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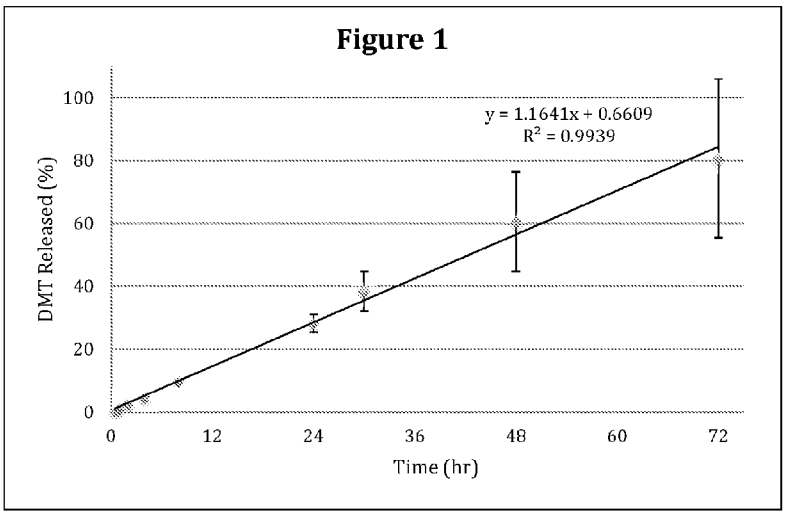
Figure 1



(57) Abstract: Pharmaceutical formulations of novel indole compounds and psilocybin analogs are manufactured, provided in novel oral, transdermal, and nasal pharmaceutical compositions for use to treat neurological, mood or abuse diseases and disorders.

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NOVEL COMPOSITIONS OF MATTER AND PHARMACEUTICAL COMPOSITIONS

CROSS-REFERENCES TO RELATED APPLICATIONS This application claims the benefit of U.S. Provisional Application 63/021,866 filed May 8, 2020, U.S. Provisional Application 63/106,516 filed October 28, 2020 and U.S. Provisional Application 63/134,805 filed January 7, 2021.

FIELD OF THE DISCLOSURE

The present invention relates to novel indole compounds, the administration of psilocybin, psilocybin chemical analogues, and novel indole chemical compounds; and pharmaceutical compositions, methods of preparing the pharmaceutical compositions and methods of treating neurological diseases or disorders using the analogues and novel compounds.

BACKGROUND OF THE INVENTION

Psychoactive drugs are compounds that affect behavior, mood, thoughts, or perception. Psychoactive drugs include antipsychotics, anti-anxiety agents, stimulants, reuptake inhibitors, monoamine oxidase inhibitors (MAOI), tricyclic antidepressants and mood stabilizers. Some of these compounds have historically been used for off label psychoactive activity and are now being investigated for positive clinical efficacy. In addition to potential therapeutic efficacy, these drugs must be investigated for all relevant pharmaceutical characteristics, including minimum and maximum dosing thresholds and the most efficacious delivery system.

Indole compounds represent a diverse class of compounds with broad biomedical potential across many targets including cancer, cardiovascular, gastrointestinal, and a wide range of neurological disorders. During *in vivo* biosynthesis, the amino acid tryptophan precursor of serotonin has been the scaffold of choice for many drugs containing the heterocyclic indole backbone. Serotonin (5-HT) supports many important bodily functions including mood, sleep, appetite, intestinal motility, and sexual health. The serotonergic system consists of a class of G-coupled protein receptors, 5-HT_1 through 5-HT_7 as well as their subtypes (1A, 2A, 2B, etc.), which modulate the range of these biological pathways.

Most serotonergic targeting therapeutics are antidepressants either as selective reuptake inhibitors (collectively SSRIs), direct 5-HT modulators (atypical) or in combination with norepinephrine inhibitors (SNRIs). While still not fully understood, the general mechanism of action of the approved therapeutics relies on increasing the concentration of the monoamines, 5-HT and norepinephrine, in the postsynaptic receptors to restore synaptic balance. However these medications generally lack efficacy (being only 20-30% effective over placebo), have considerable side effects, and have a delayed onset of weeks to months.

Sigma-1 receptor (σ receptors) are intracellular receptors expressed in specific regions of the brain. Modulation, and agonism, of Sigma-1 (σ_1) has been shown to have positive impacts on locomotion, mood disorders, increases of brain-derived neurotrophic factor (BDNF), neuronal growth, and neurogenesis. Diverse classes of psychotropic drugs, including antipsychotics, antidepressants, selective serotonin reuptake inhibitors (SSRI's) and motor neuron drugs bind to the (σ_1) receptor. Binding of the SSRI's to the σ1 receptor may mediate the serotonin independent actions of this class of drugs. The hallucinogen *N,N*-dimethyltryptamine (DMT) is an endogenous σ1 receptor regulator.

Psilocybin is an indole alkaloid and a naturally occurring psychoactive prodrug that is produced by more than 200 species of mushrooms. Psilocybin is a prodrug that is dephosphorylated in vivo via oral dosing to produce the active compound psilocin. Psilocybin and psilocin are both indole compounds and are known to be potent 5-HT agonists and can cross the blood-brain barrier. The therapeutic implications of psilocybin are broad with active clinical studies targeting depression, anxiety, migraines, addiction, dementias, Alzheimer's disease, eating disorders, obsessive compulsive disorder, and palliative care.

Magic Mushrooms is a common term for a group of over 200 species of naturally occurring mushrooms that contains psilocybin and active psilocybin chemical analogues and combinations thereof. Similarly, other naturally-occurring psychedelic indole compounds include *N,N*-dimethyltryptamine (DMT), 5-methoxy-DMT (5-MeO-DMT), lysergamides (e.g. LSD), and ibogaine. The raw fruit as well as extracts containing these natural products have been orally consumed for their psychoactive effects. Exact dose response activity has been difficult to quantify because of the variability of the individual response, the difficulty in measuring the potency of the natural organisms and extracts, and the different inherent potencies and ratio of the different analogues and combinations thereof. This is only exacerbated by the interplay of serotonin receptors activities as well as Sigma-1 (σ_1) receptors, especially for compounds like DMT. Specifically for neurodegenerative diseases and cognitive function, agonists of the σ_1 receptor (e.g. DMT) are shown to enhance brain plasticity with key roles in memory and learning.

Psilocybin and it's known analogues have been synthesized and bioengineered. In the mid-twentieth century, Sandoz Pharmaceuticals briefly marketed an oral formulation of psilocybin for adjuvant therapy in psychotherapy. The product was soon removed from the market due to the

unpredictability of individual response to the dosage form. As of 2020, the U.S. Drug Enforcement Agency has classified psilocybin as a Schedule 1 drug having a high potential for abuse, no approved medical use and a lack of accepted safety for use under medical supervision.

Dosing and assessing pharmaceutical efficacy for these compounds has proven to be difficult. One reason is that plasma concentration-time curves are highly variable. Additionally, psilocybin and especially DMT is subject to first pass metabolism of the oral dosage forms, which reduces availability of active pharmaceutical ingredient before it has entered the systemic circulation. Also, there are wide individual variances in the renal excretion of the compounds. Further, the pH and monoamine oxidase (MAO) enzymatic cleavage of psilocybin to the active pharmaceutical ingredient psilocin after oral delivery can also be a determining factor for the pharmacodynamics. Consequently, research into optimal dosage to treat various neurological disorders has not been rigorously pursued.

A 2016 Johns Hopkins study reported that relatively large doses such as 0.2 mg/kg dosing regimens are needed to induce psychedelic effects, which correlate to blood plasma concentrations between 4-8 ng/mL. The *in vivo* half-life for psilocin is about 50 minutes and leads to psychedelic experiences lasting 4-6 hours in which trained professionals monitor subjects in a clinical setting. Psychotherapy is performed before and after psychedelic doses to ready the patient and integrate the experiential outcome into a personal response to ameliorate depressive thoughts and actions, with the drug merely acting as a holistic tool. However, in-patient therapies incur significant costs for the patient and time on the care provider, not to mention the increased risk for adverse events while a patient is under the influence of a psychedelic drug.

Additionally, the positive psychological effects were seen with increasing doses, but the negative side effects of anxiety, negative ideation,

nausea, and headaches also increased as doses increased. Consequently, professional monitoring of the patients is necessary before, during and after the psychedelic session. Recently, microdosing has been used to dose psychedelic substances in very small, sub-perceptual amounts. Psychedelic substances that have been microdosed include LSD (lysergic acid diethylamide), cannabis and psilocybin analogues. Reports of microdosing substances such as DMT and 5-MeO-DMT are scant since their lack of bioavailability and short half-life makes their dosing challenging. Microdosing has been reported to have the beneficial therapeutic effects of improving mood, intellectual focus, energy levels, and creativity without the disabling hallucinogenic effects.

Microdosing of a psychedelic substance largely reduces psychotropic effects and anecdotally dosing is usually one-tenth ($1/10^{th}$) of a psychedelic dose. Many clinical investigations of psychedelics to alleviate depression and PTSD omit participants with a history of heart trouble, psychosis, and schizophrenia since the intense psychotropic effects can exacerbate these conditions microdosing could alleviate these issues. Treatments that are devoid of psychedelic effects would make the administration of the drugs in a clinical setting unnecessary, opening more traditional, flexible, and affordable drug regimens. Microdosing reports have noted improved cognitive benefits such as productivity, creativity, and abstract thinking; coupling evidence suggesting psychedelics reduce neuroinflammation and increase neuroplasticity and neuronal connections could lead to effective treatments for dementia, Alzheimer's disease, and other neurocognitive disorders.

Transdermal and nasal application of active pharmaceutical ingredients has many benefits when used for psychoactive drugs. In particular, psilocin is the product of the conversion of psilocybin, which is a prodrug that is transformed to psilocin in the gastrointestinal tract. By

avoiding the gastrointestinal tract through transdermal application of psilocin problems with absorption and food interactions can be avoided. . As therapeutic effects of orally-dosed DMT can only be realized with co-administration of MAOIs, transdermal systems offer a new delivery method with reduced metabolism and improved pharmacokinetic/pharmacodynamic (PK/PD) properties. Other benefits of transdermal dosing include avoiding of the first pass metabolism; providing multi-day therapy by single application thereby improving patient compliance; and extending the activity of drugs having short half-life through the reservoir of drug present in the delivery system and its controlled release characteristics.

Systemic delivery of pharmaceutical ingredients by administration to the nasal mucosa can be advantageous. Nasal delivery allows for avoidance of intestinal metabolism and first pass metabolism. Additionally, nasal delivery of systemic drugs can bypass the blood brain barrier and enter the brain via the olfactory and trigeminal nerve pathways, which can be advantageous for pharmaceutical dosing of diseases of the central nervous system. An additional benefit of nasal dosing is the rapid systemic absorption through the nasal mucosa; pairing this with a short half-life compound like DMT could have significant clinical advantages over longer acting psychedelics.

Oral delivery of drugs is often preferred over various other drug administration routes because of ease of ingestion, pain avoidance, good patient compliance and compounding history. However, many problems are still associated with oral delivery such as poor solubility of drugs in aqueous environments, taste, stability of the drug with the formulation excipients, varied dissolution rates, unknown gastrointestinal absorption issues and food effects. Oral pharmaceutical formulations are recognized

as a scientific endeavor that requires specific knowledge of the field in general, and innovative design.

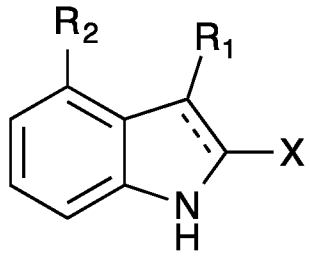
Recent studies on psilocybin and its psilocybin analogues and combinations thereof, have been reported to have efficacy in models and small clinical trials of post-treatment Lyme disease syndrome, dementias, Alzheimer's disease, post-traumatic stress disorder, anorexia nervosa, depression and anxiety, abuse disorders including opioid addiction, alcohol addiction, nicotine addiction, cannabinoid addiction, headache, central nervous system inflammation, dementia, and disorders of cognition and memory. These promising experimental reports using psilocybin and its analogues demonstrate an immediate need to determine a formulation to permit the most advantageous dosing amount and dosing period; improved pharmacokinetic (PK) profiles, pharmacodynamic (PD) profiles, or safety profiles; evaluation of the benefits of long term or maintenance therapies; development of treatment regimens that maximize biological efficacy for treating diseases; and the use of these compounds in other potential advantageous benefits. Additionally, there is a need for development of novel, safe and effective exogenous serotonergic and /or Sigma-1 modulators for the treatment of neurological, mood and abuse disorders or diseases.

Summary

Provided herein are novel indole compounds that have biological efficacy and increased clinical safety.

