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UNIVERSITY
BELFAST

IGFS

THE INSTITUTE
FOR GLOBAL
FOOD SECURITY



An evaluation of muscle cut, maturation and meat quality of beef using Rapid Evaporative Ionisation Mass Spectrometry (REIMS)

Lynda Perkins

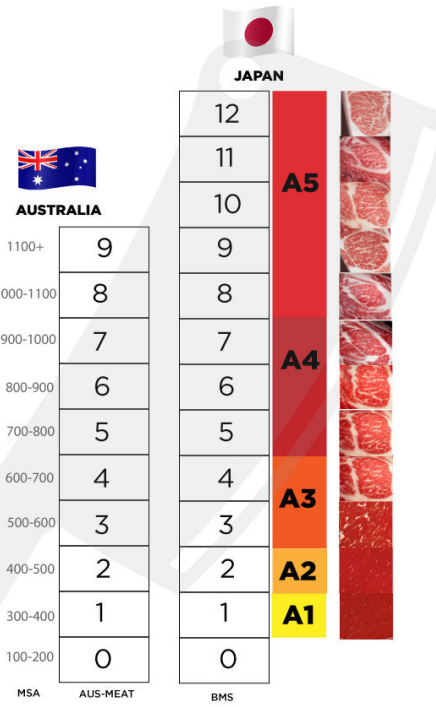
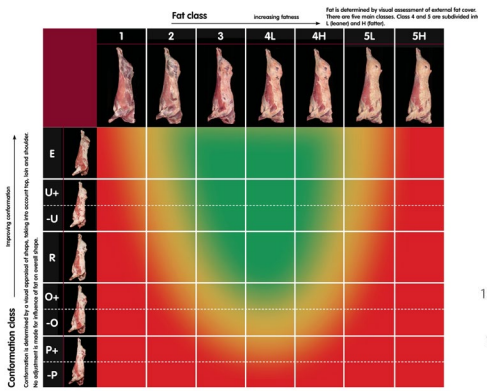
Wenyang Jia, Alix Neveu, Tim Rowe, Rod Polkinghorne, Pip Nicholas-Davies, Anastasios Koidis and Nigel Scollan

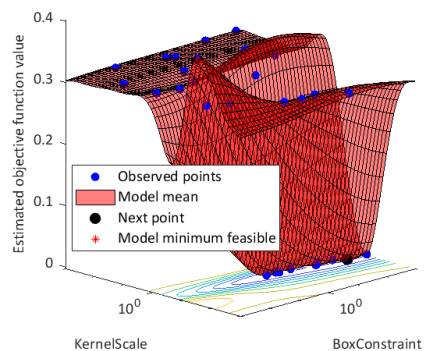
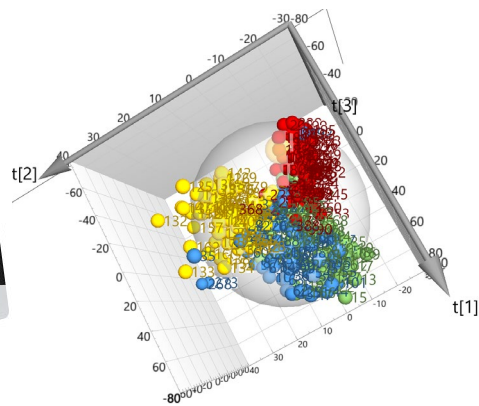


How The USDA Grades Your Steak!

Highest Quality!	Great Quality!	Good Quality!
ABUNDANT MARBLING	MODERATE MARBLING	SLIGHT MARBLING
 USDA PRIME Less Than 2% of Steaks Are Graded USDA Prime!	 USDA CHOICE	 USDA SELECT

Marbling is the most prized feature in steaks. It is characterized by thin streaks of fat between muscle tissue. When cooked, the fat melts. This gives the meat unparalleled tenderness and a rich, buttery flavor.

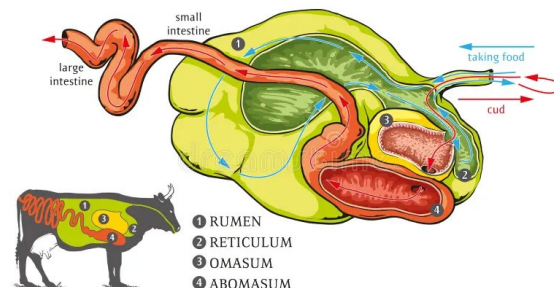




NEW
HYPOTHESES

BIOLOGY

NEW INSIGHTS



NEW
BIOLOGICAL
QUESTIONS

TECHNOLOGY

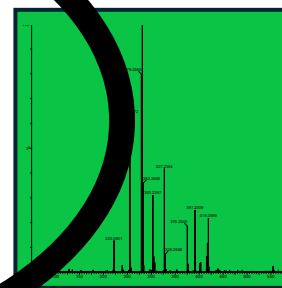
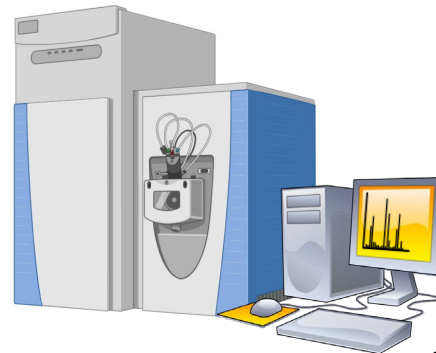
NEW TECHNOLOGIES

