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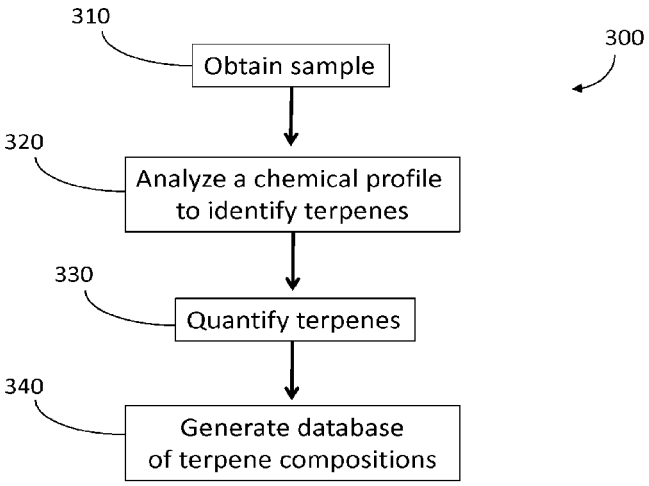

FIG. 3

(57) Abstract: Compositions which are fragrant and contain at least a member set culled from a library of compositions, each being comprised of sub-combinations of selected terpenes. Fragrances that mimic that of various states of organic and synthetic aromatics including products, processes and those from non-combusted plant products, among other things, uniquitous products, processes, medicinals, and related moieties leverage databases of all known terpene groupings are offered for consideration, and have been provided, according to the instant teachings.

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IMPROVED TERPENE-BASED COMPOSITIONS, PROCESSES, METHODOLOGIES FOR CREATION AND PRODUCTS THEREBY

Cross Reference to Related Application

[0001] The present application claims the benefit of and priority to U.S. provisional patent application number 61/879,281, filed September 18, 2013, the content of which is incorporated by reference herein in its entirety.

Field of the disclosure

[0002] The present disclosure relates to compositions, and related methods, that comprise defined mixtures of terpenes that have a distinctive fragrance that mimics that of non-combusted plant products, intermediates, and related moieties.

Background of the disclosure

[0003] The fragrant oils of oranges and lemons are used as aroma flavors in beverages, ice cream, gelatins, as well as in perfumes and soaps. Cloves, which contain aromatic oils, stimulated the establishment of global commerce between Asia and Europe. The major volatile constituent of cloves, eugenol, is used in perfumes, ice cream, baked goods, and candy. Peppermint, which also contains aromatic oils, is used in the manufacture of chewing gum, candies, and toothpaste.

[0004] The fragrant components of the oils in the above-mentioned commodities are largely terpenes. Terpenes are also known as terpenoids. In citrus fruits, the major aromatic compounds are limonene and 1,8-cineole (also called eucalyptol), which are both terpenes. The aromatic compounds of clove oil include eugenol and beta-caryophillene, which are terpenes. The aromatic compounds of peppermint include limonene, menthone, and menthol, which are all terpenes. The main terpenes in frankincense are E-beta-ocimene and limone (Al-Harrasi and Al-Saidi (2008) Molecules. 13:2181-2189). Myrrh contains the terpenes, lindestrene and furanoeudesma-1,3-diene, which represent the odor of unprocessed myrrh (Hanus et al (2005) Biomed. Papers. 149:3-28).

[0005] The founder of terpene chemistry is Otto Wallach who received the Nobel Prize in 1910 (Christmann (2010) Angew Chem. Int. Ed. Engl. 49:9580-9586). The terpenes are classified as “natural products.” They are biosynthesized from units of isoprene,

which can be linked to form linear chains or rings. In increasing length, the terpenes include hemiterpenes (single isoprenoid unit), monoterpenes (two units), sesquiterpenes (three units), diterpenes (four units), sesterterpenes (five units), triterpenes (six units), and so on. Non-aromatic terpenes include vitamin A, vitamin K, and the taxanes. The taxanes (diterpenes), such as paclitaxel, are renowned for their use in treating cancer (Heinig and Jennewein (2009) African J. Biotech. 8:1370-1385).

[0006] Some examples of terpenes, and their classification, are as follows:

Hemiterpenes: Examples of hemiterpenes, which do not necessarily have an odor, are 2-methyl-1,3-butadiene, hemialboside, and hymenoside;

Monoterpenes: pinene; alpha-pinene, beta-pinene, cis-pinane, trans-pinane, cis-pinanol, trans-pinanol (Erman and Kane (2008) Chem. Biodivers. 5:910-919), limonene; linalool; myrcene; eucalyptol; alpha-phellandrene; beta-phellandrene; alpha-ocimene; beta-ocimene, cis-ocimene, ocimene, delta-3-carene; fenchol; sabinene, borneol, isoborneol, camphene, camphor, phellandrene, alpha-phellandrene, alpha-terpinene, geraniol, linalool, nerol, menthol, myrcene, terpinolene, alpha-terpinolene, beta-terpinolene, gamma-terpinolene, delta-terpinolene, alpha-terpineol, trans-2-pinanol,

Sesquiterpenes: caryophyllene; beta-caryophyllene, caryophyllene oxide, humulene, alpha-humulene, alpha-bisabolene; beta-bisabolene; santalol; selinene; nerolidol, bisabolol; alpha-cedrene, beta-cedrene, beta-eudesmol, eudesm-7(11)-en-4-ol, selina-3,7(11)-diene, guaiol, valencene, alpha-guaiene, beta-guaiene, delta-guaiene, guaiene, farnesene, alpha-farnesene, beta-farnesene, elemene, alpha-elemene, beta-elemene, gamma-elemene, delta-elemene, germacrene, germacrene A, germacrene B, germacrene C, germacrene D, germacrene E.

Diterpenes: oridonin,

Triterpenes: ursolic acid; oleanolic acid;

"1.5 ene": guaia-1(10),11-diene can be characterized as a 1.5 ene. Guaia-1(10),11-diene is halfway between a monoterpene and diterpene, in terms of how many isoprenoid units are present. Monoterpene is $C_{10}H_{16}$, and diterpene is $C_{20}H_{32}$. Guaia-1(10),11-diene is $C_{15}H_{24}$. Isoprene is C_5H_8 (two double bonds).

[0007] The present disclosure provides formulations that include one or more of these terpenes. In exclusionary embodiments, the present disclosure can also exclude one

or more of any terpene that is disclosed herein, and/or related plant materials, depending on intended applications, inter alia.

[0008] The present disclosure provides compositions, comprising novel combinations of terpenes that mimic the fragrance of plant matter that is processed or dried. Also provided are novel combinations of terpenes that mimic a documented emotional response that is conferred by the processed or dried plant matter, or provides any number of utilitarian benefits, real or perceived.

Summary of the disclosure

[0009] The present disclosure provides a composition that contains a combination of selected terpenes. The composition has a fragrance that mimics that of a non-combusted plant product, as determinable, for example, by a human odor panel or by a synthetic nose. Human testers describe embodiments of the invention as having memorable, distinct and generally pleasant odors. One embodiment of the composition is described as having sweet citrus odors, as well as woody or earthy overtones. The embodiment has a fragrance which may also be described as having a lightly floral, fruity, flowery, lemony, or the like.

[0010] The invention provides compositions comprising terpene formulations. The terpene formulations may comprise one or more selected from a list comprising alpha-bisabolol, borneol, camphene, camphor, beta-caryophyllene, delta-3-carene, caryophyllene oxide, alpha-cedreen, beta-eudesmol, fenchol, geraniol, guaiol, alpha-humulene, isoborneol, limonene, linalool, menthol, myrcene, nerol, cis-ocimene, trans-ocimene, alpha-phellandrene, alpha-pinene, beta-pinene, sabinene, alpha-terpinene, alpha-terpineol, terpinolene, alpha-guaiene, elemene, farnesene, germacrene B, guaia-1(10),11-diene, trans-2-pinanol, Selina-3,7(11)-diene, eudesm-7(11)-en-4-ol, and valencene. In embodiments, the terpene formulation has a detectable fragrance. The various terpene formulations are described in more detail below.

[0011] In an embodiment, the invention comprises a prepared composition of terpenes comprising beta-caryophyllene, limonene, and myrcene, wherein the composition has a detectable fragrance. The fragrance can be detected, for example, by a human olfactory system or a synthetic nose.

[0012] Also provided is the above composition further comprising one or more selected from a list comprising alpha-bisabolol, borneol, camphene, camphor, delta-3-carene,

caryophyllene oxide, alpha-cedreen, beta-eudesmol, fenchol, geraniol, guaiol, alpha-humulene, isoborneol, linalool, menthol, nerol, cis-ocimene, trans-ocimene, alpha-phellandrene, alpha-pinene, beta-pinene, sabinene, alpha-terpinene, alpha-terpineol, terpinolene, alpha-guaiene, elemene, farnesene, germacrene B, guaia-1(10),11-diene, trans-2-pinanol, Selina-3,7(11)-diene, eudesm-7(11)-en-4-ol, and valencene.

[0013] Also provided is a composition comprising beta-caryophyllene, limonene, myrcene, alpha-pinene, and linalool, wherein the terpenes are present in approximately equal percentages by weight (wt%).

[0014] In another embodiment, the invention provides a composition comprising beta-caryophyllene at about 10-30 wt%, limonene at about 5-45 wt%, and myrcene at about 5-30 wt%; and wherein the sum of all terpenes in the composition is 100 wt%.

