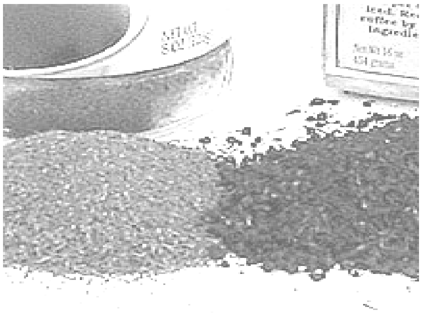
Biogas from coffee waste

Two case studies

Problem

Nestlé
Good Food, Good Life

- about 40 ton/day of coffee waste (solid content between 13 e 22%) – from coffee substitutes production
- Inicially disposed on land



Waste composition

Waste #	coffee (%)	Barley (%)	Rye (%)	Malted Barley (%)	Chicory (%)
 Eko	0	40	5	30	25
Ricoré 	45	32	0	0	23
 Pensal	0	100	0	0	0
Mokambo 	20	45	0	0	35
 Tofina	20	45	0	0	35

Other available wastes

- The factory has a WWTP producing 3.9 ton/day of sewage sludge (22%TS)

Case Study I

Co-digestion of coffee waste with sewage sludge

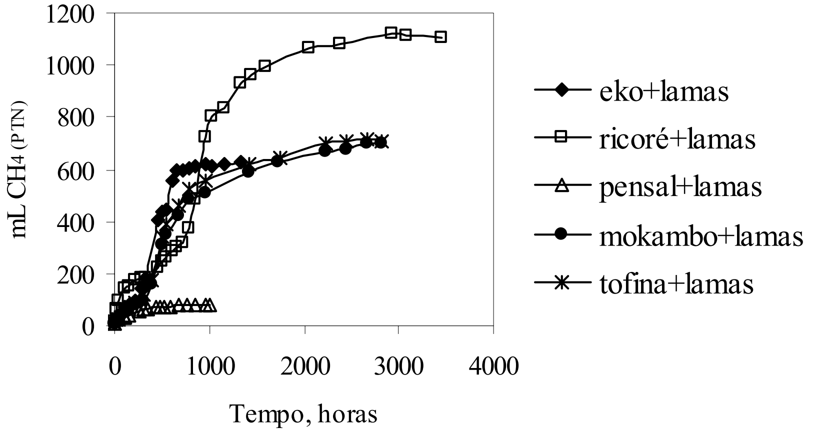
Lúcia Neves, Rosário Oliveira e Madalena Alves

Batch assays of co-digestion of coffee waste and sewage sludge

Experimental Conditions:

- ≈7g TS coffee waste/gTS sewage sludge – relative proportion of waste production
- 2.3 g TS waste (Coffee waste+sewage sludge)/g TS inoculum
- 6 to 9 % Total solids (TS) from the waste in the reactors

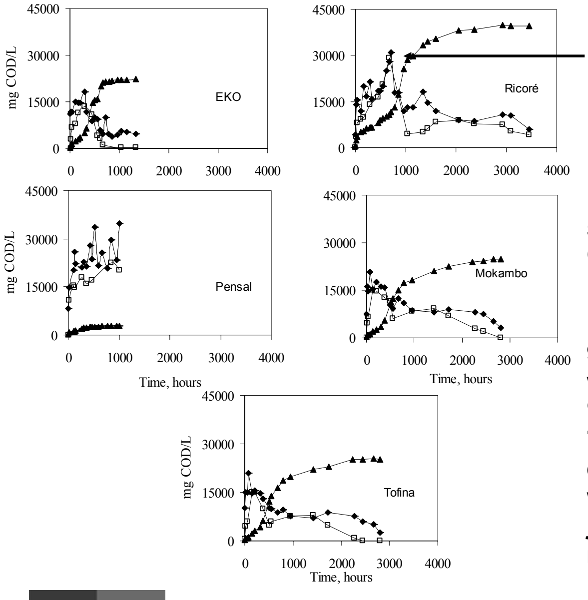
Results



Results

assay #	Methane Production (m^3 $CH_{4\ (STP)}$/ kg $VS_{initial}$)	(%) methanation	TS reduction (%)	VS reduction (%)
Eko	0.24	76	73	78
Ricoré	0.28	85	67	80
Pensal	0.02	10	31	40
Mokambo	0.25	75	50	79
Tofina	0.25	89	54	75

Results



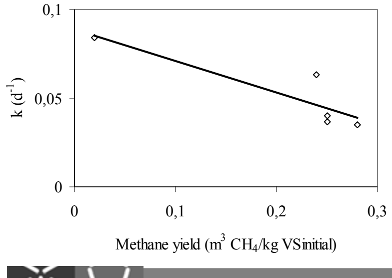
Maximum VFA concentration (29 g/l)

Soluble COD (◆), VFA (□) CH_4 (▲).

For all the assays 84 to 97 % of the initial COD was hydrolyzed, and the % of methanation was 75-89%, with the single exception of the barley waste which achieve just 10% of the maximum methane potential.

