TECHNICAL NOTE

SusCatt - Increasing productivity, resource efficiency and product quality to increase the economic competitiveness of forage and grazing based cattle production systems

Better nutritional quality in grass-fed milk and meat

Hannah Davis, Gillian Butler and Amelia Magistrali
School of Natural and Environmental Sciences, Newcastle University
E-mail: hannah.davis@newcastle.ac.uk

Challenge

Many in societies around the world fail to achieve sufficient intakes of long-chain omega-3 fatty acids (or n-3), potentially one cause of chronic physical and mental health conditions – hence dietary advice to eat oily fish. However, meat and dairy from cattle and sheep are major sources, in the absence of high-fish intakes – highly relevant since more of us eat dairy products and red meat than fish.

We can synthesise long-chain n-3 but the necessary metabolic pathway is thought to be swamped by excess omega-6 fatty acids (n-6) from our diets. So, if we are to enhance overall n-3 metabolism, it would be sensible to reduce n-6 intake, as well as eating more preformed long chain n-3. This poses the question: can we increase the long chain n-3 in milk and meat and reduce their n-6 content?

Aim

The nutritional quality of milk and beef depends on how we manage our cattle, what they eat has a direct impact on the nutritional composition of what we eat. By comparing organic and non-organic produce, we know feeding cereals or cereal by-products (concentrate feeds) to cattle diminishes n-3 and increases n-6 in milk and meat. In SusCatt, this comparison was taken to the next level - to evaluate the potential to improve nutritional quality further, by considering products from very extensive, grazing-based farming.

What did we do?

Several studies in SusCatt monitored the balance of fatty acids in different types of milk and beef, including from low-input systems where cattle eat nothing but forage (as nature

Cows at grass. Photo: Hannah Davis

intended for ruminants!) – grazing in summer and fed silage or hay in winter, when cold, wet conditions reduce plant growth.

Milk composition was considered across 5 different systems. Non-organic and organic (blue-top) milk was sourced from 5 different supermarkets on 3 occasions between April and October. The farm sourced milk came from 69 individual cows on 3 low-input farms feeding either a) 100% forage with no concentrates, b) 90% forage and 10% concentrates or c) 85% forage and 15% concentrates in the cows' diet - again collected 3 times between March and October. To put this into context, many non-organic farms might typically feed 30-50% concentrates and organic farms slightly less (certainly less than 40%).

The beef study considered non-organic and organic sirloin steak from 2 supermarkets, this time comparing them with meat from 2 certified 100% pasture-fed farms. We took the opportunity to also include meat from cattle primarily kept for vegetation management to enhance biodiversity. Strictly speaking these conservation steaks were not directly comparable with the others in the study since they were sourced at different times in the year (which we know influences composition) however it was a novel opportunity to investigate meat from these unusual systems.

What did we find?

Reporting fatty acid profiles can get confusing due to the vast number of fairly specialised results generated. Full results from these studies have been published (Davis et al. 2020a, Davis et al. 2020b, Butler et al 2021) and here we present only those likely to influence the long-chain omega-3 supply:

- sum of long-chain n-3 (EPA+DPA+DHA)
- ∝-Linolenic acid (ALA, C18:3, n-3) the precursor for long chain n-3 synthesis
- Linoleic acid (LA, C18:2) the main n-6 thought to block n-3 metabolism
- ratio of linoleic acid to ∝-linolenic acid (LA:ALA) thought to control n-3 metabolism

The 2 charts present concentrations of these fatty acids and their ratios in milk and beef from the various farming systems. They confirm the concept that feeding concentrate feeds to dairy cows or beef cattle is detrimental for the long-chain n-3 in their products – either the direct supply and/or the scope for synthesis, by increasing n-6 or LA content.

Milk is not particularly rich in n-3, although higher from 100% forage diets. However, the most striking difference between systems is the LA (n-6) content relative to ALA (n-3), with an incremental decline going from non-organic, organic, and diminishing levels of concentrate feeding. A switch from mainstream to dairy products from cows fed solely forage diets would reduce this ratio from nearly 4 :1 (4 parts 0f LA to every 1 of ALA) down to less than 1:1 - supplying more ALA than LA, which will help the overall dietary balance and potential to convert ALA to long-chain n-3.

