



Protecting the corn-fed chicken industry: Isotopic techniques for confirming feeding regimes

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Outline

- Background
- Why protecting the poultry industry?
- Isotopic techniques
- Experimental Approach
- Results
- Corn-fed monitoring



Background: EC Poultry Marketing Standard regulations

- “Corn-fed” is often used but is not included by the EC Poultry meat Marketing Standard Regulations (1999)
- Special Marketing Term (SMT) for poultry is “fed with x% y” e.g. fed with 50% corn/maize
- It is understood to mean that the feed given during greater part of the fattening period contains at least 50% corn/maize
- The fattening period is not defined but is considered to be the second half of the bird’s life

Background:

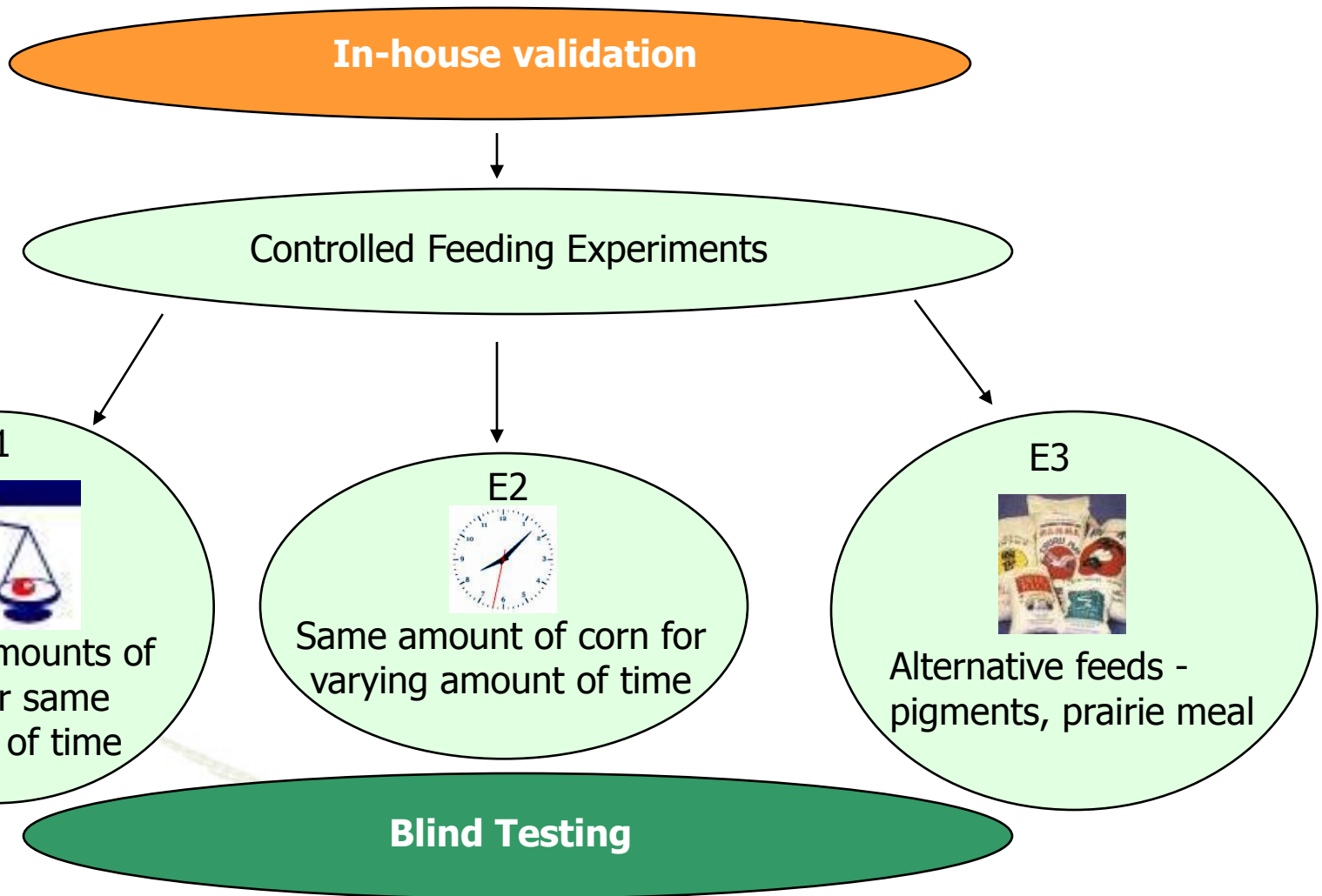
Why corn-fed chicken?