These compounds include the compounds of Structure (1) or pharmaceutically acceptable salts or solvates thereof:

Structure (1)



wherein:

X is H, CF_3, or a halogen that is selected from the group consisting of F, Cl, Br, I, and astatine; R_1 comprises an aliphatic substituent with a primary, secondary, tertiary, or quaternary amine; R_2 is hydrogen, hydroxyl, ester, ether, aldehyde, acid, amide, thiol, sulfones, sulfonamide or combinations thereof.

A further aspect of the present invention is a compound according to Structure (1), as described above, that is selected from the group consisting of:

TABLE (1) NOVEL INDOLE COMPOUNDS
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-ol
2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-ol
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-ol
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-ol
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-ol
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl dihydrogen phosphate
2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl dihydrogen phosphate
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl dihydrogen phosphate
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl dihydrogen phosphate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl dihydrogen phosphate
2-bromo-3-[2-(dimethylammonio)ethyl]-1H-indol-4-yl hydrogen phosphate
2-fluoro-3-[2-(dimethylammonio)ethyl]-1H-indol-4-yl hydrogen phosphate

2-chloro-3-[2-(dimethylammonio)ethyl]-1H-indol-4-yl hydrogen phosphate
2-iodo-3-[2-(dimethylammonio)ethyl]-1H-indol-4-yl hydrogen phosphate
3-[2-(dimethylammonio)ethyl]-2-trifluoromethyl-1H-indol-4-yl hydrogen phosphate
2-(2-bromo-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine
2-(2-fluoro-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine
2-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine
2-(2-iodo-1H-indol-3-yl)- *N,N*-dimethylethan-1-amine
N N-dimethyl-2-(2-trifluoromethyl-1H-indol-3-yl)ethan-1amine
3-[2-(dimethylamino)ethyl]-1H-indol-4-yl acetate
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl acetate
2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl acetate
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl acetate
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl acetate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl acetate
3-[2-(dimethylamino)ethyl]-1H-indol-4-yl propionate
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl propionate
2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl propionate
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl propionate
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl propionate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl propionate
3-[2-(dimethylamino)ethyl]-1H-indol-4-yl butyrate
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl butyrate
2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl butyrate
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl butyrate
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl butyrate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl butyrate
3-[2-(dimethylamino)ethyl]-1H-indol-4-yl pentanoate
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl pentanoate
2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl pentanoate
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl pentanoate
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl pentanoate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl pentanoate
3-[2-(dimethylamino)ethyl]-1H-indol-4-yl hexanoate
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl hexanoate

2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl hexanoate
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl hexanoate
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl hexanoate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl hexanoate
3-[2-(dimethylamino)ethyl]-1H-indol-4-yl heptanoate
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl heptanoate
2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl heptanoate
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl heptanoate
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl heptanoate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl heptanoate
3-[2-(dimethylamino)ethyl]-1H-indol-4-yl octanoate
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl octanoate
2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl octanoate
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl octanoate
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl octanoate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl octanoate,
3-[2-(dimethylamino)ethyl]-1H-indol-4-yl nonanoate
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl nonanoate
2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl nonanoate
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl nonanoate
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl nonanoate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl nonanoate
3-[2-(dimethylamino)ethyl]-1H-indol-4-yl decanoate
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl decanoate,
2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl decanoate,
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl decanoate,
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl decanoate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl decanoate
3-[2-(dimethylamino)ethyl]-1H-indol-4-yl undecanoate
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl undecanoate
2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl undecanoate
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl undecanoate
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl undecanoate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl undecanoate
3-[2-(dimethylamino)ethyl]-1H-indol-4-yl dodecanoate
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl dodecanoate

2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl dodecanoate
2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl dodecanoate
2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl dodecanoate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl dodecanoate
2-(4-methoxy-1H-indol-3-yl)-*N, N*-dimethylethan-1-amine
2-(2-bromo-4-methoxy-1H-indol-3-yl)-*N N*-dimethylethan-1-amine
2-(2-fluoro-4-methoxy-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine
2-(2-chloro-4-methoxy-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine
2-(2-iodo-4-methoxy-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine
2-(4-methoxy-2-trifluoromethyl-1H-indol-3-yl)-*N, N*-dimethylethan-1-amine
1-[3-[2-(dimethylamino)ethyl]-1H-indol-4-yl]ethan-1-one
1-[2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl]ethan-1-one
1-[2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl]ethan-1-one,
1-[2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl]ethan-1-one
1-[2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl]ethan-1-one
1-[3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl]ethan-1-one
3-[2-(dimethylamino)ethyl]-1H-indole-4-carboxylic acid
2-bromo-3-[2-(dimethylamino)ethyl]-1H-indole-4-carboxylic acid
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2-iodo-3-[2-(dimethylamino)ethyl]1H-indole-4 methyl carboxylate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indole-4 methyl carboxylate
3-[2-(dimethylamino)ethyl]1H-indole-4 ethyl carboxylate
2-bromo-3-[2-(dimethylamino)ethyl]1H-indole-4 ethyl carboxylate
2-fluoro-3-[2-(dimethylamino)ethyl]1H-indole-4 ethyl carboxylate
2-chloro-3-[2-(dimethylamino)ethyl]1H-indole-4 ethyl carboxylate
2-iodo-3-[2-(dimethylamino)ethyl]1H-indole-4 ethyl carboxylate

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3-[2-(dimethylamino)ethyl]1H-indole-4 pentyl carboxylate
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2-fluoro-3-[2-(dimethylamino)ethyl]1H-indole-4 pentyl carboxylate
2-chloro-3-[2-(dimethylamino)ethyl]1H-indole-4 pentyl carboxylate
2-iodo-3-[2-(dimethylamino)ethyl]1H-indole-4 pentyl carboxylate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indole-4 pentyl carboxylate
3-[2-(dimethylamino)ethyl]1H-indole-4 hexyl carboxylate
2-bromo-3-[2-(dimethylamino)ethyl]1H-indole-4 hexyl carboxylate
2-fluoro-3-[2-(dimethylamino)ethyl]1H-indole-4 hexyl carboxylate
2-chloro-3-[2-(dimethylamino)ethyl]1H-indole-4 hexyl carboxylate
2-iodo-3-[2-(dimethylamino)ethyl]1H-indole-4 hexyl carboxylate
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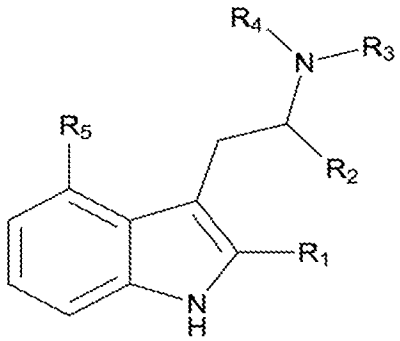
3-[2-(dimethylamino)ethyl]1H-indole-4 octyl carboxylate
2-bromo-3-[2-(dimethylamino)ethyl]1H-indole-4 octyl carboxylate
2-fluoro-3-[2-(dimethylamino)ethyl]1H-indole-4 octyl carboxylate
2-chloro-3-[2-(dimethylamino)ethyl]1H-indole-4 octyl carboxylate
2-iodo-3-[2-(dimethylamino)ethyl]1H-indole-4 octyl carboxylate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indole-4 octyl carboxylate
3-[2-(dimethylamino)ethyl]1H-indole-4 nonyl carboxylate
2-bromo-3-[2-(dimethylamino)ethyl]1H-indole-4 nonyl carboxylate
2-fluoro-3-[2-(dimethylamino)ethyl]1H-indole-4 nonyl carboxylate
2-chloro-3-[2-(dimethylamino)ethyl]1H-indole-4 nonyl carboxylate
2-iodo-3-[2-(dimethylamino)ethyl]1H-indole-4 nonyl carboxylate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indole-4 nonyl carboxylate
3-[2-(dimethylamino)ethyl]1H-indole-4 decyl carboxylate
2-bromo-3-[2-(dimethylamino)ethyl]1H-indole-4 decyl carboxylate
2-fluoro-3-[2-(dimethylamino)ethyl]1H-indole-4 decyl carboxylate
2-chloro-3-[2-(dimethylamino)ethyl]1H-indole-4 decyl carboxylate
2-iodo-3-[2-(dimethylamino)ethyl]1H-indole-4 decyl carboxylate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indole-4 decyl carboxylate
3-[2-(dimethylamino)ethyl]1H-indole-4 undecyl carboxylate
2-bromo-3-[2-(dimethylamino)ethyl]1H-indole-4 undecyl carboxylate
2-fluoro-3-[2-(dimethylamino)ethyl]1H-indole-4 undecyl carboxylate
2-chloro-3-[2-(dimethylamino)ethyl]1H-indole-4 undecyl carboxylate
2-iodo-3-[2-(dimethylamino)ethyl]1H-indole-4 undecyl carboxylate
3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indole-4 undecyl carboxylate
3-[2-(dimethylamino)ethyl]1H-indole-4 dodecyl carboxylate
2-bromo-3-[2-(dimethylamino)ethyl]1H-indole-4 dodecyl carboxylate
2-fluoro-3-[2-(dimethylamino)ethyl]1H-indole-4 dodecyl carboxylate
2-chloro-3-[2-(dimethylamino)ethyl]1H-indole-4 dodecyl carboxylate
2-iodo-3-[2-(dimethylamino)ethyl]1H-indole-4 dodecyl carboxylate

3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indole-4 dodecyl carboxylate
1-[3-[2-(dimethylamino)ethyl]-1H-indol-4-yl]-*N*-methylmethanesulfonamide
1-[2-bromo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl]-*N*-methylmethanesulfonamide
1-[2-fluoro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl]-*N*-methylmethanesulfonamide
1-[2-chloro-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl]-*N*-methylmethanesulfonamide
1-[2-iodo-3-[2-(dimethylamino)ethyl]-1H-indol-4-yl]-*N*-methylmethanesulfonamide
1-[3-[2-(dimethylamino)ethyl]-2-trifluoromethyl-1H-indol-4-yl]-*N*-methylmethanesulfonamide

and any salt forms thereof.

In another aspect of this invention, are the compounds of Structure (2) or pharmaceutically acceptable salts or solvates thereof:

Structure (2)



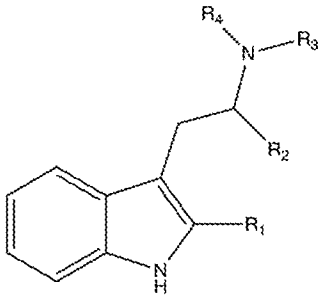
wherein R_1 is selected from the group consisting of H, F, Cl, Br, I, or CF_3 ; R_2 or CH_3 ; R_3 and R_4 are each independently optionally selected from the group consisting of H, CH_3, C_2H_5, $(H_3C)_2CH$, or $H_2C=CH-CH_2$; wherein R_5 is selected from the group consisting of OCH_3, $OCOCH_3$, O-phosphate, O-polyethylene glycol (PEG), $O-(CH_2)_2(COOH)_2$ (succinate), $O-(CH_2)_2(COOH)$

(hemi-succinate), and $CH_2SO_2NHCH_3$ (sulfonamide); wherein when R_1 is H then R_5 is $CH_2SO_2NHCH_3$.

Specific compounds of Structure (2) are 2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl acetate, 2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl acetate, 2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl hydrogen phosphate, 2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl hydrogen phosphate, 2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-ol, 2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-ol, 2-(2-chloro-4-methoxy-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine, 2-(2-bromo-4-methoxy-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine. Other specific compounds of Structure (2) are of particular interest are 1-(2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl)-*N*-methylmethanesulfonamide, 1-(2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl)-*N*-methylmethanesulfonamide, and 1-(3-(2-(dimethylamino)ethyl)-1H-indol-4-yl)-*N*-methylmethanesulfonamide

Another aspect of this invention, are the compounds of Structure (3) or pharmaceutically acceptable salts or solvates thereof:

Structure (3)



wherein R_1 is selected from the group consisting of F, Cl, Br, I, or CF_3; R_2 is CH_3; R_3 and R_4 are each independently optionally selected from the group consisting of H, CH_3, C_2H_5, $(H_3C)_2CH$, or $H_2C{=}CH{-}CH_2$

Specific compounds of Structure (3) are 2-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine, 2-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine, (R)-1-(2-chloro-1H-indol-3-yl)propan-2-amine, (R)-1-(2-chloro-1H-indol-3-yl)-*N*-methylpropan-2-amine, (R)-1-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-chloro-1H-indol-3-yl)propan-2-amine, (S)-1-(2-chloro-1H-indol-3-yl)-*N*-methylpropan-2-amine, (R)-1-(2-bromo-1H-indol-3-yl)propan-2-amine, (R)-1-(2-bromo-1H-indol-3-yl)-*N*-methylpropan-2-amine, (R)-1-(2-bromo-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-bromo-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-bromo-1H-indol-3-yl)propan-2-amine, (S)-1-(2-bromo-1H-indol-3-yl)-*N*-methylpropan-2-amine, 2-(2-chloro-1H-indol-3-yl)-*N,N*-diethylethan-1-amine, N-(2-(2-chloro-1H-indol-3-yl)ethyl)-*N*-isopropylpropan-2-amine, *N*-(2-(2-chloro-1H-indol-3-yl)ethyl)-*N*-vinylethenamine, 2-(2-bromo-1H-indol-3-yl)-*N,N*-diethylethan-1-amine, *N*-(2-(2-bromo-1H-indol-3-yl)ethyl)-*N*-isopropylpropan-2-amine, or *N*-(2-(2-bromo-1H-indol-3-yl)ethyl)-*N*-isopropylpropan-2-amine.