NEW
DATA

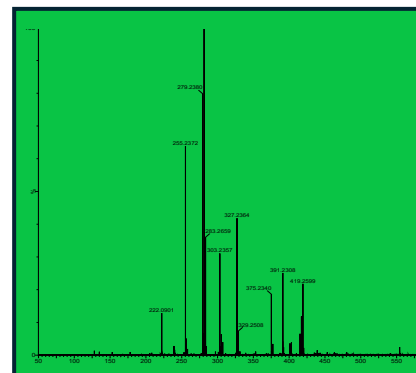
COMPUTATION

NEW
SOFTWARE

SARTORIUS



Rapid Evaporative Ionization Mass Spectrometry (REIMS**)** is an ambient technique that allows direct characterization of biological tissues, food, and environmental samples without the requirement for sample preparation





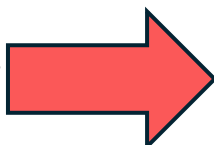
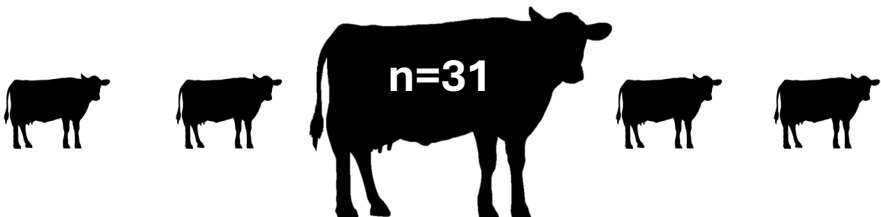
Study aim

- 1) Acquire REIMS spectral data from four raw beef muscles and determine relationships with maturation, season, consumer sensory scores and (MSA) grading**
- 2) Apply chemometric modelling to discriminate sensory attributes**

Measuring meat quality and maturity

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Chris Elliott^d, Yann Guillon^d, Jessica E. Prenni^e, Otto Savolainen^f,
Lieselot Hemeryck^g, Nanna Hjørt Vidkjær^h, Nigel Scollan^c, Sara L. Steadⁱ,
Renyu Zhang^k, Lynn Vanhaecke^g

BeefQ study



7-day

21-day



OYS

OYS



EYE

EYE



TDR

TDR



STR

STR

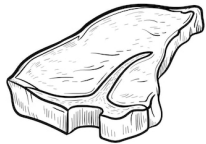
7-day

21-day



OYS

OYS



EYE

EYE



TDR

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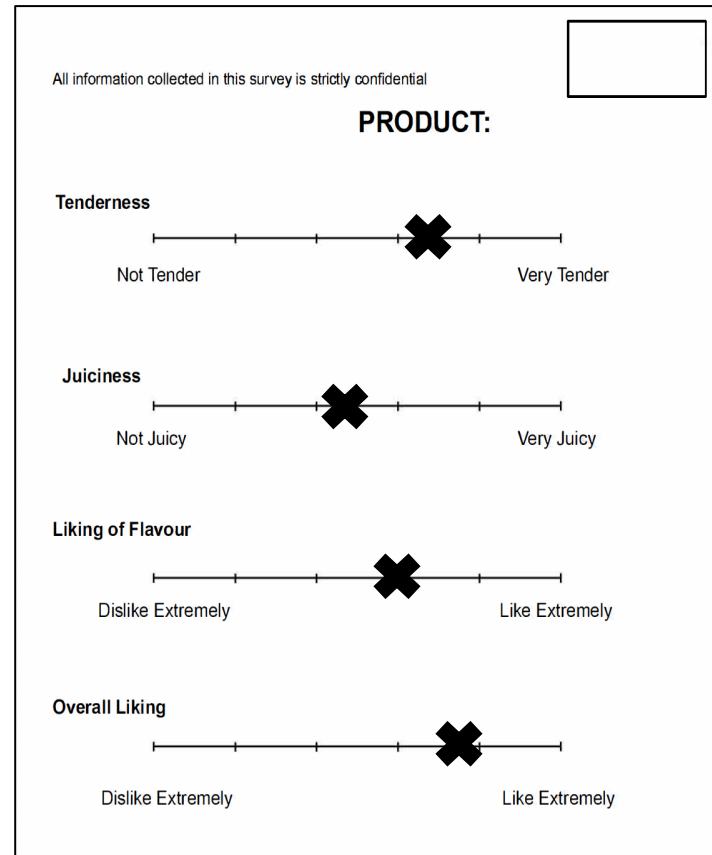


