



The University of
Nottingham

Butter: is it the dietary villain?

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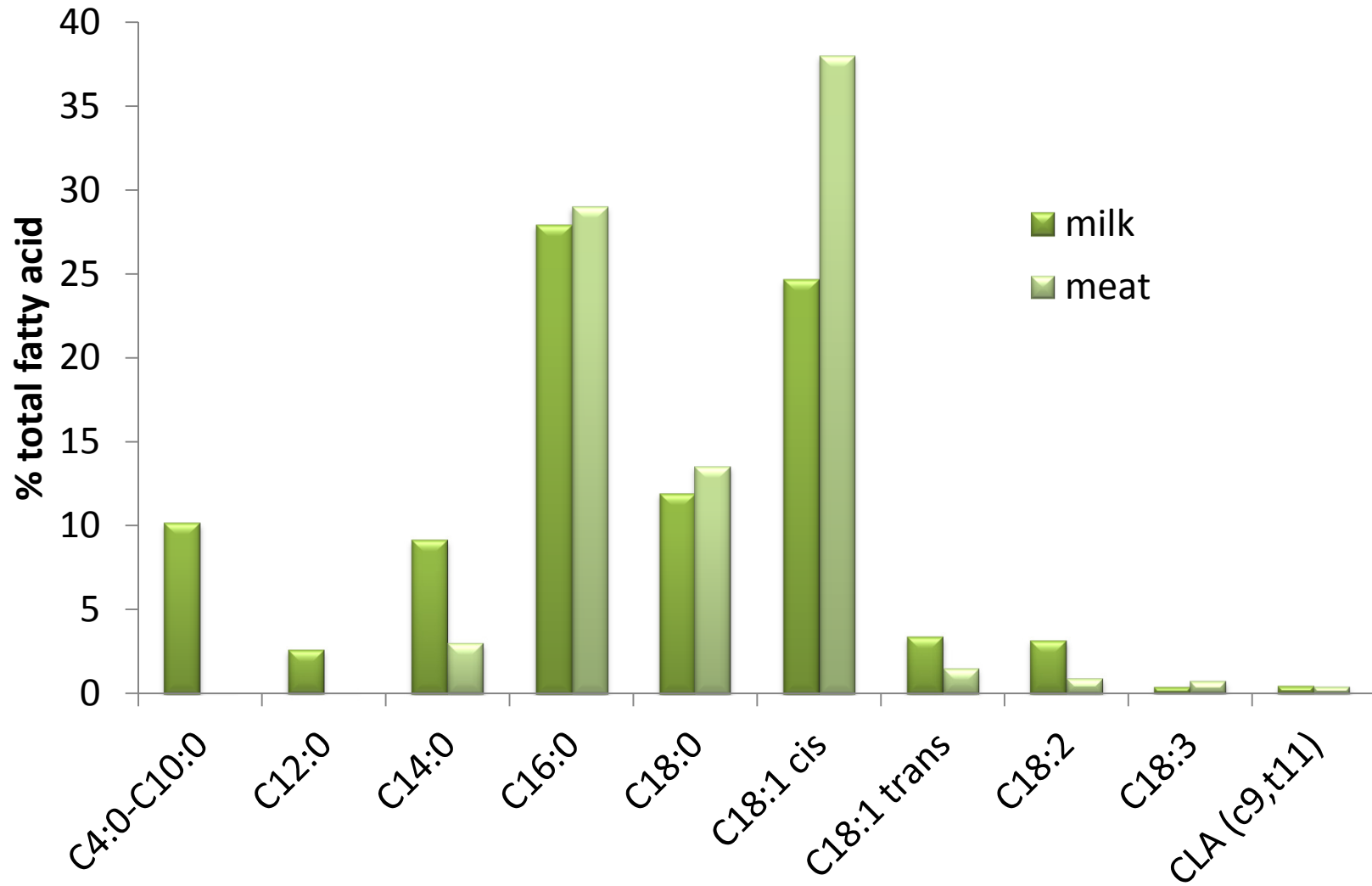
What is Butter?

- Butter is a water-in-oil [emulsion](#) resulting from an inversion of the cream, an oil-in-water emulsion; the milk proteins are the emulsifiers.
- [Unhomogenized](#) milk and cream contain [butterfat](#) in [microscopic](#) globules. These globules are surrounded by membranes made of [phospholipids](#) ([fatty acid emulsifiers](#)) and [proteins](#), which prevent the fat in milk from pooling together into a single mass.
- Butter is produced by agitating cream, which damages these membranes and allows the milk fats to conjoin, separating from the other parts of the cream.
- Variations in the production method will create butters with different consistencies, mostly due to the butterfat composition in the finished product.

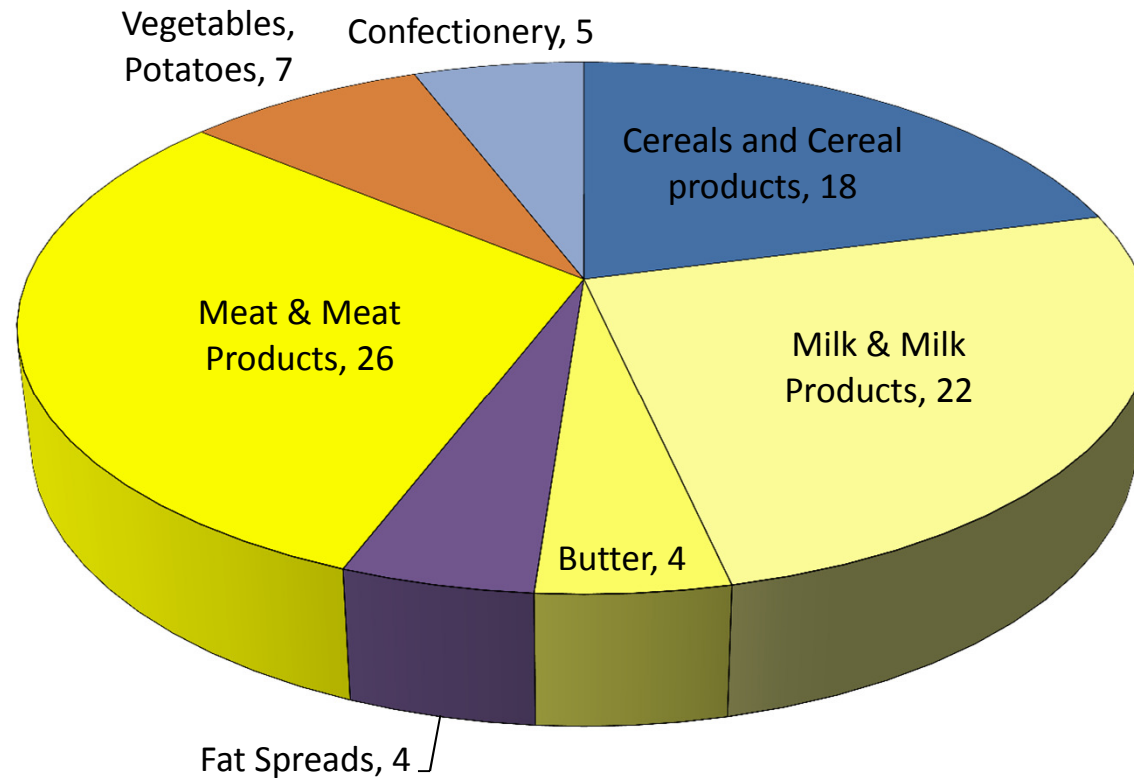
Composition of Butter (per 100g)

▪ Energy	3140kJ
▪ Fat	82g
▪ Water	15.4g
▪ Protein	0.5g
▪ Sodium (salted)	870mg
▪ Calcium	15mg
▪ Vit A	1000µg
▪ Cholesterol	220mg