Provided herein are pharmaceutical compositions wherein the compositions are designed to release the active pharmaceutical ingredients as described herein into the bloodstream through the application of the active pharmaceutical ingredient transdermally to the skin and nasal passages. These pharmaceutical compositions are transdermal or nasal pharmaceutical formulations. The active pharmaceutical ingredient may be applied by sprayable liquids, gels, creams, lotions, ointments, transdermal patch and the like.

In one embodiment, the transdermal pharmaceutical and nasal compositions of active pharmaceutical ingredients may be the compounds as described by Structures (1), (2), (3), and the compounds listed in Table (1) and any ionic or salt forms thereof.

In certain embodiments, the psilocybin analogues and combinations hereof, include any compound that is structurally related to psilocybin and functionally mimics and/or antagonizes the action of serotonin. In another embodiment the active pharmaceutical ingredient comprises psilocybin and active analogues and combinations thereof. Active analogues and combinations thereof of psilocybin include but are not limited have the compounds listed in Table (2) Psilocybin Analogues.

Table (2) Psilocybin and Psilocybin Analogs
psilocybin
psilocin
4-hydroxy-indole-3-acetic acid
4-hydroxy-indole-3-acetaldehyde
4-hydroxytryptophol
4-hydroxytryptophan
norpsilocin
aeruginascin
baeocystin
norbaeocystin
4-hydroxy-*N*-methyl-*N*-ethyltryptamine (4-OH-MET)
4-hydroxydiethyltryptamine (4-OH-DET)
4-hydroxy-*N, N*-dipropyltryptamine (4-OH-DPT
4-hydroxy-*N, N*-diisopropyltryptamine (4-OH-DiPT
N, N-dimethyltryptamine (DMT)
Indole-3-acetic acid
N,N-dimethyltryptamine-*N*-oxide (DMT-NO)
lysergic acid diethylamide (LSD)
O-acetylpsilocin (4-AcO-DMT)
5-methoxy-*N, N*-dimethyltryptamine (5-MeO-DMT
ibogaine
bufotenin (5-OH-DMT)

Provided herein is the manufacture of a transdermal or nasal medicament using as the active pharmaceutical ingredient the novel compounds and described by Structure (1), (2), and (3), the novel compounds listed of Table (1), and the psilocybin analogs of Table (2) and salts or solvates thereof for the treatment of neurological, mood, and abuse disorders or disease.

The transdermal and nasal pharmaceutical compositions of the present invention provide a composition as described for use in a medicine to treat, manage or prevent a disease.

In another embodiment, the pharmaceutical compositions are designed for oral delivery into the human systemic circulation with quick onset and duration.

In another embodiment, the pharmaceutical compositions are designed for extended release into the human systemic circulation via oral delivery, preferably providing a once daily dose.

The oral pharmaceutical compositions described herein may be designed for modified time release of the active pharmaceutical ingredients into the human systemic circulation for extended duration. The composition may be comprised of solid, semisolid, liquid, or flexible delivery systems and administered via sublingual, buccal, or oral administration. The active pharmaceutical ingredient may be supplied within a tablet, capsule, softgels, strip, sublingual strip, wafer, solution, suspensions.

In one embodiment, the oral pharmaceutical compositions contain the active pharmaceutical ingredient of the novel compounds and described by Structures (1), (2), (3), the novel compounds of Table (1), and the psilocybin analogs of Table (2) or salts or solvates thereof. Combinations of psilocybin analogs and/or the novel indole compounds as the active pharmaceutical ingredient of pharmaceutical formulations is also part of the present invention.

The present invention provides a composition as described for use in the treatment, management, or prevention of a neurological, mood, or abuse disorders or disease wherein the disorder may be depression, central nervous system inflammation, addiction, headache, or dementia, or disorders of cognition and memory.

The present invention provides for the combination of the topical, nasal, or oral application of the compounds and analogues described herein in combination with active pharmaceutical ingredients that have been approved by regulatory authority for the treatment, management or preventions of neurological, mood and abuse disorders or disease. The approved active pharmaceutical ingredients may be delivered to a patient in need by any delivery system approved by the regulatory authorities. In one aspect of the present invention, the approved active pharmaceutical ingredient for use in combination with the novel indoles or the psilocybin analogues is a MAOI. In another aspect of the present invention the approved active pharmaceutical ingredient is a 5-HT antagonist.

Also provided herein are novel synthesis pathways to provide the novel indole compounds of Structure (1), (2), and (3), and to the novel compounds of Table (1) and the psilocybin analogs of Table (2). The novel synthesis of the described compounds is described in the specific examples and as described herein.

Brief Description of the Drawings

Figure 1 demonstrates the drug release of DMT transdermal patches from Example 1. The results are averaged (n=3) as assessed by Franz cell diffusion model.

Figure 2 demonstrates the diffusion rate of the transdermal formulation by the Franz cell model.

Detailed Description

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art.

As used in the specification and the accompanying claims the indefinite articles “a” and “an” and the definite article “the” include plural as well as singular referents, unless the context clearly dictates otherwise.

The term “about” or approximately” means an acceptable error for a particular value as determined by one of ordinary skill in the art, which depends in part on how the value is measured or determined. In certain embodiments, the term “about” or approximately” means within 1, 2, 3 or 4 standard deviations. In certain embodiments, the term “about” or “approximately” means with 30%, 20%, 15%, 10%, 9%, 8%, 7%,6%, 5%, 4%, 3%, 2%, 1%, 0.5%, 0.1%, or 0.05%, of a given value or range.

As used herein, and unless otherwise specified, the terms “treat,” “treating” and “treatment” refer to the eradication or amelioration of a disease or disorder, or of one or more symptoms associated with the disease or disorder. In certain embodiment the terms refer to minimizing the spread or worsening of the disease or disorder resulting from the administration of one or more prophylactic or therapeutic agents to a subject with such disease or disorder. In some embodiments the terms refer to the administration of a compound or dosage form provided herein, with or without one or more additional active agent(s), after the onset of symptoms of a particular disease.

As used herein, and unless otherwise specified, the term “Abuse Disorder” is a disorder or disease that affects a person's brain and behavior

and leads to an inability to control the use of a legal or illegal drug or medication. Prescription medicines, non-prescription medicines, and non-approved drugs may all be abused drugs. Drugs and medication may also include substances such as amphetamines, opioids, cocaine, barbiturates, alcohol, marijuana, and nicotine.

As used herein, and unless otherwise specified, the term "Mood Disorder" is a group of conditions where a disturbance in the person's mood is the underlying feature. Mood disorders may be groups of mania (elevated mood disorders) or hypomania (depression). The classification is in the Diagnostic and Statistical Manual of Mental Disorders (DSM) and the International Classification of Diseases (ICD).

As used herein, and unless otherwise specified, the term "Neurological Disorder" refers to diseases of the central and peripheral nervous system e.g., the brain, spinal cord, cranial nerves, peripheral nerves, nerve roots, autonomic nervous system, neuromuscular junction, and muscles. These disorders include epilepsy, Alzheimer's disease and other dementias, cerebrovascular diseases including stroke, migraine, cluster headaches and other headache disorders, multiple sclerosis, Parkinson's disease, neuroinfections, brain tumors, traumatic disorders of the nervous system due to head trauma, and traumatic disorders due to traumatic or terrifying experiences (Posttraumatic Stress Disorder e.g. PTSD) and neurological disorders as a result of malnutrition and substance abuse. The substance abused may be any number of addictive substances, especially alcohol and drugs and combinations thereof. Many bacterial (e.g., Mycobacterial tuberculosis, Neisseria meningitides), viral (e.g. Human Immunodeficiency Virus (HIV), Lyme Disease, Enteroviruses, West Nile Virus, Zika), fungal (e.g., Cryptococcus, Aspergillus), and parasitic (e.g., malaria, Chagas) infections can affect the nervous system. Neurological

symptoms may occur due to the infection itself, or due to an immune response.

As used herein, and unless otherwise specified, the terms "prevent," "preventing" and "prevention" refer to the prevention of the onset, recurrence or spread of a disease or disorder or of one or more symptoms thereof. In certain embodiments, the terms refer to the treatment with or administration of a compounder dosage form provided herein, with or without one or more other additional active agent(s), prior to the onset of symptoms, particularly to a subject at risk of diseases or disorders provided herein. The terms encompass the inhibition or reduction of a symptom of the particular disease. Subjects with familial history of a disease in particular are candidates for preventive regimes in certain embodiments. In addition, subjects who have a history of recurring symptoms are also potential candidates for prevention. In this regard, the term "prevention" may be interchangeably used with the term "prophylactic treatment."

As used herein, and unless otherwise specified, the terms "manage," "managing" and "management" refer to preventing or slowing the progression, spread or worsening of a disease or disorder, or of one or more symptoms thereof. Often, the beneficial effects that a subject derives from a prophylactic and/or therapeutic agent do not result in a cure of the disease or disorder. In this regard, the term "managing" encompasses treating a subject who had suffered from the particular disease in an attempt to prevent or minimize the recurrence of the disease.

As used herein, amelioration of the symptoms of a particular disorder by administration of a particular pharmaceutical composition refers to any lessening, whether permanent or temporary, lasting or transient, that can be attributed to or associated with administration of the composition.

As used herein, and unless otherwise specified, a "prophylactically effective amount" of a compound is an amount sufficient to prevent a disease or disorder or prevent its recurrence. A prophylactically effective amount of a compound means an amount of therapeutic agent, alone or in combination with one or more other agent(s), that provides a prophylactic benefit in the prevention of the disease. The term "prophylactically effective amount" can encompass an amount that improves overall prophylaxis or enhances the prophylactic efficacy of another prophylactic agent.

As used herein, and unless otherwise specified, the terms "therapeutically effective amount" and "effective amount" of a compound mean an amount sufficient to provide a therapeutic benefit in the treatment or management of a disease or disorder, or to delay or minimize one or more symptoms associated with the disease or disorder. A "therapeutically effective amount" and "effective amount" of a compound mean an amount of a therapeutic agent, alone or in combination with one or more other agent(s), that provides a therapeutic benefit in the treatment or management of the disease or disorder. The terms "therapeutically effective amount" and "effective amount" can encompass an amount that improves overall therapy, reduces or avoids symptoms or causes of disease or disorder, or enhances the therapeutic efficacy of another therapeutic agent.

As used herein the term, and unless otherwise specified, an "Active Pharmaceutical Ingredient (API)" is any substance or mixture of substances intended to be used in the manufacture of a drug (medicinal) product and that, when used in the production of a drug, becomes an active ingredient of the drug product. Such substances are intended to affect the diagnosis, cure, mitigation, treatment, or prevention of disease or to affect the structure or function of the body.

As used herein, and unless otherwise specified, the term "Drug Product" is a finished dosage form, for example, an oral, nasal or transdermal formulation, that contains an active pharmaceutical ingredient, generally, but not necessarily in association with inactive ingredients.

The terms "composition," "formulation," and "dosage form," as used herein are intended to encompass compositions comprising the specified ingredient(s) (in the specified amounts, if indicated), as well as any product(s) that result, directly or indirectly, from combination of the specified ingredient(s) in the specified amount(s). By "pharmaceutical" or "pharmaceutically acceptable" it is meant that any diluent(s), excipient(s), absorption enhancer(s), or carrier(s) in the composition, formulation, or dosage form are compatible with the other ingredient(s) and not deleterious to the recipient thereof. Unless indicated otherwise, the terms "composition," "formulation," and "dosage form" are used herein interchangeably.

As used herein, the term "transdermal" relates to, being, or supplying a medication in a form for absorption through the skin into the bloodstream.

As used herein, the term "nasal" relates to, being or supplying a medication in a form for absorption through the nasal mucosa. Nasal delivery may be affected through a wide range of dosage forms including but not limited to solutions, gels, suspensions, emulsions, liposomes and microparticles.

As used herein "oral" relates to a medication in a form for absorption through the oral mucosal, sublingual, buccal, esophageal, gastric, or intestinal membranes. The term "capsule" refers to an oral composition in which the API and inactive ingredients are contained as a solid, liquid or semisolid within an outer shell comprised of gelatin, polymerized cellulose,

or other suitable material. A capsule is intended to be swallowed wherein the composition will dissolve and release the API for systemic absorption through the esophageal, gastric, or intestinal lining.

