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RUMINANTS AND METHANE 4:4

Sustainable food and nutrient value

GHG EMISSIONS FROM RUMINANTS

In recent years, greenhouse gas (GHG) emissions from ruminants have gained increased attention. Anthropogenic emissions of enteric methane (CH_4) are estimated to be responsible for about 18% of global GHG emissions (Gerber et al, 2013). The most important GHG are methane (CH_4) and nitrous oxide (N_2O). Enteric emission of CH_4 from domesticated ruminants, arising primarily from the fermentation of feed in the rumen, are considered as one of the three largest sources of GHG on a global scale. The emission of methane by cattle and sheep results

in losses of carbon and energy (Johnson and Johnson, 1995). If the energy could be rechanneled into weight gain or milk production, it would increase production efficiency while reducing methane emission to the atmosphere. In pastoral ecosystem management, the challenge is to reach an equilibrium between pasture growth and animal intake. When proper grazing management practices are adopted, animal productivity is high while CH_4 emissions per kg of animal product is minimized (DeRamus et al, 2003). In Norway, GHG emission from ruminants are estimated to account for 4 % (SSB,



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2018) of the total national emissions while at the same time, the production and use of fossil fuels account for 80% of the emissions.

WHAT IS SUSTAINABLE FOOD?

Sustainable food is food that is healthy for consumers and produced in a humane, ecologically beneficial, socially responsible and economically fair way. That is a wide range of criteria, as true sustainability extends beyond merely reducing greenhouse gas emissions (Byloos, 2011). Enteric methane emissions from ruminants represents an important source of GHG emissions globally and reducing the intake of red meat is suggested to be one solution to reduce GHG emissions. Perhaps not so widely communicated are the many benefits of ruminants; their unique ability to digest and utilize nutrients from plants like grasses and convert this to food (meat, milk) with a high nutrient value and other products (wool, skin). Ruminants can harvest parts of their feed on areas not suitable for production of human food (grain, vegetables). Ruminants contribute to fertilize these areas (manure), keep the vegetation down to maintain an open landscape, maintain biodiversity and store carbon in the soil. Even though ruminants represent a source of GHG emissions, they also have a potential to contribute to carbon sequestration in soil through well managed grazing systems. The guidelines from ICCP (1996/2006) state that one can assume a carbon saturation of soils "... after a finite transition period ..." and that carbon gains and losses in most grazing lands are in equilibrium, assigning them zero

carbon sequestration. However, Stewart et al. (2007) suggest that soils subjected to frequent disturbance (such as grazing) may never approach an absolute carbon saturation level.

NUTRIENTS IN RUMINANT MEAT

During several years and for different reasons, red meat (meat from ruminants and pork) production has been under pressure due to nutrition and climate gas discussions. The national diet standards in Norway (Helsedirektoratet, 2016), as well as in many other countries (e.g. Nordic Nutrition Recommendations, 2012) and WHO, recommend a reduced intake of processed meat products and red meat, partly due to the content of salinity, saturated and trans-fatty acids. However, the content of protein is often high (20-35%) and in addition, red meat is an important source for vitamin B₆, vitamin B₁₂, iron, zinc and selenium in human diets. The EAT-Lancet commission (2019) recommend a shift towards healthy diets based on increased consumption of plant-based foods and substantially reducing consumption of animal source foods. The bio-availability of e.g. protein and zinc, however, is higher in meat than in most plant-based products and must be compensated with 10 to 30% higher intake of plant-based protein. This must be considered when composing a plant-based diet to assure that the recommended nutrient intake is achieved. In Norway, a change in the diet which reduce the meat production by 45% in 2027 compared to 2017, may result in 20-30% of the agricultural areas will go out of production. At the same time, it is estimated that about 16 000 man-labour years will disappear (Asheim et al, 2019).

Meat from ruminants produced on pasture is considered "healthier" than meat from ruminants fed on high grain-diets. This is due to the beneficial ratio of omega-6 (n-6) and omega-3 (n-3) fatty acids, n-6/n-3 in pasture-based meat. Meat produced with a high proportion of pasture has a higher content of n-3 fatty acids as in contrast to grain-based meat which is higher in n-6 fatty acids (e.g. Lind et al, 2009). Nutrient recommendations in a healthy diet of the n-6/n-3 ration is 3:1 (Simopoulos, 2002). A grain-based diet can cause a ratio of n-6/n-3 in the meat as high as 15:1 while a pasture-based diet can be as low as 2:1 (Lind et al, 2009).

