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Stable C and N isotope analyses in muscle to discriminate dietary background in lambs

S. De Smet¹, K. Raes¹, E. Claeys¹, P. Boeckx², S. Kelly³

¹Laboratory for Animal Nutrition and Animal Product Quality, Ghent University, Proefhoevestraat 10, 9090 Melle, Belgium
²Laboratory of Applied Physical Chemistry-ISOFYS, Coupure Links 653, 9000 Gent, Belgium
³Institute of Food Research, Norwich Research Park, Colney, Norwich NR4 7UA, UK

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Background

- Increasing interest in traceability
 - Need for markers in end-products that allow distinguishing and tracing back production and feeding systems
 - Plant biomarkers, indirect markers, physical markers...
- Various analytical and spectroscopic methods reported for this purpose
 - E.g. stable isotope ratios, NMR-techniques, chromatographic methods

Prache et al. (2005) Small Ruminant Research 59: 157
Franke et al. (2005) Eur Food Res Technol 221: 493



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Stable isotope analyses

- Dietary isotope compositions influence isotope compositions in animal tissues → useful markers
 - Inference of C_3 and C_4 plant material in cattle diets based on large difference in $\delta^{13}C$ value between C_3 (e.g. temperate grasses; Calvin cycle; mean $\delta^{13}C$ value -27‰) and C_4 plant species (e.g. maize; Hatch-Slack cycle; mean $\delta^{13}C$ value -13‰), e.g. beef : De Smet et al. (2004), Bahar et al. (2005)
 - Animal tissue $\delta^{15}N$ less specific for dietary inputs and more dependent on metabolism, but may reflect presence of leguminous plants and application of N fertilisation, e.g. milk : Kornel et al. (1997); beef : Schmidt et al. (2005)
 - Authentication of the geographic origin of lamb (Piasentier et al., 2003) and beef (Renou et al., 2004; Boner and Förstel, 2004; Schmidt et al., 2005), and production origin of Iberian pigs (Gonzalez-Martin et al., 1999, 2001)



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Aim of this study

- Examine the potential of stable C and N isotope analyses in muscle for tracing back diets in lambs
 - Discriminate pasturing versus indoor feeding?
~ $\delta^{13}C$ analyses
 - Discriminate organic versus conventional feeding?
~ $\delta^{15}N$ analyses



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Material and methods

- Trial 1
 - Pastured group (n=4, males): slaughtered at weaning, exclusively organic pasturing with ewe
 - Infor fed groups (females) on hay/concentrate (50/50 DM) diet for 3 months

# lambs	Conventional feed	Organic feed	
0% maize	2	2	4
18% maize	2	2	4
	4	4	

- *Longissimus*, plasma and feed samples



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Material and methods (2)

- Trial 2
 - Three groups of lambs (each n=7) exclusively pastured for three months after weaning



Botanically diverse :
creeping bentgrass, soft
brome, timothee ...



Leguminosa rich :
40% white clover,
20% lucerne ...



Intensive Ryegrass :
70% perennial ryegrass ...

- *Longissimus* samples at slaughter



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Material and methods (3)

- Stable C and N isotope analyses by CF-IRMS

$$\delta^{13}\text{C} \text{ or } \delta^{15}\text{N} (\text{‰}) = \frac{(R_{\text{sample}} - R_{\text{standard}})}{R_{\text{standard}}} \times 1000$$

$$R_{\text{sample}} = {}^{13}\text{C} / {}^{12}\text{C} \text{ or } {}^{15}\text{N} / {}^{14}\text{N}$$

