

Genetics and nutritional quality of beef



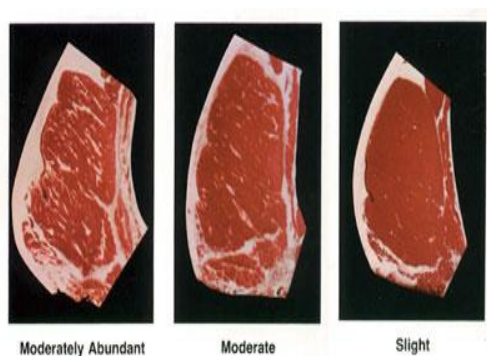
Professor Rainer Roehe



Leading the way in Agriculture and Rural Research, Education and Consulting

Meat quality

Carcass Quality



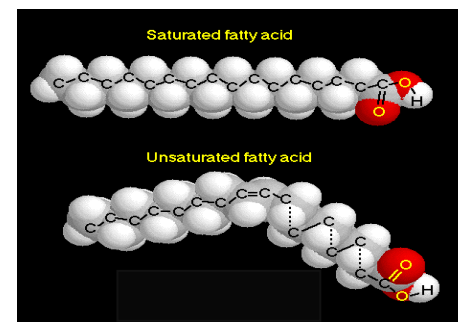
***Lean
Fat
Bone***

Meat Eating Quality



***Tenderness
Juiciness
Flavour***

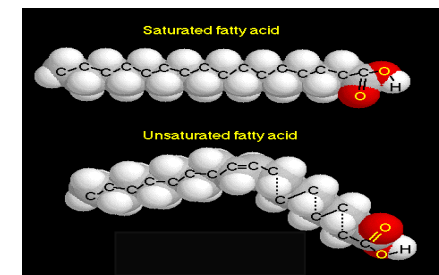
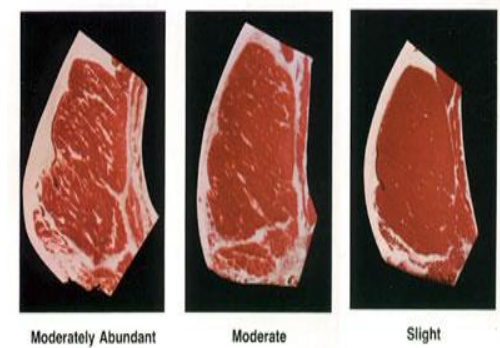
Nutritional Quality



***Proteins
Fatty acids
Minerals***

Healthy beef

- **Beef**
 - Very tasty source of food
 - High quality protein
 - Array of micronutrients
- **Concern**
 - High concentration of saturated fatty acids
 - Obesity
 - Cardiovascular disease
- **Improvement**
 - Change in fatty acid profiles



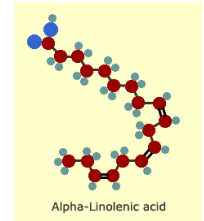
Healthy fatty acids for human diets



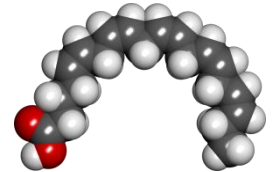
- **Omega-3 : metabolised from linolenic acid (C18:3)**
 - reduced risk of cardiovascular heart disease
 - reduced risk of cancer
- **Conjugated linoleic acid (CLA) cis-9, trans-11-CLA**
 - Cancer prevention
 - Decreased atherosclerosis
 - Improved immune response
 - Weight-loss-fat

Healthy fatty acids in meat

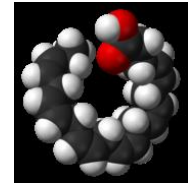
- **α -Linolenic acid (C18:3 n-3)**



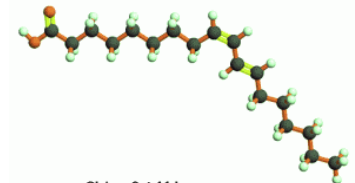
- **Eicosapentaenoic acid (EPA, C20:5 n-3)**



- **Docosahexaenoic acid (DHA, C22:6 n-3)**



- **Conjugated linoleic acid (CLA, cis9-trans11 C18:2)**



Fatty acid composition & health diet

— Linolenic acid:

- **Loin: 18 mg/100g (6 to 57 mg/100g muscle)**
- **Rump: 23 mg/100g (5 to 89 mg/100g muscle)**

— CLA

- **Loin: 16 mg/100g (3 to 54 mg/100g muscle)**
- **Rump: 23 mg/100g (2 to 91 mg/100g muscle)**