The terms “tablet” and “wafer” includes spherical, round, oval, triangular, diamond, bullet, or oblong shaped oral compositions which contain the API, inactive ingredients, and optionally a saliva stimulant, which are formed with direct compression of a powdered formulation. Upon entry into the mouth, the compositions will dissolve and release the API for systemic absorption through the buccal, sublingual, esophageal, gastric, or intestinal lining.

The terms “strip” or “oral strip” includes square, rectangular, triangular, rounded, circular or oblong shaped oral compositions that contain the API, inactive ingredients, and optionally a saliva stimulant, that form a pliable matrix. Upon entry into the mouth, commonly placed under the tongue, the composition will dissolve and release the API for systemic absorption through the buccal, sublingual, esophageal, gastric, or intestinal lining.

As used herein “immediate release” is defined as the formulation of an active pharmaceutical ingredient(s) drug taken orally, nasally or transdermally that results in the rapid absorption of the drug into the blood after administration. Immediate release may be measured in vitro using the FDA Industry guidance on dissolution and/or permeability testing, or in vivo using blood plasma levels.

As used herein, “modified release” or “extended release” is defined as a formulation of an active pharmaceutical ingredient(s) taken orally, nasally or transdermally that releases the active pharmaceutical ingredients over several hours or days, to maintain a relatively constant plasma concentration of the drug. Such modifications may have a number of objectives, such as maintaining therapeutic activity for an extended time,

reducing toxic effects, protecting the active substance against degradation due to low pH, targeting the active substance to a predefined segment of the gastrointestinal tract for local treatment or targeting active substance release at specified time-points. Modified release is measured by the appropriate FDA industry guidelines on modified release formulations.

The term "subject" is defined herein to include animals such as mammals, including, but not limited to, primates (e.g., humans), cows, sheep, goats, horses, dogs, cats, rabbits, rats, mice and the like. In specific embodiments, the subject is a human.

The terms "co-administration," "in combination with" and "in combination" include the administration of two or more therapeutic agents either simultaneously, concurrently or sequentially within no specific time limits. In one embodiment, the agents are present in the cell or in the subject's body at the same time or exert their biological or therapeutic effect at the same time. In one embodiment, the therapeutic agents are in the same composition or unit dosage form. In other embodiments, the therapeutic agents are in separate compositions or unit dosage forms. In certain embodiments, a first agent can be administered prior to (e.g., 5 minutes, 15 minutes, 30 minutes, 45 minutes, 1 hour, 2 hours, 4 hours, 6 hours, 12 hours, 24 hours, 48 hours, 72 hours, 96 hours, 1 week, 2 weeks, 3 weeks, or 4 weeks before), concomitantly with, or subsequent to (e.g., 5 minutes, 15 minutes, 30 minutes, 45 minutes, 1 hour, 2 hours, 4 hours, 6 hours, 12 hours, 24 hours, 48 hours, 72 hours, 96 hours, 1 week, 2 weeks, 3 weeks, 4 weeks, 5 weeks, 6 weeks, 8 weeks, or 12 weeks after) the administration of a second therapeutic agent.

The term "psilocybin analogue" is defined herein to include any compound that is structurally related to psilocybin and functionally mimics and/or antagonizes the action of serotonin. Certain embodiments herein provide salts, cocrystals, solvates, isomers, hydrates, ions, zwitterions,

complexes, prodrugs, precursors, metabolites, and/or other derivatives of the psilocybin. Certain embodiments herein provide mixtures of two or more of the psilocybin analogues provided herein. As described herein the psilocybin analogues are selected from the group consisting of the compounds as listed in Table (2) and salts and solvates thereof. Certain embodiments herein provide mixtures of two or more of the psilocybin analogues provided herein.

The psilocybin analogues described herein may be synthesized using any method known to one of ordinary skill in the art. Certain of the compounds are known to be able to be provided by application of biological processes to manufactured goods; the compounds are bioengineered.

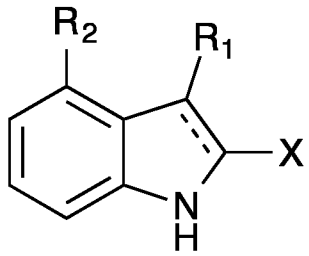
The psilocybin analogues described herein may be provided by the alcohol or acid-base extraction of the psychoactive compounds from natural source that contain the compounds. The extraction methods are well known to those of skill in the art.

In certain embodiments the inventive formulation uses psilocybin and psilocybin analogues and combinations thereof, that may be derived synthetically or bioengineered; or extracted from naturally occurring mushrooms. Some of the manufacturing processes may be novel, as described herein, others may use techniques that have been well described in the art.

Provided herein are dosage forms, pharmaceutical formulations and compositions comprising an active pharmaceutical ingredient that is either (a) a novel indole of Structure (1), Structure (2), Structure (3), or (b) or a psilocybin analog. The dosage forms, pharmaceutical formulations and compositions release the active pharmaceutical ingredients into the bloodstream upon transdermal, nasal, or oral administration. In certain

embodiments, the psilocybin analog is psilocin. In certain embodiments, the psilocybin analogue is 4-hydroxytryptophan. In certain embodiments, the psilocybin analogue is 4-hydroxytryptophol. In certain embodiments, the psilocybin analogue is 4-hydroxy-indole-3-acetaldehyde. In certain embodiments, the psilocybin analogue is 4-hydroxy-indole-3-acetic acid. In certain embodiments, the psilocybin analogue is norpsilocin. In certain embodiments, the psilocybin analogue is aeruginascin. In certain embodiments, the psilocybin analogue is baeocystin. In certain embodiment, the psilocybin analogue is norbaeocystin. In certain embodiments, the psilocybin analogue is 4-hydroxy-*N*-methyl-*N*-ethyltryptamine (4-OH-MET). In certain embodiment, the psilocybin analogue is 4-hydroxydiethyltryptamine (4-OH-DET). In certain embodiment, the psilocybin analogue is 4-hydroxy-*N N*-dipropyltryptamine (4-OH-DPT). In certain embodiments, the psilocybin analogue is 4-hydroxy-*N,N*-diisopropyltryptamine (4-OH-DiPT). In certain embodiments, the psilocybin analogue is *N,N*-dimethyltryptamine (DMT). In certain embodiments, the psilocybin analogue is indole-3-acetic acid. In certain embodiments, the psilocybin analogue is *N,N*-dimethyltryptamine-N-oxide (DMT-NO). In certain embodiments, the psilocybin analogue is lysergic acid diethylamide (LSD). In certain embodiments, the psilocybin analogue is O-acetylpsilocin (4-AcO-DMT). In certain embodiments, the psilocybin analogue is 5-methoxy-*N,N*-dimethyltryptamine (5-MeO-DMT). In certain embodiments, the psilocybin analogue is bufotenin (5-OH-DMT). In certain embodiments, the psilocybin analogue is ibogaine.

In certain embodiments, exemplary compounds have the structure as shown in Structure (1):



wherein:

X is H, CF_3, or a halogen that is selected from the group consisting of F, Cl, Br, I, or astatine; R_1 comprises an aliphatic substituent with a primary, secondary, tertiary, or quaternary amine; R_2 is hydrogen, hydroxyl, ester, ethers, aldehydes, acids, amides, thiols, sulfones, sulfonamides or combinations thereof.

In certain embodiments, the psilocybin analogues and combinations thereof, provided herein include any compound that is structurally related to psilocybin and functionally mimics and/or antagonizes the action of serotonin.

In certain embodiments, exemplary psilocybin analogues and combinations thereof, are the compounds provided in Table (2):

In certain embodiments, the pharmaceutical formulations and compositions comprising an active pharmaceutical ingredient that is either (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof, can be used in combination with other active agents.

In certain embodiments, the pharmaceutical formulations comprise MAOIs. MAOIs are drugs in a family of enzymes that catalyze the oxidation of monoamines, and certain psilocybin analogues and combinations thereof are known to be enzymatically degraded by MAOIs. The MAOIs, include but are not limited to harmala alkaloids, harmine, harmane, harmaline,

hydrazine, iproniazid, isocarboxazid, nialamide, phenelzine, hydracarbazine, tranylcypromine, bifemelane, moclobemide, pirlindole, toloxatone, rasagiline, selegiline, safinamide, and other reversible inhibitors of monoamine oxidase A (RIMAs).

Certain embodiments herein encompass pharmaceutical formulations and compositions comprising an active pharmaceutical ingredient that is either (a) an indole of Structure (1) or (b) psilocybin analogues and combinations thereof, and optionally a monoamine oxidase inhibitor (also known as MAO inhibitors or MAOIs), wherein the formulations and compositions are prepared for transdermal administration.

Certain embodiments herein encompass pharmaceutical formulations and compositions comprising an active pharmaceutical ingredient that is either (a)an indole of Structure (1), Structure (2) or Structure (3), or (b) psilocybin analogues and combinations thereof, and optionally a monoamine oxidase inhibitor (also known as MAO inhibitors or MAOIs), wherein the formulations and compositions are prepared for oral administration. In certain embodiments, 5-HT antagonists can be used as an allosteric modulator or to improve therapeutic benefit of the psilocybin analogues. It is known that certain 5-HT antagonists can reduce pyschoactivity induced by the psilocybin analogues, which can be beneficial for treatment or to reduce side effects. Certain 5-HT antagonists include but are not limited to: ketanserin, clozapine, olanzapine, quetiapine, risperidone, asenapine, cyproheptadine, trazadone, mirtazapine, nefazodone, niaprazine, pizotifen, metergoline, or 2-bromo-LSD (BOL-148).

In certain embodiments, the pharmaceutical formulations and compositions comprising the active pharmaceutical ingredient of (a) an indole of Structure (1), Structure (2) or Structure (3), or (b) psilocybin

analogues and combinations thereof are used for treating neurological, mood and abuse disorders. These formulations and compositions may be prepared for transdermal administration.

In certain embodiments, the pharmaceutical formulations and compositions comprising the active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof are used for treating neurological, mood and abuse disorders. These formulations and compositions may be prepared for nasal administration.

In certain embodiments, the pharmaceutical formulations and compositions comprising the active pharmaceutical ingredient of ((a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof are used for treating neurological, mood and abuse disorders. These formulations and compositions may be prepared for oral administration. Particular embodiments relate to the use an active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1) (c) psilocybin analogues, or (d) Table (2) and combinations thereof, for the preparation of pharmaceutical formulations and compositions for treating particular medical indications, as provided herein. The pharmaceutical formulations and compositions are intended for the transdermal delivery of the active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof, in subjects in need thereof. Transdermal formulations can be manufactured in the form of sprayable liquids, gels, creams, lotions, ointments, and transdermal patches and are applied topically to the desired area.

Particular embodiments relate to the use an active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof, for the preparation of pharmaceutical formulations and compositions for treating particular medical indications, as provided herein. The pharmaceutical formulations and compositions are intended for the oral delivery of the active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof, in subjects in need thereof. Oral formulations can be manufactured in the form of tablets, capsules, softgels, strips, oral patch's and are intended for oral delivery to patient in need of therapy.

In certain embodiments the pharmaceutical formulations may be formulated for immediate release of the API. In certain embodiments the immediate release formulations are transdermal or nasal compositions

In certain embodiments the pharmaceutical formulations may be formulated for immediate release of the API. In certain embodiments the immediate release formulations are oral compositions.

In certain embodiments the pharmaceutical formulations may be formulated for modified release of the API. In certain embodiments the immediate release formulations are transdermal compositions.

In certain embodiments the pharmaceutical formulations may be formulated for modified release of the API. In certain embodiments the immediate release formulations are oral compositions.

In certain embodiments, the transdermal composition comprises a transdermal patch or nasal formulation that delivers the active pharmaceutical ingredient across the skin or mucosal membrane into the

bloodstream. In certain embodiments, the embodiments herein encompass the use of an active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof, for the preparation of a pharmaceutical composition for treating neurological, mood and abuse disorders, wherein the composition is prepared for transdermal or nasal administration.

In certain embodiments, the formulations of an active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof, effect an immediate release of the active pharmaceutical ingredient into the plasma upon transdermal, nasal or oral administration. In particular embodiments, the formulations comprising an active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof, comprise a therapeutically or prophylactically effective amount of the active pharmaceutical ingredient, and, optionally, one or more excipients.

In certain embodiments of the inventive transdermal, nasal, or oral formulation use psilocybin and psilocybin analogues and combinations thereof, that may be derived synthetically or bioengineered; or extracted from naturally occurring mushrooms that have been well described in the art.

In certain embodiments of the inventive transdermal, nasal or oral formulation use psilocybin and psilocybin analogues and combinations thereof, that may be derived synthetically or bioengineered; or extracted from naturally occurring mushrooms using novel chemical synthesis or extraction techniques as described herein.