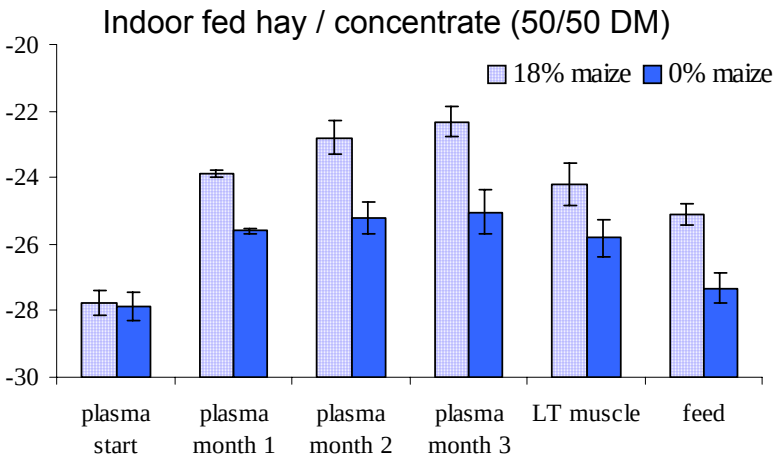
$$R_{\text{standard}} = \text{international standard}$$



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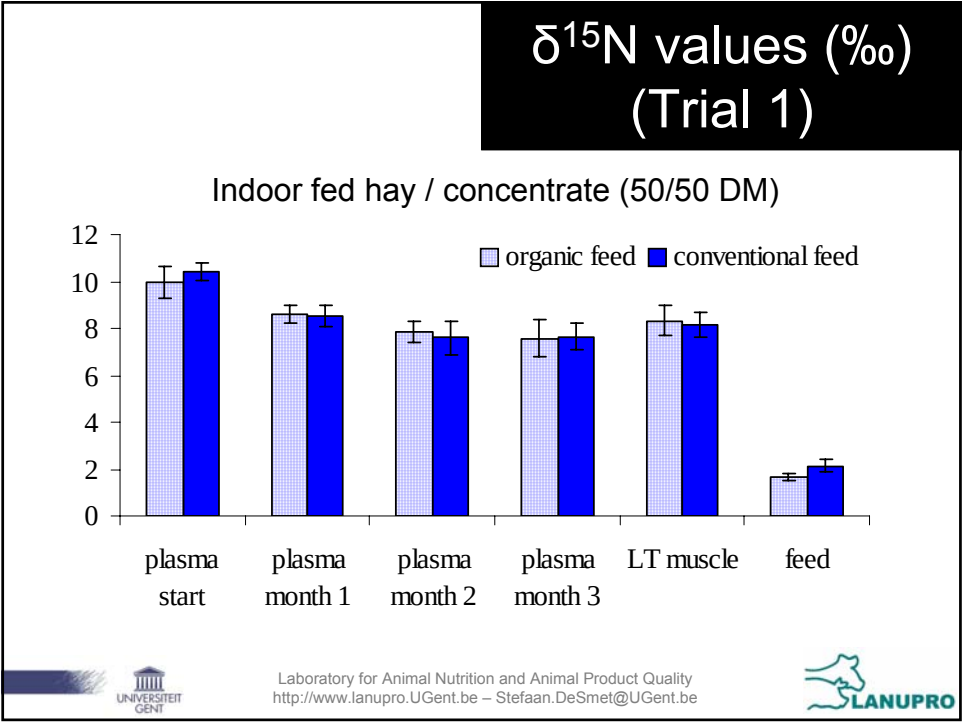
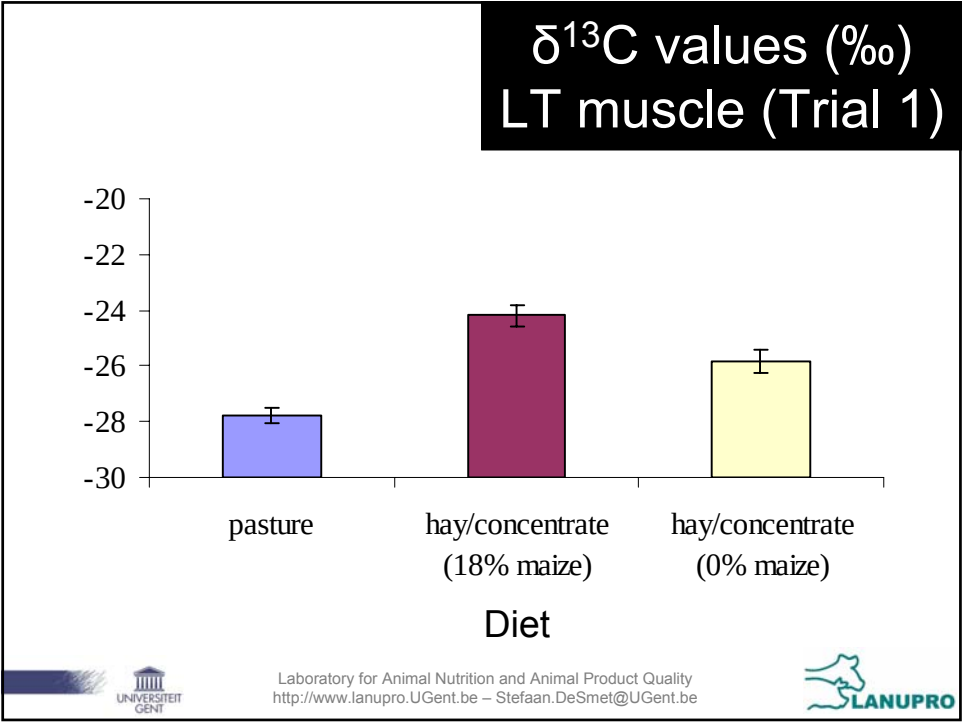