— EPA

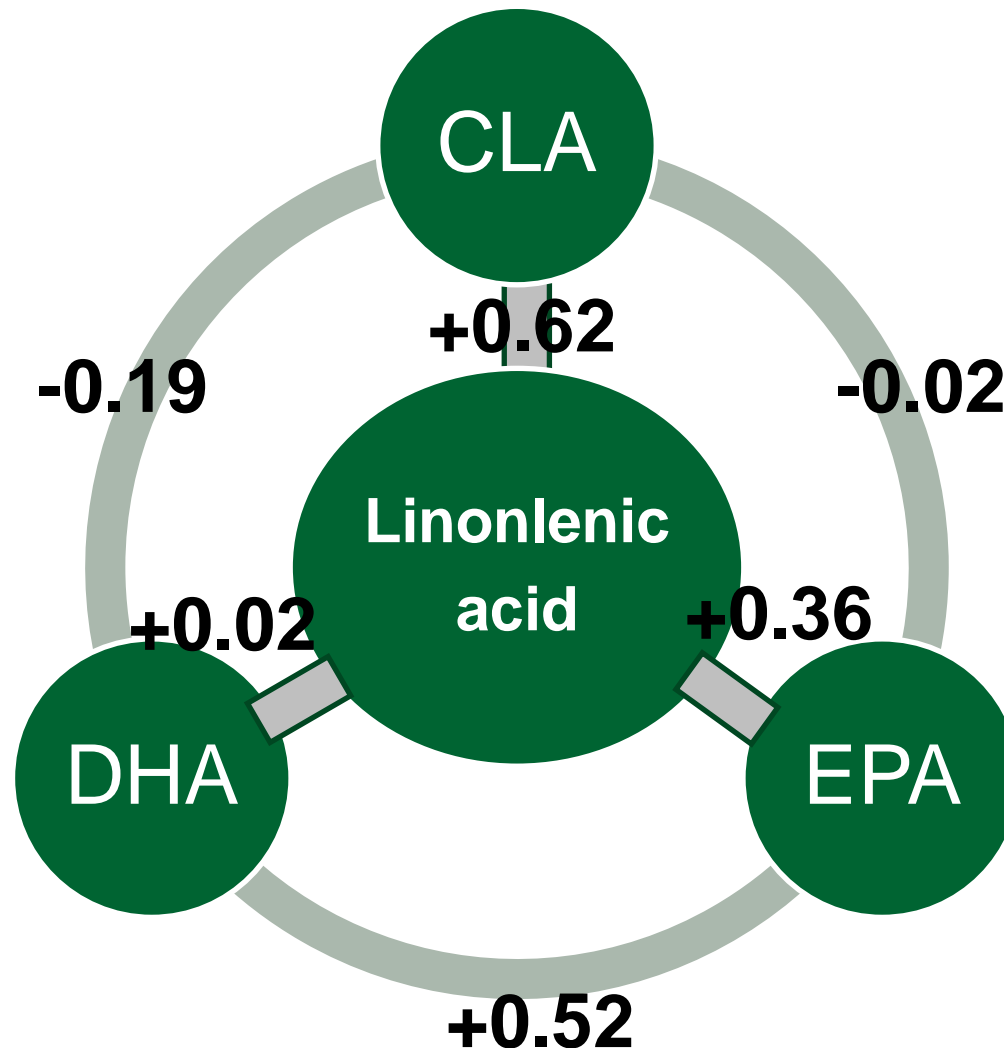
- **Loin: 6 mg/100g (1 to 20 mg/100g muscle)**
- **Rump: 13 mg/100g (3 to 35 mg/100g muscle)**

