CAN THE ADDITIVE "EFFECTIVE MICRO-ORGANISMS (EM)" REDUCE AMMONIA AND GREENHOUSE GAS EMISSIONS FROM SLURRY STORES?

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ABSTRACT

Experiments were carried out to investigate the influence of the additive "Effective Micro-Organisms (EM)" on NH_3 and GHG emissions from cattle and pig slurry stores. Emissions were measured from five 10 m^3-pilot scale slurry tanks with a large open dynamic chamber. The effect of the following treatments was investigated: cattle slurry with and without EM, pig slurry with and without EM, and pig slurry where EM (as EM FKE) had been used as feed additive in the pigs` feed. Addition of EM at the beginning of cattle slurry storage had positive environmental effects. A reduction in ammonia, nitrous oxide, and GHG emissions was observed. With pig slurry, EM addition at the beginning of slurry storage had no or negative effects on the emissions of CH_4, NH_3, N_2O, and greenhouse gases. The very low dry matter content of the pig slurry is very likely the reason for this phenomenon. EM addition to the pigs` feed declined emissions during pig slurry storage.

Keywords: *Slurry additive, manure management, methane, nitrous oxide.*

INTRODUCTION

The additive "Effective Micro-organisms ("EM") is distributed in Austria by Multikraft Ltd. EM is widely applied in horticulture, as feed additive (as EM FKE), in animal houses, as slurry additive, etc. It consists of several micro-organisms and it is anticipated that these reduce ammonia (NH_3), nitrous oxide (N_2O), methane (CH_4), and odour emissions from slurry stores. The experiments aimed at investigating the influence of EM on ammonia, and GHG emissions from cattle and pig slurry stores.

MATERIALS AND METHODS

Cattle and pig slurry was stored in five 10 m^3-pilot scale slurry tanks. A full description of the measurement technology can be taken from "Influence of different levels of covering on greenhouse gas, and NH_3 emissions from slurry stores" (these proceedings).

The effect of the following treatments was investigated: cattle slurry with and without EM, pig slurry with and without EM, and pig slurry where EM (as EM FKE) had been used as feed additive in the pigs` feed. The treatments "cattle_EM" and "pig_EM" received an EM addition of 1 l m^{-3} right after the pilot scale slurry tanks had been filled.

Cattle slurry was received from an Austrian farm that keeps 36 suckling cows (Simmental, Limousine and Murbodner) according to the regulations of organic farming. The suckling cows are fed grass silage, hay and some barley straw. The animal house has a slatted floor in the feeding area, lying boxes, and an outside pen.

Pig slurry for the treatments "pig_untreated" and "pig_EM" was received from a farm that keeps 300 fattening pigs on partly slatted floors. Slurry is diluted with rain and wash water and is stored in a below ground store outside the pig house. The pigs receive dry feed that consists of soya, peas, potato protein, barley, triticale, and maize. Pig slurry for the treatment "pig_EMfeed" was received from a farm with 35 breeding sows and 230 fattening pigs that are kept on partly slatted floors. The slurry is stored outside the house in a covered store. The pig feed consists of wheat, soya, CCM and a mixture of active agents. EM FKE is added to the active agents mixture.

Statistical data analysis was carried out with the software package SPSS, version 10.0. Regression curves were fitted to cumulative emissions. Differences in regression equations were tested with a pairwise comparison of regression parameters by the t-test. Level of significance was set to at least 0.05.

RESULTS AND DISCUSSION

Figure 1 gives an example of cumulated emissions that were measured from cattle slurry stores. More details can be found in Amon et al. (2004). Regression curves were fitted to cumulated emissions. Regression equation, and coefficient of determination are given in the respective figures. EM addition had no significant influence on methane emissions from slurry stores. They were predominantly determined by slurry temperature. An exponential correlation between slurry temperature and daily methane emission rates was observed (Fig. 2). The coefficient of determination was 0.9.

