

# SINGLE-IMPACT FICHE

## MANURE PROCESSING TECHNIQUES

### IMPACT: ANTIMICROBIAL RESISTANCE

Data extracted in July 2021

**Note to the reader:** This fiche summarises the impact of manure processing techniques on ANTIMICROBIAL RESISTANCE. It is based on 1 peer-reviewed synthesis research paper<sup>1</sup>, including 98 individual studies.

#### 1. WEIGHT OF THE EVIDENCE

- **CONSISTENCY OF THE IMPACT:**

Different manure processing techniques showed different effects on antimicrobial resistance, at the stage of land application of treated manure, as compared to raw manure (see **Table 1**). The number of synthesis papers reporting positive, negative or no effect is based on the statistical comparison of the intervention and the control. The number of synthesis papers reporting relevant results, but without statistical test of the effects is labelled as "uncertain".

Either manure drying, composting, or anaerobic digestion, have positive effects on antimicrobial resistance (i.e. decrease of antimicrobial resistance, measured as the concentration of antibiotic resistant microbes and genes in environmental compartments after treated vs untreated manure land application) according to the 1 available synthesis paper.

Other techniques, namely pasteurization, anaerobic lagoon, storage, aerobic lagoon storage and (solid manure) pile storage showed no significant effect on antimicrobial resistance.

The reviewed synthesis paper include data collected in Europe (see **Table 2**).

**Table 1.** Summary of effects. The numbers between parenthesis indicate the number of synthesis papers with a quality score of at least 50%. Details on quality criteria can be found in the next section.

Impact	Metric	Intervention (Technique)	Positive	Negative	No effect	Uncertain*
Decrease antimicrobial resistance	Antibiotic resistant microbes/genes	Drying	1 (1)	0	0	0
		Composting	1 (1)	0	0	0
		Anaerobic digestion	1 (1)	0	0	0
		Pasteurization	0	0	1 (1)	0
		Anaerobic lagoon storage	0	0	1 (1)	0
		Aerobic lagoon storage	0	0	1 (1)	0
		Pile storage	0	0	1 (1)	0

\* Number of synthesis papers that report relevant results but without statistical test comparison of the intervention and the control.

- **QUALITY OF THE SYNTHESIS PAPERS:** *The quality score summarises 16 criteria assessing the quality of three main aspects of the synthesis papers: 1) the literature search strategy and studies selection; 2) the statistical analysis; 3) the potential bias. Details on quality criteria can be found in the methodology section of this WIKI.*

<sup>1</sup> Research synthesis papers include a formal meta-analysis or systematic reviews with some quantitative results. Details can be found in the methodology section of the WIKI.

## 2. IMPACTS

The main characteristics and results of the synthesis papers are summarized in **Table 2**. Summaries of the meta-analyses provide fuller information about the results reported in each synthesis paper, in particular about the modulation of effects by factors related to soil, climate and management practices.

**Table 2.** Main characteristics of the synthesis papers reporting impacts of manure processing techniques on antimicrobial resistance.

Reference	Population	Scale	Num. papers	Intervention (technique)	Comparator	Metric	Conclusion	Quality score
Goulas, A; Belhadi, D; Descamps, A; Andremont, A; Benoit, P; Courtois, S; Dagot, C; Grall, N; Makowski, D; Nazaret, S; Nelieu, S; Patureau, D; Petit, F; Roose-Amsaleg, C; Vittecoq, M; Livoreil, B; Laouenan, C 2020	Livestock waste and sewage sludge	Global	98	Six types of treatments were considered: aerobic and anaerobic digestion, aerobic and anaerobic lagoon storage, composting, drying, pasteurization and pile storage.	No treatment	Relative abundance of antibiotic resistance markers (ARG/MGE, e.g., number of antibiotic resistance genes copies in total microbial biomass estimated by number of 16S rRNA copies in environmental sample).	The authors obtained significant results for composting, drying and a (non-significant) trend for anaerobic digestion in reducing ARG/MGE relative abundance, when organic waste treatments were compared together in the same model. Thermophilic treatments showed greater reductions in ARG/MGE relative abundance than mesophilic ones after anaerobic digestion. Consequently, treatments with thermophilic phases should be implemented before the application of organic waste products on agricultural soils. Pasteurization resulted in non-significant effect, due to a large variability and low number of observations (N=4). Anaerobic or aerobic lagoon storage and solid manure pile storage have no significant effect on antibiotic resistance genes.	100%

## 3. KNOWLEDGE GAPS

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Goulas et al. Variability of confidence intervals across studies could be explained at least by the diversity of substrates (manure, sludge, milk or mixtures), the abundances of antibiotic-resistant bacteria before treatment, the diversity of microbial community, and/or the diversity and concentrations of antibiotics tested. To address those hypotheses, more replicates of studies are needed and deeper chemical and microbial characterization of the environmental matrices is needed. The authors also identified a knowledge gap on possible other manure processing techniques.

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