- research has shown that there is a positive link between the colour of chickens and their health [1].
[1] Tyczkowski, J.K., Schaeffer, J.L. and Hamilton PB., Poultry Science (1991), 70, 2275-2279.
- >>> corn-fed chicken is traded as premium product
- >>> Temptation for fraud

Carbon isotope rationale

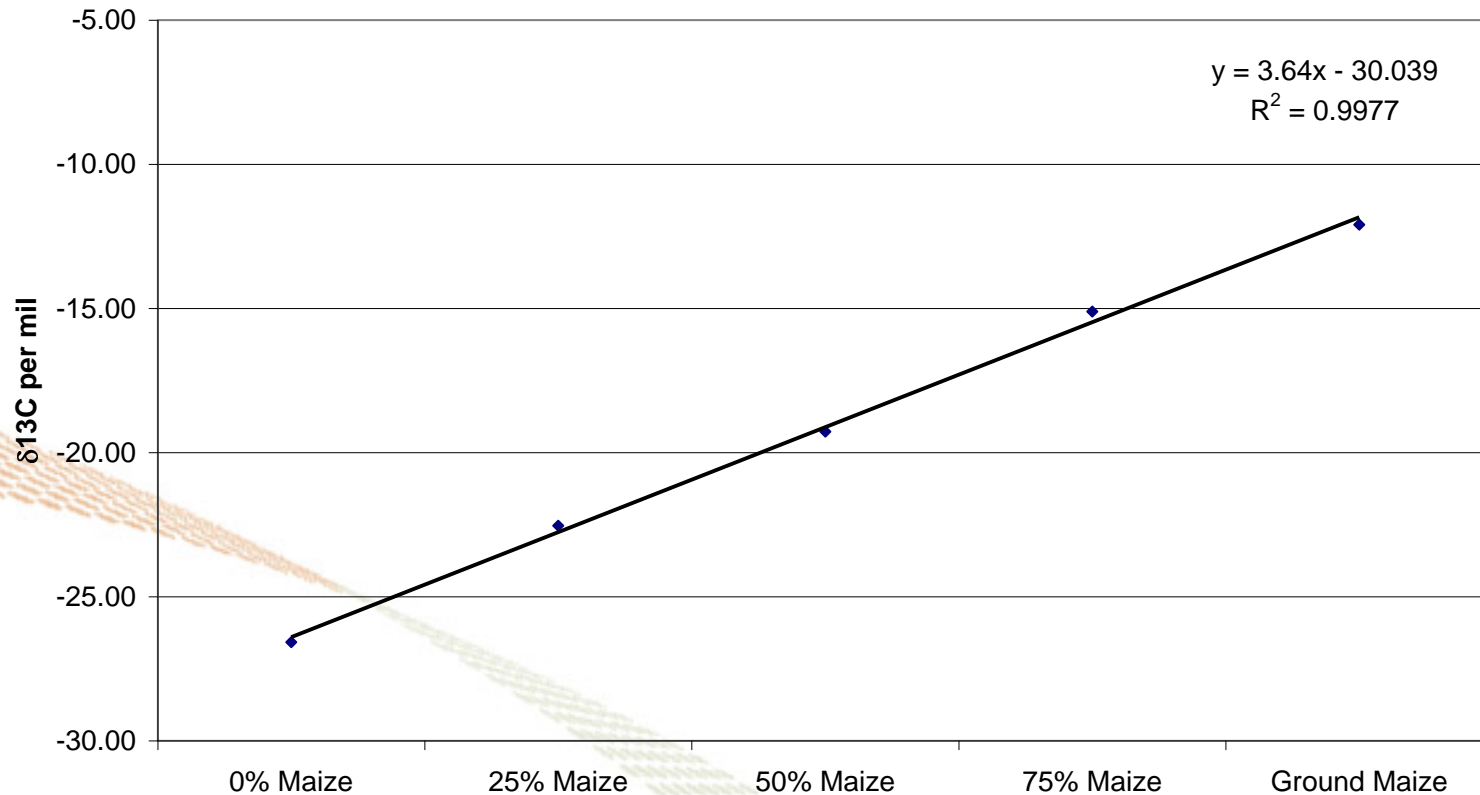
- Carbon Isotope ratio of a feed is ultimately reflected in the carbon isotope ratio of the animal
- Corn is a C₄ photosynthetic plant which incorporates more ¹³C , than C₃ plants (e.g. wheat)
- If the chicken has been fed corn this should be apparent in the $\delta^{13}\text{C}$ value, being more positive than a non corn-fed chicken

