

Chemical Analysis and Biocidal Properties of *Nigella sativa* L. (Renunculaceae) Growing in Northern Region of Algeria

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Abstract— *Nigella sativa* L. (Renunculaceae) native to the Mediterranean region and Western Asia, Black cumin is grown to India, through Sudan and Ethiopia. It is widely cultivated in Egypt, the Middle East, Saudi Arabia, Turkey, Sudan, Afghanistan and Europe. It is among the most important medicinal plants in Algeria that is known for its antifungal and antimicrobial properties. Despite its plethora of uses for treating various diseases, it has garnered very little scientific interest so far, particularly in Algeria. For this study, the seeds of Algerian *Nigella sativa* L cultivated in the area of Magra (M'sila) in northern Algeria, were collected in summer. In such a propitious context, the aim of this study was to enhance *Nigella sativa* as a medicinal herb. The phytochemical screening methods are used. For their antimicrobial activity, extracts of tannin and polyphenols were screened against four pathogenic bacterial strains and two pathogenic yeast strains. The phytochemical analysis results showed a remarkable combination of chemical components including a high content in tannins, in flavonoids, and in alkaloids. The tannins and the polyphenols have strong antimicrobial activity against all the species. The maximum zone of inhibition was noted for polyphenol and tannin extracts against *Escherichia coli* (14 mm, 12.33 mm) and an antifungic activity against *Aspergillus niger* (11.66 mm, 9 mm). These results indicate to some benefits of *Nigella sativa* seeds which can use to treatment the microbial infection.

Keywords— Algeria, antimicrobial activity, *Nigella sativa*, phytochemistry.

I. INTRODUCTION

The black cumin is native to Asia Minor, but is cultivated in almost all Asia, the Mediterranean region [1] and also the south of Europe [2]. It is known for its antifungal and antimicrobial properties. Its seeds are traditionally used as antiseptics and disinfectants.

Given the limitations of therapeutic chemical drugs [3], the development of research on medicinal plants has been directed towards the achievement of herbal medicines. These are presented in various dosage forms, responding to specific regulations for the evaluation of safety, therapeutic efficacy and stability.

Each plant has specific constituents such as tannins, glycosids, flavonoids and anthocyanins that can be used to make drugs if they are not toxic. This plant has garnered very little scientific interest so far, particularly in Algeria. The works done concern only the antimicrobial activity [4]. The aim of this study was evaluate the antimicrobial activity of some tannins and polyphenolic compounds of extracts seeds of *Nigella sativa* against a diverse range of microorganisms comprising bacteria and yeasts.

II. MATERIALS AND METHODS

A. Plant Material

The seeds of *Nigella sativa* were collected in summer from the region of Magra at the M'sila area situated in the eastern

part of Algeria. After collection, the seeds are stored in the dark at room temperature until use.

B. Phytochemical Screening

The phytochemical screening methods used are those described by [5]. The phytochemical components analysed are: tannins (catechin, gallic), free quinones, coumarins, flavonoids, alkaloids, saponins, glycosids, anthocyanins, leucoanthocyanins, starch and iridoids.

C. Preparation of Plant Extracts

Polyphenols Extract

The powdered of *Nigella sativa* (30g) were extracted with methanol (100 ml) for 72 hours. After this step, the decoction was filtered. The filtrate was concentrated by evaporation in vacuo at 40 ° C. using a rotavapor and the residue was kept at 4° C (Harbone, 1976).

Tannins Extract

Tannins extract obtained by extraction of 15 g of powdered for 24 h in about 100 ml of solvent used (Acetone). This extract was concentrated to dryness and the residue was kept at 4° C (Harbone, 1976).

D. Microorganisms Used

The test organisms used included: four bacteria strains: *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Pseudomonas aerogenosa*, *Escherichia coli*, and two yeast strains *Candida albicans* and *Aspergillus niger*. These strains were collected from the Pasteur Institute (Algiers - Algeria).

E. Culture Media and Antimicrobial Assay

Mueller-Hinton agar (MH) and Sabouraud Dextrose agar (SD) were respectively used for bacteria and yeasts growth. Microbial cultures, freshly grown at 37°C/30°C were appropriately diluted in sterile normal saline solution to obtain the cell suspension at 10⁵ CFU: ml.