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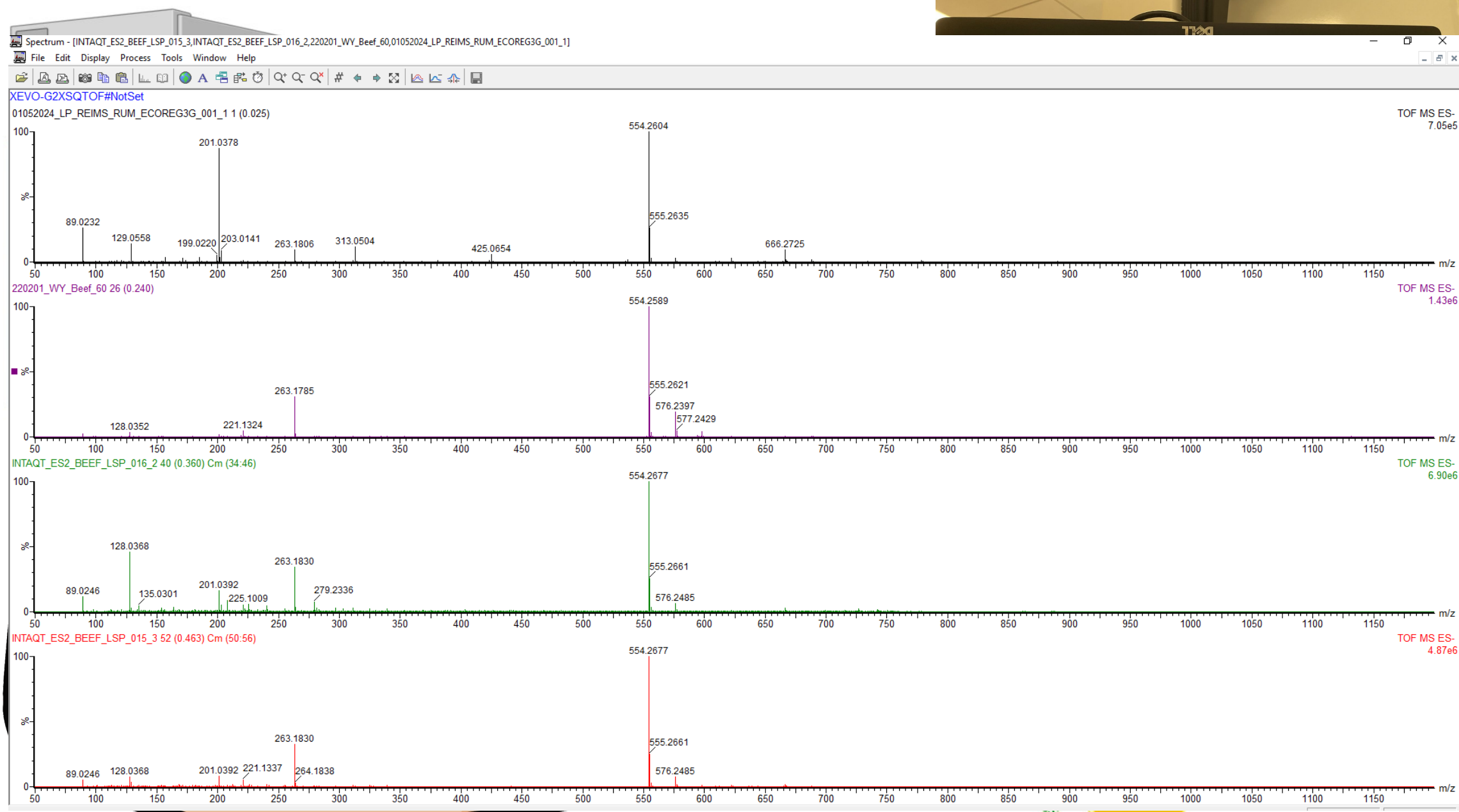
Consumer panels

- 1,200 consumers – 20 events with 60 participants per event
- Beef muscles (sirloin, tenderloin, salmon and feather blade, were evaluated as grilled steak
- Beef was tested through consumer taste panels and scored for:
 - **Tenderness**
 - **Juiciness**
 - **Flavour**
 - **Overall liking**
- CMQ4 Score determined



HOW IS CMQ4 SCORE CALCULATED

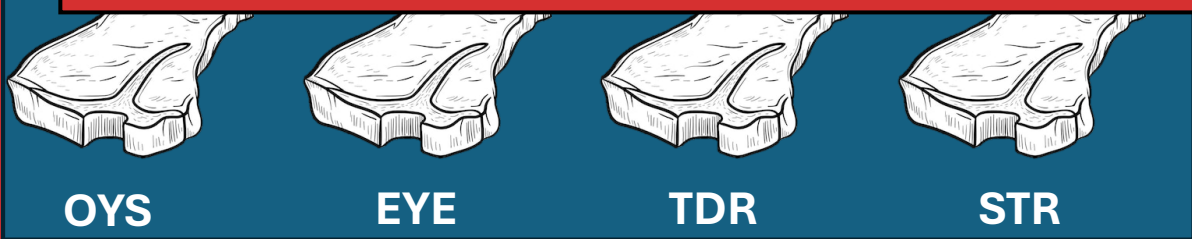




Part 1
Discrimination of muscle type,
maturation and season

Part 2
Chemometric modelling rules

Parameter	Rule (C=consumer)
CMQ4	Rule 1: Unacceptable (<40); Acceptable (>40) Rule 2: Low (<46); medium low (46- 64); medium high (65-76); high (>77)



