Discrimination of **Beef Sensory Quality** by using Rapid Evaporative Ionization Mass Spectrometry (**REIMS**)

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What is REIMS (Rapid Evaporative Ionization Mass Spectrometry)

- **Ambient ionization mass spectrometry** technique
- **No sample preparation** & **No chromatography** & **Real-time analysis**

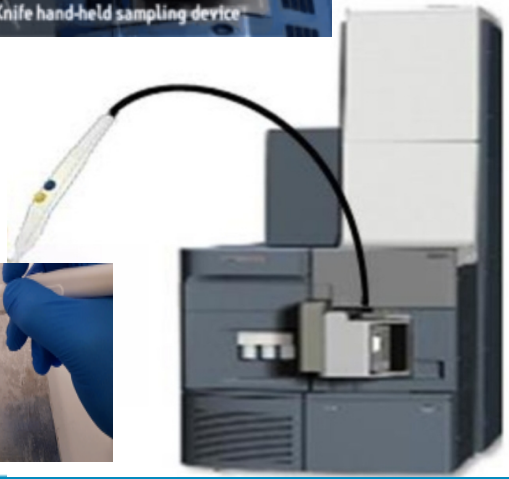
iKnife
Electrosurgical knife

Q-TOF-MS
Quadrupole
Time-of-Flight
Mass Spectrometer

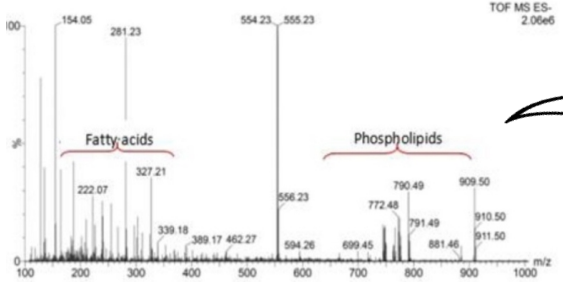
Source: Waters REIMS Research System with iKnife for Direct Sampling

How REIMS works ?

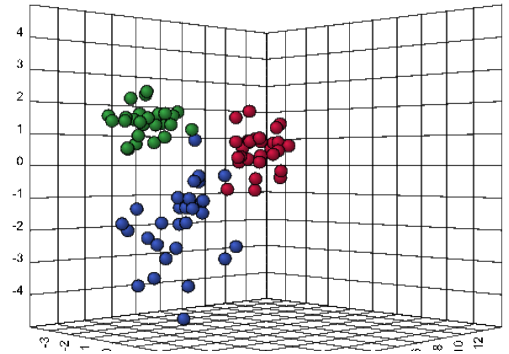
Sampling



Mass Spectrum



Model generation



Real time recognition

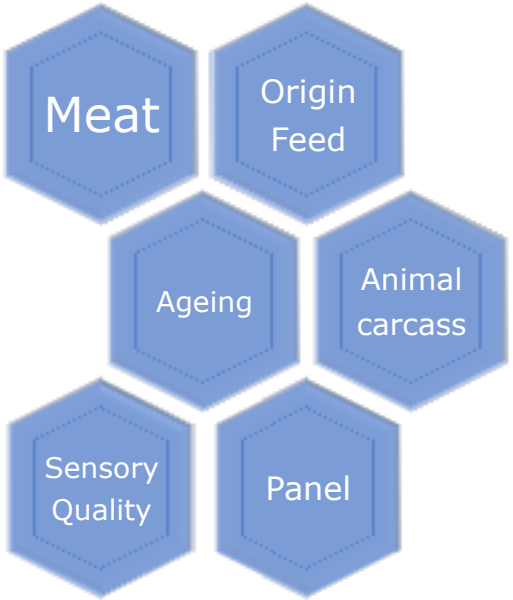
Source: Waters REIMS Research System with iKnife for Direct Sampling

Objective

- Evaluate the capacity of **REIMS** to discriminate:
  - **Muscle type**
  - **Meat sensory quality**