In certain embodiments the transdermal pharmaceutical dosage composition is in the form of sprayable liquids, gels, creams, lotions, ointments and transdermal patches, wherein the active pharmaceutical ingredient is infused with inactive ingredients that enhance the delivery properties of the composition and stabilize the active pharmaceutical ingredient. In one embodiment, penetration enhancers may be an inactive ingredient. The penetration enhancers may include fatty acids and oils that may be, but are not limited to: castor oil, coconut oil, medium chain triglycerides (MCT), jojoba oil, sunflower oil, argan oil, almond oil, olive oil, mineral oil, petroleum jelly, cocoa butter, shea butter, or other esters, triglycerides, or functional derivatives thereof.

In certain embodiments, the surfactants may be used in the transdermal delivery system as emulsifiers and stabilizers can encapsulate drugs for better stability and permeability properties. Surfactants include but are not limited to: polysorbates (e.g. Tween, polysorbate 20), sorbitans (Span), phospholipids (lecithin), lauryl sulfates, betaines, propionates, fatty alcohols and alkanolamides, fatty acid esters, amine oxides, myristates, and azones.

In certain embodiments, co-solvents may be used in the transdermal formulation to improve drug solubility and permeability, while acting as a humectant for better skin feel. Common co-solvents include but are not limited to: alcohols such as ethanol, isopropanol, glycerin, propylene glycol, dipropylene glycol, polyethylene glycol, diethylene monoethyl ether, Cremophores, siloxanes, polyethylenes, and water.

In certain embodiments, thickeners may be used in the transdermal formulation to reduce separation and provide a suitable matrix for modified delivery. Common thickeners include but are not limited to: acrylates, carbomers, cellulose matrices, silicones, carrageenans, gums, resins, polysaccharides, and high melting point waxes and oils such as

beeswax, coconut oil, palm oil, soybean oil, stearic acid, rapeseed, cocoa butter, shea butter, gums, rosins, resins, paraffins, and petroleum jelly.

In certain embodiments, tackifiers may be used in the transdermal formulation to increase adhesion for extended wearability. Common tackifiers include but are not limited to gums, resins (natural or modified), carbomers, or other natural or synthetic polymers.

In certain embodiments, preservatives may be used in the transdermal formulation to improve formulation stability and retard microbial growth. Common preservatives include but are not limited to: parabens, sorbates, benzoates, silicas, chlorides, phenols, chlorhexidine, citric acid, triclosan, Vitamin E (or tocopherols), chelators, metals, salts, and alcohols. Lastly the formulation is typically emulsified with a hydrophilic ingredient such as water, or *Aloe barbadensis* juice.

In certain embodiments, the formulations comprising an active pharmaceutical ingredient of (a) an indole of Structure (1) or (b) psilocybin analogues and combinations thereof effect a controlled release of the active pharmaceutical ingredient transdermally upon administration. In certain embodiments, the formulations comprising the active pharmaceutical ingredient, comprise a therapeutically or prophylactically effective amount of the active pharmaceutical ingredient(s) and a drug release controlling component that is capable of controlled and sustained release of the active pharmaceutical ingredients directly into the bloodstream.

In certain embodiments, the transdermal dosage form is a transdermal delivery device. Any device conventional in the art for transdermally delivering a therapeutic agent to a patient can be used for the transdermal delivery of the compositions of the invention and as the transdermal delivery device. For example, the transdermal delivery device

can be a reservoir-type transdermal delivery device, a polymer-matrix type transdermal delivery device, or a drug-in-adhesive type transdermal delivery device or a multilaminate type transdermal delivery device. The transdermal delivery device is designed so that when contacted with the patient's skin, the active pharmaceutical ingredient of the present invention is delivered in a therapeutically effective amount

In certain embodiments, the transdermal delivery device is of the drug-in-adhesive type device comprising the active pharmaceutical ingredient dispersed directly in a pressure-sensitive adhesive matrix. The adhesive matrix is preferably supported on the topside with an impermeable backing film and on the side that faces the skin with an impermeable release liner. To administer the active pharmaceutical ingredient, the release liner is removed to expose the adhesive matrix, and the device is contacted with the skin. The adhesive matrix functions to adhere the device to the skin and, typically, to control the delivery rate of the active pharmaceutical ingredient. Similar to the polymer-matrix design, the drug-in-adhesive design allows the active pharmaceutical ingredient to diffuse out of the adhesive matrix, contact the patient's skin, and penetrate the skin. The delivery rate of the active pharmaceutical ingredient is usually determined by the rate of diffusion of the active pharmaceutical ingredient(s) out of the adhesive matrix. Multiple drug-in-adhesive layers can be laminated together between rate-controlling membranes for longer, extended delivery. The delivery rate is such that effective amount of the active pharmaceutical ingredient is delivered to the patient in need of the active pharmaceutical ingredient.

In certain embodiments, a reservoir-type transdermal delivery device preferably comprises a reservoir, usually a liquid, or semisolid located between an impermeable backing film and a rate-controlling membrane that is covered with a pressure-sensitive adhesive skin-contacting layer. The

reservoir, which may be a solution or a dispersion, contains the composition of the invention. The transdermal delivery device is preferably supported by the impermeable backing film and the adhesive surface is protected by a release liner. To administer the active pharmaceutical ingredient of the present invention, the release liner is removed to expose the pressure-sensitive adhesive and the pressure-sensitive adhesive is contacted with the skin. The active pharmaceutical ingredient of the present invention is permeable through the rate-controlling membrane, and penetrates through it and the adhesive, contacts the skin, and then penetrates the skin. The delivery rate of the active pharmaceutical invention is usually determined by the rate that the active pharmaceutical ingredient penetrates the rate-controlling membrane.

In certain embodiments, the transdermal delivery device is of the polymer-matrix design. In the polymer-matrix design, the psilocybin analog and combinations thereof, are dispersed in a polymer matrix that controls the delivery rate of the active pharmaceutical ingredient. Preferably the polymer-matrix reservoir is supported on an impermeable backing layer. An adhesive layer is attached to the surface of the polymer matrix. To administer the active pharmaceutical ingredients the release liner is removed to expose the polymer matrix and the ring of pressure-sensitive adhesive, and the device is contacted with the skin. The adhesive holds the device against the skin so that the polymer matrix directly contacts the skin. When the polymer matrix is contacted with the skin, the active pharmaceutical ingredient(s) diffuse out of the polymer matrix, contacts the patient's skin, and penetrates the skin. The delivery rate of the active pharmaceutical ingredients is usually determined by the rate of diffusion active pharmaceutical ingredient out of the polymer matrix.

Adhesives comprise cross-linking monomeric units or sites can be incorporated into the adhesive polymers. For example, cross-linking

monomers can be incorporated into polyacrylate polymers. The cross-linking monomers may, for example, provide sites for cross-linking the polymer matrix after dispersing the psilocybin analog and combinations thereof, into the polymer. Known adhesives comprise cross-linking monomers for polyacrylate polymers include, for example, polymethacrylic esters of polyols such as butylene diacrylate, butylene dimethacrylate and trimethylol propane trimethacrylate, polyisobutylene type adhesives and silicone. Other monomers that provide cross-linking sites include allyl acrylate, allyl methacrylate, diallyl maleate, silyl ethers, and silanes. Monomers are then polymerized using methods known by those skilled in the art to comprise polyacrylate (acrylics), polysiloxane (silicones), or polyisobutylene (or other rubber) adhesive matrices containing cross-linkers, functional groups, or vinyl acetate to suspend, stabilize, and release the active pharmaceutical ingredient.

In an embodiment of the present invention, the transdermal delivery device may optionally include one or more penetration enhancers, which increase the rate at which the active pharmaceutical ingredients penetrate through the patient's skin. Preferably, the penetration enhancer penetrates the rate-controlling membrane or diffuses out of the polymer matrix or adhesive matrix so that it can contact the patient's skin and improve penetration of active pharmaceutical ingredient as defined herein through the patient's skin. Suitable penetration enhancers for use in the transdermal delivery devices and compositions of the invention include, for example, C_{2-4} alcohols, e.g., ethanol and isopropanol, polyethylene glycol monolaurate, polyethylene glycol-3-lauramide, dimethyl lauramide, polysorbates, sorbitans, fatty acids, esters of fatty acids having from about 10 to about 20 carbon atoms, monoglycerides or mixtures of monoglycerides of fatty acids having a total monoesters content of at least 51% where the monoesters are those with from 10 to 20 carbon atoms, and mixtures of mono-, di- and tri-glycerides of fatty acids. Suitable fatty

acids include, for example, lauric acid, myristic acid, stearic acid, oleic acid, linoleic acid and palmitic acid. Monoglyceride permeation enhancers include, for instance, glycerol monooleate, glycerol monolaurate, and glycerol monolinoleate. Terpenes and terpenoids are derived from natural isoprene biosynthesis and can also be utilized to disrupt the skin membrane and increase API permeability. Terpenes and terpenoids are derived from natural isoprene biosynthesis and can also be utilized to disrupt the skin membrane and increase API permeability. Examples of terpenes include but are not limited to: menthol, menthone, camphor, nerolidol, limonene, myrcene, anethole, eugenol, 1,8-cineole, terpinolene, pinene, and humulene.In certain embodiments, the transdermal patches as described herein are used co-administered with penetration enhancers. In certain embodiments, the penetration enhancers may include oils that may be, but are not limited to: castor oil, coconut oil, medium chain triglycerides (MCT), jojoba oil, sunflower oil, argan oil, almond oil, olive oil, mineral oil, petroleum jelly, cocoa butter, and shea butter. Other penetration enhancers for use in transdermal patches include, for example, C_{2-4} alcohols, e.g., ethanol and isopropanol, polyethylene glycol monolaurate, polyethylene glycol-3-lauramide, dimethyl lauramide, polysorbates (Tween), sorbitans (Span), fatty acids, esters of fatty acids having from about 10 to about 20 carbon atoms, monoglycerides or mixtures of monoglycerides of fatty acids having a total monoesters content of at least 51% where the monoesters are those with from 10 to 20 carbon atoms, and mixtures of mono-, di- and tri-glycerides of fatty acids. Suitable fatty acids include, for example, lauric acid, myristic acid, stearic acid, oleic acid, linoleic acid and palmitic acid. Monoglyceride permeation enhancers include, for instance, glycerol monooleate, glycerol monolaurate, and glycerol monolinoleate. Terpenes and terpenoids are derived from natural isoprene biosynthesis and can also be utilized to disrupt the skin membrane and increase API permeability. Examples of terpenes include but are not

limited to: menthol, menthone, camphor, nerolidol, limonene, myrcene, anethole, eugenol, 1,8-cineole, terpinolene, pinene, and humulene.

In certain embodiments, the delivery rate of the active pharmaceutical ingredient may be delivered in a once a day transdermal patch application. In certain embodiments, the delivery rate of the API may be delivered over the course of 6-12 hours. In certain embodiments, the delivery rate of the API may be delivered over 12-24 hours. In certain embodiments the delivery rate of the API may be delivered over 24-48 hours. In other embodiments, the transdermal patch may be applied once every 2 days; once every 3 days; once every 4 days; once every 5 days; once every 5 days; or once every 7 days. The transdermal patch delivery rate options will facilitate patient dosing compliance while delivering a steady-state systemic safe and effective drug concentrations.

As described herein, certain embodiments provide transdermal formulations of active pharmaceutical ingredient as described herein, useful in methods relating to differing dosage amounts and/or dosage periods; providing alternative pharmacokinetic profiles, pharmacodynamic profiles, and/or safety profiles; permitting long term maintenance therapies; providing for the testing of new indications for the psilocybin analogues; and other potential advantageous benefits. In particular embodiments, formulations provided herein (e.g. sprayable liquids, gels, creams, lotions, ointments, or transdermal patch for the dermal delivery of the active pharmaceutical ingredient) comprise the active pharmaceutical ingredients ((a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) alone or in combination) in a specific pharmaceutically active amount. In particular embodiments, the specific amount of the active pharmaceutical ingredient as disclosed herein, in the formulation is, e.g. about 1 mg, about 2 mg, about 3 mg, about 4 mg, about 5 mg, about 6 mg, about 7 mg, about

8 mg, least about 9 mg, about 10 mg, about 11 mg, about 12 mg, about 13 mg, about 14 mg, about 15 mg, about 16 mg, about 17 mg, about 18 mg, about 19 mg, about 20 mg, about 21 mg, about 22 mg about 23 mg, about 24 mg, about 25 mg, about 26 mg, about 27 mg, about 28 mg, about 29 mg, about 30 mg, about 31 mg about 32 mg, about 33 mg, about 34 mg, about 35 mg about 36 mg, about 37 mg, about 38 mg, about 39, about 40 mg, about 45 mg, about 50 mg, about 55 mg, about 60 mg, about 65 mg, about 70 mg, about 75 mg, about 80 mg, about 85 mg, about 90 mg, about 95 mg, or at least 100 mg. In particular embodiments, the specific amount of the psilocybin analogue in the formulation is, e.g., at least about 1 mg, at least about 2 mg, at least about 3 mg, at least about 4 mg, at least about 5 mg, at least about 6 mg, at least about 7 mg, at least about 8 mg, at least about 9 mg, at least about 10 mg, at least about 11 mg, at least about 12 mg, at least about 13 mg, at least about 14 mg, at least about 15 mg, at least about 16 mg, at least about 17 mg, at least about 18 mg, at least about 19 mg, at least about 20 mg, at least about 21 mg, at least about 22 mg, at least about 23 mg, at least about 24 mg, at least about 25 mg, at least about 26 mg, at least about 27 mg, at least about 28 mg, at least about 29 mg, at least about 30 mg, at least about 31 mg, at least about 32 mg, at least about 33 mg, at least about 34 mg, at least about 35 mg, at least about 36 mg, at least about 37 mg, at least about 38 mg, at least about 39 mg, at least 40 mg, at least 45 mg, at least 50 mg, at least about 55 mg, at least about 60 mg, at least about 65 mg, at least about 70 mg, at least about 75 mg, at least about 80 mg, at least about 85 mg, at least about 90 mg, at least about 95 mg, or at least 100 mg.