Fatty Acid Composition of Cow's Milk and Beef



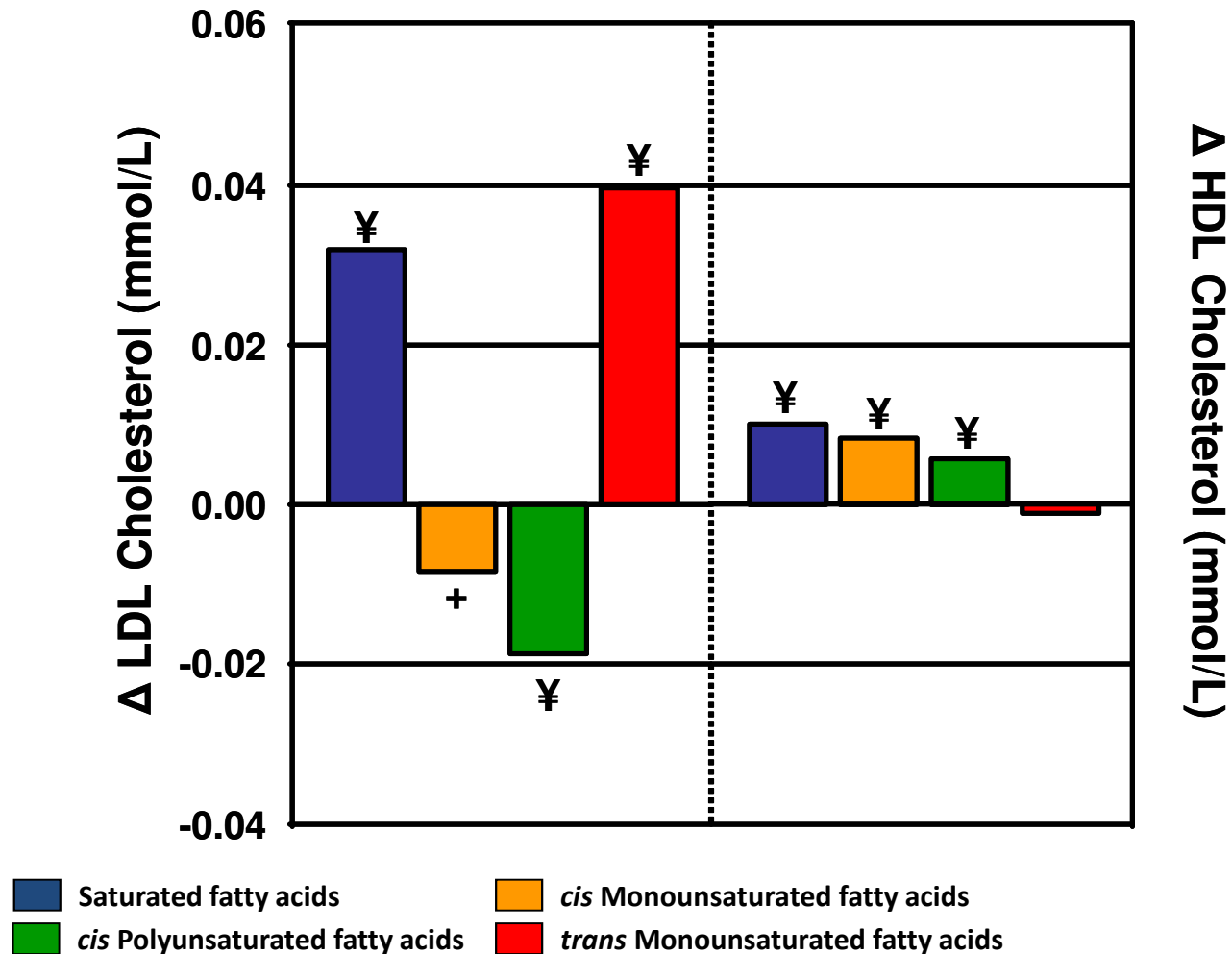
Sources of Saturated Fatty Acids



National Diet & Nutrition Survey 2008-2009, Dept of Health

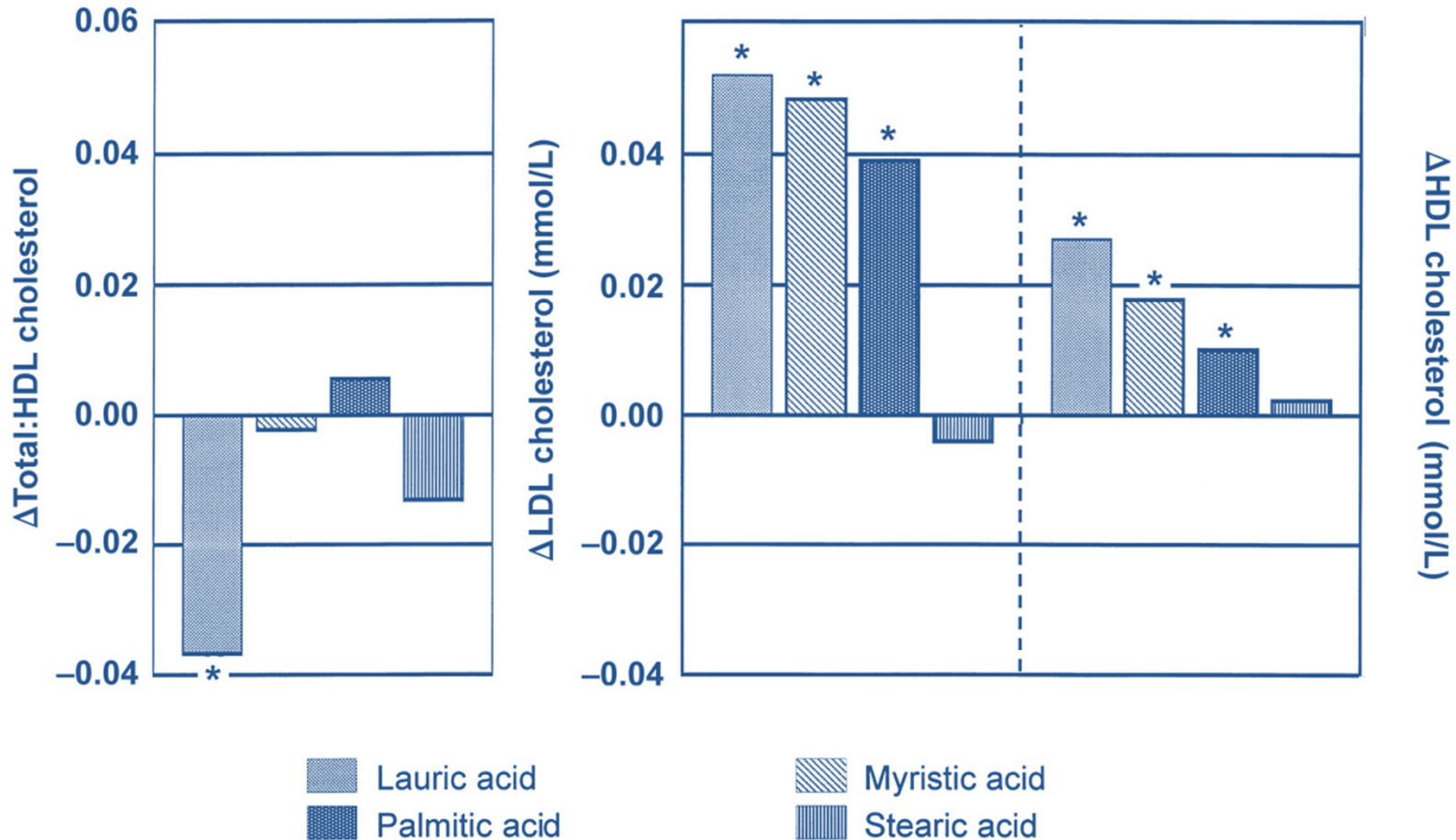
Meta-Analysis of 60 Trials

Δ Cholesterol when 1% of carbohydrate energy is replaced with fatty acids



Meta-Analysis of 60 Trials

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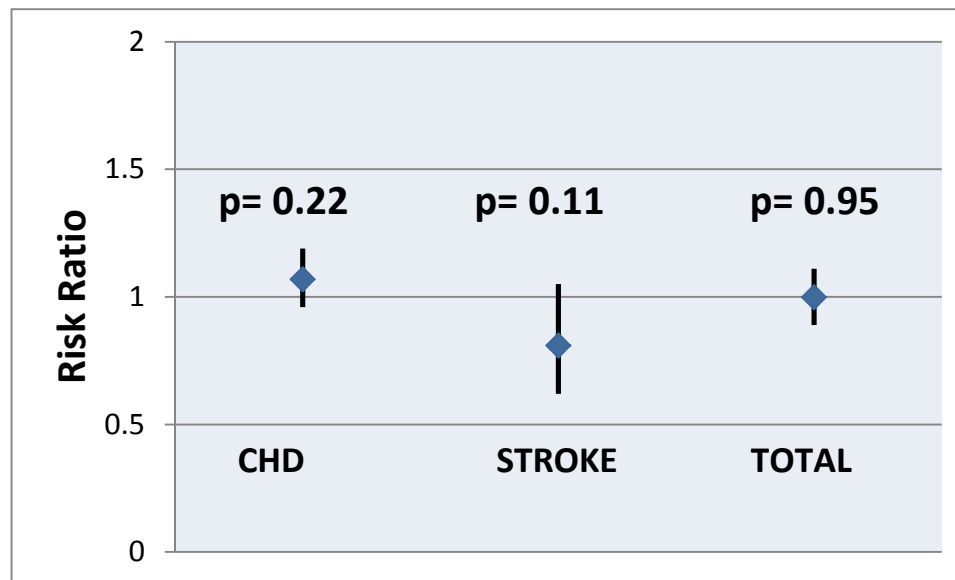


Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease

Siri-Tarino *et al* (2010) Am J Clin Nutr 91: 535-46

Meta-analysis of 21 studies including 347,747 subjects of whom 11,006 developed CHD or Stroke

Author's Conclusion: A meta-analysis of prospective epidemiological studies showed that there is no significant evidence for concluding that dietary saturated fat is associated with an increased risk of CHD or CVD

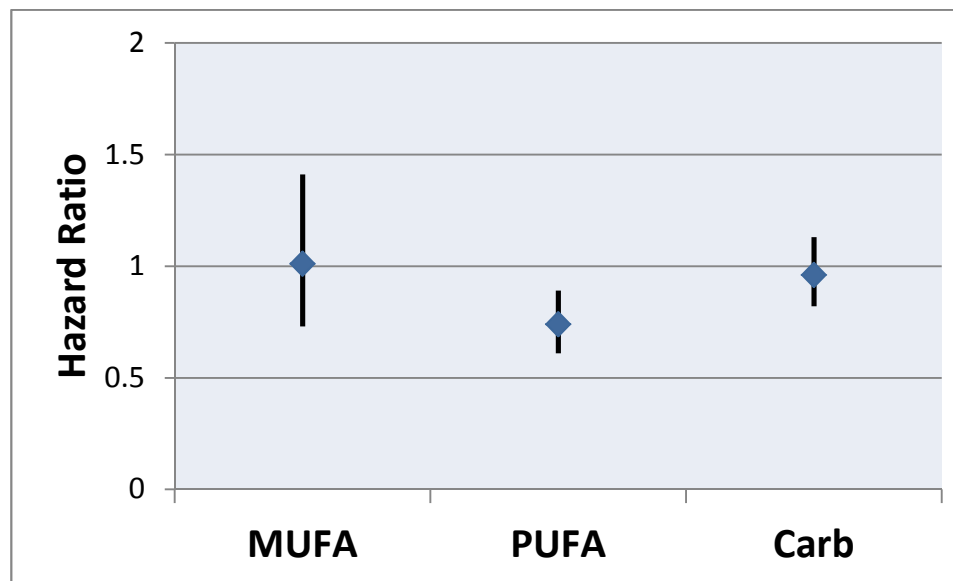


Major types of dietary fat and risk of coronary heart disease: a pooled analysis of 11 cohort studies

Jakobsen *et al* (2009) *Am J Clin Nutr* 89:1425-32

Hazard Ratio for Coronary Deaths per replacement of 5% energy from SFA with MUFA, PUFA or Carbohydrate

2155 Coronary Deaths among 344696 persons

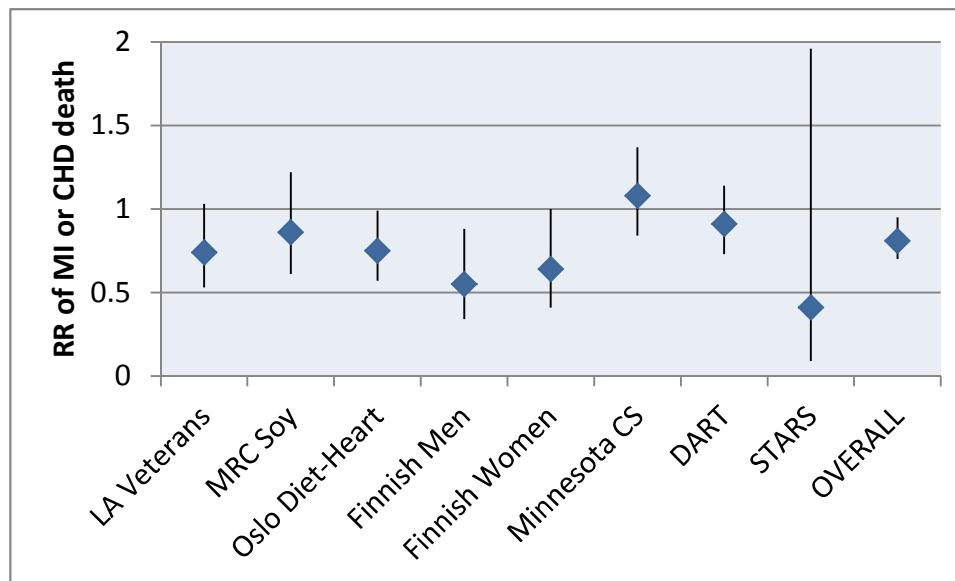


Author's Conclusion: Replacing SFAs with PUFA rather than MUFA or Carbohydrates prevents CHD over a wide range of intakes

Effects on Coronary Heart Disease of Increasing Polyunsaturated Fat in Place of Saturated Fat: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

Mozaffarian et al (2010) PLoS Medicine 7: e1000252

8 trials including 13,614 participants with 1,042 CHD Events
Average PUFA intake - low: 5.0, high: 14.9