— DHA

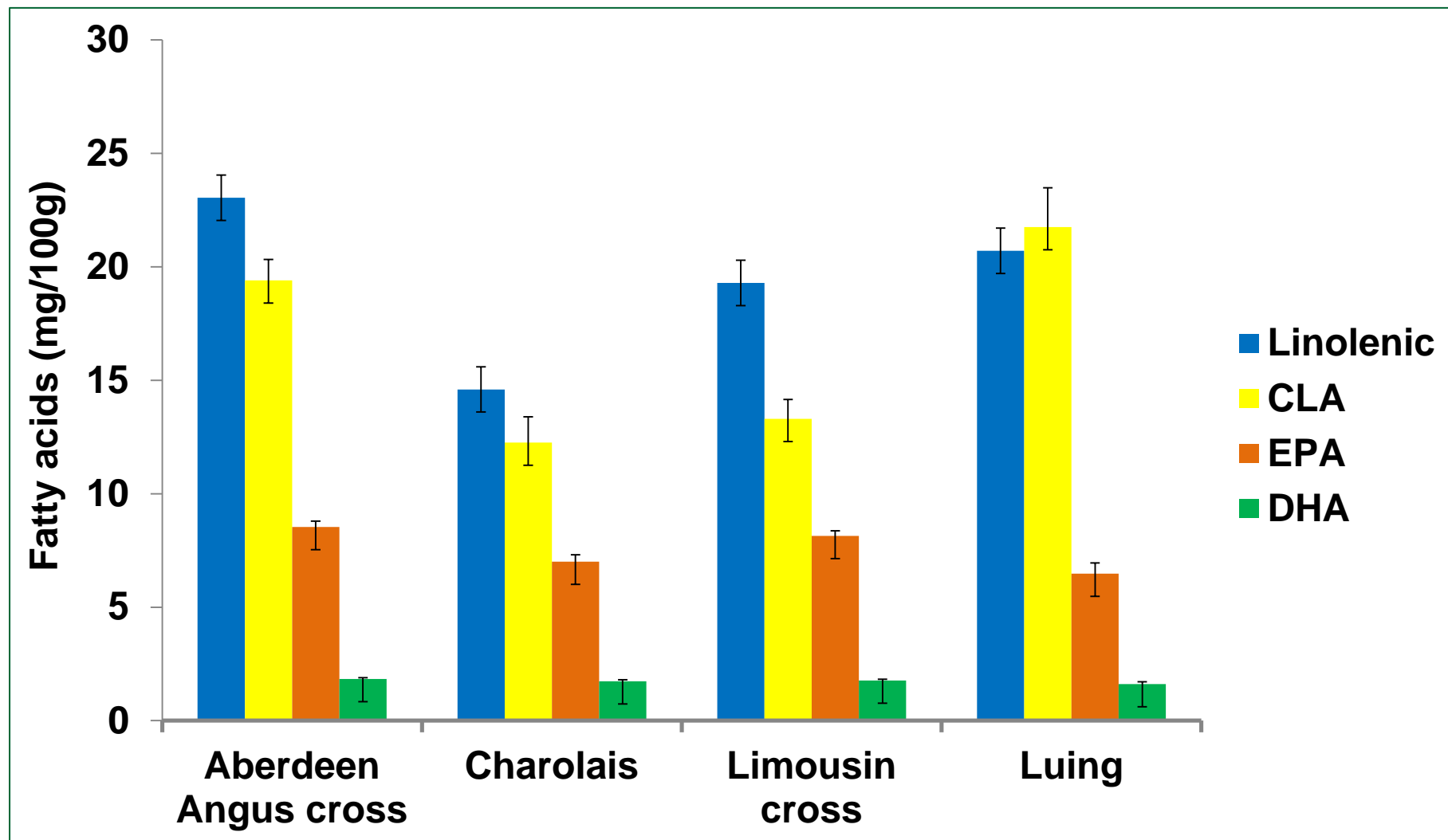
- **Loin: 2 mg/100g (0.5 to 3 mg/100g muscle)**
- **Rump: 3 mg/100g (1 to 6 mg/100g muscle)**



