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The Antimicrobrial Effect of Alkaloids (Harmin, Harmalin) Extracted from *Peganum Harmala* (L) Seeds in the South of Algeria (Bousaada)

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Abstract. This work examines the study of the antimicrobrial effect of alkaloids extracted from the seeds of *Peganum harmala* L (Zygophyllaceae). This natural substance is extracted by using different solvents (aqueous, ethanolic and hexane). The evaluation of the antimicrobial activity has only dealt with alkaloids. The antimicrobial effect of alkaloids is evaluated on several microorganisms. It has been tested on eight bacterial strains: The extract has been studied by using two yeasts. Finally, three molds have been studied. It should be noted that these agents are characterized by a high frequency of contamination and pathogenicity. Through this study, we note that *Staphylococcus aureus*, *Saccharomyces cerievisae* and *E. coli* are very sensitive in respect of the ethanol extract. *Pseudomonas aerogenosa* and *Penicillium sp.* are resistant to this extract. The other microorganisms are moderately sensitive. The study of the antimicrobial activity of different extracts of the Harmel has shown an optimal activity with the ethanol extract.

KeyWords: *Peganum harmala* L., seeds, alkaloids, bacteria, fungi, yeast, antimicrobial activity

1. Introduction

[1] notes that the World Health Organization estimates that around 80% of today's world inhabitants have recourse to traditional preparations which are based on plants as first health care. It is considered, according to [2] that nowadays around 75% of African population has recourse only to medicinal plants and don't have access to modern medicines.

[3] confirms that this traditional pharmacopoeia discovered by the first explorers of Africa was introduced in many medicines in Europe.

According to [4], empiricism is no longer used. It was possible to isolate, identify and analyze all the plants used in therapeutics.

In Algeria, plants play a key-role in the traditional medicine. Remedies which use plants are cheaper, without undesirable effects tend to be used in many chronicle diseases [5]. Although the reports which have been published in the literature about the antimicrobial activity of alkaloids of *P. harmala* [6].The aim of this work is to study the antimicrobial effect of the fruits of *P. harmala* L.

2. Experiment

2.1. Material and methods

A non-microbiological material (glasses) as well as a biological one are used.

The part of the plant taken into account is the aerial one, precisely the fruits which are rich in natural substances [7]. The antimicrobial effect of alkaloids of *P. harmala* L. seeds is evaluated on many microorganisms. It was tested on eight bacterial strains: *Staphylococcus aureus, Pseudomonas aerogenosa, Klebseilla pneumonia, Bacillus subtilis, Klebseilla ornitthinolytica, Steptococcus faecalis, Escherichia coli*

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and Entrococcus faecium. It was studied using two kinds of yeast: *Candida albicans* and *Saccharomyces cerievieae.* Finally, three moulds are used: *Aspergillus niger, Fusarium oxysporum* and *Penicillium Sp.*

2.2. Methods of the study

The methods used in the study concerns the obtaining of plant extracts (alkaloids) as well as the antimicrobial power of these alkaloids.

Concerning the extraction of the plant substances from *Peganum harmala* L. seeds, we have adopted the method of Soxhlet advocated by [8]. It permits to obtain excellent results and has a remarkable reputation when it is applied in the vegetable field. This extraction is done using different solvents which are water, ethanol and hexane.

The antimicrobial activity of alkaloids taken from *P. harmala* L. seeds is determined by the method of diffusion in an agar environment cited by [9], [10].The first step is the preparation of the microbial strains. It is followed by an antibiogram. This method has the advantage of being very flexible in the choice of the tested antibiotics, to be applied on a big number of bacterial species, and to be largely evaluated during 50 years of world usage. [11].

3. Results

3.1. Antimicrobial activity

The inhibition zones of different strains are measured. Table 2 shows that the diameters of inhibition zones obtained respectively for the vegetable extracts of EL Harmel on the chosen strains.

Table 1: The diameters of inhibition zones of *Peganum harmala* L on bacterial strains

		Diameters of inhibition zones (mm)								
		Aqueous extract			Ethanoli extract			Hexanic extract		
		Ø / test 1 and 2	M Ø mm	W	Ø /test1 and 2	M Ø mm	W	Ø /test 1 and 2	M Ø Mm	W
bacterial stumps	E. coli	9.00 9.01	9.00	9.00	14.31 16.11	15.21	10.67	10.07 9.43	9.5	9.00
	S. aureus	9.00 9.13	9.06	9.00	18.35 20. 00	19.17	9.00	10. 00 9.68	9.84	9.00
	P. aerugenosa	9.00 9.00	9.00	9.00	11.00 10,08	10.54	9.00	9.32 9.62	9.47	9.00
	B. subtilis	10 .14 10.09	10.11	9.00	13.11 12.10	12.60	10.03	9.29 9.12	9.20	9.00
	K. ornithinolytica	9.02 9.00	9. 01	9.03	13.05 17.16	15.10	9.00	11.00 9.1	10.45	9.00
	K. pneumoniae	9.00 9.00	9.00	9.07	13.17 12.33	12.75	9.00	12.00 9.80	10.90	9.00
	E. faecium D	9. 00 9.04	9.02	9.10	16.00 10.87	13.43	9.03	10.36 13.07	11.71	9.00
	Strp. Faecalis	12. 10 12.06	12.08	9.00	17.06 14.31	15.68	10.00	12.00 11.56	11.78	9.00