➢ Untrained consumer

○ Meat Standards Australia (MSA) sensory test



Animals

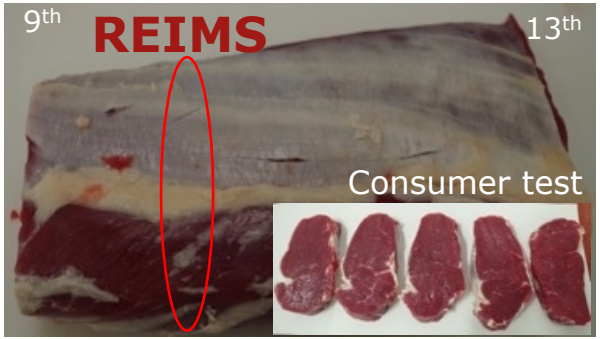
- 29 Angus x Salers crossbreed animals
  - 16 females & 15 castrated males
  - Pasture & grass feeding

The SALAMIX experiment was coordinated by Sophie Prache

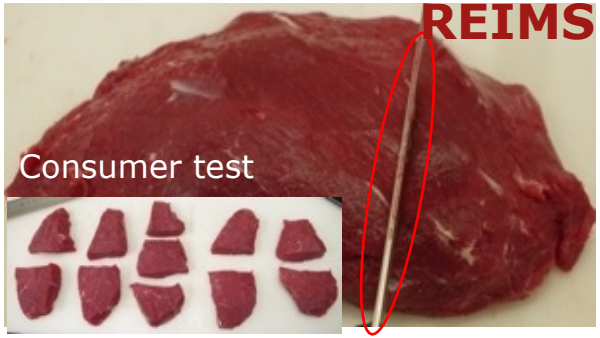
Meat samples

- *29* Loin (*m. longissimus dorsi et thoracis*)
- *58* Bolar blade (*m. triceps brachii caput longum*)
- *29* Internal flank plate (*m. obliquus internus abdominis*)

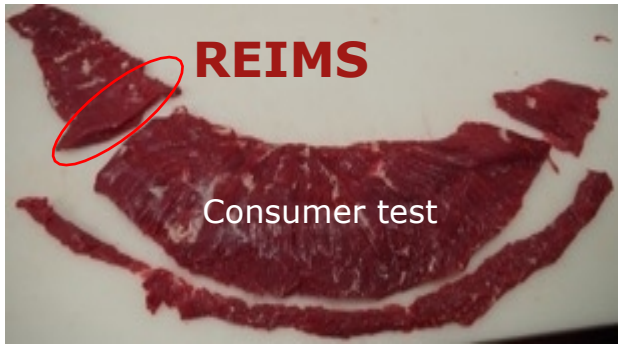
Loin



Bolar Blade



Internal Flank Plate



Methods

- **Sensory quality**
  - Untrained consumers
  - Tenderness
  - Flavor
  - Juiciness
  - MSA Quality grade