Author's Conclusion: Consuming PUFA in place of SFA reduces CHD events in RCTs

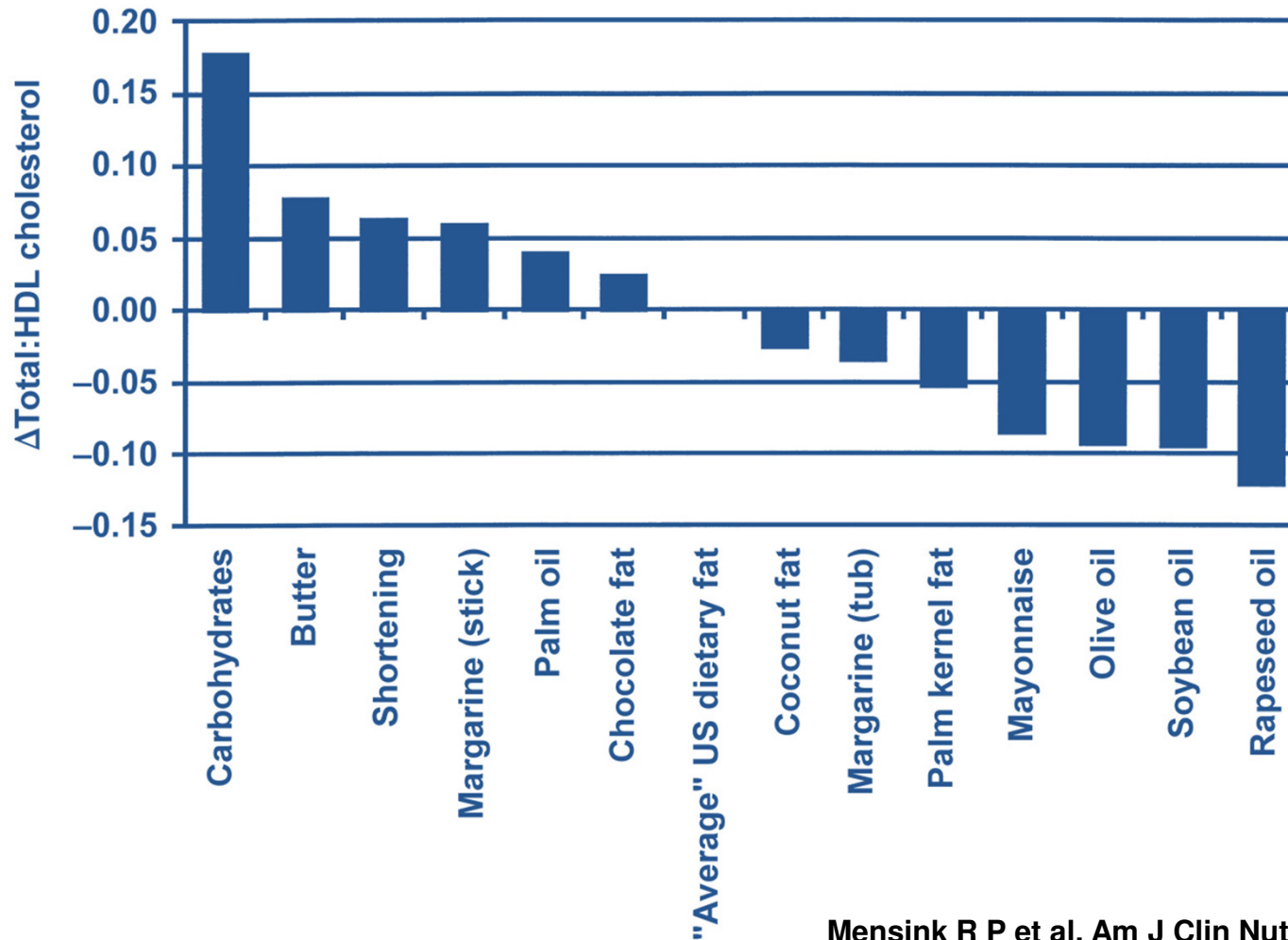
Reduced or modified dietary fat for preventing cardiovascular disease

Hooper I *et al* (2011) Cochrane Database of Systematic Reviews
7: CD002137

- 25 studies (61,958 participants) of fat reduction and 15 studies (13,004) of fat modification
- No clear effect on total mortality or CVD mortality
- 14% decrease in risk of CVD events (RR 0.86, 95%CI 0.77-0.96)
 - Associated with substitution of SFA with UFA not reduction
 - Related to degree of effect on total and LDL cholesterol
 - Only in studies of at least 2 years and only in men.

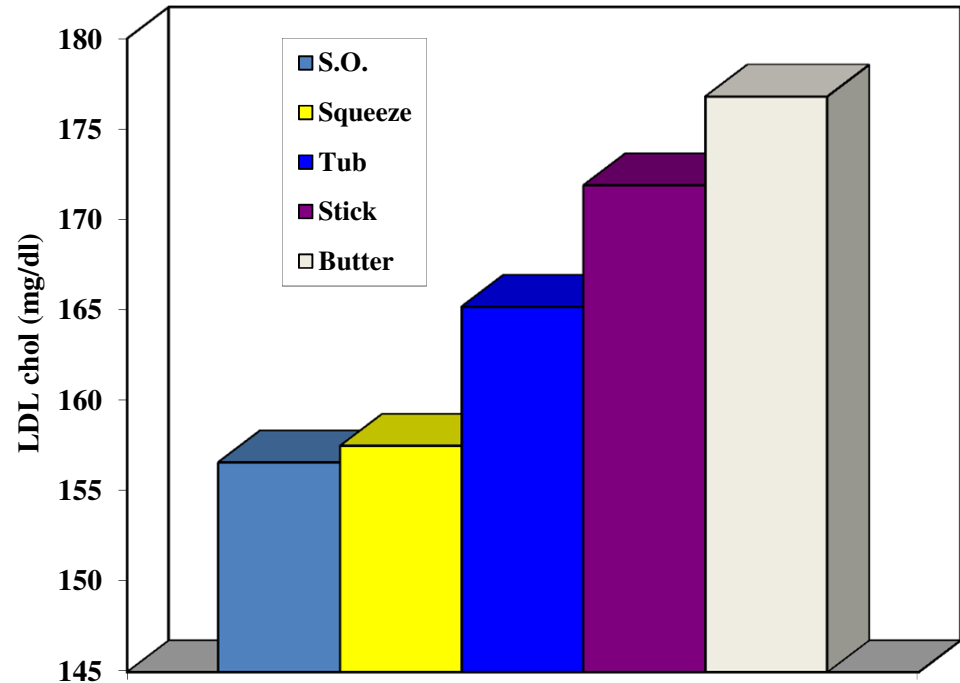
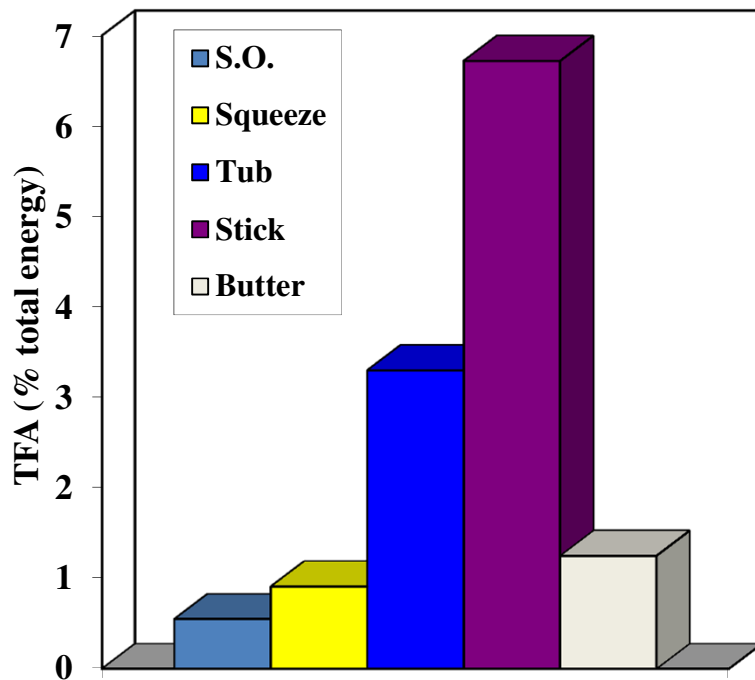
Meta-Analysis of 60 Trials

Predicted changes (Δ) in the ratio of serum total to HDL cholesterol when mixed fat constituting 10% of energy in the "average" US diet is replaced isoenergetically with a particular fat or with carbohydrates.



Effect of different spreads on LDL cholesterol in Women

14 women fed reduced fat diets (30% kcal) where two-thirds of the fat was either soybean oil (SO), low trans squeeze, medium trans tub, or high trans stick margarines, or butter (BT).



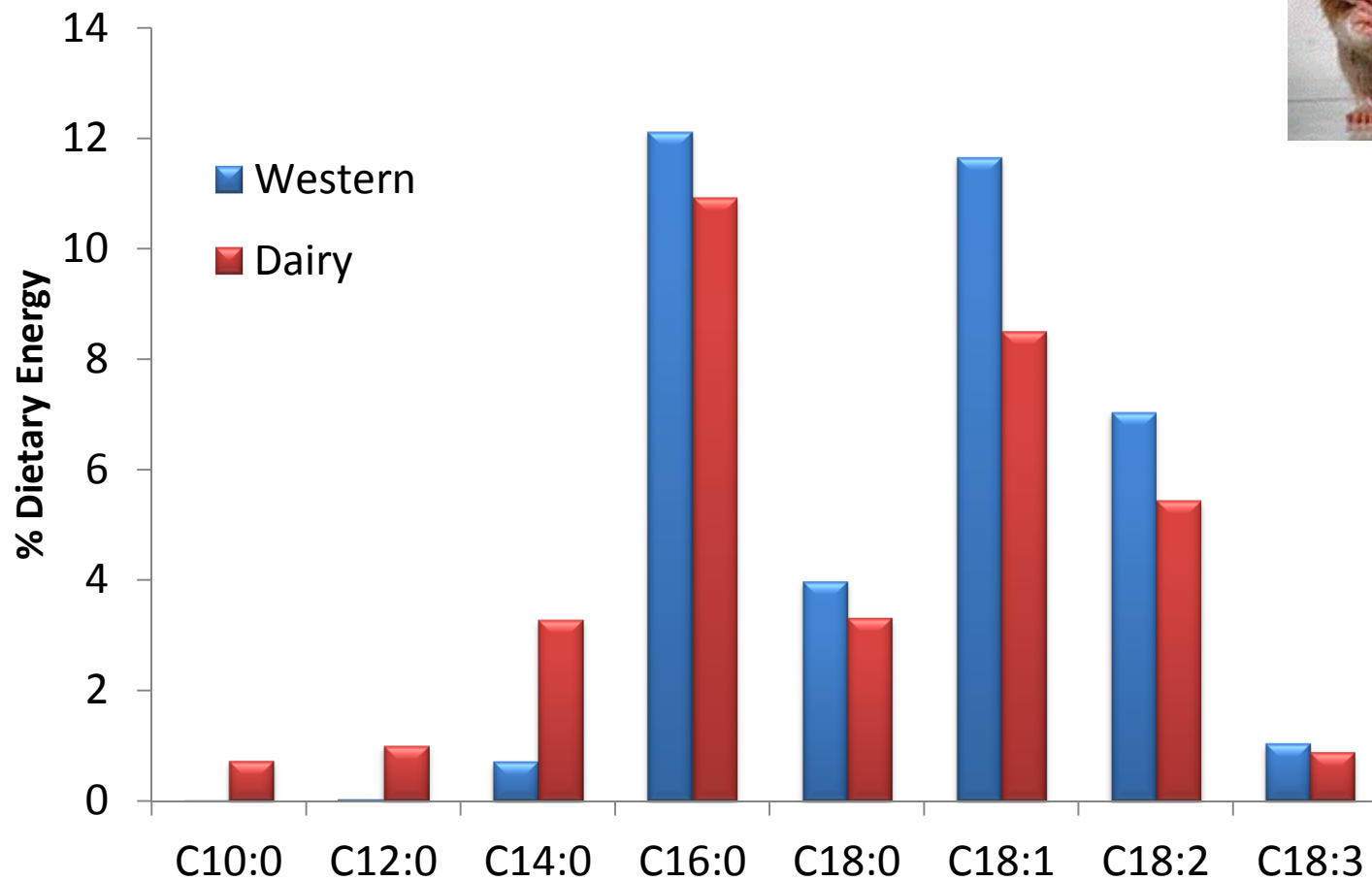
Matthan et al (2000) *J Lipid Res* 41:834