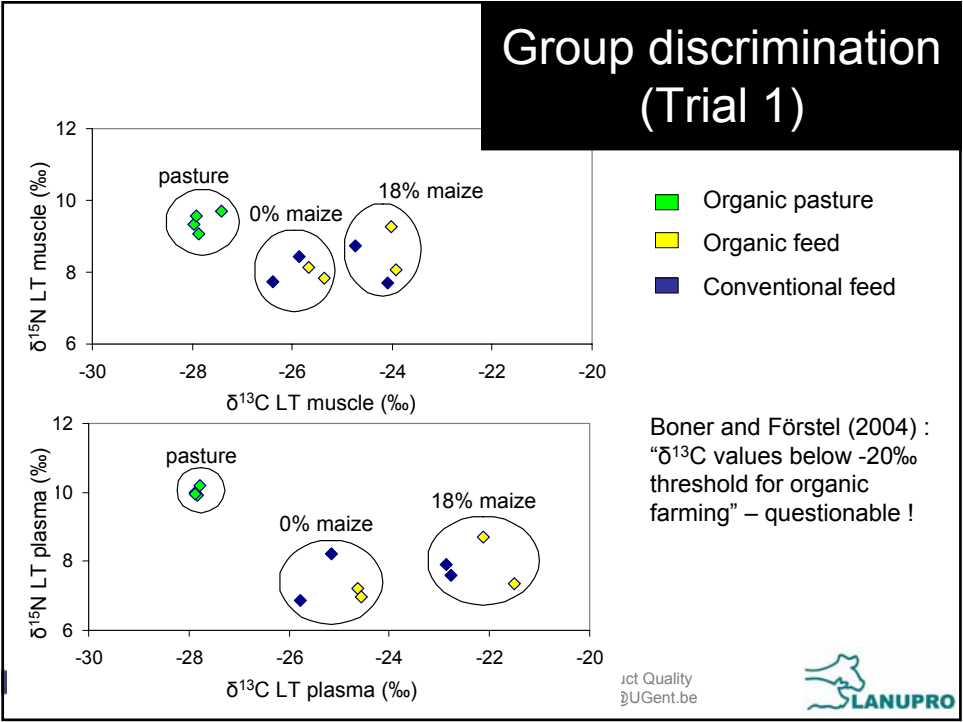
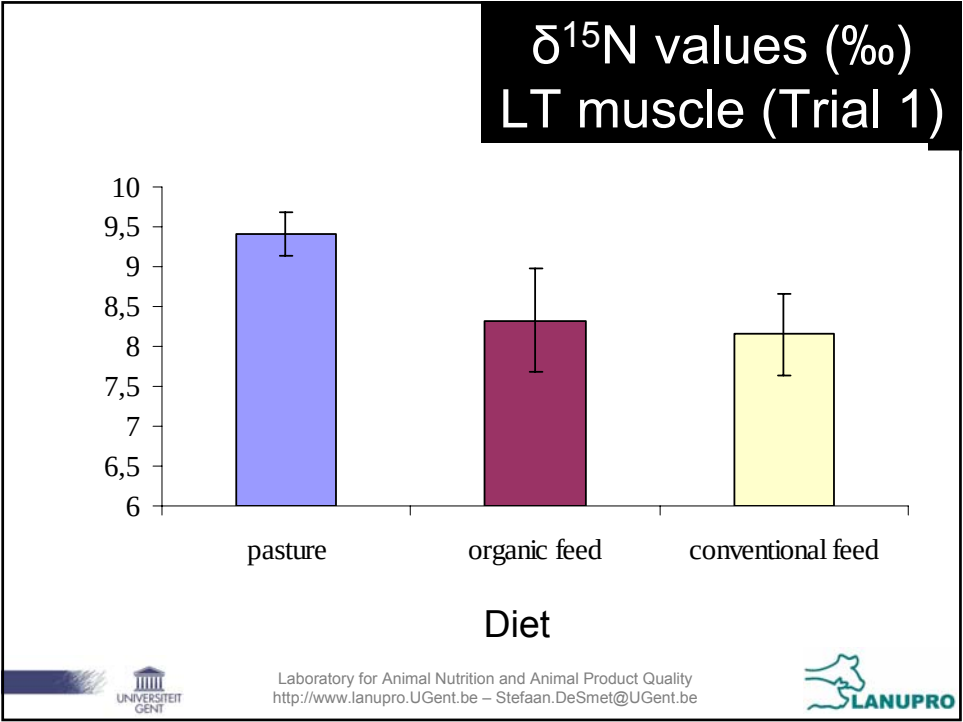
$\delta^{13}\text{C}$ values (‰) (Trial 1)