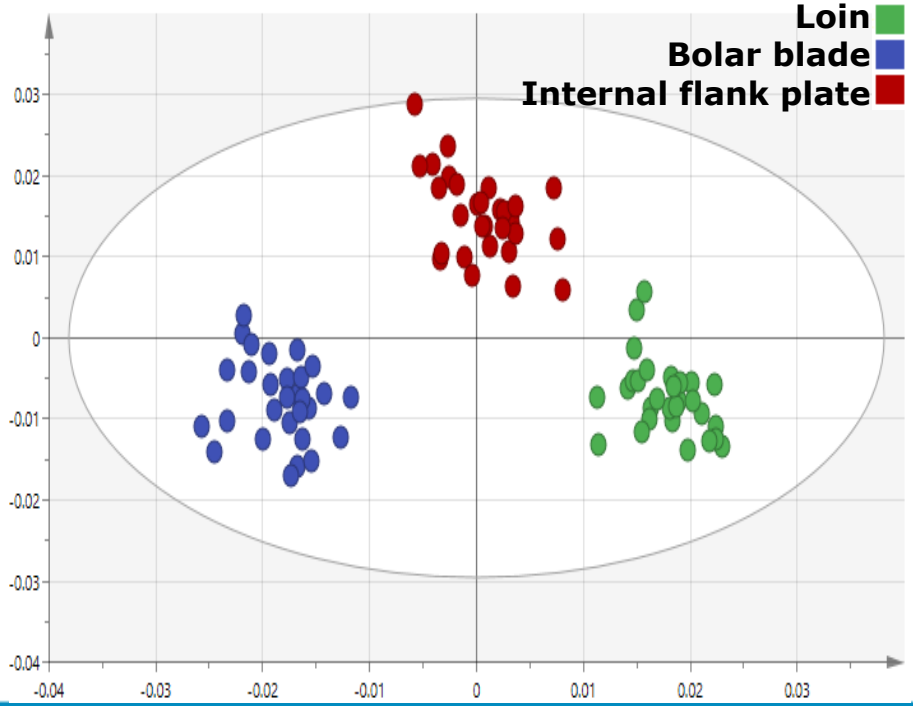
Statistical analysis

- **OPLS-DA**

  Orthogonal Partial Least Squares – Discriminant Analysis

Muscle type

OPLS-DA score plot



R^2 = 0.87

Q^2 = 0.71

[Q^2: prediction accuracy]

CV-ANOVA: $P < 0.05$

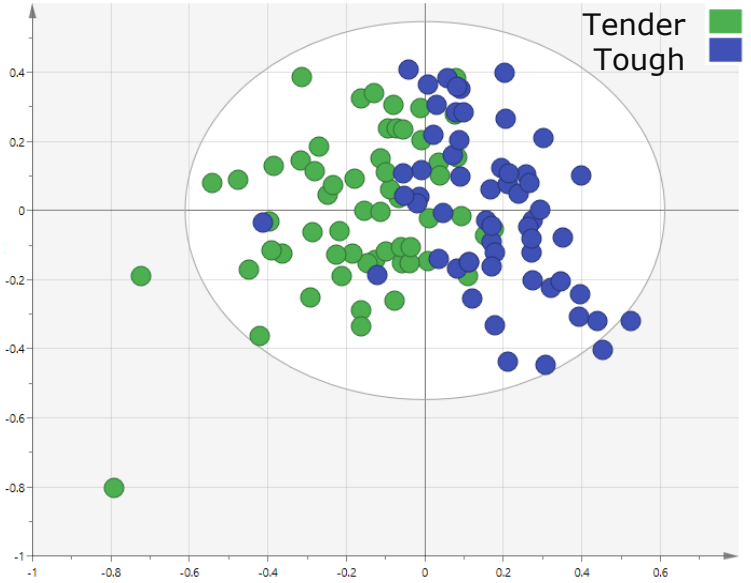
71% accuracy

Sensory quality – Tenderness

Tenderness scale: 0-100

Tenderness score: 27-89 (n=116)

Binary class
Tough: 27-66 (n=58)
Tender: 67-89 (n=58)



