Cannabis Second-Hand/Passive Exposure and Vaporization Research Highlights


**Abstract:** Although cannabis may have potential therapeutic value, inhalation of a combustion product is an undesirable delivery system. The aim of the study was to investigate vaporization using the Volcano device as an alternative means of delivery of inhaled Cannabis sativa. Eighteen healthy inpatient subjects enrolled to compare the delivery of cannabinoids by vaporization to marijuana smoked in a standard cigarette. One strength (1.7, 3.4, or 6.8% tetrahydrocannabinol (THC)) and delivery system was randomly assigned for each of the 6 study days. Plasma concentrations of Δ9-THC, expired carbon monoxide (CO), physiologic and neuropsychologic effects were the main outcome measures. Peak plasma concentrations and 6-h area under the plasma concentration–time curve of THC were similar. CO levels were reduced with vaporization. No adverse events occurred. Vaporization of cannabis is a safe and effective mode of delivery of THC. Further trials of clinical effectiveness of cannabis could utilize vaporization as a smokeless delivery system.


**Abstract:** Cannabis vaporization is a technology designed to deliver inhaled cannabinoids while avoiding the respiratory hazards of smoking by heating cannabis to a temperature where therapeutically active cannabinoid vapors are produced, but below the point of combustion where noxious pyrolytic byproducts are formed. This study was designed to evaluate the efficacy of an herbal vaporizer known as the Volcano®, produced by Storz & Bickel GmbH & Co. KG, Tuttlingen, Germany (http://www.storz-bickel.com). Three 200 mg samples of standard NIDA cannabis were vaporized at temperatures of 155°–218°C. For comparison, smoke from combusted samples was also tested. The study consisted of two phases: (1) a quantitative analysis of the solid phase of the vapor using HPLC-DAD-MS (High Performance Liquid Chromatograph-Diode Array-Mass Spectrometry) to determine the amount of cannabinoids delivered; (2) a GC/MS (Gas Chromatograph/ Mass Spectrometer) analysis of the gas phase to analyze the vapor for a wide range of toxins, focusing on pyrene and other polynuclear aromatic hydrocarbons (PAHs). The HPLC analysis of the vapor found that the Volcano delivered 36%–61% of the THC in the sample, a delivery efficiency that compares favorably to that of marijuana cigarettes. The GC/MS analysis showed that the gas phase of the vapor consisted overwhelmingly of cannabinoids, with trace amounts of three other compounds. In contrast, over 111 compounds were identified in the combusted smoke, including several known PAHs. The results indicate that vaporization can deliver therapeutic doses of cannabinoids with a drastic reduction in pyrolytic smoke compounds. Vaporization therefore appears to be an attractive alternative to smoked marijuana for future medical cannabis studies.

**Abstract:** Marijuana is the most commonly used illegal drug in the United States and is considered by young adults to be the illicit drug with the least risk. On the other hand, marijuana smoke contains several of the same carcinogens and co-carcinogens as the tar from tobacco, raising concerns that smoking of marijuana may be a risk factor for tobacco-related cancers. We reviewed two cohort studies and 14 case–control studies with assessment of the association of marijuana use and cancer risk. In the cohort studies, increased risks of lung or colorectal cancer due to marijuana smoking were not observed, but increased risks of prostate and cervical cancers among non–tobacco smokers, as well as adult-onset glioma among tobacco and non–tobacco smokers, were observed. The 14 case–control studies included four studies on head and neck cancers, two studies on lung cancer, two studies on non-Hodgkin’s lymphoma, one study on anal cancer, one study on penile cancer, and four studies on childhood cancers with assessment of parental exposures. Zhang and colleagues reported that marijuana use may increase risk of head and neck cancers in a hospital-based case–control study in the United States, with dose-response relations for both frequency and duration of use. However, Rosenblatt and co-workers reported no association between oral cancer and marijuana use in a population-based case–control study. An eightfold increase in risk among marijuana users was observed in a lung cancer study in Tunisia. However, there was no assessment of the dose response, and marijuana may have been mixed with tobacco. Parental marijuana use during gestation was associated with increased risks of childhood leukemia, astrocytoma, and rhabdomyosarcoma, but dose-response relations were not assessed. In summary, sufficient studies are not available to adequately evaluate marijuana impact on cancer risk. Several limitations of previous studies include possible underreporting where marijuana use is illegal, small sample sizes, and too few heavy marijuana users in the study sample. Recommendations for future studies are to (1) focus on tobacco-related cancer sites; (2) obtain detailed marijuana exposure assessment, including frequency, duration, and amount of personal use as well as mode of use (smoked in a cigarette, pipe, or bong; taken orally); (3) adjust for tobacco smoking and conduct analyses on nonusers of tobacco; and (4) conduct larger studies, meta-analyses, or pooled analyses to maximize statistical precision and investigate sources of differences in results. Despite the challenges, elucidation of the association between marijuana use and cancer risk is important in weighing the benefits and risks of medical marijuana use and to clarify the impact of marijuana use on public health.


