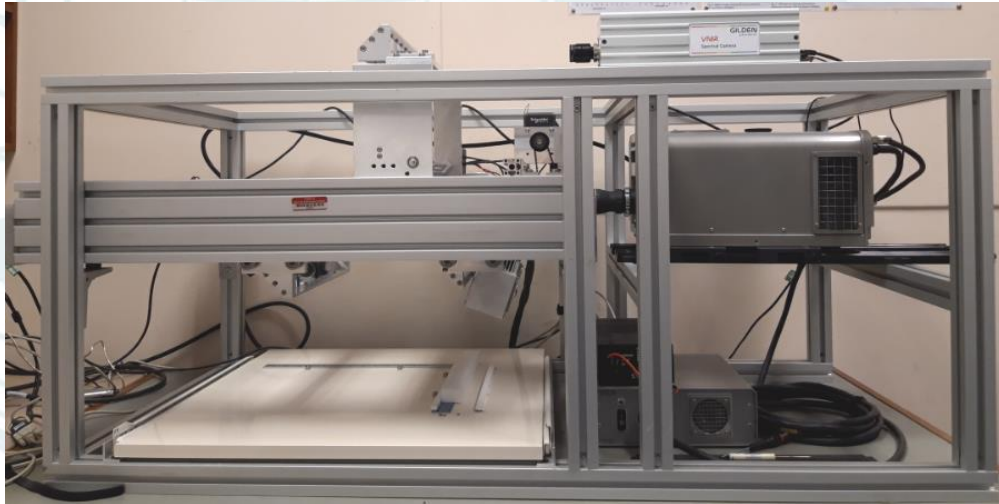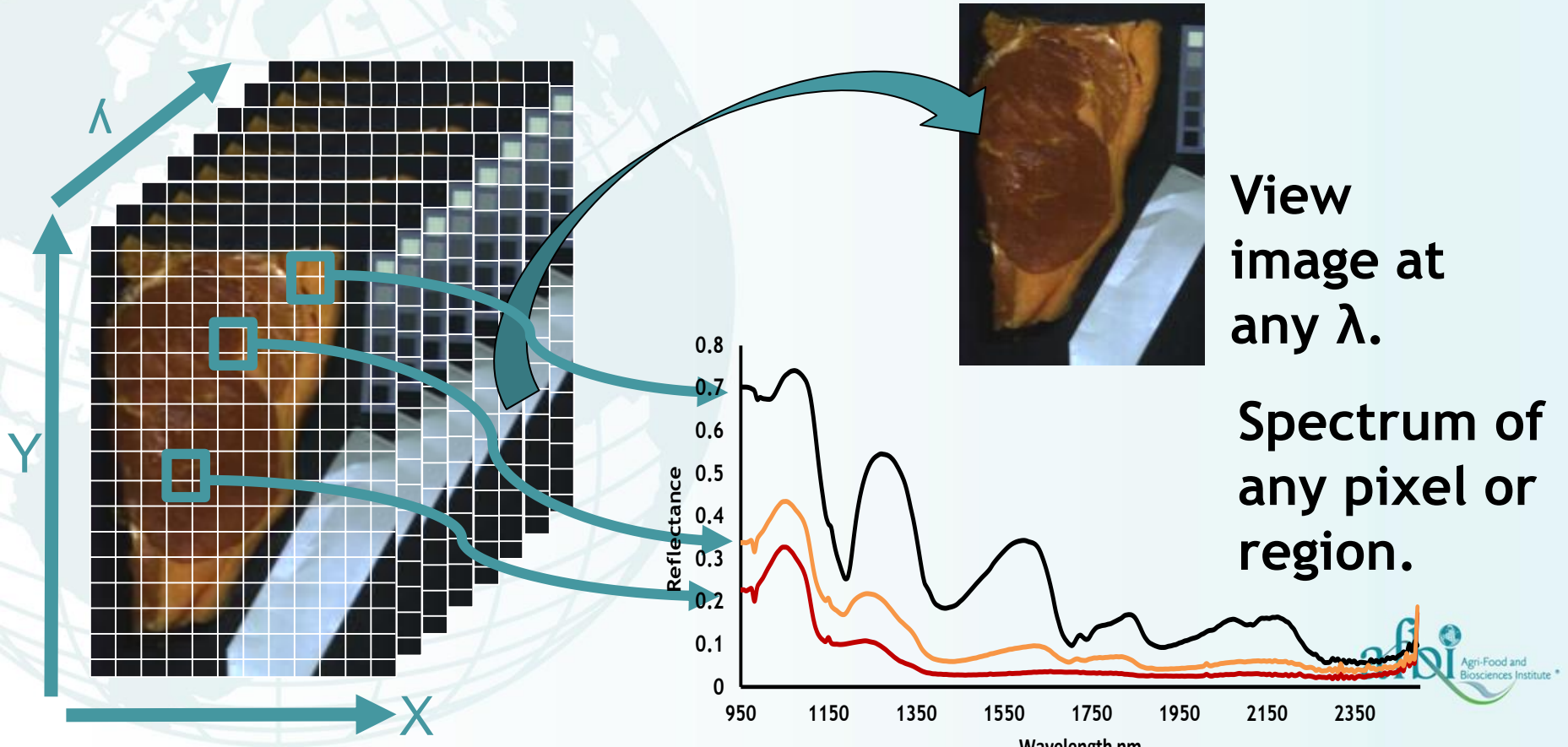# Hyperspectral Imaging for Meat Quality

