Investigating the Antimicrobial Properties of Cannabinoids and Terpenes.

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Background

Cannabinoid compounds are naturally produced in the plant family *Cannabacae*. These include terpenes, which are fragrant aromatic oils. Some common cannabinoids are Cannabigerol (CBG), Tetrahydrocannabinol (THC), and Cannabidiol (CBD).

Cannabinoid compounds have recently been found to have antimicrobial properties and could be an alternative strategy to combat antibiotic resistant strains of bacteria.

The antimicrobial mechanism of cannabinoids has been investigated and seems to be linked to the disruption of membrane potentials although a direct mechanism has not been elucidated.

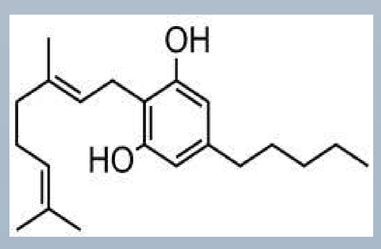


Fig 1. Chemical structure of cannabigerol (CBG).

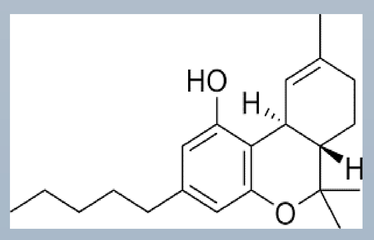


Fig 2. Chemical structure of tetrahydrocannabinol (THC).

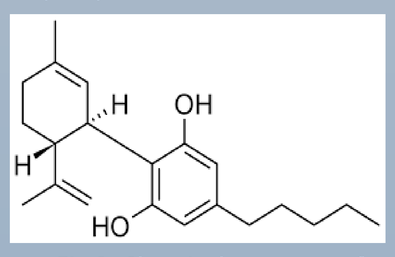


Fig 3. Chemical structure of cannabidiol (CBD).

Results

Eugenol and Carvacrol were the two most effective antimicrobial compounds and Myrcene and Beta-Caryophyllene were completely ineffective.

Eugenol and Carvacrol were extremely effective at inhibiting fungal growth.

Cannabinoid compounds were ineffective at inhibiting growth against all gram-negative bacterial species.

There seems to be no change in susceptibility to cannabinoids or terpenes when comparing antibiotic resistant strains to antibiotic susceptible strains.

Microbial species are either susceptible to the cannabinoids tested or resistant with no species exhibiting susceptibility to just one cannabinoid compound.

Table 1. Measured average zones of inhibition (mm) for all the cannabinoids and terpenes tested on a wide range of microbial species.

	Control	CBD	CBG	CBD/CBG Mix	Myrcene	Carvacrol	Eugenol	Beta-Caryophyllene	Linalool	α-Pinene	THC
Escherichia coli #33	Amp(10ug) 20mm	0	0	0	0	26mm	20mm	0	17mm	18mm	0
Escherichia coli (15-124)	Amp(10ug) 0mm	0	0	0	0	17mm	14mm	0	8mm	0	0
Staphylococcus aureus	Amp(10ug) 45mm	13mm	11mm	14mm	0	22mm	17mm	0	9mm	0	9mm
Staphylococcus aureus (MRSA)	Amp(10ug) 0mm	15mm	13mm	13mm	0	31mm	15mm	0	10mm	0	11mm
Staphylococcus epidermis	Amp(10ug) 17mm	15mm	13mm	15mm	0	32mm	15mm	0	8mm	0	10mm
Staphylococcus hycius	Amp(10ug) 17mm	13mm	12mm	13mm	0	30mm	17mm	0	12mm	10mm	10mm
Staphylococcus intermedius	Amp(10ug) 42mm	14mm	14mm	15mm	0	32mm	21mm	0	11mm	11mm	9mm
Beta Streptococcus Group A	-	-	-	-	-	-	-	-	-	-	-
Beta Streptococcus Group B	Amp(10ug) 22mm	0	0	0	0	25mm	12mm	0	0	0	0
Beta Streptococcus Group C	Amp(10ug) 32mm	0	0	0	0	25mm	15mm	0	0	0	0
Beta Streptococcus Group D	Amp(10ug) 25mm	0	0	0	0	21mm	10mm	0	0	0	0
Strep pneumoniae	-	-	-	-	-	-	-	-	-	-	-
Enterococcus	Amp(10ug) 14mm	0	0	0	0	17mm	9mm	0	0	0	0
Klebsillae pneumoniae	Cl(10ug) 12mm	0	0	0	0	22mm	13mm	0	16mm	0	0
Pseudomonas aerigonosa	Cl(10ug) 15mm	0	0	0	0	11mm	0	0	0	0	0
Candida albicans	Nystatin(10ug) 12mm	0	0	0	0	~60mm	38mm	0	11mm	22mm	0

Methods

All microbes grown on MH media or MH media infused with blood.

Disk diffusion assay was run on all compounds.

Zones of inhibition were measured after a 24hr incubation.

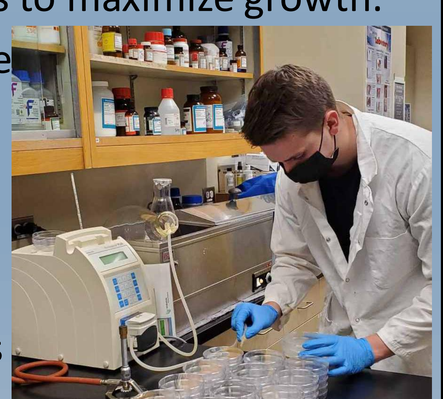
Growth conditions dependent on the specific microbial requirements to maximize growth.

A 20%v/v stock mixture was created for all terpenes.

A 10%w/v was created for THC.

A 200mg/mL stock was created for CBD/CBG.

25uL was used on each diffusion disk.



Discussion and Future Research

Although antimicrobial activity of cannabinoids has been shown it is greatly dependent on the organism that is being acted on.

The effectiveness of these compounds seems to be unaffected regardless of antibiotic resistance.

Carvacrol and Eugenol were extremely effective at inhibiting *C.albicans growth.*

Carvacrol and Eugenol have both been shown to act on the membrane permeability of the cell membranes of cells.

When added to MH blood agar plates both Carvacrol and Eugenol seem to exhibit α-Hemolysis with Carvacrol also causing a large red/orange discoloration on the plate.

Future research should focus on determining the MIC of these compounds and how different combinations of these compounds change the effectiveness of the antimicrobial activity.

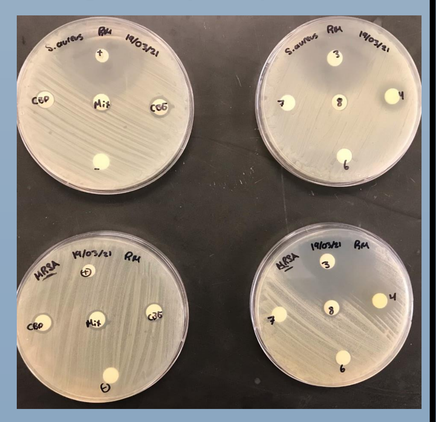


Fig 4. Spread plates of S.aureus and Methicillin resistant S.aureus.

Fig 5. Spread plates of Enterococcus (Top) and Strep D (Bottom) on MH infused with blood.

Works Cited

Blaskovich, M. A., Kavanagh, A. M., Elliott, A. G., Zhang, B., Ramu, S., Amado, M., . . . Thurn, M. (2021). The antimicrobial potential of cannabidiol. Communications Biology, 4(1). doi:10.1038/s42003-020-01530-y

Acknowledgements

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