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Environmental impacts of feed additives used in dairy production systems using LCA approach

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Introduction The reduction of enteric CH₄ in ruminant production represents both an environmental and a nutritional interest. The use of feed additives is an alternative that is being explored for reducing CH₄ emissions from ruminants (Martin *et al.* 2010). Production and use of feed additives, however, generate also GHG emissions and consumes resources that should be accounted for when assessing the environmental impact of their application. Through the FP7 project SMethane, we had access to enteric CH₄ emission measurement from *in vivo* experiments and to information on the industrial production processes of two plant additives. The objective of this work was to give a more holistic vision of the results obtained on animals in SMethane trials by assessing environmental impacts at the whole farm scale.

Material and methods Two reference systems, one with 11% of silage maize in the forage area (FA, T10%) and one with 33% of silage maize in the FA (T30%) were based on the work of Nguyen (2012). Eight virtual farms with the same usable agricultural area (55 ha) and the same total milk production (250 000 L of fat-and-protein-corrected milk) were then simulated. For additive 1 (Ad1) that was only given to cull cows, we created four sub-systems, two within each reference system in which the additive in one case decreased CH₄/kg DMI by 20.4% (Ad1 case 1) and in the second case it decreased CH₄ to the same degree and increased feed intake by 15 % (Ad1 case 2). For additive 2 (Ad2) that was given to producing and cull dairy cows, the simulation was made on the two reference systems. The additive 2 increased by 4.8 % CH₄ emissions by kg DMI (Ad2). For both additives, CH₄ emission and intake data were based on SMethane trials. The environmental impacts (climate change, eutrophication, total cumulative energy demand, acidification and land occupation) of the studied systems were calculated by the life cycle assessment (LCA) method (ISO 2006).

Results Climate change impact (Fig. 1) as well as other environmental impacts of the systems supplemented with additives decreased less than 1% as compared to the reference systems. The effect of Ad 1 on the environmental impacts of the farm was very low. This can be explained by the fact that Ad 1 was only given to cull cows, which represented one third of the herd, and only during 2 months of fattening. Ad 2 increased climate change impact by up to 2.5% and other environmental impacts were also negatively affected. The effect of Ad 2 on the environmental impacts of the T10% system was lower than those of the T30%. In contrast, additives intrinsically contributed to less than 0.1% for most environmental impacts studied, except for the energy demand of Ad 2. The contribution of Ad 2 that was 7.9 and 11.9% for T10% and T30%, respectively.

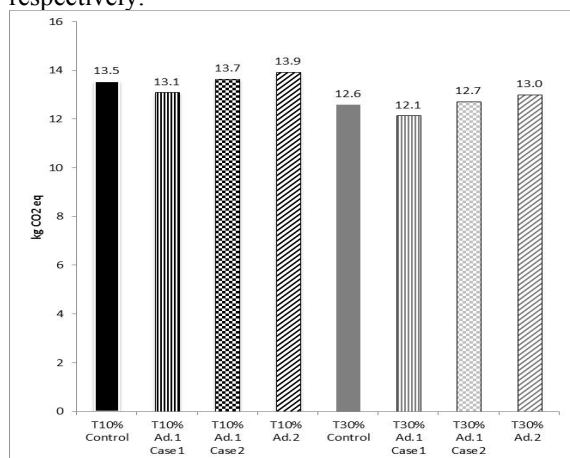


Figure1 Climate Change impact of two plant additives (Ad 1 and 2) for 1 kg of carcass weight of cull cow in eight virtual farms

Conclusions The additives tested in this work were either supplied to a small numbers of cows in the herd or they were marginally effective in reducing enteric methane emissions. Consequently, their supplementation did not affect farms' environmental impacts. The results also showed a weak environmental cost to produce additives, meaning that they have to be effective at reducing enteric methane and if they should be given to the majority of animals in order to reduce the environmental impact of the farm. Further work is needed to assess additives effects in beef production system.

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