

# Analysis of the Antimicrobial Effects of Garlic (*Allium sativum*) Extracts on Waterborne Pathogenic Microorganisms

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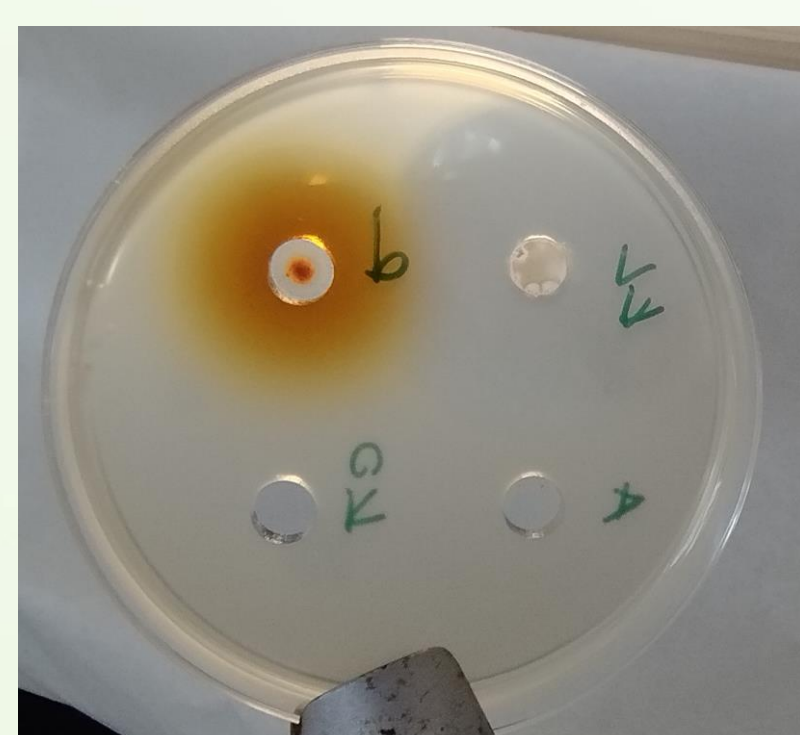
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## INTRODUCTION

The antimicrobial properties of various natural compounds are becoming a significant area of research, mostly due to the growing resistance of microorganisms to antibiotics that have been widely used so far. Garlic (*Allium sativum*) is highly valued in cooking, however, its medicinal properties have been known since ancient times. It contains a number of biologically active compounds, including many with antimicrobial properties. In this paper, the antimicrobial effect of different extracts of home grown (HG-G) and purchased/imported (IM-G) garlic (originating from China) on pathogenic microorganisms present in natural waters was investigated.

## MATERIAL AND METHODS

Acetone, ethanol, methanol, and ultrapure water were used for the preparation of garlic extracts. The ultrasound extraction method was used to obtain extracts in ultrapure water. Microbiological testing



**Figure 1.** Agar well diffusion method was used to assess the antimicrobial activity of garlic extract.

was carried out using the agar well diffusion method on 2 Gram (+) and two Gram (-) bacterial strains. The content of active compounds in the extracts was determined using gas chromatography-mass spectrometry (GC-MS).

**Table 1.** GC-MS analysis of garlic extracts. Results are given as the compound content (%) in the extract; RT – retention time, RI – Kováts retention index.

