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ANTIMICROBIAL ACTIVITY OF DIFFERENT COMMERCIAL PLANT EXTRACTS

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Current Trends in Natural Sciences

Abstract
Due to the development of adverse effects and microbial resistance to the chemically synthesized drugs, the interest in various plant extracts for their antibacterial properties increased over the years. Plants were once considered as a daily food. Now, plants are popularly used as a common source in medicinal agents, food additives, cosmeceuticals and nutraceuticals (as a promising source of antimicrobial, antioxidant and anti-inflammatory substances). The aim of this paper was to establish the antimicrobial properties of some alcoholic plant extracts against three reference bacterial strains (Staphylococcus aureus ATCC 25923, Bacillus subtilis ISM 68/53 and Escherichia coli ATCC 25922). The ethanolic and methanolic extracts of two types of cabbage (red and white), two types of onion (red and green) and turmeric were used. The disk diffusion method was used, and the most promising results were obtained for ethanolic extracts of red and green onion against E. coli and for turmeric ethanolic extract. Common plants have therefore some antibacterial effects and can be used both in food and pharmaceutical industries.

Keywords: antimicrobial effect, plant extracts, food.

1. INTRODUCTION

The interest for antimicrobial properties of different plants increased in recent years because they are important sources of phytochemicals with various biological activities (Rutkovska and Pasqualone, 2025), inclusive antimicrobial effect (essential in treatment of bacterial disease, where more and more clinical bacterial strains become resistant to usual antibiotics). So, the tendency to replace these antibiotics with natural substances was observed in population, as reasonable alternative. Also, the plants are a promising sourse of antioxidant and anti-inflammatory substances. Natural products, such as plants extract, either as pure compounds or as standardized extracts, provide unlimited opportunities for new drug discoveries. Many beneficial biological activities such as anticancer, antimicrobial, antioxidant, antidiarrheal, analgesic and wound healing activity were reported.

The natural antimicrobials substances have a more profitable impact, both environmental and economic, than synthetic ones. In a circular economy, the natural substances may come from agricultural wastes (Arrais et al., 2022).

Biochemical composition of plants includes: peptides, polysaccharides, polyphenols, carotenoids, phytoestrogens, phytosterols, polyunsaturated fatty acids, and chlorophylls as bioactive compounds

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The concentration of them depend of species, part and status of plant. The modern technologies for extraction of functional compounds were invented, like ultrasound-assisted extraction (UAE), supercritical (SC) fluid extraction, microwave-assisted extraction (MAE), pulsed electric fields (PEF), and pressurized liquid extraction (PLE) (Rutkovska and Pasqualone, 2025). But some etracts can be obtained in a simple way, by immersing plant parts in alcohol.

2. MATERIALS AND METHODS

In this study the ethanolic and methanolic extracts obtained from two types of cabbage (red and white), two types of onion (red and green) and turmeric were used. Plant material was randomly selected and purchased from the market.

White and red cabbage (*Brassica oleracea* L.) was carefully washed and exfoliated, and the leaves were blended with a moderate speed for 3 minutes. Red and green onion (*Allium cepa* L.) was washed and blended, too. The turmeric powder (*Curcuma longa* L.) was used for turmeric extracts. A certain amount of plant material was used for extracts, 10 g plant material in 50 mL alcohol (Tabel 1). Then the plant material was dipping in alcohol for 24 hours at room temperature and filtered using Double Rings Qualitative 12.5 cm filter paper. The extracts were preserved in glass bottle till we use. All experimental variants are presented in Table 1 and Figure 1.

Table 1. Experimental variants

Plant material	Solvent	Symbol
White cabbage	*Ethanol*	*VAE*
White cabbage	*Methanol*	*VAM*
Red cabbage	*Ethanol*	*VRE*
Red cabbage	*Methanol*	*VRM*
Red onion	*Ethanol*	*CRE*
Red onion	*Methanol*	*CRM*
Green onion	*Ethanol*	*CVE*
Green onion	*Methanol*	*CVM*
Turmeric powder	*Ethanol*	*CPE*
Turmeric powder	*Methanol*	*CPM*

Three different reference bacterial strains were used: *Staphylococcus aureus ATCC* 25923 (S.a.), *Bacillus subtilis ISM 68/53* (B.s.) and *Escherichia coli ATCC 25922* (E.c.). The overnight young cultures in nutrient broth at 37°C were obtained.

