

# Valorization and biorefinery of kaffir lime peels waste for antifungal activity and sustainable control of mango fruit anthracnose

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## Abstract

In the biorefinery approach, Kaffir lime (*Citrus hystrix*) peel wastes can be used to produce a varied range of biomaterials, biochemicals, and bioenergy. Kaffir lime fruit peels are a rich source of phenolic, flavonoid, and volatile compounds. Peel essential oil contains volatile compounds including monoterpenes. This covers antifungal activities. Essential oils and their components commonly inhibit fungal growth in citrus fruit. Therefore, the potential of kaffir lime essential oils against *Colletotrichum gloeosporioides*, the causative agent of anthracnose disease in mango fruit, was investigated. The major compounds of essential oil were beta-pinene, limonene, and beta-citronellol. In vitro antifungal activities of unripe kaffir essential oil (UKLO) at a 1500 to 50,000 ppm concentration showed the highest inhibition activities against *C. gloeosporioides* mycelial growth. The in vivo efficacy showed that UKLO and ripe kaffir essential oil (RKLO) at a concentration of 1500 ppm significantly suppressed the disease development of *C. gloeosporioides* compared to the control group. The mango coating with UKLO at 1500 ppm had significantly reduced disease severity index has scored 1.00 compared to scored 3.13 of the control group. This study suggested that kaffir lime peel waste essential oil could be applied to protect against mango fungal contamination.