Salinomycin and lasalocid adsorption/desorption by different soils and bioadsorbents from Galicia (NW Spain)

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INTRODUCTION

Salinomycin and lasalocid are polyether ionophore antibiotics commonly used in animal production as anticoccodia

These antibiotics are partially metabolised and excreted

These drugs enter the environment by direct deposition of urine and faeces on soil, or when manure is applied to soils as fertilizer.

The objective of this work was to investigate the adsorption/desorption capacity of salinomycin and lasalocid of three soils from Galicia (NW Spain) with different properties, and also that of the four residues previously indicated, which could be added to soils to improve the adsorption capacity of these antibiotics.

MATERIAL AND METHODS

SOILS

Soil	pH H_2O	CO	MO	N	Area	Limo	Arxila	eCEC	Ca	Mg	Na	K	Al
		%						$cmol_c\ kg^{-1}$					
ES	4,80	9,78	16,87	0,67	67,28	19,86	12,86	6,59	0,05	0,00	0,12	0,12	6,29
CS	7,97	10,49	18,08	0,85	53,00	28,00	19,00	63,24	55,18	4,97	0,70	2,34	0,04
GS	4,71	5,22	9,00	0,34	67,58	17,86	14,56	8,03	1,37	0,78	0,23	0,49	5,15

Corn soil (CS)

Grassland soil (GS)

Eucalyptus soil (ES)

BIOADSORBENTS

Parameter	Unity	Oak ash	Pine bark	Mussel shell	Olive residue
C	%	13,23	48,70	11,43	46,19
N	%	0,22	0,08	0,21	0,89
C/N		60,14	608,75	55,65	52,08
pH H_2O		11,31	3,99	9,39	5,95
Ca_e	$cmol_c\ kg^{-1}$	95,00	5,38	24,75	10,45
Mg_e	$cmol_c\ kg^{-1}$	3,26	2,70	0,72	2,86
Na_e	$cmol_c\ kg^{-1}$	12,17	0,46	4,37	0,1
K_e	$cmol_c\ kg^{-1}$	250,65	4,60	0,38	3,46
Al_e	$cmol_c\ kg^{-1}$	0,07	1,78	0,03	0,09
eCEC	$cmol_c\ kg^{-1}$	361,15	14,92	30,25	16,96
Sat Al	%	0,02	11,93	0,10	0,53
P Olsen	$mg\ kg^{-1}$	462,83	70,45	54,17	73,55

