

EFFECTS OF WATER FILTRATION ON MARIJUANA SMOKE: A LITERATURE REVIEW

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A DRUG
DELIVERY
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COMBINES THE
RAPID AND
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AND ABILITY TO
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Editors Note: MAPS funded Nicholas Cozzi, a pharmacology Ph.D student working with Dr. David Nichols at Purdue University, to conduct this literature review. This review is in preparation for a study of the effectiveness of water pipes in selectively filtering out unhealthy substances from the therapeutic constituents in marijuana smoke. MAPS has received a pledge of \$10,000 to conduct this study from a single MAPS member, as well as an additional \$5,000 pledge from a marijuana law reform activist (an additional \$9,000 is required before the study can begin). The water pipe study itself is preparation for a larger study that MAPS is seeking to facilitate comparing smoked marijuana versus the THC pill in the treatment of the HIV-related wasting syndrome. MAPS has received a pledge of \$50,000 for this comparison study (an additional \$70,000 is required before this study can begin).

MAPS' water pipe study was initially intended to test a standard water pipe to quantify its effectiveness in filtering marijuana smoke. However, because of the encouraging findings from this literature review regarding the health benefits of water pipes, the focus of MAPS' water pipe study has been refined. The new goal is to refine a standard water pipe and then test a prototype's effectiveness. If the remaining funding for the study can be found soon, and if the water pipe is proven beneficial, it is my hope that this water pipe could eventually be used by patients in the wasting syndrome study.

A DRUG derived from marijuana, THC (*tetrahydrocannabinol*) in sesame oil capsules (Marinol®), is currently legally available as a prescription drug in the treatment of two diseases or conditions, the treatment of nausea and vomiting associated with cancer chemotherapy and the AIDS wasting syndrome. The marijuana plant in smokable form is available to about 10 patients in the entire United States for disorders such as glaucoma, spasticity, and the wasting syndrome. Each of these drug delivery systems, oral pills and smoked plant, has its advantages and disadvantages, and each may be appropriate in particular circumstances. However, a drug delivery system that combines the rapid and reliable onset and ability to easily titrate an ingested dose (such as occurs by smoking marijuana cigarettes) with the least amount of health risk (such as occurs by oral ingestion of capsules) would also be desirable. The use of water filtered marijuana smoke, as produced by a water pipe, is one little-explored alternative. This article reviews some of the scientific work that has been done regarding the results of water filtration on the composition and effects of marijuana and tobacco smoke.

WHILE MOST of the research on water filtration has focused on tobacco smoke, the work with marijuana smoke has revealed that, except for their respective psychoactive components (nicotine and cannabinoids), both smokes share many common constituents and physical properties. Many of the results obtained by studying tobacco smoke are applicable to marijuana smoke.

In the late 1970's, a group based at the University of Athens Medical School (Greece) conducted a series of chemical and pharmacological studies on marijuana and tobacco smoke.^{1,2,3,4} These scientists tested smoke that had been filtered through a water pipe and also tested the water itself, which contained both soluble and insoluble compounds. Chemical analysis revealed many different com-

pounds in the smoke and the water, as expected from the combustion of plant materials. The water did trap some THC, as well as other psychoactive compounds, however, most of the THC present in the marijuana passed through the water pipe unchanged. Pharmacological tests (in mice) revealed that some of the water-trapped marijuana compounds were responsible for producing catatonia and for suppressing spontaneous motor activity. In contrast, the water filtered smoke itself did not affect spontaneous motor activity and did not induce catatonia, though it was richer in THC. These results indicate that water filtration removes some behaviorally active compounds in preference to others; this may be important when comparing the therapeutic effects of whole marijuana smoke to water filtered smoke.

Research has shown that water filtration reduces both the amount of particulate matter and the number and quantity of toxic substances in the smoke that passes through it. In a 1963 study by Hoffman, et al.,⁵ the water pipe was found to retain 90% of the phenol and 50% of the particulate matter and benzo(a)pyrene of the original tobacco smoke. In another study,⁶ tobacco smoke components that were passed through a water pipe showed only a minor hyperplastic reaction and no sebaceous gland destruction when they were painted onto mouse skin. (The application of substances to mouse skin to assess carcinogenic potential is a classic toxicological test; the induction of abnormal cell proliferation [hyperplasia] is a red flag.) In contrast, tobacco smoke condensate that was not water filtered induced strong hyperplasia and complete sebaceous gland destruction when applied to mouse skin in the same concentration. Salem and Sami,⁷ also using the mouse skin test, showed that there was a significant reduction of carcinogenic potential in water filtered smoke compared to the water remaining in the pipe, i.e., the water-trapped material was more carcinogenic than the smoke that passed through it. Indeed, when analyzed by thin layer chromatography, two carcinogenic agents were identified in the water itself, while only one was identified in the water filtered smoke. Therefore, water filtration removes at least two known carcinogens

that would normally be found in the smoke.

