# Evaluation of the methane production of livestock wastes : ultimate productivity and organic matter characterisation

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## INTRODUCTION

Livestock wastes could be used as an environmental benefit and this would include anaerobic digestion with the production of renewable energy. But, natural degradation of livestock wastes during the storage leads naturally to the release of $CH_4$ to the atmosphere.

Although maximum $CH_4$ production of cattle manure was systematically lower than swine manure's, a wide range of ultimate $CH_4$ yield values are available in the literature for each animal manure species.

## OBJECTIVES

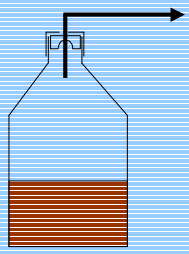
**In this context, the aims of this work were to :**

- **determine the influences of the method measurement on $CH_4$ ultimate productivity,**
- **identify the role of organic matter on $CH_4$ productions.**

## METHOD

Eleven products were studied including swine, cattle, calves and duck liquid manures.

### 1) Biogas and $CH_4$ measurements at 30°C



1. Pressure measurement,
2. Gas sampling,
3. Analysis of $CO_2$ and $CH_4$ by GC-FID,
4. Removing remaining overpressure.

Cumulating $CH_4$ and biogas ($CH_4$+$CO_2$) over time.

### 2) Organic matter composition

- Total volatile fatty acids (TVFA) by HPLC,

- Van Soest procedure was used to obtain total organic solubles, carbohydrates (cellulose and hemicellulose) and lignin fractions,

- Other organic solubles = total solubles–TVFA

## RESULTS

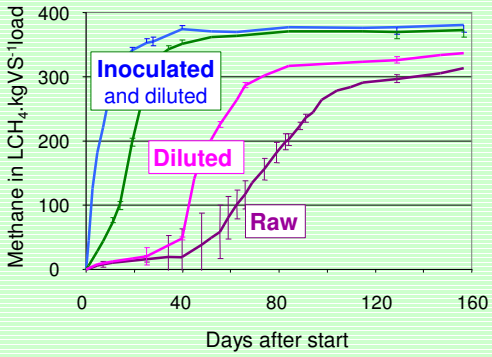
### Analytical conditions

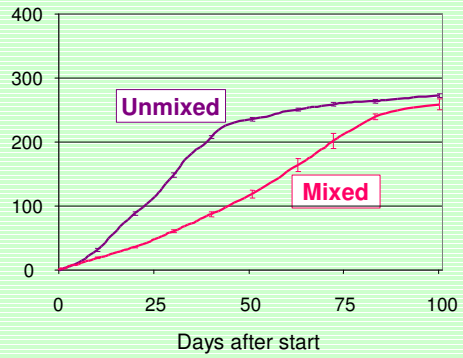
➢ **Organic matter lost up to 25%, linked to TVFA volatilisation, occurred during TS determination at 105° C and could affect significantly the ultimate methane productivity expressed on VS basis.**

➔ quantification of remaining TVFA in dried matter to know the amount lost are needed. Then corrections of TS and VS content were applied.

➢ **Positive effects of unmixing, of inocula (from slurry or vinasse) and/or dilution to obtain faster equal ultimate $CH_4$ yield** (expressed at 20°C and 1 atm)**.**

➔ whatever these incubating conditions, for a given slurry, similar ultimate $CH_4$ productivity values are obtained (excepted for those with organic load > 100 gVS.L$^{-1}$).




### Organic matter fractions and methane production

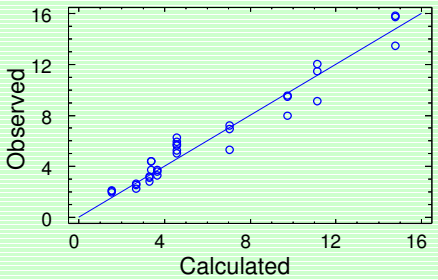
**A strong relationship** ($p<0.05$) is highlighted between $CH_4$ production (on raw slurries basis) and fractions concentrations. The relation ($r^2 = 0.98$) for $CH_4$ production from liquid manures in, **g $CH_4$-C.m$^{-3}$**, with 4 organic fractions in **g.L$^{-1}$**, is:

**$CH_4$-C = 0,75.TVFA + 0,54.Other Organic Solubles + 0,73.Hemicelluloses – 0,81.Lignin**

➔ Statistical analysis excludes the cellulose fraction from the model,

➔ Easily and quite easily biodegradable fractions, respectively the 2 soluble fractions and hemicelluloses have positive relationship on methane production,

➔ Lignin, known to limit biodegradation processes, shows a negative relationship.




Correlation between observed and estimated $CH_4$ productions.

## CONCLUSIONS

Analytical and incubating conditions could influence the ultimate methane productivity determination. A correction of TS as regard to TVFA lost and incubation with inoculum, dilution and without mixing, are recommended. The ultimate methane production is strongly linked to the characteristics of the organic matter which could be different for a given specie.