Salinity impact on seed yield, polyphenols composition and antioxidant activity of Fennel (*Foeniculum vulgarae* Mill) extracts

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INTRODUCTION

Recently, medicinal and aromatic plants have received much attention in several fields such agroalimentary, perfumes, pharmaceutical industries and natural cosmetic products. The consumption of herbal medicines is widespread and is continuously increasing worldwide. Although, secondary metabolites in the medicinal and aromatic plants were fundamentally produced by genetic processing but, their biosynthesis is strongly influenced by environmental factors. Salinity is one of the major factors that affect essential oil biosynthesis and secretion. In Tunisia, salt-affected soils cover about 10% of the total area of the country. Salinity led to biochemical disorders and can change plant behaviour regarding the biosynthesis of primary and secondary metabolites. Among all the secondary metabolites synthesized by plants, phenolic compounds are some of the most widespread. In this context, this research evaluated the effect of salinity on total and individual polyphenols contents as well as the antioxidant activities of fennel (*Foeniculum vulgarae* Mill.) seeds of two geographic origins, Tunisia (TFS) and Egypt (EFS).

MATERIAL & METHODS

Plant material: Mature fennel (*Foeniculum vulgarae* Mill.) seeds were puted to germinate on perlite in the dark at 25° C. 10 days old, fennel seedlings were grown in quarter-strength Hoagland solution laced with 0 and 75 mM of NaCl. After treatment for 15 weeks, the samples were harvested at the fruiting stage.

Preparation of extracts Extraction was carried out using maceration at room temperature for 24 h followed by filtration through Whatman No. 4 filter paper and after evaporation to dryness.

Total phenolic amounts The total phenolic amount of the acetone extracts was determined by using Folin–Ciocalteu reagent,

RP-HPLC evaluation of phenolic compounds The phenolic compound analysis was carried out using an Agilent Technologies 1100 series liquid chromatograph (RP-HPLC) coupled with an UV-Vis multiwavelength detector Proestos et al. (2006).

DPPH radical scavenging assay: DPPH methanolic solution Radical-scavenging activity was determined according to Hanato et al. (1998).

β-Carotene/linoleic acid bleaching assay : was evaluated according to the method described by Tepe et al. (2004).

Chelating effect on ferrous ions: FeCl2-4H2O solution was assessed as described by Zhao et al. (2006).

Reducing power: K3Fe (CN)6

RESULTS

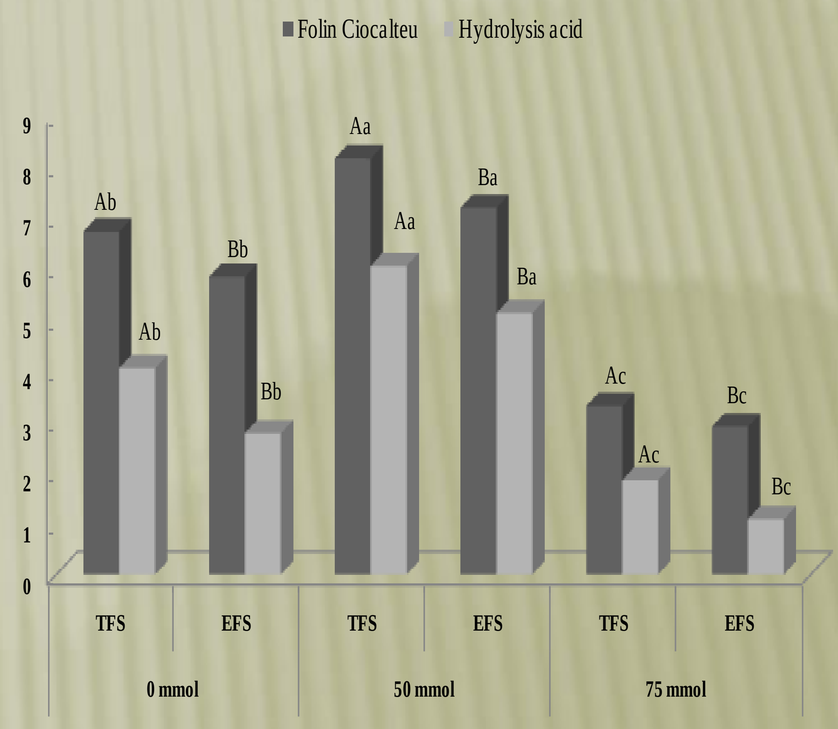

Fig. 1 Salinity impact on total phenolic contents of fennel seed extracts.

