

In vitro Antibacterial Activity of *Foeniculum vulgare* Seed Extract

Khan NT*

Department of Biotechnology, Balochistan University of Information Technology Engineering and Management Sciences (BUIITEMS), Quetta, Pakistan

Abstract

Foeniculum vulgare (Apiaceae) is a popular plant with valuable medicinal and culinary importance. It is mostly used in the treatment of ailments associated with digestive and respiratory systems. Besides its fruit are dry seeds which is used as flavoring agent for meat, fish and beverages. Phytoconstituents of *F. vulgare* seed extracts such as phenols and aromatic derivatives possess different physicochemical properties including competence to inhibit the growth of certain bacteria. Thus this study was conducted to determine the antibacterial property of *Foeniculum vulgare* seed extract against a variety of pathogenic bacteria.

Keywords: Anti-bacterial; *Foeniculum vulgare*; Phytoconstituents

Introduction

Foeniculum vulgare is a periodic herb with potent medicinal importance belonging to the family Umbelliferae (Apiaceae). In English it is known by the name of Fennel, Fenouil in French, Shmr (Razianaj) in Arabic and Razianeh in Persian. It is an herbaceous and aromatic plant, with a height of 1 to 2 m, grows in many parts of Europe, the Mediterranean, and Asia. Fennel is a perennial herb with stems grooved, intermittent leaves, often combined with dark green, fluffy with a blade divided into thin pieces, petiole with sheath; flowers are usually bisexual, regular or irregular, with yellow umbrella in the form of oval beads [1,2]. Fennel has small seed with a length of about 8 mm and a width of 3 mm with an aromatic odor and sweet taste. Fennel seeds are narrow, long, cylindrical appearance and dimensions vary depending on plant growth. The crack groove light green surface [3,4]. The water content of fennel seed is 6.3% water, fat 10%, protein 9.5%, minerals 13.4%, fibers 18.5% and carbohydrates 42.3% [5,6]. The oil extracted from *Foeniculum vulgare* seeds showed the capability to inhibit bacterial growth including *Escherichia coli*, *Bacillus megaterium* and *Staphylococcus aureus* [7], *Listeria monocytogenes* and *S. aureus* [8,9]. Its alcoholic and aqueous extracts are known to effective towards *Campylobacter jejuni* and *Helicobacter pylori* [10]. It was revealed in another study that *Foeniculum vulgare* seed extracts also inhibits the growth of multidrug resistant bacteria such as *Acinetobacter baumannii*. The aromatic secondary metabolites present in the extracts were mainly responsible for this activity [11]. The main purpose of this study was to evaluate the antibacterial activity of *Foeniculum vulgare* against a number of disease causing bacteria.

Materials and Methods

Plant extraction

100 g of dried *Foeniculum vulgare* seeds were bought from a local shop in satellite town Quetta and milled to form a coarse powder and then extracted with methanol (500 ml). The aqueous extract was prepared by boiling 10 g of dried ground seed in 20 ml distilled water for 2 h.

Antibacterial activity evaluation by disc diffusion assay

Antibacterial activity of aqueous and methanolic extract was individually tested against a number of pathogenic bacteria by disc diffusion method. Using 1 cm sterilized discs prepared from Whatman's filter paper no.1, impregnated with alcoholic and aqueous seed extracts on nutrient agar incubated for 48 hrs at 37°C. Test species

of bacteria includes *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Bacillus cereus*, *Bacillus pumilus*, *Bacillus megaterium*, *Shigella dysenteriae*, *Shigella shiga*, *Salmonella typhi*, *Shigella boydii*, *Micrococcus luteus*, *Pseudomonas pupida*, *Pseudomonas syringae*, *Salmonella typhimurium*, *Shigella dysenteriae*, *Staphylococcus albus*, *Streptococcus haemolyticus* and *Agrobacterium tumefaciens*. Presence or absence of inhibition zone around the impregnated discs indicated the antibacterial property of the extracts. Nutrient agar plates with discs impregnated with autoclaved distilled water was taken as control in all experiments.

Results

Foeniculum vulgare seed extracts were evaluated for their antibacterial activity (Table 1).