**Abstract:** A number of research studies have been published which have attempted to determine the relationship of the passive inhalation of marijuana smoke to the consequent production of urinary cannabinoids. At least superficially, most of these studies appear to support the proposition that passive inhalation should be seriously considered as a possible explanation for a positive urine test for marijuana. Examination of the experimental conditions that are required to produce positive test results indicates that passive inhalation does not have a major effect outside the laboratory and should not affect drug test results in the workplace.

**Abstract:** What is currently needed for optimal use of medicinal cannabinoids is a feasible, nonsmoked, rapid-onset delivery system. Cannabis “vaporization” is a technique aimed at suppressing irritating respiratory toxins by heating cannabis to a temperature where active cannabinoid vapors form, but below the point of combustion where smoke and associated toxins are produced. The goal of this study was to evaluate the performance of the Volcano vaporizer in terms of reproducible delivery of the bioactive cannabinoid tetrahydrocannabinol (THC) by using pure cannabinoid preparations, so that it could be used in a clinical trial. By changing parameters such as temperature setting, type of evaporation sample and balloon volume, the vaporization of THC was systematically improved to its maximum, while preventing the formation of breakdown products of THC, such as cannabinol or delta-8-THC. Inter- and intra-device variability was tested as well as relationship between loaded- and delivered dose. It was found that an average of about 54% of loaded THC was delivered into the balloon of the vaporizer, in a reproducible manner. When the vaporizer was used for clinical administration of inhaled THC, it was found that on average 35% of inhaled THC was directly exhaled again. Our results show that with the Volcano a safe and effective cannabinoid delivery system seems to be available to patients. The final pulmonal uptake of THC is comparable to the smoking of cannabis, while avoiding the respiratory disadvantages of smoking.


**Abstract:** More people are using the cannabis plant as modern basic and clinical science reaffirms and extends its medicinal uses. Concomitantly, concern and opposition to smoked medicine has occurred, in part due to the known carcinogenic consequences of smoking tobacco. Are these reactions justified? While chemically very similar, there are fundamental differences in the pharmacological properties between cannabis and tobacco smoke. Cannabis smoke contains cannabinoids whereas tobacco smoke contains nicotine. Available scientific data, that examines the carcinogenic properties of inhaling smoke and its biological consequences, suggests reasons why tobacco smoke, but not cannabis smoke, may result in lung cancer.


**Abstract:** Two studies were conducted to determine if extreme passive exposure to cannabis smoke in a motor vehicle would produce positive results for Δ9-tetrahydrocannabinol (THC) in oral fluid. Passive exposure to cannabis smoke in an unventilated room has been shown to produce a transient appearance of THC in oral fluid for up to 30 min. However, it is well known that such factors as room size and extent of smoke exposure can affect results. Questions have also been raised concerning the effects of tobacco when mixed with marijuana and THC content. We conducted two passive cannabis studies under severe passive smoke exposure conditions in an
unventilated eight-passenger van. Four passive subjects sat alongside four active cannabis smokers who each smoked a single cannabis cigarette containing either 5.4%, 39.5 mg THC (Study 1) or 10.4%, 83.2 mg THC (Study 2). The cigarettes in Study 1 contained tobacco mixed with cannabis; cigarettes in Study 2 contained only cannabis. Oral fluid specimens were collected from passive and active subjects with the Intercept® Oral Specimen Collection Device for 1 h after smoking cessation while inside the van (Study 1) and up to 72 h (passive) or 8 h (active) outside the van. Additionally in Study 1, Intercept collectors were exposed to smoke in the van to assess environmental contamination during collection procedures. For Study 2, all oral fluid collections were outside the van following smoking cessation to minimize environmental contamination. Oral samples were analyzed with the Cannabinoids Intercept MICRO-PLATE EIA and quantitatively by gas chromatography-tandem mass spectrometry (GC-MS-MS). THC concentrations were adjusted for dilution (× 3). The screening and confirmation cutoff concentrations for THC in neat oral fluid were 3 ng/mL and 1.5 ng/mL, respectively. The limits of detection (LOD) and quantitation (LOQ) for THC in the GC-MS-MS assay were 0.3 and 0.75 ng/mL, respectively. Urine specimens were collected, screened (EMIT, 50 ng/mL cutoff), and analyzed by GC-MS-MS for THCCOOH (LOD/LOQ = 1.0 ng/mL). Peak oral fluid THC concentrations in passive subjects recorded at the end of cannabis smoke exposure were up to 7.5 ng/mL (Study 1) and 1.2 ng/mL (Study 2). Thereafter, THC concentrations quickly declined to negative levels within 30–45 min in Study 1. It was found that environmentally exposed Collectors contained 3–14 ng/mL in Study 1. When potential contamination during collection was eliminated in Study 2, all passive subjects were negative at screening/confirmation cutoff concentrations throughout the study. Oral fluid specimens from active smokers had peak concentrations of THC approximately 100-fold greater than passive subjects in both studies. Positive oral fluid results were observed for active smokers 0–8 h. Urine analysis confirmed oral fluid results. These studies clarify earlier findings on the effects of passive cannabis smoke on oral fluid results. Oral fluid specimens collected in the presence of cannabis smoke appear to have been contaminated, thereby falsely elevating THC concentrations in oral fluid. The risk of a positive lest for THC was virtually eliminated when specimens were collected in the absence of THC smoke.