Experimental design

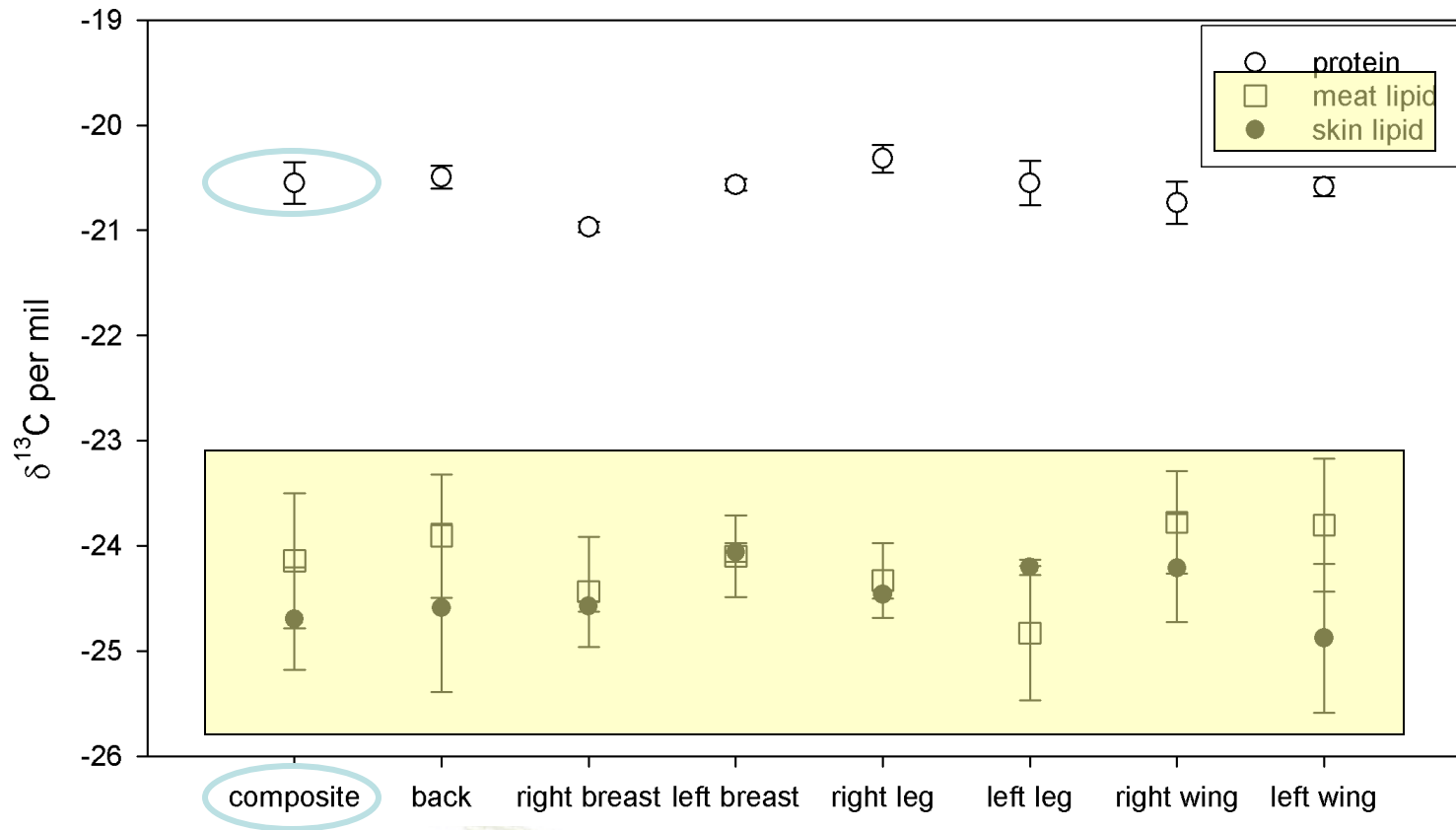


In-house validation: Variation of the corn (maize) content in the feed

Correlation between % Corn and $\delta^{13}\text{C}$ value

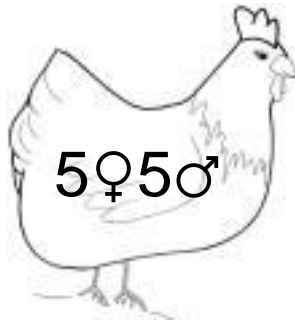


In-house validation: Homogeneity of meat cuts



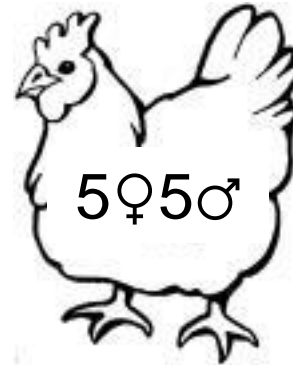
Controlled feeding Experiment 1: Variation of %corn in feed

- Two poultry strains



Hubbard

slow growing bird used in
organic production (56 days)



