lperkins01@qub.ac.uk

Omega-3 fatty acids for healthier lamb

Lynda Perkins[1]

Anne Nugent[1], Jayne Woodside[1], Johanna Brans[1], Steven Morrison[2], Aurélie Aubry[2], Anna Meljon[1], Marie Cantwell[1] and Nigel Scollan[1]

[1]The Institute for Global Food Security, Queen's University Belfast, UK

[2]Agri-Food and Biosciences Institute, Hillsborough, UK

lperkins01@qub.ac.uk

Omega-3 and human health

Mayo Clin Proc. 2017 Jan;92(1):15-29. doi: 10.1016/j.mayocp.2016.10.018.

A Meta-Analysis of Randomized Controlled Trials and Prospective Cohort Studies of Eicosapentaenoic and Docosahexaenoic Long-Chain Omega-3 Fatty Acids and Coronary Heart Disease Risk.

Alexander DD[1], Miller PE[2], Van Elswyk ME[3], Kuratko CN[4], Bylsma LC[5].

ORIGINAL RESEARCH | 2 APRIL 2013

Plasma Phospholipid Long-Chain ω-3 Fatty Acids and Total and Cause-Specific Mortality in Older Adults: A Cohort Study

Dariush Mozaffarian, MD, DrPH; Rozenn N. Lemaitre, PhD, MPH; Irena B. King, PhD; Xiaoling Song, PhD; Hongyan Huang, PhD; Frank M. Sacks, MD; Eric B. Rimm, ScD; Molin Wang, PhD; David S. Siscovick, MD, MPH

JAMA Intern Med. 2016 August 01; 176(8): 1155–1166. doi:10.1001/jamainternmed.2016.2925.

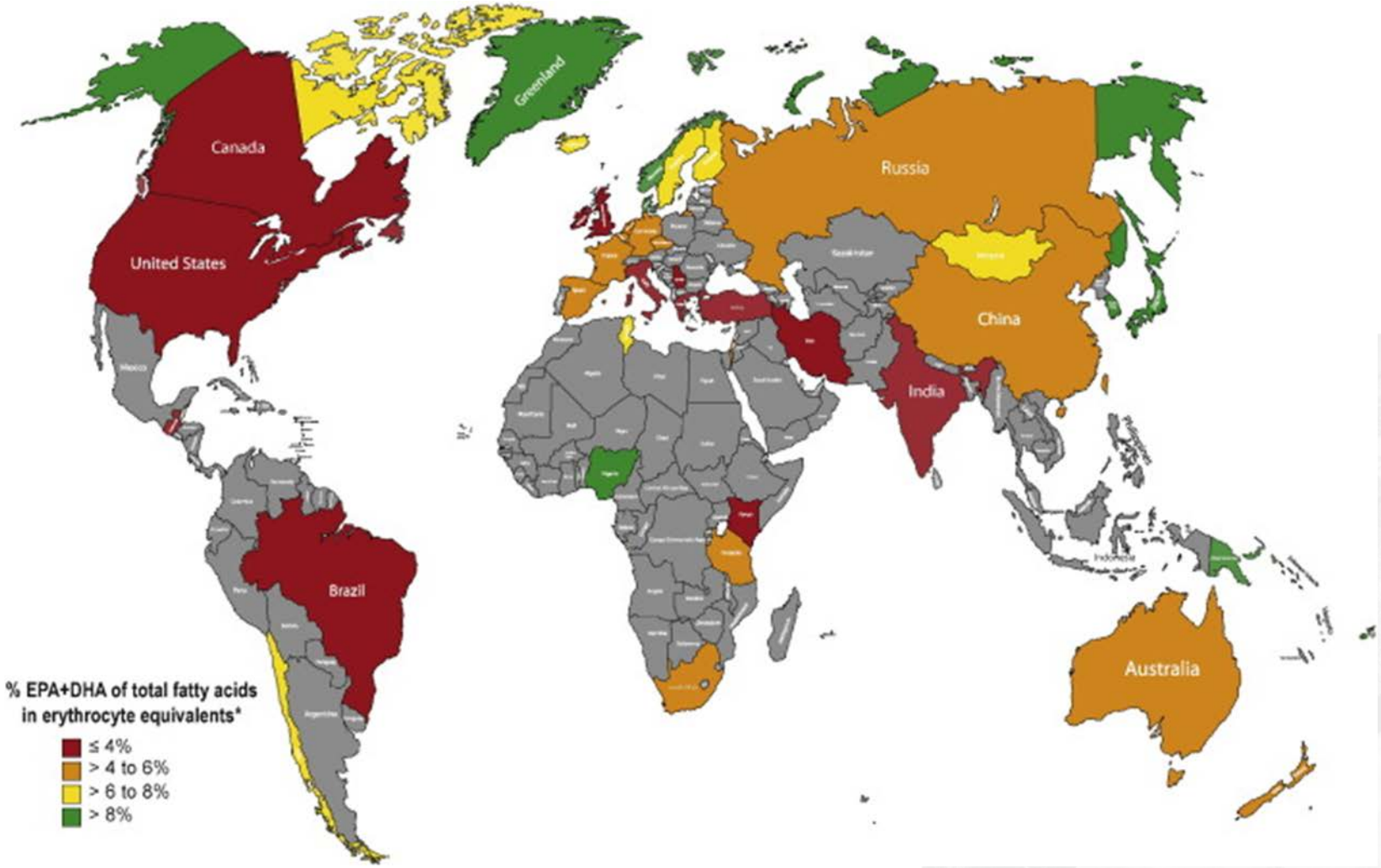
ω-3 Polyunsaturated Fatty Acid Biomarkers and Coronary Heart Disease:

Pooling Project of 19 Cohort Studies

Liana C. Del Gobbo, PhD, Fumiaki Imamura, PhD, Stella Aslibekyan, PhD, Matti Marklund, PhD, Jyrki K. Virtanen, PhD, Maria Wennberg, PhD, Mohammad Y. Yakoob, PhD, Stephanie E. Chiuve,

lperkins01@qub.ac.uk

Global blood omega-3 PUFA

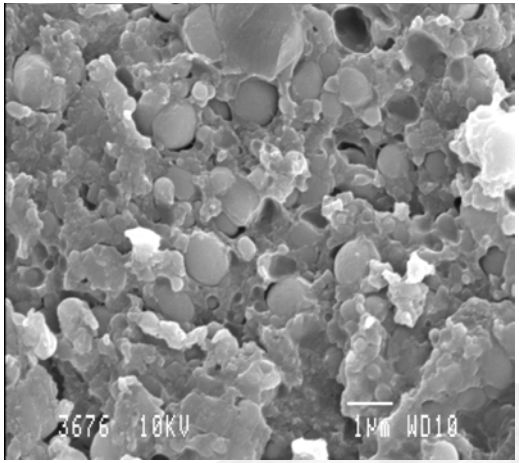


lperkins01@qub.ac.uk

Where do we get omega-3 from?