**Abstract:** Oral fluid testing for ∆9-tetrahydrocannabinol (THC) provides a convenient means of detection of recent cannabis usage. In this study, the risk of positive oral fluid tests from passive cannabis smoke exposure was investigated by housing four cannabis-free volunteers in a small, unventilated, and sealed room with an approximate volume of 36 m³. Five active cannabis smokers were also present in the room, and each smoked a single cannabis cigarette (1.75% THC). Cannabis smoking occurred over the first 20 min of the study session. All subjects remained in the room for approximately 4 h. Oral fluid specimens were collected with the Intercept DOA Oral Specimen Collection Device. Three urine specimens were collected (0, 20, and 245 min). In addition, three air samples were collected for measurement of THC content. All oral fluid specimens were screened by enzyme immunoassay (EIA) for cannabinoids (cutoff concentration = 3 ng/mL) and tested by gas chromatography-tandem mass spectrometry (GC-MS-MS) for THC (LOQ/LOD = 0.75 ng/mL). All urine specimens were screened by EIA for cannabinoids (cutoff concentration = 50 ng/mL) and tested by GC-MS-MS for THCCOOH (LOQ/LOD = 1 ng/mL). Air samples were measured for THC by GC-MS (LOD = 1 ng/L). A total of eight oral fluid specimens (collected 20 to 50 min following initiation of smoking) from the four passive subjects screened and confirmed positive for THC at concentrations ranging from 3.6 to 26.4 ng/mL. Two additional specimens from one passive subject, collected at 50 and 65 min, screened negative but contained THC in concentrations of 4.2 and 1.1 ng/mL, respectively. All subsequent specimens for passive participants tested negative by EIA and GC-MS-MS for the remainder of the 4-h session. In contrast, oral fluid specimens collected from the five cannabis smokers generally screened and confirmed positive for THC throughout the session at concentrations substantially higher than observed for passive subjects.
Urine specimens from active cannabis smokers also screened and confirmed positive at conventional cutoff concentrations. A biphasic pattern of decline for THC was observed in oral fluid specimens collected from cannabis smokers, whereas a linear decline was seen for passive subjects suggesting that initial oral fluid contamination is cleared rapidly and is followed by THC sequestration in the oral mucosa. It is concluded that the risk of positive oral fluid tests from passive cannabis smoke inhalation is limited to a period of approximately 30 min following exposure.


http://doi.org/10.1093/jat/34.4.196

**Abstract:** Cannabinoid concentrations in blood and urine after passive exposure to cannabis smoke under real-life conditions were investigated in this study. Eight healthy volunteers were exposed to cannabis smoke for 3 h in a well-attended coffee shop in Maastricht, Netherlands. An initial blood and urine sample was taken from each volunteer before exposure. Blood samples were taken 1.5, 3.5, 6, and 14 h after start of initial exposure, and urine samples were taken after 3.5, 6, 14, 36, 60, and 84 h. The samples were subjected to immunoassay screening for cannabinoids and analyzed using gas chromatography-mass spectrometry (GC-MS) for Δ9-tetrahydrocannabinol (THC), 11-nor-hydroxy-Δ9-tetrahydrocannabinol (THC-OH), and 11-nor-9-carboxy-Δ9-tetrahydrocannabinol (THC-COOH). It could be demonstrated that all volunteers absorbed THC. However, the detected concentrations were rather small. None of the urine samples produced immunoassay results above the cutoff concentration of 25 ng/mL. THC-COOH concentrations up to 5.0 and 7.8 ng/mL before and after hydrolysis, respectively, were found in the quantitative GC-MS analysis of urine. THC could be detected in trace amounts close to the detection limit of the used method in the first two blood samples after initial exposure (1.5 and 3.5 h). In the 6 h blood samples, THC was not detectable anymore. THC-COOH could be detected after 1.5 h and was still found in 3 out of 8 blood samples after 14 h in concentrations between 0.5 and 1.0 ng/mL.