[0015] In an embodiment, the present disclosure provides a composition comprising a terpene formulation, wherein the terpene formulation consists of beta-caryophyllene, limonene, myrcene, and at least one other terpene, wherein the composition does not contain 3,3'-dihydroxy-5,4'-dimethoxybibenzyl, wherein the terpene formulation is the only source of terpenes in the composition, and wherein the beta-caryophyllene, limonene, and myrcene together comprise at least 25% (wt./vol.) of the terpene formulation, or at least 30%, at least 35%, at least 40%, at least 45%, at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, of the terpene composition.

[0016] Also provided is a prepared composition of terpenes comprising myrcene and alpha-pinene, wherein the composition has a detectable fragrance. Also provided is the above composition further comprising one or more selected from a list comprising alpha-bisabolol, borneol, camphene, camphor, beta-caryophyllene, delta-3-carene, caryophyllene oxide, alpha-cedreen, beta-eudesmol, fenchol, geraniol, guaiol, alpha-humulene, isoborneol, limonene, linalool, menthol, nerol, cis-ocimene, trans-ocimene, alpha-phellandrene, beta-pinene, sabinene, alpha-terpinene, alpha-terpineol, terpinolene, alpha-guaiene, elemene, farnesene, germacrene B, guaia-1(10),11-diene, trans-2-pinanol, Selina-3,7(11)-diene, eudesm-7(11)-en-4-ol, and valencene.

[0017] In an embodiment, the invention provides a composition wherein myrcene is present at about 20-95 wt%; and alpha-pinene is present at about 5-35 wt%; and wherein the sum of all terpenes in the composition is 100 wt%.

[0018] In another embodiment, the composition comprises a modifier. The modifier (described in more detail below) may comprise a thiol, an ester, a ketone, an aldehyde, a cannabinoid, another compound, or any combination thereof.

[0019] In an exclusionary embodiment, the invention provides any of the above compositions, wherein the composition does not contain 3,3'-dihydroxy-5,4'dimethoxybibenzyl. In another exclusionary embodiment, the invention provides any of the above compositions, wherein the composition does not contain cellulose. In another exclusionary embodiment, the invention provides any of the above compositions, wherein the composition does not contain chlorophyll.

[0020] Also provided is any of the above compositions, wherein each terpene is either purified from a natural source or is synthetic.

[0021] Also provided is a composition wherein the terpene formulation consists of beta-caryophyllene, limonene, myrcene, alpha-pinene, and linalool. Also provided is the above composition, wherein the terpene formulation consists of beta-caryophyllene, limonene, myrcene, beta-pinene, and linalool. Also provided is the above composition, wherein the terpene formulation consists of beta-caryophyllene, limonene, myrcene, and terpinolene. Also provided is the above composition, wherein the terpene formulation consists of beta-caryophyllene, limonene, myrcene, terpinolene, and beta-pinene.

[0022] In device embodiments, what is provided is a device comprising one of the above-disclosed compositions. In other device embodiments, what is provided is the above device that is a wax candle, a container or wrapper that comprises a soap, a container that comprises a perfume, a container that comprises a cosmetic crème, an electronic cigarette, a scratch and sniff device, an edible substance, a tincture, or a container holding a pressurized composition that is configured for aerosol dispersal.

[0023] In a methods embodiment, what is provided is a method for applying a fragrance, the method comprising providing a composition of terpenes, contacting an olfactorily detectable quantity of the composition with the atmosphere, and causing a human olfactory system or electronic nose to detect the presence of the composition in the atmosphere. The method may further comprising contacting the olfactorily detectable quantity of composition with a carrier substance, which may comprise a perfume, incense, cosmetic, moisturizer, emollient, toiletry, edible substance, inhalable

substance, electronic cigarette liquid, candle, an aerosolizer, or an oil fragrancer, such as a PlugIn® commercially available from Glade® (Racine, WI).

[0024] In a methods embodiment, what is provided is a method for using one of the above compositions, comprising the step of contacting the composition with the atmosphere, the step of allowing a detectable quantity of vaporize and migrate into the atmosphere, and the step of inhaling by a human subject of at least a portion of the detectable quantity, wherein the detectable quantity can be detected by one or both of an olfactory system or by an electronic nose.

[0025] In other embodiments, what is provided is an apparatus for dispensing at least a fragranted terpene-based composition according to any claims, and the specification, including said terpene-based fragranted composition disposed or effective to be emplaced therein. In a process embodiment, what is provided is a process to impart any terpene-based fragranted compositions in whole, or in part to a perfume, flavor material, incense, cosmetic or toiletry, according to any claims, and the specification above. In a system embodiment, what is provided is a system for repelling or attracting olfactorily sentient organisms based upon the claims, and the specification above. In another system embodiment, what is provided is a system for addressing masking of odors, according to any claims, or disclosures herein comprised of at least one prepared version of a terpene-based composition. In products by process embodiments, what is provided is a products by processes of any claims herein. Moreover, what is provided is a product, according to the and specification herein, for treating mammals in need thereof.

[0026] What is provided is a composition comprising a terpene formulation, wherein the terpene formulation consists of beta-caryophyllene, limonene, myrcene, and at least one other terpene that is not alpha-pinene, wherein the composition does not contain 3,3'-dihydroxy-5,4'-dimethoxybibenzyl, and wherein the terpene formulation is the only source of terpenes in the composition.

[0027] Also provided is the above composition, wherein each one of the terpenes is either purified from a natural source or is synthetic. Also provided is the above composition, wherein the terpene formulation consists of beta-caryophyllene, limonene, myrcene, beta-pinene, and linalool.

[0028] Also provided is the above composition, wherein the terpene formulation consists of beta-caryophyllene, limonene, myrcene, and terpinolene. Also provided is

the above composition, wherein the terpene formulation consists of beta-caryophyllene, limonene, myrcene, terpinolene, and beta-pinene.

[0029] In yet another embodiment, what is embraced is a composition comprising a terpene formulation, wherein the terpene formulation consists of myrcene, alpha-pinene, and at least one other terpene that is not limonene, wherein the composition does not contain limonene, and wherein the terpene formulation is the only source of terpenes in the composition.

[0030] In yet another embodiment, what is embraced is a composition comprising a terpene formulation, wherein the terpene formulation consists of myrcene, alpha-pinene, and at least one other terpene that is not limonene, wherein the composition does not contain 3,3'-dihydroxy-5,4'-dimethoxybibenzyl, and wherein the terpene formulation is the only source of terpenes in the composition.

[0031] In another aspect, what is provided is the above composition, wherein the terpene formulation consists of myrcene, alpha-pinene, and: (i) beta-pinene, (ii) beta-carophyllene, or (iii) beta-pinene and beta-carophyllene.

[0032] In device embodiments, what is provided for each of the above-disclosed compositions, that is, provided separately for each and every one of the above compositions, is a device that comprises the composition. The device can be a holder, a vial, a bottle, a canister, a paper wrapper, a foil wrapper, a plastic wrapper, and so on. The device can be a wax candle, a container or wrapper that comprises a soap, a container that comprises a perfume, a container that comprises a cosmetic crème, an electronic cigarette, a scratch and sniff device, an edible substance, a tincture, or a container holding a pressurized composition that is configured for aerosol dispersal.

[0033] Also provided is a process for generating a library of prepared terpene compositions, the process comprising: obtaining a sample; analyzing a chemical profile of the sample to identify terpenes in the sample; quantifying the terpenes identified; and preparing a blend of terpenes based on those quantities. The sample can be from any plant or other natural product, including Cannabis sativa, Humulus lupulus, or other plants. The analysis step may comprise separating substances from a mixture, genetic analysis, chemotaxonomic analysis, compound extraction, gas chromatography flame ionization detection, chemical formula identification, chromatography, or any other analytical chemistry technique known in the art. Terpenes identified can be any of those listed in this application or any other terpene. Terpenes may be quantified based on their mass fraction, percent weight, mole fraction, percentage by volume, or the like.

The prepared blend may comprise all natural terpenes, all synthetic terpenes, or a combination thereof.

[0034] Also provided is a database or library of terpene compositions produced by the above process.

[0035] Also provided is a system for treating a patient involving administering various terpene blends to the patient, comparing the patient's responses, and determining a treatment regimen based on the comparison. The system may also involve electronically sending an receiving terpene combination and dosage information. Also provided is the above system, wherein the patient responses are transmitted to a medical diagnostic site over an electronic network and the treatment regimen is transmitted to the patient from the medical diagnostic site over the electronic network. The system involves electronically sending and receiving terpene combination and dosage information, and designing a treatment regiment comprising dosage and formulation instructions. The invention can be used in conjunction with a remote diagnostic system, such as that described in U.S. Patent 6,598,084, incorporated by reference herein in its entirety.

[0036] The disclosure further provides a product-by-process, namely a prepared blend of terpenes by a process that involves measuring cannabinoid levels before and after administration of certain terpene formulas, in order to find the optimal formula and dosage for an individual. The selected blend of terpenes can be further refined and fine-tuned for an individual patient by adjusting the total cannabinoid activation level by administering supplemental doses of tetrahydrocannabinol (THC), cannabidiol (CBD), or other phytocannabinoids. The doses can be ingestible, inhalable, or the like. The phytocannabinoids may comprise anywhere from 0 to 99% of the total formulation.

[0037] The disclosure further provides a system of measuring the effect of terpenes on THC uptake in the blood, by measuring THC uptake in the presence of terpenes versus in the absence of terpenes.

[0038] The present disclosure encompasses all possible combinations of the above embodiments, and encompasses all possible disclosures of each independent claim with its dependent claims. For example, what is encompassed is an invention that is the combination of: Claim 1 + Claim 2; or the combination of: Claim 1 + Claim 2 + Claim 3; or the combination of Claim 1+ Claim 3 + Claim 4; or the combination of Claim 1 + Claim 2 + Claim 3 + Claim 4; and the like.

