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Research paper

Antitumoral and anti-inflammatory activities of the red alga *Sphaerococcus coronopifolius*

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ABSTRACT

Introduction: Algae are the source of a great variety of natural products exhibiting an array of biomedical properties associated with remedies of various kinds of diseases, including cancer and inflammatory bowel diseases. As a part of our research on bioactive products from algae, we aimed to study the isolation and pharmacological evaluation of marine natural products, we have analyzed specimens of the alga *Sphaerococcus coronopifolius* collected from the Moroccan Mediterranean Sea.

Methods: The antitumoral effect of *S. coronopifolius* extracts on human cervix, breast and pancreatic cancer cells was investigated via cell viability and apoptosis assays. The crude extracts were tested by IL-8 inhibition assays to evaluate their anti-inflammatory properties.

Results: S. coronopifolius extracts inhibited the growth of HeLa, SKBR-3 and MIA PaCa-2 cells in dose- and time-dependent manners. After treatment with the extracts, the apoptotic rate significantly increased in these cell lines. IL-8 secretion in LPS- and TNF-α-stimulated HUVEC-tert endothelial cells was found to be significantly inhibited by *S. coronopifolius* extracts.

Conclusion: The present study suggests that *S. coronopifolius* can significantly inhibit the proliferation of HeLa, SKBR-3 and MIA PaCa-2 cells, induces apoptosis and possesses interesting anti-inflammatory properties. Furthermore, its application as nutraceuticals and functional food could also be considered.

1. Introduction

Natural products have been reported to be a great source for new drugs and the search for novel therapeutic agents with pharmacological properties has resulted in a huge interest among scientific groups and pharmaceutical industrialists. The marine environment represents a relatively inexhaustible source of functional compounds and promising bioactive molecules for a wide range of applications, including new therapeutics, cosmetics, and biotechnology [1,2,3]. Among marine organisms, seaweeds have proven to be a very valuable source of diverse structurally bioactive compounds with diverse biological activities including anticancer, antiviral, antioxidant and anti-inflammatory properties [4,5,6]. Rhodophyta represent an important source of different secondary metabolites, they are richer than those of other classes of macroalgae [7]. The majority of reports (57%) on Rhodophyta chemistry come from the Rhodomelaceae family and 85% of them correspond to compounds from the genus *Laurencia*, which produces a wealth of halogenated sesquiterpenes and acetogenins, along with a few higher terpenes [8]. The red alga *Sphaerococcus coronopifolius* Stackhouse is an unusually prolific source of diterpenes [9,10,11]. However, despite the richness of marine flora, only a few reports have been published on the isolation and characterization of bioactive compounds from *S. coronopifolius*, and even more restricted information is available on their biological activity.

Cancer constitutes the second main mortality cause in the world, after cardiovascular diseases. In spite of the progresses in chemotherapeutics treatments, many patients fail chemotherapy, mainly because of side effects or multidrug resistance, supporting the need and importance of research for new molecules with anticancer activity, more effective and with lower adverse effects [12].

There are many reports on the association between chronic inflammation and cancer; many found that chronic inflammation has