Antimicrobial effect of ethanolic and methanolic plant extracts were tested using disc diffusion test, following the Kirby-Bauer method (Thampi and Shalini, 2015). Each bacterial culture was homogenous spread over the Mueller Hinton agar, using single use and sterile nasopharyngeal swabs, after the turbidity was adjusted to 0.5 McFarland units. Sterile blank discs 6 mm diameter were placed onto the solid medium, and 20 µL/disk of every extract were added in three repetitions. The positive control Gentamicin (A) 10 µg/disc and negative control (the solvent: methanol 99,9% (M), ethanol 99,5% (E) - 20 µL/disk) were used, too.

The Petri dishes were incubated inverted for 18-24 hours at 37°C, and the results were read next day. The antimicrobial activity of extracts were estimated by measuring the diameters of growth inhibition zones, as a clear zones around discs (measured in millimetres). The average of three

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values of each variant was registered and compared with positive and negative controls (higher diameter of growth inhibition zone than negative control means antibacterial activity of tested extract).

Because of the disc diffusion test results against *E. coli*, with green onion ethanolic extracts, the minimum inhibitory concentration (MIC) was evaluated only for this variant by serial dilution method in a liquid medium (according to the CLSI standard, adapted broth dilution method)(Kowalska-Krochmal and Dudek-Wicher, 2021). Extract dilutions were binary, starting from tube 2 to tube 7 (1/2 in tube 2 until 1/64 in tube 1). Tube 1 had non-diluted extract. Tubes were incubated 18-24 hours at 37°C. The results were establised by the unaided eye as: clear culture medium: absent bacterial development, cloudy medium: bacterial development. The average between the highest concentration of extract which allows the bacterial growth and the lowest concentration of extract where growth was inhibited was recorded as MIC (the minimum inhibitory concentration).

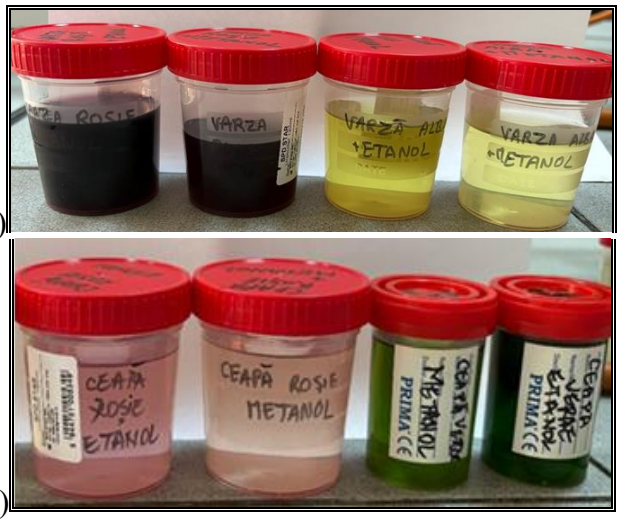
a)
b)


Figure 1. Alcoholic plant extracts: a) red and white cabbage; b) red and green onion

3. RESULTS AND DISCUSSIONS

In this study the antibacterial effects of turmeric against *Staphylococcus aureus* was the highest, with the largest inhibition zones (Table 2), the average of repetition were 18 mm and 19,3 mm for ethanolic and respectively methanolic extracts. This spice shows the antimicrobial effect higher than negative control, but lower than positive control Gentamicin.

The ethanolic extracts from cabbage and onion were effective against especially *E. coli* (the green onion ethanolic extract determined 11 mm diameter of inhibition zone). Although some studies have shown bacterial inhibition of Gram-positive *S. aureus* bacteria by white cabbage extract higher than Gram-negative bacteria *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* (Kirilov et al., 2014, Arrais et al., 2022), in our study *E. coli* demonstrate a higher sensitivity than *S. aureus* to all cabbage and onion extracts.

The red variant of cabbage was more efficient than the white one, but the red variant of onion was less efficient than the green one. The ethanolic extracts demonstrated antibacterial effect, while the cabbage and onion methanolic extracts did not demonstrate any inhibition against Gram-positive

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bacteria (*Staphylococcus aureus* and *Bacillus subtilis*). Just against *E. coli* the turmeric extracts had almost the same effect like cabbage and onion ethanolic extracts.

Even we know the benefits of these plants for their anticancer, antimicrobial, antioxidant, antidiarrheal, analgesic and wound healing activity, the non-concentrated extracts showed low antibacterial effect *in vitro*.