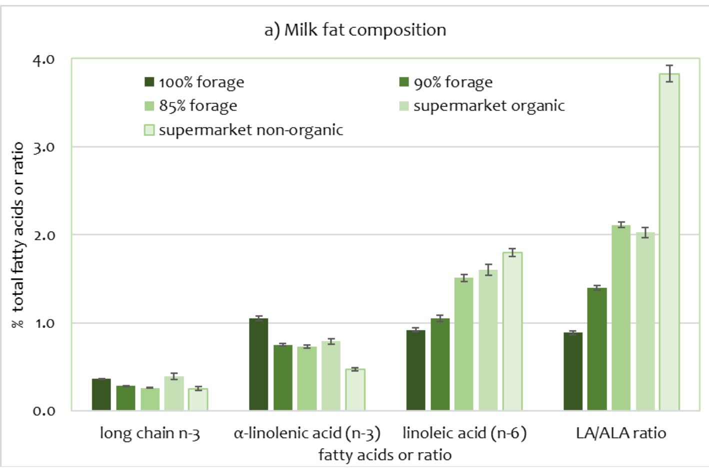

Figure a. Mean concentration of fatty acids in milk (± standard error of means) from 5 production systems

We see a different picture with beef; it is considerably higher in long-chain n-3 and ALA than milk, although the ratio with LA is also higher (ie poorer). All show clear differences between the farming systems – favouring meat from the extensive conservation and pasture production. System differences are less clear cut for LA content but the ratios relative to ALA range from around 2:1 for the beef from conservation and pastured cattle up to 7:1 for the non-organic beef. One really exciting result here identifies meat from extensive forage-based systems could legally be considered as a 'source of long chain omega-3 fatty acid' (unlike supermarket sourced steaks) (see: https://ec.europa.eu/food/safety/labelling_nutrition/claims/nutrition_claims_en) and the relative concentration of LA and ALA is likely to enhance further metabolic synthesis.

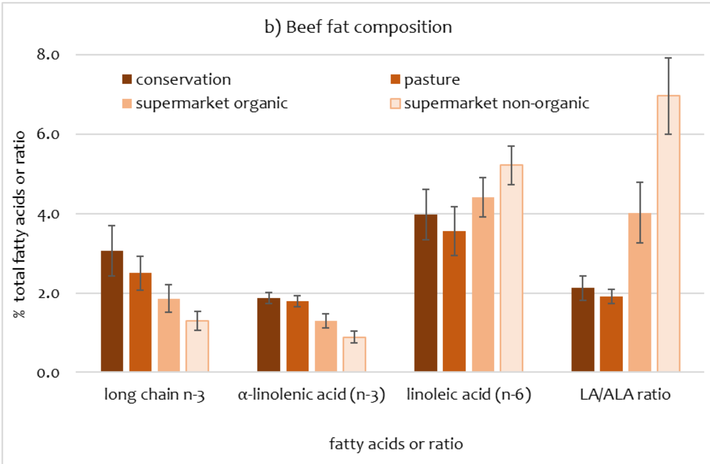

Figure b. Mean concentration of fatty acids in muscle tissue (± standard error of means) in sirloin steaks from 4 production systems

Conclusions

These results from SusCatt add to the evidence on the superior nutritional quality of products from extensive farming, highlighting the potential benefits from forage only feeding. In addition, they show the scope for certified pasture-fed beef to lessen consumer deficiencies in long chain omega-3 fatty acids consumption.

Imprint

Citing: Davis, H., Butler G. and Magistrali, A. (2020): Better nutriti-onal quality in milk and meat. SusCatt technical note 2.4.1 / 3.1.2. Download at https://bit.ly/2GT1OHF

References: Davis, H., E. Chatzidimitriou, C. Leifert and G. Butler (2020)a. "Evidence that forage-fed cows can enhance milk quality." Sustainability (Switzerland) 12(9).
Davis, H., S. Stergiadis, E. Chatzidimitriou, R. Sanderson, C. Leifert and G. Butler (2020)b. "Meeting Breeding Potential in Organic and Low-Input Dairy Farming." Frontiers in Veterinary Science 7.
Butler G., Mohamed Ali A.,Oladokun S., Wang J., David H. (2021) Forage - fed cattle point the way forward for beef? Future Foods 3 100012

SusCatt was possible by funding from SusAn, an ERA-Net co-fun-ded under European Union's Horizon 2020 research and innovation programme (www.era-susan.eu), Grant Agreement n°696231 and DEFRA (SCF0211)

Disclaimer: The contents of this technical note are the sole respon-sibility of the authors. Whilst all reasonable effort is made to ensure the accuracy of information contained in this technical note, it is provided without warranty and we accept no responsibility for any use that may be made of the information.

Review: Håvard Steinshamn
Editor: Håvard Steinshamn
Publishers: Consortium of the SusCatt project, c/Norwegian Institu-te of Bioeconomy Research, Norway