Quantification of zoonotic pathogenic bacteria in manures and raw digestates of three biogas plants

Christine Ziebal, Martine Denis, Céline Druilhe, Caroline Le Maréchal, Lorine Derongs, Elisabeth Répérant, Sandra Rouxel, Lorette Heurtevent, Typhaine Poezevara, Bérengère Nagard, et al.

Quantification of zoonotic pathogenic bacteria in manures and raw digestates of three biogas plants

Ziebal Christine[1,3], Denis Martine[2,3] Druilhe Céline[1,3], Le Maréchal Caroline[2,3], Lorine Derongs[1,3], Sophie Michel-Leroux[1,3], Repérant Elisabeth[2,3], Sandra Rouxel[2,3], Lorette Heurtevent[1,3], Typhaine Poëzévara[2,3], Boschet Evelyne[2,3], Nagard Bérengère[2,3], Martin Laure[2,3], Catherine Houdayer[2,3], Frédéric Barbut[2,3], Pourcher Anne-Marie[1,3]

1. Irstea, Rennes, France
2. Anses, Unité HQPAP, F-22440 Ploufragan, France
3. *Université Européenne de Bretagne, Rennes, France*

Introduction

On-farm anaerobic digestion (AD) which has expanded in Europe, produced biogas and a by-product (digestate) used as fertilizer. However, very few studies have been devoted to the effect of AD on the level of pathogenic bacteria. The study aims to evaluate the impact of mesophilic AD on the concentrations of zoonotic pathogenic bacteria (*Listeria monocytogenes, Salmonella* spp, thermotolerant campylobacters) and on indicator bacteria (*E. coli* and enterococci) in manures and in raw digestates sampled in three biogas plants (BGP).

Materials and Methods

Samples were collected in storage tank (manures) and at the outlet valve of the digester (raw digestates) from three BGP during a one-year period (8 sampling dates per BGP, 3 replicates per sampling date). Two digesters were fed with pig manure. The third digester was essentially fed with cattle manure. Indicator bacteria were enumerated on specific agar media. Pathogenic bacteria were quantified after an enrichment step by MPN. A total of 144 samples (72 inputs, 72 digestates) were analyzed.

Results

The pathogens have been detected in manure at a frequency ranged between 92 and 96%. They were also present in raw digestate at a frequency of 38% (thermotolerant campylobacters), 83% (*L. monocytogenes*) and 88 % (*Salmonella* spp.). The concentrations were lower in raw digestates than in manures. The average concentrations of thermotolerant campylobacters, *L. monocytogenes* and *Salmonella* spp. in raw digestates were 2, 23 and 5 MPN/g, respectively. The average levels of *E.coli* and enterococci (10^4-10^5 cfu/g in manure) decreased by 1 to 2 Log_{10} during AD.

Conclusion

Although mesophilic AD did not eliminate the pathogenic bacteria, it reduced their concentration. Raw digestates are not directly spread on agricultural land. It is thus likely that their post-treatment (*eg.* storage or post-digestion) also contribute to limit the spread of pathogens together with the digestate onto agricultural land.