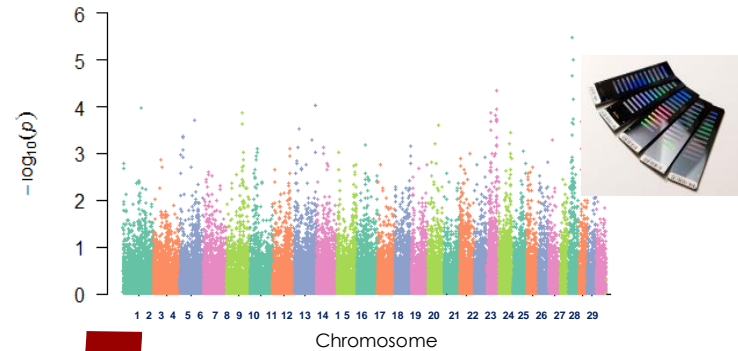
Aim of the study

PTR-ToF-MS

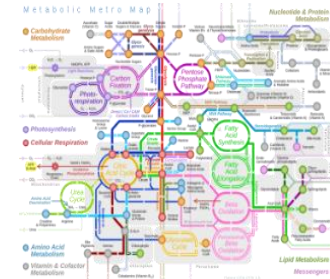


www.ionicon.it

GWAS (P-val & additive effect)