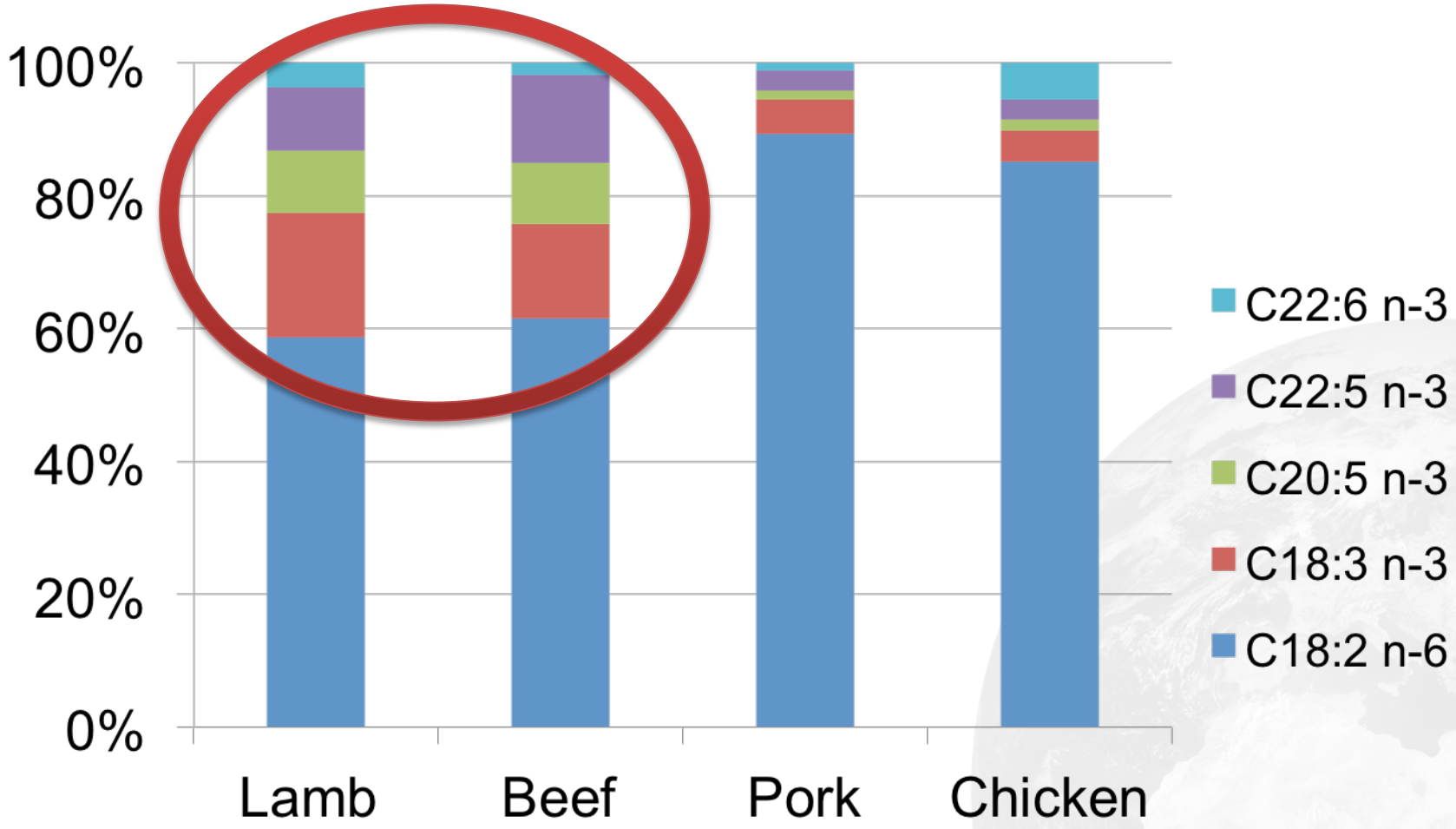
lperkins01@qub.ac.uk

Improving lipid profiles



lperkins01@qub.ac.uk

Meat and fat



lperkins01@qub.ac.uk

European Food Safety Authority guidelines (2009)

- 250 mg per day of EPA and DHA OR 2g per day of ALA
  - "A source of" – 40mg/100g of EPA and DHA
    - "High in" – 80mg/100g of EPA and DHA

AND

- Per 100 kcal

efsa
European Food Safety Authority

lperkins01@qub.ac.uk

Lamb and the grass effect (n=200)

