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Apple pomace anaerobically co-digested with swine manure for organic waste valorisation

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Introduction

The apple processing industry for juice, cider and jelly produces millions of tons of waste, since 25% of fresh fruit is discarded after processing (Dhillon et al., 2013a). One alternative for its valorization is its use as co-substrate for anaerobic digestion (AD), a profitable technology specially interesting for apple wastes (Awasti et al., 2021).

The objective of this study was to assess the AD performance of different proportions of apple pomace (AP) and swine manure (SM), under semi-continuous operation and mesophilic conditions (38°C), and to compare the results of biogas production and methane yield with the AD of SM alone.

Material and methods

- AP as solid fresh waste from the cider production in Asturias (Spain), with 265.4 ± 14.4 g volatile solids (VS) kg^{-1}.
- SM as centrate, collected after centrifugation from a farm in Narros de Cuéllar (Segovia, Spain), with 30.6 ± 4.5 g VS L^{-1}.
- The AD process was evaluated in terms of stability, methane production and biodegradability for a total of 240 days, divided in 3 periods (**Table 1**).
  The operational conditions of the initial period caused the destabilization of both reactors, therefore, the organic loading rate (OLR) and the hydraulic retention time (HRT) were adapted.

Table 1.Operational conditions for the AD process

	Days of experiment	OLR (gVS $L^{-1}d^{-1}$)	HRT (days)
Initial period	0 - 26	1.04	25
Period I	27 - 138	0.78	33
Period II	139 - 240	0.78	33

Results and conclusions

- They were obtained similar specific methane yields ($p<0.05$) when digesting SM alone and up to 15% of AP (on VS basis) in the feed mixture (Table 2).
- The addition of 30% of AP in the feed (on VS basis) produced a significative decrease in the specific methane yield, probably caused by a lower biodegradability due to lignocellulosic components (Dhillon et al., 2013b; Labatut et al., 2011) (**Table 2**).
- AP could be a good option as co-substrate for AD process with livestock wastewaters, valorizing these organic wastes especially the apple residues in a growing food sector and in a bioeconomy frame.

Table 2. Performance of the AD process for the different mixtures of AP and SM

		Apple pomace (%)	Biogas (mL day^{-1})	Specific methane yield (mL g^{-1} VS day^{-1})	VS reduction (%)
R1	Period I	0.0	3057 ± 1255	421.6 ± 153.6	30.3 ± 16.4
	Period II	7.5	3529 ± 542	412.3 ± 62.6	44.3 ± 15.9
R2	Period I	15.0	2827 ± 1135	381.8 ± 134.1	35.9 ± 10.5
	Period II	30.0	3029 ± 1130	341.9 ± 7.1	39.7 ± 14.5

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