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The specificity of antimicrobial activity of *Brassicaceae* isothiocyanates

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Statement of the Problem: Food preservation is an ongoing challenge to food industries, particularly with the increased interest in mild processing to preserve flavors and to meet consumer demand for natural preservatives. Application of plant-derived antimicrobial compounds has obtained renewed interest in this respect. Condiments are known to contain antimicrobial compounds, such as mustard and wasabi, both belonging to the *Brassicaceae* family. Allyl Isothiocyanate (AITC) is the active component in these condiments and is reported to possess antimicrobial activity. Chemically diverse ITCs can be obtained from their precursors, i.e. glucosinolates, and thus the antimicrobial activity of ITCs may vary.

Purpose: The purpose of this study is to determine the specificity of antimicrobial activity of various ITCs.

Methodology: Broth microdilution assays were done to test 11 ITCs for their antimicrobial activity against food spoilage or pathogenic microorganisms including: *Listeria monocytogenes, Staphylococcus aureus, Bacillus cereus, Escherichia coli, Salmonella typhimurium, Pseudomonas aeruginosa, Candida holmii, Saccharomyces cerevisiae and Aspergillus niger.*

Findings: All tested ITCs displayed growth-inhibitory effect on all tested microorganisms in a dose-dependent manner. 9-methylsulfonyl-nonyl ITC (9-MSoITC) and 9-methylsulfinyl-nonyl ITC (9-MSITC) were the most potent against *B. cereus*, with a minimum inhibitory concentration (MIC) of 25 and 50 µg/mL, respectively. The same ITCs were also the most potent against *L. monocytogenes, S. cerevisiae* and *A. niger* (MIC 25 µg/mL). 9-MSITC was the most potent against *S. aureus* (MIC 50 µg/mL). 9-MSITC and phenethyl ITC (PhEITC) had the highest efficacy against *C. holmii* (MIC 50 µg/mL). 3-MSoITC and 3-MSITC were the most potent against *E. coli* (MIC 25 µg/mL), *S. typhimurium* (MIC 50 µg/mL) and *P. aeruginosa* (MIC 400 µg/mL). Furthermore, ITCs showed killing effect on all tested microorganisms.

Conclusion & Significance: Various ITCs have stronger antimicrobial potency than AITC. ITCs with long side chain were active against gram-positive bacteria and fungi, whereas those with short side chain were active against gram-negative bacteria.

Recent Publications:

1. Clemente et al. (2016) Antimicrobial properties and mode of action of mustard and cinnamon essential oils and their combination against foodborne bacteria. Innovative Food Science and Emerging Technologies. 36:26-33.
2. Herzallah S and Holley R (2012) Determination of sinigrin, sinalbin, allyl- and benzyl isothiocyanates by RP-HPLC in mustard powder extracts. LWT - Food Science and Technology. 47(2):293-299.
3. Lu Z et al. (2016) Antibacterial activities of wasabi against *Escherichia coli* O157:H7 and *Staphylococcus aureus.* Frontiers in Microbiology. 7:1403.
4. Monu E A et al. (2014) Effect of white mustard essential oil on the growth of foodborne pathogens and spoilage microorganisms and the effect of food components on its efficacy. Journal of Food Protection. 77(12):2062-2068.
5. Nadarajah D et al. (2005) Use of mustard flour to inactivate *Escherichia coli* O157:H7 in ground beef under nitrogen flushed packaging. International Journal of Food Microbiology. 99(3):257-267.

Biography

Silvia Andini is currently a PhD student working in the Laboratory of Food Chemistry at Wageningen University & Research, The Netherlands under supervision of Dr. Ir. Jean Paul Vincken (co-promotor) and Prof. Dr. Harry Gruppen (promotor). Her PhD research is about exploring novel natural antimicrobial compounds derived from *Brassicaceae* plants, with a particular interest in isothiocyanates (ITCs), the biologically active form of glucosinolates (GSLs), which are the major secondary metabolites in this plant family. In her PhD research, she has developed a novel analytical method to simultaneously analyze ITCs and GSLs by using LC-MS. Her research is focused on the quantitative structure-activity relationship (QSAR) of ITCs as antimicrobials and revealing their mechanism of action.

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