		Model 1			Model 2 (inc. pedigree)		
	HMD	LMD	HMD – LMD diff				P-Value
Fatty acid	Geomean (mg/100g FW)		Log_{-10}				
C12‡	8	8	-0.02				0.681
C14‡	88	94	-0.03				0.498
C16‡	494	537	-0.04				0.341
C16:1 cis 9‡	32	34	-0.03				0.383
C18‡	297	327	-0.04				0.189
C18:1 cis 9‡	735	820	-0.05				0.246
C18:1 trans11‡	61	70					0.139
C18:2n-6‡ (LA)	77	76					0.404
C18:3n-3‡ (ALA)	49						0.259
C18:3n-6‡	1	1					0.860
CLA cis9 trans11‡	30	34					0.150
CLA trans10 cis12‡	0	0					0.899
C20:3n-6‡	4	4					0.686
C20:4n-6‡	31	30					0.232
C20:5n-3‡ (EPA)	31	30					0.890
C22:4n-6‡	1	1	-0.03	±0.014	0.096	-0.03	±0.016	0.098
C22:5n-3‡ (DPA)	27	27	0.00	±0.006	0.834	-0.01	±0.009	0.382
C22:6n-3‡ (DHA)	10	9	0.01	±0.024	0.628	0.02	±0.026	0.838

‡Log_{-10} transformed † not transformed. Italic indicates tendency (P>0.05>0.10). LA – linoleic acid. ALA – Alpha linolenic acid. EPA - eicosapentaenoic acid. DPA - docosapentaenoic acid. DHA - docosahexaenoic acid

Beef

EPA ~ 20mg/100g

DHA ~ 4mg/100g

Lamb

EPA ~ 30 mg/100 g

DHA ~ 10 mg/100g

(Price *et al*. 2017)

lperkins01@qub.ac.uk

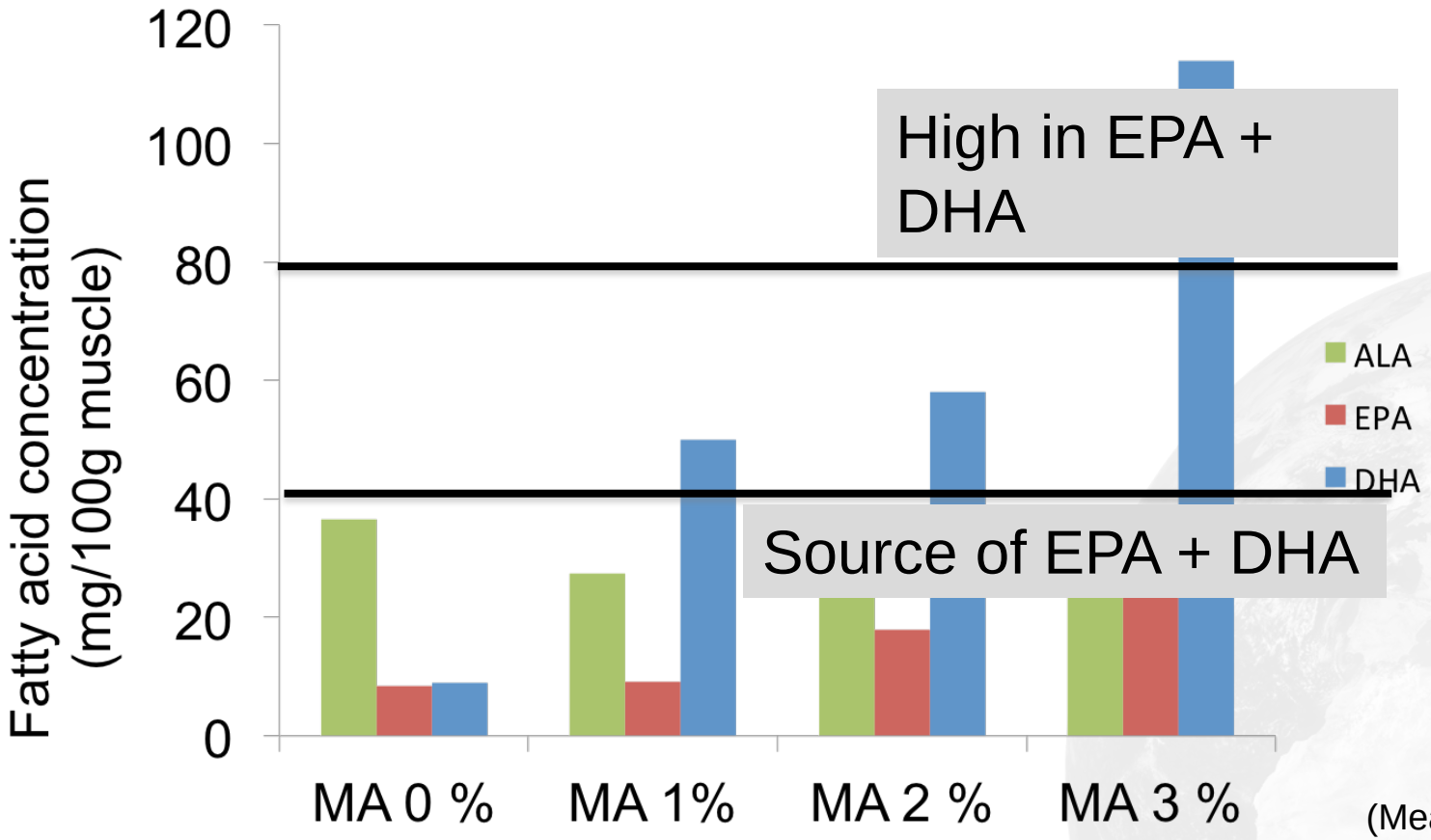
Lamb and the grass effect (n=614)