In more particular embodiments, the specific amount of the active pharmaceutical ingredient as disclosed herein, in the formulation is, e.g. about 5 mg, about 6 mg, about 7 mg, about 8 mg, about 9 mg, about 10 mg, about 11 mg, about 12 mg, about 13 mg, about 14 mg, about 15 mg, about 16 mg, about 17 mg, about 18 mg, about 19 mg, about 20 mg, about

21 mg, about 22 mg about 23 mg, about 24 mg, about 25 mg, about 30 mg, about 35 mg, about 40 mg, about 45 mg, about 50 mg, about 55 mg about 60 mg, about 65 mg, about 70 mg, about 75 mg about 80 mg, about 85 mg, about 90 mg, or at least 100 mg.

In more particular embodiments, the specific amount of the active pharmaceutical ingredient in the formulation is, e.g., at least about 5 mg, at least about 6 mg, at least about 7 mg, at least about 8 mg, at least about 9 mg, at least about 10 mg, at least about 11 mg, at least about 12 mg, at least about 13 mg, at least about 14 mg, at least about 15 mg, at least about 16 mg, at least about 17 mg, at least about 18 mg, at least about 19 mg, at least about 20 mg, at least about 21 mg, at least about 22 mg, at least about 23 mg, at least about 24 mg, at least about 25 mg, at least about 30 mg, at least about 35 mg, at least about 40 mg, at least about 45 mg, at least about 50 mg, at least about 55 mg, at least about 60 mg, at least about 65 mg, at least about 70 mg, at least about 75 mg, at least about 80 mg, at least about 85 mg, at least about 90 mg, at least about 95 mg, or at least 100 mg.

In a particular embodiment the active pharmaceutical ingredient in the pharmaceutical formulation is from about 5 mg to 100mg, or from about 5 mg to 25 mg, or from about 25 mg to 50 mg, or from about 50 mg to 75 mg, or from about 75 mg to 100 mg.

As described herein, certain embodiments provide transdermal formulations of active pharmaceutical ingredient as described herein, relating to the skin application size for transdermal delivery devices. Application area is a crucial metric for determining drug fluxes, to differ dosage, and to provide sufficient area for efficient transdermal delivery. In particular embodiments the API (compounds of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) (alone or in combination) is contained

within a drug delivery device (e.g. sprayable liquids, gels, creams, lotions, ointments, or transdermal patch) and is applied to the skin of a human or mammal in an area of not more than 1 cm, or at least 2 cm^2, at least 3 cm^2, at least 4 cm^2, at least 5 cm^2, at least 6 cm^2, at least 7 cm^2, at least 8 cm^2, at least 9 cm^2, at least 10 cm^2, at least 15 cm^2, at least 20 cm^2, at least 25 cm^2, at least 30 cm^2, at least 35 cm^2, at least 40 cm^2, at least 45 cm^2, at least 50 cm^2, at least 60 cm^2, at least 70 cm^2, at least 80 cm^2, at least 90 cm^2,or at least 100 cm^2 at least 150 cm^2, at least 200 cm^2, at least 250 cm^2, at least 300 cm^2, at least 350 cm^2, at least 400 cm^2, at least 450 cm^2, at least 500 cm^2, at least 600 cm^2, at least 700 cm^2, at least 800 cm^2, at least 900 cm^2, or at least 1000 cm^2.

In particular embodiments the API alone or in combination, is contained within a drug delivery device (e.g. sprayable liquids, gels, creams, lotions, ointments, or transdermal patch) and is applied to the skin of a human or mammal in an area of not more than 1 cm, or at least 2 cm^2, at least 3 cm^2, at least 4 cm^2, at least 5 cm^2, at least 6 cm^2, at least 7 cm^2, at least 8 cm^2, at least 9 cm^2, at least 10 cm^2, at least 15 cm^2, at least 20 cm^2, at least 25 cm^2, at least 30 cm^2, at least 35 cm^2, at least 40 cm^2, at least 45 cm^2, at least 50 cm^2, at least 60 cm^2, at least 70 cm^2, at least 80 cm^2, at least 90 cm^2, or at least 100 cm^2.

In an embodiment the API alone or in combination is applied to the skin of a human or mammal in an area from about 1 cm^2 to 10 cm^2, from about 10 cm^2 to 40 cm^2, from about 40 cm^2 to 100 cm^2, or more preferably 5 cm^2 to 40 cm^2

In certain embodiments the active pharmaceutical ingredients are delivered in an oral pharmaceutical formulation composition comprising a capsule or tablet that delivers the API into the bloodstream through the esophageal, gastric, and/or intestinal membranes.

In certain embodiments the oral composition is swallowed and the active pharmaceutical ingredients are further delivered into the bloodstream through the esophageal, gastric, and/or intestinal membranes

In certain embodiments the oral composition comprises a tablet, wafer, or strip that delivers the active pharmaceutical ingredient into the bloodstream through the sublingual, buccal, or other oral mucosal membrane.

In certain embodiments the oral composition comprises an oral patch or oral film that delivers the active pharmaceutical ingredient into the bloodstream through the sublingual, buccal, or other oral mucosal membrane.

In certain embodiments the oral composition is swallowed, and the active pharmaceutical ingredients are further delivered into the bloodstream through the esophageal, gastric, and/or intestinal membranes.

In certain embodiments the oral composition comprises a powder, solution, or suspension that delivers the active pharmaceutical ingredient into the bloodstream through the sublingual, buccal, or other oral mucosal membrane.

In certain embodiments the oral composition is swallowed, and the active pharmaceutical ingredients are further delivered into the bloodstream through the esophageal, gastric, and/or intestinal membranes.

In certain embodiments, the formulations of active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table

(2)and combinations thereof, effect an immediate release of the active pharmaceutical ingredient into the plasma upon oral administration. In particular embodiments, the formulations comprising an active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1) (c) psilocybin analogues, or (d) Table (2) and combinations thereof, comprise a therapeutically or prophylactically effective amount of the active pharmaceutical ingredient, and, optionally, one or more excipients.

In certain embodiments, the formulations of active pharmaceutical ingredient of (a) an indole of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof, effect a modified release of the active pharmaceutical ingredient into the plasma upon oral administration. In particular embodiments, the formulations comprising an active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof, comprise a therapeutically or prophylactically effective amount of the active pharmaceutical ingredient, and, optionally, one or more excipients.

In certain embodiments, the embodiments herein encompass the use of an active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof, for the preparation of a pharmaceutical composition for treating neurological, mood and abuse disorders, wherein the composition is prepared for oral administration.

In certain embodiments, the embodiments herein encompass the use of an active pharmaceutical ingredient of (a) an indole of the genus

compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof, for the preparation of a pharmaceutical composition for treating neurological, mood and abuse disorders, wherein the composition is prepared for oral administration.

In certain embodiments the oral composition contains inactive ingredients that enhance drug delivery properties and stabilize the active ingredient.

In one embodiment fillers may be included as an inactive ingredient. The fillers can act as matrix to affect the dissolution time or act as binders to improve tablet stability. The fillers may include but are not limited to: starch, citric acid, tartaric acid, bicarbonates, phosphates, polyvinyl pyrrolidone, cellulose (natural and modified), croscarmellose, glycolates, acrylates, acetates, gelatin, gums, alginates, pectin, chitosan, chitin, salts, polysaccharides, mucilages, sugars, sucrose, lactose, and dextrose.

In another embodiment, lubricants may be included as an inactive ingredient. The lubricants act to improve powder flowability or reduce friction on manufacturing parts; these may include but are not limited to: magnesium stearate, talc, stearic acid, and silicon dioxide.

In yet another embodiment, flavorings may be included as an inactive ingredient. The flavorings can mask the taste of bitter agents or improve the taste of the oral composition; these include but are not limited to: sugars, dextrose, sucrose, sucralose, stevia, essential oils, citric acid, and natural or artificial flavorings. Optionally, coloring agents can be included in the powders to improve visual properties or to differentiate product offerings; these coloring agents can be natural or artificial dyes, pigments, chelates, or metals.

In certain embodiments the oral composition contains surfactants that are emulsifiers and stabilizers that can encapsulate drugs for better stability, taste, permeability, and drug release properties. Surfactants include but are not limited to vegetable oils, triglycerides, esters, polysorbates (Tween), sorbitans (Span), phospholipids (e.g. lecithin), lauryl sulfates, betaines, propionates, fatty acids, fatty alcohols, saponins and alkanolamides, amine oxides, cyclodextrins, myristates and azones.

In certain embodiments the oral composition contains co-solvents to improve drug solubility, dissolution, and permeability. Co-solvents include but are not limited to: alcohols such as ethanol, isopropanol, glycerin, propylene glycol, dipropylene glycol, polyethylene glycol, diethylene monoethyl ether, Cremophores, siloxanes, polyethylenes, and water.

In certain embodiments the oral composition contains thickeners to reduce dissolution and provide a suitable matrix for delivery. Thickeners include but are not limited to: acrylates, carbomers, cellulose matrices, silicones, carrageenans, polysaccharides, and high melting point waxes and oils such as beeswax, coconut oil, palm oil, soybean oil, stearic acid, rapeseed, cocoa butter, shea butter, gums, rosins, resins, paraffins, and petroleum jelly.

In certain embodiments the oral composition contains preservatives to improve formulation stability and retard microbial growth. Preservatives include but are not limited to: parabens, sorbates, benzoates, silicas, chlorides, phenols, chlorhexidine, citric acid, triclosan, Vitamin E (or tocopherols), chelators, metals, salts, and alcohols.

In certain embodiments the oral composition contains enteric coatings to modify and extend release within the gastrointestinal tract. Enteric coatings include high melting point waxes, fatty acids, sugars, fibers, and polymers and others.

In another embodiment the oral composition contains inactive ingredients that change the physical properties of the drug delivery system such as pH, solubility, dissolution, hydrophobicity, and stability. Many such compounds are known to those of skill in the art.

In certain embodiments the oral composition contains membrane penetration enhancers to increase systemic delivery. Suitable penetration enhancers for use in the oral composition include, for example, C_{2-4} alcohols, e.g. ethanol and isopropanol, polyethylene glycol monolaurate, polyethylene glycol-3-lauramide, dimethyl lauramide, sorbitans (Span), polysorbates (e.g. Tween, polysorbate 20),fatty acids, esters of fatty acids having from about 10 to about 20 carbon atoms, monoglycerides or mixtures of monoglycerides of fatty acids having a total monoesters content of at least 51% where the monoesters are those with from 10 to 20 carbon atoms, and mixtures of mono-, di- and tri-glycerides of fatty acids. Suitable fatty acids include, for example, lauric acid, myristic acid, stearic acid, oleic acid, linoleic acid and palmitic acid. Monoglyceride permeation enhancers include, for instance, glycerol monooleate, glycerol monolaurate, and glycerol monolinoleate. Terpenes and terpenoids are derived from natural isoprene biosynthesis and can also be utilized to disrupt the skin membrane and increase API permeability. Terpenes and terpenoids are derived from natural isoprene biosynthesis and can also be utilized to disrupt the skin membrane and increase API permeability. Examples of terpenes include but are not limited to: menthol, menthone, camphor, nerolidol, limonene, myrcene, anethole, eugenol, 1,8-cineole, terpinolene, pinene, and humulene.