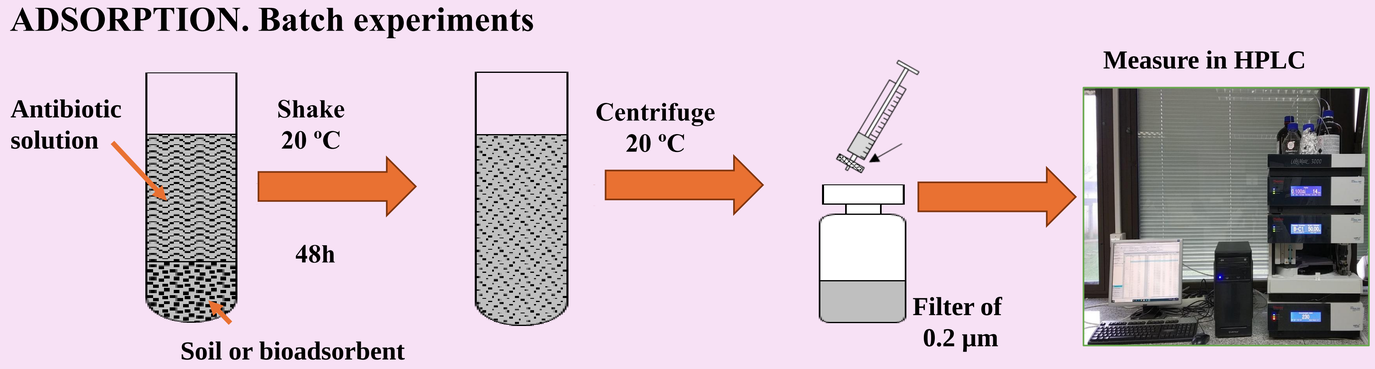
Mussel shell

Olive residue

Pine bark

Oak ash

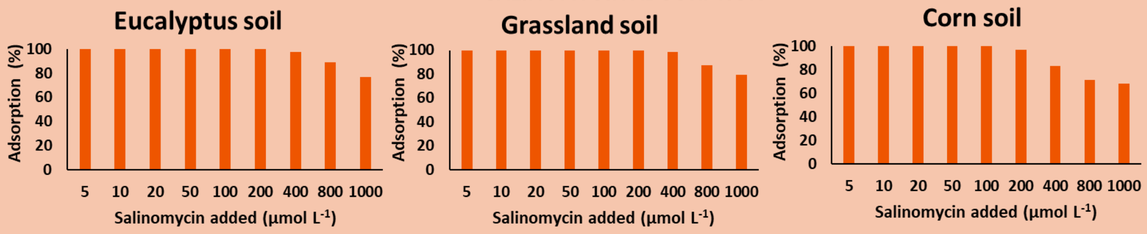
ADSORPTION. Batch experiments



RESULTS AND DISCUSSION

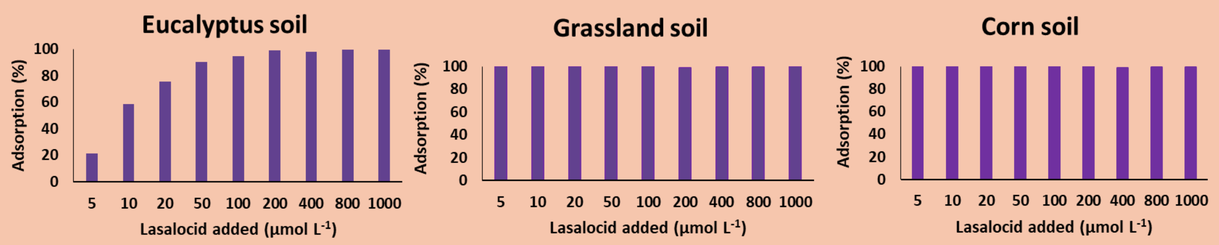
ADSORPTION BY SOILS

SALINOMYCIN ADSORPTION



- Salinomycin was adsorbed totally by soils when the concentration added was between 5-200 µmol L^{-1}
- When the concentration added increased (up to 1000 µmol L^{-1}), adsorption decreased up to 68%.
- Corn soil, with a high pH value (7,97), presented slightly lower adsorption values.

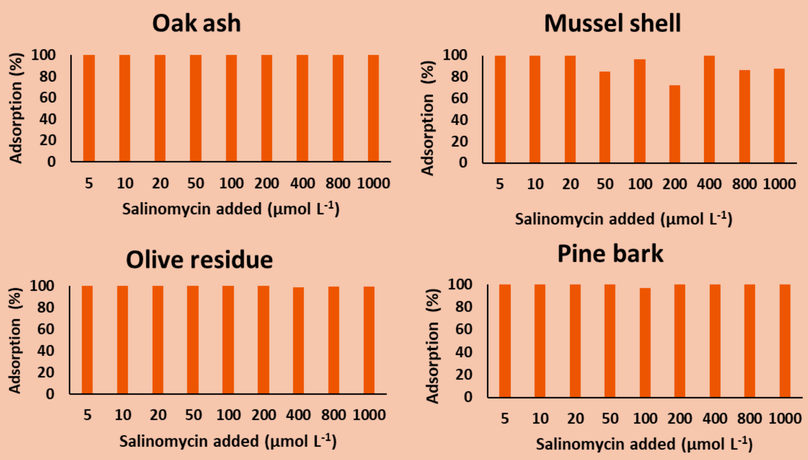
LASALOCID ADSORPTION



- All soils adsorbed 100% of lasalocid when the highest concentrations were added

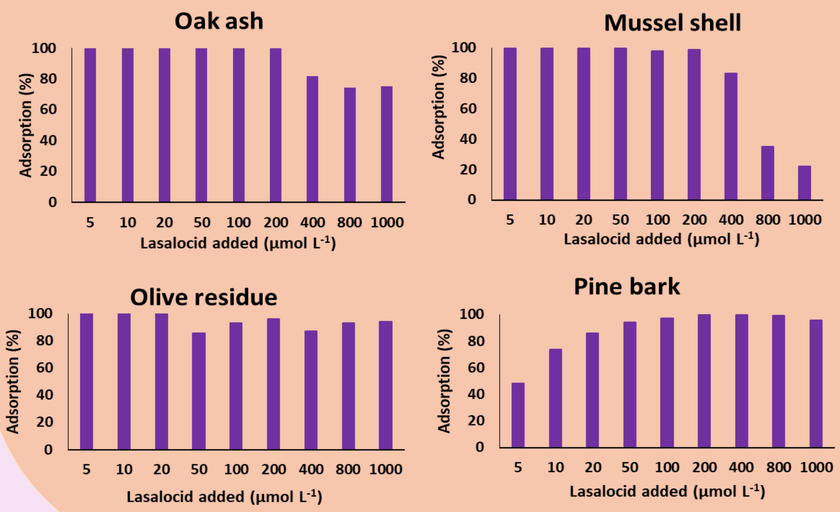
ADSORPTION BY BIOADSORBENTS

SALINOMYCIN



- Oak ash (pH=11.31), olive residue and pine bark adsorbed 100% of salinomycin in all cases.
- These residues could increase the capacity of the soils and purification processes to adsorb this antibiotic.
- Mussel shell was the bioadsorbent with the lowest adsorption values. The adsorption when the highest concentration was added (1000 µmol L^{-1}) decreased up to 87%

