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# Antimicrobial activity of essential oil of *Artemisia herba alba Asso* from Eastern Algeria

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**Abstract**

Artemisia, one of the larger genera in the family Asteraceae comprises from 200 to more than 500 taxa. It was known for its therapeutic and medicinal properties, and was used in both traditional and modern medicine. The antimicrobial properties of essential oils obtained by hydrodistillation from the aerial parts of the plant were determined using the disk diffusion method on agar towards seven bacterial species: *Staphylococcus aureus* (ATCC 25923), *Pseudomonas aeruginosa* (ATCC 27853), *E coli* (ATCC 25922) and *Enterobacter cloacae* (ESBL), *Staphylococcus aureus* (MRSA), *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* MBL. Essential oil yield was about 0.526%. The antibacterial assay showed a good activity against different microorganisms. *Candida albicans* and Gram-positive bacteria were more sensitive than Gram negatives ones. The present study demonstrated that *Artemisia herba-alba* appears to be effective against all the tested bacteria. Therefore, it deserves to be exploited by pharmaceutical and food industry.

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## Introduction

In the last few years, due to the misuse of antibiotics and the increasing incidence of immunodeficiency-related diseases, the development of microbial drug resistance has become more and more of a pressing problem. Recently, natural products from aromatic and medicinal plants represent a fertile ground for the development of novel antibacterial agents (Wang *et al.,* 2012). The Aromatic and Medicinal Plants sector represents an important commercial activity through the world. For the eastern regions, Artemisia and Rosemary are the two species that dominate the aromatic and medicinal landscape and are the subject of important commercial transactions (Bencheqroun *et al.,* 2012). The Mediterranean region is relatively rich with plants (between 15,000 and 20,000 species). Algeria, a North African country with a large variety of soils (littoral, steppe, mountains and desert) and climates, possesses a rich flora (more than 3,000 species and 1,000 genders) (Lakehal *et al.,* 2016).

Artemisia is among the largest and most widely distributed genera of the family Asteraceae, consisting of 522 small herb and shrub species native to the northern hemisphere, South America, southern Africa, and the Pacific Islands (Baykan *et al.,* 2012; Hayat *et al.,* 2009).

White wormwood has a wide geographical distribution, covering approximately 6 million hectares in Algeria (Elkouli, 2016) and growing in clay steppes and compact soils with relatively low permeability. It is a means of combating erosion and desertification (Ayad *et al.,* 2013).

The essential oil contained in the Artemisia leaves commonly named 'Chih' is known for its regulating properties of the menstrual cycle. It is also used to treat urinary tract infections. Moreover, the name of its genus comes from the latin name of the goddess Artemis and whose role was to protect sick women (Khireddine, 2013). In Chinese medicine, it is used to make moxas: sticks of dried wormwood that are burned near the meridian points to heat them. This principle is used in moxibustion and is an alternative to acupuncture and acupressure (Bencheqroun *et al.,* 2012). This plant is also suggested to be important as a fodder for sheep and for livestock in the plateau regions of Algeria where it grows abundantly. Ascaridae from hogs and ground worms were killed by the oil of the Libyan *A. herba-alba* in a short time. In this paper, we report the results of a study aimed at evaluating the *in vitro* antibacterial activity of the essential oil of Artemisia herba alba Asso grown in eastern Algeria.

## Materials and methods

*Plant material*

White wormwood is a plant belonging to the Asteraceae family. It is a forage, medicinal and aromatic plant used as a treatment for many diseases such as diabetes, diarrhea and as a vermifuge, its essential oil is intended for the cosmetology and perfumery industry.

The aerial parts (leaves and flowered tops) of the plant ware collected in March 2017, in the region of Chemora, Batna governorate at the Tell-Stepp interface in northeastern Algeria. The essential oil was obtained by hydrodistillation of 100 g of the powdered seed for 4 h using a Clevenger-type apparatus to collect the oil.