Ross

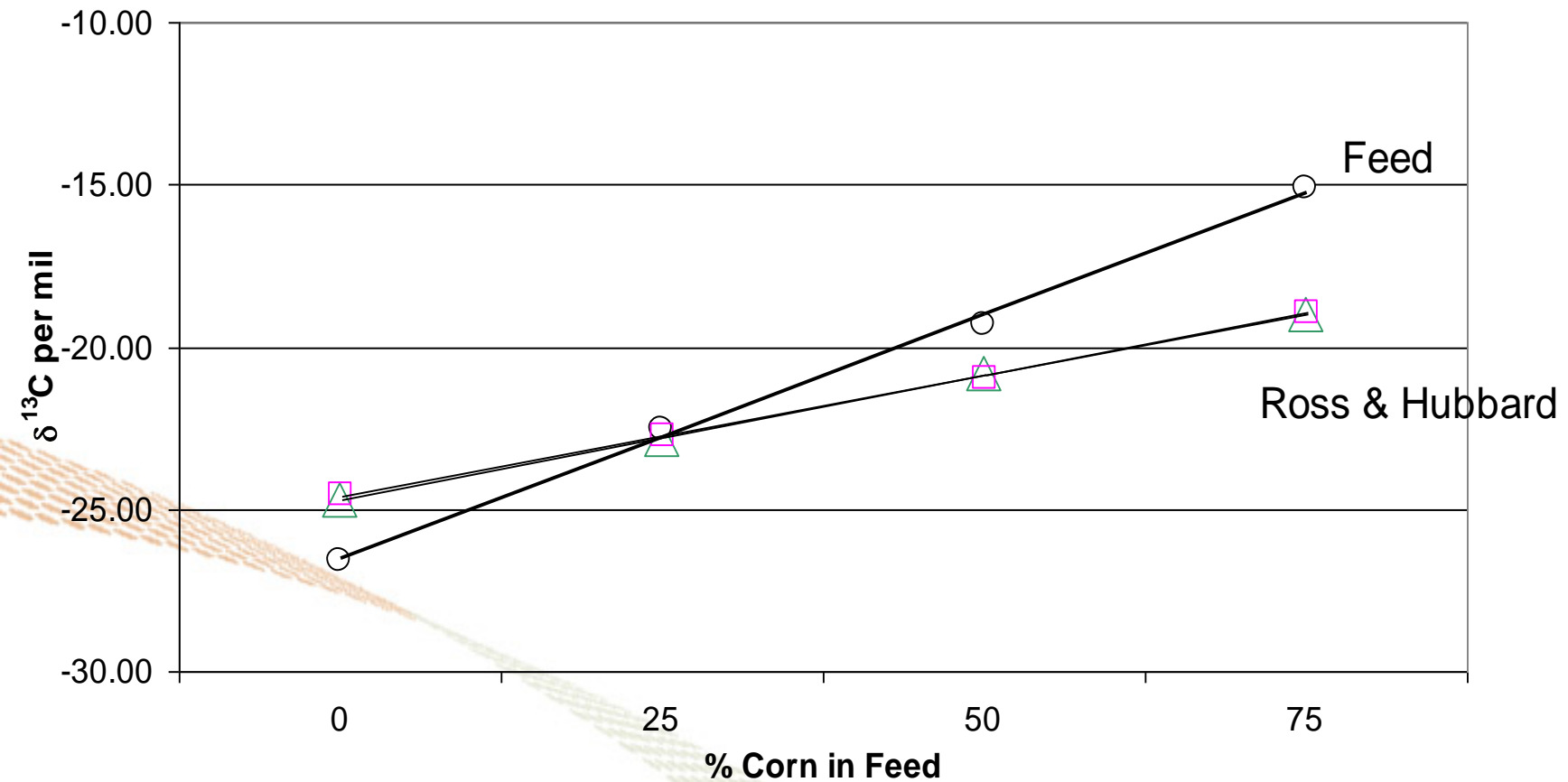
fast growing broiler used in
conventional production (42 days)

- Four feeding regimes for 2nd half of the bird's life



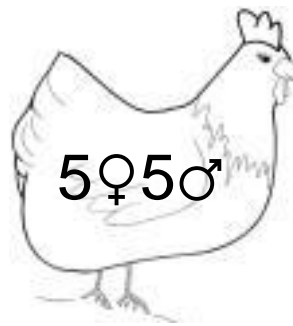
Controlled feeding Experiment 1: Results for chicken compared to feed