Dairy Fat and Plasma Lipoproteins

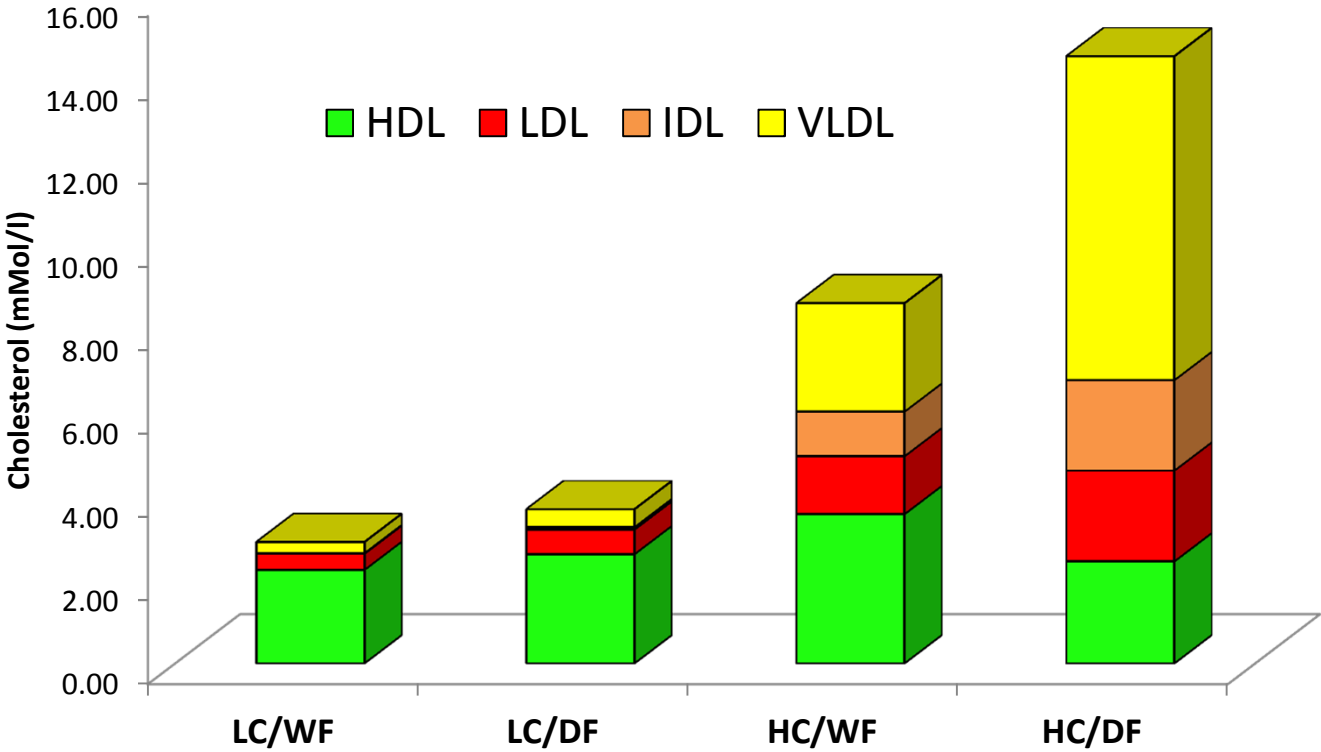
Western (WF) = 20MJ/kg, 39% from fat (50% beef tallow)

Dairy (DF) = 19MJ/kg, 39% from fat (100% butter fat)

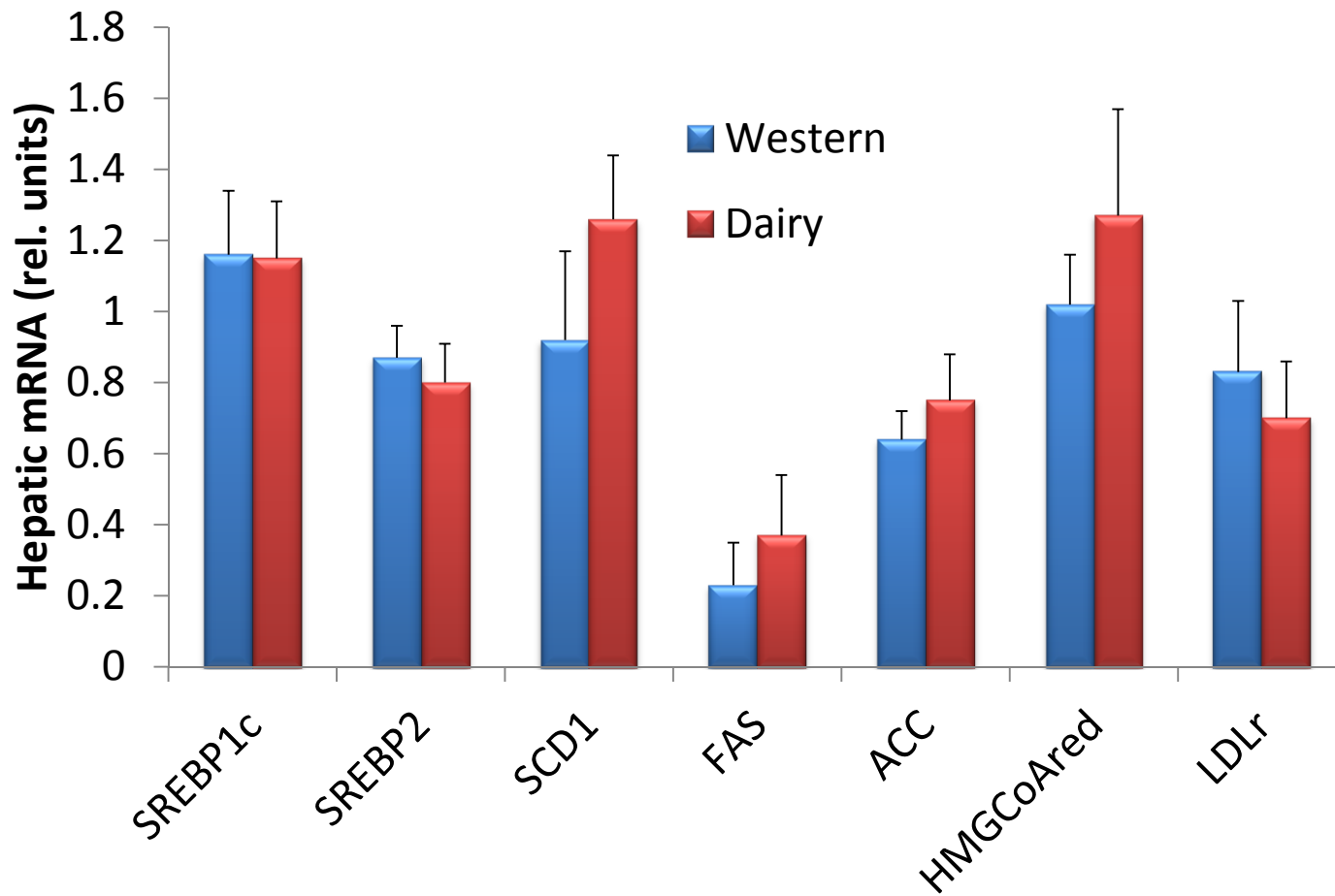
With (HC) or without (LC) 0.2% cholesterol



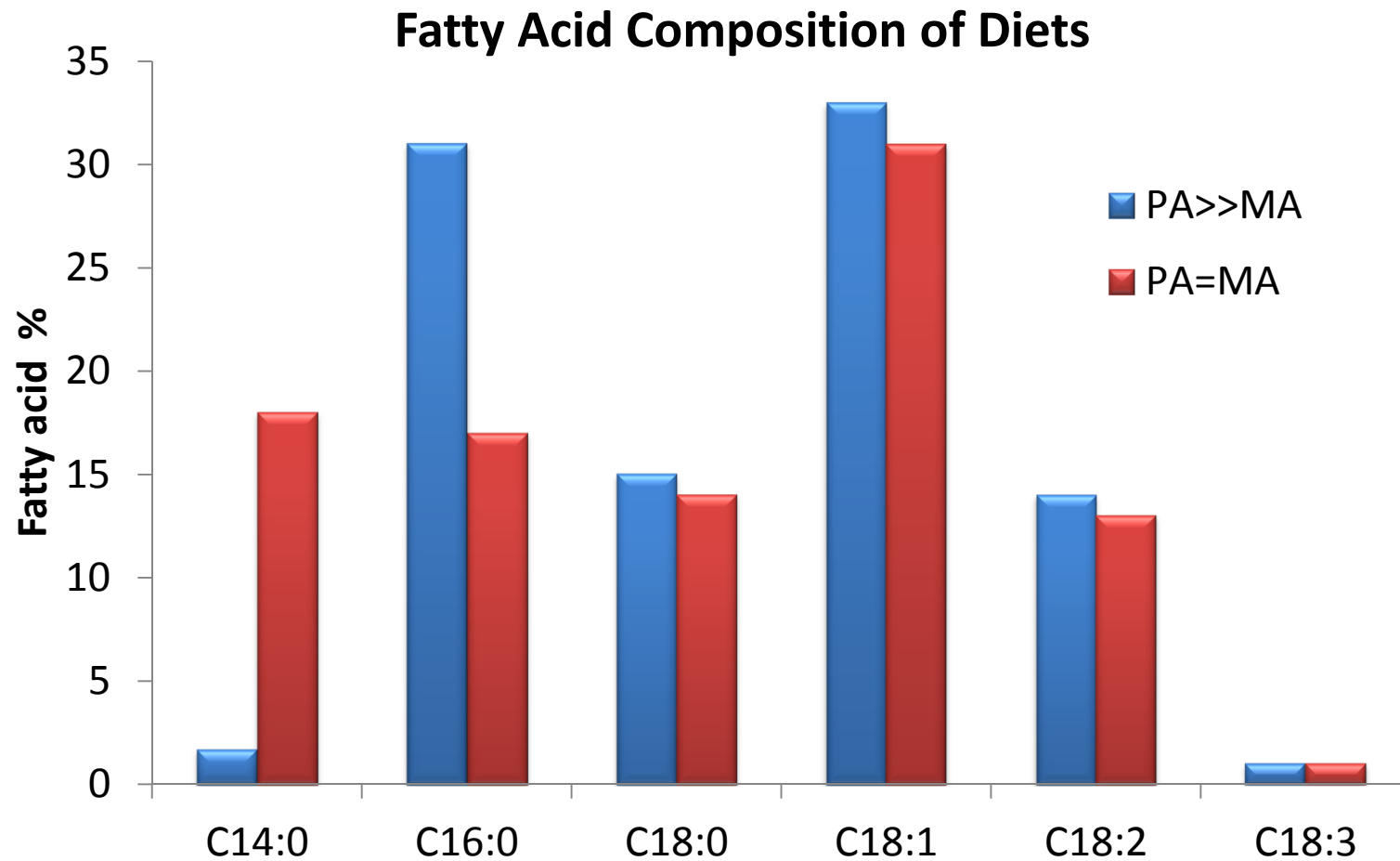
Comparison of the Effects of “Western” and Dairy Fat on Lipoprotein Cholesterol



