



## Antimicrobial potentials of aqueous and methanolic crude extracts of *Zingiber officinale* and *Foeniculum vulgare*

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### ABSTRACT

Ginger roots (*Zingiber officinale*) and fennel seeds (*Foeniculum vulgare* Mill.) have been widely used in traditional medicine for treatment of various diseases and some of their major constituents are reported to be pharmacologically active. This study was designed to evaluate the potential of different extracts of Ginger and fennel as natural antimicrobial. Indeed, Ginger and Fennel extracts were obtained using maceration extraction by two solvents (water and methanol) and the antimicrobial properties (antibacterial and antifungal) of the aqueous and methanolic extracts were assessed against Gram positive and negative bacteria (*Escherichia coli*, *Bacillus subtilis* and *Salmonella abony*) and one yeast (*Candida albicans*) strains by determining growth inhibition zone. The results suggest that only aqueous extracts of fennel and ginger have efficient antimicrobial activity against the microorganisms tested.

**Keywords:** *Zingiber officinale*, Ginger roots, *Foeniculum vulgare*, fennel seeds, antibacterial activity, antifungal activity, aqueous extract, methanolic extract.

### INTRODUCTION

Until synthetic drugs were developed in nineteenth century, herbs were the basis for nearly all medicinal therapy. Today, the interest for use of herbal remedies (herbs) instead of chemical drugs is increasing because of lesser side effects [1, 2].

Most of the bacterial pathogens are resistant to existing synthetic antibacterial agents demanding an increasing effort to seek for effective phytochemicals as antimicrobial agents against such pathogens [3, 4].

As the public becomes more interested in herbal medicine and bacterial pathogens become more resistant to commercial antibiotics, scientists are increasingly investigating the antibacterial properties of plant extracts and fractions [5-8]. Medicinal plants are important therapeutic aids for various ailments and the use of those that are native to Morocco in various traditional system of medicine are awe inspiring [3].

Ginger and fennel are widely used both as spices and for their medicinal properties [9, 10]. *Foeniculum vulgare* Mill. (Apiaceae), known as fennel, is a widespread aromatic herbaceous plant, and its essential oil is used as additive in the food, pharmaceutical, cosmetic, and perfume industries [11, 12].

Ginger has been used as a spice and as natural additives for more than 2000 years, and also possesses many medicinal properties [2, 13]. Ginger has been identified as an herbal medicinal product with pharmacological effect [14].

In traditional medicine, ginger has been used to treat a wide range of ailments including stomach aches, diarrhea, nausea, asthma, respiratory disorders [15, 16].

As ginger and fennel are widely used both as a spices and for their medicinal properties, the present study was undertaken to investigate the antimicrobial potentials of Ginger roots and fennel seeds extracts (aqueous and methanolic), obtained by maceration extraction, against different bacterial and fungal strains.

## EXPERIMENTAL SECTION

### Preparation of plants materials:

The ginger root (*Zingiber officinale*) and fennel seeds (*Foeniculum vulgare* Mill.) were purchased from a local herbal shop in Morocco. The seeds and roots materials were washed with distilled water and dried at 40°C overnight and were ground to powder in a grinder and stored at room temperature.

### Microorganisms and media:

The antimicrobial activities of aqueous and methanolic extracts were individually tested against a panel of microorganisms, including one Gram-positive bacterium (*Bacillus subtilis* CIP 52-62), two Gram-negative bacteria (*Escherichia coli* CIP53.126 and *Salmonella abony* CIP80.39) and one yeast (*Candida albicans* CIP 48.72). The strains were grown on Trypton Casein Agar (TCA) for bacteria and Sabouraud Dextrose Agar (SDA) with Chloramphenicol for the yeast.

### Preparation of extracts:

5 g of each of the dried seeds and roots powders were weighed accurately and suspended in a 50 ml of each solvent (water and methanol). They were shaken for 3 hours on an electronic shaker at room temperature for 24 h in a dark place. The suspensions were filtrated through sterile filter papers (Whatman-1) and the filtrates were centrifuged at 4000 rpm for 15 min. The final concentration of each extracts was fixed to about 100 mg/ml.