COLike	Equally distributed into four classes: low, medium low; medium high; high
CMQ4	Rule 1: Unacceptable (<40); Acceptable (>40) Rule 2: Low (<46); medium low (46- 64); medium high (65-76); high (>77)

The Meat Standards Australia System

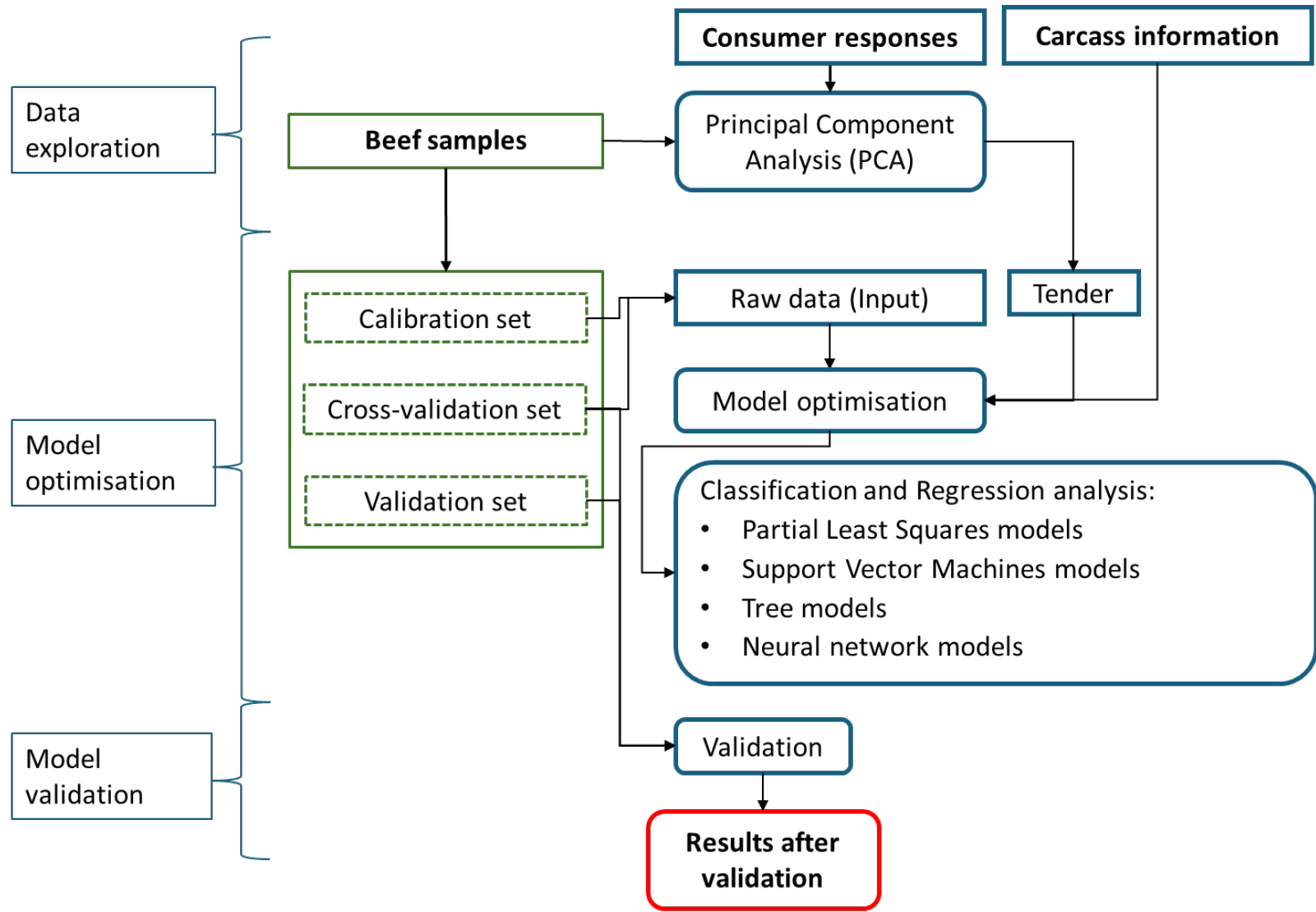
Parameter	Rule (C=consumer)
CMQ4	Rule 1: Unacceptable (<40); Acceptable (>40) Rule 2: Low (<46); medium low (46- 64); medium high (65-76); high (>77)

