



UNIVERSITÀ DEGLI STUDI DI MILANO

DIPARTIMENTO DI SCIENZE AGRARIE E AMBIENTALI:
Produzione, Territorio, Agroenergia
PRODUZIONE. TERRITORIO. AGROENERGIA

Milan, April 21, 2026

“Valorization of Poultry Manure through Anaerobic Co-Digestion with Locally Available Organic Waste” by
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This doctoral thesis presents a clear investigation into the sustainable management of poultry manure through anaerobic co-digestion. The work is in the context of circular economy principles and addresses a highly relevant environmental and technological challenge: the efficient treatment of nitrogen-rich agricultural waste while simultaneously producing renewable energy and recovering nutrients (through digestate). This aspect is important being Poland the first poultry producer in EU (paper D4, Figure 1)

One of the main aspects of the dissertation is the integration of theoretical background and experimental research (see the Scheme reported in Figure 1 and Paper D1, D2 and D3). The author started proposing a series of reviews, identifying key limitations of mono-digestion of poultry manure, particularly the unfavorable carbon-to-nitrogen ratio and ammonia inhibition—and justifying the need for co-digestion strategies (e.g. sewage sludge (see paper D4).

Interesting the co-digestion with sewage sludge (Paper D4) with interesting and conclusive result,

The study demonstrates that co-digestion of poultry manure with sewage sludge and other organic wastes significantly enhances methane production and process stability, with optimal performance observed at 20–40% manure content. This finding is supported by detailed monitoring of process parameters and provides valuable insights for both research and industrial applications. A discussion about sewage sludge quality (inorganic and organic pollutants) and the effect of it on final digestate quality can be of interest for readers taking into consideration, also, law aspects, i.e. waste vs. fertilizers (see e.g. EU fertilizer regulation).

Another notable contribution is the evaluation of digestate quality and its potential reuse (see Paper D5). The thesis goes beyond energy production and explores practical applications of digestate, including its use as a soil amendment and even as a component in mushroom cultivation. This multidimensional approach strengthens the relevance of work within a circular economic framework. Again, probably taking into consideration aspect linked to sewage sludge quality and the effect on digestate quality and product quality should be taken into consideration further as mushroom are marked as human food.

The research on process intensification through pretreatment methods represents a significant achievement (see Paper D6 and D7). The demonstrated increase in methane yield—up to 63% through thermo-alkaline pretreatment—highlights the innovative and applied nature of the study. These results have clear implications for improving the efficiency of biogas systems.



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The saponification of waste mix allowed an increase of biomass biodegradation (carbohydrates etc) increasing methane yield.

This paper reported interesting results under batch conditions that are far from the reality, but they serve better focalized further CSTR approach.

Scientific work represents a logical approach to poultry waste valorization through anaerobic digestion producing energy and recovering both organic matter and nutrient by digestate use, offering a interesting solution to manage poultry waste. Some questions remain about environmental and legal issues (e.g. organic pollutants) in the case of co-digestion with sewage sludge.

In summary, I conclude that:

- the reviewed doctoral dissertation demonstrates the doctoral candidate's general theoretical knowledge in the discipline of Environmental Engineering, Mining, and Energy, and proves her ability to conduct scientific work independently.
- the subject of the doctoral dissertation is an original solution to a scientific problem consisting of poultry waste valorization through anaerobic digestion producing energy.

In light of the above, the reviewed doctoral dissertation meets the requirements for doctoral dissertations set forth in Act of 20 July 2018 - The Law on Higher Education and Science (Journal of Laws of 2024, item 1571, as amended),