[0039] As used herein, including the appended claims, the singular forms of words such as "a," "an," and "the" include their corresponding plural references unless the context clearly dictates otherwise. All references cited herein are incorporated by reference to the same extent as if each individual publication, patent, and published patent application, as well as figures and drawings in said publications and patent documents, was specifically and individually indicated to be incorporated by reference.

[0040] The terms “adapted to,” “configured for,” and “capable of,” mean the same thing. Where more than one of these terms are used in a claim set, it is the case that each and every one of these terms, as they might occur, means, “capable of.”

Brief description of the drawings

[0041] Fig. 1 shows a system for determining a treatment regimen based on the methods disclosed herein.

[0042] Fig. 2 shows a process for preparing a blend of terpenes.

[0043] Fig. 3 shows a method for generating a library of prepared terpene compositions.

[0044] Fig. 4 shows the result of a chromatographic analysis of a typical blend or strain of plant by terpene content, according to the present inventions.

Detailed description of the disclosure

Definitions and methods

[0045] An “agonist” is a compound that stimulates an increase in a biochemical or physiological activity. The activity can be the rate of ion transport by an ion channel, rate of signal transmission by a receptor such as a G-protein-linked receptor, rate of secretion of a substance from a cell, enzymatic activity, genetic expression, and so on.

[0046] An “antagonist” is a compound that reduces or inhibits a biochemical or physiological activity. For a compound to be an antagonist, it is not necessary that there exist any known agonist, and it is not necessary that the antagonist work by reducing the activity of a corresponding agonist.

[0047] The cannabinoid receptors include CB_1 and CB_2. CB_1 and CB_2 are members of the G protein-coupled receptor family. The ligands of CB_1 include $delta^9$-tetrahydrocannabinol ($delta^9$-THC), as well as an endogenous ligand,

N-arachidonyl ethanolamide (AEA; anandamide). In addition to CB_1 and CB_2, cannabinoids can bind to "receptors" such as various ion channels, such as vanilloid (TRPV) receptors, and to nuclear receptors, such as peroxisome proliferator-activated receptor (PPAR) (Console-Bram et al (2012) Prog. Neuropsychopharmacol. Biol. Psychiatry. 38:4-15). Biochemical properties of terpenes, including receptor binding, can be assessed using labeled terpenes and labeled ligands where a terpene influences binding properties of the labeled ligand. Useful labels include ^{32}P, ^{33}P, ^{35}S, ^{14}C, ^{3}H, ^{125}I, stable isotopes, epitope tags, fluorescent dyes, electron-dense reagents, substrates, or enzymes, e.g., as used in enzyme-linked immunoassays, or fluorettes (see, e.g., Rozinov and Nolan (1998) Chem. Biol. 5:713-728). Terpenes in cannabis have been described (see, e.g., Flores-Sanchez and Verpoorte (2008) Secondary metabolism in cannabis in Phytochem. Rev. DOI 10.1007/s11101-008-9094-4).

[0048] "Synergy" refers to the phenomenon where a first compound stimulates a first level of a particular activity, where a second compound stimulates a second level of the same particular activity, and where the presence of both compounds results in a third level of the same particular activity, where the third level is greater than the additive sum of the first level and the second level. Synergy can occur where the first compound and second compound are used at the same time, or where the first compound and second compound are used sequentially.

[0049] "Entourage compound" is a compound that can increase the effects of one or more naturally-occurring ligands that bind to one or more receptors, but that has little or no affinity for the receptor. In a preferred, but non-limiting embodiment, an entourage compound increases the effects of a naturally-occurring ligand that binds to one or more cannabinoid receptors, but that has little or no affinity for the cannabinoid receptor.

[0050] Suppliers of terpenes that are pure and homogeneous, contract laboratories that synthesize terpenes, and contract laboratories that purify terpenes from natural products, e.g., essential oils, are available (see, e.g., Sigma-Aldrich, St. Louis, MO; TCI America, Portland, Oregon; Arizona Chemical, Jacksonville, Florida). Without implying any limitation, the term "pure" can refer to a terpene that is over 95% pure, over 98% pure, over 99% pure, over 99.5% pure, over 99.9% pure, over 99.99% pure, and the like. Generally, the term "pure" does not take into account any solvent that may be used for dissolving the terpene, such as a solvent that is ethanol, acetone, tetrahydrofuran, and so on. In other words, unless specified otherwise, either explicitly

or by the context, any solvent that is present is not relevant to the characterization of a given terpene as pure and homogeneous.

Biochemical assays for entourage compounds

[0051] The ability of a compound, such as a terpene, to serve as an agonist, an antagonist, to synergize with another compound, or to function as an entourage compound, can be assessed by a number of assay methods. Methods for determining binding to cells or subcellular particles that express a cannabinoid receptor have been described (Leggett et al (2004) Br. J. Pharmacol. 141:253-262). Leggett et al, supra, determined that a fatty acid amide (oleamide) can activate cannabinoid receptor CB1.

Human sensory panel for odors; correlating odors with chemical quantitation of odiferous compounds

[0052] At least the following methods are available for use in the present disclosure. Human panels have been trained to evaluate odors, such where the odors had the names, grassy green, green spicy, sweet, seasoned, sharp, soupy, mellow, metallic, fragrant fruity, cardboard-like, and complex (Kurobayashi et al (2006) Biosci. Biotechnol. Biochem. 70:958-965). The Kurobayashi et al, supra, study included detection of odor of terpenes, e.g., myrcene. Human panels have been trained to evaluate the level of odorants, including terpenes (linalool; L-carvone) on a scale of zero (extremely mild) to ten (extremely intense). Odorants were delivered to human subjects using an air stream. The subjects receiving the odorants, and providing subjective responses on odor intensity, also provided objective responses using electroolfactograms (EOG). The EOG test involved placing electrodes on the contralateral bridge of the nose, earlobe, and mastoids.

[0053] A variety of physiological parameters have been tested, in studies of subject response to terpenes, e.g., linalolol. These parameters include blood oxygen saturation, pulse rate, breathing rate, eye-blinks, skin conductance, skin temperature, and surface electromyogram (Heuberger et al (2004) Neuropsychopharmacology. 29:1925-1932). Various subjective parameters have also been tested, in subject response to terpenes, including subjective attentiveness, mood, cheerfulness, subjective relaxation, vigor, calmness, alertness (see, e.g., Heuberger et al (2004) Neuropsychopharmacology. 29:1925-1932; Diego et al (1998) Int. J. Neurosci. 96:217-224; Knasko (1992) Chem. Senses. 17:27-35). Sugawara's group (Sugawara

et al (1998) J. Home Econ. Jpn. 49:1281-1290; Sugawara et al (2013) Molecules. 18:3312-3338; Satoh and Sugawara (2003) Analytical Sciences. 19:139-146), have used sensory tests for assessing subjective responses to a variety of terpene-containing oils. The terpene-containing oils were tested for subjective impressions, that is, fresh-stale, soothing-activating, airy-heavy, plain-rich, natural-unnatural, elegant-unrefined, soft-strong, pleasant-unpleasant, warm-cool, comfortable-uncomfortable, woodsy-not woodsy, floral-peppery, lively-dull. Sugawara's group also provided methods for the statistical analysis of data on subjective response, for example, calculation of the p value. These investigators also acquired electroencephalography data. Odorant was administered by a 300 mL inhaler flask, where 0.02 to 0.2 mL of odorant was applied to a strip of filter paper placed at the bottom of the flask.

[0054] Moss et al (2008) Intern. J. Neuroscience. 118:59-77, discloses tests for assessing various psychological responses to aromas such as peppermint odor. The tests include those for alertness, calmness, contentedness, immediate word recall, ability to match digits quickly, memory of details of a picture of a 3-dimensional house, and time to respond by pressing yes or no in order to match a screen that displays either "yes" or "no."

Fragrance panels with human subjects

[0055] Odorants, volatile chemicals, and fragrances, can be administered by various devices, e.g., Aroma-Stream (Tisserand, Hove, Sussex, England), H2EO Aircare Ultrasonic Diffuser (Aromatics International, Lolo, MT), ZAQ NoorAir Aromatherapy Essential Oil Diffuser (Enovize, Inc., Skokie, IL).

[0056] Detecting the presence of odiferous chemicals, as well as the quantification of one or more odiferous chemicals, can be assessed by the human nose. Quantification can be in terms of, for example, micrograms/liter of air, nanograms/L of air, picograms/L of air, femtograms/L of air, attograms/L of air, and so on. Also, quantification can be in terms of micromoles/liter of air, nanomoles/L of air, picomoles/L of air, femtomoles/L of air, attomoles/L of air, and so on. The skilled artisan is able to quantify the concentrations of various volatile compounds, by way of odor. For example, 2,4,6-trichloroanisole (TCA) can be detected by way of smell, when it exists at a concentration of a few nanograms/L of air (H. Rudy. Gerstel Solutions Worldwide, No. 11, pages 9-11). To give another example, the lower limit of detection of

formaldehyde in the air has been determined to be 0.03-1.0 milligrams formaldehyde per cubic meter of air (Salthammer et al (2010) Chem. Rev. 110:2536-2572).

[0057] Sensory panels with human subjects are used to identify odors, including odors of degradation products of polypropylene and polyethylene. These degradation products can include aldehydes, ketones, carboxylic acids, alcohols, and lactones. Studies have demonstrated the correlation of human odor perceptions with chemical quantitation by mass spectroscopy and gas chromatography (Hopfer et al (2012) Anal. Bioanal. Chem. 402:903-913). Human sensory panels have been used for detecting and quantifying a variety of organic chemicals (see, e.g., Johnson et al (2012) PLoS ONE. 7:e32693 (7 pages); Zhou et al (1999) J. Agric. Food Chem. 47:3941-3953; Brattoli et al (2011) Sensors (Basel). 11:5290-5322).