### Antibacterial test:

The different extracts (aqueous and methanolic) were first tested *in vitro* for their activities against three bacterial strains (*Escherichia coli* CIP53.126, *Salmonella abony* CIP80.39 and *Bacillus subtilis* CIP 52-62) and against one yeast strain (*Candida albicans* CIP 48.72). The activities were determined by the agar diffusion technique as previously described [17]. 18 mL of Muller-Hinton agar medium were poured into Petri dishes as a first layer. A suspension of each test strain was diluted with an appropriate volume of Muller-Hinton agar medium to contain about 10<sup>6</sup> CFU/ml and 8 mL of the suspension was poured onto the first layer in the Petri dish. The Petri dishes were kept 15 min. at room temperature and then at 4°C (about 60 min.). Cylindrical cavities were punched into the agar layer with a suitable device. 50µl volume of each extract was loaded into the cavities prepared in the agar. The periods and temperatures of incubation were 48h at 37 °C for bacteria and 72h at 25°C for the yeast.

## RESULTS AND DISCUSSION

This study reports the antimicrobial activity of various extracts (aqueous and methanolic) of ginger root (*Zingiber officinale*) and fennel seeds (*Foeniculum vulgare* Mill.) against three bacterial strains (*Escherichia coli* CIP53.126, *Salmonella abony* CIP80.39 and *Bacillus subtilis* CIP52-62) and against fungal strain (*Candida albicans* CIP48.72). The antimicrobial activity has been assessed qualitatively by the presence or absence of inhibition zones. The results of the antimicrobial activity of the investigated extracts are shown in Table 1.

Surprisingly only the aqueous extracts of the two plants under tests show positive activities, and only *Bacillus subtilis* strain in particular shows high sensitivity to these extracts, in contrast the rest of the strains were completely resistant to the aqueous extracts of the two plants. Concerning the methanolic extracts of the fennel and ginger, no effect was noticed during the experimentation and neither bacteria or yeast strain show any demonstrable sensitivity. These data coincide with those reported previously by other authors [18, 19] who reported that water and methanolic extracts of some plants displayed significant antimicrobial activities and moreover water extracts of fennel in particular possess antifungal activity against *Candida albicans*. It has also been reported that water and methanolic extracts of some other plants displayed significant antimicrobial activities [20]. And parallel, it was showed that the aqueous and acetone extracts of galls of Oak displayed similarities in antimicrobial activity on some bacterial species [21].

Despite the modest results obtained during this work, this study constitute a positive contribution to a set of works previously done to find out the unseen effect of some constituents of these two plants against microorganisms [4, 22-24].

Table 1. Antimicrobial activity of aqueous, methanolic extracts

Plant under tests	Tests	<i>E. Coli</i>	<i>B. subtilis</i>	<i>S. abony</i>	<i>C. albicans</i>
<i>Ginger roots</i>	Aqueous extract	--	++	--	--
	Methanolic extract	--	--	--	--
<i>Fennel seeds</i>	Aqueous extract	--	++	--	--
	Methanolic extract	--	--	--	--

--: No inhibition zone.

++: Presence of inhibition zone.

### CONCLUSION

Due to the increased resistance of microorganisms against the currently used antibiotics and the high cost of production of synthetic drugs, pharmaceutical companies are now searching for alternatives. Medicinal plants could be one approach because most of them are safe with little side effects, if any, are of low cost and affect a wide range of antibiotic resistant microorganisms [4]. Based on the results obtained in this work, it may be concluded that plant extracts of *Zingiber officinale* and *Foeniculum vulgare* Mill. may possess a panel of constituents having strong and broad spectrum of antimicrobial activity against a number of food borne bacteria and the extracts may be used to discover bioactive natural products that may serve as basic source for the development of new antimicrobial compounds to overcome the problem of increasing resistance to known traditional antibiotics. Finally, the present findings demonstrated that the plant material has been blessed with many of the natural phytoconstituents. These phytoconstituents as well as plant extracts are undoubtedly responsible for antimicrobial activity.

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