In certain embodiments the active pharmaceutical ingredient of (a) an indole of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof is included in at least one matrix of the oral

composition. In another embodiment active pharmaceutical ingredient of ((a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof is included in at least two matrices of the oral composition. In another embodiment the active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (1) and combinations thereof is included in at least three matrices of the oral composition. In another embodiment the active pharmaceutical ingredient of (a) an indole of (a) an indole of the genus compound of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof is included in at least four matrices of the oral composition. In yet another embodiment the active pharmaceutical ingredient of (a) an indole of the genus compound of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof is included in at least five matrices of the oral composition.

In certain embodiments the active pharmaceutical ingredients are single active ingredients. In a preferred embodiment the compounds of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) are orally administered in a capsule. In a preferred embodiment the compounds of (a) an indole of the genus compound of Structure (1), (2), (3), (b) Table 1, (c) psilocybin analogues, or (d) Table (2) are orally administered in a tablet. In a preferred embodiment the compounds of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) are orally administered in a wafer. In a preferred embodiment the compounds of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) is orally administered in a strip. In a preferred embodiment the compounds of (a) an indole of the genus

compound of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) is orally administered in a transdermal patch. In a preferred embodiment the compound of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) is orally administered in a powder. In a preferred embodiment the compounds of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) is orally administered in a suspension. In a preferred embodiment the compounds of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) is orally administered in a solution.

In another embodiment mixtures of psilocybin analogues are delivered in the same oral composition as described herein. In a preferred embodiment the compounds of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) is orally administered either singularly or in combination with other (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) in an oral composition as described herein.

In certain embodiments the oral composition contains at least 1 mg, at least 2 mg, at least 3 mg, at least 4 mg, at least 5 mg, at least 6 mg, at least 7 mg, at least 8 mg, at least 9 mg, at least 10 mg, at least 15 mg, at least 20 mg, at least 25 mg, at least 30 mg, at least 35 mg, at least 40 mg, at least 45 mg, at least 50 mg, at least 60 mg, at least 70 mg, at least 80 mg, at least 90 mg, at least 100 mg, at least 120 mg, at least 140 mg, at least 160 mg, at least 180 mg, at least 200 mg, at least 250 mg, at least 300 mg, at least 350 mg, at least 400 mg, at least 450 mg, and/or at least 500 mg of the active pharmaceutical ingredient of (a) an indole of the genus

compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof.

In certain embodiments the systemic drug release of the oral composition containing the active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof occurs with therapeutically active onset of not more than 1 minute, not more than 3 minutes, not more than 5 minutes, not more than 7 minutes, not more than 9 minutes, not more than 11 minutes, not more than 13 minutes, not more than 15 minutes, not more than 17 minutes, not more than 19 minutes, not more than 21 minutes, not more than 23 minutes, not more than 25 minutes, not more than 27 minutes, not more than 30 minutes, not more than 45 minutes, not more than 60 minutes, not more than 90 minutes, not more than 120 minutes, not more than 150 minutes, and not more than 180 minutes.

In certain embodiments the duration of the therapeutic or prophylactic effect of the oral composition containing the active pharmaceutical ingredient of (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) and combinations thereof sustains for at least 5 minutes, at least 15 minutes, at least 30 minutes, at least 45 minutes, at least 60 minutes, at least 90 minutes, at least 120 minutes, at least 3 hours, at least 4 hours, at least 5 hours, at least 6 hours, at least 8 hours, at least 10 hours, at least 12 hours, at least 18 hours, at least 1 day, at least 2 days, at least 3 days, at least 4 days, at least 5 days, at least 6 days, and at least 1 week.

As described herein, certain embodiments provide oral compositions of active pharmaceutical ingredient as described herein, useful in methods relating to differing dosage amounts and/or dosage periods; providing alternative pharmacokinetic profiles, pharmacodynamic profiles, and/or

safety profiles; permitting long term maintenance therapies; providing for the testing of new indications for the psilocybin analogues; and other potential advantageous benefits.

Provided herein are methods of preventing, managing, and treating neurological, mood or addictive disorders including post-treatment Lyme disease syndrome, dementias, Alzheimer's disease, post-traumatic stress disorder, anorexia nervosa, depression, anxiety, addiction, substance abuse including but not limited to opioid addiction, alcohol addiction, nicotine addiction, cannabinoid addiction, headache, central nervous system inflammation, dementia, cognition and memory by administering psilocybin analogues transdermally, intranasally, or orally.

In certain embodiment the active pharmaceutical ingredients are single active pharmaceutical ingredients. In a preferred embodiment, the compounds of (a) an indole of the genus compound of the structures of Formula (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2) delivered in a transdermal patch delivery system. In a preferred embodiment, the active pharmaceutical ingredient is transdermally delivered in a transdermal patch delivery system.

In another embodiment, mixtures of psilocybin analogues are delivered in the same transdermal delivery system. In a preferred embodiment the psilocybin analogue is transdermally delivered either singularly or in combination with other psilocybin analogues in a transdermal patch delivery system.

In another embodiment, the active pharmaceutical ingredients thereof are co-administered with one or more therapeutic agent. The co-administered agent may be MAOI. In another embodiment, a compound from another class of neurologically active agents is co-administered providing for a synergistic therapeutic effect is. Other neurologically active

agents include those compounds that fall into the following classes of compounds: antipsychotics, antidepressants, anxiolytics, stimulants, reuptake inhibitors (SSRI or SSNRI), monoamine oxidase inhibitors (MAOI), cognitive-enhancing agents, tricyclic antidepressants, mood stabilizers, NMDA antagonists and 5-HT antagonists.

In yet another embodiment, the (a) an indole of the genus compound of the structures of Structure (1), (2), (3), (b) Table (1), (c) psilocybin analogues, or (d) Table (2), either singularly or in mixtures, are co-administered with one or more therapeutic agents to reduce substance abuse. For the treatment of opioid addiction, other co-administered compounds can include: methadone, buprenorphine, naloxone, naltrexone, and the like. For the treatment of alcoholism, other co-administered compounds can include ethyl alcohol, disulfiram, naltrexone, acamprosate, benzodiazepines, and the like. For the treatment of nicotine addiction, other co-administered compounds can include low dose nicotine, Bupropion, Varenicline and the like.

Provided herein are methods of preventing, managing, treating neurological, mood or addictive disorders including post-treatment Lyme disease syndrome, dementias, Alzheimer's disease, post-traumatic stress disorder, anorexia nervosa, depression, anxiety, addiction, substance abuse including but not limited to opioid addiction, alcohol addiction, nicotine addiction, cannabinoid addiction, headache, central nervous system inflammation, dementia, cognition and memory by administering psilocybin analogues transdermally.

EXAMPLES

Example 1:

Purified *N, N*-dimethyltryptamine (DMT1.8% w/w, wet) was dissolved with a combination of ethyl acetate (7.2% w/w, wet) and ethanol (7.2% w/w, wet) and incorporated into a Duro-Tak 4098 acrylate adhesive (83.8% w/w, wet) and mixed thoroughly. The mixture was formulated to a 150 µm thickness onto the siliconized side of a Scotchpak 9709 release liner. The formulation was dried at 75°C and laminated onto an occlusive Scotchpak 9733 polyester backing before cutting transdermal patches to a size of 10 cm^2. The final transdermal patches were stored within a heat-sealed aluminized pouch to reduce oxidation.

Linear drug release (n= 3 transdermal patches) was observed over 72 hours with over 80% DMT released at 72 hours (Figure 1). Average DMT flux was quantified at 37 ug/cm^2*hr over 72 hours.

Example 2:

Purified DMT (2.0% w/w, wet) was dissolved in ethanol (8.0% w/w, wet) and incorporated into Duro-Tak 4098 adhesive (90.0% w/w, wet) and mixed thoroughly. The mixture was formulated to a 250 µm thickness onto a release liner. The formulation was dried and laminated onto an occlusive backing before cutting transdermal patches to a size of 10 cm^2. The final transdermal patches (6.4% w/w DMT) were stored within a heat-sealed aluminized pouch to reduce oxidation. Average DMT flux was quantified at 43 µg/cm^2*hr over 72 hours

Example 3:

Purified DMT (2.0% w/w, wet) was dissolved in ethanol (8.1% w/w, wet) and incorporated into silicone adhesives Bio PSA 7-4302 (44.9% w/w, wet)

and Bio PSA 7-4202 (44.9% w/w, wet) and mixed thoroughly. The mixture was formulated to a 150 µm thickness onto a release liner. The formulation was dried and laminated onto an occlusive backing before cutting transdermal patches to a size of 10 cm^2. The final transdermal patches (3.9% w/w DMT) were stored within a heat-sealed aluminized pouch to reduce oxidation. Average DMT flux was quantified at 31 µg/cm^2*hr over 48 hours.

Example 4:

Purified DMT (2.0% w/w, wet) was dissolved in ethanol (4.0% w/w, wet) and incorporated into a Duro-Tak 6908 polyisobutylene adhesive (94.0% w/w, wet) and mixed thoroughly. The mixture was formulated to a 150 µm thickness onto a release liner. The formulation was dried and laminated onto an occlusive backing before cutting transdermal patches to a size of 10 cm^2. The final transdermal patches (5.4% w/w DMT) were stored within a heat-sealed aluminized pouch to reduce oxidation. Average DMT flux was quantified at 7 µg /cm^2*hr over 30 hours.

Example 5:

Purified DMT (3.8% w/w, wet) was dissolved in ethanol (15.9% w/w, wet) and incorporated into Duro-Tak 4098 adhesive (80.3% w/w, wet) and mixed thoroughly. The mixture was formulated to a 200 µm thickness onto a release liner. The formulation was dried and laminated onto an occlusive backing before cutting transdermal patches to a size of 10 cm^2. The final transdermal patches (10.9% w/w DMT) were stored within a heat-sealed aluminized pouch to reduce oxidation. Average DMT flux was quantified at 57 µg /cm^2*hr over 48 hours.

Example 6

Purified DMT (4.2% w/w, wet) was dissolved in ethanol (11.2% w/w, wet) and incorporated into a Duro-Tak 4098 acrylate adhesive (77.5% w/w, wet) before isopropyl myristate (7.1% w/w, wet) was added and mixed thoroughly. The mixture was formulated to a 200 µm thickness onto a release liner. The formulation was dried and laminated onto an occlusive backing before cutting transdermal patches to a size of 10 cm^2. The final transdermal patches (10.3% w/w DMT) were stored within a heat-sealed aluminized pouch to reduce oxidation. Average DMT flux was quantified at 145 $\mu g/cm^2$*hr over 48 hours.

Example 7:

Purified 4-acetoxy-*N, N*-dimethyltryptamine (4-AcO-DMT, 3.2% w/w, wet) was dissolved in ethanol (12.4% w/w, wet) and incorporated into a Duro-Tak 4098 acrylate adhesive (84.4 w/w, wet) and mixed thoroughly. The mixture was formulated to a 200 µm thickness onto the siliconized side of a release liner. The formulation was dried and laminated onto an occlusive polyester backing before cutting transdermal patches to a size of 10 cm^2. The final transdermal patches (9.0% w/w 4-AcO-DMT) were stored within a heat-sealed aluminized pouch to reduce oxidation. Average 4-AcO-DMT flux was quantified at 98 $\mu g/cm^2$*hr over 48 hours.

Example 8:

A second DIA with excipients listed above will be cast directly onto the backing and laminated onto a rate-controlling membrane. The DIA-coated liner from Example 1 will then be laminated to the backing/DIA/membrane material to form a multi-layered delivery system. The transdermal patch is then die cut to a suitable size.

The DIA cast on the liner, will then be applied directly on the skin, does not require as high of a drug loading as the second DIA. The second DIA acts as a reservoir and will diffuse drugs through the rate-controlling membrane after manufacture until equilibrium between the first DIA is achieved. Once applied, the second DIA will permeate drug in a zero-order rate through the membrane into the skin until drug reservoir is sufficiently depleted.

Example 9:

N,N-dimethyltryptamine (DMT) freebase was dissolved in 25 mg/mL acetone. 7 mg/mL fumaric acid was added dropwise to precipitate DMT fumarate. The precipitate was washed with fresh acetone twice and dried under nitrogen.

DMT fumarate (18.0% w/w) was dissolved in deionized water (82.0% w/w) to afford a therapeutically effective aqueous gel vehicle for intranasal absorption at a suitable pH = 6. The formulation of DMT fumarate gel can be administered via the nasal cavity in small volumes of between 0.04 and 0.50 mL for therapeutic effects. Potency analysis using tryptamine internal standard quantification revealed DMT freebase concentration of 135.5 mg/mL with no other degradation byproducts after storage for 106 days in dark conditions at room temperature.

Example 10:

A Franz Cell apparatus was used to determine API release and permeability through a human skin mimic (Strat-M membrane, Millipore) and to compare patch effectiveness in Examples 1-8. The receiving well (10% ethanol in water) was kept at 32°C throughout the experiment and all 10 mL were removed per sampling point. Drug flux was determined using the slope of zero-order permeated API over a specified time range. Potency

analysis of API was accomplished using LC-MS while tryptamine (50 µg/mL) was added as an internal standard and used to quantify API with UV detection at 280 nm in Examples 1-9.