*Microbial strains*

For investigating the anti-microbial effect, *Candida albicans* and 7 bacterial strains were tested against *Artemisia herba alba* Asso essential oil; *Staphylococcus aureus* ATCC (25923), *Pseudomonas aeruginosa* ATCC (27853), *Escherichia coli* ATCC (25922) and 4 resistant clinical strains *Enterobacter cloacae* producing fan extended-spectrum beta-lactamase (ESBL), Methecillin-resistant *Staphylococcus aureus* (MRSA), *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* producing a-methallo-Beta-Lactamase (MBL). Bacterial strains were clinical isolates provided from the Microbiology laboratory, Faculty of Medicine, Batna, Algeria.

*The antimicrobial assay*

Antimicrobial potential of *Artemisia herba alba* essential oil was assessed using the disk-diffusion method on agar according to Bouzidi Maghraoui *et al.* (2015). The micribial strains are seeded on nutrient agar and incubated at 37°C for 24 hours, to optimize their growth. After growth, a suspension is prepared with diluted distilled water and adjusted to a concentration of 0.5mc Farland (OMS Recommandations, 2001). Microbial suspensions were streaked over the surface of Mueller Hinton agar using a sterile cotton swabs to ensure uniform inoculation. Then, disks impregnated with 20µl of the essential oil are gently placed on the surface of the inoculated agar. Antibiotic disc were used as controls. The culture plates were incubated at 37°C for 24 and 48 hours for bacteria and fungi respectively. The inhibition zone (IZ) was measured in millimeters and recorded (Mahboubi and Farzin, 2009).

**Results and discussion**

*Extraction yield*

Hydrodistillation of the aerial parts of these *A. herba alba* samples yielded yellowish liquid oils with strong and pleasant odor. It seems to be in accordance with Kheffach (2015). These properties are related to the climatic and edaphic conditions of the study region and the condition of the plant.

The oil yield was about 0.526%. Comparable yields were obtained from white wormwood samples from different regions in Algeria (0.7%, 0.94% in Setif and 0.95% in Biskra (Dob, and Chelghoum, 2006; Amor, 2010; Bezza *et al.,* 2010 respectively). Same yield rates were observed in Tunisia and Morocco with 0.62% and 065% (Ghanmi *et al.,* 2010; Akrout *et al.,* 2010 respectively]. Our values seem to be below several works carried out in Algeria; Dob and Benabdelkader (2006) in M'sila with 1.02% and Kheffach (2015) in El Oued with an average of 1.4%.

The obtained yield represents an average value relative to other plants. It is higher than that of *Artemisia maritima* with 0.33% (Sharma *et al.,* 2014) and rose (0.1-0.35%) but lower than that of thyme (2-2.5%) (Bencheqroun *et al.,* 2012). These variations are due to several factors; the geographical origin and the age of the plant (Bouzidi, 2016), soil temperature, fertilization and others factors etc.) (Kheffach, 2009).

*Antimicrobial activity*

In general, the screening of medicinal plants for antimicrobial activities is important for finding new potential compounds for medicinal and industrial purposes. Some pathogenic bacteria are commonly resistant to many antibiotics. So, interests at antimicrobial properties of extracts from aromatic plants particularly essential oils are very important.

The analysis of *A. herba-alba* oil showed that it exhibited an antimicrobial activity against different microorganisms as illustrated (Fig. 3, 4, 5, 6, 7, 8) and varied according to the type of pathogen. The maximum zone of inhibition was recorded against *Candida albicans* 33.85 mm. Same result was reported by Bouzidi Maghraoui *et al.* (2015) and Bouzidi (2016).

