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## Book of Abstracts

**Guest Editors: Massimo Trabalza-Marinucci (Coordinator), Cesare Castellini, Emiliano Lasagna, Stefano Capomaccio, Katia Cappelli, Simone Ceccobelli, Andrea Giontella**

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## O151

# Environmental impact of milk production in two samples of organic and conventional farms in Lombardy

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There is an increasing interest on organic milk (OM) production in Italy even because it is considered more respectful of the environment. However, literature shows inconsistent results, where OM production is associated with higher emissions of greenhouse gases and, on the contrary, lower levels of water and land acidification (AC) and water eutrophication (EU). Considering the overwhelming increase of OM production and the special features of dairy farms in northern Italy, the environmental impacts of conventional milk (CM) and OM production systems have been compared. In 2016, eight conventional and six organic dairy farmers in the Lombardy plain were interviewed about the technical and economical results in 2015. Environmental performances have been assessed according with LCA approach. The environmental effects that have been considered were global warming (GW), AC, and EU. Functional unit was 1 kg of FPCM. Calculations have been performed by a version of LatteGHG, taking into account carbon sink and estimating AC and EU.

Results showed some differences between the rearing systems considered. Data are reported as means ± SD. Herd sizes did not differ, but variability in O herds'size (330 ± 293) was larger than C ones (317 ± 110). FPCM production was significantly ($p<.05$) higher in C than in O farms (9004 ± 113 *vs* 7736 ± 1430, kg/cow/yr). There was no difference in GW (1.24 ± 0.180 *vs* 1.37 ± 0.305, kg $CO_2$eq), AC (0.025 ± 0.005 *vs* 0.026 ± 0.003, kg $SO_2$eq), and EU (0.0109 ± 0.0019 *vs* 0.0111 ± 0.0022, kg $P_2O_4^{3-}$eq) associated to 1 kg of FPCM in C and O respectively.

In conclusion, OM production has not improved environmental categories examined, even though O farms do not use mineral fertilizers and use lower amount of off-feeds. Probably the expected benefits have been compensated by the negative effect of solid manure management, that is more frequent in organic dairy farms, and by the higher FPCM production in C farms. This survey has given an initial snapshot of organic milk production in a dairy area in Italy.

*Acknowledgements*

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## O152

# Carbon footprint from a dairy farm with combined milk production and bioenergy systems

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Milk production is a source of greenhouse gas emissions (GHG), which mostly consist of methane ($CH_4$) from gastro-enteric fermentation and from manure management. Implementing mitigation strategies, such as electricity generation from manure anaerobic digester (AD) and photovoltaic (PV) system contributes to mitigate manure $CH_4$ emissions and fossil energy use for the dairy farm energy needs.

This approach allows to consequently reduce the environmental impact of milk production. In the present study to evaluate this approach, a Life Cycle Assessment (LCA) was performed to analyze the carbon footprint (CF) of milk production in a dairy farm (1368 animals), provided by an AD and PV systems.

"From cradle to farm gate" approach was chosen to detect the main environmental hotspots of milk production. The functional unit (FU) was referred to one kilogram of fat-and-protein-corrected-milk (FPCM). Beside milk product, other important co-products need to be considered are: meat and renewable energy production from AD and PV systems. AD plant was fed with a mix of manure and worse maize silage, not suitable for animal feed.

IPCC's tiered approach was adopted to associate a level of emission to each item in the life cycle inventory. A physical allocation was applied to attribute GHG emissions among milk and meat products. Renewable energy production from AD and PV systems were accounted discounting carbon credits due to the less $CH_4$ manure emissions and to the minor exploitation of fossil energy.

If mitigation options are not considered, CF of milk production was 1.36 kg $CO_2$eq/kg FPCM. Considering the integrated dairy farm with bioenergy system, the mitigation resulted from milk production by 0.29 kg $CO_2$eq/kg FPCM. AD had the highest reduction of GHG emissions, whereas PV system contribution in this case farm was negligible due to the small dimensions of the technology.

The results obtained on this study show that integrating dairy farms with bioenergy systems (AD and PV) is one of the successful strategies to mitigate the environmental burden of milk production. The main benefit of this approach is the offset of fossil energy use and a more efficient manure management. In this case farm a preliminary approach was adopted, nevertheless exploring different domains such as

technological, environmental and territorial features, social and economic ones, allows to achieve a more integrated LCA.

