Marijuana Identification Supplement
Division of Forensic Sciences

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Chapter One
The Georgia Controlled Substances Act

Drugs in Georgia are controlled by the Official Code of Georgia, Annotated Title 16, Block 13. Found in this piece of legislation are the requirements surrounding all legal and illegal possession and distribution of controlled substances. The mirror piece of legislation in Federal Law is the Code of Federal Regulations 1308. Although similar, there are some distinct differences. Marijuana is not listed in 16-13 as a scheduled item, while in 1308 marijuana is a schedule I drug.

The criteria that determine the schedule of a drug are as follows:

- Actual/relative potential for abuse
- Scientific evidence of pharmacology
- State of current knowledge about the drug
- History and pattern of abuse
- Scope, duration, and significance of abuse
- Risk to public health
- Potential of substance to produce mental or physical dependence
- Whether the substance is an immediate precursor of a controlled substance
- Designation of substance as a Federal Controlled Substance

Individual Scheduling Requirements:

Schedule I
- High potential for abuse
- No currently accepted medical use
- Lack of accepted safety for use
- Dependence not a requirement

Schedule II
- High potential for abuse
- Accepted medical use with severe restrictions
- Abuse may lead to sever psychological or physical dependence

Schedule III
- Potential for abuse less than I, or II
- Accepted medical use
- Abuse may lead to moderate/low physical, or high psychological dependence

Schedule IV
- Potential for abuse less than I, II, or III
- Accepted medical use
- Abuse may lead to limited dependence
Schedule V
- Potential for abuse less than I, II, III or IV
- Accepted medical use
- Abuse may lead to limited dependence

An extensive list of exempted preparations follows the listings of the schedules. Penalties for possession and intent to distribute/manufacturing are linked to each of the schedules.

Marijuana is defined by the GCSA, and then given penalties. It is not listed in any schedule. Schedule I THC cannot be prosecuted because of case law involving the definition of marijuana as “All parts of the plant of the genus Cannabis…and any derivative….” Aycock v. state.

Pseudoephedrine and related compounds are also controlled under certain circumstances.

Cocaine, amphetamines, opiates (including heroin), marijuana, MDMA and methaqualone can be trafficked. There are special guidelines concerning the trafficking of methamphetamine in clandestine laboratory situations.

Dangerous Drug Act

Section A states that any drug requiring a prescription is a dangerous drug in Georgia. Section B is an exhaustive list of drugs currently in Dangerous Drug status. Possession of a dangerous drug without a prescription is a misdemeanor.

Drugs often bounce from the Dangerous Drug list to over-the-counter status, as in the example of loratidine, ibuprofen, ranitidine, and others. On rare occasions abuse of a dangerous drug prompts the placement of that drug into the schedules (carisoprodol).

History of Drug Legislation

The main focus of drug legislation occurred in 1970, with the Federal Controlled Substances Act. The first real attempt to control substances was the Pure Food and Drug Act of 1906 (United States Statutes at Large (59th Cong., Sess. 1, Chp. 3915, p. 768-772)). This made the manufacture, sale, or transportation of mislabeled or poisonous foods, liquors, and drugs a misdemeanor. The next legislation was the Harrison Narcotics Tax Act, 1914. This legislation required dealers to register, and pay a tax to dispense various drugs, including coca, opium, and marijuana.
Chapter Two
Scientific Characterization of Marijuana

In order to obtain the most complete understanding of marijuana, as well as deliver this understanding as an expert witness to the lay jurist, the scientific classification and characterization of marijuana is a must. Scientists may be familiar with the different areas of science that deal with specific features of marijuana, but the layperson may not be. The following definitions were obtained from Dictionary.com, and are useful in explaining the various disciplines of science used by the expert.

- **Science** - knowledge or a system of knowledge covering general truths or the operation of general laws especially as obtained and tested through the scientific method and concerned with the physical world and its phenomena.
- **Taxonomy** - orderly classification of plants and animals according to their presumed natural relationships.
- **Biology** - a branch of science that deals with living organisms and vital processes. Biology includes the disciplines of zoology and botany.
- **Zoology** - The branch of biology that deals with animals and animal life, including the study of the structure, physiology, development, and classification of animals.
- **Botany** - The branch of biology that deals with the study of plants.
- **Chemistry** - The science of the composition, structure, properties, and reactions of matter, especially of atomic and molecular systems.
- **Forensics** - The use of science and technology to investigate and establish facts in criminal or civil courts of law.
- **Morphology** - The form and structure of an organism or one of its parts.

**Taxonomic Classification**

During the 18th century, and since, the scientific world has come to use the Linnaean Taxonomic system of classification. Developed by Carolus Linnaeus (23 May 1707-10 January 1778) this system uses a hierarchal system of different categories. Starting with the most general and ending with the most specific: Kingdom, Phylum, Class, Order, Family, Genus, and Species. More specificity among species can sometimes result in the recognition of different varieties or races. There are additional subgroups of several categories above that are not considered here.

All living organism can be classified in this way. For example, humans are classified as the following:

- **Kingdom**: Animalia (animals)
- **Phylum**: Chordata (having a neural tube)
  - **Subphylum**: Vertebrata (having a spinal cord)
- **Class**: Mammalia (mammals)
  - **Subclass**: Eutheria (placental mammals)
- **Order**: Primates (includes apes, monkeys, and man)
  - **Suborder**: Haplorrhini (dry-nosed primates)
Family: Homonids (Humans, and the great apes)
Genus: Homo (Humans, and extinct species that walk erect)
Species: Sapiens (only modern humans)

Cannabis can be classified the following way:
Kingdom: Plantae (plants)
Phylum: Tracheophyta (vascular plants)
   Subphylum: Spermatophytes (seed bearing plants)
Class: Angiosperm (flowering plants)
   Subclass: Dicots (two leaf seedlings)
Order: Rosales
Family: Cannabinacea
Genus: Cannabis
Species: Sativa, with suffix L denoting Linnaeus

Marijuana, like humankind, is the only species within the genus. However, marijuana shares the family Cannabinacea with the genus Humulus. Humulus contains the species commonly referred to as hops, which is used in brewing beer. This is the source of the term “hop-head” that refers to a marijuana user. Hops is the closest relative of marijuana and shares many features, hence it is often referred to as a “cousin.” The next closest members are in the order Rosales, which includes elm trees, nettles, and even the rose bush.

It is widely recognized that there are several different varieties of marijuana. The degree of difference between what constitutes a different variety versus a different species is not well documented or agreed upon. Some species are defined by the population of an organism that can interbreed and produce fertile offspring. This rule applies well to distinguish between horses and donkeys because they can interbreed to produce an infertile offspring (a mule). But this definition fails when applied to dogs, wolves, and coyotes, which can interbreed and produce fertile offspring. Biology doesn’t conform to any set of rules applied by humans. Because of the various claims that Cannabis Indica and Cannabis Ruderalis are actually different species of Cannabis, the State of Georgia defined marijuana as all members of the genus Cannabis. This eliminates the use of the so-called “Species Defense,” where attorneys argued that only Cannabis Sativa was illegal, and that the Harrison Narcotic Act of 1914 recognized that other species of marijuana existed.

**Morphology and Biology**

The microscopic and macroscopic features of marijuana are recognized by the Scientific Working Group for Drug Identification (SWGDRUG) as scientifically valid tests to support conclusive findings in determining the identity of marijuana. Scientists and law enforcement personnel around the world are trained in the use of microscopes to note the exclusive features of marijuana. The features that differentiate the marijuana plant from all others tend to be described using scientific jargon that is not easily understood by the
layperson. However, one need not be a botanist, or even a biologist, to be an expert in the physical identification of marijuana.

The marijuana plant is dioecious, meaning that the plant consists of male and female plants. The word comes from “di” meaning two, and “oecious” meaning house, indicating that the male and female exist in different houses. The male plant possesses flowers that have stamen, which are the pollen producing organs of the plant. The female plant possesses flowers that consist of the ovary, style, and stigma. To reproduce, the pollen is released from the male flower of one plant and received by the female flower of another plant. This fertilizes the seed that is contained in the ovary. The fertilized seeds are dropped by the female plant after maturation. The female dies shortly thereafter.

