Effect of food waste autoclaving on digestate usability

Elina Tampio[1], Saija Rasi[1], Jukka Rintala[2]

[1]MTT Agrifood Research Finland, FI-31600 Jokioinen, Finland, [2]Tampere University of Technology, FI-33720Tampere, Finland

Introduction

- Autoclaving is an efficient way to maintain hygienic quality of food waste (FW) and to facilitate material handling before and after anaerobic digestion
- Biogas production and ammonium nitrogen formation during anaerobic digestion have been reported to decrease after FW autoclaving in high temperatures due to formation of hardly degradable Maillard compounds
- Due to the reduced ammonium nitrogen content it is important to evaluate the fertilizer potential of the autoclaved FW digestate

Materials and methods

- Substrates: autoclaved (160 °C, 6.2 bar) and control food waste
- Digesters: 11-litre laboratory-scale semi-continuously stirred tanks reactors
- The energy use during digestate application calculated according to Finnish legislation, where the limit for digestate's total-N is 170 kgN/ha and for soluble-N 90 kgN/ha (barley cultivated on coarse mineral soil in Southern Finland)
- Energy consumption values for digestate application with tractor (Figure 1) were adopted from literature

Figure 1. The energy input during fertilization was defined as the fuel consumption of a tractor.

Results and discussion

The 40-50 % lower ammonium and soluble-N in the autoclaved FW digestate compared to the control indicated that the nitrogen molecules in the autoclaved FW digestate were not in easily plant available form (Table 1). While the phosphorus and potassium concentrations were also 20-40 % less compared to the control, the autoclaved digestate was evaluated to have reduced fertilizer value.

Table 1. Characteristics of studied digestates.

Composition (g/kgFM)	Control FW digestate	Autoclaved FW digestate
TS	68.1	78.8
TKN	8.7	7.8
NH4-N	4.5	1.7
P-tot	0.8	0.6
Soluble-N[a]	6.0	3.0
Soluble-K[a]	3.2	2.5

[a] 1:5 water extraction

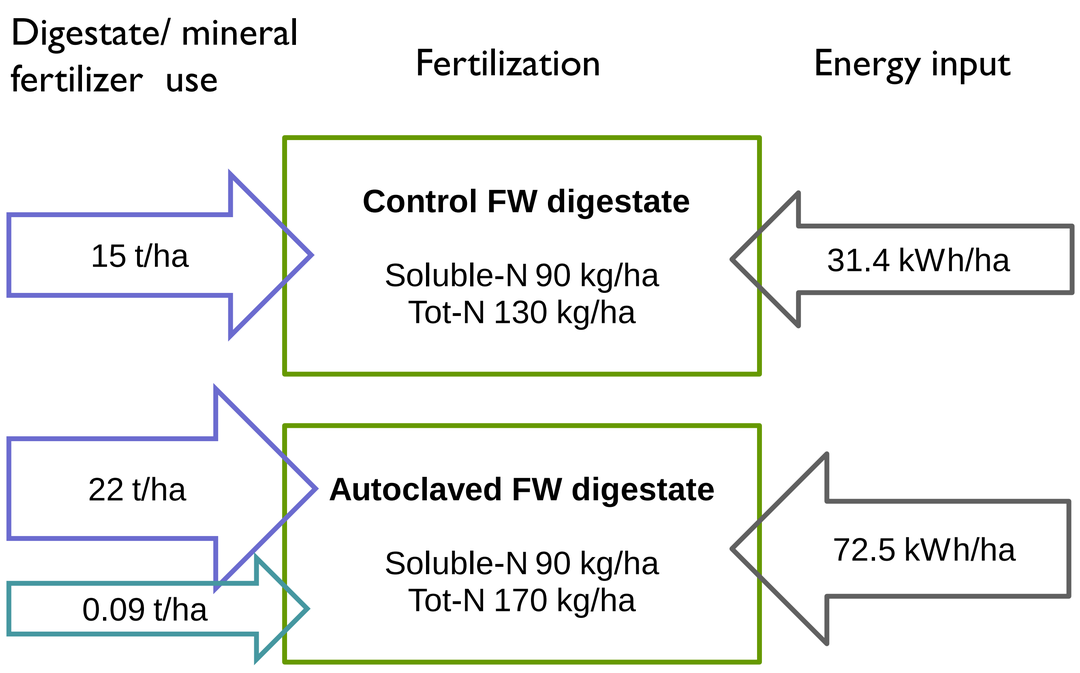

Figure 2. Digestate and additional mineral fertilizer use and energy input during fertilization with studied digestates.

With control FW digestate the application per hectare was calculated according to the soluble N limit, while the TKN limit was used with autoclaved FW digestate. Autoclaved FW digestate needed additional soluble-N fertilization to meet the soluble-N limit which is why mineral fertilizer was added.

Due to the lower soluble nitrogen content of the autoclaved FW digestate, the amount of digestate needed was 40 % higher compared to the control FW digestate (Figure 2).

The mineral fertilizer supplementation further increased the energy input of the autoclaved FW digestate application which was calculated to be 55 % higher compared to the control FW digestate.

Conclusions

The reduced nutrient content, increased digestate application volumes and energy input during application did not support the use of raw autoclaved FW digestate as fertilizer in agriculture.

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