Synthetic Nasal Devices

[0058] Synthetic nasal devices, including electronic nose devices are available. See for example, Cyranose® 320, Sensigent, Baldwin Park, CA; Arshak et al (2004) Sensor Review. 24:181-198; Monge et al (2004) Comb. Chem. High Throughput Screen. 7:337-344; Ye et al (2011) J. Pharm. Biomed. 55:1239-1244; Hodgins et al (1995) J. Automat. Chem. 17:179-185.

Classification of a chemical or oil by fragrance notes

[0059] The present disclosure encompasses terpene formulations that can be characterized by one or more of the following sensory terms, that is, citrus, citrus peel, lemon, lemon rind, lime, grapefruit, grapefruit peel, fruity, creamy, nut-like, melon, berry, seedy, strawberry, cranberry, pineapple, floral, earthy, wood, pine, woody/pine, herbal, tea-like, musty and cheesy aromas, raspberry, orange, acacia, cassie, chypre, cyclamen, fern, gardenia, hawthorn, heliotrope, honeysuckle, hyacinth, jasmine, lilac, lily, magnolia, mimosa, narcissus, freshly-cut hay, orange blossom, orchid, reseda, sweet pea, trefle, tuberose, vanilla, violet, wallflower, musk, sweet, balsamic, spicy, woody, heavy floral, cheesy, mandarin, ugli fruit; anise, cinnamon clove, basil, mint, lavender, lavandin, thyme, rosemary, geranium, roses, citronella, cypress, eucalyptus, Peru balsam, camphor, sandalwood, ylang, cedarwood, Amyris oil, cedarwood oil, cocoa absolute, copaiba balsam, menthe oil pays, myrrh resin, patchouli oil, vanillin, vetiver oil. See, US 2010/0111880 of Chen, US 7,534,460 of Dewis, US 2009/0257973 of Fraser, which are each incorporated herein by reference in their

entirety. The disclosure also encompasses compositions with a fragrance that has, e.g., bewitching, warm, powdery, slightly animal and velvety connotation (see, RE38,659 of Williams, which is incorporated by reference). Also encompassed are compositions with a fragrance that has, e.g., a green note, floral note, fruity note, chypre note, oriental note, leather note, tobacco note.

[0060] The present disclosure provides a formulation that contains a top note terpene, middle note terpene, and bottom note terpene. US 6,769,428 of Cronk identifies terpenes that are top note (e.g., citronellal, citronellol, citronellyl acetate, dihydrolinalool, dihydromyrcenol, eucalyptol, geraniol, geraniol, geranyl acetate, geranyl nitrile, hydroxycitronellal, d-limonene, linalool, linaool oxide, linalyl acetate, linalyl propionate, methyl anthranilate, alpha-methyl ionone, methyl nonyl acetaldehyde, menthone, iso-menthone, myrcene, myrcenyl acetate, myrocenol, nerol, neryl acetate, alpha-pinene, beta-pinene, gamma-terpinene, alpha-terpineol, beta-terpineol, terpinyl acetate), middle note (e.g., coumarin, ethyl vanillin, eugenol, iso-eugenol), and bottom note (e.g., hexyl cinamic aldehyde).

[0061] The present disclosure provides terpene compositions that contain individual terpenes with a high volatility and low substantivity. Chemicals with a high volatility and low substantivity are used to give an initial burst of characters, such as light, fresh, fruity, citrus, green or floral, which are detected soon after application. Such materials are referred to, by the artisan skilled in the field of fragrances as "top notes". Less volatile, and more substantive, chemicals, at least in perfumes, are used to give characters such as musk, sweet, balsamic, spicy, woody or heavy floral to the fragrance oil which, although may also be detected soon after application, also last for longer. The skilled artisan refers to these materials as "middle notes" or "base notes". The skilled artisan can blend perfume raw materials so that the resultant fragrance oils have the desired overall fragrance character profile (see US 7,208,464 of Heltovics, which is incorporated herein by reference in its entirety). "Top note" fragrances are "fragrances having a high vapor pressure, and when applied to a paper sachet, vaporization takes place within 2 hours, and no scent remains. "Middle note" fragrances are "fragrances having a medium vapor pressure, and when applied to a paper sachet, the scent remains from about 2 to about 6 hours. "Base note" fragrances are fragrances having a low vapor pressure and high retentivity, and when applied to a paper sachet, the scent remains for more than about 6 hours. The terms "top note", "middle note", and "base note" are recognized by those skilled in the art of

fragrance-containing compositions. See, US 6,013,618 of Morelli, which is incorporated herein by reference in its entirety.

[0062] The present disclosure provides a formulation that comprises at least one terpene that provides a top note aroma, at least one terpene that provides a middle note aroma, and at least one terpene that provides a bottom note aroma. Also provided is a formulation that contains one or more terpenes that provides only a top note aroma. Also provided is a formulation that contains one or more terpenes that provides only a middle note aroma. Also provided is a formulation that contains one or more terpenes that provides only a bottom note aroma. Also provided is a formulation that contains only terpenes that provide a top note aroma and a bottom note aroma. Also provided is a formulation that contains only terpenes that provide a top note aroma and a middle note aroma. Also provided is a formulation that contains only terpenes that provide a middle note aroma and a bottom note aroma.

Modifiers

[0063] The present disclosure provides a composition that comprises a terpene formulation and one or more modifiers. As used herein, the term "modifier" refers to other classes of chemicals that are not terpenes. Chemicals such as thiols, esters, ketones, and aldehydes are potential modifiers. These compounds have distinct fragrances. The present invention contemplates using such other chemicals in conjunction with terpenes.

[0064] Thiols are organosulfur compounds that contain a carbon-bonded sulfhydryl group. They have pungent odors often resembling garlic.

[0065] Esters are organic compounds that occur naturally in fats and oils. They often have a pleasant fruity odor. They are responsible for the aromas of many fruits, including apples, bananas, and strawberries.

[0066] Some modifier compounds that are contemplated by the invention are 3-methyl-2-butene-1-thiol (sulfur compound) and hexanoic acid hexyl ester (pungent odor). Another modifier compound for use with the present invention is 2-heptanone, which is a naturally occurring compound in beer, bread, and some cheeses, and which has a banana-like odor.

[0067] Octanal and cis-4-decenal are aldehydes that have a fruit-like citrus odor. Either or both compounds can be used as modifiers with in the compositions of the disclosed invention.

[0068] Cannabinoids are another class of modifiers contemplated by the invention. Cannabinoids are a class of diverse chemical compounds that act on cannabinoid receptors in the brain. Many are produced naturally in the human body. Others known as phytocannabinoids are found in and on plants. Some commonly known phytocannabinoids include tetrahydrocannabinol (THC) and cannabidiol (CBD). Cannabinoids can also be created synthetically.

[0069] The addition of cannabinoids of 60-99% purity to a composition of terpenes and propylene glycol emulsifies the terpenes in the mixture. Cannabinoids added at 10-70% act as an emulsifier.

[0070] Without implying any limitation, other modifiers can be selected from 4-hydroxy-2,5-dimethyl-3(2H)-furanone (strawberry), ethyl butyrate (apple, fruity), isoamyl acetate (banana), propyl hexanoate (pineapple, fruity), allyl hexanoate (pineapple, fruity), valencene (orange, fresh fruity), methyl anthranilate (also known as methyl 2-aminobenzoate) (grape), methyl butyrate (fruity, apple, pineapple), benzyl acetate (fruity, strawberry), p-mentha-8-thiol-3- one (grapefruit), (1S,4S)-trans-p-menthan-8-thiol-3-one acetate (black currant, exotic), (1R,4S)-cis-p-menthan-8-thiol-3-one acetate (fruity, sweet).

Isolation and analysis of terpenes

[0071] Terpenes can be purified, analyzed, and identified, by various techniques, including high pressure liquid chromography (HPLC), gas chromatography, and other chromatographic techniques (see, e.g., Musenga et al (2006) J. Sep. Sci. 29:1251-1258; Yang et al (2009) J. Nat. Prod. 72:484-487; Jella et al (1998) J. Agric. Food Chem. 46:242-247; Andrea et al (2003) J. Agric. Food Chem. 51:4978-4983; Villa et al (2007) J. Pharm. Biomed. Anal. 44:755-762).

[0072] Terpenes and other chemicals can be analyzed by mass spectrometry (Hendriks and Bruins (1983) Biol. Mass Spectrom. 10:377-381; gas chromatography-mass spectrometry (GC-MS) (Gadulo et al (2010) J. Food Sci. 75:C199-207), nuclear magnetic resonance (NMR) (Mucci et al (2013) Food Chem. 141:3167-3176; Zhang et al (2013) Food Chem. 138:208-213), mass spectroscopy, and Matrix-Assisted Laser Desorption/Ionization Time-of-Flight mass spectrometry (MALDI-TOF) (Scalarone et al (2005) J. Mass Spectrom. 40:1527-1535).

Creation of a Database of Terpenes

[0073] The present invention involves the isolation and analysis of naturally-occurring terpene compositions, and also the preparation of terpene compositions that mimic those compositions found in nature.

[0074] Methods of the inventions involve generating a library of prepared terpene compositions, the process comprising: obtaining a sample; analyzing a chemical profile of the sample to identify terpenes in the sample; quantifying the terpenes identified; and generating a library or database of terpene compositions based on those quantities. The method may further comprise preparing a blend of terpenes that mimics one or more of the compositions represented in the library.

