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Bio-basierte Ökonomie
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Certification

I confirm that I follow the issue of the medical use of cannabis and cannabinoids since 1994 and am aware of all relevant publications concerning vaporization of cannabis and cannabinoids since this time. Since the preparation of my review for Storz & Bickel and my last certification of September 2, 2014 three relevant new studies on this issue came to my attention. The objective of my literature review was to detect new data on the use of the Volcano Vaporizer or other vaporizers for the administration of cannabinoids in humans. The primary focus were studies on safety issues. Two studies were published, which used the Volcano Vaporizer, and one study with a new vaporizer. There was one study on safety issues, which has been published since my last certification. However, this study was not conducted with the Volcano Vaporizer but with a new vaporizer developed in Israel (Syqe Inhaler).

Instead, the Volcano Vaporizer is used for clinical studies and other research areas on cannabinoids in humans due to the favorable safety of this way of administration.

1. Investigation on blood and plasma cannabinoids with and without alcohol by using the Volcano Vaporizer

Researchers of the Intramural Research Program of the National Institute on Drug Abuse in Baltimore, USA, investigated blood and plasma cannabinoids with and without alcohol by using the Volcano Vaporizer in 19 healthy participants (Hartman et al. 2015). Researchers concluded that "vaporization is an effective THC delivery route." They found significantly higher blood THC and 11-OH-THC Cmax values with alcohol than without alcohol.

2. A series of studies conducted to determine the vaporization efficiency of high doses of CBD, alone and in combination with Δ9-tetrahydrocannabinol (THC)

Researcher of the School of Psychology at the University of Wollongong, Australia, conducted a series of studies conducted to determine the vaporisation efficiency of high doses of CBD, alone and in combination with Δ9-tetrahydrocannabinol (THC), to achieve faster onset effects in experimental and clinical trials and emulate smoked cannabis (Solowij et al. 2014). THC showed 55% availability when vaporised alone or with low dose CBD, while large variation in the availability of high dose CBD impacted upon the availability of THC when co-administered, with each compound affecting the vaporisation efficiency of the other in a dynamic and dose-dependent manner. They concluded that their "protocols provide a technical advance that may inform methodology for clinical trials in humans, especially for examining interactions between THC and CBD and for therapeutic applications of CBD."

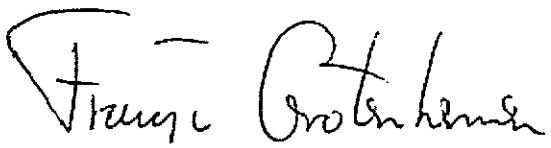
3. Investigation into the pharmacokinetics, efficacy, safety, and ease of use of a novel portable metered-dose cannabis inhaler in patients with chronic neuropathic pain

Researchers of the Israel Institute of Technology in Haifa, Israel, investigated the pharmacokinetics, efficacy, safety, and ease of use of a novel portable metered-dose cannabis inhaler in patients with chronic neuropathic pain (Eisenberg et al. 2014). They did not use the Volcano Vaporizer but a new inhaler developed in Israel. In a single-dose, open-label study, patients inhaled a single 15.1 ± 0.1 mg dose of cannabis using the Syqe Inhaler device. Blood samples for Δ(9)-tetrahydrocannabinol (THC) and 11-hydroxy-Δ(9)-THC were taken at baseline and up to 120 minutes. A uniform pharmacokinetic profile was exhibited across all participants. They concluded that "this trial suggests the potential use of the Syqe Inhaler device as a smokeless delivery system of medicinal cannabis, producing a Δ(9)-THC pharmacokinetic profile with low interindividual variation of Cmax, achieving pharmaceutical standards for inhaled drugs."

Summary:

The Volcano Medic continues to be used for clinical and basic research with cannabinoids. Recently the Volcano was also used for CBD administration to humans. CBD (cannabidiol) is another cannabinoid of the cannabis plant, which is of therapeutic interest. So far, most clinical studies have been conducted on THC or cannabis rich in THC.

I declare that literature quoted in this review reflects current state-of-the-art, that references in this review are taken from recognized scientific publications, and that this review is outcome of a study according to scientific principles.