The seed will sprout in three to seven days. The sprout will usually consist of two small, oval-shaped sprout leaves known as the cotyledons (remember that marijuana belongs to the subclass dicotyledon, meaning two leaf seed sprouts). As the sprout grows the true leaves will sprout in pairs on opposite sides of the stalk, and will grow leaflets as it matures. The leaflets are long, thin, and pointed—consisting of a center vein, with minor veins angled out to a serrated edge. The leaves grow palmately compound. This means that the leaves consist of single leaflets that are radially connected all together at one spot, known as the petiole, or stem. A single leaflet appears first, followed by two smaller leaflets, then two smaller leaflets, and so on. This results in a leaf that will usually possess an odd number of leaflets. The palmately compound leaf gives marijuana leaves the distinct shape familiar on marijuana paraphernalia, as opposed to a pinnately compound leaf like a fern. The stems are close together near the top of the stalk, but grow farther apart as the stalk grows. Each stem-pair separates from the stalk in a flat plane that alternates 90° from the previous pair. The stalk itself is vascular, fibrous when mature, and hollow. The fiber in the stalk is the source of material for hemp. If the plant is growing by itself in the open, each stem will become a stalk with stems, and leaflets of its own, creating a branched, bushy appearance. When growing uncultivated in a field with many other marijuana plants the center stalk will not usually branch.
The male plant (see right) has the staminate, or male flowers. These flowers hang inverted in clusters from the fork of the stem and stalk. The flowers may be white, yellow, or green. The flowers release the pollen when blooming. The male plant is considerably less bulky than the female due to the decreased energy requirements of producing pollen. The male dies shortly after blooming.

The female plant (see below) has the pistillate, or female flowers. These flowers also grow from the fork of the stem and stalk, but protrude up. The flower consists of the ovary, which contains the immature seed, the style, which covers the seed and attaches to the stalk, and the stigma, that provides the structure that the pollen lands on to be delivered to the seed. The flower can be different colors depending on the variety, but are almost always various shades of green. Since the stems separate from the stalk more closely at the top, the female flowers tend to bunch up and be more visible and concentrated there.

The plant possesses three types of trichomes, or plant “hair,” that are more easily observed under magnification of ten to forty times.

1. Cystolithic trichomes are found on the anterior (top side) of all leaflet surfaces, and cover the veins, stems, and stalks. Cystolithic comes from Greek “cysto”, meaning an encapsulation or sac, and “lithos”, referring to stone. The cystolithic trichome is a trichome that is encapsulated with calcium carbonate. The encapsulation takes on the shape of a small, warty protuberance when young, then a long, pointed claw shape when mature. For this reason the cystolithic trichomes are commonly referred to as “bear claw hairs.”

2. Covering trichomes are found on the posterior (bottom side) surface of the leaves. These trichomes are notably softer in appearance, and can be matted down by the resinous secretions of the plant. The ratio of covering trichomes to cystoliths is approximately ten to one.

3. Glandular trichomes are located throughout the plant except on the anterior surface of the leaves. These trichomes are most abundant on the female flowers, but they are also present in significant abundance on the anterior surface of the
leaves (although difficult to see because of the covering trichomes). These trichomes produce the resins that contain the active ingredients in marijuana.

The marijuana plant can be forced to produce more resin by not allowing pollination to occur. The plant has only one goal: to produce more marijuana plants. The female will produce flowers and resins to increase the chances of pollination. The longer the female goes without pollination the more energy she will devote to flower and resin production. Once pollination does occur, she will devote all of her energy into maturing the seed, and this is not desirable if the plant is being grown for a smokeable product.

The plant may also be stripped of the lower leaves so that the plant will devote all of her energy into supporting the flower production. This must be done carefully so that the plant still has enough leaf cover to support photosynthesis. Treating the plants in this manner produces long stalks with heavy flower formation at the top. These flowering tops, commonly referred to as “buds” or “colas,” are then carefully dried and cured to maximize the active ingredients.

Marijuana grown in vast fields across the world generally cannot be cared for in this manner. Uncultivated marijuana does not make a good product for smoking directly, and also will not yield enough of the fiber necessary for making cloth and rope. People in these parts of the world rely more on hash production to reap the psychoactive effects.
Marijuana Chemistry

There are over 400 chemical compounds that are indigenous to the marijuana plant. Among these compounds are waxes, sugars, fats, plant hormones and more. The class of compounds that makes marijuana special is known as cannabinoids. Cannabinoids are compounds that are specific to the marijuana plant. There are over 60 known cannabinoids, almost all of which exist only in marijuana.

Many products are produced chemically from the marijuana plant. Hash oil is a chemical extraction of the marijuana plant that contains the cannabinoid resins in a concentrated form.

Hash is a compressed, semi-solid material that is made from resins that have been rubbed off of the plant using the hands and body.

Arguably, the two most important of the cannabinoids are tetrahydrocannabinol, abbreviated THC, and cannabinol, abbreviated CBN. The pharmacology of THC is responsible for the euphoric feeling, or “high,” associated with marijuana use. THC causes other effects, such as appetite stimulation, suppression of the emetic response, and pain relief. The pharmacology of CBN is responsible for the depressant, or “stoned” feeling. Other effects of CBN include anticonvulsant properties, lowering of intra-ocular pressure, and lowering of electrochemical activity in the cerebral cortex. Although technically classified as a hallucinogenic substance, there are too many variables associated with each plant variety and how it has been treated.

Dronabinol is a synonym for THC under the brand Marinol®. This is a pharmaceutical product manufactured with THC (encapsulated in sesame oil). These items are schedule III under Georgia Law.

The following is the PDR entry for dronabinol as published by the manufacturer.

Marinol Capsules
Manufacturer: Unimed

DESCRIPTION

Dronabinol is a cannabinoid designated chemically as (6 aR-trans)-(6a,7,8,10a-tetrahydro-6,6,9-trimethyl-3-penty-6 H-dibenzo[b,d]pyran-1-ol. Dronabinol has the following empirical and structural formulas:
Dronabinol, the active ingredient in MARINOL® Capsules, is synthetic delta-9-tetrahydrocannabinol (delta-9-THC). Delta-9-tetrahydrocannabinol is also a naturally occurring component of *Cannabis sativa L.* ( Marijuana).

Dronabinol is a light yellow resinous oil that is sticky at room temperature and hardens upon refrigeration. Dronabinol is insoluble in water and is formulated in sesame oil. It has a pKa of 10.6 and an octanol-water partition coefficient: 6,000:1 at pH 7.

Capsules for oral administration: MARINOL® Capsules is supplied as round, soft gelatin capsules containing either 2.5 mg, 5 mg, or 10 mg dronabinol. Each MARINOL® Capsule is formulated with the following inactive ingredients: FD&C Blue No. 1 (5 mg), FD&C Red No. 40 (5 mg), FD&C Yellow No. 6 (5 mg and 10 mg), gelatin, glycerin, methylparaben, propylparaben, sesame oil, and titanium dioxide.

**CLINICAL PHARMACOLOGY**

Dronabinol is an orally active cannabinoid which, like other cannabinoids, has complex effects on the central nervous system (CNS), including central sympathomimetic activity. Cannabinoid receptors have been discovered in neural tissues. These receptors may play a role in mediating the effects of dronabinol and other cannabinoids.

**Pharmacodynamics**

Dronabinol-induced sympathomimetic activity may result in tachycardia and/or conjunctival injection. Its effects on blood pressure are inconsistent, but occasional subjects have experienced orthostatic hypotension and/or syncope upon abrupt standing.

Dronabinol also demonstrates reversible effects on appetite, mood, cognition, memory, and perception. These phenomena appear to be dose-related, increasing in frequency with higher dosages, and subject to great interpatient variability.

After oral administration, dronabinol has an onset of action of approximately 0.5 to 1 hours and peak effect at 2 to 4 hours. Duration of action for psychoactive effects is 4 to 6 hours, but the appetite stimulant effect of dronabinol may continue for 24 hours or longer after administration.

Tachyphylaxis and tolerance develop to some of the pharmacologic effects of dronabinol and other cannabinoids with chronic use, suggesting an indirect effect on sympathetic neurons. In a study of the pharmacodynamics of chronic dronabinol exposure, healthy male volunteers (N = 12) received 210 mg/day dronabinol, administered orally in divided doses, for 16 days. An initial tachycardia induced by dronabinol was replaced successively by normal sinus rhythm and then bradycardia. A decrease in supine blood pressure, made worse by standing, was also observed initially. These volunteers developed tolerance to the cardiovascular and subjective adverse CNS effects of dronabinol within 12 days of treatment initiation.

Tachyphylaxis and tolerance do not, however, appear to develop to the appetite stimulant effect of MARINOL® Capsules. In studies involving patients with Acquired Immune Deficiency Syndrome (AIDS), the appetite stimulant effect of MARINOL® Capsules has been sustained for up to five months in clinical trials, at dosages ranging from 2.5 mg/day to 20 mg/day.
Pharmacokinetics

Absorption and Distribution: MARINOL® (Dronabinol) Capsules is almost completely absorbed (90 to 95%) after single oral doses. Due to the combined effects of first pass hepatic metabolism and high lipid solubility, only 10 to 20% of the administered dose reaches the systemic circulation. Dronabinol has a large apparent volume of distribution, approximately 10 L/kg, because of its lipid solubility. The plasma protein binding of dronabinol and its metabolites is approximately 97%.