Table 2. Growth inhibition zones

Extract/ Bacterial strain	Inhibition zone (mm)/												
	VAE	VAM	VRE	VRM	CRE	CRM	CVE	CVM	CPE	CPM	E	M	A
S. aureus	6.6	0	7.6	0	7.6	0	10.6	0	18	19.3	10	8.6	25
B. subtilis	9.0	0	8.6	0	7.6	0	7.6	0	16.6	15.6	10.6	7.6	26
E. coli	7.3	0	9.0	0	9.3	6.6	11.0	6.16	10.6	10.6	8.6	7.6	20.6

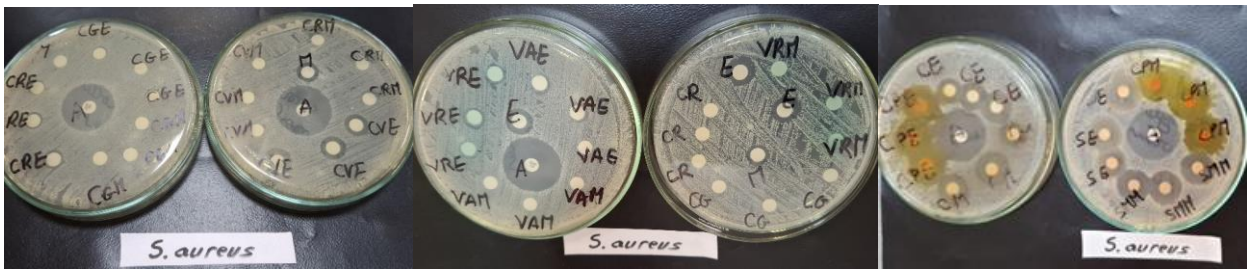

Figure 2. The antibacterial effects of alcoholic extracts against S. aureus ATCC 25923

Figure 3. The antibacterial effects of alcoholic extracts against B. subtilis ISM 68/53

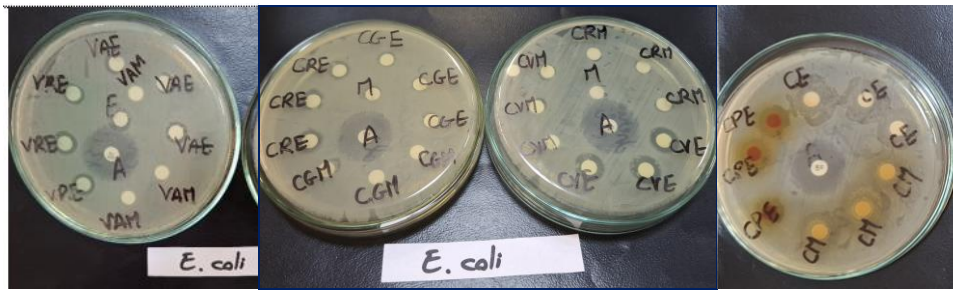

Figure 4. The antibacterial effects of alcoholic extracts against E. coli ATCC 25922

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The minimum inhibitory concentration (MIC) of green onion ethanolic extract was 1/11 from initial extract (0,093) (Figure 5). This result encourages us to continue testing the antimicrobial effect of commercial plant extracts to demonstrate the value of these plants both as food and as medicine.

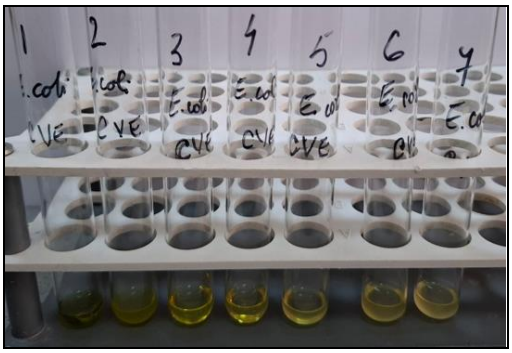

Figure 5. MIC evaluation by broth dilution method for green onion ethanolic extract against E. coli ATCC 25922

4. CONCLUSIONS

The ethanolic plant extracts from commercial plants were more efficient than the methanolic variants of the same extracts due to their active principles. The methanol seems to be less efficient as solvent. The most active extracts were the turmeric extracts, especially against Garm-positive bacteria (*Staphylococcus aureus* and *Bacillus subtilis*).

In general, the most sensitive bacteria to alcoholic extracts of commercial plants were *Escherichia coli*. The red and green onion ethanolic extracts demonstrate an inhibitory effect against the reference strain *E. coli* ATCC 25922. The minimum inhibitory concentration (MIC) of green onion ethanolic extract was 1/11.

Plants prove their worth once again, both as food and medicine.

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