$Q^2 = 0.31$
$P < 0.05$

Sensory quality – Flavor & Juiciness

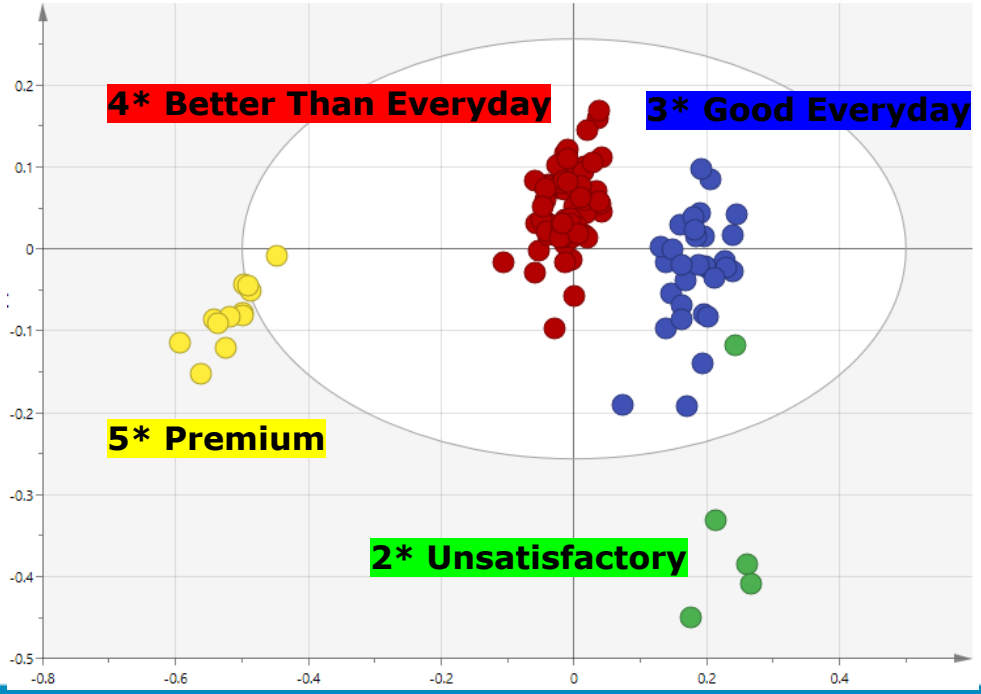
Sensory trait	Binary class	Q^2	*P*
Consumer scored flavor	More flavor/less flavor	99%	< 0.05
Consumer scored juiciness	More juicy/less juicy	99%	< 0.05

REIMS classifies beef flavor with the highest accuracy of 84% - Hernandez-Sintharakao et al., 2023
REIMS classifies boar taint pork with an accuracy of 98% - Verplanken et al., 2017