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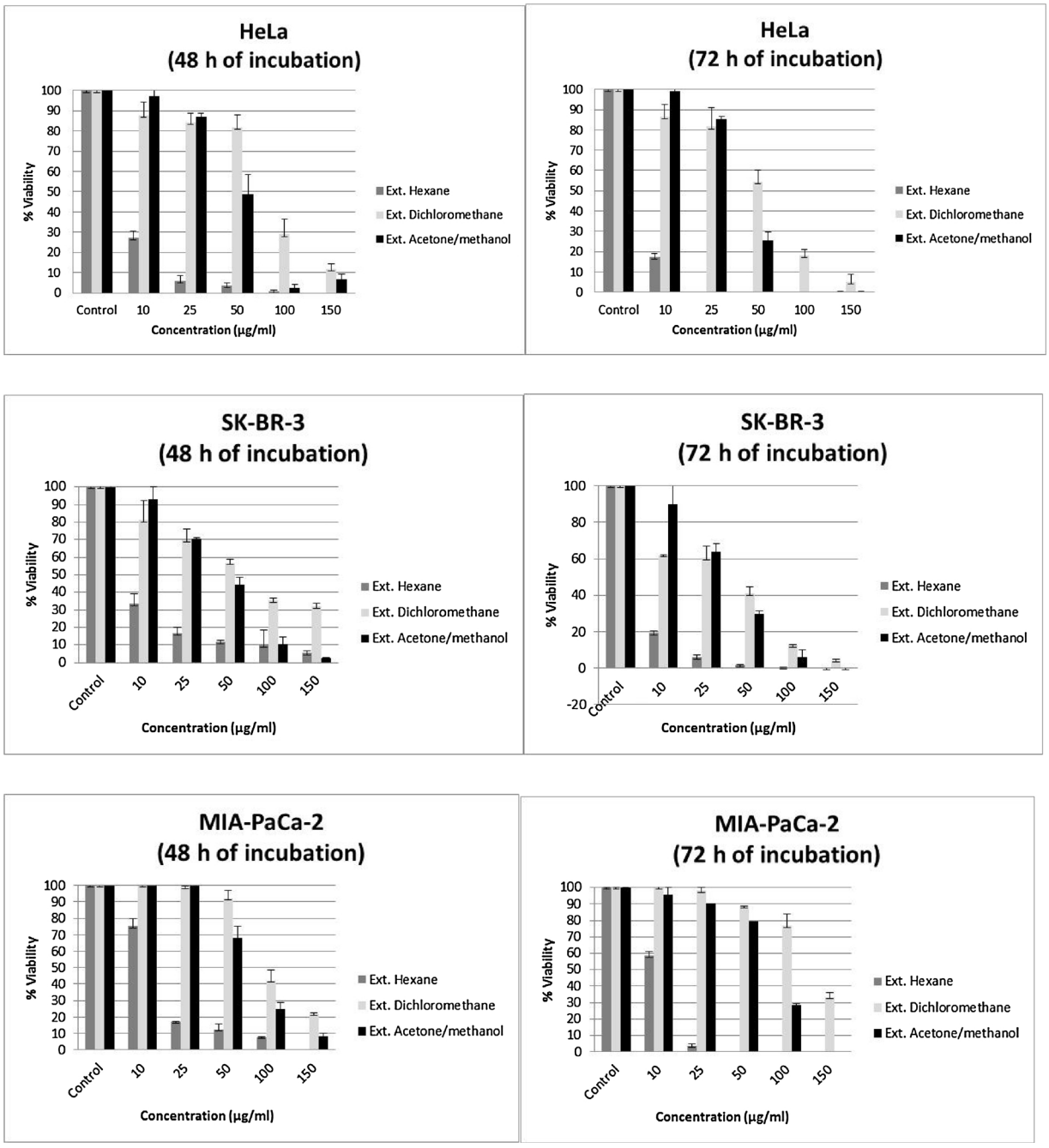

Fig. 1. Anti-proliferative activity of *S. coronopifolius* n-hexane, dichloromethane and acetone/methanol extracts against human cancer cell lines after 48 h and 72 h of incubation. a. Effect of extracts treatment on the growth of HeLa cervix cancer cells; b. Effect of extracts treatment on the growth of SKBR-3 breast cancer cells; c. Effect of extracts treatment on the growth of MIA PaCa-2 pancreatic cancer cells. Cells were treated with varying concentrations of *S. coronopifolius* extracts (10, 25, 50, 100 and 150 µg/mL) for 48 and 72 h. Cell viability was determined by MTT assay.

Table 1
Cytotoxic activity (IC50) of different extracts of *S. coronopifolius* against three different tumorigenic cell lines (HeLa, SKBR-3 and MIA PaCa-2). Compounds were tested from 10 to 150 µg/mL. Values are mean of three independent experiments ± standard error of the mean (SEM). IC50 is expressed as µg per milliliter (µg/mL).

	S. coronopifolius IC50 (µg/mL)					
	Hx. extract		Dichl. extract		Ac/M extract	
	48 h	**72 h**	**48 h**	**72 h**	**48 h**	**72 h**
HeLa	3.72 ± 0.78	1.80 ± 0.41	76.56 ± 2.37	53.56 ± 8.87	49.02 ± 6.55	37.73 ± 0.89
SK-BR-3	3.76 ± 2.97	1.23 ± 0.65	62.16 ± 3.74	36.95 ± 7.54	43.80 ± 3.41	33 ± 2.28
MIA PaCa-2	12.05 ± 0.57	13.81 ± 0.59	91.26 ± 6.39	127.93 ± 5.16	66.33 ± 2.90	60.26 ± 14.78