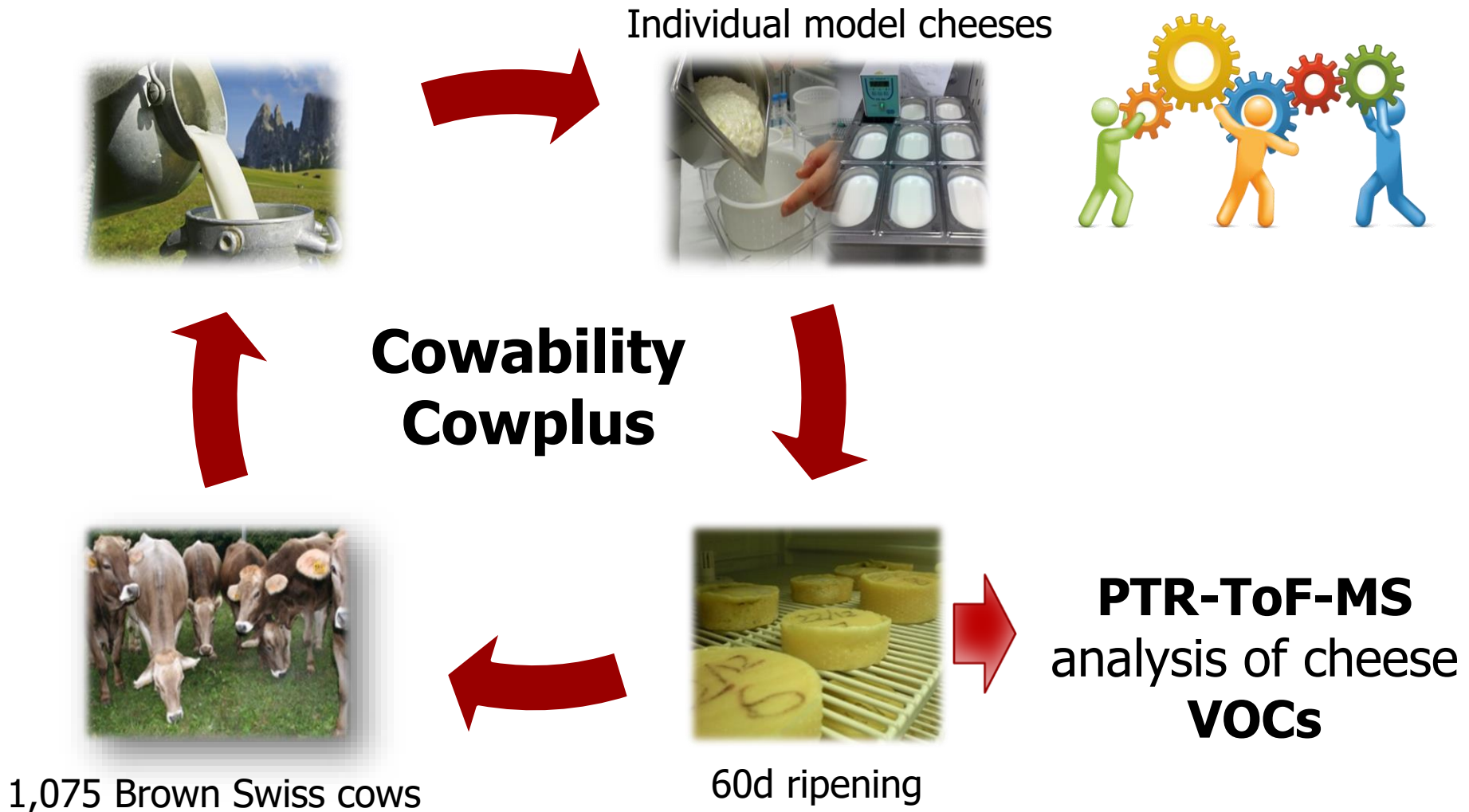
Gene-set enrichment analysis



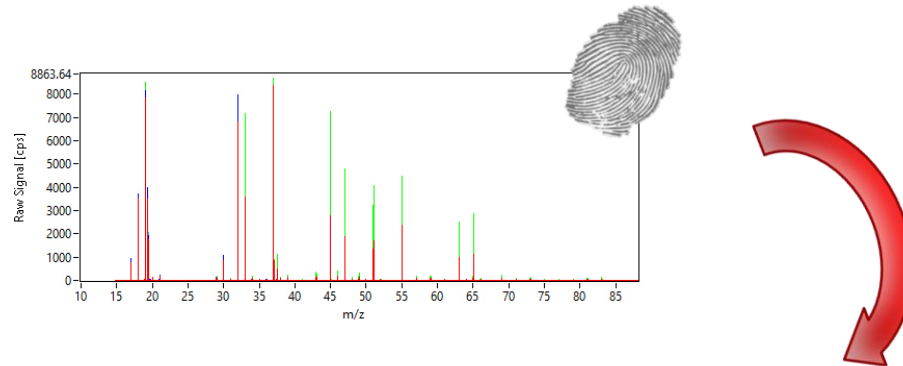
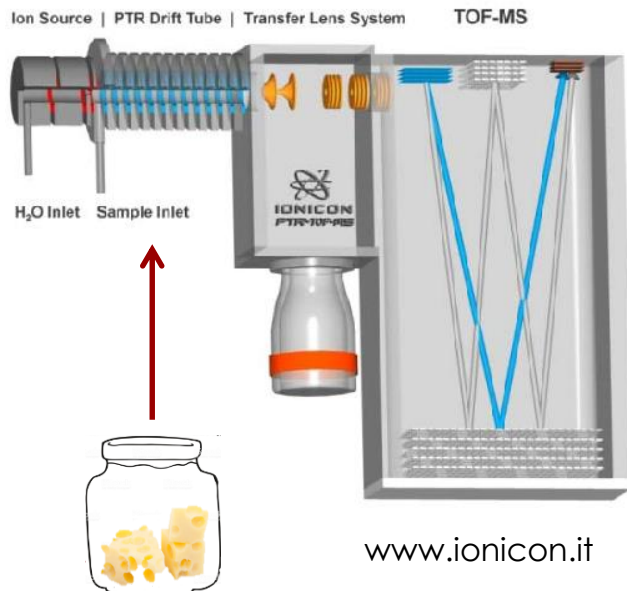
Genomic regions and **biological functions** potentially contributing to the **synthesis of cheese VOCs**



Cowability/Cowplus projects



Methods-PTR-ToF-MS analysis



- 1. Data transformation:** $\ln [(peak\ fraction + 1) * 10^6]$
- 2. Quality filtering:** peaks < 1 ppbv, interfering ions and isotopologues ($r > 0.95$, $P < 0.001$)
- 3. Tentative association to cheese VOCs**

- Direct injection
- Short analysis time
- High sensitivity

128 unknown peaks

+

45 peaks associated to cheese VOCs



Methods-GWAS and pathway analysis

Dataset

- Phenotypes:** 173 cheese VOCs + milk and cheese composition
- Genotypes:** 1,011 animals and 37,568 SNPs (Illumina Bovine SNP50)



ExpressionCorrelation
ClusterOne

GWAS

Single marker regression: DIM, parity, herd as fixed factors, $P < 5 \times 10^{-5}$ (*GenABEL R package*)