1. What is Hyperspectral Imaging?

2. Hyperspectral Imaging & Meat Quality.

3. Hyperspectral Imaging at AFBI.

4. Next steps.

1. What is Hyperspectral Imaging?

- **Technique that generates a spatial map of spectral variation.**

- Equipment involves 2 cameras, 1 scanner and the creation a data cube:

  – VNIR : 400nm – 900nm

  – SWIR: 900nm – 2493nm

  – Scanner in push broom configuration.

What is Hyperspectral Imaging?

λ

Y

X

View image at any λ.

Spectrum of any pixel or region.

Reflectance

0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

950 1150 1350 1550 1750 1950 2150 2350

Wavelength nm

What can we measure?

- **Gross Components**: Quantification of the area of components within a scanned image

- **Chemical Composition**: Quantification of non-visible components within a scanned image

2. Hyperspectral Imaging & Meat Quality

| Variable	R^2/ % Correctly classified	Reference
Colour L, a*, b*	0.88- 0.92	Wu et al. 2010
Water, Fat & Protein	0.89, 0.84, 0.86	ElMasry et al. 2013
pH	0.73, 0.86	ElMasry et al. 2013 Wu et al. 2010
Fatty Acids (individual)	0.68- 0.89	Kobayashi et al. 2010
Fatty Acids (groups)	0.87- 0.90	Kobayashi et al. 2010
Shear force classification	73- 93%	Naganathan 2015a & b Cluff et al. 2013
Shear force classification	96%	Naganathan 2008
Sensory attributes	0.21- 0.59	Prieto et al. 2009

3. Hyperspectral Imaging at AFBI

1. Measuring lean, fat and marbling using image software

2. Latest beef quality correlations

3. Predicting eating quality of chicken

Image Software: Lean, fat & Marbling
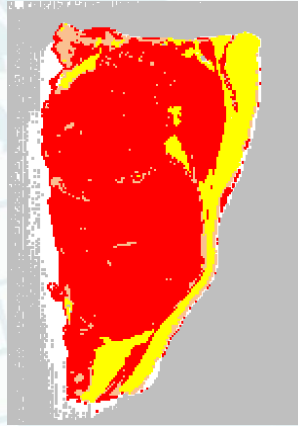
	Pixels	% Meat Area
Fat	2538	17.1
Marbling	834	5.6
Lean	11492	77.3
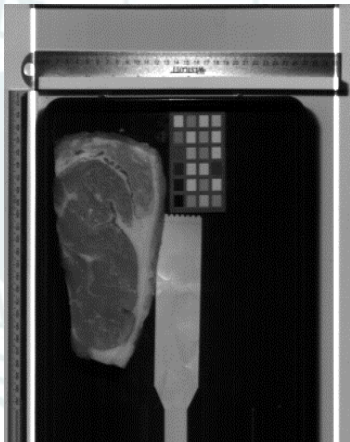
	Pixels	% Meat Area
Fat	2684	18.9
Marbling	885	6.2
Lean	10668	74.9