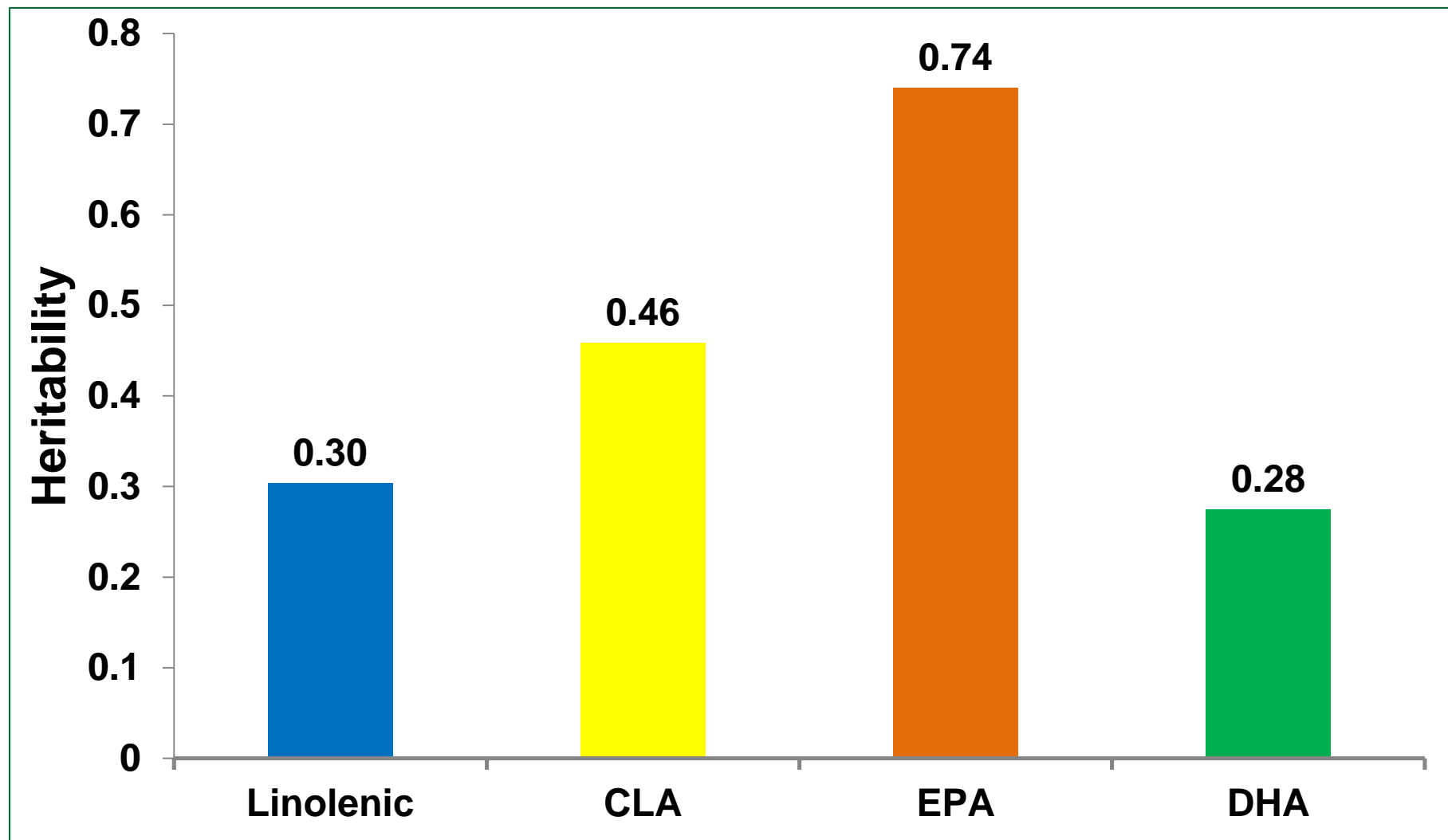
Phenotypic correlations among healthy fatty acids



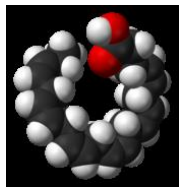
Fatty acids profiles of breeds



Heritabilities of fatty acids



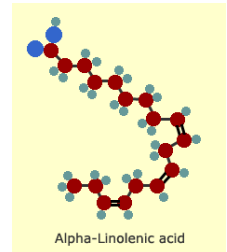
Prediction of fatty acids in loin meat using near infrared spectroscopy (NIR) in different breeds



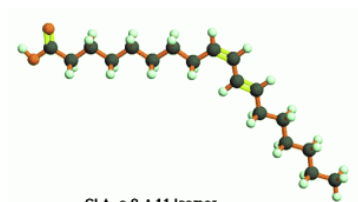
DHA
 $R^2 = 0.40$



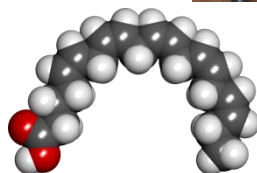
Linolenic
 $R^2 = 0.51$



CLA
 $R^2 = 0.28$

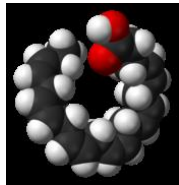


EPA
 $R^2 = 0.52$



Roehe *et al.* (2013)

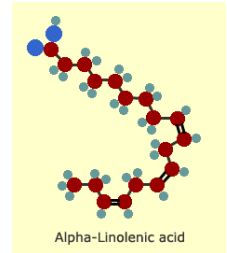
Prediction of fatty acids in rump meat using near infrared spectroscopy (NIR) in different breeds