LASALOCID



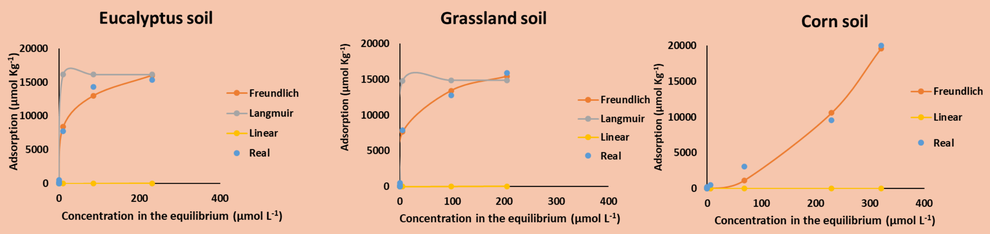
- The adsorption of lasalocid by bioadsorbents was 100% when the concentration added was between (5-200 µmol L^{-1})
- When the concentration added was the highest (1000 µmol L^{-1}) the adsorption decreased up to:
  - 75% by oak ash
  - 94% by olive residue
  - 95% by pine bark
  - 22% by mussel shell

ADSORPTION ISOTERMS

SALINOMYCIN

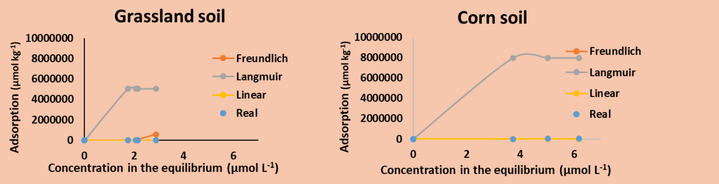
Samples	Freundlich					Langmuir					Lineal		
	KF	Error	n	Error	R^2	KL	Error	qm	Error	R^2	Kd	Error	R^2
Eucalyptus soil	5107454	617.112	0.21	0.025	0.992	0.087	0.005	16157.7	197.306	0.999	79.735	14.35	0.68
Grassland soil	5701.55	378.36	0.187	0.014	0,997	0.224	0.05	14863.94	579.722	0.987	87.928	12.959	0.961
Corn soil	0.487	0.64	1.838	0.231	0.986	--	--	--	--	--	55.236	3.256	0.961

- Freundlich is the model that present the best adjustment in soils for both antibiotics



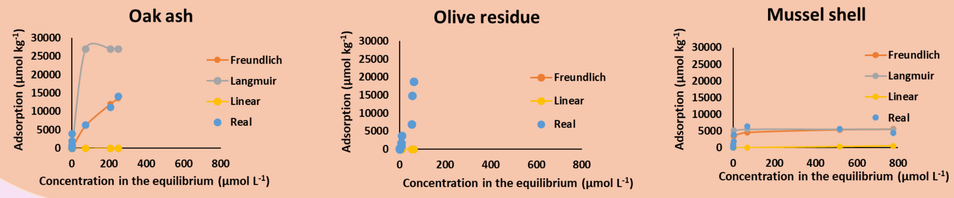
LASALOCID

Samples	Freundlich					Langmuir					Lineal		
	KF	Error	n	Error	R^2	KL	Error	qm	Error	R^2	Kd	Error	R^2
Eucalyptus soil	--	--	--	--	--	--	--	--	--	--	--	--	--
Grassland soil	0.151	0.696	14.322	6.017	0.982	0.001	1.058	5051631,00	7.62E+09	0.753	3337.57	500.365	0.753
Corn soil	990.845	250.862	1.664	0.148	0.994	0	0.057	7986332	1.1E+09	0.973	3010.75	146.698	0.973



Samples	Freundlich					Langmuir					Lineal		
	KF	Error	n	Error	R^2	KL	Error	qm	Error	R^2	Kd	Error	R^2
Oak ash	393.47	497.847	0.642	0.238	0.908	0.004	0.004	27085.2	16513.4	0.906	57.592	5.123	0.889
Mussel shell	3296.31	717.325	0.079	0.041	0.852	0.647	0.299	5531.11	478.565	0.906	--	--	--
Olive residue	0	0.001	4.5	1.312	0.918	--	--	--	--	--	249.864	25.435	0.868
Pine bark	--	--	--	--	--	--	--	--	--	--	--	--	--

- Eucalyptus soil did not adjust well with any model
- For salinomycin, bioadsorbents did not present a good adjustment for any model
- In the case of lasalocid, Freundlich presented a good adjustment for oak ash and olive residue.
- Langmuir model obtained a R^2>0.9 for oak ash and mussel shell, but presented high errors, invalidating the adjustment



CONCLUSION

Soils adsorbed 100% of lasalocid, however, salinomycin adsorption was lower. To retain salinomycin, the use of bioadsorbent would be interesting, specially, pine bark, olive residue and ash. In the case of lasalocid, the best bioadsorbents were olive residue and pine bark

DESORPTION

The desorption was lower tan 7% for both antibiotics (salinomycin and lasalocid) in soils and bioadsorbents for the added concentrations.

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