Recently, Dr. Gary Huber at the University of Texas along with colleagues from Harvard's School of Public Health conducted a cellular toxicity study of marijuana and tobacco smoke.⁸ This research group showed that passing marijuana or tobacco smoke through water, or even exposing the smoke to a wetted surface of about 48 square inches (as exists in the human throat), effectively removed substances (acrolein and acetaldehyde) which are toxic to alveolar macrophages. Alveolar macrophages are one of the major defense cells of the lung and are an important component of the immune system. When the macrophages were exposed to smoke that was not water filtered, there was a marked impairment of their capacity to kill bacteria. However, when the smoke was water filtered, there was no reduction in the bactericidal ability of the macrophages. Therefore, marijuana smoke that has been passed through sufficient water will have less impact on the immune system than marijuana smoke that has not been water filtered. This intriguing finding would be of particular importance when treating patients with the AIDS wasting syndrome.

The laboratory results discussed above parallel what is known from studying human tobacco smoking populations. Thus, there is substantial epidemiological evidence that among tobacco smokers, those who smoke through a water pipe have a much lower incidence of carcinoma than those who smoke cigarettes or smoke a "regular" pipe or cigars.^{6,7,9,10}

In summary, it appears that water filtration can be effective in removing components from marijuana smoke that are known toxicants, while allowing the THC to pass through relatively intact. The effectiveness of toxicant removal is related to the smoke's water contact area. Specially designed water pipes, incorporating particulate filters and gas dispersion frits would likely be most effective in this regard; the gas dispersion frit serves to break up the smoke in very fine bubbles, thereby increasing its water contact area. While individuals vary greatly in their smoking technique, state of health, dosing regimen, and so on, it seems that many

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patients would benefit from the use of water pipes to deliver THC. This would allow patients to titrate their dose easily while reducing the health hazard associated with smoke. ●●●

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MEDICAL MARIJUANA RESEARCH UPDATE

by Rick Doblin, MAPS President

In December, 1992, the FDA approved the oral THC pill for prescription use in stimulating appetite and reducing weight loss associated with the HIV-related wasting syndrome. However, numerous patients and physicians believe that smoked marijuana is a much better medicine than the oral THC pill. Some reasons cited in support of smoked marijuana's claimed superiority are its more rapid and reliable absorption in the body as compared to oral THC, as well as the variety of cannabinoids (ingredients chemically related to THC) that are present in the marijuana plant but absent in the THC pill.

MAPS intends to help resolve the controversy over the medical use of marijuana by working to facilitate a scientific pilot study comparing the safety and efficacy of smoked marijuana to the oral THC pill in treating the wasting syndrome. The study will be directed by Dr. Donald Abrams, a faculty member at the University of California San Francisco and the research director of the AIDS Consortium.

The study will involve 60 subjects, 30 in the smoked marijuana group and 30 in the oral THC group. Each subject will take the study drug for a period of three months, during which their weight will be monitored on a monthly basis. Subjects will also be monitored for a wide range of side effects as well as for various quality of life issues. At the end of the study period, an average weight difference of more than three kilograms between the two groups will be considered clinically significant. If the study demonstrates smoked marijuana's superiority, a larger multi-site

study (hopefully funded by the government) will need to be conducted to see if the results can be replicated.

In order to minimize the potentially deleterious effects of marijuana smoke in AIDS patients, MAPS is seeking to design and test a water pipe for possible use in this study. In addition, MAPS is working to secure permission to import high-THC content marijuana (10% THC) from the Netherlands for the study rather than accept the low-THC content marijuana (2 or 3% THC) available from the National Institute on Drug Abuse. Obviously, the higher the THC content of the marijuana, the less smoke that patients will need to inhale per dose of THC and related compounds. Roxane Laboratories, Inc., the company that markets the THC pill, has generously offered to provide all the pills required for the research project.

This protocol is nearing the end of the design phase (several months after the too optimistic timetable I reported in the last MAPS newsletter) and a final budget will be drawn up soon. My working estimate for the entire study (based on the Consortium's rule of thumb that studies cost about \$2,000 per subject) is \$120,000. MAPS has received a pledge of \$50,000 for this study from an individual in the Netherlands. I will not actually request that the \$50,000 be contributed until the experiment has been approved by all the required authorities and the remaining funds have been pledged.

My current hope is that the study will begin in late 1993. ●●●

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