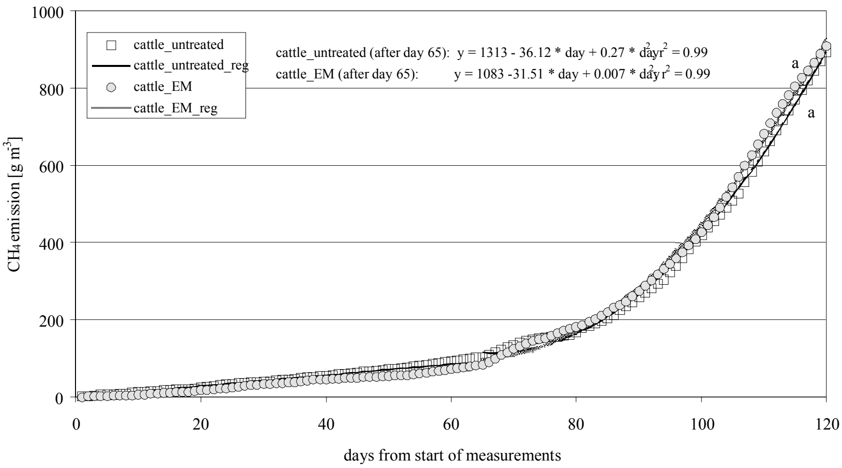

***Figure 1**. Cumulated methane emissions from cattle slurry with and without addition of EM*

Table 1 summarises CH_4, NH_3, N_2O, and greenhouse gas emissions during storage of cattle slurry with and without EM addition. Greenhouse gas emissions are given as CO_2 equivalents. Net total CO_2 eq. result from the addition of methane emissions * 21 and nitrous oxide emissions * 310 (Houghton et al. 1996). EM addition did not significantly alter CH_4 emissions. N_2O emissions were significantly lowered through EM. Net total greenhouse gas emissions were lower from EM amended cattle slurry than from untreated cattle slurry. Ammonia emissions and thus nitrogen losses during slurry storage were significantly reduced when EM was added to cattle slurry at the beginning of the storage period. Addition of EM showed a positive effect on the reduction of CH_4, N_2O, NH_3, and greenhouse gas emissions. Negative effects were not observed.

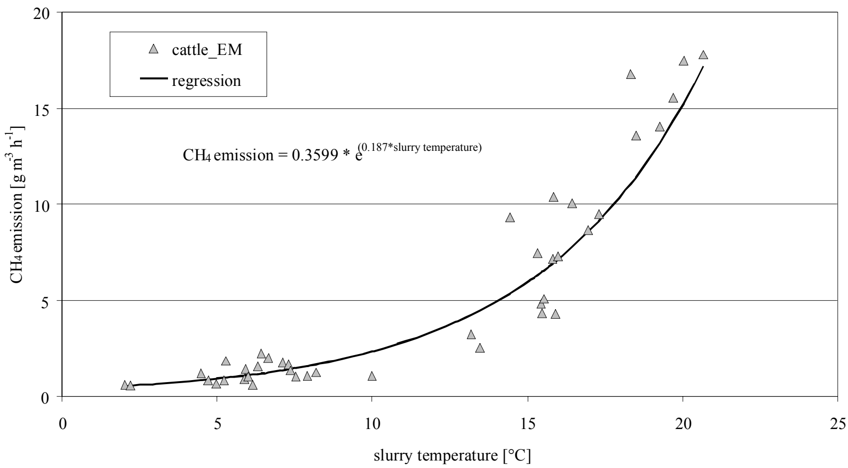

***Figure 2**. Correlation between daily methane emissions and slurry temperature (treatment: cattle slurry with EM addition)*

***Table 1**. NH_3, CH_4, N_2O and greenhouse gas emissions during storage of cattle slurry with and without EM*

Treatment	CH_4 [g m^{-3} slurry]	NH_3 [g m^{-3} slurry]	N_2O [g m^{-3} slurry]	GHG[a] [kg CO_2 eq. m^{-3}]
cattle_withoutEM	894.2	152.7	60.0	37.4
cattle_withEM	910.1	121.9	50.1	34.6