Average fat content = 2.52%

Omega-3 fatty acid	Average (mg/100g fresh weight)
Alpha-linolenic acid 18:3 n-3	55.6 Range = 19.5-254.5
Eicosapentaenoic acid (EPA) 20:5 n-3	27.2 Range = 7.6-74.6
Docosapentaenoic (DPA) 22:5 n-3	28.1 Range = 10.9-76.28
Docosahexaenoic acid (DHA) 22:6 n-3	7.5 Range = 2.7-22.1

lperkins01@qub.ac.uk

Microalgae supplementation - lamb

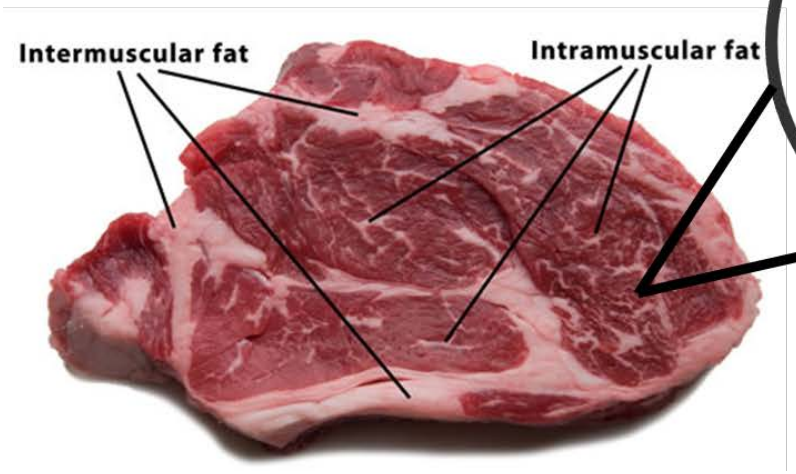


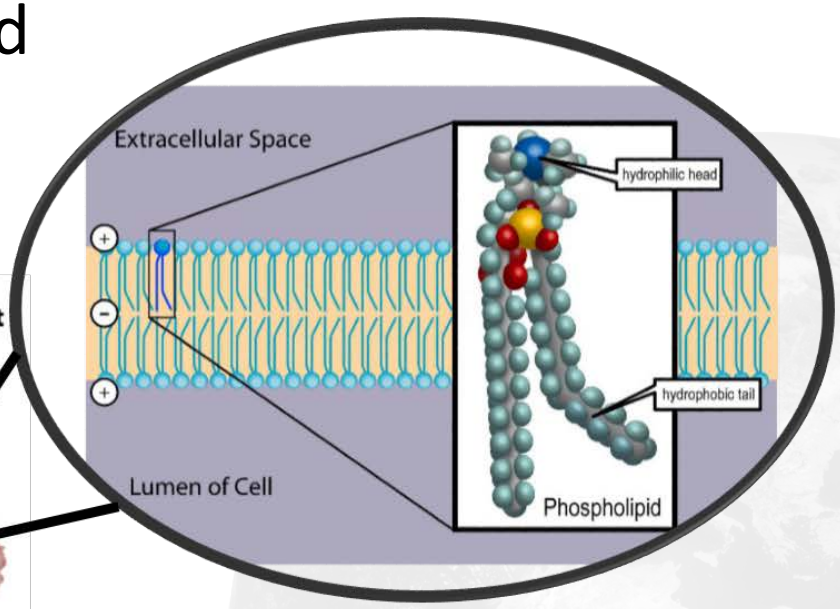
(Meale *et al.*, 2014)

lperkins01@qub.ac.uk

Maximum levels of enrichment

- Beef – 100mg/ 100g muscle
- 20% of muscle phospholipid
- Overspill into TAG fraction





(Bessa *et al.* 2015)

lperkins01@qub.ac.uk