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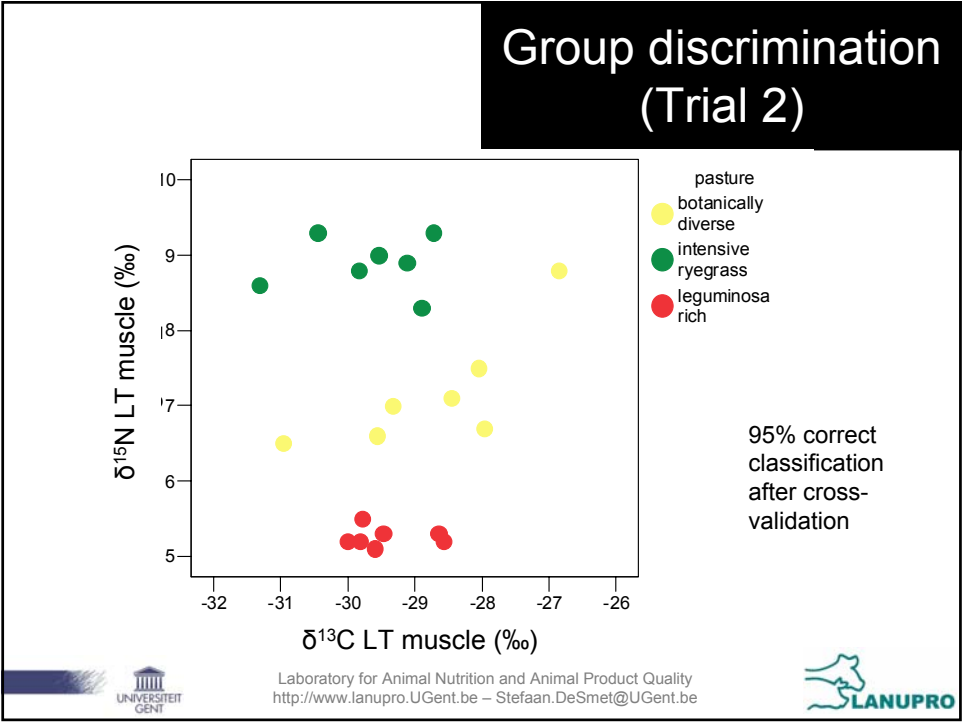
Stable isotope composition feeds