[0075] The sample can be from any plant or other natural product, including Cannabis sativa, Humulus lupulus, or other plant strains. The analysis step may comprise separating substances from a mixture, genetic analysis, chemotaxonomic analysis, compound extraction, gas chromatography flame ionization detection, chemical formula identification, chromatography, or any other analytical chemistry technique described herein or otherwise known in the art. Terpenes can be identified based on their chromatography profiles or other chemical properties of the analyzed compounds. Terpenes identified can be any of those listed in this application, or any other terpene. Terpenes may be quantified based on their mass fraction, percent weight, mole fraction, percentage by volume, or the like. The compositions and their quantities can be assembled as a library or database, or any other data management format known in the art. In embodiments that involve creating a prepared blend that mimics a naturally-occurring composition, the synthetic blend may comprise all naturally-occurring terpenes, all synthetic terpenes, or a combination thereof.

[0076] Also provided is a database or library of terpene compositions produced by the above process.

[0077] Also provided is a system 100 for treating a patient, shown in FIG. 1. The system 100 comprises a first step 110 of obtaining a database of terpene compositions, the terpene compositions comprising identities and quantities of terpene compounds; a second step 120 of administering to a patient a first blend of terpenes, which mimics a first terpene composition from the database, and observing the patient's response; a third step 130 of administering to the patient a second blend of terpenes, which mimics a second terpene composition from the database, and observing the patient's response; a fourth step 140 of comparing the patient's

responses to the two terpene blend administrations; and a fifth step 150 of determining a treatment regimen based on the comparison.

[0078] Also provided is the above system, wherein the patient responses are transmitted to a medical diagnostic site over an electronic network and the treatment regimen is transmitted to the patient from the medical diagnostic site over the electronic network. The system involves electronically sending and receiving terpene combination and dosage information, and designing a treatment regiment comprising dosage and formulation instructions. The invention can be used in conjunction with a remote diagnostic system, such as that described in U.S. Patent 6,598,084, incorporated by reference herein in its entirety.

[0079] The disclosure further provides a product-by-process 200, the process shown in FIG. 2. The product is namely a prepared blend of terpenes by a process comprising: a first step 210 of measuring a baseline endocannabinoid level in a patient; a second step 220 of obtaining a terpene composition from a database of terpene compositions, such as that described above; a third step 230 of administering to a patient a blend of terpenes based on the terpene composition; a fourth step 240 of measuring another endocannabinoid level of the patient after having administered the blend; a fifth step 250 of comparing the measurements to determine cannabinoid activation level associated with the blend of terpenes; and a sixth step 260 of selecting the blend of terpenes that provides a desired cannabinoid activation level. The selected blend of terpenes can be further refined and fine-tuned for an individual patient by adjusting the total cannabinoid activation level by administering supplemental doses of tetrahydrocannabinol (THC), cannabidiol (CBD), or other phytocannabinoids. The doses can be ingestible, inhalable, or the like. The phytocannabinoids may comprise anywhere from 0 to 99% of the total formulation.

[0080] The process described above is a way of finding the optimal THC or CBD dose for an individual, and allows a caregiver to administer a personalized medicinal or palliative treatment. The fine-tuned dosage and formulation information gleened from the process described above provides a more effective individualized medical treatment than a plant could be bred to provide. The blend of terpenes can be delivered to a patient by any of the delivery vehicles described herein, including orally, inhaled (candles or aromatherapy), or topically with a cream or ointment. Endocannabinoids whose levels can be measured in conjunction with the process described above include anandamide, 2-acylglycerol, and any others known in the art.

[0081] The present disclosure further provides a system for measuring the effect of terpenes on THC uptake in the blood, the system comprising: obtaining a database of terpene compositions, the terpene compositions comprising identities and quantities of terpene compounds; administering to a patient a dose of THC in combination with a blend of terpenes, which mimics a terpene composition from the database, and measuring THC levels in the patient's blood; administering to the patient the dose of THC in the absence of the blend of terpenes, and measuring THC levels in the patient's blood; comparing the measured THC levels; and determining based on the comparison the effect of the terpenes on THC uptake.

[0082] It is proposed that the presence of terpenes results in enhanced levels of THC uptake by the blood. Terpenes generally should increase uptake, especially when administered via inhalation, because some terpenes are known as bronchodilators, which further enhances the effect.

Fluids

[0083] In "comprising" embodiments, the present disclosure provides a formulation that comprises a fluid that is a transparent liquid, a translucent liquid, an opaque liquid, a slurry, an emulsion, a suspension, a gel, and the like. In "consisting" embodiments, the present disclosure provides a formulation that consists of a fluid that is a transparent liquid, a translucent liquid, an opaque liquid, a slurry, an emulsion, a suspension, a gel, and the like. The designation of liquid, slurry, emulsion, gel, and so on, refers to this characterization as determined at room temperature (about 23 degrees centigrade).

[0084] Solvents are encompassed, such triacetin, dipropylene glycol, diethyl phthalate, isoparaffins, paraffins, silicon oils, perfluorinated aliphatic ethers, glycol ethers, glycol ether esters, esters, or ketones, propylene glycol, ethanol, triacetin, dimethicone or cyclomethicone, and so on.

[0085] Solvents such as propylene glycol are commonly used in electronic cigarette (e-cigarette) formulations. As discussed above, the addition of 10-70% cannabinoids to a mixture of terpenes and propylene glycol creates an emulsified mixture ideal for use in e-cigarettes.

Exclusionary embodiments

[0086] In embodiments, the present disclosure can exclude a composition that has any essential oil. Also, the disclosure can exclude a composition that contains one or more

specific oils, such as ocimum oil, jasmine oil, cymbopogon oil (lemongrass), santalum oil, eucalyptus oil, bergamote oil, lemon oil, lavandin oil, spearmint oil, wintergreen oil, cardamom oil, neroli bigarade oil, rosemary oil, orange oil, petitgrain oil, cinnamon leaf oil, vetiver oil, patchouli oil, grapefruit oil, mandarine oil, mandarin oil, pepper oil, valerian oil, almond oil, citronella oil, anise oil, geranium oil, mint oil, verbena oil, clove oil, cajeput oil, fennel oil, girfole oil, myrtle oil, thyme oil, cypress oil, pine oil, armoise oil, and so on. What can be excluded is a composition that contains any kind of citrus fruit oil, e.g., from orange, lemon, grapefruit, and so on. Where applicable, the present disclosure encompasses an oil that is an "essential oil." Also, the present disclosure can encompass any formulation that includes one or more of the above oils.

[0087] In an exclusionary embodiment, the invention provides any of the above compositions, wherein the composition does not contain 3,3'-dihydroxy-5,4'-dimethoxybibenzyl. In another exclusionary embodiment, the invention provides any of the above compositions, wherein the composition does not contain cellulose. In another exclusionary embodiment, the invention provides any of the above compositions, wherein the composition does not contain chlorophyll.

[0088] Without implying any limitation, what can also be excluded from the present disclosure is any composition that includes one or more excipients, viscosity-imparting agents, solvents, binders, lubricants, preservatives, anti-oxidants, and the like. For example, what can be excluded from the present disclosure is, paraffin oil, isopropyl palmitate, cetryl alcohol, beeswax, polyethylene glycol, glycerol, pheoxyethanol, silica, sodium bicarbonate, sodium carbonate, cellulose, carboxymethyl cellulose, acacia agar, gums, hydrogels, alginic acid, a monosaccharide, a disaccharide, and so on. In embodiments, the present disclosure can include one or more excipients, viscosity-imparting agents, solvents, binders, lubricants, preservatives, and the like, such as one or more of those disclosed herein.

[0089] In other exclusionary embodiments, what can be excluded is a composition, where a fluid component of the composition, does not contain one or more of the following molecules (see, e.g., Flores-Sanchez and Verpoorte (2008) Secondary metabolism in cannabis in Phytochem. Rev. DOI 10.1007/s11101-008-9094-4): cannabigerol; cannabichromene; cannabitriol; cannabidiol; cannabicyclolol; cannabielsoin, cannabinodiol; cannabinol; delta8-tetrahydrocannabinol; delta9-tetrahydrocannabinol; cannabichromanone; cannabicoumaronone; cannabicitran; 10-oxo-delta6a10a-tetrahydrocannabinol; cannabiglendol; delta7-isotetrahydrocannabinol;

CBLVA; CBV; CBEVA-B; CBCVA; delta9-THCVA; CBDVA; CBGVA; divarinolic acid; quercetin; kaemferol; dihydrokaempferol; dihydroquercetin; cannflavin B; isovitexin; apigenin; naringenin; eriodictyol; luteolin; orientin; cytisoside; vitexin; canniprene; 3,4'-dihydroxy-5-methoxy bibenzyl; dihydroresveratrol; 3,4'dihydroxy-5,3'-dimethoxy-5'-isoprenyl; cannabistilbene 1; cannabistilbene 11a; cannabistilbene 11b; cannithrene 1; cannithrene 2; cannabispirone; iso-cannabispirone; cannabispirenon-A; cannabispirenone-B; cannabispiradienone; alpha-cannabispiranol; beta-cannabispiranol; acetyl-cannabispirol; 7-hydroxy-5-methoxyindan-1-spiro-cyclohexane; 5-hydroxy-7-methoxyindan-1-spiro cyclohexane; 5,7-dihydroxyindan-1-cyclohexane; cannabispiradienone; 3,4'-dihydroxy-5-methoxybibenzyl; canniprene; cannabispirone; cannithrene I; cannithrene 2; alpha-cannabispiranol; acetyl-cannabispirol; vomifoliol; dihydrovomifoliol; beta-ionone; dihydroactinidiolide; palustrine; palustridine; plus-cannabisativine; anhydrocannabisativine; dihydroperiphylline; cannabisin-A; cannabisin-B; cannabisin-C; cannabisin-D; grossamide; cannabisin-E; cannabisin-F; cannabisin-G; and so on.

