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Original Article

Pharmacological and chemical properties of some marine echinoderms

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ABSTRACT

Echinoderms have attracted the attention of scientists over the past few years after identifying a variety of unique structures endowed by interesting biological properties. However, the Moroccan coast biodiversity is still uninvestigated. In our ongoing attempts to valorize the rich Moroccan marine environment, this study aimed at assessing the antimicrobial activity of extracts obtained from three echinoderms *Astropecten irregularis*, *Luidia sarsi* and *Ophiura albida* against the human pathogens: *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella enterica* and *Bacillus subtilis*. Moreover, their antioxidant activities were tested using standard methods in addition to the antidiabetic activity which has been evaluated *in vitro* against α-amylase and α-glucosidase enzymes. HPLC-DAD-QTOF-MS analysis revealed a significant content of some phenolic compounds such as pyrogallol, gallic, sinapic, ferulic, *p*-hydroxybenzoic and salicylic acids whose existence can be related to the endophytic fungi and/or dietary intake whereas GC-MS analysis exhibited diverse chemical structures such as cholesterol, oleic acid and glycerol 1-palmitate.

Introduction

The branch of echinoderms makes up one of the essential and distinctive components of the marine animal kingdom containing more than 7000 living species and 13 000 extinct (Brusca and Brusca, 2003). Echinoderms are classified into five classes: *Crinoidea*, *Holothuroidea*, *Echinoidea*, *Asteroidea* and *Ophiuroidea* (Brusca and Brusca, 2003) which are deeply distinguished from other classes by their particular anatomy and ecology. Echinoderm species occupy a variety of subtidal substrates ranging from rough gravel to fine sludge, despite they are more commonly found in sand in the coastal waters (Freeman et al., 1998). In traditional medicine, echinoderms such as *Oreaster reticulates*, *Echinaster echinophorus*, *Luidia senegalensis*, *Mellita quinquiesperforata* and *Echinometra lucunter* are used in Brazil against asthma, alcoholism, bronchitis, diabetes and heart diseases (Alves et al., 2009). In addition, *Echinaster brasiliensis* is drank as a tea from the powdered toasted starfish (Costa-Neto, 1999). This therapeutic potential is due to the rich chemical diversity of echinoderms as an interesting source in ethnopharmacology and natural products research (Uzair et al., 2011; Gupta and Abu-Ghannam, 2011). Metabolites from echinoderms could be subdivided into steroids, glycosides, ceramide derivatives and miscellaneous compounds (Dong et al., 2011). Recent investigations resulted in the isolation of many compounds from echinoderms species, such as triterpene glycosides, glycosaminoglycans, chondroitin sulphate and neuritogenic gangliosides (Kelly, 2005; Higuchi et al., 2007). Recent studies have reported that phytoplankton accumulates phenolic compounds in a carbonic environment, leading to an increase in their levels in marine organisms which have profound consequences on marine ecosystem and seafood quality with the possibility that fishery industries could be influenced as a result of progressive ocean changes (Jin et al., 2015). Despite the interesting contribution of many reports (Kuznetsova et al., 1982; Sasaki et al., 1985; Haug