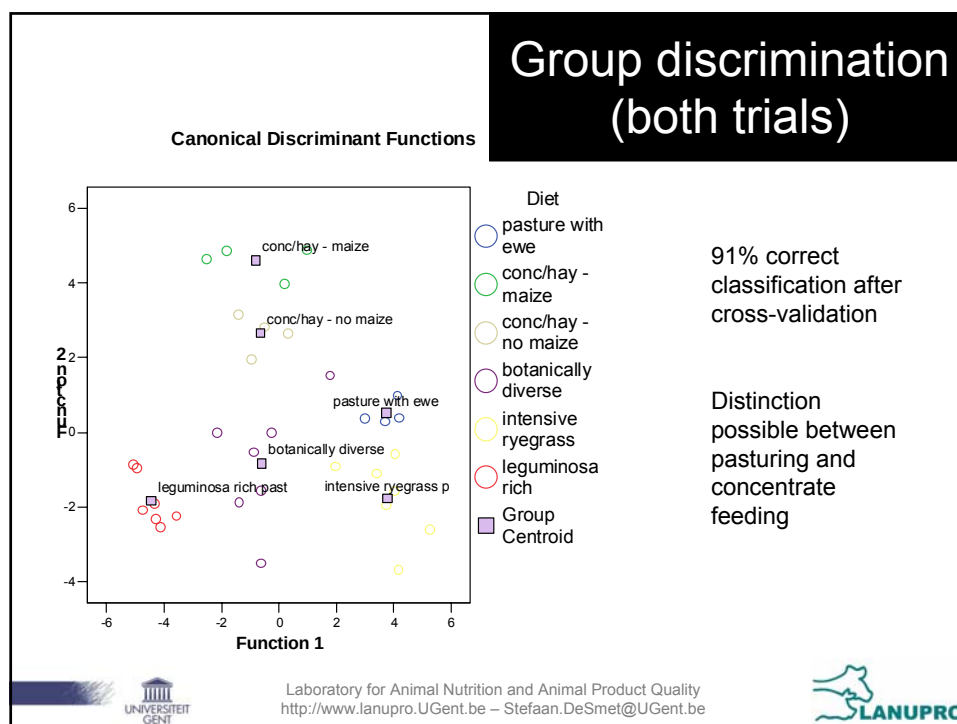
	$\delta^{13}\text{C}$ (‰)		$\delta^{15}\text{N}$ (‰)	
	Organic	Conventional	Organic	Conventional
Maize	-12.0	-11.4	5.1	4.5
Wheat	-26.3	-26.6	2.6	2.5
Barley	-25.2	-27.6	3.4	2.4
Lucerne	-25.5	-28.6	2.0	-0.3
Soybean		-25.4		0.9
Sunflower seeds		-26.0		4.2
Hay	-28.7	-29.3	0.4	2.0
			0.0	5.0



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Conclusions

- Combined stable C and N isotope analyses in muscle or plasma did not allow discrimination between organic and conventional feeding.
- The use of concentrates versus pasturing and the type of pasture could be distinguished.

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Thanks for your
attention

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Contact

Stefaan.DeSmet@UGent.be



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