Table 1. Quantitative (mg/g DW) changes of phenolic compounds in Tunisian and Egyptian seed extracts as influenced by salinity

		0 mmol	50 mmol	75 mmol
Phenolic acids	*TFS*	2.58	4.28	0.98
	EFS	1.79	3.40	0.74
Gallic acid	*TFS*	0.29 ± 0.02^{aA}	0.30 ± 0.01^{aA}	0.17 ± 0.02^{bA}
	EFS	0.09 ± 0.01^{aAB}	0.15 ± 0.01^{aAB}	0.05 ± 0.01^{abB}
Chlorogenic acid	*TFS*	1.22 ± 0.01^{bA}	2.18 ± 0.04^{aA}	0.71 ± 0.01^{cA}
	EFS	0.96 ± 0.01^{bB}	2.13 ± 0.01^{aA}	0.66 ± 0.02^{cA}
Ferrulic acid	*TFS*	1.07 ± 0.03^{aA}	1.80 ± 0.05^{aA}	0.10 ± 0.05^{bA}
	EFS	0.74 ± 0.04^{bAB}	1.12 ± 0.01^{abAB}	0.03 ± 0.01^{cA}
Flavonoids	*TFS*	1.46	1.79	0.72
	EFS	1.04	1.82	0.29
Luteolin-7-O glucoside	*TFS*	0.29 ± 0.24^{aA}	0.56 ± 0.03^{aA}	0.08 ± 0.11^{abA}
	EFS	0.09 ± 0.11^{abAB}	0.12 ± 0.01^{aB}	0.02 ± 0.02^{aA}
Quercetin-3-O rutinoside	*TFS*	1.04 ± 0.01^{aA}	1.50 ± 0.03^{aB}	0.42 ± 0.01^{bA}
	EFS	0.93 ± 0.01^{bA}	1.69 ± 0.01^{aA}	0.25 ± 0.01^{aB}
Apigenin	*TFS*	0.13 ± 0.00^{bA}	0.03 ± 0.01^{cA}	0.22 ± 0.02^{aA}
	EFS	0.02 ± 0.01^{aAB}	0.01 ± 0.01^{aA}	0.02 ± 0.01^{aAB}

Table 2. Effect of salinity on antioxidant activities of Tunisian and Egyptian fennel seed extracts

	DPPH (IC50, µg/ml)		β-carotene bleaching (IC50, µg/ml)		Chelating ability (IC50, mg/ml)		Reducing power (EC50, µg/ml)	
	TFS	EFS	TFS	EFS	TFS	EFS	TFS	EFS
0 mmol	76.24±0.64	95.14±0.04	125.86±0.23	137.05±0.05	1.65±0.87	3.73±0.83	190.34±3.74	213.87±2.11
50 mmol	54.03±0.06	67.25±0.01	82.12±0.97	92.80±0.04	1.12±0.09	2.52±0.22	52.11±1.34	88.14±1.19
75 mmol	155.83±0.02	212.66±0.01	259.23±0.54	354.77±0.01	8.75±1.43	12.13±0.14	110.23±0.77	157.22±1.22

CONCLUSION

This study showed that salinity-induced biochemical changes in fennel seeds which could reflect an adaptation response to stress. Moreover, our results demonstrated that cultivation of medicinal plants like *F. vulgarae* under salt conditions could increase its secondary metabolism as shown by the enhancement of total polyphenols. On the other hand, under salt treatment, fennel seed extracts were characterized by the prevalent of phenolic content for both accessions. Furthermore, TFS grown at 50 mmol showed higher antioxidant ability as compared to EFS. The highest response of TFS under salt constraint, especially to moderate salinity, was correlated with the antioxidant abilities. These activities could be directly linked to the content of phenols. TFS is promising and therefore further investigations should be targeted on such important issues as activity in real food systems relative to commercially used antioxidant extracts and economic feasibility of practical applications due to higher phenolic content and antioxidant activities than in EFS,