Consumers class meat as:

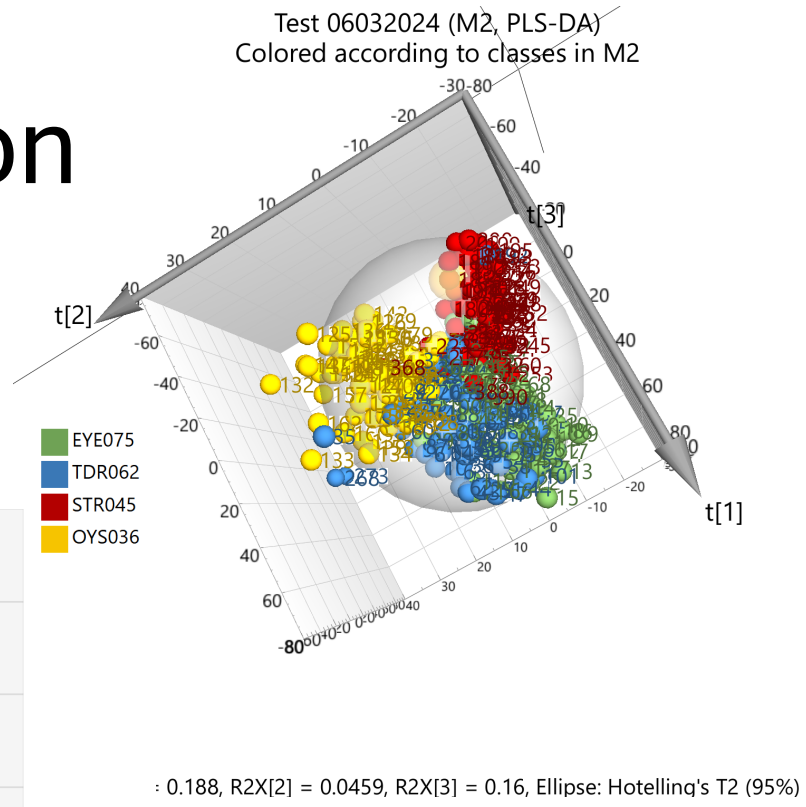
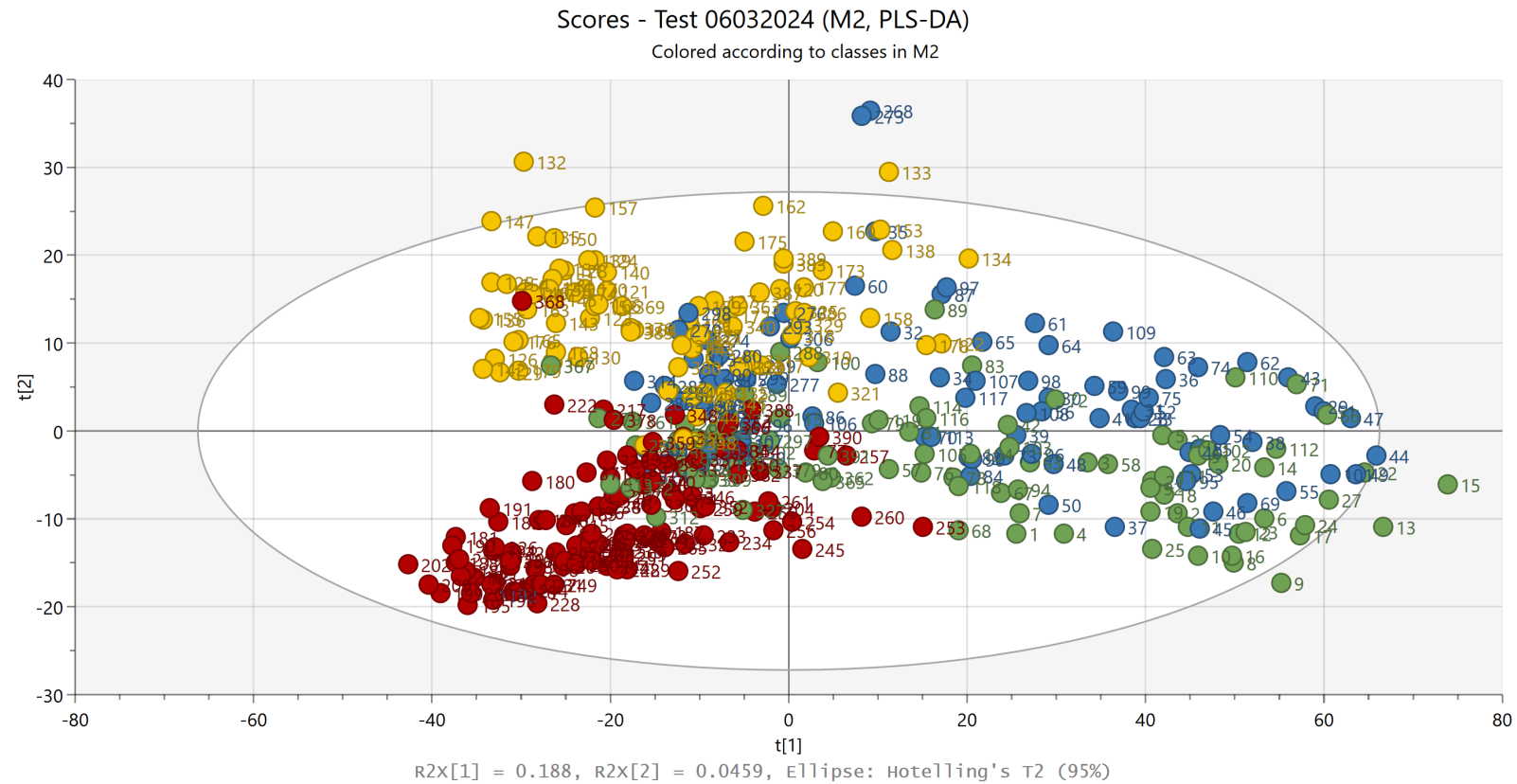