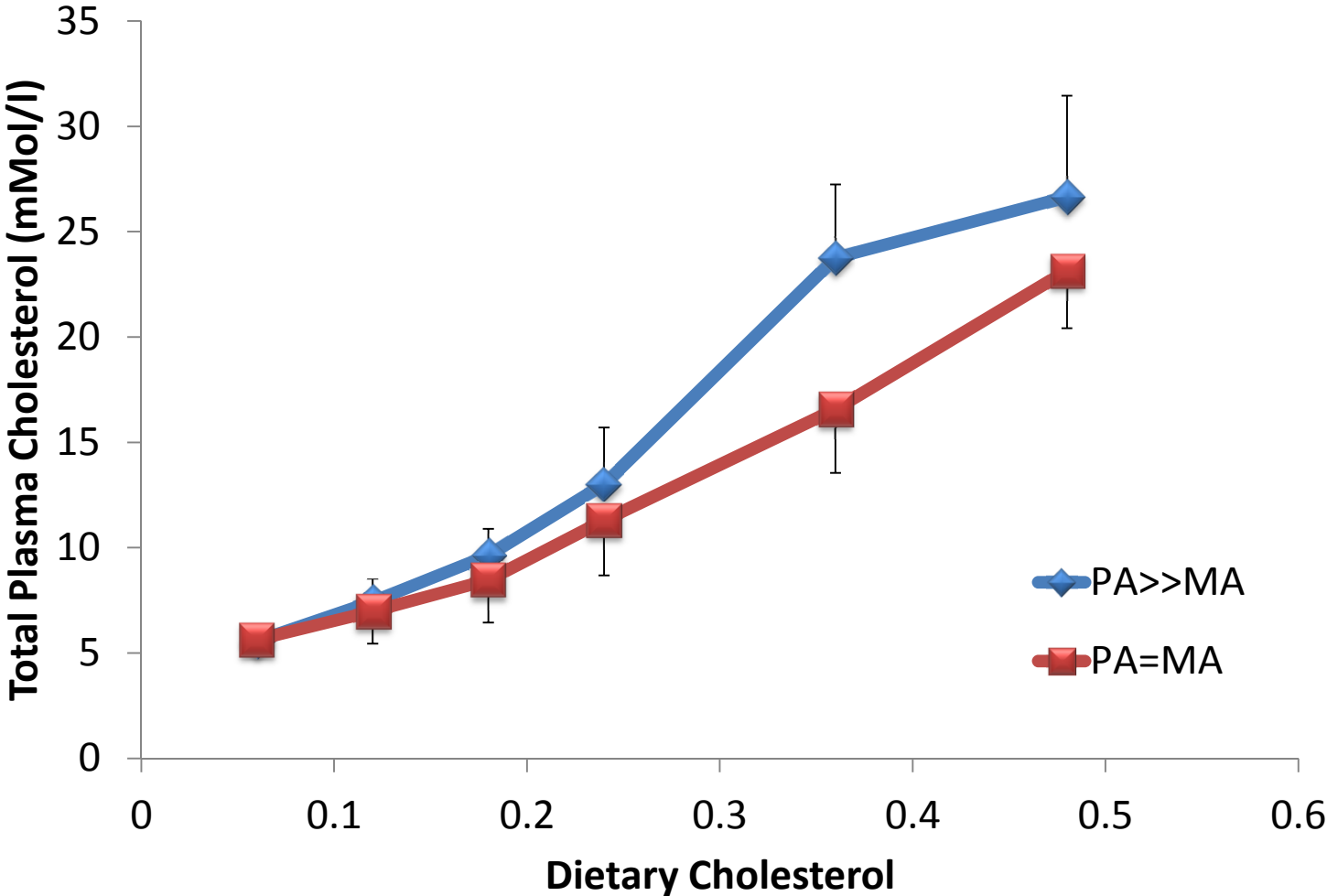
Effect of “Western and Dairy Fat on Hepatic gene expression in cholesterol-fed hamsters



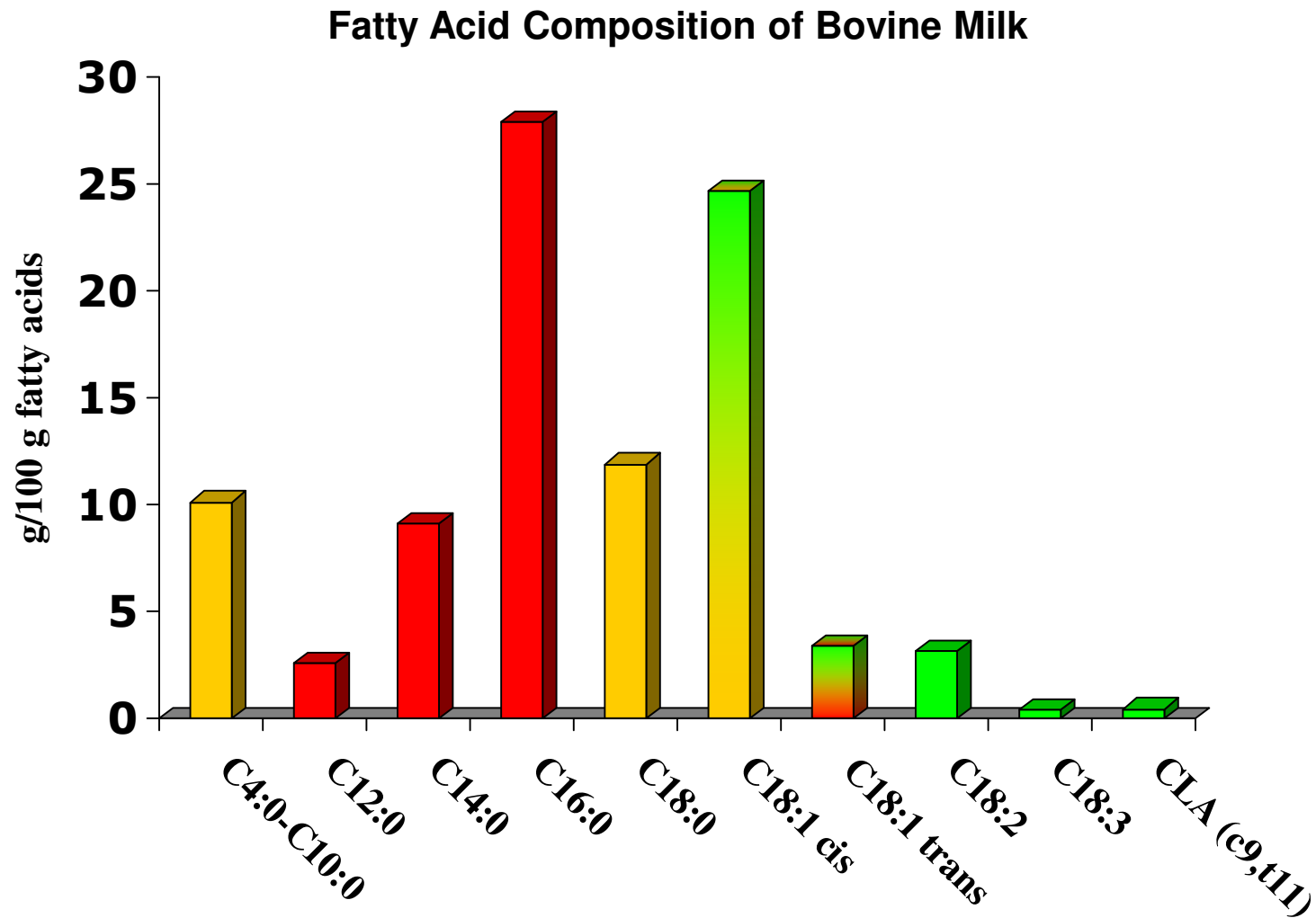
Comparison of effects of Myristic (C14:0) and Palmitic (C16:0) Acids



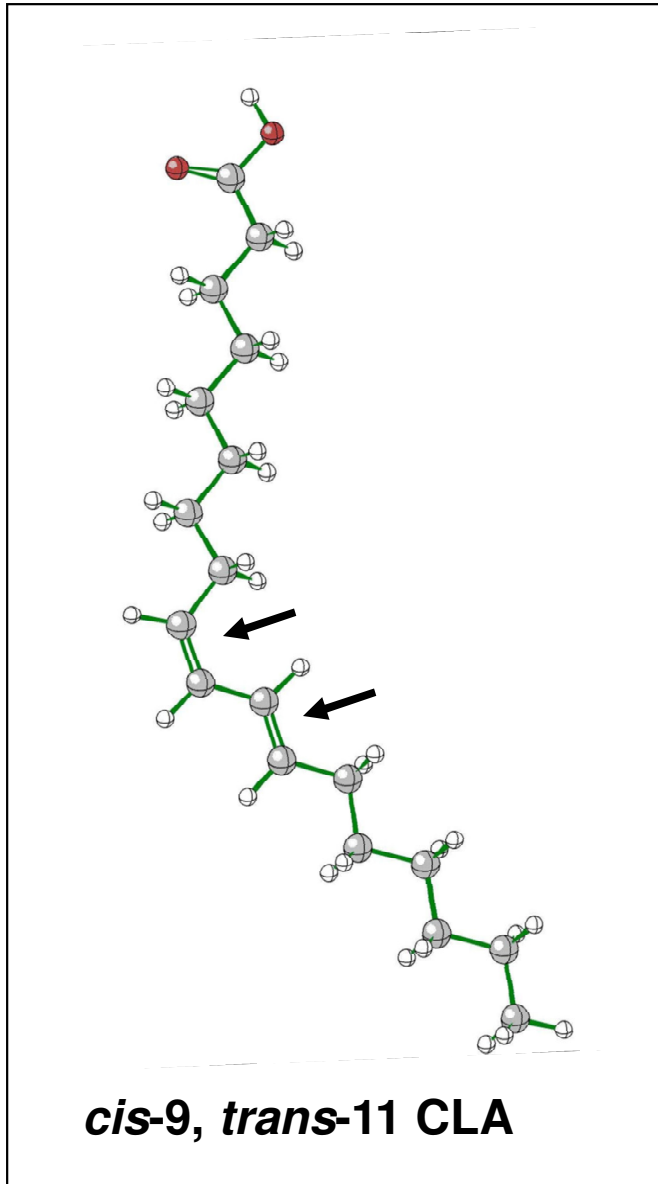
Interaction of dietary saturated fat and cholesterol on plasma cholesterol



Manipulating Fatty Acid Content of Butter



Conjugated Linoleic Acids (CLA)



Biological Effects

Anticarcinogenic effects (in vivo and in vitro)

Antiatherogenic properties

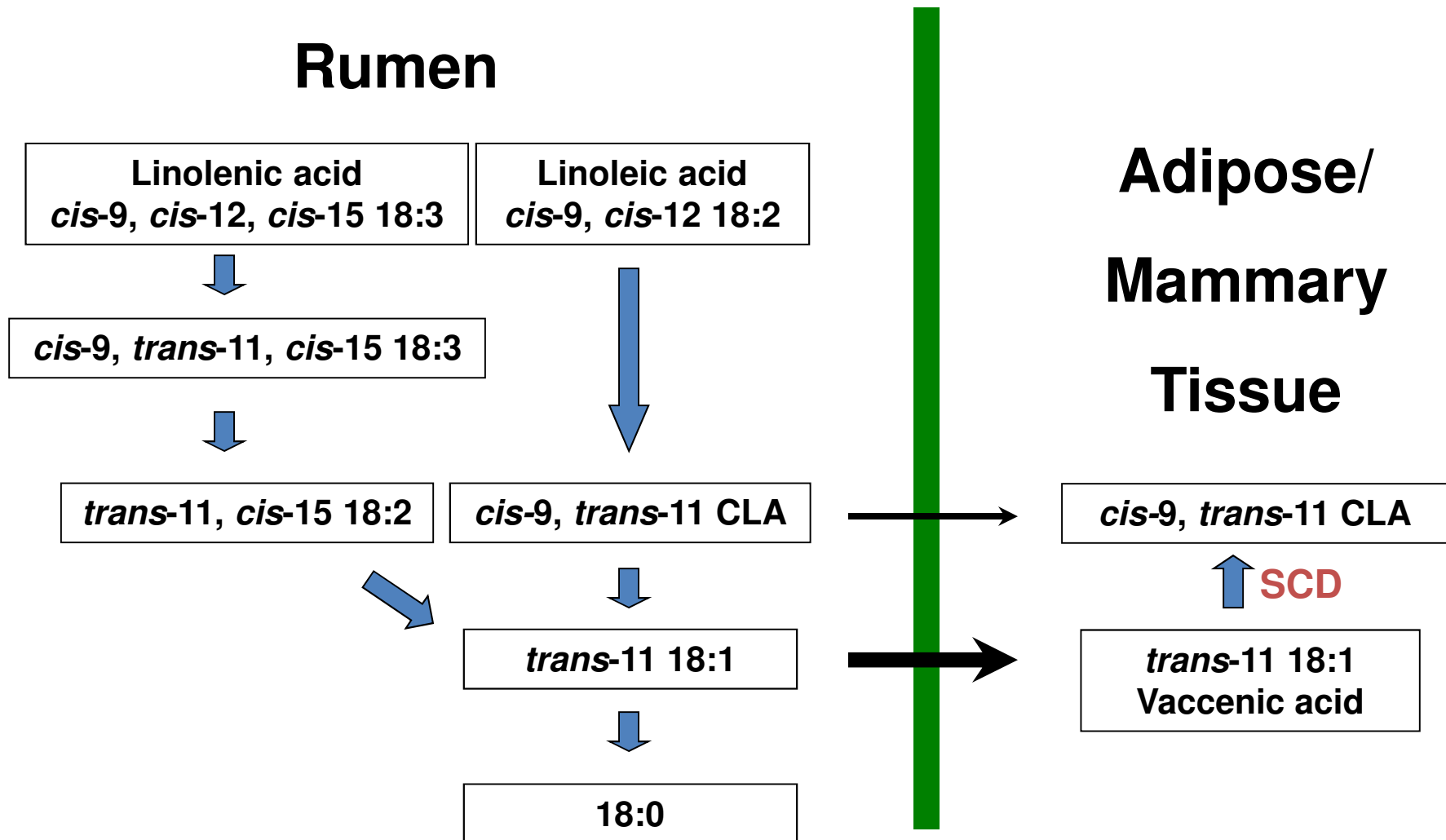
Altered nutrient partitioning and lipid metabolism

