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The effect of the combinations of antibiotics and natural products on the antimicrobial effect for combating bacterial resistance

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The steadily increasing in bacterial resistance to existing antimicrobial drugs is a serious problem, and therefore there is a dire need to search for new approaches of bacterial treatment. The use of antibiotics alone sometimes does not produce the effective inhibitory action. To overcome this problem, a combination of drugs often used. One approach to treat infectious diseases is the use of combination of antibiotics together or with plant extracts. Combination therapy is helpful and useful for patients with serious infections caused by drug resistant pathogens.

Seven classes of antibiotics were purchased from local pharmacy (gentamicin, ceftazidime, ciprofloxacin, doxycycline, amoxicillin, ceftriaxone, and azithromycin). MICs were calculated and different antimicrobial combinations were studied on 20 clinical isolates (10 *S. aureus* and 10 *P. aeruginosa*). Also, the antibacterial activity of limonene, rosemary, salvia, thymol, thymus, capsicum, black pepper, moringa seed, curcumin and chitosan were detected against *S. aureus* and *P. aeruginosa* using broth microdilution method.

Our results revealed that the combination of ceftriaxone with either gentamicin or ciprofloxacin for *S. aureus* was significantly synergistic. Also the combination of amoxicillin with ceftazidime was synergistic and exhibited decrease of MIC by 5-6 folds. The combination of azithromycin with doxycycline exhibited decrease of MIC of azithromycin about 5-6 folds.

Our MDR clinical isolates of *P. aeruginosa* showed that the combination of gentamicin with ceftriaxone was significant. Thymol, rosemary oil and moringa seed extract exhibited the highest antibacterial activity.

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