DHA
 $R^2 = 0.65$

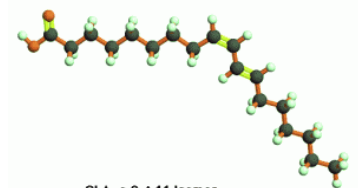


Linolenic
 $R^2 = 0.68$



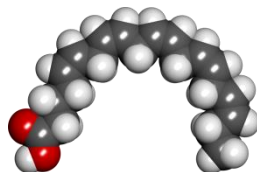
Alpha-Linolenic acid

CLA
 $R^2 = 0.59$

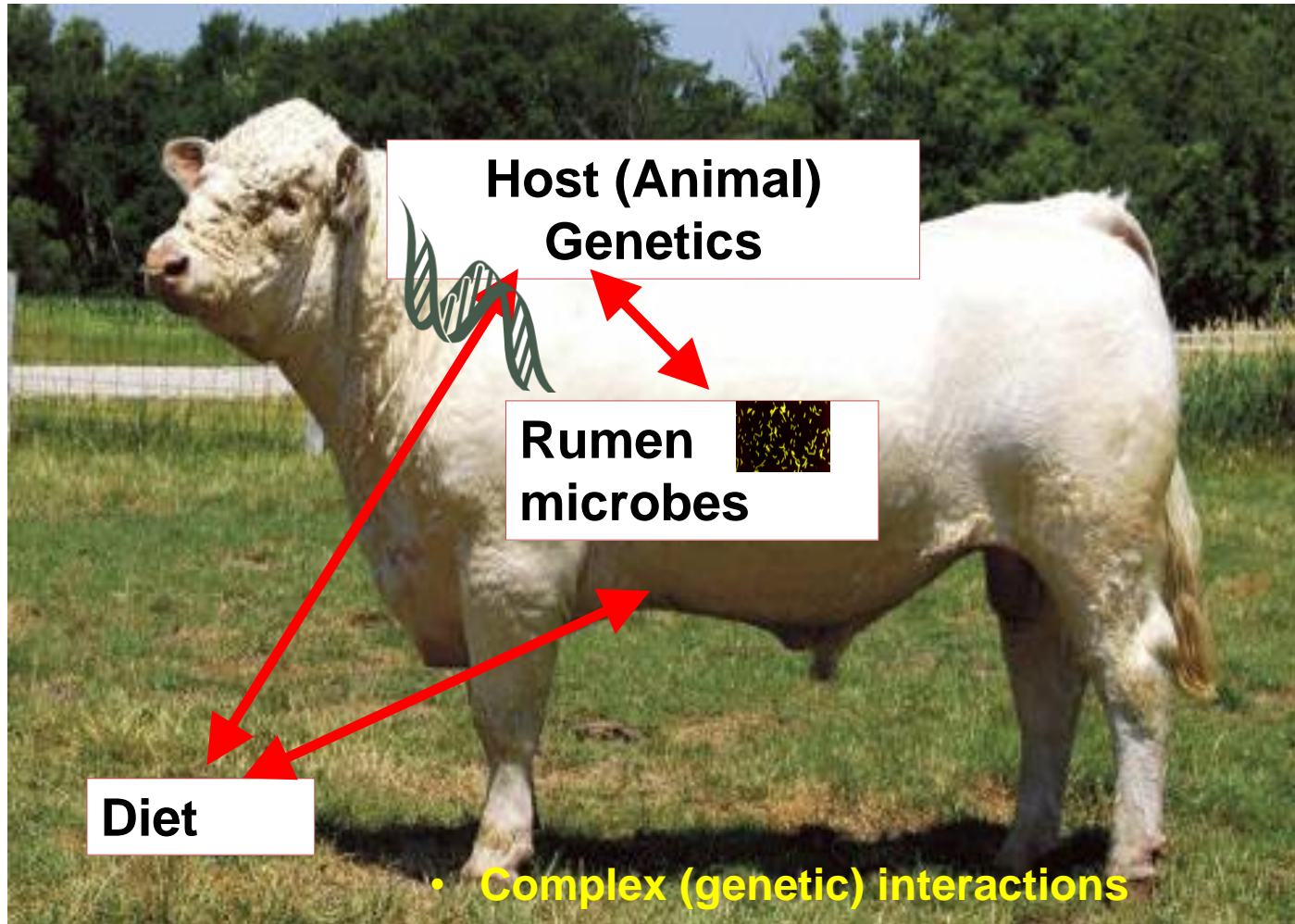


CLA- c-9, t-11 Isomer

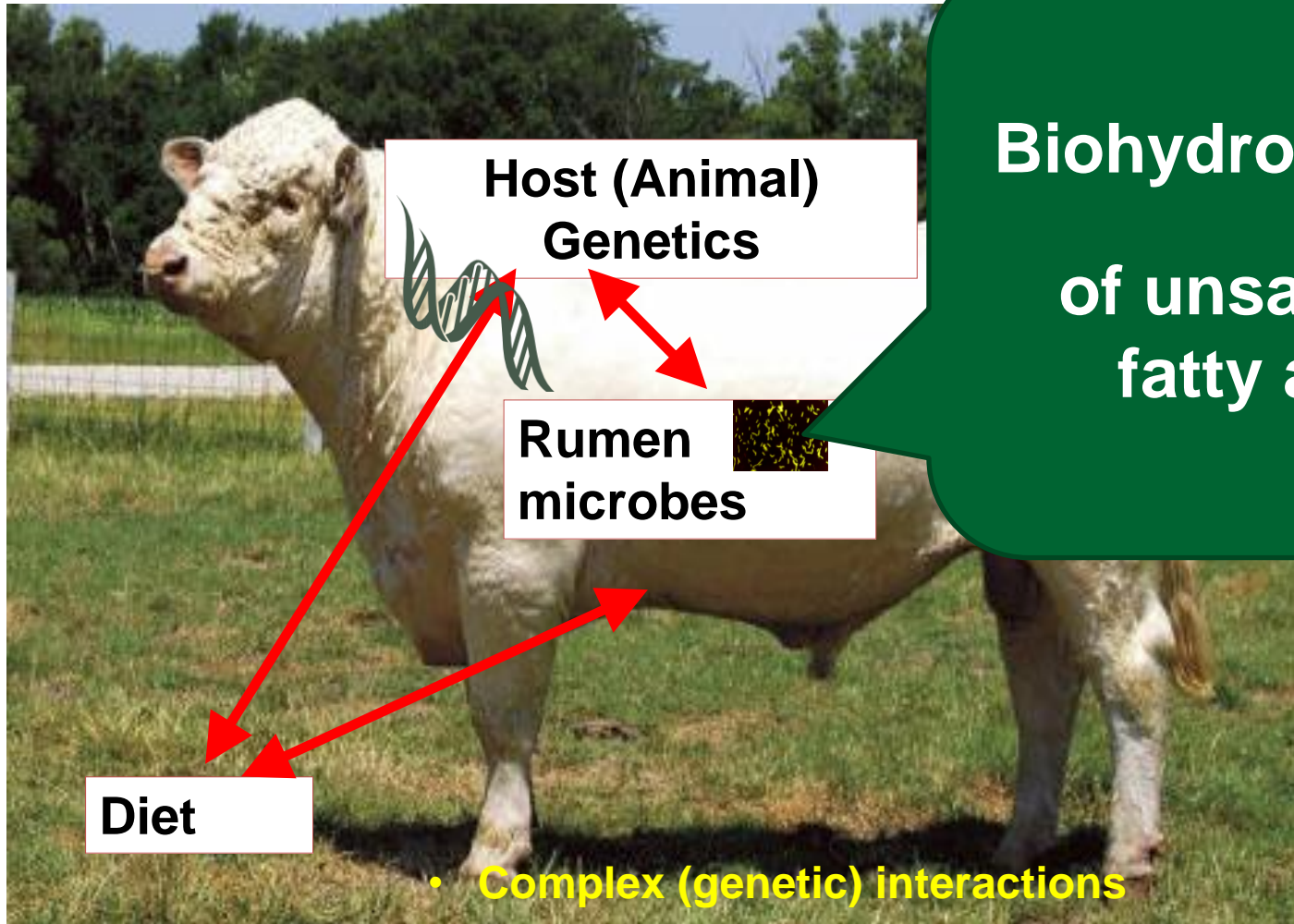
EPA
 $R^2 = 0.68$