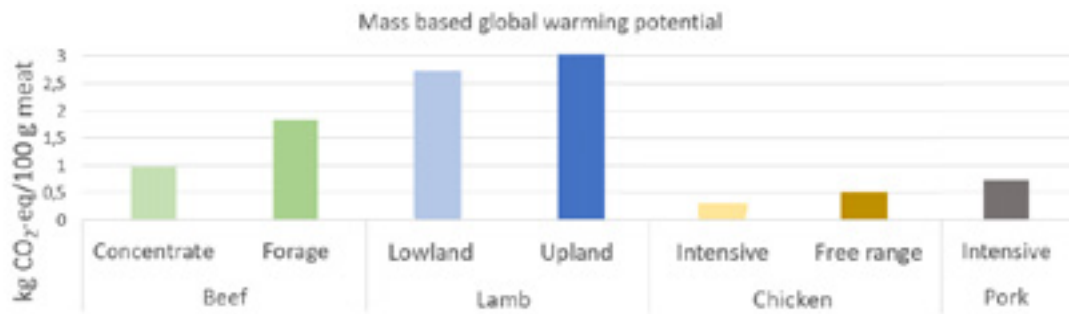


Figure 1a Mass-based Global Warming Potential for seven meat production systems (McAuliffe et al, 2018)

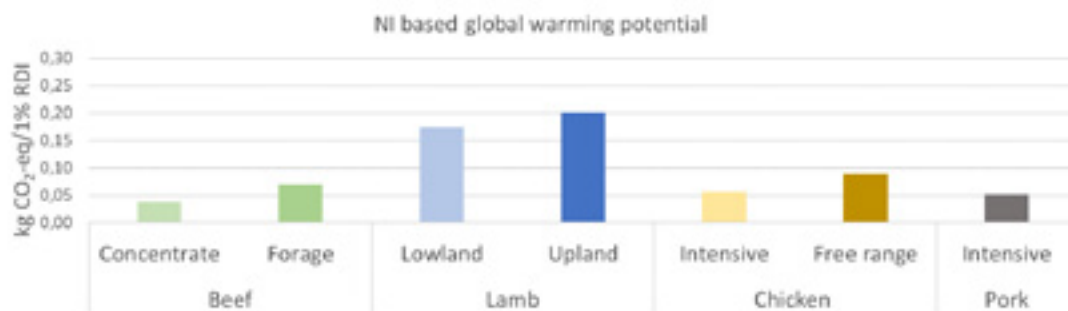


Figure 1b Nutrient index-based Global Warming Potential for seven meat production systems (McAuliffe et al, 2018)

REPORT ENTERIC METHANE EMISSIONS

Traditionally, enteric methane emissions from ruminants are reported as a mass-based index (g CH₄ / kg product (meat or milk)) which is useful when comparing different farming systems. However, it is becoming more recognized that the product quality also needs to be accounted for to truly understand the societal value of a farming system. In 2017, Saarinen et al. developed a method to combine nutritional and environmental aspects within the food life cycle assessment (LCA). The authors use a nutrient index (NI) including seven¹ or ten² beneficial and two³ detrimental nutrients to human health in red meat and relate this index to climate impacts (Saarinen et al, 2017). The methodological approaches were demonstrated by an assessment of 29 food products. The product systems included all main stages of the life cycle from primary production to consumption. Also, an approach was used as a general method for food LCA to take nutritional aspects into account.

1 NI_{prot,7}: Protein, MUFA (monounsaturated fatty acids), Eicosapentaenoic acid (EPA) + Docosahexaenoic acid (DHA), Ca, Fe, riboflavin, folate

2 NI_{prot,10}: NI_{prot,7}; vitamin B12, selenium, zinc

3 SFA (Saturated fatty acids), sodium

In 2018, McAuliffe et al. followed up the method developed by Saarinen et al. (2017). They compared meat from concentrate and forage fed beef, lowland and upland lamb, intensive and free-range chicken and intensive pork production was compared due to mass-based or quality-based Global Warming Potential (GWP). Figure 1a shows the difference in GWP for the seven categories of meat produced when expressed as mass-based or when expressed related to nutrient index (Figure 1b).

Looking at nutrient-based GWP in different production systems change the traditional way of expressing the GWP. When comparing beef with chicken and pork the differences are pronounced with forage-fed beef even better than free range chicken production. This could highlight that the effect of farming methods on product quality should be included rather than ignored in comparative studies. The presented results are likely to play a key role in sustainable livestock production and warrants future studies in this area.



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