Table 2: The diameters of inhibition zones of *Peganum harmala* L. on yeasts and moulds

		Diameters of inhibition zones (mm)								
		Aqueous extract			Ethanoli extract			Hexanic extract		
		Ø / test 1 and 2	M Ø mm	W	Ø /test1 and 2	M Ø mm	W	Ø /test 1 and 2	M Ø Mm	W
yeasts and moulds	A.niger	9.00 9.00	9.00	9.00	9.00 9.00	9.00	9.00	9.00 9.00	9.00	9.00
	F. oxysporum	10. 87 10.12	10. 49	9.00	13.08 12.53	12.80	9.00	11.07 10.91	10.99	9.00
	Penicillium sp	9.00 9.00	9.00	9.00	9.00 9.00	9.00	9.00	9.00 9.00	9.00	9.00
	C. albicans	10.16 9.78	9.97	10.00	13.56 15.07	14.31	10.65	12.16 11.26	11.71	9.00
	S. cerievisea	9.00 9.07	9.03	9.00	17.46 16.31	16.88	9.00	9.07 9.15	9.11	9.00

W: witness Ø: diameter

Through tables 1 and 2, it is remarked that vegetable extract of *P. harmala* L seeds have inhibitory actions on all bacterial strains, yeasts and moulds, but with different degrees. The diameter of inhibition zone varies from a strain to another.

4. Discussion

From the results of antimicrobial activity cited above, it is noticed that the vegetable extract of *P. harmala* L seeds have inhibitory actions on all bacterial strains, on yeasts and on moulds. The Antimicrobial activity of the vegetable extracts depends on two essential parameters. The first parameter is the nature and the composition of the extract. Whereas the second parameter is the genotype of microbial strain. This antimicrobial effect of a substance is due to the presence of some molecules endowed with this power. In fact, the seeds of *P. harmala* L are rich of some alkaloids like harmaline, harmine and harman which possess antimicrobial properties [12]. These alkaloids are also antifungal [13].

According to the results of the present study, vegetable extracts of Harmel seeds possess antimicrobial activity, and the most sensitive strain is *S. aureus* with a diameter of 19.17 mm of the inhibitory zone for the ethanol extract. Whereas the most resistant strain is *P. aerogenosa* with a diameter of 10.54 mm of the inhibition zone for the ethanol extract.

The results of the present work are similar to the works of [14]. This later shows that *P. aeroginosa* is well known to be very resistant to many antimicrobial agents and antibiotics in general which is probably due to the capacity of bacteria to form a bio-film or a polysaccharide barrier. This barrier is a complex organization composed of different strata connected from the internal to the external membrane where the bacteria are found in a specific physiological state to their situation. Therefore, all the bacterial population is not simultaneously and identically exposed to the product. It is established that the treatment of such bacteria require considerable concentrations of antimicrobial agents.

The results of the antifungal activity reveal the inefficiency of all the extracts against the majority of tested strains which could be due to a contamination. Consequently, the results show inhibition zones of ethanol extracts of EL Harmel seeds against *C. albicans*, of *S. cerievisea* and of *F. oxysporum*. These microorganisms have an action which is moderately sensitive.

According to [15], when the alkaloids of *P. harmala* L seeds are individually examined on *B. subtilis* and on *C. albicans*, these pathogens agents are more sensitive to harmin. Whereas Harman is more active against *E.coli* and *A. niger*. Harmalin is more efficient against *C. albicans*. Whereas harmalol shows a moderate activity. The combination of harman and harmine is the most efficient against *E. coli*, but a mixture of Harman and harmaline gives good results against *C. albicans*. [15] indicates that *Berberis aetnensis* methanolic root extract has shown a good activity against *C. albicans, C. krusei and C. tropicalis, whereas the isolated isoquinoline alkaloid berberine has generally shown a* weaker activity. [16] notes that there are many reports in literature showing a big variety of pharmacological activities for the *P. harmala* L

Finally, we are attached to study the antimicrobial and antifungal activity of diverse extracts against different germs. The evaluation of the antimicrobial effect of the vegetable extracts of *P. harmala* L seeds has permitted to affirm that it has an inhibitor power against some microorganism tested independently from their Gram and their morphology. *S. aureus* and *E. coli* are very sensitive to ethanol extract. *P. aerugenosa* and *Penicillium sp* are resistant to that extract. The other microorganisms are moderately sensitive. The study of the antimicrobial activity of different extracts of Harmel has shown an optimal activity with the extract of ethanol. It emerged from this work that *P. harmala* L is a medicinal plant which has many substances used for a medical interest. Among these substances, alkaloids which is found in the seed with interesting quantity and quality. The present work shows the interest of *P. harmala* L in traditional medicine under different using forms.

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