[a] GHG = greenhouse gas

Table 2 summarises CH_4, NH_3, N_2O, and greenhouse gas emissions during storage of pig slurry with and without EM addition, and of pig slurry that was received from pigs that were fed EM FKE. CH_4, and GHG emissions are given per kg of VS in the slurry. NH_3 and N_2O emissions are expressed as g per g of total nitrogen. The treatments “pig_withoutEM”, and “pig_withEM” had a very low dry matter content of 1.97 %. Dry matter content of the slurry “pig_EMfeed” was 5.40 %. Net total emissions can therefore not be compared if expressed as per g of slurry fresh matter.

***Table 2**. NH_3, CH_4, N_2O, and greenhouse gas emissions during storage of pig slurry with and without EM and of slurry from pigs where EM was used as feed additive.*

Treatment	CH_4-C [g (kg VS)$^{-1}$]	NH_3-N [g/ (kg N_t)$^{-1}$]	N_2O-N [g/ (kg N_t)$^{-1}$]	GHG[a] [kg CO_2 eq./ (kg VS)$^{-1}$]
pig_withoutEM	97.9	51.9	4.3	4.83
pig_withEM	99.8	58.7	5.3	5.37
pig_EMfeed	22.8	31.6	3.3	2.24

[a] GHG = greenhouse gas

Pig slurry without EM addition emitted 97.9 g CH_4-C (kg VS)$^{-1}$. When EM was added at the beginning of slurry storage, CH_4 emissions slightly rose to 99.8 g CH_4-C (kg VS)$^{-1}$. The difference was not significant. EM addition to the pigs` feed drastically reduced methane emissions during slurry storage to 22.8 g CH_4-C (kg VS)$^{-1}$. From untreated slurry, 51.9 g NH_3-N (kg N_t)$^{-1}$ were lost. EM addition at the beginning of slurry storage increased NH_3 emissions by *c.* 13 %. When pigs were fed EM, NH_3 emissions during slurry storage significantly decreased by *c.* 40 %. Addition of EM at the beginning of slurry storage led to an increase in net total nitrous oxide emissions. Untreated pig slurry emitted 4.3 g N_2O-N (kg N_t)$^{-1}$. When EM was added, cumulated emissions of 5.3 g N_2O-N (kg N_t)$^{-1}$ were measured. N_2O-N emissions from the treatment "pig_EMfeed" were *c.* 23 % lower than from untreated slurry. EM addition to the pigs´ feed reduces N_2O-N emissions during slurry storage. As with the other gases, a net total increase in GHG emissions was observed when EM was added only at the beginning of pig slurry storage. Feeding EM resulted in a *c.* 54 % reduction in GHG emissions.

CONCLUSIONS

Addition of "Effective Micro-Organisms (EM)" at the beginning of cattle slurry storage had positive environmental effects. Methane emissions were only to a small extent influenced by EM addition. A significant reduction in ammonia and nitrous oxide emissions was observed. Net total greenhouse emissions were lower with EM addition. In further experiments the impact of EM FKE addition to cattle feed on emissions during slurry storage should be clarified.

With pig slurry, EM addition at the beginning of slurry storage had no or negative effects on the emissions of CH_4, NH_3, N_2O, and greenhouse gases. The very low dry matter content of the pig slurry is very likely the reason for this phenomenon. Dry matter content was only 1.97 %, which is unusually low. Effective Micro-Organisms can not optimally develop in slurry with a very low dry matter content. Thus, the experiment will be repeated with pig slurry that has a higher dry matter content. Only then reliable information on the effect of EM addition on emissions during pig slurry storage can be obtained. EM FKE addition to the pigs´ feed significantly reduced emissions of CH_4, NH_3, N_2O, and greenhouse gases. EM addition to the feed has positive environmental effects on emissions during pig slurry storage.

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