Dr. F. Grotenhermen

Literature

Hartman RL(1), Brown TL(2), Milavetz G(3), Spurgin A(3), Gorelick DA(4), Gaffney G(5), Huestis MA(6). Controlled Cannabis Vaporizer Administration: Blood and Plasma Cannabinoids with and without Alcohol. Clin Chem. 2015 Jun;61(6):850-69. doi: 10.1373/clinchem.2015.238287. Epub 2015 May 27.

Eisenberg E, Ogintz M, Almog S. The pharmacokinetics, efficacy, safety, and ease of use of a novel portable metered-dose cannabis inhaler in patients with chronic neuropathic pain: a phase 1a study. J Pain Palliat Care Pharmacother. 2014 Sep;28(3):216-25. doi: 10.3109/15360288.2014.941130. Epub 2014 Aug 13.

Solowij N(1), Broyd SJ, van Hell HH, Hazekamp A. A protocol for the delivery of cannabidiol (CBD) and combined CBD and Δ9-tetrahydrocannabinol (THC) by vaporisation. BMC Pharmacol Toxicol. 2014 Oct 16;15:58. doi: 10.1186/2050-6511-15-58.

Abstracts of the cited literature, which are all available in the database PubMed

Clin Chem. 2015 Jun;61(6):850-69. doi: 10.1373/clinchem.2015.238287. Epub 2015 May 27.

Controlled Cannabis Vaporizer Administration: Blood and Plasma Cannabinoids with and without Alcohol.

Hartman RL(1), Brown TL(2), Milavetz G(3), Spurgin A(3), Gorelick DA(4), Gaffney G(5), Huestis MA(6).

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BACKGROUND: Increased medical and legal cannabis intake is accompanied by greater use of cannabis vaporization and more cases of driving under the influence of cannabis. Although simultaneous Δ(9)-tetrahydrocannabinol (THC) and alcohol use is frequent, potential pharmacokinetic interactions are poorly understood. Here we studied blood and plasma vaporized cannabinoid disposition, with and without simultaneous oral low-dose alcohol. METHODS: Thirty-two adult cannabis smokers (≥1 time/3 months, ≤3 days/week) drank placebo or low-dose alcohol (target approximately 0.065% peak breath-alcohol concentration) 10 min before inhaling 500 mg placebo, low-dose (2.9%) THC, or high-dose (6.7%) THC vaporized cannabis (6 within-individual alcohol-cannabis combinations). Blood and plasma were obtained before and up to 8.3 h after ingestion. RESULTS: Nineteen participants completed all sessions. Median (range) maximum blood concentrations (Cmax) for low and high THC doses (no alcohol) were 32.7 (11.4-66.2) and 42.2 (15.2-137) μg/L THC, respectively, and 2.8 (0-9.1) and 5.0 (0-14.2) μg/L 11-OH-THC. With alcohol, low and high dose Cmax values were 35.3 (13.0-71.4) and 67.5 (18.1-210) μg/L THC and 3.7 (1.4-6.0) and 6.0 (0-23.3) μg/L 11-OH-THC, significantly higher than without alcohol. With a THC detection cutoff of ≥1 μg/L, ≥16.7% of participants remained positive 8.3 h postdose, whereas ≤21.1% were positive by 2.3 h with a cutoff of ≥5 μg/L. CONCLUSIONS: Vaporization is an effective THC delivery route. The significantly higher blood THC and 11-OH-THC Cmax values with alcohol possibly explain increased performance impairment observed from cannabis-alcohol combinations. Chosen driving-related THC cutoffs should be considered carefully to best reflect performance impairment windows. Our results will help facilitate forensic interpretation and inform the debate on drugged driving legislation.

BMC Pharmacol Toxicol. 2014 Oct 16;15:58. doi: 10.1186/2050-6511-15-58.

A protocol for the delivery of cannabidiol (CBD) and combined CBD and Δ9-tetrahydrocannabinol (THC) by vaporisation.

Solowij N(1), Broyd SJ, van Hell HH, Hazekamp A.

Author information: (1)School of Psychology, Ψ-P3: Centre for Psychophysics, Psychophysiology and Psychopharmacology and Illawarra Health and Medical Research Institute, University of Wollongong, Wollongong, NSW 2522, Australia. nadia@uow.edu.au.