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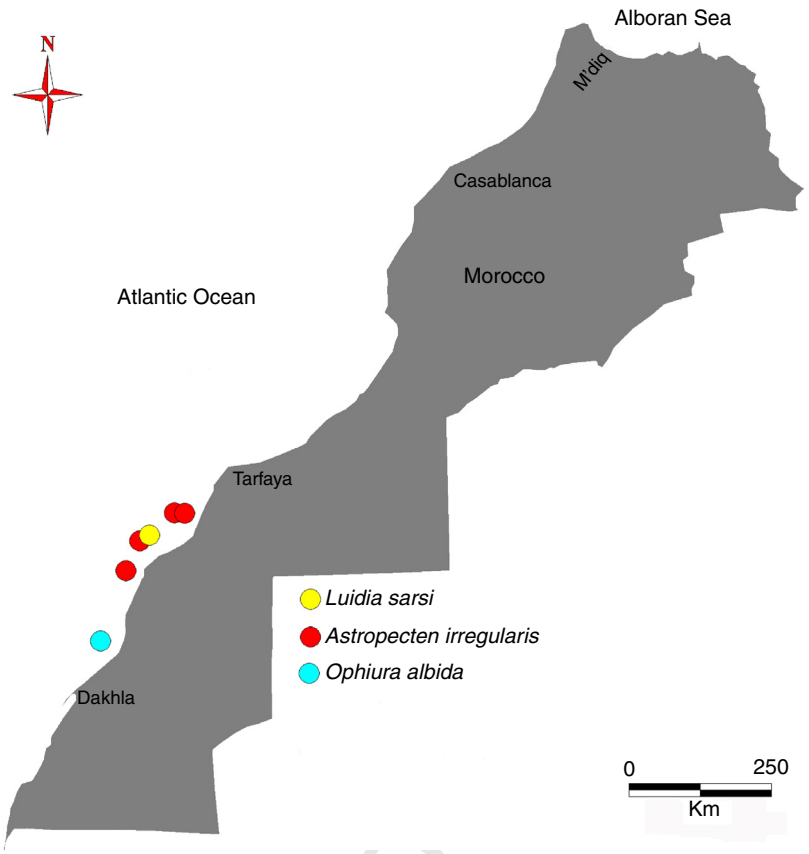

Figure 1. Location of collection sites.

Table 1
Coordinates of collection sites.

		A. irregularis	*L. sarsi*	*O. albida*
15°10′35″N	24°38′45″	–	–	x
14°36′7″N	25°57′9″	x	–	–
14°13′8″N	26°31′6″	x	–	–
13°37′28″N	26°58′32″	x	x	–
13°29′66″N	26°58′85″	x	–	–

et al., 2002), research directed toward chemistry and bioactivity of echinoderm compounds is still in its infancy, regarding the huge contribution of marine products in modern therapeutic development. Data from literature reported the antibacterial property of the body wall, coelomocytes and eggs in a variety of echinoderm species (Stabili and Pagliara, 1994; Stabili et al., 1996; Haug et al., 2002). To the best of our knowledge, the antidiabetic effects of such organism are still not or little investigated.

Currently, there is an increased interest in new chemical and therapeutic agents modulating postprandial rise in blood glucose levels and therefore considered as key agents in the management of diabetes and its complications. For instance, α-glucosidase is a key enzyme in the intestinal glucose metabolism, localized in the epithelium of the small intestine and catalysing the cleavage of disaccharides to glucose. It can be considered as one of the main targets in antidiabetic therapy (Toeller, 1994; Henrissat, 1998; Kimura, 2000).

In order to evaluate the chemical diversity and bioactivities of Moroccan echinoderms, three species namely *Astropecten irregularis* (Pennant, 1777), *Luidia sarsi* Düben & Koren, 1846 and *Ophiura albida* Forbes, 1839 were investigated. In this study, we assessed the potential antidiabetic effect *via* α-amylase and α-glucosidase inhibition. The antioxidant activity linked to many pathological diseases has also been investigated using different methods. In addition, the antimicrobial activities of the collected echinoderms from Moroccan coast were evaluated against many pathogenic isolates.

Material and methods

Echinoderms collection, identification and extraction

Specimens of *A. irregularis* (Pennant, 1777), *L. sarsi* Düben & Koren, and *O. albida* Forbes, 1839 were collected in May 2015 between 26 and 84 m of depths using rectangular dredge. The dredge was towed by the boat. All specimens were collected between Tarfaya and Dakhla (Table 1 and Fig. 1). Species identification was carried out by Dr. O. Wangensteen (University of Barcelona) and N. Tamsouri (Institut National de Recherche Halieutique, INRH, Morocco). Voucher specimens were deposited at the institute under the following numbers LPNA15, LPNA16, LPNA17. The fresh animals (25 g each) were cut into small pieces and extracted three times with MeOH. MeOH extracts were filtered, concentrated and stored for evaluation.

Phenolic, flavonoid and tannin contents

The amount of phenolic contents was determined according to Folin-Ciocalteu method as described in our previous works (Marmouzi et al., 2015). The total phenolic content was measured as milligrams of gallic acid equivalents per gram of extract dry weight (mg GAE/g edw). The total flavonoids in the extracts were determined using a colorimetric assay method. The flavonoid content was determined as rutin equivalent from the calibration curve of rutin standard solution (mg RE/g edw). For the condensed

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