Latest Beef Correlations

- PLSR for colour, marbling (MSA), pHu, cooking loss and shear force (N = 104).

Predicted variable	%RSQc	%RSQv
Meat Colour L*	91	46
Meat Colour a*	99	58
Meat Colour b*	97	63
MSA marbling	83	17
pHu	99	55
% Cooking loss	99	36
WBSF	97	27

Results obtained from DAERA funded PhD project.

DA: Identifying Dark Cutting Beef

Variable	% C	% V
pHu[1]	94	96
pHu[2]	94	92

pHu1: cut off pH 5.9. pHu2: cut off pH 6.0

Calibration (94%)

Count

Predicted		≤5.9	>5.9
	≤5.9	47	4
	>5.9	0	19

Validation (96%)

Count

Predicted		≤5.9	>5.9
	≤5.9	19	1
	>5.9	0	5

Predicting the EQ of Chicken

Results obtained from AFQCC funded project.

Predicting EQ of Chicken

Variable	%RSQ
Free Amino Acids	20- 65
Fatty Acids: Saturated MUFA PUFA N3 N6	 89 73 81 84 81
pH	83
Ribonucleotides	60s
Sugars/ Sugar Phosphates	80- 90
TBARS	88

Variable	%RSQ
Flavour – Boiled chicken	43
Flavour Intensity	43
Tenderness	56

Results obtained from AFQCC funded project.

Next Steps

Research

On-line Technology

Colour,
Wu et al.
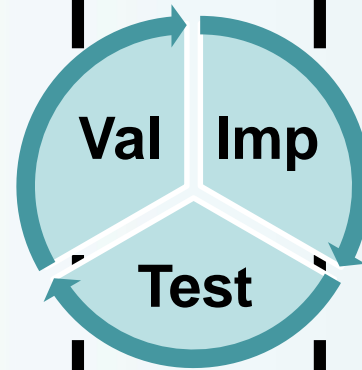N= 33

pH,
ElMasry et al.
N= 27

Composition,
ElMasry et al.
N= 81 (27)

Fatty Acids,
Kobayashi et al.
N= 90 (3)

Shear Force,
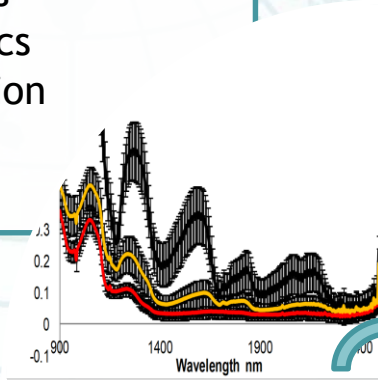Naganathan et al.
N= 338

Sensory,
Prieto et al.
N= 194

AFBI
CIC

Val   Imp

Test

£, €, 🕐 & ☹☺,

What's Needed?

- Analysis
- Statistics
- Validation

- Instruments
- installation

On-line Implementation

- Industry
- Sample Nos.
- Big data

- Funding,
- Support

0.3
0.2
0.1
0
-0.1
900 1400 1900
Wavelength nm

Acknowledgements

Conclusions

- HSI shows potential for on-line prediction/ measurement of meat quality.

- Models described in literature are based on relatively small sample sizes.

- Larger sample sizes, more variation and greater model validation are required to achieve on-line meat quality assessment.

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