Antidiabetic (type II) and reduced hyperglycemia

Immune modulation

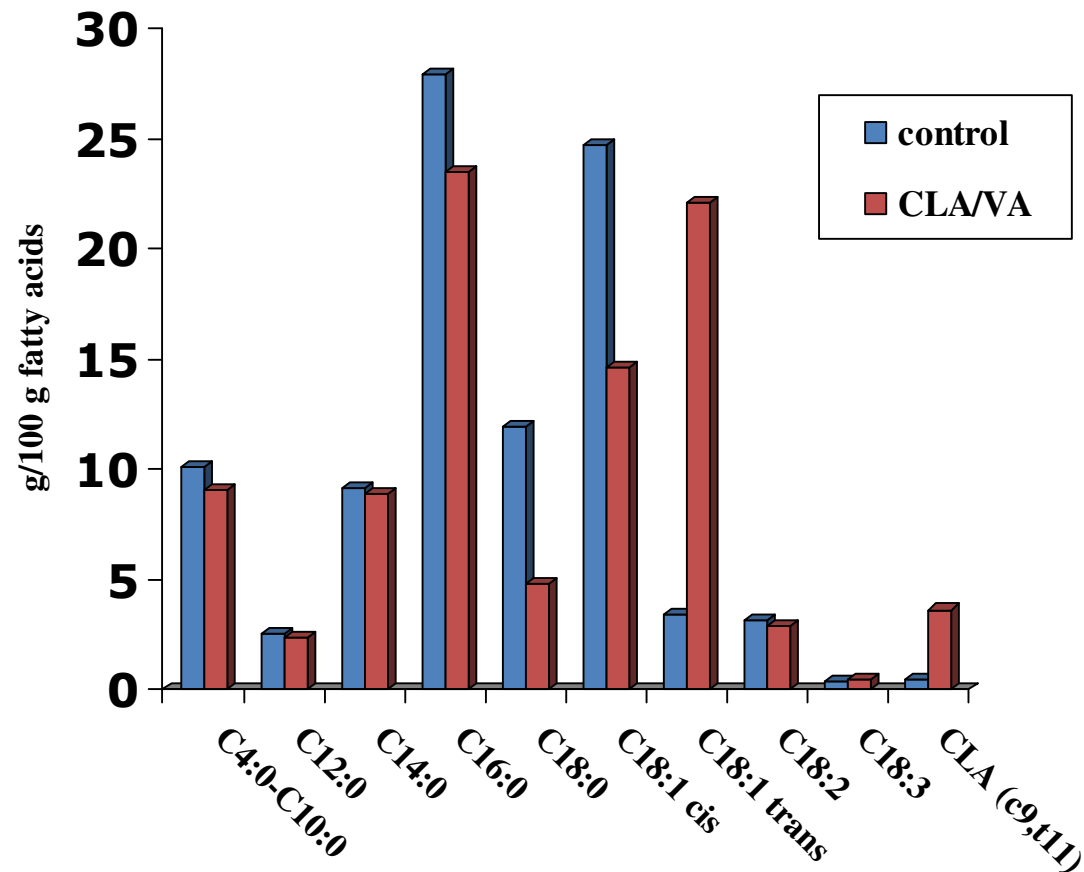
Improved bone mineralization

Fatty Acid metabolism in the Ruminant



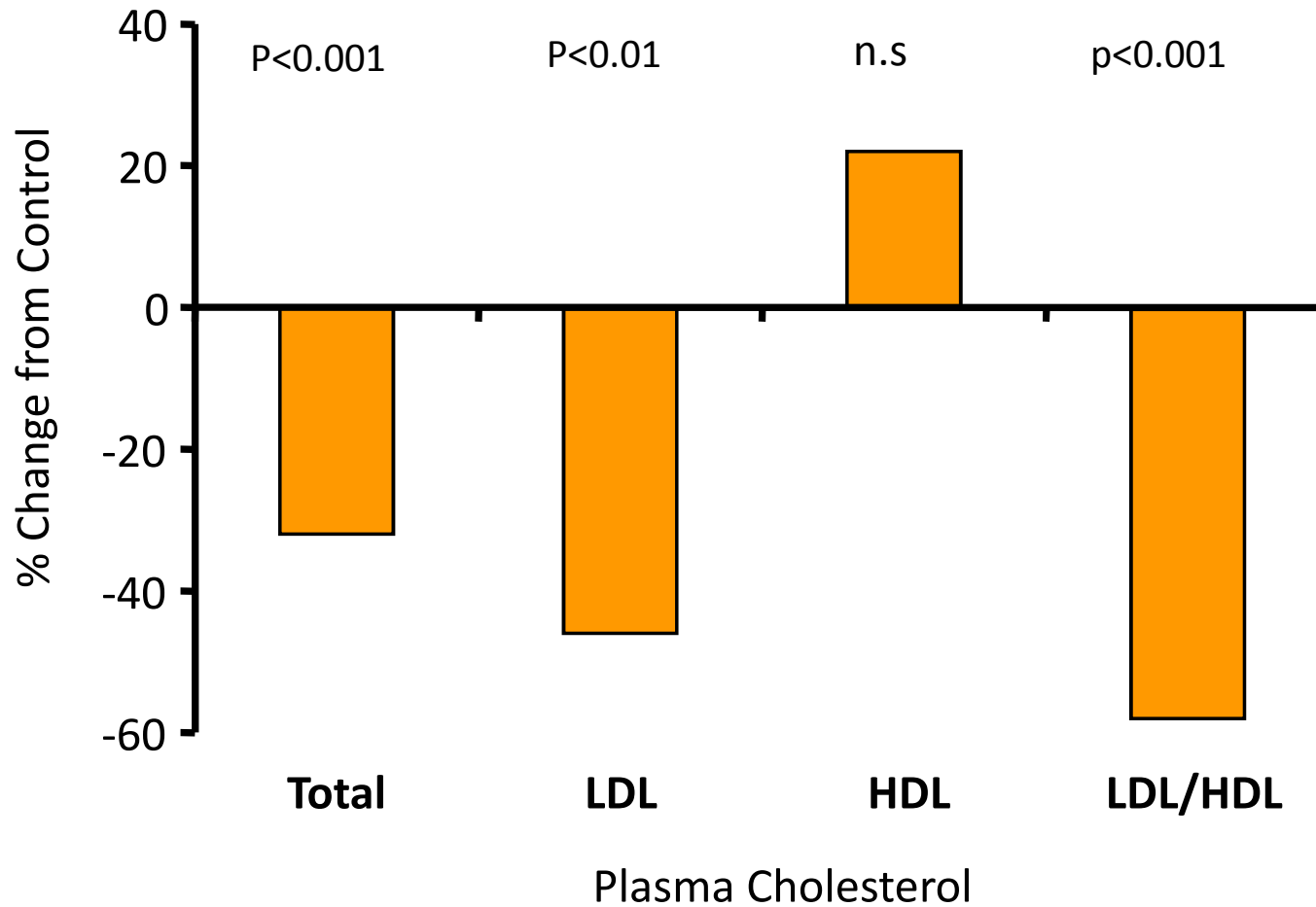
Production of CLA-enriched butter

- Control cows fed a corn-based total mixed ration
- CLA/VA cows fed the same ration + 2% sunflower oil and 1% fish oil to produce a milk fat enriched with *cis*-9, *trans*-11 CLA. Cows producing highest level of CLA selected for butter production