Host Genetics, Diet, Microbiome



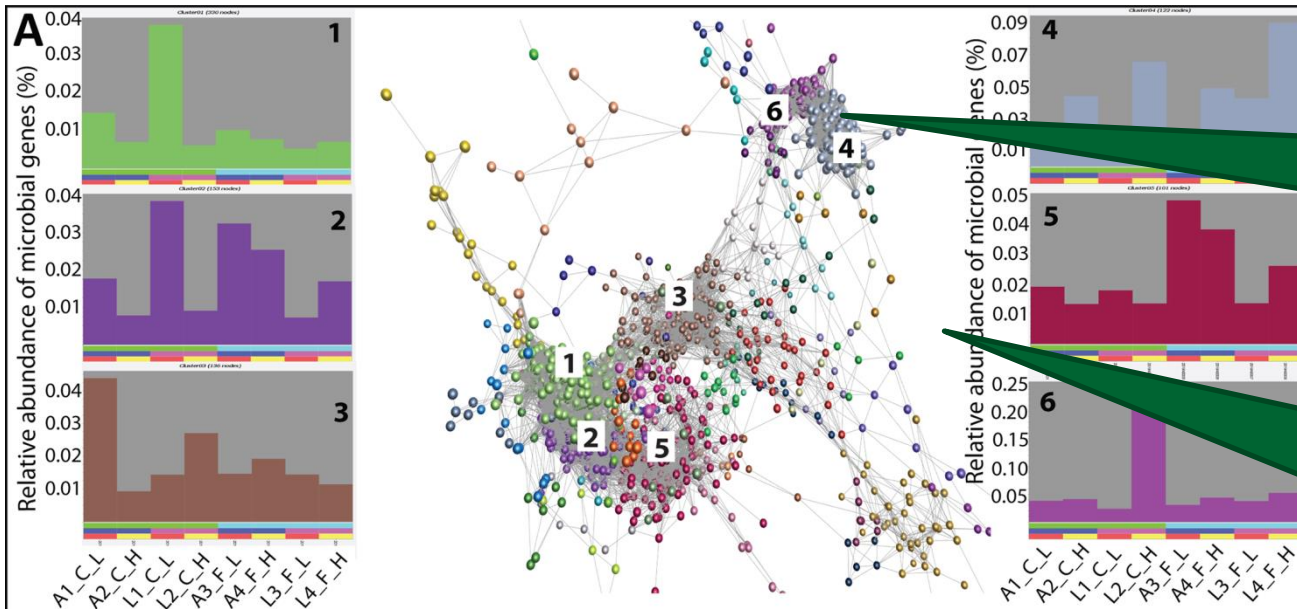
Microbiome & Fatty acids



Network of rumen microbial genes

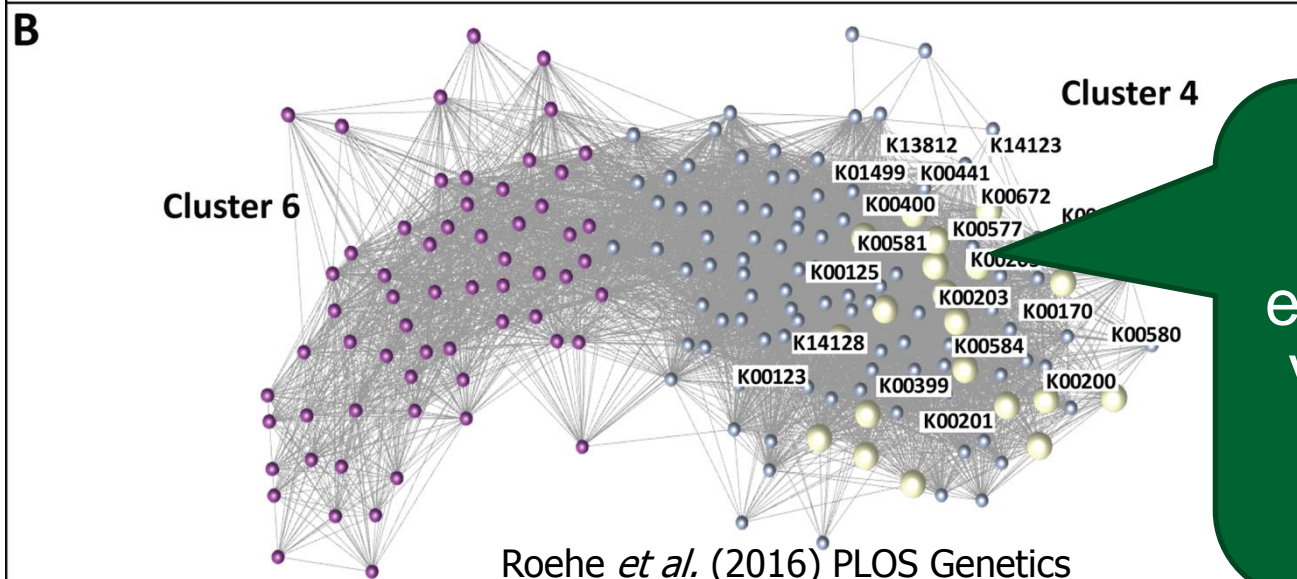


SRUC



Methane emissions

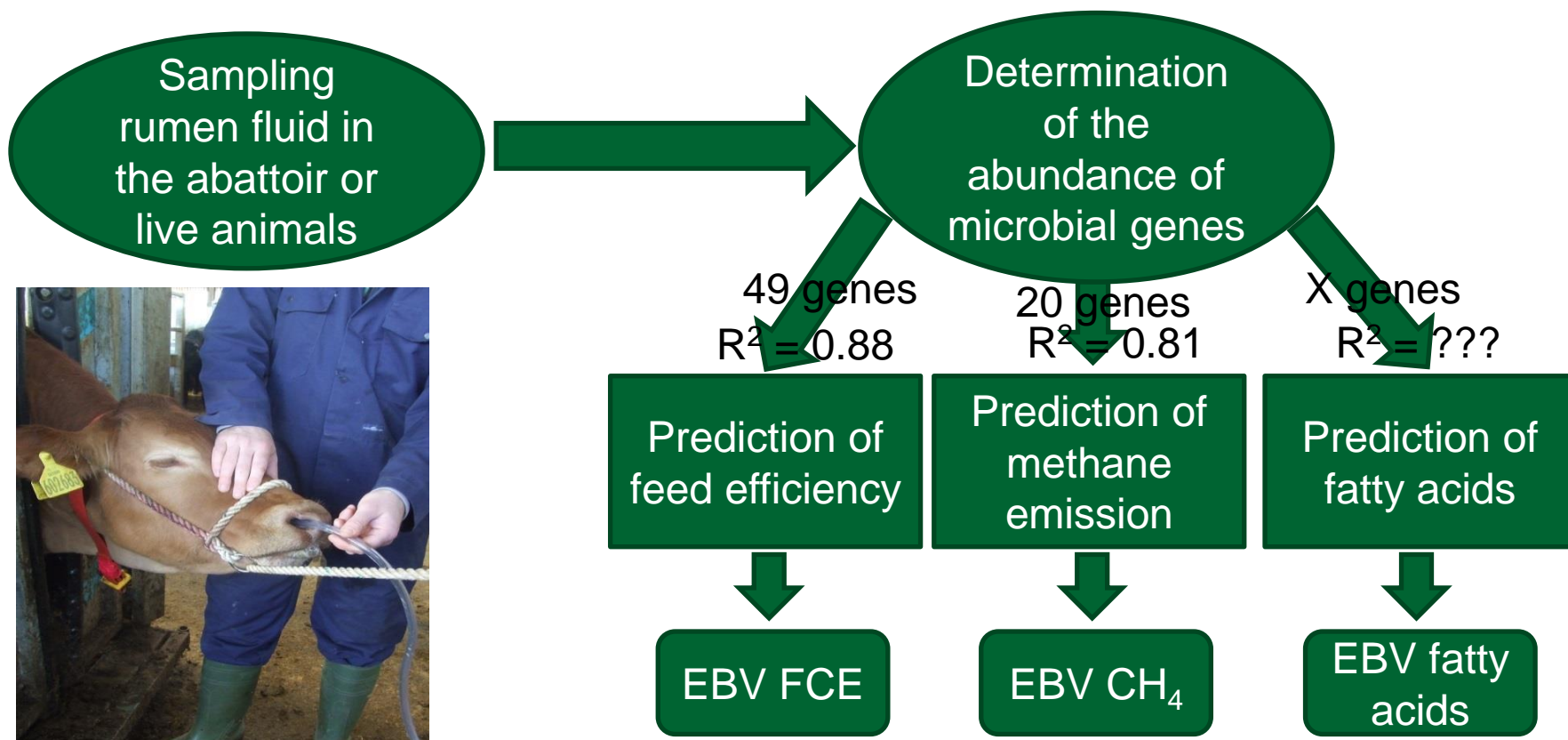
3970 microbial genes



20 genes explaining 81% of VAR in methane emissions

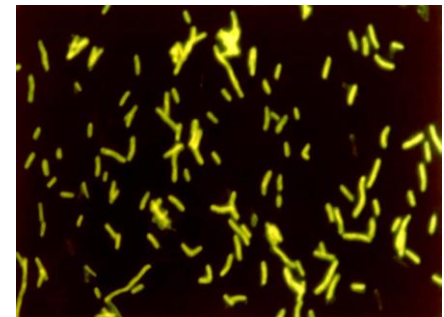
Roehe *et al.* (2016) PLOS Genetics

Selection using rumen microbial information



Conclusions

- **Omega-3 fatty acids and CLA**
 - Large variation between animals
 - Difference between breeds
 - Moderate to high heritabilities
- **Measuring**
 - Chemical analysis
 - Prediction using NIR
 - Prediction using microbiome
- **Determination of the microbiome**
 - Resulting in low biohydrogenation of FA related to human health



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- Other collaborators are shown below



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