**Fig. 1.** Artemisia herba alba.

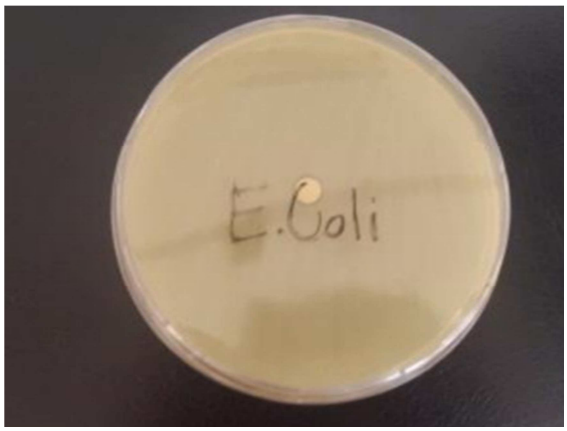


**Fig. 2.** The inhibition zone of EO on *Candida albicans.*


**Fig. 3.** The inhibition zone Of EO on *E coli*.


**Fig. 4.** The inhibition zone Of EO on *K pneumoniae*.


**Fig. 5.** The inhibition zone Of EO on *P aeruginosa*.

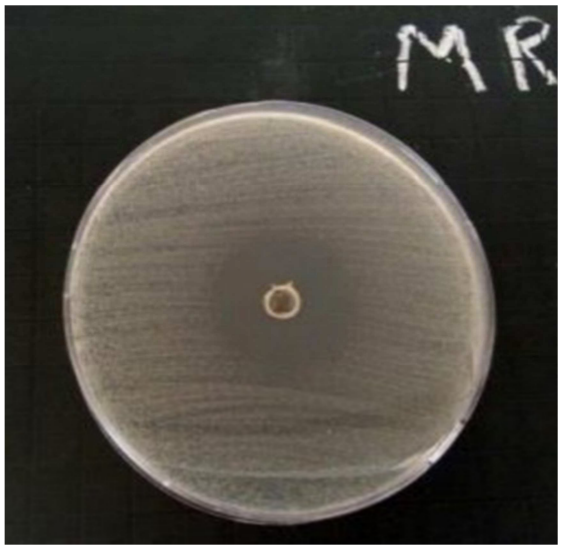


**Fig. 6.** The inhibition zone Of EO on *S aureus*.


**Fig. 7.** The inhibition zone Of EO on *E cloacae*.

It was followed by Gram positive bacteria; *Staphylococcus aureus* MRSA 27.60 mm and *Staphylococcus aureus* ATCC (25923) with 27.04mm (Table. 1). Indeed most of the studies investigating the action of essential oils against food spoilage organisms agreed that, essential oils are slightly more active against Gram-positive than Gram-negative bacteria (Mahboubi and Farzin, 2009; Janaćković *et al.,* 2015). On the other hand, the growth of 5 Gram-negative bacteria *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, *Enterobacter cloacae* ESBL, *Klebsiella pneumoniae* ESBL and *Pseudomonas aeruginosa* MBL was partially inhibited. Same result was reported by Sharma *et al.,* (2014).

*E. coli* ATCC (25922) was the most tested sensitive Gram-negative strains with a medium inhibition zone of about 14.05mm. These results are consistent with those described in the study of Lakehal *et al.* (2016). Modest activities were observed against *Pseudomonas aeruginosa* ATCC (27853) an inhibition zone of 12.52mm.

The effectiveness of this oil against *S aureus* and *E. coli* demonstrated the application of this oil in food industry as preservative and flavoring agents. Also, it can be used in water sterilization since colonization of animals is most commonly due to exposure to water containing *P. aeruginosa*.

**Conclusion**

Wormwood is a medicinal and aromatic plant, used for a long time in the traditional algerian medicine. Essential oils are aromatic substances of a complex chemical composition which gives them mainly antimicrobial biological properties interesting to use in several areas. The procurement of essential oil of hydrodistillation and harvested from Batna's region provided a good yield compared with other works.

The present study demonstrated that *Artemisia herba-alba* appears to be effective against all tested microorganisms (bacteria and yeast) where even most drug-resistant bacteria were sensitive. Therefore, it should be considered as a suitable candidate as a drug and deserves to gain more interest to advance the research of the characterization of active molecules present in this plant and their exploitation by the pharmaceutical and food industry.

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