Meat Standards Australia (MSA) quality grade

2* Unsatisfactory | 3* Good Everyday | 4* Better Than Everyday | 5* Premium

OPLS-DA score plot



$R^2 = 0.77$

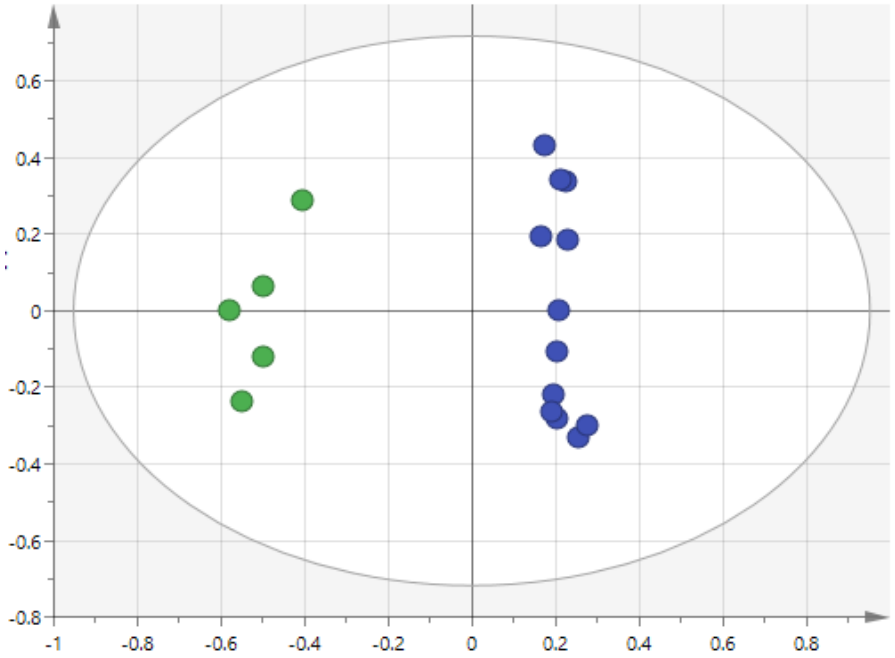
$Q^2 = 0.36$

$P < 0.05$

36% accuracy

MSA quality grade

2* Unsatisfactory *vs* 5* Premium

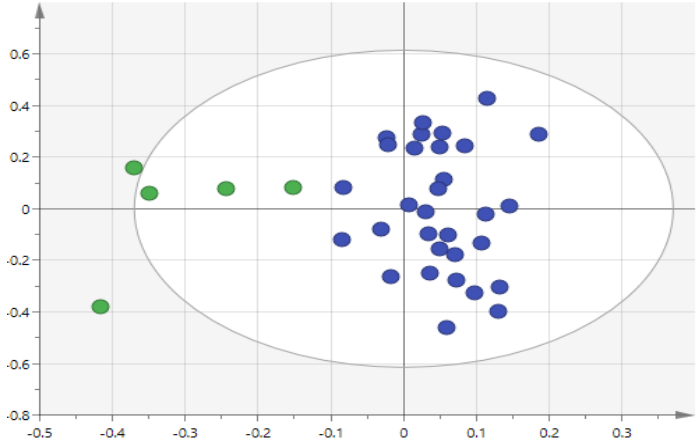


R^2 = 0.66
Q^2 = 0.99
P< 0.05

99% accuracy

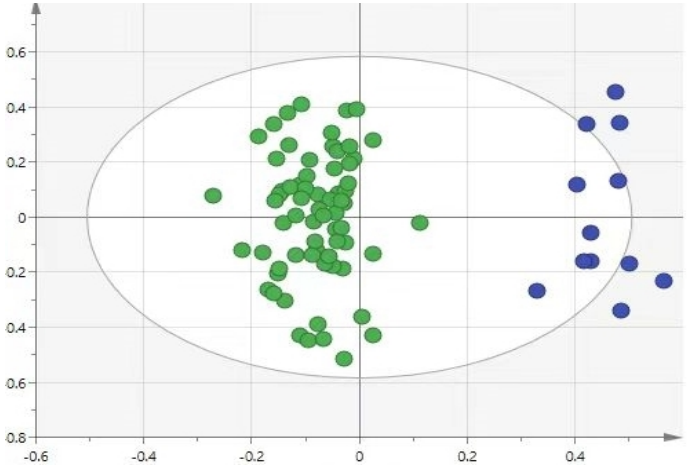
MSA quality grade

2* Unsatisfactory *vs* 3* Good Everyday



55% accuracy

4* Better Than Everyday *vs* 5* Premium



62% accuracy

Significant features

VIP (Variable Importance in Projection)

- A measure of importance of individual metabolites in the OPLS-DA model for discriminating between different classes

High VIP values & frequency of occurrence

- m/z 128.0331
- m/z 276.1374
- m/z 375.1824
- m/z 726.5429
- m/z 744.5513
- m/z 763.5605
- m/z 863.5484
- …

Putative identification of lipid species to distinguish different sensory quality grade

Conclusion

- REIMS capacity for accurate classification in meat quality **varies** in different characteristics

- REIMS has a potential to classify meat according to **sensory quality**
- Greater efficacy for **lipid-related traits** such as **flavour** and **juiciness**

- The full realization of this novel technology would require **a large sample size** that allows **robust REIMS fingerprinting** and more accurate chemometric modeling

Thanks for your listening

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Acknowledgement

Brian Quinn & Nick Birse (Queen's University Belfast): REIMS Analysis

Jean-François Hocquette (INRAE): Project supervision

Nigel Scollan (QUB): Supervision of REIMS approach

Rod Polkinghorne (IMR3G): MSA predictions

Carlos Álvarez (Teagasc): Mass spectrum analysis

Isabelle Legrand (IDELE): Sensory analysis

Marie-Pierre Ellies-Oury (INRAE): Sensory analysis

Sophie Prache (INRAE): Animal experiment

INRAE