Lipidomic profiling of metabolites - beef

- Wagyu-Freisian cross heifers (n=5)
- Pasture based diets

Main findings

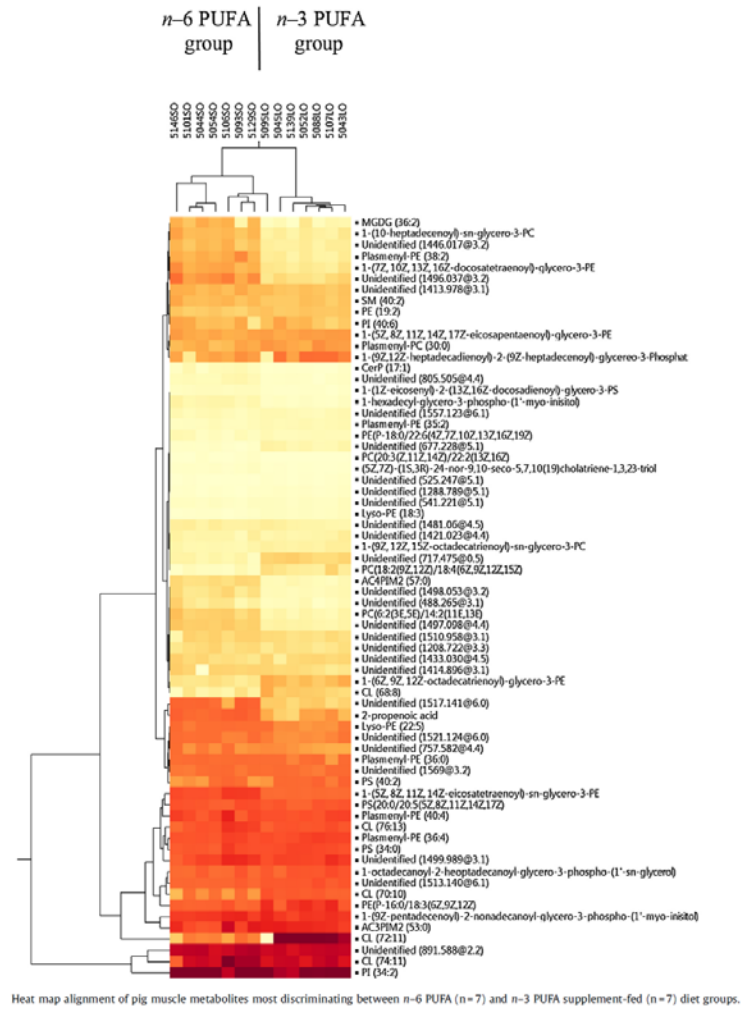
- Main metabolite of Wagyu cattle – phosphatidylcholine (PC)
- Phosphatidylethanolamine (PE) and Phosphatidylinositol (PI) higher proportions of PUFA
- Sphingomyelin (SM) metabolites constituted predominantly by SFA

- No defined requirements of lipid metabolites for human consumption

(Bermingham *et al*, 2018)

lperkins01@qub.ac.uk

Lipidomic profiling of metabolites - pigs



Heat map alignment of pig muscle metabolites most discriminating between *n*–6 PUFA (n = 7) and *n*–3 PUFA supplement-fed (n = 7) diet groups.