Discussion

The antifungal activity of different *Foeniculum vulgare* seed extracts expressed as the presence or absence of inhibition zone is summarized in Table 1. Methanolic extract of *Foeniculum vulgare* seeds showed activity against *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, and *Klebsiella pneumoniae* but no activity against *Pseudomonas aeruginosa*, *Bacillus cereus*, *Bacillus pumilus*, *Bacillus megaterium*, *Shigella dysenteriae*, *Shigella shiga*, *Salmonella typhi*, *Shigella boydii*, *Micrococcus luteus*, *Pseudomonas pupida*, *Pseudomonas syringae*, *Salmonella typhimurium*, *Shigella dysenteriae*, *Staphylococcus albus*, *Streptococcus haemolyticus* and *Agrobacterium tumefaciens*. However its aqueous extract found to be more effective in terms of its antibacterial activity. As the obtained result clearly revealed that aqueous extract inhibited the growth of a number of bacterial species such as *Pseudomonas pupida*, *Pseudomonas syringae*, *Shigella dysenteriae*, *Staphylococcus albus*, *Streptococcus haemolyticus*, *Staphylococcus aureus*, *Bacillus subtilis*, *Bacillus pumilus*, *Bacillus*

*Corresponding author: Khan NT, Department of Biotechnology, Faculty of Life Sciences and Informatics, Balochistan University of Information Technology Engineering and Management Sciences (BUIITEMS), Quetta, Pakistan, Tel: 03368164903; E-mail: nidatabassumkhan@yahoo.com

Received July 31, 2017; Accepted August 04, 2017; Published August 11, 2017

Citation: Khan NT (2017) In vitro Antibacterial Activity of *Foeniculum vulgare* Seed Extract. Agrotechnology 6: 162. doi: [10.4172/2168-9881.1000162](https://doi.org/10.4172/2168-9881.1000162)

Copyright: © 2017 Khan NT. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

S. No.	Names	Aqueous extract inhibition zone	Methanolic extract inhibition zone
1.	<i>Escherichia coli</i>	-	+
2.	<i>Pseudomonas pupida</i>	+	-
3.	<i>Pseudomonas syringae</i>	+	-
4.	<i>Salmonella typhimurium</i>	-	-
6.	<i>Staphylococcus albus</i>	+	-
7.	<i>Streptococcus haemolyticus</i>	+	-
8.	<i>Agrobacterium tumefaciens</i>	-	-
9.	<i>Micrococcus latus</i>	-	-
10.	<i>Staphylococcus aureus</i>	+	+
11.	<i>Bacillus subtilis</i>	+	+
12.	<i>Pseudomonas aeruginosa</i>	-	-
13.	<i>Bacillus cereus</i>	-	-
14.	<i>Bacillus pumilus</i>	+	-
15.	<i>Bacillus megaterium</i>	+	-
16.	<i>Shigella dysenteriae</i>	+	-
17.	<i>Shigella shiga</i>	+	-
18.	<i>Klebsiella pneumoniae</i>	+	+
19.	<i>Salmonella typhi</i>	-	-
20.	<i>Shigella boydii</i>	-	-

(+) Indicates the inhibition of the fungal growth
(-) Indicates no inhibition of fungal growth

Table 1: Observed inhibition zone.

Figure 1: *Foeniculum vulgare* seeds.

megaterium, *Shigella shiga* and *Klebsiella pneumoniae*. *Bacillus subtilis* was found to be sensitive to the aqueous and methanolic extracts of the fennel seeds. The high antibacterial activity of fennel aqueous seed extracts is probably due to the high concentration of secondary metabolites that are very much soluble in water [12,13]. The aqueous extract of fennel seed showed broad antibacterial spectrum against a wide range of gram negative and gram positive bacteria [14]. This is due to the presence of compounds such as, linoleic acid, undecanal, 1, 3-benzenediol, oleic acid and 2, 4-undecadienal in the extract. It is reported that fennel seed extract contain 5-hydroxy-furanocoumarin which contributes in antimicrobial property of this plant [15].