The elimination phase of dronabinol can be described using a two compartment model with an initial (alpha) half-life of about 4 hours and a terminal (beta) half-life of 25 to 36 hours. Because of its large volume of distribution, dronabinol and its metabolites may be excreted at low levels for prolonged periods of time.

Metabolism: Dronabinol undergoes extensive first-pass hepatic metabolism, primarily by microsomal hydroxylation, yielding both active and inactive metabolites. Dronabinol and its principal active metabolite, 11-OH-delta-9-THC, are present in approximately equal concentrations in plasma. Concentrations of both parent drug and metabolite peak at approximately 2 to 4 hours after oral dosing and decline over several days. Values for clearance average about 0.2 L/kg-hr, but are highly variable due to the complexity of cannabinoid distribution.

Elimination: Dronabinol and its biotransformation products are excreted in both feces and urine. Biliary excretion is the major route of elimination with about half of a radio-labeled oral dose being recovered from the feces within 72 hours as contrasted with 10 to 15% recovered from urine. Less than 5% of an oral dose is recovered unchanged in the feces.

Following single dose administration, low levels of dronabinol metabolites have been detected for more than 5 weeks in the urine and feces.

In a study of MARINOL® Capsules involving AIDS patients, urinary cannabinoid/creatinine concentration ratios were studied bi-weekly over a six week period. The urinary cannabinoid/creatinine ratio was closely correlated with dose. No increase in the cannabinoid/creatinine ratio was observed after the first two weeks of treatment, indicating that steady-state cannabinoid levels had been reached. This conclusion is consistent with predictions based on the observed terminal half-life of dronabinol.

Special Populations: The pharmacokinetic profile of MARINOL® Capsules has not been investigated in either pediatric or geriatric patients.

CLINICAL TRIALS

Appetite Stimulation: The appetite stimulant effect of MARINOL® (Dronabinol) Capsules in the treatment of AIDS-related anorexia associated with weight loss was studied in a randomized, double-blind, placebo-controlled study involving 139 patients. The initial dosage of MARINOL® Capsules in all patients was 5 mg/day, administered in doses of 2.5 mg one hour before lunch and one hour before supper. In pilot studies, early morning administration of MARINOL® Capsules appeared to have been associated with an increased frequency of adverse experiences, as compared to dosing later in the day. The effect of MARINOL® Capsules on appetite, weight, mood, and nausea was measured at scheduled intervals during the six-week treatment period. Side effects (feeling high, dizziness, confusion, and somnolence) occurred in 13 of 72 patients (18%) at this dosage level and the dosage was reduced to 2.5 mg/day, administered as a single dose at supper or bedtime.

As compared to placebo, MARINOL® Capsules treatment resulted in a statistically significant improvement in appetite as measured by visual analog scale (see figure). Trends toward improved body weight and mood, and decreases in nausea were also seen.

After completing the 6-week study, patients were allowed to continue treatment with MARINOL® Capsules in an open-label study, in which there was a sustained improvement in appetite.
**Antiemetic:** MARINOL® (Dronabinol) Capsules treatment of chemotherapy-induced emesis was evaluated in 454 patients with cancer, who received a total of 750 courses of treatment of various malignancies. The antiemetic efficacy of MARINOL® Capsules was greatest in patients receiving cytotoxic therapy with MOPP for Hodgkin's and non-Hodgkin's lymphomas. MARINOL® Capsules dosages ranged from 2.5 mg/day to 40 mg/day, administered in equally divided doses every four to six hours (four times daily). As indicated in the following table, escalating the MARINOL® Capsules dose above 7 mg/m² increased the frequency of adverse experiences, with no additional anti-emetic benefit.

<table>
<thead>
<tr>
<th>MARINOL® Capsules Dose</th>
<th>Complete (%)</th>
<th>Partial (%)</th>
<th>Poor (%)</th>
<th>None (%)</th>
<th>Nondysphoric (%)</th>
<th>Dysphoric (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;7 mg/m²</td>
<td>36</td>
<td>32</td>
<td>32</td>
<td>23</td>
<td>65</td>
<td>12</td>
</tr>
<tr>
<td>&gt;7 mg/m²</td>
<td>33</td>
<td>31</td>
<td>36</td>
<td>13</td>
<td>58</td>
<td>28</td>
</tr>
</tbody>
</table>

*Nondysphoric events consisted of drowsiness, tachycardia, etc.*

Combination antiemetic therapy with MARINOL® Capsules and a phenothiazine (prochlorperazine) may result in synergistic or additive antiemetic effects and attenuate the toxicities associated with each of the agents.

**INDIVIDUALIZATION OF DOSAGES**

The pharmacologic effects of MARINOL® (Dronabinol) Capsules are dose-related and subject to considerable interpatient variability. Therefore, dosage individualization is critical in achieving the maximum benefit of MARINOL® Capsules treatment.

**Appetite Stimulation:** In the clinical trials, the majority of patients were treated with 5 mg/day MARINOL® Capsules, although the dosages ranged from 2.5 to 20 mg/day. For an adult:

1. Begin with 2.5 mg before lunch and 2.5 mg before supper. If CNS symptoms (feeling high, dizziness, confusion, and somnolence) do occur, they usually resolve in 1 to 3 days with continued dosage.
2. If CNS symptoms are severe or persistent, reduce the dose to 2.5 mg before supper. If symptoms continue to be a problem, taking the single dose in the evening or at bedtime may reduce their severity.
3. When adverse effects are absent or minimal and further therapeutic effect is desired, increase the dose to 2.5 mg before lunch and 5 mg before supper or 5 and 5 mg. Although most patients respond to 2.5 mg twice daily, 10 mg twice daily has been tolerated in about half of the patients in appetite stimulation studies.

The pharmacologic effects of MARINOL® Capsules are reversible upon treatment cessation.

**Antiemetic:** Most patients respond to 5 mg three or four times daily. Dosage may be escalated during a chemotherapy cycle or at subsequent cycles, based upon initial results. Therapy should be initiated at the lowest recommended dosage.
and titrated to clinical response. Administration of MARINOL® Capsules with phenothiazines, such as prochlorperazine, has resulted in improved efficacy as compared to either drug alone, without additional toxicity.

**Pediatrics:** MARINOL® Capsules is not recommended for AIDS-related anorexia in pediatric patients because it has not been studied in this population. The pediatric dosage for the treatment of chemotherapy-induced emesis is the same as in adults. Caution is recommended in prescribing MARINOL® Capsules for children because of the psychoactive effects.

**Geriatrics:** Caution is advised in prescribing MARINOL® Capsules in elderly patients because they are generally more sensitive to the psychoactive effects of drugs. In antiemetic studies, no difference in tolerance or efficacy was apparent in patients >55 years old.

**INDICATIONS AND USAGE**

MARINOL® (Dronabinol) Capsules is indicated for the treatment of:

1. anorexia associated with weight loss in patients with AIDS; and
2. nausea and vomiting associated with cancer chemotherapy in patients who have failed to respond adequately to conventional antiemetic treatments.

**CONTRAINDICATIONS**

MARINOL® (Dronabinol) Capsules is contraindicated in any patient who has a history of hypersensitivity to any cannabinoid or sesame oil.

**WARNINGS**

Patients receiving treatment with MARINOL® Capsules should be specifically warned not to drive, operate machinery, or engage in any hazardous activity until it is established that they are able to tolerate the drug and to perform such tasks safely.

**PRECAUTIONS**

**General:** The risk/benefit ratio of MARINOL® (Dronabinol) Capsules use should be carefully evaluated in patients with the following medical conditions because of individual variation in response and tolerance to the effects of MARINOL® Capsules.

MARINOL® Capsules should be used with caution in patients with cardiac disorders because of occasional hypotension, possible hypertension, syncope, or tachycardia (see CLINICAL PHARMACOLOGY).

MARINOL® Capsules should be used with caution in patients with a history of substance abuse, including alcohol abuse or dependence, because they may be more prone to abuse MARINOL® Capsules as well. Multiple substance abuse is common and marijuana, which contains the same active compound, is a frequently abused substance.

MARINOL® Capsules should be used with caution and careful psychiatric monitoring in patients with mania, depression, or schizophrenia because MARINOL® Capsules may exacerbate these illnesses.

MARINOL® Capsules should be used with caution in patients receiving concomitant therapy with sedatives, hypnotics or other psychoactive drugs because of the potential for additive or synergistic CNS effects.

MARINOL® Capsules should be used with caution in pregnant patients, nursing mothers, or pediatric patients because it has not been studied in these patient populations.