Data analysis

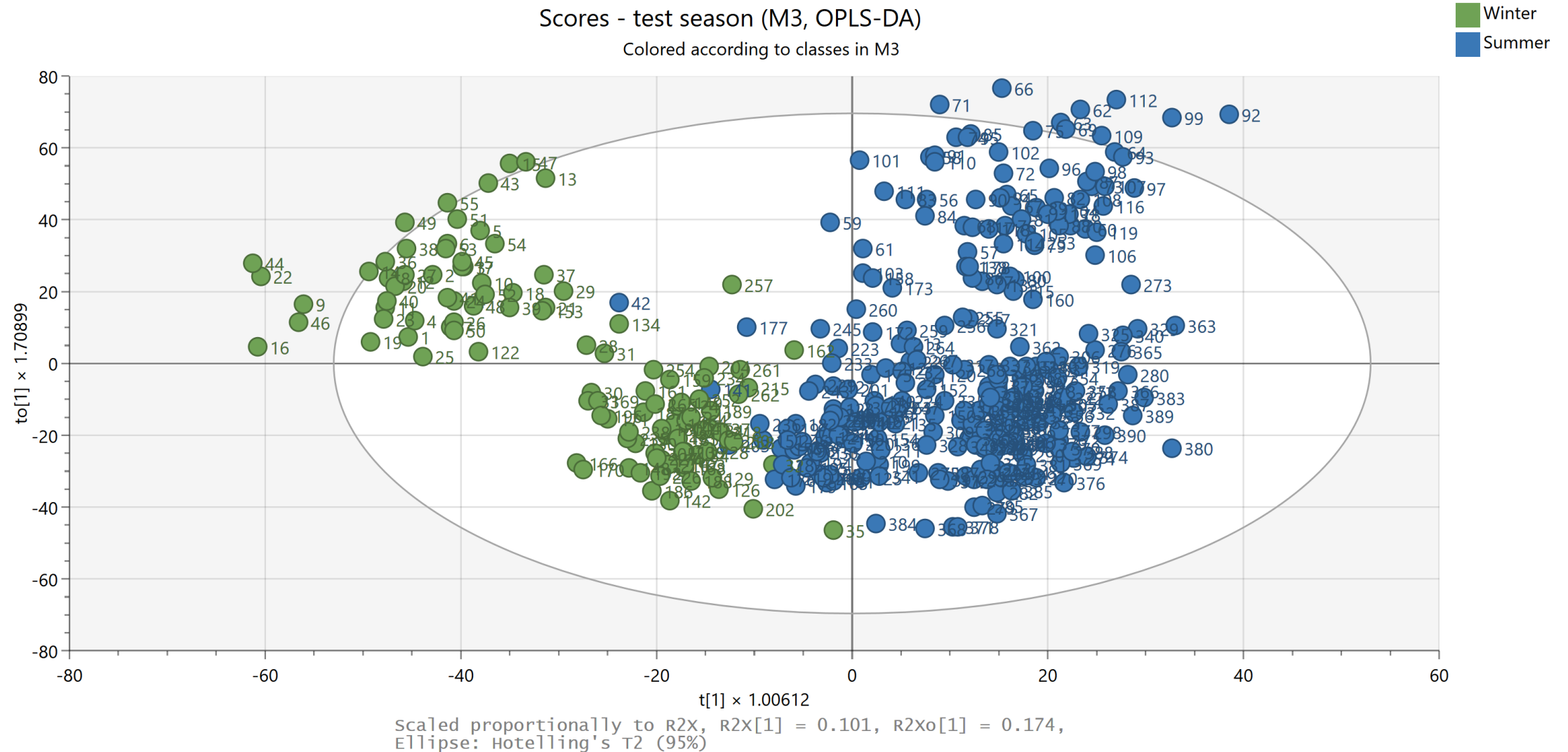
Calibration/Validation :
80/20
for each category