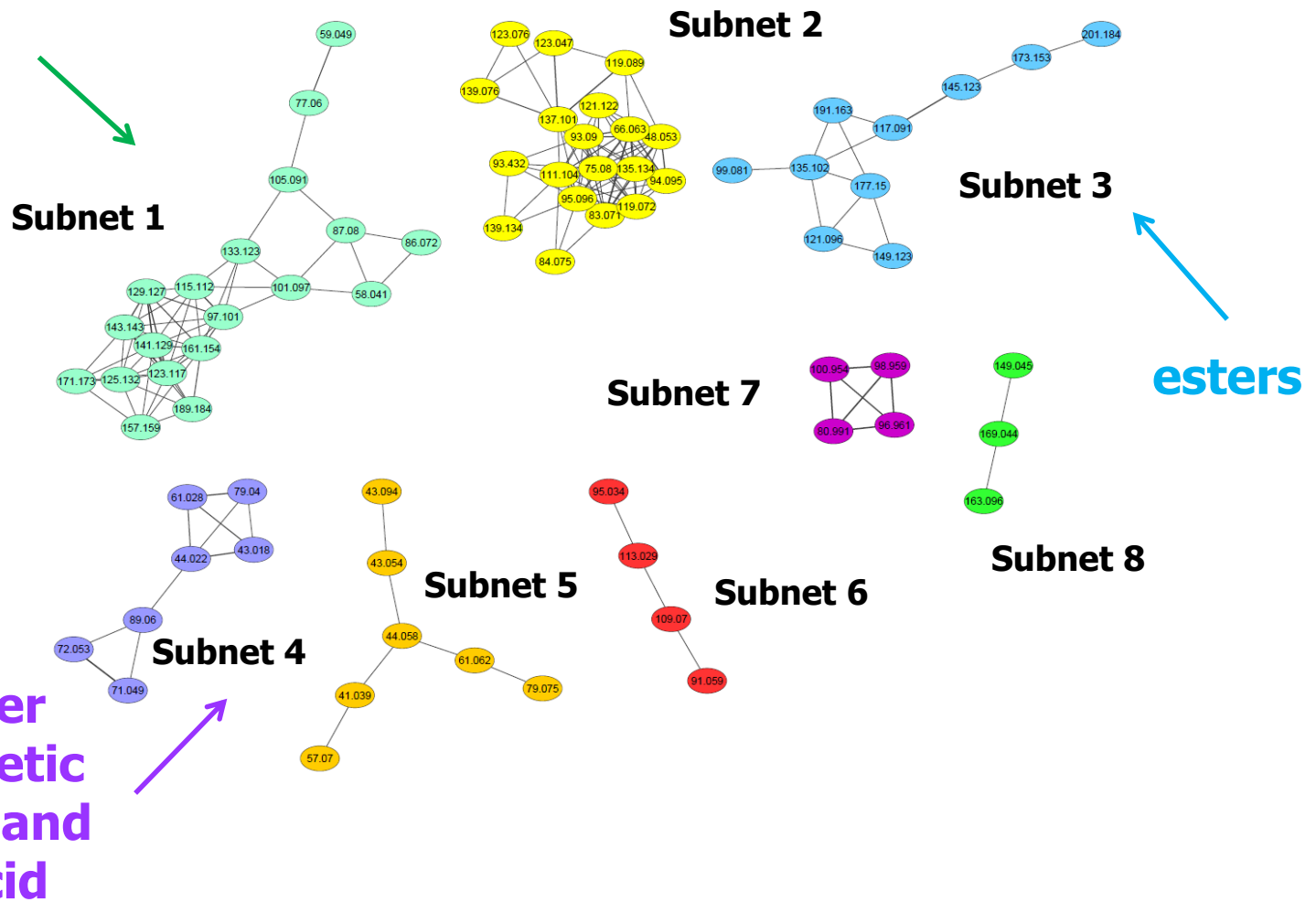
Pathway analysis

SNP selection: SNP-to-gene distance < 15 kb, $P < 0.05$ (*BiomaRt R package*)
Gene-set enrichment: GO and KEGG databases, $FDR < 0.05$ (*goseq R package*)



Results-VOCs correlations based on additive effect

ketones and aldehydes



Results – Pathway analysis

	■		■	
			■	
■				
		■		■

Phenol

Heptan-2-one

Octan-1-one

EPE, E2MB, E3MB, HA

Nonan-2-one

kegg_bta04530 Tight junction

kegg_bta0910 Nitrogen metabolism

kegg_bta00230 Purine metabolism

kegg_bta04720 Long-term potentiation

Transcellular transport of
lactose, K⁺, Na⁺ and Cl⁻

Proteolysis and
AA metabolism

Fatty acid metabolism

Conclusions & Challenges



Does **cow's genetic background** contribute to **cheese flavour**?



Integration of PTR-ToF-MS, GWAS and pathway analysis

Cow's genes related to **protein, fat and carbohydrate** metabolism influence cheese VOCs

More accurate identification of VOCs

Improvement of genome annotation



THANK YOU
 GRACIAS
 ARIGATO
 SHUKURIA
 JUSPAXAR
 DANKSCHEEN
 TASHAKKUR ATU
 YAQHANYELAY
 SUKSAMA
 EKHMET
 GRAZIE
 MEHRBANI
 PALDIES
 BOLZIN
 MERCI
 BIYAN
 SHUKRIA
 TINGKI
 SPASSIBO
 SNACHALHUYA
 NUHUN
 CHALTU
 WADEEJA
 MAITEKA
 HUI
 YUSPAGARATAM
 DHANNYABAD
 ANHIA
 ATTO
 MERISI
 SPASIBO
 DENKAUJA
 NENACHALHYA
 UNALCHEESH
 HATUR
 GUI
 EKOJU
 SIKOMO
 MAKETRI
 MINMONCHAR
 MERASTAWHY
 GAEJTHO
 TAVTAPUCH
 MEDAWASSE
 BAIKA
 SANKO
 KOMAPSUMNIDA
 MAAKE
 LAH
 AGUYJE
 FAKAAUE



ANARB



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UNIVERSITA' DEGLI STUDI DI PADOVA

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