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1976, Volume 42, Issue 1-2, pp 9-12

# Antibacterial activity of $\Delta^9$ -tetrahydrocannabinol and cannabidiol

## Abstract

The minimum inhibiting concentrations (MIC) of  $\Delta^9$ -tetrahydrocannabinol (THC) and cannabidiol (CBD) for staphylococci and streptococci in broth are in the range of 1–5  $\mu\text{g}/\text{ml}$ . In the same range, both compounds are also bactericidal. In media containing 4% serum or 5% blood the antibacterial activity is strongly reduced (MIC 50 $\mu\text{g}/\text{ml}$ ). Gram-negative bacteria are resistant to THC and CBD.

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*Antonie van Leeuwenhoek* **42** (1976) 9–12

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## Antibacterial activity of $\Delta^9$ -tetrahydrocannabinol and cannabidiol

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VAN KLINGEREN, B. and TEN HAM, M. 1976. Antibacterial activity of  $\Delta^9$ -tetrahydrocannabinol and cannabidiol. *Antonie van Leeuwenhoek* **42**: 9–12.

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## INTRODUCTION

Extracts of *Cannabis sativa* (marijuana, hashish) do not only influence

Extracts of *Cannabis sativa* (*maritima*, hashish) do not only influence human and animal behaviour, but also display an antibacterial action on gram-positive bacteria (Kabelik, 1957; Krejčí, 1958; Ferenczy, Gracza and Jacobey, 1958; Schultz and Haffner, 1959). Most observations on this action however have been made with crude extracts or with only partly purified unidentified substances isolated from such extracts. The present report pertains to quantitative determinations of the bacteriostatic and bactericidal action of purified  $\Delta^9$ -tetrahydrocannabinol (THC) and cannabidiol (CBD) which are the main constituents of cannabis.

## MATERIALS AND METHODS

*Drugs.*  $\Delta^9$ -trans-tetrahydrocannabinol (batch UNC 332) was obtained from the Bureau of Narcotic Drugs of the United Nations. Cannabidiol was isolated by Dr. F. J. Küppers, Laboratory of Organic Chemistry, University of Utrecht. Both drugs were dissolved in ethanol 70% to a concentration of 2 mg/ml. From this stock solution, dilutions were made in saline.

*Strains.* *Staphylococcus aureus* ATCC 6538; laboratory strains of staphylococci, streptococci and Enterobacteriaceae.

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*Media.* Nutrient broth agar pH 7.4 (RIV). Horse blood agar prepared by adding 5% defibrinated horse blood to nutrient broth agar pH 7.4 (RIV).

*Antibacterial tests.* Two methods were employed to estimate the antibacterial activity of THC and CBD.

1. Minimum inhibitory concentrations (MIC's) were determined as follows. Agar media containing increasing concentrations of the drugs were inoculated with suspensions of the test organisms in saline by means of a Steers replicator (Steers, Folts and Graves, 1959), the inoculum being approximately  $10^3$  cells of each of the test organisms. MIC's were read after incubation overnight at 37 C.

2. To investigate whether the action of both substances is primarily bacteriostatic or bactericidal, suspensions of *Staphylococcus aureus* ATCC 6538 were prepared in saline (without and with 4% horse serum) containing appropriate concentrations of THC or CBD. The mixtures were placed in a waterbath at 20 C. At regular time intervals the number of living cells per ml were determined

by a standard pour-plate method. The bactericidal effect is expressed as the number of decimals reduction of viable cells.

## RESULTS

Minimum inhibitory concentrations are listed in Table 1. THC and CBD were significantly active only against the gram-positive bacteria tested. The MIC's on horse blood agar were at least ten times higher than those on nutrient broth agar.

The results of the tests for the determination of bactericidal activity, using *S. aureus* as the test organism, are summarized in Table 2. 4% horse serum when added to the saline made both THC and CBD ten times less active. These data agree with the results given in Table 1.

Table 1.

Organism	Number of strains	M.I.C. ( $\mu\text{g/ml}$ )			
		Nutrient broth agar		Horse blood agar	
		THC	CBD	THC	CBD
<i>Staphylococcus aureus</i>	4	2-5	1-5	20-50	20-50
<i>Streptococcus pyogenes</i>	1	5	2	50	50
<i>Streptococcus milleri</i>	1	2	1	50	50
<i>Streptococcus faecalis</i>	1	5	5		
<i>Escherichia coli</i>	4	>100	>100		
<i>Salmonella typhi</i>	1	>100	>100		
<i>Proteus vulgaris</i>	1	>100	>100		

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9 Citations

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### Title

Antibacterial activity of  $\Delta^9$ -tetrahydrocannabinol and cannabidiol

### Journal

Antonie van Leeuwenhoek  
Volume 42, Issue 1-2 , pp 9-12

### Cover Date

1976-03-01

### DOI

10.1007/BF00399444

### Print ISSN

0003-6072

### Online ISSN

1572-9699

### Publisher

Kluwer Academic Publishers

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