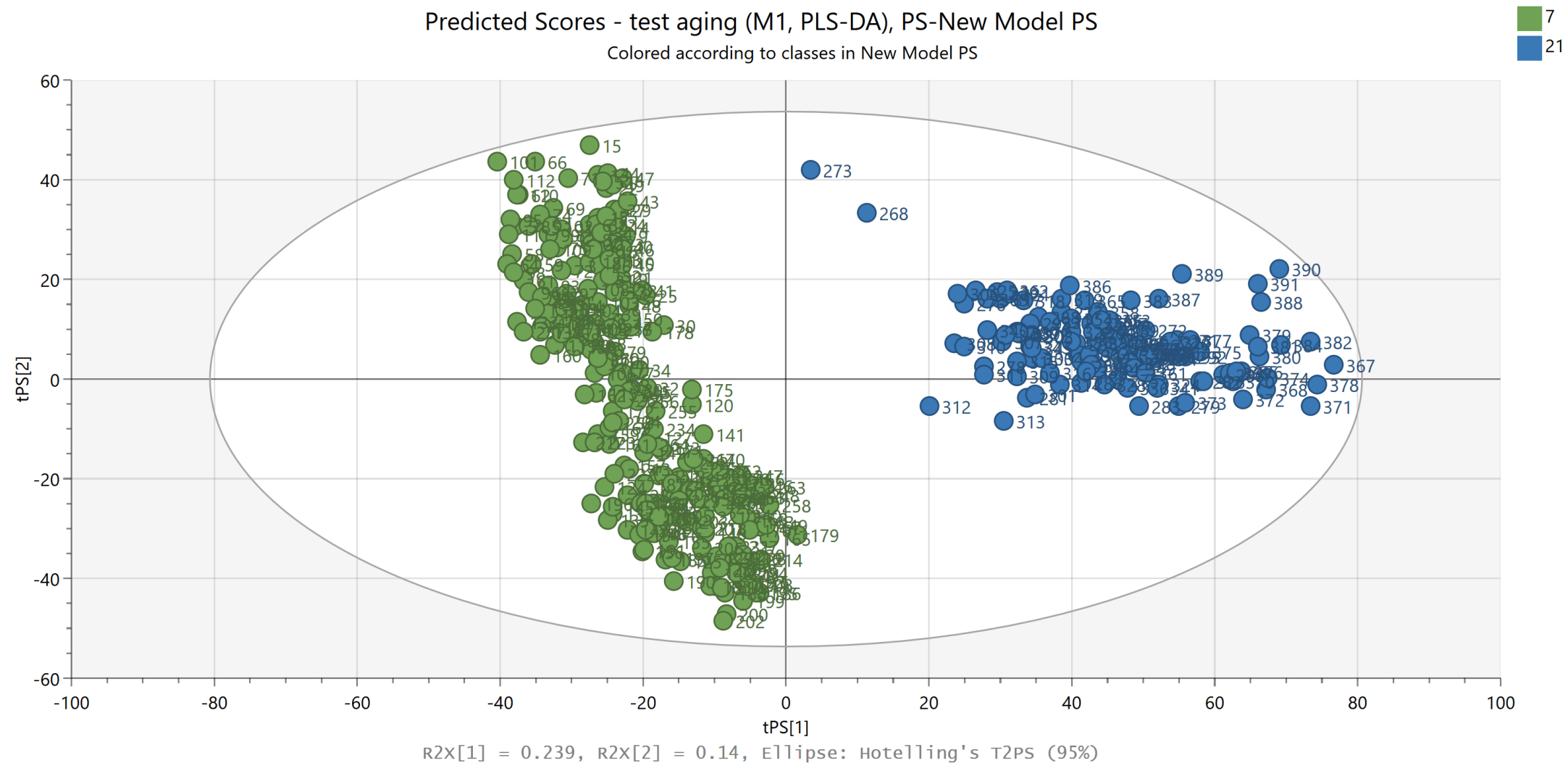
Part 1 – muscle cut discrimination



Part 1 – season discrimination

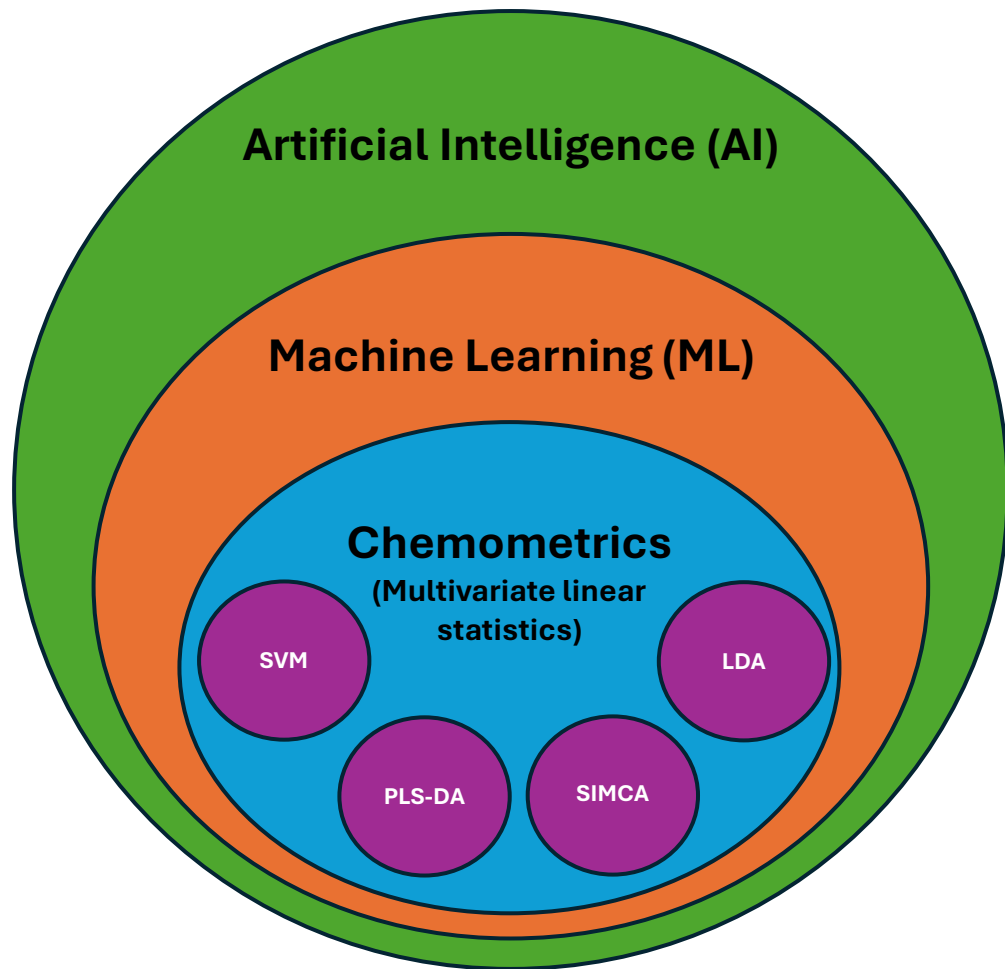


Part 1 – maturation discrimination



Part 2 – chemometric modelling progress

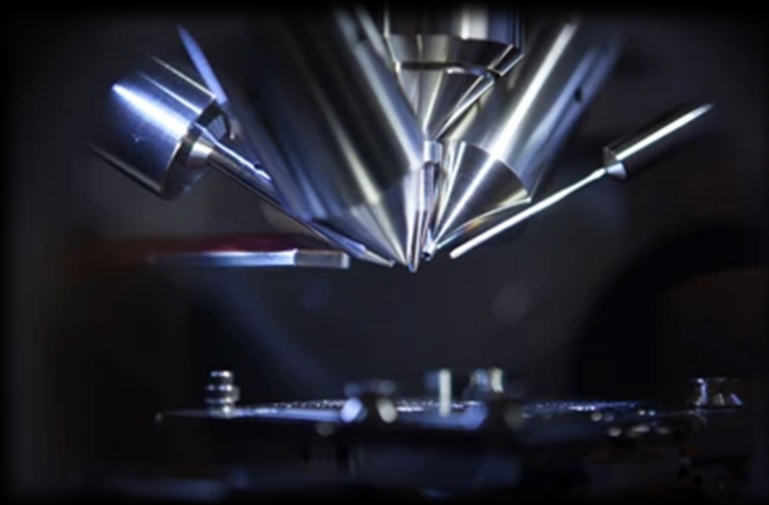
Model	Class	Accuracy (%)	Overall accuracy (%)	Accuracy (%)	Overall accuracy (%)	Accuracy (%)	Overall accuracy (%)
		Calibration		Cross-Validation		Validation	
LDA	high	100	100	48	48	81	63
LDA	low	100		48		73	
LDA	medium high	100		48		75	
LDA	medium low	100		48		96	
SIMCA	high	100	100	45	45	84	59
SIMCA	low	100		45		73	
SIMCA	medium high	100		45		68	
SIMCA	medium low	100		45		92	
PLSDA	high	100	100	24	24	77	28
PLSDA	low	100		24		59	
PLSDA	medium high	100		24		67	
PLSDA	medium low	100		24		53	
SVM	high	100	100	54	54	84	60
SVM	low	100		54		71	
SVM	medium high	100		54		69	
SVM	medium low	100		54		96	



Discussion and next steps

- Model optimization of four rule models (minimum 70% accuracy)
 - Tweak the rule/ classes
 - Increase sample size across all four classes (increasing 'training points')
 - Create a 'library' of data from multiple projects
- Other factors to take into consideration for a global approach
 - e.g., geographical differences – can an approach take co-variates into consideration?

Opportunities for science



Application for industry



Thank you



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