[0090] The present disclosure provides a terpene formulation that comprises only one monoterpene. The present disclosure provides a terpene formulation that comprises only two monoterpenes. The present disclosure provides a terpene formulation that comprises only three monoterpenes. The present disclosure provides a terpene formulation that comprises only four monoterpenes.

[0091] The present disclosure provides a terpene formulation that comprises only one sesquiterpene. The present disclosure provides a terpene formulation that comprises only two sesquiterpenes. The present disclosure provides a terpene formulation that comprises only three sesquiterpenes. The present disclosure provides a terpene formulation that comprises only four sesquiterpenes.

[0092] In exclusionary embodiments, the present disclosure can exclude any composition, and can exclude any formulation that includes an essential oil. Also, the present disclosure can exclude any composition, and can exclude any formulation that includes one or more of salicyladlehyde, glycerol, polyethylene glycol, ionic detergent, non-ionic detergent, surfactant, phenylgycidate compound, calone, vanillin, jamunate, manzanate, verdox, vertoliff, furaneol, methyl cinnamate, butyl valerate, amyl acetate, furfural, ethyl vanillin, a lactone compound, any kind of aldehyde, methyl ionone, citrate, fumarate, amyl cinnamal, benzyl alcohol, free ions or salts of carbonate, free

ions or salts of sulfate, free ions or salts of phosphate, cymene, any salicylate compound, anisyl alcohol, methyl heptin carbonate, any compound with a ketone group, any compound with a benzoate group, any sugar, dextrose, dextrate, silica, maltodextrin, sorbitol, and oil that is other than an essential oil, and the like. Other compounds, which can be excluded from the compositions and formulations of the present disclosure, or in the alternative, which can be included, are disclosed (see, e.g., US 2008/0194455 of Widder, US 5,948,812 of Kraft, US 2003/0024997 of Welch, US 2009/0004303 of Perring each of which is incorporated herein by reference in its entirety).

[0093] The present disclosure provides formulations that include one or more of these terpenes. In exclusionary embodiments, the present disclosure can also exclude one or more of any terpene that is disclosed herein.

Example 1

[0094] In a first example, a composition was provided comprising equal parts myrcene, limonene, linalool, alpha-pinene, and beta-caryophyllene. This particular composition of terpenes was designed to have a citrus scent. Three human subjects tested the organoleptic properties of the composition and reported the odor qualities of the composition. The first human subject reported a “sweet citrus” scent, with “woody earthen overtones.” The second human subject described the composition as having a “light floral” aroma with a hint of “fruity citrus.” The third human subject reported a “pleasant flowery scent” with notes of “lemony citrus.”

Example 2

[0095] To create a database of terpene compositions like the database or library described herein, naturally occurring plant samples were analyzed for their chemical properties. Fig. 3 shows a method 300 for generating such a database. The method 300 involves obtaining a sample in step 310. The sample can be a naturally occurring plant product, such as a member of the Cannabis genus, or any other plant product. Step 320 of the method involves analyzing a chemical profile of the sample to identify terpenes therein. The analysis can be any of the chemical analyses described herein, including chromatography. The analysis step may further comprise other processes for extracting compounds or otherwise preparing the sample for analysis. The method further comprises quantifying terpenes in step 330. The terpenes can be quantified by

mass fraction, percent weight, mole fraction, percentage by volume, or the like. The quantities can be used to determine a ratio of terpenes in the composition. In step 340, those quantities, ratios, or other chemical properties are entered into a database of terpene compositions. The database may comprise chromatography profiles or other chemical properties found in the terpene compositions.

[0096] An example of one such analysis is shown in Fig. 4. A sample of a naturally occurring plant was isolated and analyzed using chromatography. The five most abundant terpenes in the composition were found to be beta-caryophyllene, limonene, linalool, myrcene, and alpha-pinene. These terpenes were determined to be present in quantities of 1.85 mg/g, 3.56 mg/g, 2.50 mg/g, 3.31 mg/g, and 8.40 mg/g, respectively. Other terpenese were found in trace quantities, including camphene, alpha-humulene, alpha-phellandrene, and beta-pinene. These quantities and chemical properties were entered into a database, like the one described herein.

Terpene combinations

[0097] Compositions of the present disclosure encompass, but are not limited to, combinations of the following terpenes: Alpha-bisabolol Borneol; Camphene Camphor; Delta-3-carene; Beta-caryophyllene; Caryophyllene oxide; Alpha-cedrene; Beta-eudesmol; (+)Fenchol; Geraniol; Guaiol; Alpha-humulene; Isoborneol; Limonene; Linalool; Menthol; Myrcene; Nerol; Cis-ocimene; Trans-ocimene; Alpha-phellandrene; Alpha-pinene; Beta-pinene; Sabinene; Alpha-terpinene; Sabinene; Alpha-terpinene; Alpha-terpineol; Terpinolene; Alpha-guaiene; Elemene; Farnesene; Germacrene B; Guaia-1(10),11-diene; Trans-2-pinanol; Selina-3,7(11)-diene; Eudesm-7(11)-en-4-ol; and Valencene.

[0098] The present disclosure provides terpene formulations that comprise combinations of two, three, four, or more of the above-mentioned terpenes. Also, the present disclosure provides terpene formulations that include those combinations of terpenes and that do not have any additional terpenes. Also included is any of the above combinations, further comprising additional terpenes. Also provided is any of the above-mentioned combinations wherein each terpene present in the combination comprises at least 0.01%wt, and at most 99.99%wt of the blend.

[0099] While the method and apparatus have been described in terms of what are presently considered to be the most practical and preferred embodiments, it is to be

understood that the disclosure need not be limited to the disclosed embodiments. It is intended to cover various modifications and similar arrangements included within the spirit and scope of the claims, the scope of which should be accorded the broadest interpretation so as to encompass all such modifications and similar structures. The present disclosure includes any and all embodiments of the following claims.

What is claimed is:

1. A system for electronically generating inhalable or ingestible treatment options for a patient, the system comprising:

obtaining a database of terpene compositions, the terpene compositions comprising identities and quantities of terpene compounds;

administering to a patient a first blend of terpenes, which mimics a first terpene composition from the database, and observing the patient's response;

administering to the patient a second blend of terpenes, which mimics a second terpene composition from the database, and observing the patient's response;

comparing the patient's responses to the two terpene blend administrations; and

determining a treatment regimen based on the comparison.

2. The system of claim 1, wherein the patient responses are transmitted to a medical diagnostic site over an electronic network and the treatment regimen is transmitted to the patient from the medical diagnostic site over the electronic network.

3. The system of claim 1, wherein each terpene composition comprises one or more terpene compounds selected from a list comprising alpha-bisabolol, borneol, camphene, camphor, delta-3-carene, beta-caryophyllene, caryophyllene oxide, alpha-cedreen, beta-eudesmol, fenchol, geraniol, guaiol, alpha-humulene, isoborneol, limonene, linalool, menthol, myrcene, nerol, cis-ocimene, trans-ocimene, alpha-phellandrene, alpha-pinene, beta-pinene, sabinene, alpha-terpinene, alpha-terpineol, terpinolene, alpha-guaiene, elemene, farnesene, germacrene B, guaia-1(10),11-diene, trans-2-pinanol, Selina-3,7(11)-diene, eudesm-7(11)-en-4-ol, and valencene

4. The system of claim 1, wherein a terpene composition further comprises a modifier comprising a thiol, an ester, a ketone, an aldehyde, or a cannabinoid.

5. The system of claim 1, wherein the treatment regimen comprises dosage and terpene formulation instructions.

6. A prepared blend of terpenes by a process comprising the steps of:

measuring a baseline endocannabinoid level of a patient;

obtaining a terpene composition from a database of terpene compositions;

administering to the patient a blend of terpenes based on the terpene composition;

measuring another endocannabinoid level of the patient;

comparing the measurements to determine cannabinoid activation level associated with the blend of terpenes; and

selecting the blend of terpenes that provides a desired cannabinoid activation level.

7. The prepared blend of terpenes of claim 6, by a process further comprising adjusting the cannabinoid activation level by administering phytocannabinoids.

8. The prepared blend of terpenes of claim 7, wherein the phytocannabinoids comprises THC or CBD.

9. The prepared blend of terpenes of claim 6, wherein the endocannabinoids comprise anandamide or 2-acylglycerol.

10. The prepared blend of terpenes of claim 6, by a process further comprising contacting the blend with a carrier substance.

11. The prepared blend of terpenes of claim 10, wherein the carrier substance is one selected from a list comprising a perfume, incense, a cosmetic, a moisturizer, an emollient, a toiletry, an edible substance, an ingestible substance, an absorbable substance, an inhalable substance, an e-cigarette liquid, a candle, an aerosolizer, or an oil fragrancer.

12. The prepared blend of terpenes of claim 6, wherein the blend comprises one or more terpene compounds selected from a list comprising alpha-bisabolol, borneol, camphene, camphor, delta-3-carene, beta-caryophyllene, caryophyllene oxide, alpha-cedreen, beta-eudesmol, fenchol, geraniol, guaiol, alpha-humulene, isoborneol, limonene, linalool, menthol, myrcene, nerol, cis-ocimene, trans-ocimene, alpha-phellandrene, alpha-pinene, beta-pinene, sabinene, alpha-terpinene, alpha-terpineol,

terpinolene, alpha-guaiene, elemene, farnesene, germacrene B, guaia-1(10),11-diene, trans-2-pinanol, Selina-3,7(11)-diene, eudesm-7(11)-en-4-ol, and valencene.