Conclusion

Available researches have shown that extracts of fennel possess pharmacological properties such as antibacterial activity. Medicinal properties of the plant are due to its different chemical compounds. Among the various compounds found in fennel plant essence and

phenolic compounds are considered as the most important and most active compounds of it. The fennel bioactive molecules can be used for different drug production and for the synthesis of antimicrobial agents

References

- Pourabbas S, Kesmati M, Rasekh A (2011) Study of the the anxiolytic effects of fennel and possible roles of both gabaergic system and estrogen receptors in these effects in adult female rat. *Physiol Pharmacol* 15: 134-143.
- Bernath J, Nemeth E, Kattaa A, Hethelyi E (1996) Morphological and chemical evaluation of fennel (*Foeniculum vulgare* Mill.) populations of different origin. *J Essent Oil Res* 8: 247-253.
- Ahmadi A, Nasiri Nejad F, Parivar K (2007) Effect of aqueous extract of the aerial part of the *Ruta graveolens* on the spermatogenesis of immature Balb/C mice. *Razi J Med Sci* 14: 13-20.
- Moura LS, Carvalho RN, Stefanini MB, Ming LC, Meireles MAA (2005) Supercritical fluid extraction from fennel (*Foeniculum vulgare*): global yield, composition and kinetic data. *J Supercrit Fluids* 35: 212-219.
- Rather MA, Dar BA, Sofi SN, Bhat BA, Qurishi MA (2016) *Foeniculum vulgare*: A comprehensive review of its traditional use, phytochemistry, pharmacology, and safety. *Arab J Chem* 9: 1574-1583.
- Miguel MG, Cruz C, Faleiro L, Simoes M, Figueiredo AC, et al. (2010) *Foeniculum vulgare* essential oils: chemical composition, antioxidant and antimicrobial activities. *Nat Prod Commun* 5: 319-328.
- Mohsenzadeh M (2007) Evaluation of antibacterial activity of selected Iranian essential oils against *Staphylococcus aureus* and *Escherichia coli* in nutrient broth medium. *Pak J Biol Sci* 10: 3693-3697.
- Dadalioglu I, Evrendilek GA (2004) Chemical compositions and antibacterial effects of essential oils of Turkish oregano (*Origanum minutiflorum*), bay laurel (*Laurus nobilis*), Spanish lavender (*Lavandula stoechas* L.), and fennel (*Foeniculum vulgare*) on common food borne pathogens. *J Agric Food Chem* 52: 8255-8260.
- Cantore PL, Iacobelli NS, Marco AD, Capasso F, Senatore F (2004) Antibacterial activity of *Coriandrum sativum* L. and *Foeniculum vulgare* Miller Var. *vulgare* (Miller). *Essential oils*. *J Agric Food Chem* 52: 7862-7866.
- Mahady GB, Pendland SL, Stoia A, Hamill FA, Fabricant D, et al. (2005) In vitro susceptibility of *Helicobacter pylori* to botanical extracts used traditionally for the treatment of gastrointestinal disorders. *Phytother Res* 19: 988-991.
- Kwon YS, Choi WG, Kim WJ, Kim WK, Kim MJ, et al. (2002) Antimicrobial constituents of *Foeniculum vulgare*. *Arch Pharmacol Res* 25: 154-157.
- Parejo I, Jauregui O, Sanchez-Rabaneda F, Viladomat F, Bastida J, et al. (2004) Separation and in fennel (*Foeniculum vulgare*) using liquid chromatography-negative electrospray ionization tandem characterization of phenolic compounds mass spectrometry. *J Agric Food Chem* 52: 3679-3687.
- Dusko BL, Comic L, Sukdolak S (2006) Antibacterial activity of some plants from family Apiaceae in relation to selected phytopathogenic bacteria. *Kragujevac J Sci* 28: 65-72.
- Cwikla C, Schmidt K, Matthias A, Bone K, Lehmann R, et al. (2010) Investigations into the antibacterial activities of phytotherapeutics against *Helicobacter pylori* and *Campylobacter jejuni*. *Phytother Res* 24: 649-656.
- Esquivel-Ferrino PC, Favela-Hernandez MJM, Garza-Gonzalez E, Waksman N, Rios MY, et al. (2012) Ant mycobacterial activity of constituents from *Foeniculum vulgare* var. *dulce* grown in Mexico. *Molecules* 17: 8471-8482.