

The problem of fungal contamination in halophytes: The case of *Salicornia*

Lopes, M.^{A,B}; Castilho, M.^A; Sanches-Silva, A.^{C,D}; Freitas, A.^{B,C}; Barbosa, J.^B; Gonçalves, M. J.^{A,E}; Cavaleiro C.^{A,E}; Ramos, F.^{A,B}

^A University of Coimbra, Faculty of Pharmacy, Coimbra, Portugal

^B REQUIMTE/LAQV, University of Porto, Oporto, Portugal

^C National Institute for Agricultural and Veterinary Research (INIAV), Vila do Conde, Portugal

^D Centre for Study in Animal Science (CECA)-ICETA, University of Porto, Oporto, Portugal

^E Chemical Process Engineering and Forest Products Research Centre, Coimbra, Portugal

*mlopes108@gmail.com



Introduction

The species that belong to the *Salicornia* L. genus are extremophiles that thrive in salt marshes. Characterised by their fleshy stems and reduced leaves, their simple morphology is well adapted to the hostile environment where they prosper. Owing to the global freshwater crisis and soil salinisation issues, traditional crops face great challenges, wherefore halophytes such as *Salicornia* are increasingly regarded as crucial. Fungi are well-known agricultural pests and producers of various toxins that threaten the health of the ecosystem. A solid knowledge of the menace they pose to halophytes, like *Salicornia*, is thus greatly relevant [1].



Objective

To screen the occurrence of fungi and mycotoxins — Aflatoxins (AFs) (AFB1, AFB2, AFG1, AFG2) — in *Salicornia*.

Methods

Sampling

Table 1. Description of the analysed samples.

Samples	Species	Location - specific regions	Form	Harvest time	Acquisition	Production	Commercially available
1	<i>Salicornia ramosissima</i>	Mondego estuary	A	July	Harvest by the researchers	Wild	No
2	November						
3	<i>Salicornia ramosissima</i>		B	July	Small local producer	Cultivated; Conventional	Yes
4	November						
5	<i>Salicornia</i> sp.	Ria de Aveiro	B	Lot 1; Unknown	Shop	Cultivated; Organic	Yes
6				Lot 2; Unknown			
7	<i>Salicornia</i> sp.			A			
8	<i>Salicornia</i> sp.	B	Powder	Lot 1; Unknown	Shop	Cultivated; Organic	Yes
9				Lot 2; Unknown			
10	<i>Salicornia ramosissima</i>	D	Powder	Unknown	Shop	Cultivated; Conventional	Yes
11	<i>Salicornia</i> sp.						

Fungal profile

Direct plating in selective media



AFs levels

UHPLC-ToF-MS



Results

Fungi

Table 2. Presence of fungi in *Salicornia*.

Samples	Fungi
1	<i>A. fumigatus</i> , <i>Tricoderma</i> sp.
2	<i>A. niger</i> , <i>A. fumigatus</i>
3	<i>A. niger</i> , <i>A. fumigatus</i> , <i>A. flavus</i> , <i>Penicillium</i> sp.
4	<i>A. niger</i> , <i>A. fumigatus</i> , <i>A. flavus</i> , <i>Rhizopus</i> sp.
5	<i>A. niger</i> , <i>A. flavus</i>
6	<i>A. niger</i> , <i>A. flavus</i>
7	ND
8	ND
9	ND
10	<i>A. niger</i> , <i>A. fumigatus</i>
11	ND

ND: not detected

Mycotoxins

Table 3. AFs contamination in *Salicornia*.

Samples	AFs (µg/kg)								Total	
	B1		B2		G1		G2			
	Mean (µg/kg)	SD (µg/kg)	Mean (µg/kg)	SD (µg/kg)	Mean (µg/kg)	SD (µg/kg)	Mean (µg/kg)	SD (µg/kg)		
1	ND		<LOQ	1.2	0.2	ND	ND	10.0	0.6	11.2
2	>8		ND	ND	ND	ND	ND	6.5		>8
3	6.5	0.3	ND	ND	ND	ND	ND	ND	ND	6.5
4	ND		ND	ND	ND	ND	13.1	0.7	13.1	
5	1.21	0.4	ND	ND	ND	ND	ND	ND	ND	1.21
6	ND		ND	ND	ND	ND	ND	ND	ND	0.0
7	ND		ND	ND	ND	ND	ND	ND	ND	0.0
8	ND		ND	ND	ND	ND	ND	ND	ND	0.0
9	ND		ND	ND	ND	ND	ND	ND	ND	0.0
10	4.0	0.1	ND	ND	ND	ND	ND	ND	ND	4.0
11	ND		ND	ND	ND	ND	ND	ND	ND	0.0

Conclusions

- ✓ *Salicornia* is quite susceptible to fungal invasion, mainly by fungi of the *Aspergillus* genus.
- ✓ High levels of contamination by AFs were detected.
- ✓ Some simple mitigation measures include: avoiding drought or mechanical stress and harvesting at appropriate time. Also, it is crucial to increase *Salicornia* producers' awareness of the risks of AFs contamination, its effects and management.