- n-3 vs n-6 diets *ad libitum*
- Distinct diet-induced pattern
- Main effect: Fatty acid variation within the lipid metabolites

Outlook and application

- Identification of novel biomarkers of dietary exposure
- Deeper insight of lipid metabolism pathways by combining genomic and lipidomic/metabolomic approaches

(Dannenberger et al, 2017)

lperkins01@qub.ac.uk

Human intervention studies

1

Fatty acid analysis and lipidomic profiling of meat

2

Blood plasma and platelet, cholesterol, blood pressure, BMI

1 Lamb study

2 Human intervention study

lperkins01@qub.ac.uk

Valorex

ICI, LA NATURE INNOVE

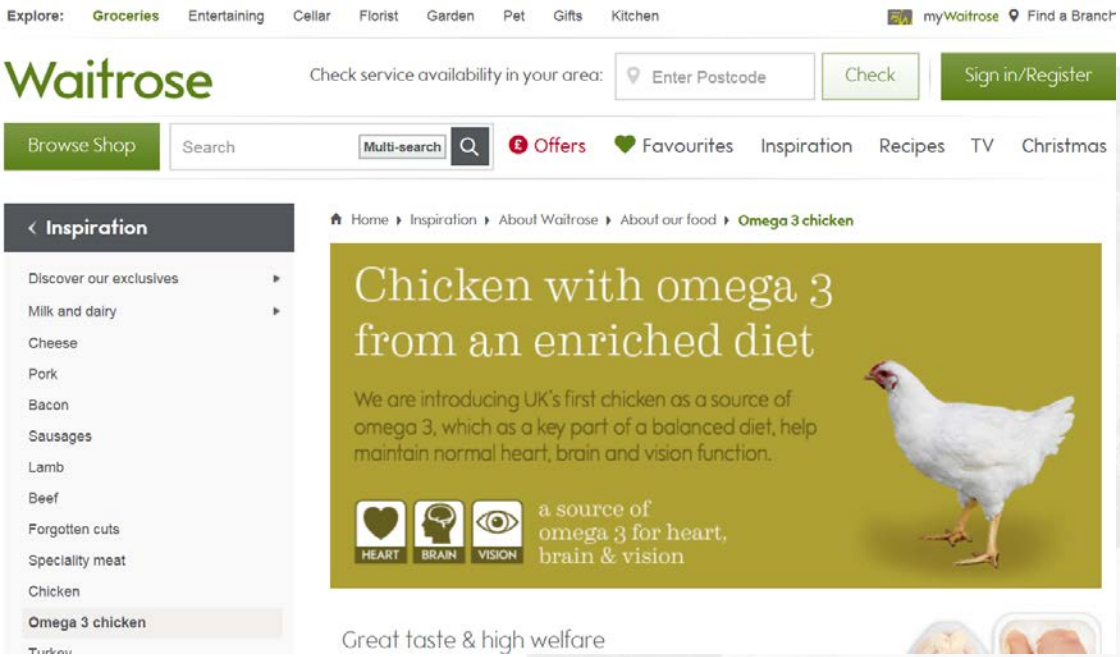
Goed voor je gezondheid!

Columbus

Bon pour la santé !

BLEU BLANC COEUR

OUI on a tous le droit de bien manger.fr



lperkins01@qub.ac.uk

Thank you for listening

Department for the Economy

afbi Agri-Food and Biosciences Institute

cafre College of Agriculture, Food & Rural Enterprise