Correlation between % Corn and $\delta^{13}\text{C}$ value for 80 chickens

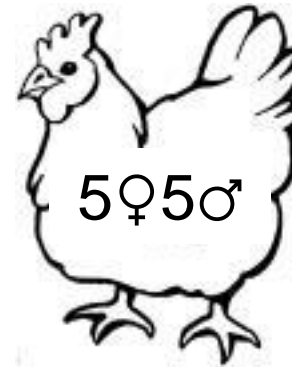


Controlled feeding Experiment 2: Timely variation of corn-feeding

- Two poultry strains

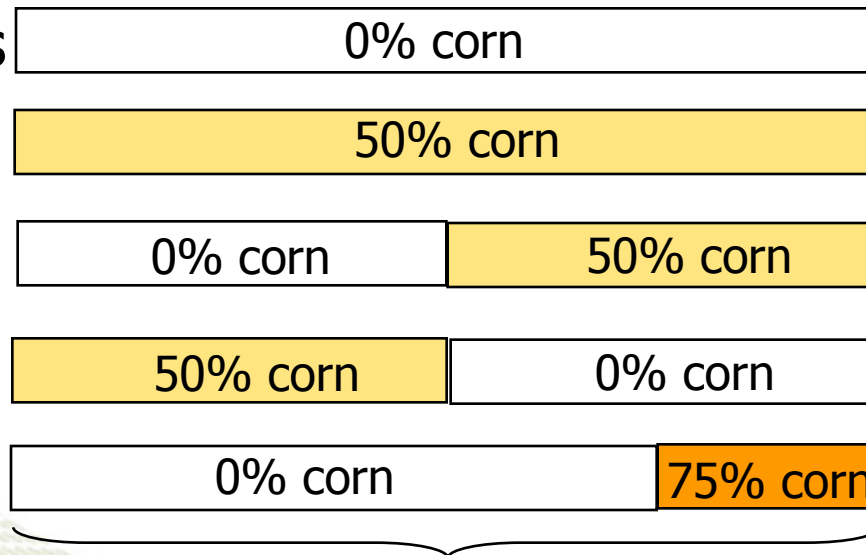


Hubbard



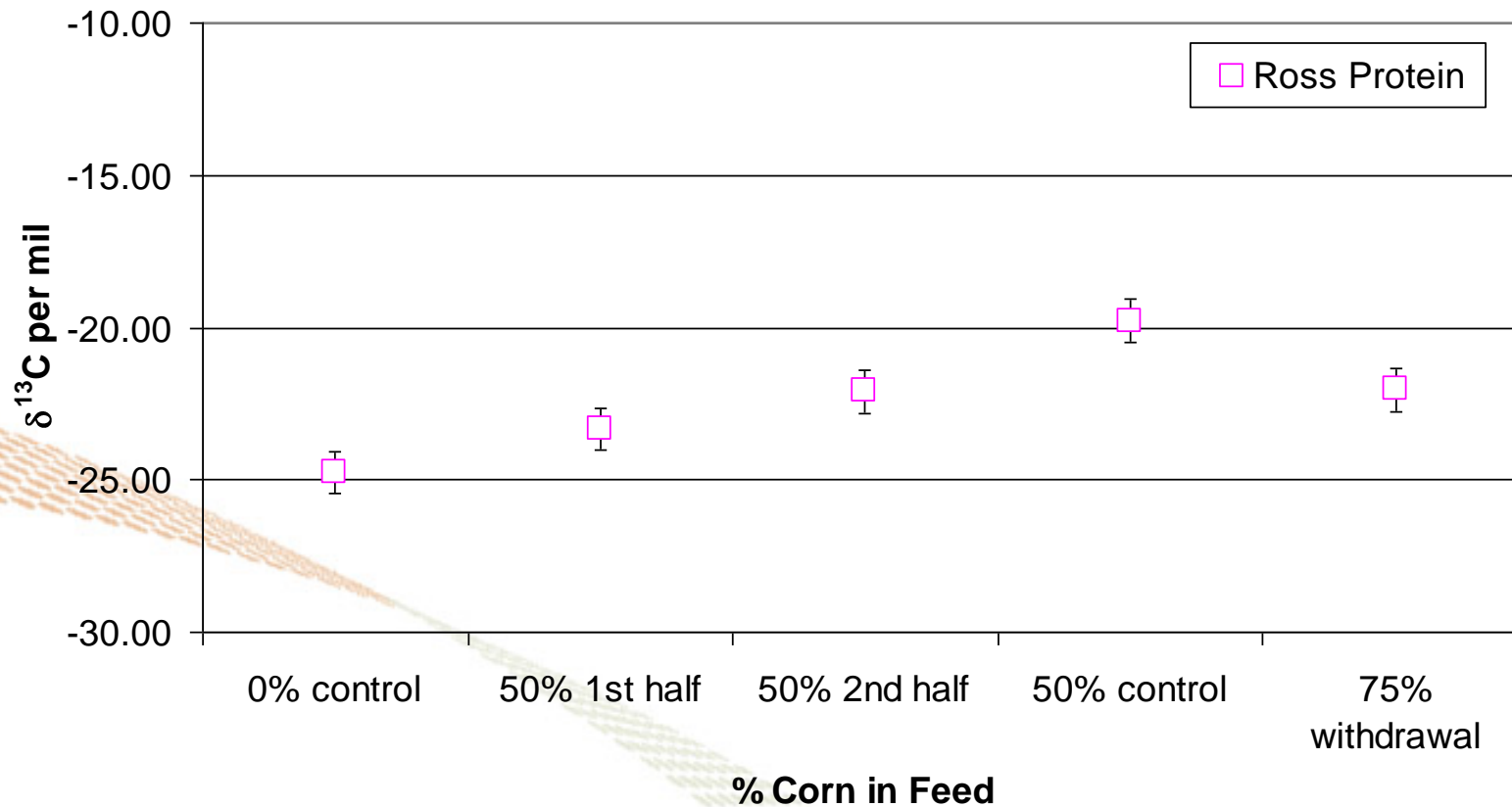
Ross

- Five feeding treatments



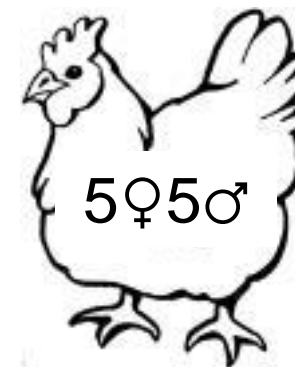
2nd half of the bird's life

Controlled feeding Experiment 2: Results for Ross strain



Controlled feeding Experiment 3: Alternative feeds

- One poultry strain



Ross

- Seven feeding regimes

0% corn control

50% corn control

0% corn + 10% prairie meal

0% corn + Oroglo

40% corn + 10% prairie meal

40% corn + 10% prairie meal + Carophyll Red

50% corn + Oroglo

for the 2nd half of the
bird's life

Controlled feeding experiment 3:

$\delta^{13}\text{C}\text{‰}$ Results

Ross % Corn	Protein Median	SD	n
0% corn	-24.71	0.08	10
0% corn + oroglo	-24.40	0.09	10
0% corn + 10 % prairie meal	-22.86	0.18	10
40% corn + 10% prairie meal	-19.52	0.26	10
40% corn + 10 % prairie meal + carophyll red pigment	-19.39	0.16	10
50% corn + oroglo	-20.60	0.18	10
50% corn	-20.54	0.16	10
Prairie Meal	-13.90	0.25	
Carophyll Red Pigment	-18.52	0.25	
Oroglo Pigment	-30.39	0.10	

Controlled feeding experiment 3: $\delta^{13}\text{C}\text{‰}$ Results

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Carophyll Red Pigment	-18.52	0.25	
Oroglo Pigment	-30.39	0.10	

Analysis of 'authentic' samples:

- Corn-fed chickens from commercial producers:

Producer	$\delta^{13}\text{C}$ of feed	$\delta^{13}\text{C}$ of birds	comments
1	-20.93 (+/- 0.38)	-21.04 (+/- 0.23) (n=4)	Corn in finishing pellet both with and without coccidiostat
2	-19.28 (+/- 0.03)	-20.46 (+/- 0.19) (n=4)	30 days of 55 day life on mix of pellet with 53% corn and 6% wheat grain

- Non corn-fed chicken samples:

Breed	Organic status	$\delta^{13}\text{C}$ of protein
BAC 657	Non Organic	-24.82
BAC 657	Organic	-25.58
Cob 500	Non organic	-24.67
Cob 500	Organic	-25.04
Maron Gold Line	Non Organic	-24.22

Blind testing: Selection of samples

- A total of 54 blind samples were collected consisting of
 - samples from the experimental cohort
 - samples of known provenance
 - samples from retailers

