

ANTIMICROBIAL ACTIVITY OF BY-PRODUCT EXTRACTS IN COMBINATION WITH PURE COMPOUNDS

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AIM OF STUDY AND METODOLOGY

Numerous scientific studies indicate the possibility of using by-products to fortify other products or as substitutes for synthetic antimicrobials. The antioxidant and antimicrobial effects of berries have already been confirmed and are primarily related to their phenolic content. However, blackberry leaves contain interesting chemical profiles as well as strong biological activity. The aim of this work was to test the antimicrobial activity of blackberry leaf extract in combination with selected phenolic compounds (vanillic acid, catechin, rutin, apigenin and oleuropein) against the most common foodborne pathogens: *Staphylococcus aureus*, *Bacillus cereus*, *Listeria monocytogenes*, *Escherichia coli*, *Enterococcus faecalis* and *Salmonella enteritidis*. Minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) methods were used in the study. The interaction between extract and compounds in terms of antibacterial activity was determined by calculating the fractional inhibitory concentration index (FICI).

RESULTS AND CONCLUSION

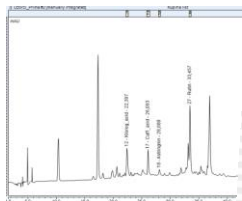
The low MIC (0.63 mg/mL) and good bactericidal activity (MBC 1.25 mg/mL) were confirmed for the blackberry leaf extract against *S. aureus*. while the MIC values for other tested bacteria were 5 mg/mL. All binary mixtures of blackberry leaf extract and selected phenolic compounds showed very good antimicrobial activity and mostly indicated additive activity. Only mixture of blackberry leaf extract and oleuropein had a synergistic effect against *L. monocytogenes* (MIC=1.25+0.31 mg/L, and FICI 0.5).

Samples	<i>S. aureus</i>		<i>B. cereus</i>		<i>L. monocytogenes</i>	
	MIC	MBC	MIC	MBC	MIC	MBC
Blackberry leaves	0.63	1.25	5	>10	5	5
Vanillic acid	>1.25	/	>1.25	/	>1.25	/
Catechin	>1.25	/	1.25	>1.25	0.63	>1.25
Rutin	>1.25	/	1.25	>1.25	1.25	>1.25
Apigenin	>0.51	/	>0.51	/	>0.51	/
Oleuropein	>1.45	/	>1.45	/	>1.45	/

Samples	<i>E. coli</i>		<i>E. faecalis</i>		<i>S. enteritidis</i>	
	MIC	MBC	MIC	MBC	MIC	MBC
Blackberry leaves	5	>10	5	>10	5	>10
Vanillic acid	>1.25	/	>1.25	/	>1.25	/
Catechin	1.25	>1.25	1.25	>1.25	1.25	>1.25
Rutin	1.25	>1.25	1.25	>1.25	1.25	>1.25
Apigenin	>0.51	/	0.51	>0.51	>0.51	/
Oleuropein	>1.45	/	>1.45	/	>1.45	/

Extract +	<i>S. aureus</i>		<i>B. cereus</i>		<i>L. monocytogenes</i>	
	MIC	MBC	MIC	MBC	MIC	MBC
Vanillic acid	1.25 + 0.31	2.5 + 0.63	5 + 1.25	>5 + 1.25	2.5 + 0.63	>5 + 1.25
Catechin	0.63 + 0.16	1.25 + 0.31	5 + 1.25	>5 + 1.25	1.25+0.31	5 + 1.25
Rutin	1.25 + 0.31	2.5 + 0.63	5 + 1.25	>5 + 1.25	5 + 1.25	5 + 1.25
Apigenin	1.25 + 0.13	2.5 + 0.26	5 + 1.25	>5 + 0.51	5 + 0.51	>5 + 0.51
Oleuropein	0.63 + 0.18	1.25 + 0.36	5 + 1.25	>5 + 1.45	1.25+0.36	1.25+0.36

Extract +	<i>E. coli</i>		<i>E. faecalis</i>		<i>S. enteritidis</i>	
	MIC	MBC	MIC	MBC	MIC	MBC
Vanillic acid	2.5 + 0.63	≥5 + 1.25	5 + 1.25	>5 + 1.25	5 + 1.25	>5 + 1.25
Catechin	5 + 1.25	>5 + 1.25	5 + 1.25	5 + 1.25	5 + 1.25	>5 + 1.25
Rutin	5 + 1.25	>5 + 1.25	5 + 1.25	>5 + 1.25	5 + 1.25	>5 + 1.25
Apigenin	>5 + 1.25	>5 + 1.25	>5 + 1.25	>5 + 1.25	>5 + 1.25	>5 + 1.25
Oleuropein	5 + 1.25	>5 + 1.45	2.5 + 0.73	≥5 + 1.25	5 + 1.45	5 + 1.45



Extract +	FICI					
	<i>S. aureus</i>	<i>B. cereus</i>	<i>L. monocytogenes</i>	<i>E. coli</i>	<i>E. faecalis</i>	<i>S. enteritidis</i>
Vanillic acid	1.25	2.00	1.00	1.00	2.00	2.00
Catechin	2.11	2.00	0.74	2.00	2.00	2.00
Rutin	2.23	2.00	2.00	2.00	2.00	2.00
Apigenin	2.24	3.45	2.00	2.00	2.00	2.00
Oleuropein	1.12	1.86	0.50	1.86	1.00	2.00