## O153

## Carbon footprint of PDO cheeses: Grana Padano and Gorgonzola

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The aim of the study was to evaluate the carbon footprint of two PDO Italian cheeses: Grana Padano and Gorgonzola.
Grana Padano is a hard long ripening cheese, composed by 65% of dry matter, consisting of 38% protein and 24% fat. Gorgonzola cheese, instead, is a blue soft cheese with a short ripening period composed by 58.6% of dry matter (28.7% fat and 21.4% protein).
The productive process of Grana Padano was studied at a cheese factory that in 2015 processed 86,165,255 L of milk, producing 183,611 cheese wheels, with an average yield of 7.6%. For Gorgonzola, a cheese factory was studied; in 2015, it processed 12,542,552 L of milk, producing 126,910 Gorgonzola wheels with an average cheese yield of 12.5%.
The Carbon footprint was quantified using Life Cycle Assessment (LCA) method, carried out through a "cradle to cheese factory gate" point of view. All data considered were referred to 2015 and the functional unit was 1 kg of cheese. Gas emissions of milk production, at farm level, were calculated using IPCC (2009) and EEA (2009) equations, then impact categories were evaluated using IPCC (2007) method. Both economic and dry matter allocations were applied.
Assuming the economic allocation and considering the whole productive process, Global Warming Potential (GWP) was 16.9 kg $CO_2$ eq. per kg of Grana Padano, higher than GWP of Gorgonzola that resulted 10.7 kg $CO_2$ eq. Using the DM allocation, the unitary GWP resulted 10.3 kg $CO_2$ eq. for Grana Padano and 6.0 kg $CO_2$ eq. for Gorgonzola. These different values are mainly due to the lower cheese yield of Grana Padano in comparison to Gorgonzola, which implies a higher unitary value of environmental impact.
The milk production at farm was the most important contribute of the GWP using an economic allocation at cheese factory (excluding ripening and packaging): 95.6% for Grana Padano and 90.3% for Gorgonzola.
The phase of milk processing slightly contributed to GWP of both cheese but some differences were observed: a higher use of cleaning products (0.54% *vs* 0.02% of GWP) for the sanitization of the plant and use of electricity, principally for air conditioning of cheese factory (5.79% *vs* 1.64% of GWP) for Gorgonzola and Grana Padano processing respectively.
The outcomes of this study highlight how, due to the multiple products produced at the dairy plants, the choice of the allocation method deeply affects of the environmental burdens of cheeses.

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## O154

## In vitro study of the effects of different tannin extracts on rumen ammonia and methane production

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Several feeding strategies have been proposed to mitigate $CH_4$ and $NH_3$ production. Dietary tannins may modulate the activity of rumen microbes and modify carbohydrates fermentation, lipid bio-hydrogenation and protein degradation. However, effect on rumen fermentation may significantly differ accordingly to the nature of tannins (i.e. condensed or hydrolysable tannins). Changes in $CH_4$ and $NH_3$ accumulation during in batch fermentation may be useful to compare the effectiveness of different tannins in the modulation of rumen metabolism. Four different tannin extracts have been compared: Mimosa (MT; *Acacia dealbata*) and Gambier (GT; *Uncaria gambir*) as condensed tannins and Tara (TT; *Casealpinia spinosa*) and Chestnut (CT; *Castanea sativa*) as hydrolysable tannins. Tannins were included at 4% of DM in a diet composed by barley, wheat bran, alfalfa hay, soybean cake, molasses and vitamin mix. Control (C) diet contained the same ingredients with the addiction of 4% of bentonite. Samples of rumen liquor were collected from 5 sheep, conditioned with the C diet, using a stomach tube connected to a manual pump. Feeds (2 g) were incubated in triplicate with 200 mL of inoculum filtered into a flask under a continuous flow of $CO_2$. The incubator consisted of a thermostatic chamber (39-40 °C) equipped with glass fermentation vessels provided with one inlets (to release gas through a valve) and connected to an electronic pressure transducer. Gas pressure inside the vessels was recorded every 30 seconds over 24-hours. $CH_4$ and $NH_4^+$ concentration was analysed at 0, 6, 12


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