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Article

Piper betel Compounds Piperidine, Eugenyl Acetate, and Chlorogenic Acid Are Broad-Spectrum Anti-*Vibrio* Compounds that Are Also Effective on MDR Strains of the Pathogen

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Abstract: The natural population of the aquatic environment supports a diverse aquatic biota and a robust seafood industry. However, this environment also provides an appropriate niche for the growth of pathogenic bacteria that cause problems for human health. For example, species of the genus *Vibrio* inhabit marine and estuarine environments. This genus includes species that are pathogenic to aquaculture, invertebrates, and humans. In humans, they can cause prominent diseases like gastroenteritis, wound infections, and septicemia. The increased number of multidrug resistant (MDR) *Vibrio* strains has drawn the attention of the scientific community to develop new broad-spectrum antibiotics. Hence, in this paper we report the bactericidal effects of compounds derived from *Piper betel* plants: piperidine, chlorogenic acid, and eugenyl acetate, against various strains of *Vibrio* species. The different MIC90 values were approximately in a range of 2–6 mg/mL, 5–16 mg/mL, 5–20 mg/mL, and 30–80 mg/mL, for piperidine, chlorogenic acid, and eugenyl acetate, respectively. Piperidine showed the best anti-*Vibrio* effect against the five *Vibrio* species tested. Interestingly, combinations of sub-inhibitory concentrations of piperidine, chlorogenic acid, and eugenyl acetate showed inhibitory effects in the *Vibrio* strains. Furthermore, these compounds showed synergism or partial synergism effects against MDR strains of the *Vibrio* species when they were incubated with antibiotics (ampicillin and chloramphenicol).

Keywords: antibiotics; multidrug resistances; *Vibrio cholera*; *Piper betel* compounds