**Information for Patients:** Patients receiving treatment with MARINOL® (Dronabinol) Capsules should be alerted to the potential for additive central nervous system depression if MARINOL® Capsules is used concomitantly with alcohol or other CNS depressants such as benzodiazepines and barbiturates.

Patients receiving treatment with MARINOL® Capsules should be specifically warned not to drive, operate machinery, or engage in any hazardous activity until it is established that they are able to tolerate the drug and to perform such tasks safely.
Patients using MARINOL® Capsules should be advised of possible changes in mood and other adverse behavioral effects of the drug so as to avoid panic in the event of such manifestations. Patients should remain under the supervision of a responsible adult during initial use of MARINOL® Capsules and following dosage adjustments.

**Drug Interactions:** In studies involving patients with AIDS and/or cancer, MARINOL® (Dronabinol) Capsules has been co-administered with a variety of medications (e.g., cytotoxic agents, anti-infective agents, sedatives, or opioid analgesics) without resulting in any clinically significant drug/drug interactions. Although no drug/drug interactions were discovered during the clinical trials of MARINOL® Capsules, cannabinoids may interact with other medications through both metabolic and pharmacodynamic mechanisms. Dronabinol is highly protein bound to plasma proteins, and therefore, might displace other protein-bound drugs. Although this displacement has not been confirmed in vivo, practitioners should monitor patients for a change in dosage requirements when administering dronabinol to patients receiving other highly protein-bound drugs. Published reports of drug/drug interactions involving cannabinoids are summarized in the following table.

<table>
<thead>
<tr>
<th>CONCOMITANT DRUG</th>
<th>CLINICAL EFFECT(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphetamines, cocaine, other sympathomimetic agents</td>
<td>Additive hypertension, tachycardia, possibly cardiotoxicity</td>
</tr>
<tr>
<td>Atropine, scopolamine, anticholinesterases, other anticholinergic agents</td>
<td>Additive or super-additive tachycardia, drowsiness</td>
</tr>
<tr>
<td>Amitriptyline, amoxapine, desipramine, other tricyclic antidepressants</td>
<td>Additive tachycardia, hypertension, drowsiness</td>
</tr>
<tr>
<td>Barbital, benzodiazepines, ethanol, lithium, opioids, buspirona, antihistamines, muscle relaxants, other CNS depressants</td>
<td>Additive drowsiness and CNS depression</td>
</tr>
<tr>
<td>Disulfiram</td>
<td>A reversible hypomanic reaction was reported in a 28 y/o man who smoked marijuana; confirmed by dechallenge and rechallenge</td>
</tr>
<tr>
<td>Fluoxetine</td>
<td>A 21 y/o female with depression and bulimia receiving 20 mg/day fluoxetine X 4 wks became hypomanic after smoking marijuana; symptoms resolved after 4 days</td>
</tr>
<tr>
<td>Antipyrine, barbiturates</td>
<td>Decreased clearance of these agents, presumably via competitive inhibition of metabolism</td>
</tr>
<tr>
<td>Theophylline</td>
<td>Increased theophylline metabolism reported with smoking of marijuana; effect similar to that following smoking tobacco</td>
</tr>
</tbody>
</table>

**Carcinogenesis, Mutagenesis, Impairment of Fertility:** Carcinogenicity studies in mice and rats have been conducted under the US National Toxicology Program (NTP). In the 2-year carcinogenicity study in rats, there was no evidence of carcinogenicity at doses up to 50 mg/kg/day, about 20 times the maximum recommended human dose on a body surface area basis. In the 2-year carcinogenicity study in mice, treatment with dronabinol at 125 mg/kg/day, about 25 times the maximum recommended human dose on a body surface area basis, produced thyroid follicular cell adenoma in both male and female mice but not at 250 or 500 mg/kg/day.

Dronabinol was not genotoxic in the Ames tests, the in vitro chromosomal aberration test in Chinese hamster ovary cells, and the in vivo mouse micronucleus test. It, however, produced a weak positive response in a sister chromatid exchange test in Chinese hamster ovary cells.

In a long-term study (77 days) in rats, oral administration of dronabinol at doses of 30 to 150 mg/m², equivalent to 0.3 to 1.5 times maximum recommended human dose (MRHD) of 90 mg/m²/day in cancer patients or 2 to 10 times MRHD of 15 mg/m²/day in AIDS patients, reduced ventral prostate, seminal vesicle and epididymal weights and caused a decrease in seminal fluid volume. Decreases in spermatogenesis, number of developing germ cells, and number of Leydig cells in the testis were also observed. However, sperm count, mating success, and testosterone levels were not affected. The significance of these animal findings in humans is not known.

**Pregnancy:** Pregnancy Category C. Reproduction studies with dronabinol have been performed in mice at 15 to 450 mg/m², equivalent to 0.2 to 5 times maximum recommended human dose (MRHD) of 90 mg/m²/day in cancer patients or 1 to 30 times MRHD of 15 mg/m²/day in AIDS patients, and in rats at 74 to 295 mg/m³ (equivalent to 0.8 to 3 times MRHD of 90 mg/m³ in cancer patients or 5 to 20 times MRHD of 15 mg/m³/day in AIDS patients). These studies have revealed no evidence of teratogenicity due to dronabinol. At these dosages in mice and rats, dronabinol decreased maternal weight gain and number of viable pups and increased fetal mortality and early resorptions. Such effects were dose dependent and less apparent at lower doses which produced less maternal toxicity. There are no adequate and well-controlled studies in pregnant women. Dronabinol should be used only if the potential benefit justifies the potential risk to the fetus.
**Nursing Mothers:** Use of MARINOL® Capsules is not recommended in nursing mothers since, in addition to the secretion of HIV virus in breast milk, dronabinol is concentrated in and secreted in human breast milk and is absorbed by the nursing baby.

**Geriatric Use:** Clinical studies of MARINOL® (Dronabinol) Capsules in AIDS and cancer patients did not include the sufficient numbers of subjects aged 65 and over to determine whether they respond differently from younger subjects. Other reported clinical experience has not identified differences in responses between the elderly and younger patients. In general, dose selection for an elderly patient should be cautious usually starting at the low end of the dosing range, reflecting the greater frequency of decreased hepatic, renal, or cardiac function, increased sensitivity to psychoactive effects and of concomitant disease or other drug therapy.

**ADVERSE REACTIONS**

Adverse experiences information summarized in the tables below was derived from well-controlled clinical trials conducted in the US and US territories involving 474 patients exposed to MARINOL® (Dronabinol) Capsules. Studies of AIDS-related weight loss included 157 patients receiving dronabinol at a dose of 2.5 mg twice daily and 67 receiving placebo. Studies of different durations were combined by considering the first occurrence of events during the first 28 days. Studies of nausea and vomiting related to cancer chemotherapy included 317 patients receiving dronabinol and 68 receiving placebo.

A cannabinoid dose-related "high" (easy laughing, elation and heightened awareness) has been reported by patients receiving MARINOL® Capsules in both the antiemetic (24%) and the lower dose appetite stimulant clinical trials (8%) (see CLINICAL TRIALS).

The most frequently reported adverse experiences in patients with AIDS during placebo-controlled clinical trials involved the CNS and were reported by 33% of patients receiving MARINOL® Capsules. About 25% of patients reported a minor CNS adverse event during the first 2 weeks and about 4% reported such an event each week for the next 6 weeks thereafter.

**PROBABLY CAUSALLY RELATED: Incidence greater than 1%.

Rates derived from clinical trials in AIDS-related anorexia (N=157) and chemotherapy-related nausea (N=317). Rates were generally higher in the anti-emetic use (given in parentheses).

---

**Body as a whole:** Asthenia.

**Cardiovascular:** Palpitations, tachycardia, vasodilation/facial flush.

**Digestive:** Abdominal pain *, nausea *, vomiting *.

**Nervous system:** (Amnesia), anxiety/nervousness, (ataxia), confusion, depersonalization, dizziness *, euphoria *, (hallucination), paranoid reaction *, somnolence *, thinking abnormal *.

*Incidence of events 3% to 10%

**PROBABLY CAUSALLY RELATED: Incidence less than 1%.

Event rates derived from clinical trials in AIDS-related anorexia (N=157) and chemotherapy-related nausea (N=317).

---

**Cardiovascular:** Conjunctivitis *, hypotension *.

**Digestive:** Diarrhea *, fecal incontinence.

**Musculoskeletal:** Myalgias.
Nervous system: Depression, nightmares, speech difficulties, tinnitus.

Skin and Appendages: Flushing.*

Special senses: Vision difficulties.

*Incidence of events 0.3% to 1%

CAUSAL RELATIONSHIP UNKNOWN: Incidence less than 1%.