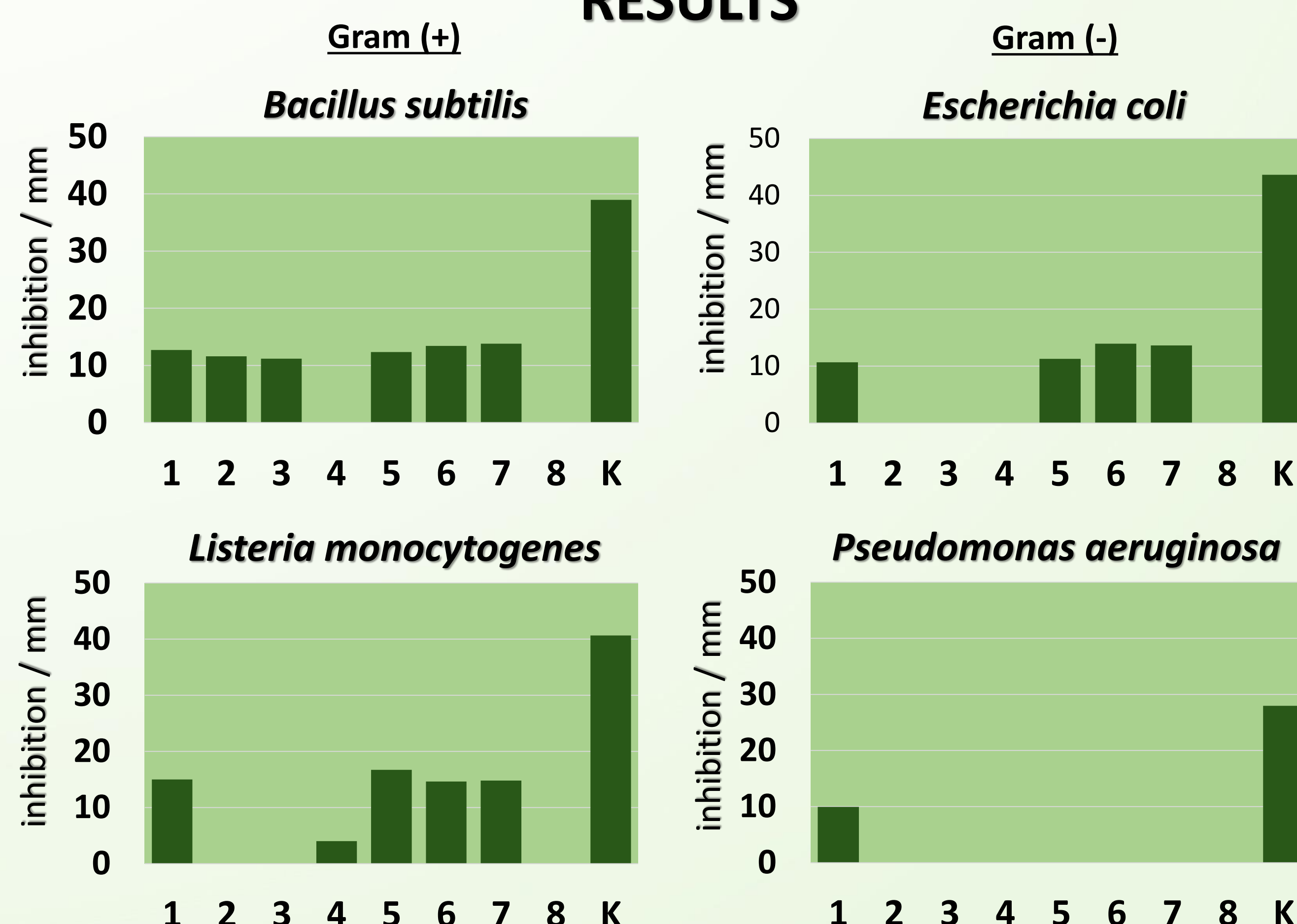
Compound	Rt	RI	HG-G/ethanol [%]	HG-G/methanol [%]	HG-G/ultrapure water [%]	IM-G/ethanol [%]	IM-G/methanol [%]	IM-G/ultrapure water [%]
Methyl disulfide	2,437	761	0,06	0,06	0,04	3,95	1,58	0,03
Diallyl sulfide	3,651	867	0,11	0,06	0,04	-	0,42	0,10
Methyl allyl disulfide	4,702	924	0,47	2,87	1,37	9,09	4,54	1,32
Dimethyl trisulfide	5,991	978	-	-	0,12	0,41	0,16	0,15
Diallyl disulfide	9,335	1083	11,29	35,06	9,70	29,22	28,88	13,49
Sulfur (S8)	44,316	2011	1,92	0,46	2,58	0,50	0,10	1,51

## RESULTS

The best antimicrobial activity was demonstrated by the extract of home-grown garlic in ultrapure water against the bacterium *Listeria monocytogenes*. More pronounced antimicrobial activity was observed for most extracts on Gram (+) bacteria compared to Gram (-) ones. Compounds with known antimicrobial activity, such as: diallyl sulfide, diallyl disulfide, methyl disulfide, dimethyl trisulfide, methyl allyl disulfide, and sulfur were detected with GC-MS in almost all extracts. The obtained results provide insight into the potential use of natural compounds from garlic for controlling waterborne pathogens, thereby contributing to addressing key challenges in public health and environmental protection.

**REFERENCES:** Bar et al., *Antioxidants*, **2022**, 11; Bhatwalkar et al. *Front. Microbiol.*, **2021**, 12..

## RESULTS



**Figure 2.** Antimicrobial activity of garlic extracts against four pathogens present in waters. Results represent the inhibition zone in mm for each extract. 1 – HG-G/ethanol; 2 – IM-G/ethanol; 3 – HG-G/methanol; 4 – IM-G/methanol; 5 – HG-G/acetone; 6 – IM-G/acetone; 7 – HG-G/ultrapure water; 8 – IM-G/ultrapure water; K – Klavocin as positive control