Blind testing: Appearance of retail samples



Retailer 1 free range chicken



Retailer 2 corn-fed chicken drumsticks

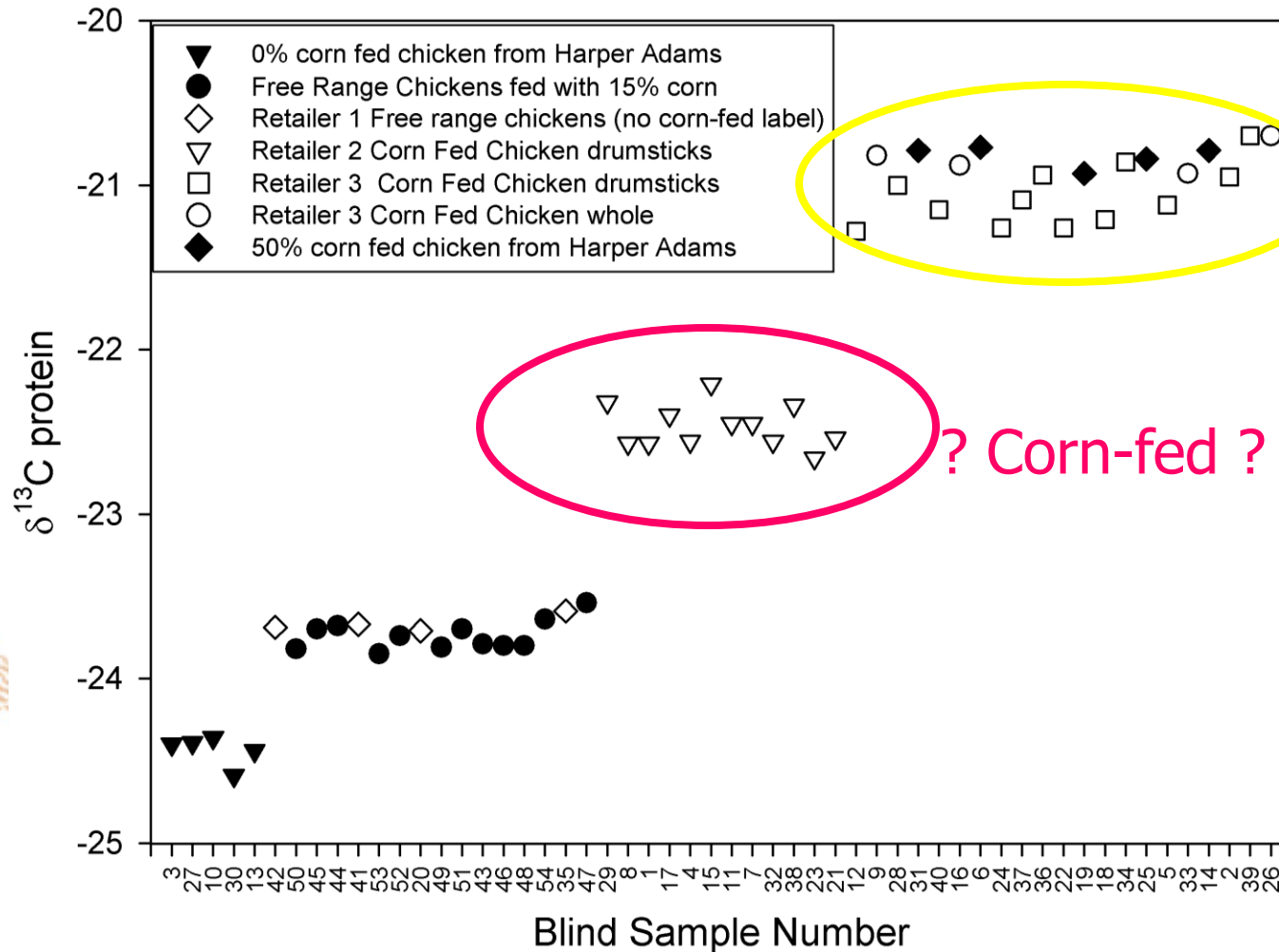


Retailer 3 corn-fed chicken drumsticks



Retailer 3 corn-fed chicken

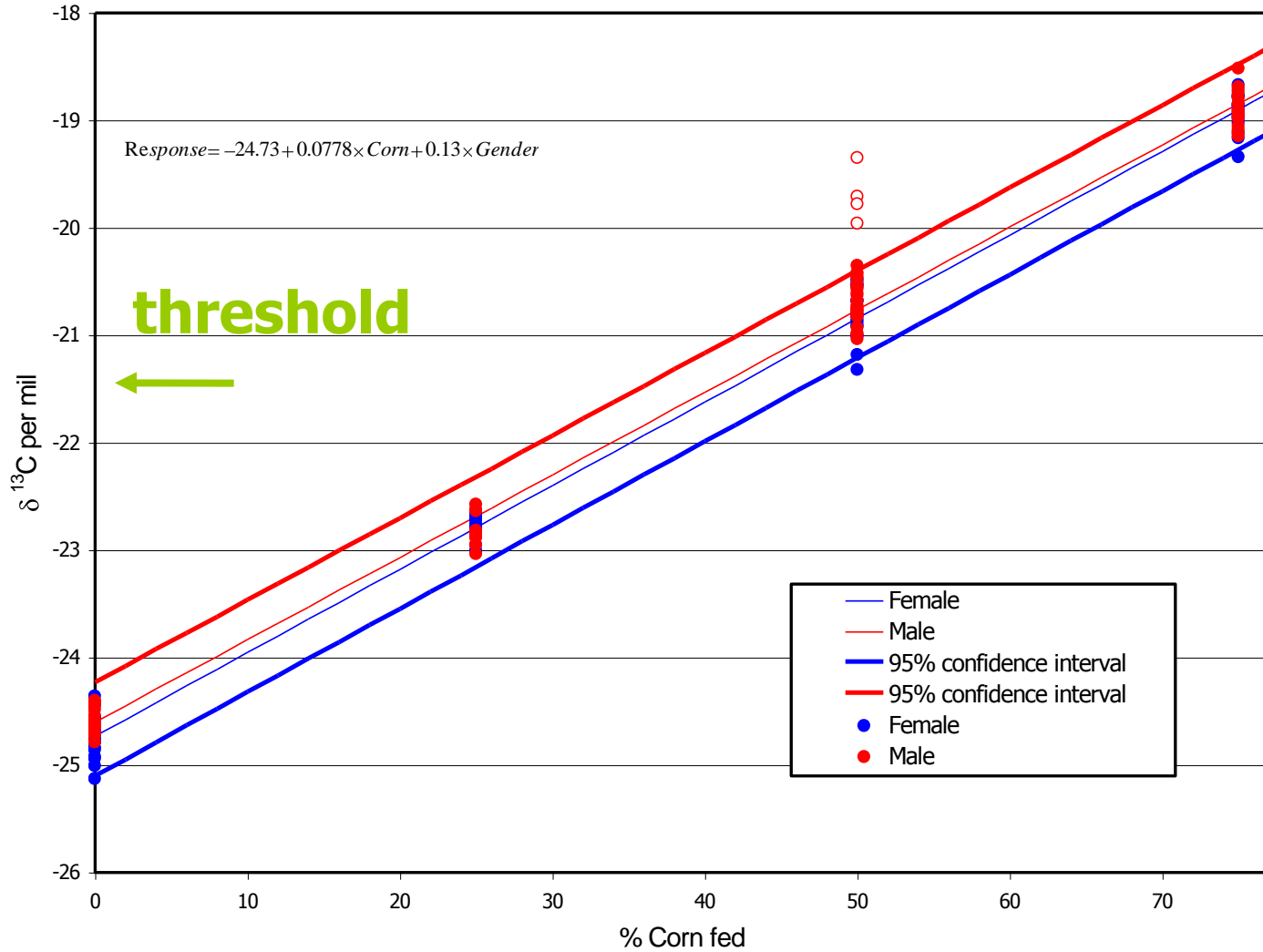
Blind testing: $\delta^{13}\text{C}\%$ Results