The clinical significance of the association of these events with MARINOL® Capsules treatment is unknown, but they are reported as alerting information for the clinician.

Body as a whole: Chills, headache, malaise.

Digestive: Anorexia, hepatic enzyme elevation.

Respiratory: Cough, rhinitis, sinusitis.

Skin and Appendages: Sweating.

DRUG ABUSE AND DEPENDENCE

MARINOL® (Dronabinol) Capsules is one of the psychoactive compounds present in cannabis, and is abusable and controlled [Schedule III (CIII)] under the Controlled Substances Act. Both psychological and physiological dependence have been noted in healthy individuals receiving dronabinol, but addiction is uncommon and has only been seen after prolonged high dose administration.

Chronic abuse of cannabis has been associated with decrements in motivation, cognition, judgement, and perception. The etiology of these impairments is unknown, but may be associated with the complex process of addiction rather than an isolated effect of the drug. No such decrements in psychological, social or neurological status have been associated with the administration of MARINOL® Capsules for therapeutic purposes.

In an open-label study in patients with AIDS who received MARINOL® Capsules for up to five months, no abuse, diversion or systematic change in personality or social functioning were observed despite the inclusion of a substantial number of patients with a past history of drug abuse.

An abstinence syndrome has been reported after the abrupt discontinuation of dronabinol in volunteers receiving dosages of 210 mg/day for 12 to 16 consecutive days. Within 12 hours after discontinuation, these volunteers manifested withdrawal symptoms that intensified to include "hot flashes", sweating, rhinorrhea, loose stools, hiccoughs and anorexia. These withdrawal symptoms gradually dissipated over the next 48 hours. Electroencephalographic changes consistent with the effects of drug withdrawal (hyperexcitation) were recorded in patients after abrupt dechallenge. Patients also complained of disturbed sleep for several weeks after discontinuing therapy with high dosages of dronabinol.

OVERDOSAGE

Signs and symptoms following MILD MARINOL® (Dronabinol) Capsules intoxication include drowsiness, euphoria, heightened sensory awareness, altered time perception, reddened conjunctiva, dry mouth and tachycardia; following MODERATE intoxication include memory impairment, depersonalization, mood alteration, urinary retention, and reduced bowel motility; and following SEvere intoxication include decreased motor coordination, lethargy, slurred speech, and postural hypotension. Apprehensive patients may experience panic reactions and seizures may occur in patients with existing seizure disorders.

The estimated lethal human dose of intravenous dronabinol is 30 mg/kg (2100 mg/ 70 kg). Significant CNS symptoms in antiemetic studies followed oral doses of 0.4 mg/kg (28 mg/70 kg) of MARINOL® Capsules.
Management: A potentially serious oral ingestion, if recent, should be managed with gut decontamination. In unconscious patients with a secure airway, instill activated charcoal (30 to 100 g in adults, 1 to 2 g/kg in infants) via a nasogastric tube. A saline cathartic or sorbitol may be added to the first dose of activated charcoal. Patients experiencing depressive, hallucinatory or psychotic reactions should be placed in a quiet area and offered reassurance. Benzodiazepines (5 to 10 mg diazepam po) may be used for treatment of extreme agitation. Hypotension usually responds to Trendelenburg position and IV fluids. Pressors are rarely required.

DOSAGE AND ADMINISTRATION

Appetite Stimulation: Initially, 2.5 mg MARINOL® (Dronabinol) Capsules should be administered orally twice daily (b.i.d.), before lunch and supper. For patients unable to tolerate this 5 mg/day dosage of MARINOL® Capsules, the dosage can be reduced to 2.5 mg/day, administered as a single dose in the evening or at bedtime. If clinically indicated and in the absence of significant adverse effects, the dosage may be gradually increased to a maximum of 20 mg/day MARINOL® Capsules, administered in divided oral doses. Caution should be exercised in escalating the dosage of MARINOL® Capsules because of the increased frequency of dose-related adverse experiences at higher dosages (see PRECAUTIONS).

Antiemetic: MARINOL® Capsules is best administered at an initial dose of 5 mg/m², given 1 to 3 hours prior to the administration of chemotherapy, then every 2 to 4 hours after chemotherapy is given, for a total of 4 to 6 doses/day. Should the 5 mg/m² dose prove to be ineffective, and in the absence of significant side effects, the dose may be escalated by 2.5 mg/m² increments to a maximum of 15 mg/m² per dose. Caution should be exercised in dose escalation, however, as the incidence of disturbing psychiatric symptoms increases significantly at maximum dose (see PRECAUTIONS).

STORAGE CONDITIONS

MARINOL® (Dronabinol) Capsules should be packaged in a well-closed container and stored in a cool environment between 8° and 15°C (46° and 59°F) and alternatively could be stored in a refrigerator. Protect from freezing.

HOW SUPPLIED

MARINOL® Capsules (dronabinol solution in sesame oil in soft gelatin capsules)

2.5 mg white capsules (Identified UM or RL).

NDC 0051-0021-21 (Bottle of 60 capsules).

5 mg dark brown capsules (Identified UM or RL).

NDC 0051-0022-11 (Bottle of 25 capsules).

10 mg orange capsules (Identified UM or RL).

NDC 0051-0023-21 (Bottle of 60 capsules).

MARINOL® is a registered trademark of Unimed Pharmaceuticals, Inc. and is Manufactured by Banner Pharmacaps, Inc.

High Point, NC 27265

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UNIMED PHARMACEUTICALS, INC.

A Solvay Pharmaceuticals, Inc. Company

Marietta, GA 30062
Matter can exhibit certain properties or characteristics that science has developed units in order to measure. The strict definition of matter is something that has mass and takes up space. In that definition, the characteristics of mass and volume are used to describe matter. The units used to describe these quantities have varied greatly over the course of history and industry. Only two systems are currently used in forensic science: The English, or Avoirdupois System, and the SI, or Metric system.

Units in the Avoirdupois System include gallons and fluid ounces for volume, and slugs for mass. The most common units used to describe weight are the pound and ounce. These units are units of force, not units of mass. The “weight” of something is technically the force that an object exerts in a given gravitational acceleration. The Moon has a mass 1/6\(^\text{th}\) that of Earth, and therefore has 1/6\(^\text{th}\) the gravitational acceleration. Objects on the Moon weigh 1/6\(^\text{th}\) that of their weight on Earth. However, the objects have the same mass independent of the gravitational acceleration.

The metric system was developed by scientists specifically so that all of the units of mass, volume, force, work, etc. work interchangeably, without conversion factors. For instance, the unit of length, the meter, is derived from the properties of water at standard temperature and pressure (STP). A quantity of water defines the metric unit of mass, the gram. One gram of water occupies one milliliter of volume at STP. Since volume is length times width times height, the volume of water at STP gives the unit of each side of the cube—the centimeter. So, from a given quantity of water the metric system has derived volume, length, and mass. The quantities are maintained, and defined by the National Institute of Standards and Technology (NIST) in Denver, Colorado.

Balances have been used for centuries to determine the physical quantity of mass. The simplest form of a balance consists of two pans connected to a bar that has a fulcrum in the middle (see right). The two pans are equidistant from the fulcrum, so an unknown mass placed on one side will tip the balance. An equal mass placed in the opposite pan will balance the system again. By using known masses we can determine the unknown quantity.

A modified version of the simple balance eliminates the need for a separate set of known masses by permanently fixing these masses to a sliding bar. This balance is known as a beam balance, and is the most common balance found in the high school classroom. The
triple beam balance has three bars with three separate weight magnitudes to cover a greater range of masses (see below, image from Ohaus Instruments).

Characteristics of an individual balance are referred to by the following terms:

- **Readability**- The smallest unit that the balance displays, for instance 0.01 grams is typical of many top loading electronic balances.
- **Capacity**- The largest mass that the balance can determine and display.
- **Graduation**- The number of units between the readability and capacity (sometimes referred to as resolution).
- **Repeatability**- The precision of the balance as determined by multiple measurements of the same mass

For example, the triple beam balance above has a readability of 0.1 grams, a capacity of 500 grams, and a graduation of 5000 units. Electronic top loading balances most frequently used by the crime lab have a readability of 0.01 grams, a capacity of 500 grams, corresponding to a graduation of 50,000 units with a repeatability of +/- 0.03 grams. More expensive balances have greater capacity with the same readability and repeatability resulting in a larger graduation. If only a single balance for a location is chosen, then the higher capacity balances with 0.01 gram readability should be considered.