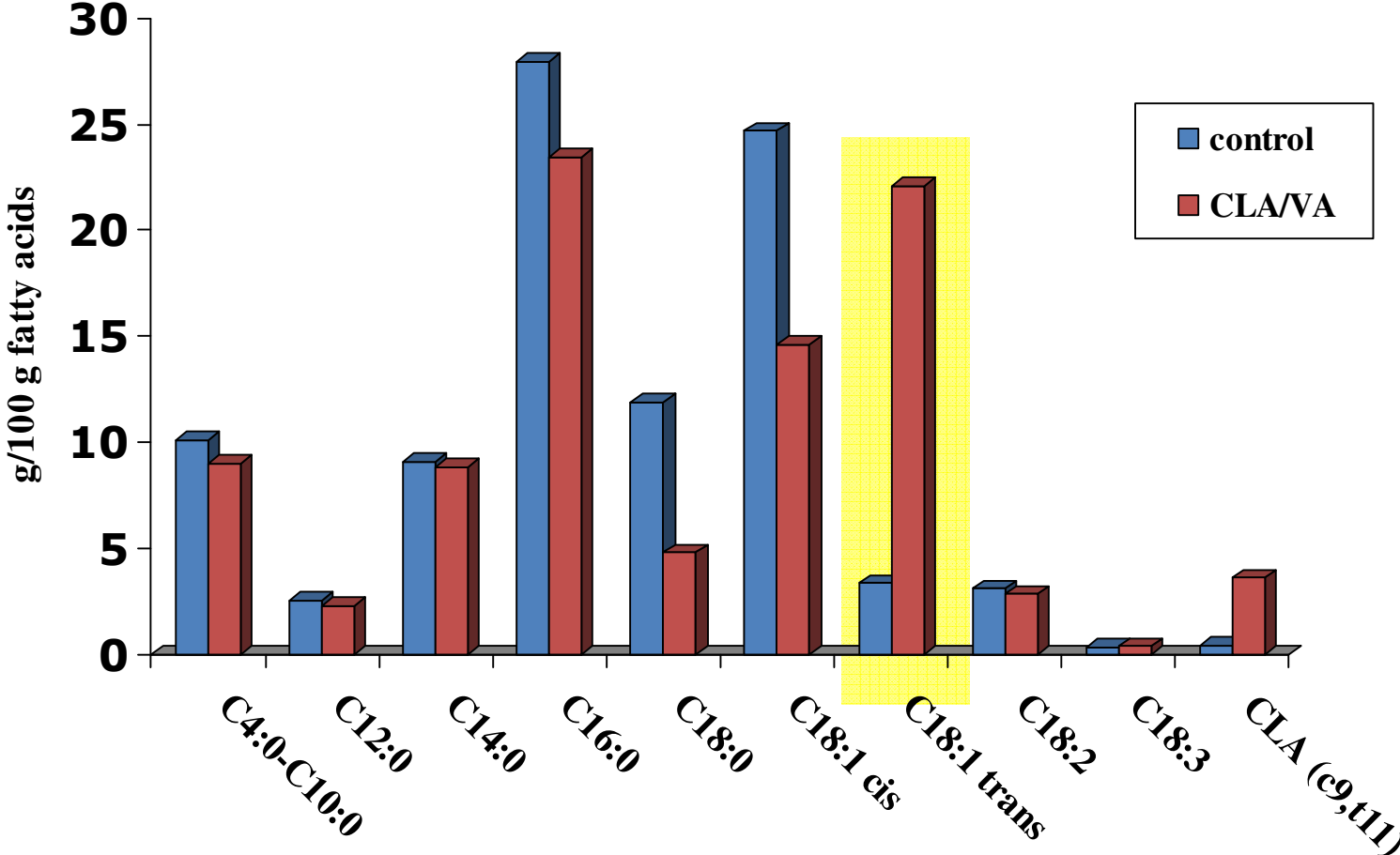


Data from Lock *et al* 2005

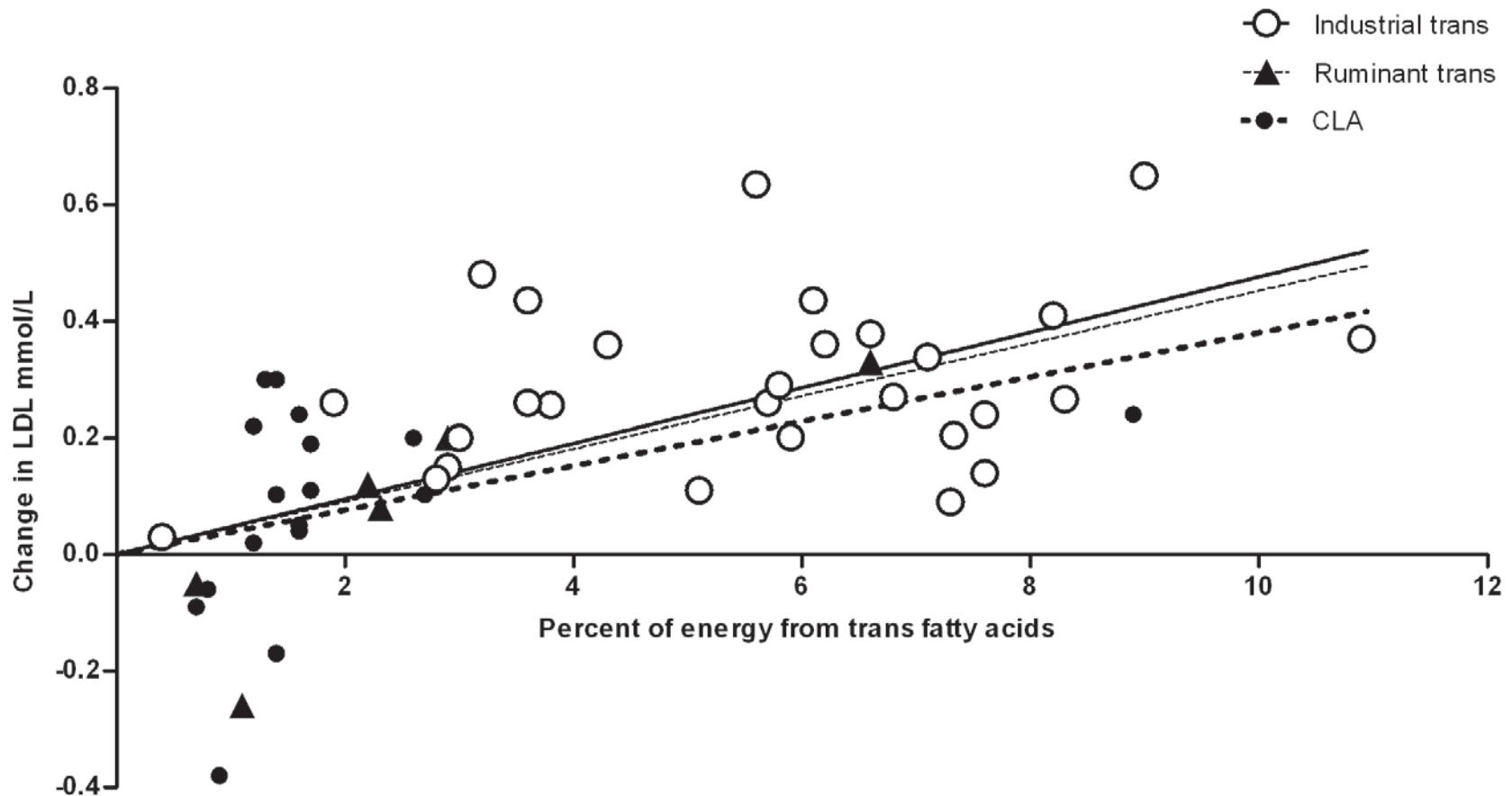
Effect of VA/CLA-Enriched Butter on Plasma Lipoproteins in Hamsters



Fatty Acid Composition of VA/CLA-enriched Butter



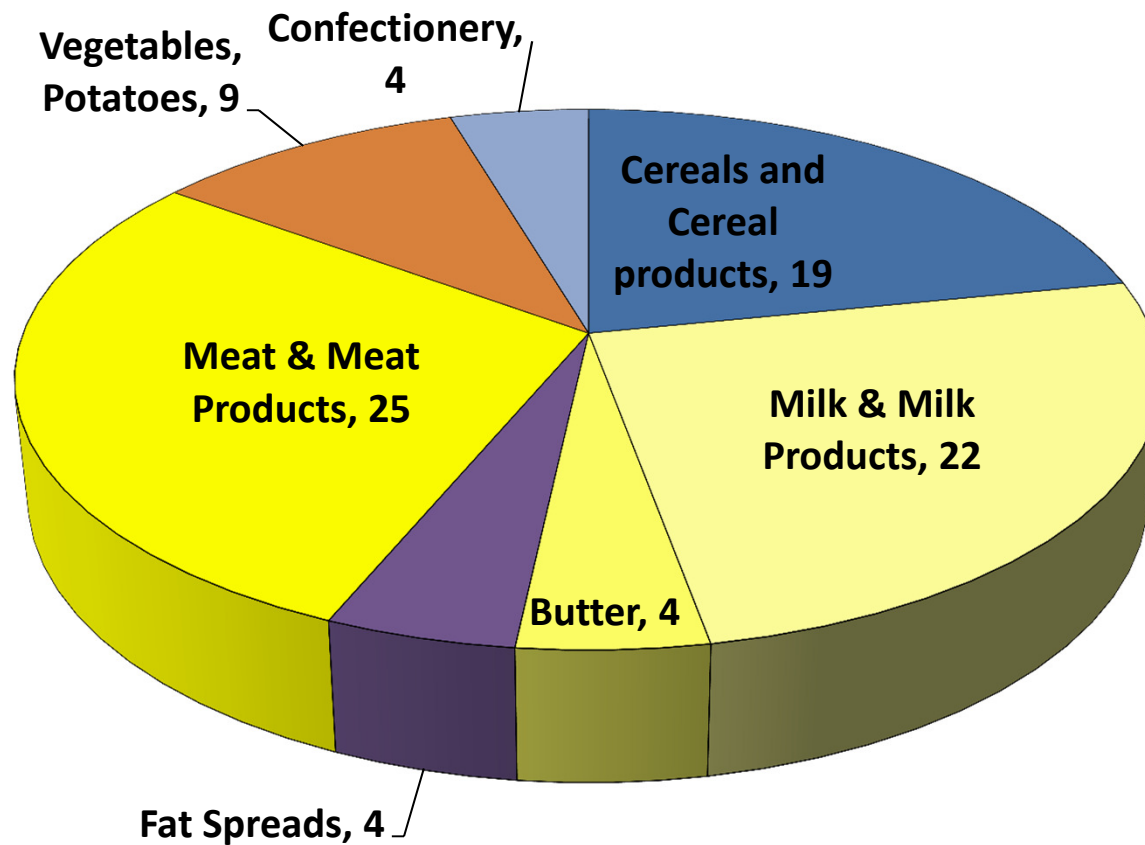
Meta-Analysis of Impact of trans fatty acids on LDL cholesterol in humans



Citation: Brouwer IA, Wanders AJ, Katan MB (2010) Effect of Animal and Industrial Trans Fatty Acids on HDL and LDL Cholesterol Levels in Humans – A Quantitative Review. PLoS ONE 5(3): e9434. doi:10.1371/journal.pone.0009434

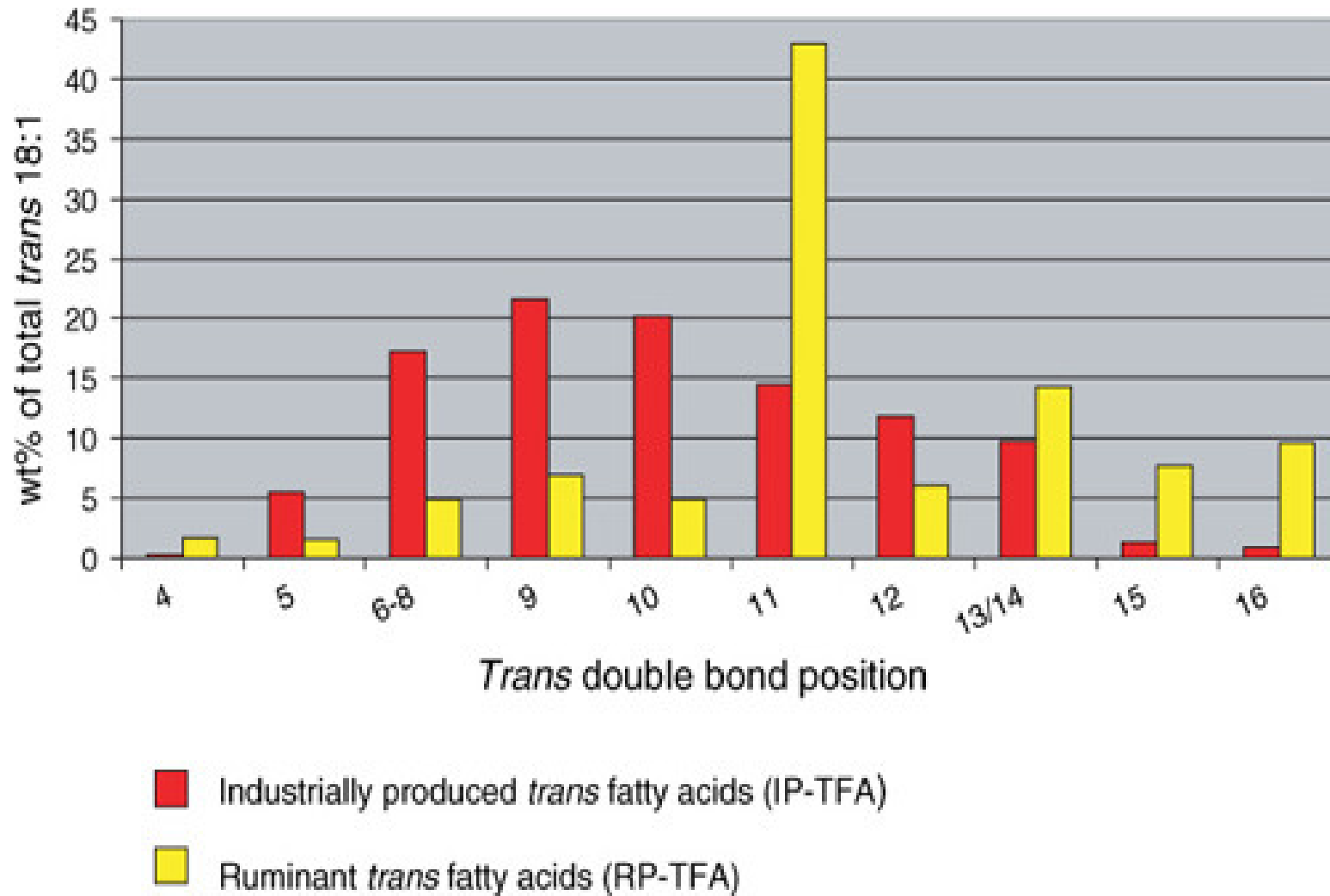
Sources of *Trans* Fatty Acids

1.6g/day (0.8% food energy)