13. The prepared blend of terpenes of claim 6, wherein the terpenes present in the blend are beta-caryophyllene, limonene, myrcene, alpha-pinene, and linalool; and wherein the terpenes are present in approximately equal percentages by weight (wt%).

14. The prepared blend of terpenes of claim 6, wherein the blend does not contain 3,3'-dihydroxy-5,4'dimethoxybibenzyl.

15. The prepared blend of terpenes of claim 6, wherein beta-caryophyllene is present at about 10-30 wt%; limonene is present at about 5-45 wt%; and myrcene is present at about 5-30 wt%; and wherein the sum of all terpenes in the blend is 100 wt%.

16. The prepared blend of terpenes of claim 6, wherein myrcene is present at about 20-95 wt%; and alpha-pinene is present at about 5-35 wt%; and wherein the sum of all terpenes in the blend is 100 wt%.

17. A system for measuring the effect of terpenes on THC uptake, the system comprising:

obtaining a database of terpene compositions, the terpene compositions comprising identities and quantities of terpene compounds;

administering to a patient a dose of THC in combination with a blend of terpenes, which mimics a terpene composition from the database, and measuring THC levels in the patient's blood;

administering to the patient the dose of THC in the absence of the blend of terpenes, and measuring THC levels in the patient's blood;

comparing the THC levels; and

determining, based on the comparison, the effect of the terpenes on THC uptake.

18. The system of claim 17, wherein each terpene composition comprises one or more terpene compounds selected from a list comprising alpha-bisabolol, borneol, camphene, camphor, delta-3-carene, beta-caryophyllene, caryophyllene oxide, alpha-

cedreen, beta-eudesmol, fenchol, geraniol, guaiol, alpha-humulene, isoborneol, limonene, linalool, menthol, myrcene, nerol, cis-ocimene, trans-ocimene, alpha-phellandrene, alpha-pinene, beta-pinene, sabinene, alpha-terpinene, alpha-terpineol, terpinolene, alpha-guaiene, elemene, farnesene, germacrene B, guaia-1(10),11-diene, trans-2-pinanol, Selina-3,7(11)-diene, eudesm-7(11)-en-4-ol, and valencene

19. The system of claim 17, wherein a terpene composition further comprises a modifier comprising a thiol, an ester, a ketone, an aldehyde, or a cannabinoid.

20. The system of claim 17, wherein the blend further comprises a carrier substance.

21. The system of claim 17, wherein the carrier substance is one selected from a list comprising a perfume, incense, a cosmetic, a moisturizer, an emollient, a toiletry, an edible substance, an ingestible substance, an absorbable substance, an inhalable substance, an e-cigarette liquid, a candle, an aerosolizer, or an oil fragrancer.

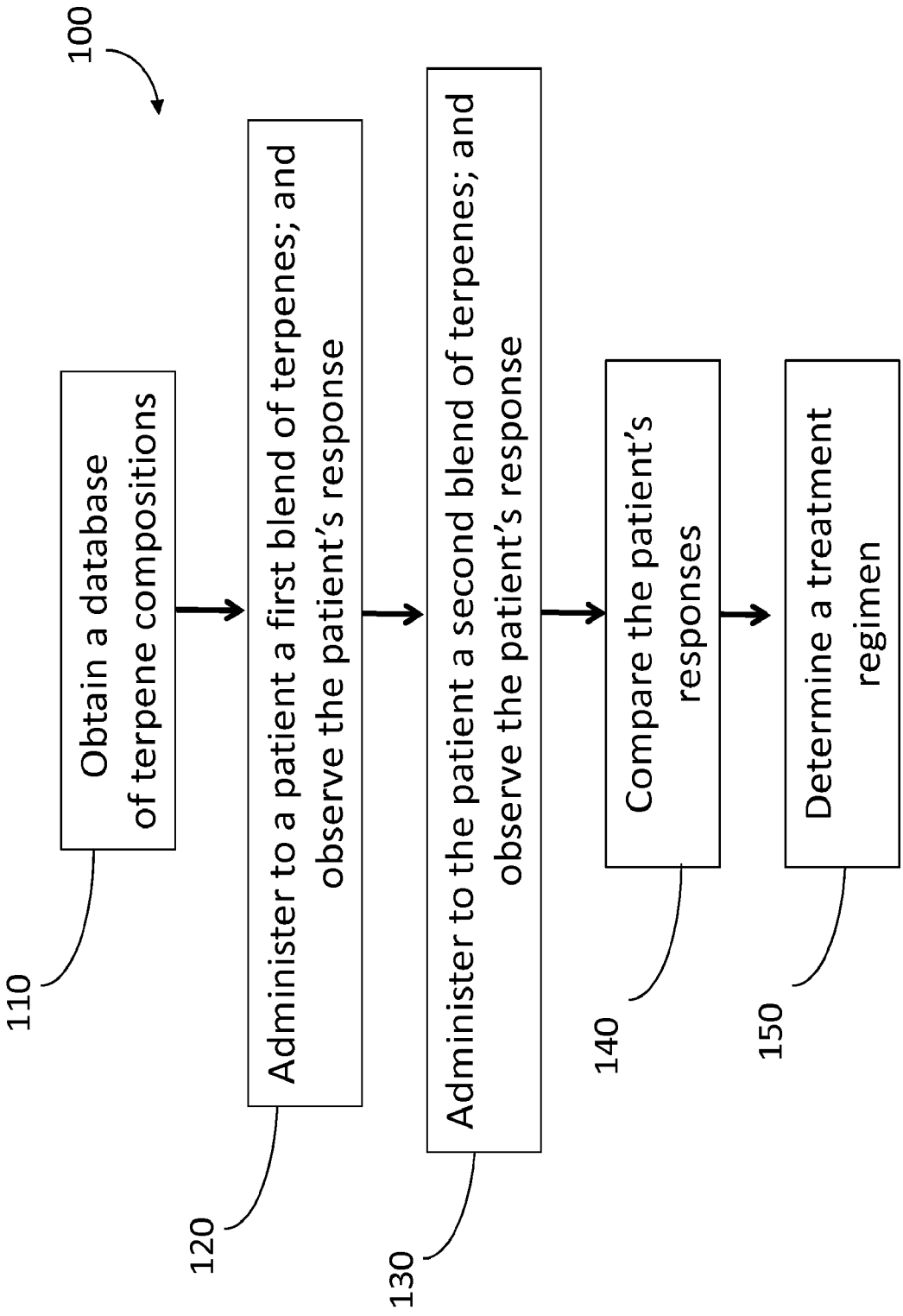
100
Obtain a database of terpene compositions
110
Administer to a patient a first blend of terpenes; and observe the patient's response
120
Administer to the patient a second blend of terpenes; and observe the patient's response
130
Compare the patient's responses
140
Determine a treatment regimen
150

FIG. 1

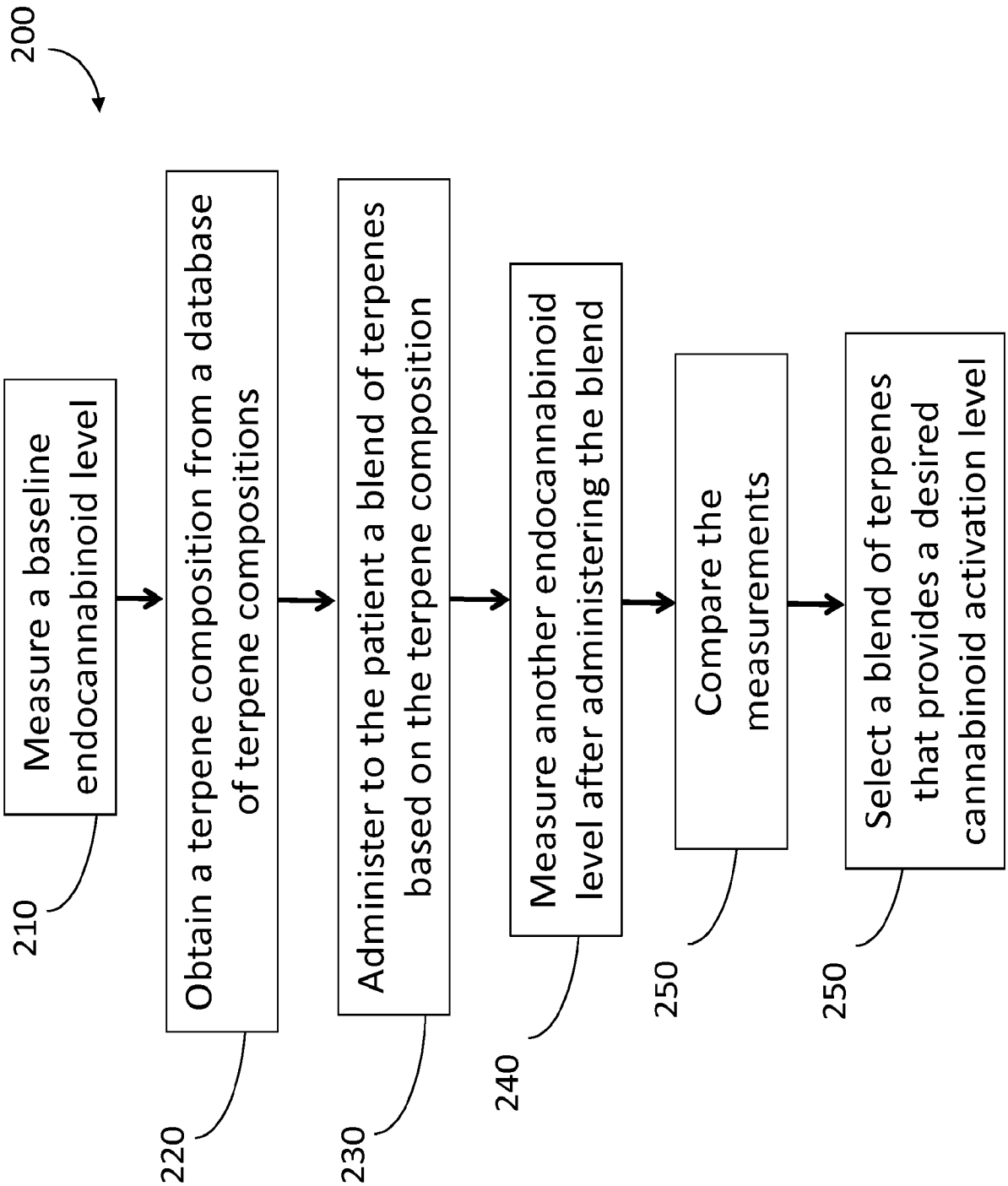
200
Measure a baseline endocannabinoid level
210
Obtain a terpene composition from a database of terpene compositions
220
Administer to the patient a blend of terpenes based on the terpene composition
230
Measure another endocannabinoid level after administering the blend
240
Compare the measurements
250
Select a blend of terpenes that provides a desired cannabinoid activation level
250