Electronic balances do not directly compare known masses to unknown masses. Instead, quality electronic balances use a “load cell” that responds to the mass placed on the balance pan by deforming. Electronics detect this deformation and counteract it using electrical principles. The amount of electricity needed to counteract the deformation is directly proportional to the mass on the pan. The balance is calibrated using a known mass (some high quality balances have internal masses that can be used to calibrate the cell at the push of a button). The balance is calibrated by the manufacturer prior to sale, but due to the electronic nature of the balance, and differences in gravitational acceleration around the globe, occasional re-calibration of the load cell is necessary.

The terms mass and weight are often used interchangeably. This is acceptable as long as the fundamental difference of mass and weight is understood (since very few mass determinations are made anywhere else but Earth).
One big advantage of an electronic balance is the ability to reset the zero point with a button push. Disposable weighing boats can be used to directly measure the mass of materials without soiling the balance pan. A boat can be placed on the balance, and then the balance is re-set to zero. The material to be weighed is placed in the boat. The mass displayed is only the mass of the added material (known as a net weight). Triple beam balances can only determine net weight by first measuring the boat, then the boat and material (this is a gross weight, or the weight of the material plus packaging). The net weight is then obtained by subtracting the boat weight from the gross weight. Obviously the electronic balance is easier.

As previously indicated, electronic balances will require calibration from time to time. Calibration can drift due to circumstances such as an un-level pan, vibration, voltage fluctuation, re-locating the balance, temperature variation, and extended use. Since calibration will be necessary it is important that the user of the balance also purchase a mass standard for calibration. The balance manual will indicate the mass value needed for calibration.

Since the balance calibration is only as good as the mass used, and there are many different types of balances available, there are many different types and tolerances of mass standards available for purchase. There are also many different conventions for classifying mass standards, such as the International Organization of Legal Metrology (OIML), American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), and the now defunct National Bureau of Standards (NBS). The format adopted by the crime lab, and recognized by NIST as traceable to their masses are the ANSI/ASTM E617-97 protocol of class 1, 2, 3, and 4. There are also class 5 and 6 categories where ASTM class 6 corresponds to NIST class F. Class 4 mass standards can be used to check daily calibration of top loading balances with a capacity of 500 to 2000 grams with a readability of 0.01 grams. It is recommended that calibration of the balance be performed with class 3, or better mass standards. All of the weights are purchased with a NIST Certificate of Traceability to provide an unbroken link of traceable comparison all the way back to NIST in Denver.

Companies can be hired to inspect, clean and calibrate balances on an annual basis to provide even greater quality assurance. These companies will typically determine if the balance is still performing within the specifications of the balance manufacturer, and also if the environmental conditions are suitable in the location of use.
Chapter 4

Microscopy

Microscopy is the science of using a microscope for the investigation of objects too small to be seen by the naked eye. A microscope, in its simplest form, uses visible light and a lens or combination of lenses to produce magnified images of small objects. There are many types of microscopes, each capable of different levels of magnification.

The two basic types of microscopes are the compound microscope and the stereomicroscope, also known as a stereoscope or dissecting microscope. The compound microscope is a high-powered microscope capable of magnifying an object up to 1000 times its original size. Due to its limited depth of field, it is used in examining thin specimens and results in a two-dimensional image. The compound microscope generally uses transmitted light, meaning the light source shines light up through the specimen into the optical system. The stereomicroscope (see right) is a low-powered microscope capable of magnifying an object 10-40 times its original size (10x-40x). It uses two eyepieces, which provide slightly differing viewing angles to the right and left eyes resulting in a three-dimensional magnified image. The stereomicroscope generally uses reflected light, meaning the light is reflected off the specimen up into the optical system.

There are three basic parts to a microscope—the stage, the focusing tower, and the optical system. The stage holds the object to be examined. The focusing tower allows the analyst to focus the image on the object. The optical system contains the lenses that magnify the object.

In order to view the unique physical characteristics of marijuana leaves, a 10x-40x stereomicroscope with a reflective light source is essential. With a small amount of leafy material placed on the stage, the analyst should look for several types of “hairs,” or trichomes, which are unique to the marijuana plant: covering hairs and cystolithic hairs. The covering hairs are long, thin hairs located on the lower surface of the leaflet and generally point toward the tip of the leaflet. The cystolithic hairs, also called “bear claws” because of their resemblance to a bear claw, are shorter, somewhat thicker hairs and have calcium carbonate deposits at their base. They are located on the upper surface of the leaflet and point toward the tip of the leaflet as well. The observation of the cystolithic hairs on top and the covering hairs on the bottom of a single leaf fragment is a positive microscopic identification for marijuana. As such, the analyst should then proceed to the two chemical tests. If these hairs are absent from the leaf fragment, it is then sufficient that the analyst note the microscopic test as negative, discontinue any further testing, and report the sample as “Negative for Marijuana.”
Chapter Five
Duquenois-Levine Color Test

The Duquenois-Levine color test is employed throughout the world as part of the procedure for identifying cannabis. No reports indicate that cannabinoids have ever been isolated from any plant or animal other than cannabis. This means that cannabinoids are found nowhere else in nature other than in marijuana. No sample of authentic marijuana has failed to respond to the Duquenois-Levine test, however, it is not absolutely specific for cannabinoids. This color test is designed to detect structures similar to the cannabinoids, but like any other color test, it reacts with a chemical moiety and not just a specific compound. For this reason, DOFS uses this test in conjunction with at least one other test prior to conclusive drug identification.

History
Pierre Duquenois and Hassan Negm proposed the Duquenois-Negm test in 1937. This test involved making a petroleum ether extract of the plant material and then adding Duquenois reagent and hydrochloric acid to the dried extract. The test was considered positive if a blue or violet color was observed. In an attempt to make this test more specific, Levine added an additional step in 1941 and the test was renamed Duquenois-Levine test. This change incorporated the extraction of the color into chloroform, which was added 10 minutes after the addition of hydrochloric acid. Upon addition of this chemical, the test formed two distinct layers, one of which was aqueous or water based and the other, which was organic, or carbon-hydrogen based. The test is positive only if the color seeps or transfers into the chloroform (bottom) layer. The Rapid Duquenois (RD-L) test omits the petroleum ether stage; thus, the reagent is exposed directly to the plant material. This step is followed by the addition of hydrochloric acid and then chloroform. Again, the test is positive only if the color transfers to the bottom organic layer.

Composition
The Rapid Duquenois-Levine test must have three ampoules consisting of Duquenois Reagent, hydrochloric acid, and chloroform. Any vendor meeting these requirements is acceptable.

The Duquenois reagent consists of vanillin, ethanol, and acetaldehyde; this reagent is stored in the refrigerator. Hydrochloric acid is a strong acid that can cause severe burns if left untreated. Chloroform is a known carcinogenic organic solvent that should also be washed with water after skin contact.

Usage
1. Open plastic pack and place a small amount (pinch) of leafy substance into the bottom of the pack. Make sure to seal with plastic holder to remove the possibility of leakage.
2. Carefully break the first vial, which contains the Duquenois reagent. As the liquid solution mixes with the leafy material, the ethanol extracts the cannabinoids
from the plant material. If the mixture is allowed to stand for longer than a few minutes, poor results will occur.

3. Break the center vial, which contains the hydrochloric acid. Mix and observe the color change.

4. Break the third vial, containing the chloroform layer. Mix and observe both layers for the purple color. If both layers have the purple color, the test is positive for marijuana.

**Mechanism**

Cannabinoids are the predominate group of compounds found in cannabis having the 1,3-dimethoxybenzene substitution, and the development of the color can be ascribed to their presence. \( \Delta^9 \)-tetrahydrocannabinol, \( C_{23}H_{30}O_4 \), MW = 358.5, CAS 23978-85-0), pictured above, is the most common cannabinoid and is largely responsible for the physiological and physical effects.

The role of the acetaldehyde is somewhat debatable. According to one study, the acetaldehyde may be functioning as an oxidizer. However, the same study suggests that the acetaldehyde is incorporated into the molecular structure. Other aldehydes were used in place of acetaldehyde, with totally different results, meaning acetaldehyde is considered unique. The role of the hydrochloric acid is two-fold. First, it catalyzes the reaction of vanillin or acetaldehyde or both, with the phenolic ring of the cannabinoid. Second, the reaction products are pH dependent, and the acidity of the solution creates the characteristic blue to violet color.

**Experimental Data**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Initial Color</th>
<th>Color extracted by CHCl(_3) layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cannabis</td>
<td>Violet-blue</td>
<td>Violet</td>
</tr>
<tr>
<td>Coffee (roasted)</td>
<td>Violet-brown</td>
<td>None</td>
</tr>
<tr>
<td>Patchouli Oil</td>
<td>Violet</td>
<td>None</td>
</tr>
<tr>
<td>Tea (leaves)</td>
<td>Green-Blue</td>
<td>None</td>
</tr>
</tbody>
</table>

More thorough experimental data was produced by Bailey and Phil; for this experimental data, please see reference 1.