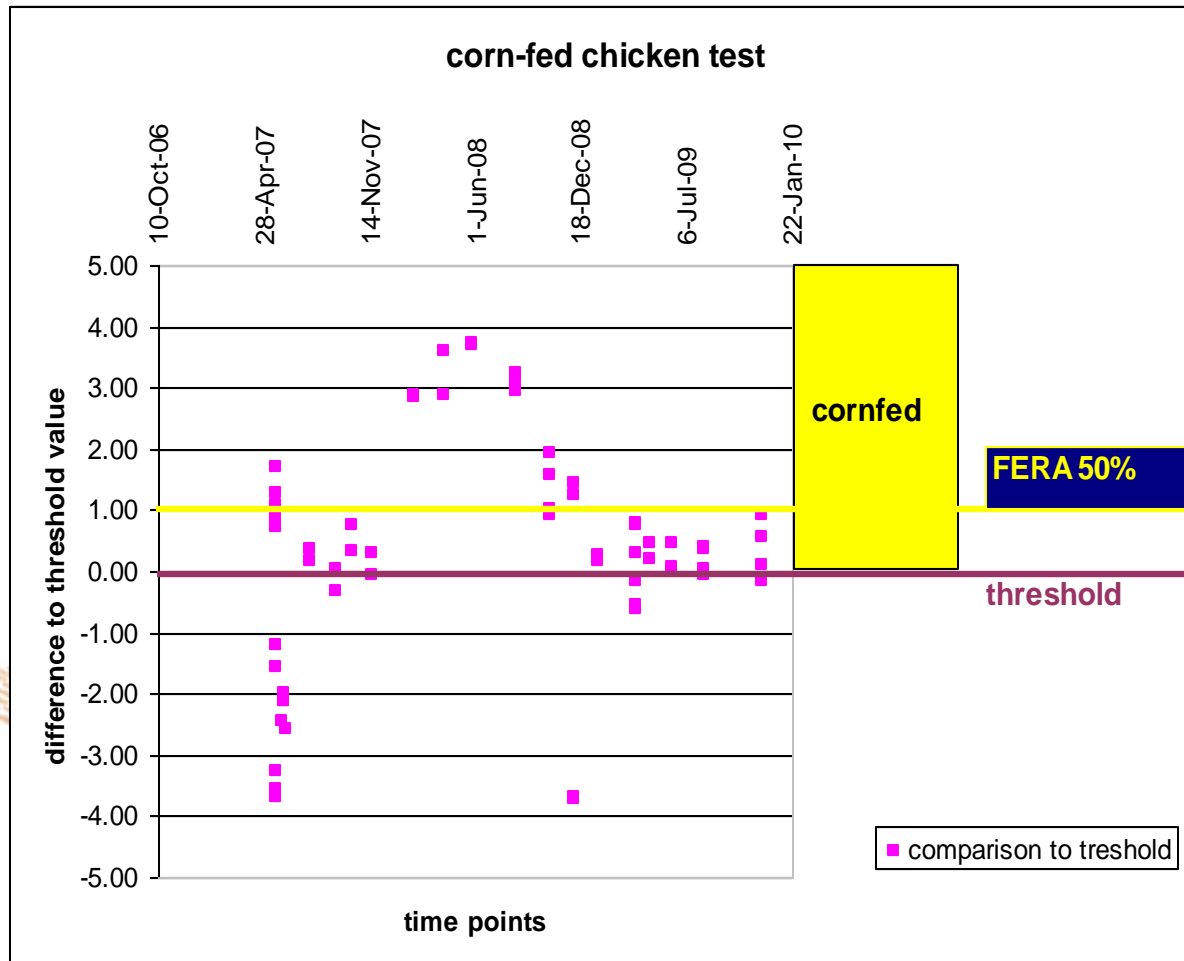
Experimental design: Overall findings

- Possible to detect differences in $\delta^{13}\text{C}$ values for feed containing varying amounts of corn
- As expected these differences are translocated into the chicken tissues
- Differences in values between breeds are less than the SD of the measurements – although statistically significant, but negligible
- Generally no significant difference between male and female birds

Calibration curve to define threshold:



Protecting the poultry industry



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Reece

&



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More detailed information:

- Paul Reece et al (2010), 'The use of stable carbon isotopes to authenticate claims that poultry have been corn-fed', *Food chemistry*, 118 (4), 927-932.