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ORIGINAL ARTICLE

Screening of antimicrobial activity of macroalgae extracts from the Moroccan Atlantic coast

Criblage de l'activité antimicrobienne des extraits des macroalgues des côtes atlantiques marocaines

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Summary The aim of this work is the screening of the antimicrobial activity of seaweed extracts against pathogenic bacteria and yeasts. The antimicrobial activity of the dichloromethane and ethanol extracts of ten marine macroalgae collected from the Moroccan's Atlantic coast (El-Jadida) was tested against two Gram+ (*Bacillus subtilis* and *Staphylococcus aureus*) and two Gram— (*Escherichia coli* and *Pseudomonas aeruginosa*) human pathogenic bacteria, and against two pathogenic yeasts (*Candida albicans* and *Cryptococcus neoformans*) using the agar disk-diffusion method. Seven algae (70%) of ten seaweeds are active against at least one pathogenic microorganisms studied. Five (50%) are active against the two studied yeast with an inhibition diameter greater than 15 mm for *Cystoseira brachycarpa*. Six (60%) seaweeds are active against at least one studied bacteria with five (50%) algae exhibiting antibacterial inhibition diameter greater than 15 mm. *Cystoseira brachycarpa*, *Cystoseira compressa*, *Fucus vesiculosus*, and *Gelidium sesquipedale* have a better antimicrobial activity with a broad spectrum antimicrobial and are a potential source of antimicrobial compounds and can be subject of isolation of the natural antimicrobials.

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MOTS CLÉS
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Résumé L'objectif de ce travail est le criblage de l'activité antimicrobienne des extraits d'algues marines contre des bactéries et des levures pathogènes. L'activité antimicrobienne des extraits organiques et hydroalcooliques de dix macroalgues récoltées des côtes atlantiques marocaines (El-Jadida) a été effectuée contre deux bactéries Gram positif (*Bacillus subtilis* et *Staphylococcus aureus*), deux bactéries Gram négatif (*Escherichia coli* et *Pseudomonas aeruginosa*) et deux levures pathogènes (*Candida albicans* et *Cryptococcus neoformans*) par la méthode de diffusion à partir des disques de cellulose. Parmi les dix algues étudiées, sept (70 %) ont montré une activité contre au moins un microorganisme pathogène étudié, cinq (50 %) sont actifs contre les deux levures étudiées avec un diamètre d'inhibition supérieur à 15 mm pour *Cystoseira brachycarpa*, six (60 %) algues présentent une activité antibactérienne dont cinq (50 %) présentent un diamètre d'inhibition antibactérien supérieur à 15 mm. Les algues brunes, *Cystoseira brachycarpa, Cystoseira compressa* et *Fucus* vesiculosus et l'algue rouge, *Gelidium sesquipedale* ont montré une forte activité antimicrobienne avec un large spectre antimicrobien et peuvent être une source potentielle de composés antimicrobiens et peuvent faire l'objet de l'isolement d'agents antimicrobiens naturels.

Introduction

With severe fungal infections, responsible for a high mortality rate among immunosuppressed patients (cancer, AIDS, transplantation) and the emergence of new bacterial strains resistant to current antibiotics, the search of a new antimicrobial from natural source became an obligation.

Lower marine organisms are one of the richest sources of both biologically active secondary metabolites and chemical diversity [1,2]. These natural products have as important role in repulsion of predators [3,4] and pathogen organisms. Algae are found in all seas, at all latitudes and to record depths of 268 m (Bahamas) [5]. The algae are also used for their nutrition, fertilizers and therapeutic properties.

In Morocco, the use of seaweed from the Atlantic coast began in the mid 20th century by exploiting *Gelidium* for the production of agar. Marine algae have been widely used as biological material in Moroccan laboratories [6,7] and were the source of many biological molecules [8—11]. However, the chemistry of marine algae of the Moroccan coast is still undefined. In this report, we describe the biological effect activity of dichloromethane and ethanol extracts of ten marine algae collected from the Moroccan Atlantic coasts for their antimicrobial activities against four human pathogenic bacteria and two human pathogenic yeasts in order to find new potent antimicrobial metabolites with a broad spectrum antibiotic.

Materials and methods

Biological materials

Two green algae, three red algae and five brown algae were collected from three difference sites in the Atlantic coast of El-Jadida province, Morocco. After sampling, seaweeds were cleaned, washed with sea water and immediately transported to the laboratory to be washed with distilled water. Algae species and their sampling sites are reported in Table 1 and the geographical localisation of these sampling sites is shown in Fig. 1.

Preparation of the seaweed extracts

Each alga (100 g of crushed fresh algae) was ground and extracted with absolute ethanol (3×300 mL) with stirring in a dark chamber for 48 h and filtered. The filtrates were combined and evaporated at reduced pressure until total evaporation of ethanol. The suspension is completed with distilled water to 100 ml as final volume and extracted with CH_2Cl_2 (3×100 ml). The CH_2Cl_2 extracts were combined, dried on anhydrous sodium sulphate (Na_2SO_4), filtered and concentrated at reduced pressure to give a dichloromethane extract (extract C).

Table 1 Algae specie and their sampling sites.
Espèces d'algues et leur site de récolte.

Algae class	Algae specie	Sampling site
Chlorophyceae	*Ulva lactuca*	1
	Codium fragile	3
Rhodophyceae	*Gelidium sesquipedale*	3
	Gelidium attenuatum	3
	Chondrus crispus	3
Pheophyceae	*Bifurcaria bifurcata*	3
	Fucus vesiculosus	1
	Laminaria ochroleuca	2
	Cystoseira compressa	3
	Cystoseira brachycarpa	3

The geographical location of sampling sites are shown in Fig. 1.

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