**False Positives**

The Duquenois reagent does react with some phenolic and terpene derivatives, but the color may not be within the proper blue to violet color range. Some essential oils and extracts of vegetable origin can give false positives with the RD-L test. Additionally, some fresh coffee preparations may yield positive results. There may be material which can produce the same color as the cannabinoids, but this material will not exhibit the same morphological features as marijuana, nor will it yield a positive result in the second chemical test, Fast Blue B.
False Negatives
False negatives can occur with this test with items of low concentration, such as young plants or washed seeds. Keep in mind that this test has a minimum detection limit with respect to concentration and that false negatives can occur.

Examination Safety
Routes of exposure include inhalation, contact with eyes and skin, and ingestion. Irritation of eyes, nose and throat may exist with overexposure along with irritation to mucous membranes and respiratory tract. If chloroform is swallowed, induce vomiting and continue until fluid is clear. If hydrochloric acid is swallowed, give tap water, milk or milk of magnesia. For skin contact, flush with water for 15 minutes. Hydrochloric acid reacts with metals, such as iron and aluminum, to produce hydrogen gas. Chloroform is carcinogenic and may decompose to toxic fumes of chlorides. Chloroform is also incompatible with strong base and excess water. Store in a cool, well ventilated area and keep away from reactive materials. Avoid storing test kits in direct sunlight such as front or back seats of vehicles or near windows. If expansion or heat develops in the test kit, slide the safety closure clip to a 45 degree angle, and allow the heat and gas to escape. Then slide the safety clip back into place and continue testing. With the limited sample in the test kits, exposure to toxic and noxious fumes from the pouches is minimized.

Do not keep the test kits to introduce into evidence and do not store them with evidence in lockers; this can result in leakage from the original containers. The colors remaining in the test package after minutes, hours, or days later do not mean anything and should not be preserved as evidence. Try to use the kits within one year of purchase date.

Conclusion
It is not unexpected that there will be some chemical compounds in the world that react like marijuana. However, it is important to note that these chemicals do not exhibit the morphological features of marijuana. Again, DOFS requires the use of at least one additional test prior to conclusive drug identification. For the certified marijuana examiner program, the D-L test must be used in conjunction with a microscopic examination and the Fast Blue B (KN Reagent) color test. The D-L test requires the presence of cannabinoids, which produce chloroform-soluble purple colors on reaction with the reagent. The D-L test is the most widely employed color test in the world for the identification process of cannabis.

References:


[7] [www.fiu.edu/~mccordb/Manualv7.2.doc](http://www.fiu.edu/~mccordb/Manualv7.2.doc)
Chapter 6
Fast Blue B Color Test

This color test is also known as KN reagent, and it is the final examination performed for the Certified Marijuana Examiner’s course. GBI-DOFS does not use this color test. This color test is designed to detect structures similar to the cannabinoids, but like any other color test, it reacts with a chemical moiety and not just a specific compound. For this reason, this color test should be used in conjunction with the microscopic examination and with the Duquenois-Levine color test prior to conclusive identification.

History
The earliest literature references to this test date back to 1974, when the reaction of delta-8-tetrahydrocannabinol with KN reagent was examined. The reagents are exposed directly to the plant material, as with the Duquenois-Levine test. The test was considered positive if an orange, then red color was observed and this is still the accepted criteria.

Composition
The KN reagent test kit must have two ampoules consisting of Fast Blue B salt mixed with Trichloroethylene in the first ampoule and aqueous sodium hydroxide solution in the second ampoule. Any vendor meeting these requirements is acceptable.

The fast blue B reagent is also called Diazo Blue B and has molecular formula C₁₄H₁₂Cl₂N₄O₂*ZnCl₂. Sodium Hydroxide is a caustic and a strong base. Commonly known as caustic soda, lye, or sodium hydrate, it is available commercially in various solid forms, e.g., pellets, sticks, or chips, and in water solutions of various concentrations; both solid and liquid forms vary in purity. The major use of sodium hydroxide is as a chemical and in the manufacture of other chemicals; because it is inexpensive, it is widely used wherever a strong base is needed.

Usage
5. Open plastic pack and place a small amount (pinch) of leafy substance into the bottom of the pack. Make sure to seal with plastic holder to remove the possibility of leakage.
6. Carefully break the first vial, which contains the Fast Blue B reagent. As the liquid solution mixes with the leafy material, the cannabinoids are extracted from the plant material. If the mixture is allowed to stand for longer than a few minutes, poor results will occur.
7. Break the final vial, which contains the sodium hydroxide. Mix and observe the color change. If an orange to red color is observed, the test is positive.
Mechanism

\[
\begin{align*}
\text{H}_3\text{CO} & \quad \text{OCH}_3 \\
\text{N}_2 & \quad \text{N}_2 \\
\text{Cl} & \quad \text{Cl} \\
\end{align*}
\]

Pictured above is Fast Blue B salt. When combined with cannabinoids in the presence of sodium hydroxide, an orange-red colored complex is formed.

False Positives
The KN reagent does react with many compounds, in addition to the cannabinoids. However, the material will not exhibit the same morphological features as marijuana and will not test positive utilizing the Duquenois Levine test simultaneously. For this reason, the Fast Blue B test is only used in conjunction with the other required examinations prior to identification of the leafy substance.

False Negatives
False negatives can occur in this test with items of low concentration, such as young plants or washed seeds. Keep in mind that this test has a minimum detection limit with respect to concentration and that false negatives can occur.

Examination Safety
Routes of exposure include inhalation, contact with eyes and skin, and ingestion. Splashes in the eyes or on the skin can cause severe burns. Inhalation of vapor may also irritate mucous membranes and respiratory tract. Fast blue B salt is listed as a carcinogen or potential carcinogen by IARC, not by OSHA or NTP. Limited studies have been done with this salt. In case of contact with eyes, flush for 15 minutes. If sodium hydroxide is swallowed, dilute with several glasses of milk or water and then induce vomiting. If trichloroethylene is swallowed, induce vomiting and repeat until fluid is clear. With the limited sample in the test kits, exposure to toxic and noxious fumes from the pouches is minimized.

Do not keep the test kits to introduce into evidence and do not store them with evidence in lockers; this can result in leakage from the original containers. The colors remaining in the test package after minutes, hours, or days later do not mean anything and should not be preserved as evidence. Try to use the kits within one year of purchase date.

Conclusion
It is not unexpected that there will be some chemical compounds in the world that react similar to marijuana. However, it is important to note that these chemicals do not exhibit the morphological features of marijuana. Again, DOFS requires the use of at least one additional test prior to conclusive drug identification. For the certified marijuana.
examiner program, the D-L test must be used in conjunction with a microscopic examination and the Fast Blue B (KN Reagent) color test.

References:


[3] NIK Public Safety, Inc, MSDS, Test #6409 KN Reagent
Chapter 7
Sampling

The simplest scenario for marijuana testing is the case that has a single sample of leafy material, whether it be one bag, one hand rolled cigarette, a blunt, or loose leafy material. The net weight of the sample can easily be determined by direct weighing—emptying the contents of the one bag directly onto the balance. The cigarette paper or blunt paper is not considered “packaging material” as it will be consumed when smoked, therefore it is included in the net weight of a hand-rolled cigarette. Small portions of the sample will then be removed for microscopy and finally chemical testing.

Gross weight: Weight of the leafy material and packaging

Net Weight: Weight of the leafy material only.

The analyst’s report must reflect the net weight of the leafy material as this is what determines the criminal charge.

Cases that have multiple samples of leafy material may require more consideration. Examine the overall contents of the case. If all the items are similar in appearance, then random sampling would be appropriate. If any of the items differ in their appearance, then representative sampling must occur. It is also important to delineate in the analyst’s notes the net weight of the samples chosen for testing (as well as label the individual bags tested) in cases with multiple samples.

Random sampling: All items have similar texture, color, and general appearance. Samples are chosen at random where enough samples are tested with regard to critical weights in order to prove misdemeanor, felony, or trafficking.

Representative sampling: Some items differ in general appearance. Samples are grouped based on appearance. Samples are taken from each group, again with regard to critical weights.

Critical weights: The net weight of the marijuana determines the criminal charge the subject will receive. Test enough to prove the charge.