Results

assay#	Constante de hidrólise (d^{-1})
Eko	0.063
Ricoré	0.035
Pensal	0.084
Mokambo	0.040
Tofina	0.036



The highest the hydrolysis rate the lowest the methane yield.

↓

Probably there was some accumulation of intermediates (aromatic compounds?) that could be potentially toxic to the methanogens.

Conclusions

- TS reduction in the range 50-73%
- VS reduction in the range 75-80%
- Low values of hydrolysis constants... between 0.035-0.063 d-1
- However hydrolysis was not the rate limiting step
- Barley waste only achieved 10% of the maximum methane potential and TS and VS reduction of 31 e 40%, respectively.

Case Study II

Enhancement of methane production from a barley waste

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Universidade do Minho, Departamento de Engenharia Biológica

Two strategies

I) alcaline pré-hydroysis of the barley waste before the co-digestion with sewage sludge

II)Co-digestion of the barley waste with kitchen waste

I – Alcaline pre-hydrolysis (preliminary study)

- 0.3g NaOH/gTS , 24 hours, at 25º C.
- Followed by co-digestion with sewage sludge as previously defined.

$7gST_{coffee\ wastel}/gST_{sewage\ sludge}$
$2.3gTS_{substrate}/gST_{inoculum}$

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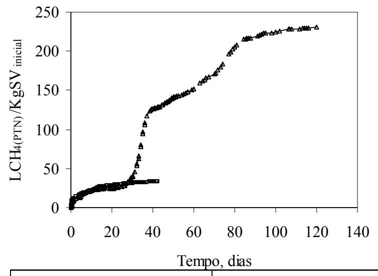
Results



#	$(LCH_{4(STP)}/$ kg $VS_{initial})$	metanation (%)	ST reduction (%)	SV reduction (%)
Without pre-treatment	25	11	31	40
With pre-treatment	222	100	67	84

II - Co-digestion of coffee waste with kitchen waste

+

Digester I
60% of kitchen waste +40% of barley waste

Digester II
100% of kitchen waste

TS in both digesters: 22%

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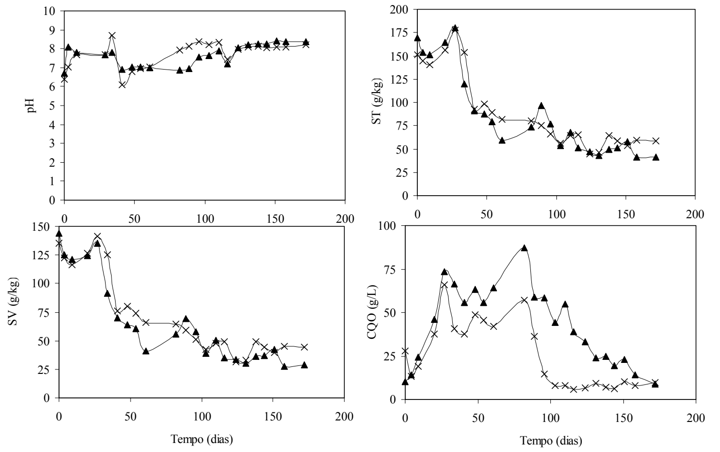
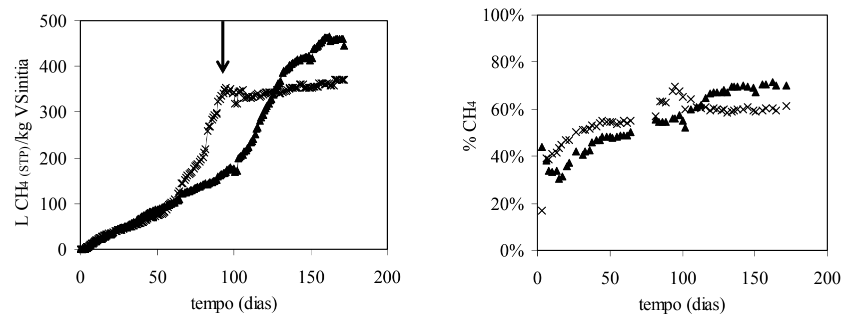
Results – pH, TS, VS and COD



Digester I (×) e Digester II (▲)

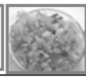
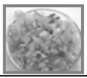
Results – methane production

Mixed wastes stabilized earlier than the kitchen waste



Digestor I (×) e Digestor II (▲)

Results

#	Methane production ($LCH_{4(STP)}$/kg $SV_{initial}$)	methanation (%)	TS reduction (%)	VS Reduction (%)
I  	**363**	**92**	**61**	**67**
II 	**432**	**83**	**75**	**80**

Conclusions

- The pre-treatment process should be optimized, but the preliminary results confirm its potential to enhance the biodegradability of the barley waste
- The addition of the barley waste to an existing AD plant working with organic or kitchen waste is feasible