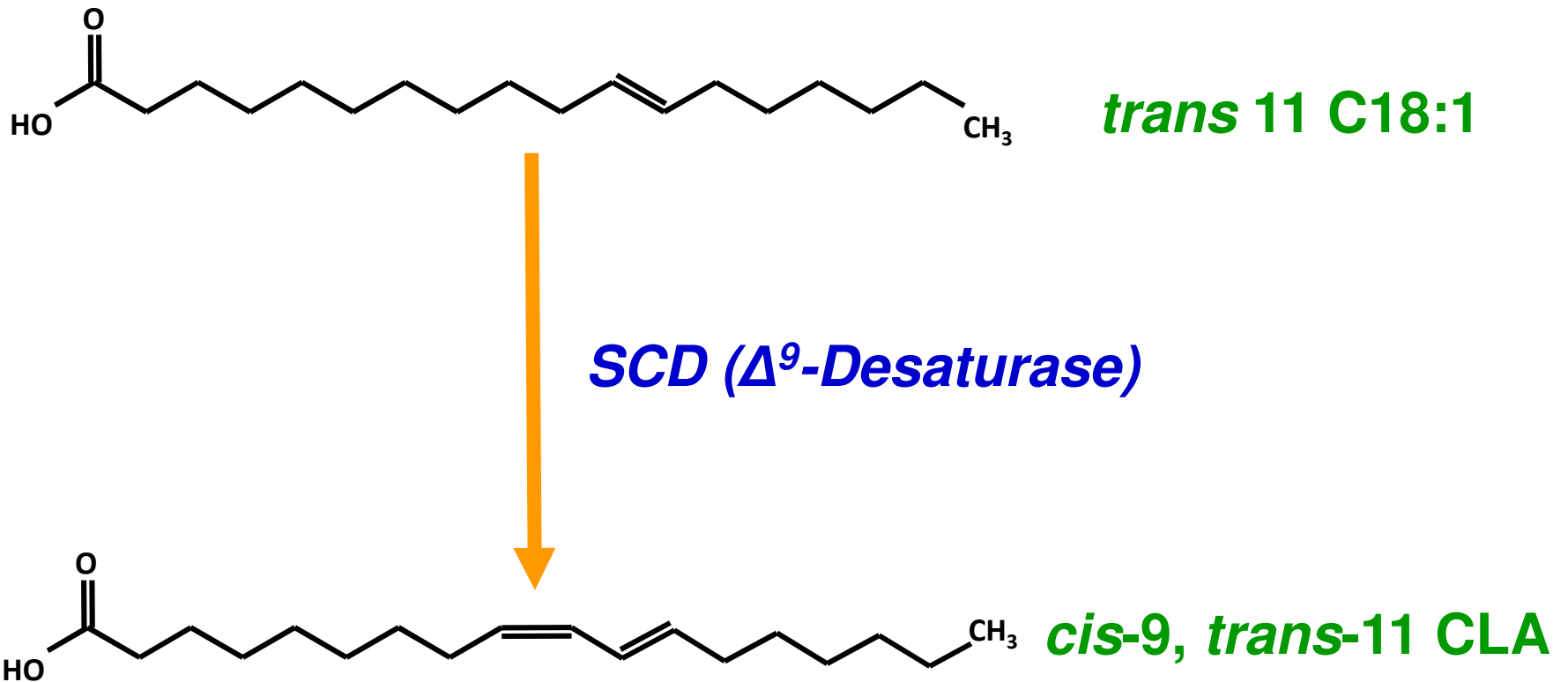


National Diet & Nutrition Survey 2008-2009, Dept of Health

Ruminant vs. Industrial Sources TFA



Endogenous Synthesis of c9, t11 CLA

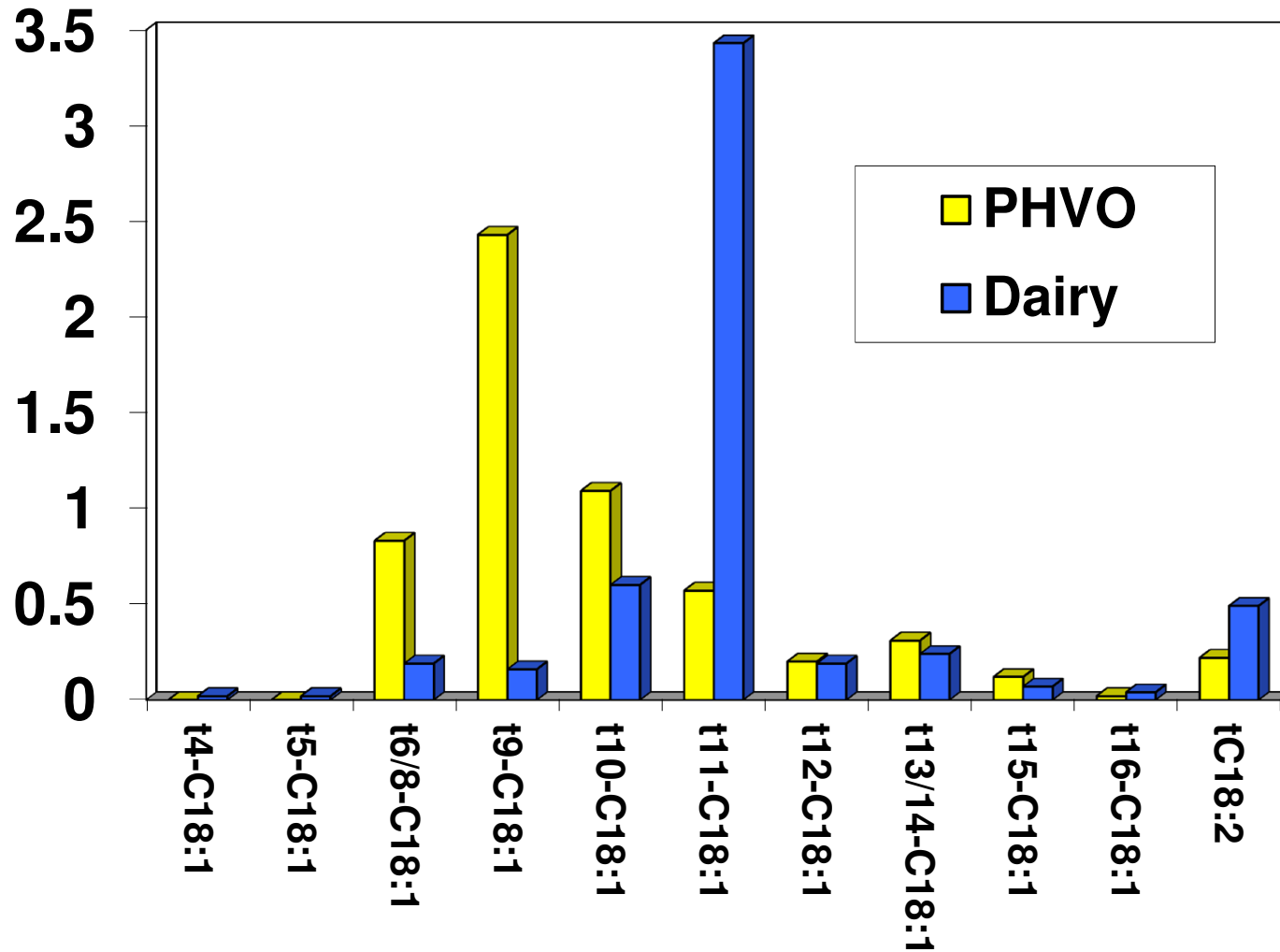


TRANSFACT Study

- 46 Health Volunteers
- Randomized, double blind, controlled, cross-over
- 11-12g/day (5% energy) *trans* fatty acids from
 - Hydrogenated vegetable oil
 - VA enriched dairy produce
 - Fed as “butter”, cheese, cookies
 - 3 weeks + 1 week wash out

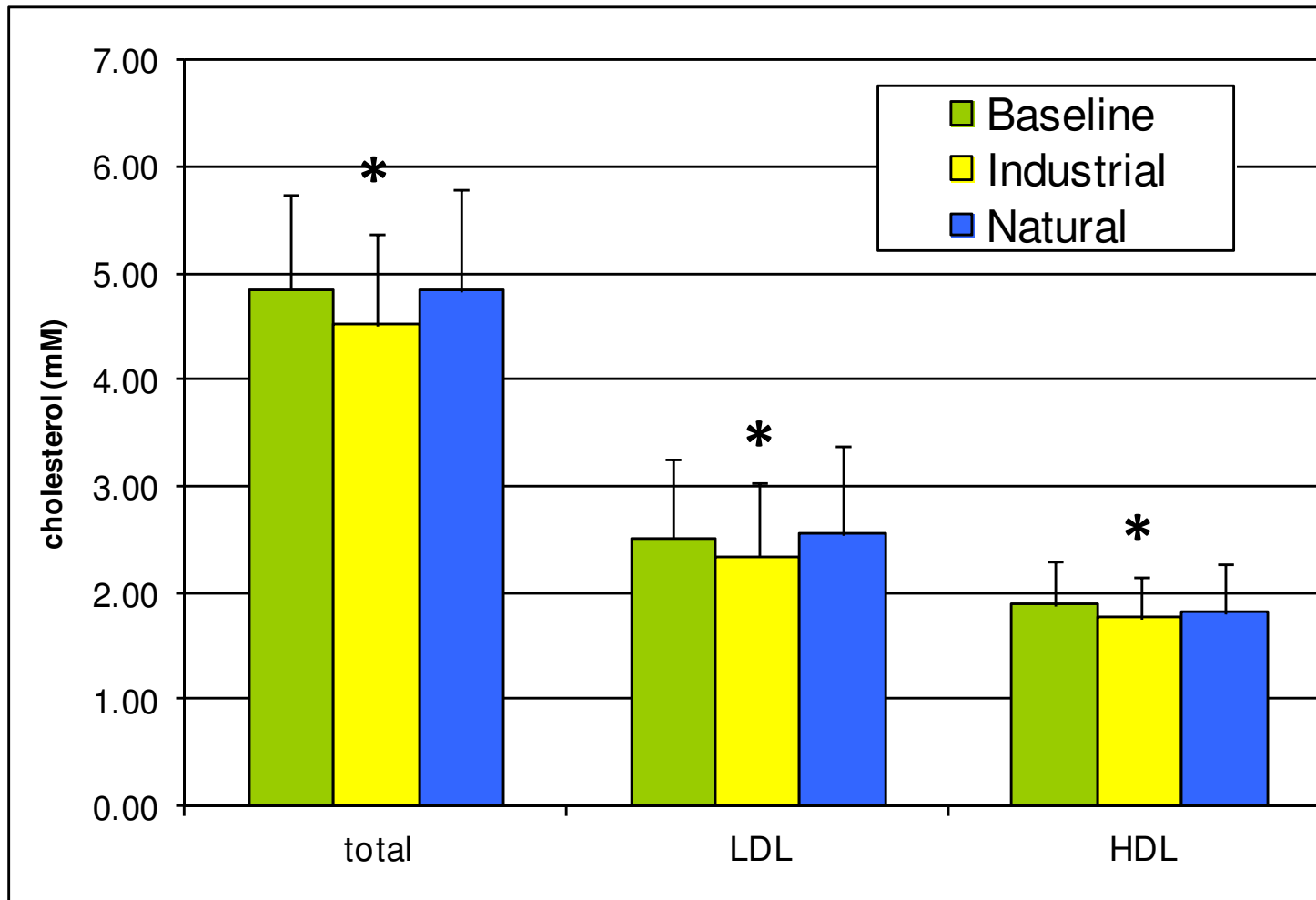
TRANSFACT

(Daily intake (% energy) of trans fatty acids)



TRANSFACT

Plasma & Lipoprotein Cholesterol



Butter: is it the dietary villain?

- The fatty acid composition of butter would predict that it would be relatively hypercholesterolaemic
- However, butter makes up a relatively small proportion of total saturated fat content
- There is potential to alter the fatty acid composition of milk and perhaps reduce impact of butter on cholesterol
- Still do not really know whether milk trans fatty acids are good or bad

Acknowledgements

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