To evaluate antimicrobial activity, an agar well diffusion method was used as described by [6]. The organisms were spread on MH and SD agar plates by cotton swab. Wells of 6 mm diameter were punched into the agar medium and filled with 50 µl of plants extracts. The plates were incubated for 24 h at 37°C for bacteria and 48h at 28°C for yeast. Determining the sensitivity of the microbial strains to the polyphenols and tannins *Nigella sativa* is done using the antibiogram.

Antimicrobial activity was evaluated by measuring the inhibition zone diameter against the test organism according Duraffour and colleagues (1990).

III. RESULTS

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A. Phytochemical study

Results (Table 1) show that *Nigella sativa* is very rich in total tannins, gallic tannins, flavonoids and alkaloids. It is moderately rich in catechic tannins. Finally, we must point out that *Nigella sativa* has no free quinone, starch, and anthocyanins. It is also richer in total polyphenols than in tannins (Fig. 1).

B. Biocidal activity

The extracts seeds of *Nigella sativa* have inhibitory action on some microbial strains tested, but the diameter of the zone of inhibition varies from one strain to another. The screening antibacterial activity shows that *Escherichia coli* is extremely sensitive to the methanol extract and acetone extract with a zone of inhibition (14 ± 1.24) mm for polyphenols (12.33 ± 1.35) mm for tannins (Table 2).

TABLE I
PHYTOCHEMICAL SCREENING RESULTS OF *NIGELLA SATIVA*

Substances	<i>Nigella sativa</i>
Total tannins	+++
Catechic tannins	+
Gallic tannins	+++
Flavonoids	+++
Anthocyanins	---
Leucoanthocyanins	---
Alkaloids	++
Starch	---
Glucosids	---
Saponins	---
Iridoids	---
Free quinons	---
Coumarins	---
Mucilage	---

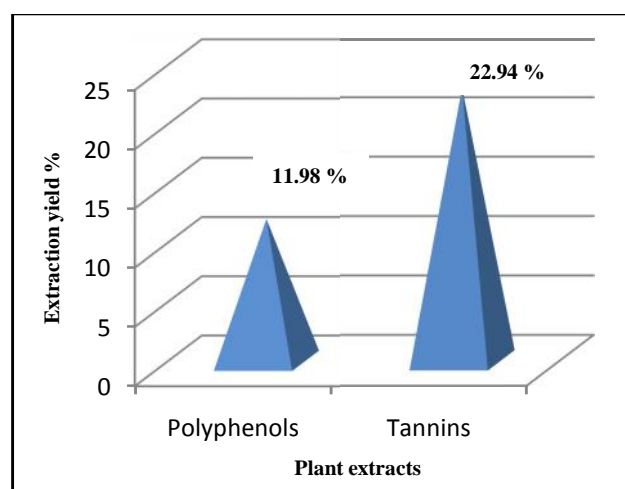


Fig. 1. Graphical representation extraction of total polyphenols and tannins of *Nigella sativa*

TABLE III
 SCREENING ANTIBACTERIAL ACTIVITY OF *NIGELLA SATIVA*
 LEAVES EXTRACTS COLLECTED FROM BOUMERDES
 MOUNTAINOUS REGION (ALGERIA)

Plant extracts	Polyphenols	Tannins
Microbial strains tested		
Bacterial strains		
<i>Escherichia coli</i>	13.66± 1.41	11.33± 0.58
<i>Staphylococcus aureus</i>	9.66± 3.54	9.33± 1.15
<i>Klebsiella pneumoniae</i>	9± 0.58	9±0.62
<i>Pseudomonas aeruginosa</i>	9.66± 1.33	9± 0.58
Yeast strains		
<i>Candida albicans</i>	8± 1.17	8± 1.42
<i>Aspergillus niger</i>	9±0.63	9.33±0.15

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IV. CONCLUSIONS

The extracts seeds of *Nigella sativa* could be good antimicrobial agents. In perspective, it would be desirable to complete this study by the extraction of active ingredients from different parts of the plant (roots, stems, leaves, and flowers) and evaluation of their antimicrobial activity of several strains of pathogen.

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