FIG. 2

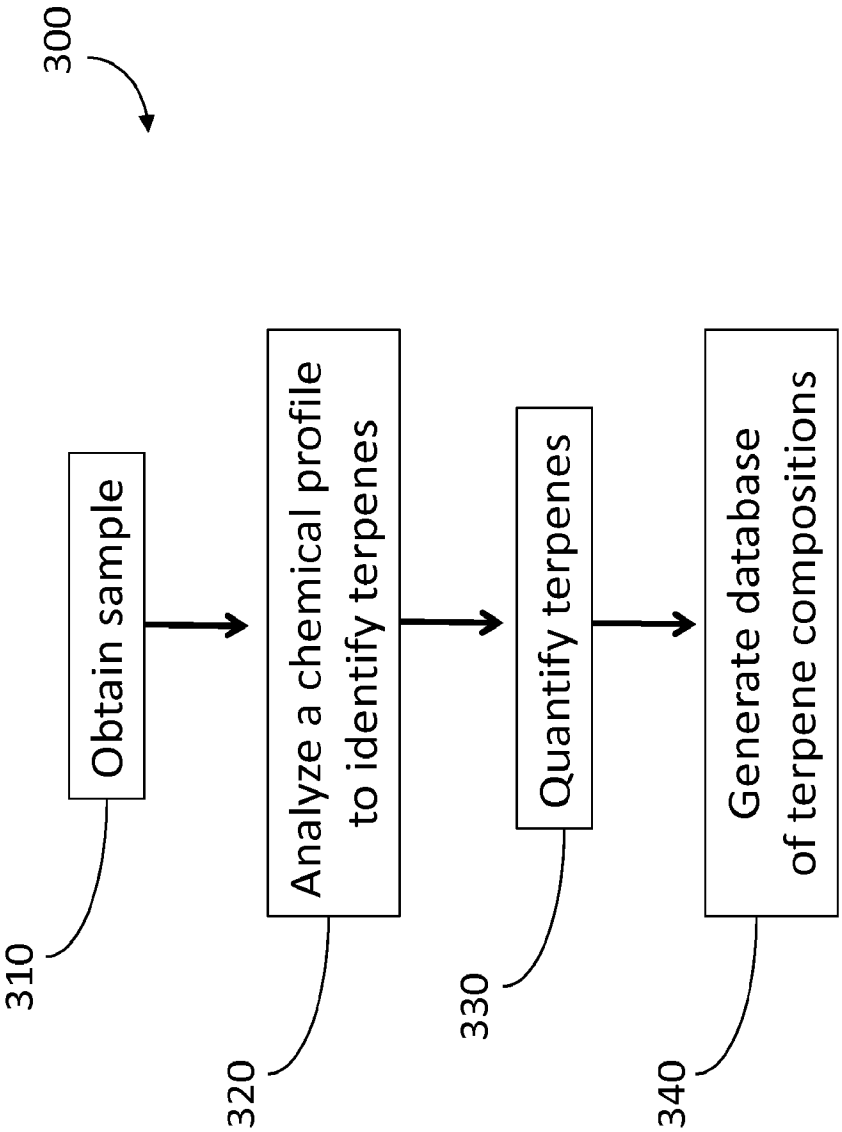
300
Obtain sample
Analyze a chemical profile to identify terpenes
Quantify terpenes
Generate database of terpene compositions
310
320
330
340

FIG. 3

Terpenes	mg/g
α-Bisabolol	<LLOQ
Borneol	<LLOQ
Camphene	0.11
Campher	0.01
Δ3-Carene	0.01
β-Caryophyllene	1.85
Caryophyllene oxide	<LLOQ
α-Cedrene	0.00
β-Eudesmol	<LLOQ
(+) Fenchol	<LLOQ
Geraniol	<LLOQ
Guaiol	<LLOQ
α-Humulene	0.17
Isoborneol	0.01
Limonene	3.56
Linalool	2.50
Menthol	<LLOQ
Myrcene	3.31
Nerol	0.00
cis-Ocimene	<LLOQ
trans-Ocimene	<LLOQ
α-Phellandrene	0.16
α-Pinene	8.40
β-Pinene	0.04
Sabinene Hydrate	0.00
α-Terpinene	<LLOQ
α-Terpineol	0.00
Terpinolene	0.01
α-Guaiene (t)	<LLOQ
Elemene (t)	<LLOQ
Farnesene (t)	0.01
Germacrene (t)	<LLOQ
Guaia-1(10),11-diene (t)	<LLOQ
t-2-Pinanol (t)	0.00
Selina-3,7(11)-diene (t)	<LLOQ
Eudesm-7(11)-en-4-ol (t)	<LLOQ
Valencene (t)	<LLOQ
Sum of Terpenees	**20.15**

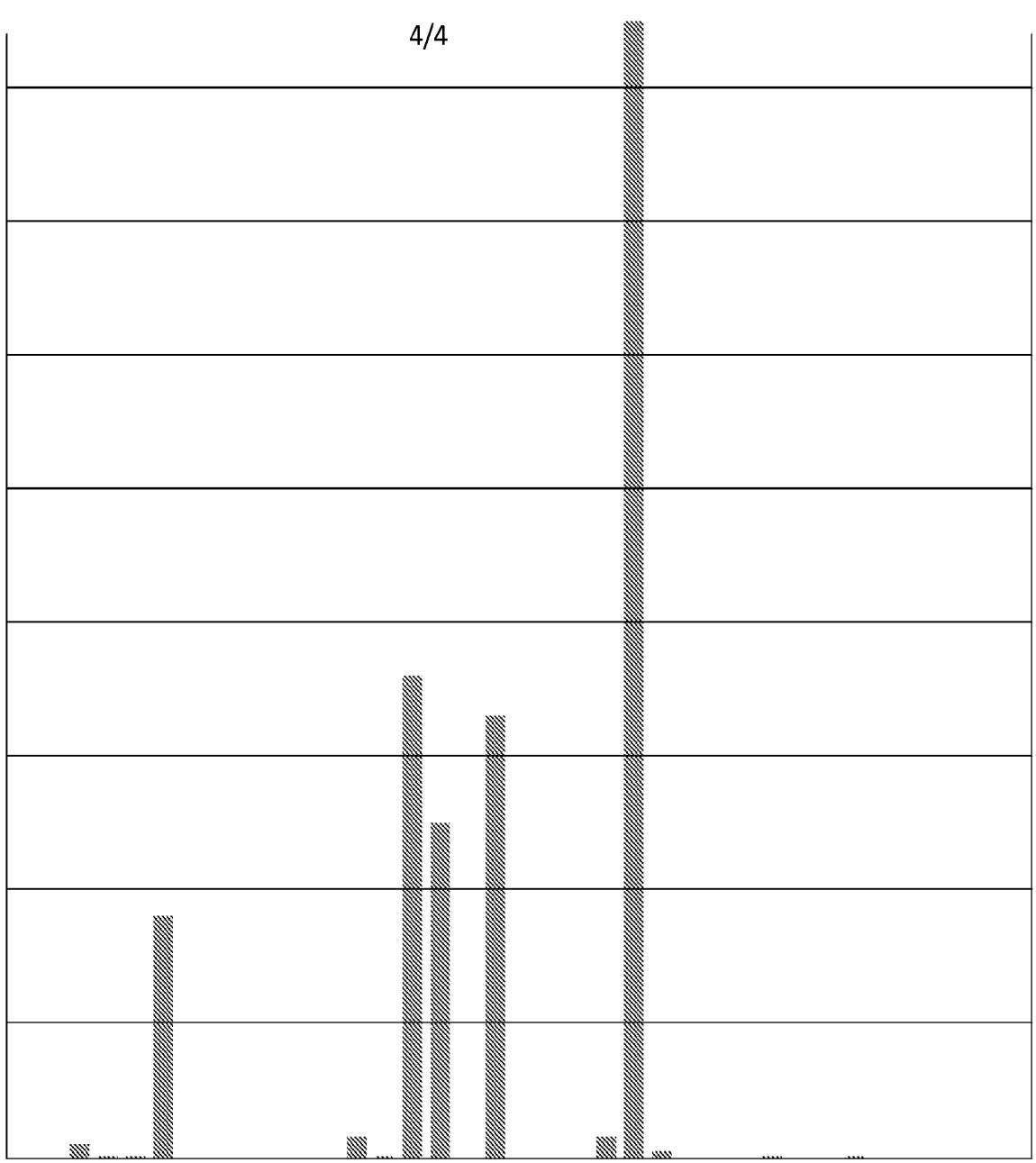

FIG. 4