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เกศจักร ดร. เกรียงศักดิ์ เอี่ยมเก็บ
สาขาวิชาชีววิทยา สำนักวิชาวิทยาศาสตร์
มหาวิทยาลัยเทคโนโลยีสุรนารี

REVERSING β -LACTAM ANTIBIOTIC RESISTANCE WITH SOME FLAVONOIDS IN GRAM-POSITIVE BACTERIA

Griangsak Eumkeb^{1*} and Richards R. Michael E.²

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Abstract

The antibacterial action of naturally occurring flavonoids was investigated. When combined amoxicillin with galangin 12.5 $\mu\text{g/ml}$, minimum inhibitory concentrations (MICs) of amoxicillin against twelve clinical isolates of resistant *Staphylococcus aureus* (*S. aureus*) and four isolates of methicillin-resistant *S. aureus* (MRSA) were reduced from an initial range of 2- > 250 $\mu\text{g/ml}$ and 32- > 250 $\mu\text{g/ml}$ to a range of < 0.25-2 $\mu\text{g/ml}$ and < 0.25 $\mu\text{g/ml}$, respectively. Furthermore, six clinical isolates of ceftazidime-resistant *S. aureus* with MICs 32-250 $\mu\text{g/ml}$ had their resistance to ceftazidime reversed by galangin 25 $\mu\text{g/ml}$ to MICs of < 0.25 $\mu\text{g/ml}$. Viable counts showed that the killing of penicillin-resistant *S. aureus* cells by 10 and 50 $\mu\text{g/ml}$ benzylpenicillin was potentiated by 25 $\mu\text{g/ml}$ baicalin. Electronmicroscopy clearly showed that the combination of 25 $\mu\text{g/ml}$ benzylpenicillin with 25 $\mu\text{g/ml}$ galangin caused damage to the ultrastructures of MRSA cells. Enzymes assays indicated that galangin, tectochrysin and 6-chloro-7-methylflavone had inhibitory activity against β -lactamase I from *Bacillus cereus*. Apigenin showed marked inhibitory activity against penicillinase type IV from *Enterobacter cloacae*. It was concluded that galangin, baicalin and tested flavonoids exhibited the potential to reverse bacterial resistance to β -lactam antibiotics against MRSA and other strains of β -lactam-resistant *S. aureus*.

Keywords: Methicillin-resistant *S. aureus*, traditional herbal remedies, antibacterial agents, reverse bacterial resistance, minimum inhibitory concentrations