BACKGROUND: Significant interest has emerged in the therapeutic and interactive effects of different cannabinoids. Cannabidiol (CBD) has been shown to have anxiolytic and antipsychotic effects with high doses administered orally. We report a series of studies conducted to determine the vaporisation efficiency of high doses of CBD, alone and in combination with Δ9-tetrahydrocannabinol (THC), to achieve faster onset effects in experimental and clinical trials and emulate smoked cannabis. METHODS: Purified THC and CBD (40 mg/ml and 100 mg/ml respectively) were loaded onto a liquid absorbing pad in a Volcano vaporiser, vaporised and the vapours quantitatively analysed. Preliminary studies determined 200 mg CBD to be the highest dose effectively vaporised at 230 ° C, yielding an availability of approximately 40% in the vapour phase. Six confirmatory studies examined the quantity of each compound delivered when 200 mg or 4 mg CBD was loaded together with 8 mg of THC. RESULTS: THC showed 55% availability when vaporised alone or with low dose CBD, while large variation in the availability of high dose CBD impacted upon the availability of THC when co-administered, with each compound affecting the vaporisation efficiency of the other in a dynamic and dose-dependent manner. We describe optimised protocols that enable delivery of 160 mg CBD through vaporisation. CONCLUSIONS: While THC administration by vaporisation is increasingly adopted in experimental studies, often with oral predosing with CBD to examine interactive effects, no studies to date have reported the administration of CBD by vaporisation. We report the detailed methodology aimed at optimising the efficiency of delivery of therapeutic doses of CBD, alone and in combination with THC, by vaporisation. These protocols provide a technical advance that may inform methodology for clinical trials in humans, especially for examining interactions between THC and CBD and for therapeutic applications of CBD. TRIAL REGISTRATION: Current Controlled Trials ISRCTN24109245.

J Pain Palliat Care Pharmacother. 2014 Sep;28(3):216-25. doi: 10.3109/15360288.2014.941130. Epub 2014 Aug 13.

The pharmacokinetics, efficacy, safety, and ease of use of a novel portable metered-dose cannabis inhaler in patients with chronic neuropathic pain: a phase 1a study.

Eisenberg E, Ogintz M, Almog S.

Chronic neuropathic pain is often refractory to standard pharmacological treatments. Although growing evidence supports the use of inhaled cannabis for neuropathic pain, the lack of standard inhaled dosing plays a major obstacle in cannabis becoming a "main stream" pharmacological treatment for neuropathic pain. The objective of this study was to explore the pharmacokinetics, safety, tolerability, efficacy, and ease of use of a novel portable thermal-metered-dose inhaler (tMDI) for cannabis in a cohort of eight patients suffering from chronic neuropathic pain and on a stable analgesic regimen including medicinal cannabis. In a single-dose, open-label study, patients inhaled a single 15.1 ± 0.1 mg dose of cannabis using the Syqe Inhaler device. Blood samples for Δ(9)-tetrahydrocannabinol (THC) and 11-hydroxy-Δ(9)-THC were taken at baseline and up to 120 minutes. Pain intensity (0-10 VAS), adverse events, and satisfaction score were monitored following the inhalation. A uniform pharmacokinetic profile was exhibited across all participants (Δ(9)-THC plasma Cmax ± SD was 38 ± 10 ng/mL, Tmax ± SD was 3 ± 1 minutes, $AUC_0 \rightarrow$infinity ± SD was 607 ±

200 ng·min/mL). Higher plasma Cmax increase per mg Δ(9)-THC administered (12.3 ng/mL/mg THC) and lower interindividual variability of Cmax (25.3%), compared with reported alternative modes of THC delivery, were measured. A significant 45% reduction in pain intensity was noted 20 minutes post inhalation (P = .001), turning back to baseline within 90 minutes. Tolerable, lightheadedness, lasting 15-30 minutes and requiring no intervention, was the only reported adverse event. This trial suggests the potential use of the Syqe Inhaler device as a smokeless delivery system of medicinal cannabis, producing a Δ(9)-THC pharmacokinetic profile with low interindividual variation of Cmax, achieving pharmaceutical standards for inhaled drugs.