Misdemeanor – less than one ounce and equal to one ounce (28.35 grams)
Felony – more than one ounce (28.35 grams)
Trafficking – more than ten pounds

If all the representative samples are positive for marijuana, then the net weights of all the different groups can be added together for a total net weight. If testing of any sample results in a negative test, all samples must be tested to determine the results of the entire case. The reported net weights of the samples will reflect the weights of the respective positive and negative groupings of material.
Hash, hash oil, residues, and smoking devices cannot be analyzed using the methods taught in this class. If suspected cocaine is observed during microscopic analysis, testing should cease and the case sent to the Crime Lab that serves the incident county.
As with any testing procedures, one must be aware of the potential hazards. If one uses good common sense, then there should be no unnecessary safety problems. It is always good practice to wear personal protective equipment such as latex or nitrile gloves, safety glasses, and dust masks.

In the botany testing, there is concern for a fungus called *Aspergillus fumigatus*. This fungus is found on decaying plant material. Its spores are released when the plant is moved for analysis or drying. Breathing the spores may result in *Aspergillosis*, which may affect the pulmonary system in different ways. Make sure the plant material is packaged properly and be sure to work in a ventilated area. If working with large amounts of dried marijuana material, the examiner should wear a dust mask. In addition to this fungus, there could be bacteria and/or viruses present on the marijuana that may cause intestinal infections. The bacteria and/or viruses usually come from the animal manure that may have been used to fertilize the plants.

In the chemical tests, the use of caustic, acidic, and cancer-causing organic chemicals must be noted. Proper use and disposal of these chemicals will result in no hazards to the examiner. Refer to the MSDS for each chemical test for proper handling and disposal. Ensure that a sink with running water is easily accessible to the examiner’s workspace should exposure to the chemicals occur. If any of the chemicals are spilled, wash the area immediately with large amounts of water. If any chemical is splashed into the eyes, immediately wash with water and contact a physician.
The legislative branch of government is responsible for making laws, rules, and codes of conduct. The executive branch holds the responsibility of enforcement. The judicial branch of the government is responsible for interpreting and applying those laws when conflict arises.

The judicial branch of government holds hearings whenever a wrong is alleged. Wrongs can be alleged against individuals or property (civil), or against society (criminal). The judicial branch includes both civil and criminal law. The following table compares and contrasts the two types of law.

<table>
<thead>
<tr>
<th><strong>Civil Law</strong></th>
<th><strong>Criminal Law</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plaintiff alleges wrong against respondent (or defendant).</td>
<td>Prosecutor alleges wrong against defendant. The prosecutor may be a district attorney, solicitor, or law enforcement official, depending on the jurisdiction.</td>
</tr>
<tr>
<td>Trier of fact may be a judge or 12 person jury.</td>
<td>Trier of fact may be a judge or 12 person jury.</td>
</tr>
<tr>
<td>Verdict given by the jury must be shared by at least nine of the 12.</td>
<td>Verdict given by a jury must be unanimous.</td>
</tr>
<tr>
<td>The burden of proof is by a preponderance of the evidence.</td>
<td>The burden of proof must be beyond reasonable doubt.</td>
</tr>
<tr>
<td>Wrongs are limited to torts (civil wrongs redressed by damages) and contract disputes.</td>
<td>Wrongs are defined as crimes against society</td>
</tr>
<tr>
<td>Respondent is subject to the rigorous examination by the plaintiff in order to establish facts concerning the wrong.</td>
<td>Defendant is protected by the 5th Amendment to the U.S. Constitution, “No person shall be made to witness against one’s self.”</td>
</tr>
<tr>
<td>Court may award compensatory damages, and in the case of intentional wrongs punitive damages.</td>
<td>Court may impose fines and/or incarceration.</td>
</tr>
</tbody>
</table>

The United States Constitution does not allow for debtors prison, therefore civil cases do not involve prison terms. However, criminal cases often result in a period of probation, where the defendant waives certain rights in order to be out of confinement. One of these waived rights is the right to a trial by jury on any issue involving a violation of terms of probation. This means that probation revocation hearings only require proof of wrong by a preponderance of the evidence (as in civil cases). Persons serving probation are also required to waive their Fourth Amendment protections, allowing law enforcement officers the right to search without probable cause.
The following information regarding the state court system was derived from the listed web sites.

**Municipal and Special Courts** ([http://georgiacourts.org/municipal.html](http://georgiacourts.org/municipal.html))

Special and municipal court: Approximately 400 local courts are also part of the Georgia court system. These special courts and courts serving incorporated municipalities operate under various names with varying jurisdictions.

Courts of incorporated municipalities try municipal ordinance violations, issue criminal warrants, conduct preliminary hearings, and may have concurrent jurisdiction over shoplifting cases and cases involving possession of one ounce or less of marijuana.

Qualifications of judges and terms of office in municipal courts are set by local legislation.

**Probate Courts** ([http://www.georgiacourts.com/probate.html](http://www.georgiacourts.com/probate.html)) - gaprobate.org

County probate courts exercise exclusive, original jurisdiction in the probate of wills, administration of estates, appointment of guardians and involuntary hospitalization of incapacitated adults and other individuals.

All probate court judges administer oaths of office and issue marriage licenses. They may hold habeas corpus hearings or preside over criminal preliminary hearings. Unless a jury trial is requested, probate court judges may also hear certain misdemeanors, traffic cases and violations of state game and fish laws in counties where there is no state court. When authorized by local statute, probate judges serve as election supervisors and make appointments to certain local public offices.

In counties with population greater than 96,000, a party to a civil case may request a jury trial in the probate court by a written demand with the first pleading. Appeals from such civil cases may be to the Supreme Court or the Court of Appeals depending on the particular matter.

Most probate court judges are elected to four-year terms in countywide, partisan elections. A candidate for judge of the probate court must be at least 25 years of age, a high school graduate, a U.S. citizen and a county resident for at least two years preceding the election. In counties with population over 96,000, a candidate for probate judge must have practiced law for seven years and be at least 30 years of age.

**Juvenile Courts** ([http://www.georgiacourts.com/juvenile.html](http://www.georgiacourts.com/juvenile.html))

The purpose of our juvenile courts is to protect the well-being of children, provide guidance and control conducive to child welfare and the best interests of the state, and secure care for children removed from their homes.
The exclusive, original jurisdiction of juvenile courts extends to delinquent children under the age of 17 and deprived or unruly children under the age of 18. Juvenile courts have concurrent jurisdiction with superior courts in cases involving capital felonies, custody and child support cases, and in proceedings to terminate parental rights. The superior courts have original jurisdiction over those juveniles who commit certain serious felonies. The juvenile court also has jurisdiction over minors committing traffic violations or enlisting in the military services, consent to marriage for minors, and cases involving the Interstate Compact on Juveniles.

Juvenile court judges are appointed by the superior court judges of the circuit to four-year terms. Judges must be 30 years of age, have practiced law for five years, and have lived in Georgia for three years. Full-time judges cannot practice law while holding office.

**Magistrate Courts** in Georgia (http://www.georgiacourts.org/magistrate.html)

Magistrate court jurisdiction includes: civil claims of $15,000 or less; certain minor criminal offenses; distress warrants and dispossessory writs; county ordinance violations; deposit account fraud (bad checks); preliminary hearings; and summonses, arrest and search warrants. A chief magistrate, who may be assisted by one or more magistrates, presides over each of Georgia’s 159 magistrate courts.

Magistrates may grant bail in cases where the setting of bail is not exclusively reserved to a judge of another court. No jury trials are held in magistrate court. If a defendant submits a written request for a jury trial, cases may be removed to superior or state court.

The chief magistrate of each county assigns cases, sets court sessions, appoints other magistrates (with the consent of the superior court judges) and sets policy for the magistrate court. The number of magistrates in addition to the chief is usually set by majority vote of the county’s superior court judges.

Most chief magistrates are elected in partisan, countywide elections to four-year terms. The chief magistrate may be appointed, if so provided by local legislation. Terms for other magistrate judges run concurrently with that of the chief magistrate who appointed them.

To qualify as a magistrate, an individual must reside in the county for at least one year preceding his or her term of office, be 25 years of age, and have a high school diploma or its equivalent. A magistrate court judge may also serve as a judge of another limited jurisdiction court in the same county.

**State Court** (http://www.georgiacourts.org/state.html)

The state court was established by a 1970 legislative act that designated certain existing countywide courts of limited jurisdiction as state courts. State courts may exercise jurisdiction over all misdemeanor violations, including traffic cases, and all civil actions,
regardless of the amount claimed, unless the superior court has exclusive jurisdiction.

State courts are authorized to hold hearings on applications for an issuance of search and arrest warrants and to hold preliminary hearings. The Georgia Constitution grants state courts authority to review lower court decisions as provided by statute.

The General Assembly creates state courts by local legislation. Legislation also establishes the number of judges and whether the judges are to be full or part-time. Part-time judges may practice law, except in their own courts.

State court judges are elected to four-year terms in nonpartisan, countywide elections. Candidates must be at least 25 years old, have been admitted to practice law for at least seven years, and have lived in the state for at least three years.