Example 11:

Freebase 4-AcO-DMT (8% w/w) was dissolved in ethanol (4% w/w) and further added was povidone (2% w/w), butylated hydroxytoluene (1% w/w), and FD&C Blue No. 1. This solution was added to Ceolus KG 1000 microcrystalline cellulose (16% w/w) and mannitol (47% w/w) with simultaneous mixing and subsequent drying to form a homogenously coated powder. Further added was Prosolv HD 90 silicified microcrystalline cellulose (20% w/w), Cabosil silicon dioxide (1% w/w), and magnesium stearate (1% w/w) and blended to uniformity. Using a die set and sufficient force, a 250 mg tablet was formed for ingestion of 4-AcO-DMT for therapeutic use.

Example 12: 2-(2-chloro-1*H*-indol-3-yl)-*N*,*N*-dimethylethan-1-amine

A mixture of tryptamine hydrochloride salt (1 g, 5.1 mmol) and *N*-chlorosuccinimide (NCS, 0.69 g, 5.2 mmol) in acetic acid (50 mL) and formic acid (15 mL) was stirred for approximately 20 minutes. The product, 2-chloro-tryptamine (verified via 2D NMR spectroscopy), was dried and purified, and 211 mg (1.09 mmol) was further reacted with sodium cyanoborohydride (139.26 mg, 2.22 mmol) in methanol (21 mL) and formaldehyde (0.222 mL, 2.75 mmol) under nitrogen at 0°C and stirred for 2.5 hours. The reaction was quenched with 1.0 M sodium hydroxide (27 mL) and extracted three times with methyl-tert-butyl-ether (MTBE). The residue was dried over sodium sulfate and concentrated down as a light brown oil/solid. Based on the LC-MS, ^{1}H and ^{13}C NMR data, the final product contained majority 2-chloro-*N,N*-dimethyltryptamine. Product Formula $C_{12}H_{15}N_2Cl$ *m/z* 222.0924, $[M+H]^+$ 223.0997

^{1}H NMR (600 MHz, DMSO-d_6) δ ppm 2.13 (s, 6 H) 2.34 - 2.38 (m, 2 H) 2.68 - 2.80 (m, 3 H) 6.91 - 6.99 (m, 1 H) 7.02 (t, *J*=7.54 Hz, 2 H) 7.20 (d, *J*=7.99 Hz, 2 H) 7.40 (d, *J*=7.81 Hz, 1 H) 11.53 (br s, 1 H)

Example 13: 2-(2-bromo-1*H*-indol-3-yl)-*N*,*N*-dimethylethan-1-amine

Previously documented methods were used to synthesize *N,N*-dimethyltryptamine (2.88 mmol) and dissolved in anhydrous acetonitrile (36 mL, 15 mg/mL) under inert conditions. This was combined with copper (II) bromide (1.93 g, 8.65 mmol) and stirred for 2 hours. The reaction was quenched with 40 mL of water and 100 mL EtOAc was added followed by 40 mL of saturated ammonium carbonate. The organic layer was washed and dried over sodium sulfate, filtered and concentrated down to a light brown oil (302.3 mg). The final major product, 2-bromo-*N,N*-dimethyltryptamine, was verified via LC-MS, 1D and 2D NMR spectroscopy. Product formula: $C_{12}H_{15}N_2Br$ *m/z* 266.0419, $[M+H]^+$ 267.0491

^{1}H NMR (600 MHz, DMSO-d_6) δ ppm 2.21 (s, 6 H) 2.38 - 2.47 (m, 2 H) 2.73 - 2.88 (m, 3 H) 6.93 - 7.03 (m, 1 H) 7.03 - 7.11 (m, 1 H) 7.28 (br d, *J*=7.99 Hz, 1 H) 7.46 - 7.51 (m, 1 H) 11.61 (br s, 1 H)

Example 14: 2-bromo-3-(2-(dimethylamino)ethyl)-1*H*-indol-4-yl acetate

Previously documented methods were used to synthesize 4-acetoxy-*N,N*-dimethyltryptamine (14.9 mg, 0.06 mmol) and dissolved in anhydrous acetonitrile (1 mL) under inert conditions. Copper (II) bromide (40.5 mg, 0.18 mmol) was added and the reaction was stirred for 2 hours. Upon work-up, the major product, 2-bromo-4-acetoxy-*N,N*-dimethyltryptamine was verified via LC-MS and 1D NMR spectroscopy. Product formula: $C_{14}H_{17}N_2O_2Br$*m/z* 324.0473, $[M+H]^+$ 325.0546^{1}H NMR (600 MHz, DMSO-d_6) δ ppm 2.21 - 2.25 (m, 13 H) 2.32 - 2.39 (m, 12 H) 2.71 - 2.75 (m, 3 H) 6.74 (d, *J*=7.63 Hz, 1 H) 7.06 - 7.10 (m, 2 H) 7.18 (d, *J*=8.17 Hz, 2 H) 11.91 (s, 1 H)

Example 15*:* 2-(2-chloro-4-methoxy-1*H*-indol-3-yl)-*N*,*N*-dimethylethan-1-amine

Previously documented methods were used to synthesize 4-methoxy-*N*,*N*-dimethyltryptamine (130 mg, 0.6 mmol) and dissolved in anhydrous acetonitrile (3.6 mL) . Copper (II) chloride (241 mg, 1.8 mmol) was added and stirred overnight under inert atmosphere. Quenched with water (14 mL) and extracted three times with EtOAc and washed with saturated ammonium carbonate. The organic layer was dried over sodium sulfate, filtered and concentrated to an orange semi-solid (38.2 mg, 25% yield). This was purified via HPLC to produce 2-chloro-4-methoxy-*N*,*N*-dimethyltryptamine and verified via LC-MS, 1D and 2D NMR spectroscopy.

Product formula: $C_{13}H_{17}N_2OCl$ *m/z* 252.1029, $[M+H]^+$ 253.1102 ^{1}H NMR (600 MHz, DMSO-d_6) δ ppm 2.27 - 2.39 (m, 14 H) 2.50 - 2.60 (m, 6 H) 2.89 - 3.05 (m, 5 H) 3.84 - 3.99 (m, 9 H) 6.54 - 6.66 (m, 2 H) 6.92 (d, *J*=8.17 Hz, 1 H) 7.03 - 7.19 (m, 2 H) 11.71 (s, 1 H)

Example 16: 1-(3-(2-(dimethylamino)ethyl)-1H-indol-4-yl)-N-methylmethanesulfonamide

The nitro group of *N*-methyl-3-nitrobenzenesulfonamide will be reduced via palladium on carbon (H_2/Pd/C) in ethanol solvent and aqueous HCl to the subsequent aniline. This product will be treated with sodium nitrite to give the diazonium salt and subsequently reduced to the hydrazine with $SnCl_2$, all at 0°C. The hydrazone will be generated upon condensation with 4,4-dimethyoxy-*N*,*N*-dimethylbutylamine in aqueous hydrochloric acid. The final product will be produced via the Fischer indole reaction, where the hydrazone will be reacted with polyphosphoric acid in refluxing chloroform to initiate cyclization.

This compound can be further halogenated at the C-2 position following the Copper (II) halide protocols of previous examples.

Example 17: Computational Analysis

Six distinct receptor models were tested depending on the documented crystal structures in the RCSB Protein Data Bank (PDB) for various serotonin receptors and sigma-1. These receptor structures include 5-HT_{2A}, 5-HT_{2B}, 5-HT_{1B}, and σ_1 (PDB ID's also shown in column headings).

For each static protein structure, the PDB files of crystal structures containing bound ligands most chemically similar to the tryptamine scaffold were used for most accuracy where possible (e.g. LSD or ergotamine-bound). The overall workflow was performed using various aspects of the Schrödinger software suite. The 3D SMILES for each ligand was uploaded following literature recommended protonation and/or charge for tryptamines and various conformers were generated and minimized using Schrödinger LigPrep. A final list of compounds were screened with Glide scores being generated by Schrödinger Glide including the structures listed in Table 3. Validation of this technique was done by including known agonists of 5-HT and σ_1 receptors and compared to experimental binding assay data. The docking scores of the known agonists and the experimental data were comparable and within the experimental error for activity. For example, the (+)-LSD enantiomer shows greater activity *in vitro* at the 5-HT_{2A} receptor than the (-)-LSD enantiomer, and our computationally rendered values show the same trend in activity.

Table 3: Virtual Docking Glide Scores of Compounds in Table (1)

Compound	Name	6WGT (5-$HT2_A$)	5TVN (5-$HT2_B$)	4IAR (5-$HT1_B$)	5HK2 (Sigma-1)	5HK1 (Sigma-1)	4IB4 (5-$HT2_B$)
1	2-(2-chloro-1*H*-indol-3-yl)-*N*,*N*-dimethylethan-1-amine	-9.11	-7.09	-6.27	-9.2	-8.04	-8.82

2	2-(2-bromo-1*H*-indol-3-yl)-*N*,*N*-dimethylethan-1-amine	-9.12	-8.85	-7.19	-9.39	-7.4	-8.91
3	2-chloro-3-(2-(dimethylamino)ethyl)-1*H*-indol-4-yl acetate	Z-4.92	-6.39	-5.31	-10.74	-9.08	-8.79
4	2-bromo-3-(2-(dimethylamino)ethyl)-1*H*-indol-4-yl acetate	-10.89	-6.97	-5.89	-10.72	-9.42	-8.9
5	2-chloro-3-(2-(dimethylamino)ethyl)-1*H*-indol-4-yl hydrogen phosphate	-9.28	-3.54	-5.94	-7.5	-10.56	-8.48
6	2-bromo-3-(2-(dimethylamino)ethyl)-1*H*-indol-4-yl hydrogen phosphate	-7.84	-3.4	-5.68	-9.58	-10.17	-8.71
7	2-bromo-3-(2-(dimethylamino)ethyl)-1*H*-indol-4-ol	-8.76	-7.46	-6.73	-8.05	-9.19	-8.53
8	2-chloro-3-(2-(dimethylamino)ethyl)-1*H*-indol-4-ol	-8.74	-6.49	-6.81	-7.68	-8.98	-8.44
9	1-(2-chloro-3-(2-(dimethylamino)ethyl)-1*H*-indol-4-yl)-*N*-methylmethanesulfonamide	-6.72	-6.64	-4.43	-7.69	-10.55	-5.96
10	1-(2-bromo-3-(2-(dimethylamino)ethyl)-1*H*-indol-4-yl)-*N*-methylmethanesulfonamide	-3.85	-6.37	-5.87	-10.83	-10.46	-8.54
11	1-(3-(2-(dimethylamino)ethyl)-1*H*-indol-4-yl)-*N*-methylmethanesulfonamide	-7.53	-7.47	-6.92	-11.54	-10.41	-8.07
12	2-(2-chloro-4-methoxy-1*H*-indol-3-yl)-*N*,*N*-dimethylethan-1-amine	-8.86	-5.81	-6.26	-9.26	-10.95	-8.37

13	2-(2-bromo-4-methoxy-1*H*-indol-3-yl)-*N*,*N*-dimethylethan-1-amine	-8.77	-6.43	-6.24	-8.51	-9.03	-8.49
14	(*R*)-1-(2-chloro-1*H*-indol-3-yl)propan-2-amine	-7.71	-6.36	-6.46	-8.31	-7.89	-8.63
15	(*R*)-1-(2-chloro-1*H*-indol-3-yl)-*N*-methylpropan-2-amine	-8.76	-6.77	-6.31	-8.04	-8.78	-9
16	(*R*)-1-(2-chloro-1*H*-indol-3-yl)-*N*,*N*-dimethylpropan-2-amine	-9.55	-6.15	-6.9	-9.04	-8.23	-8.91
17	(*S*)-1-(2-chloro-1*H*-indol-3-yl)-*N*,*N*-dimethylpropan-2-amine	-9.07	-7.06	-7.48	-9.05	-7.52	-8.69
18	(*S*)-1-(2-chloro-1*H*-indol-3-yl)propan-2-amine	-7.98	-6.52	-7.19	-7.49	-7.69	-8.96
19	(*S*)-1-(2-chloro-1*H*-indol-3-yl)-*N*-methylpropan-2-amine	-8.74	-6.74	-7.2	-9.76	-7.62	-9.28
20	(*R*)-1-(2-bromo-1*H*-indol-3-yl)propan-2-amine	-7.93	-6.58	-6.66	-8.25	-8.06	-8.64
21	(*R*)-1-(2-bromo-1*H*-indol-3-yl)-*N*-methylpropan-2-amine	-10.36	-6.7	-7.31	-8.2	-8.81	-8.99
22	(*R*)-1-(2-bromo-1*H*-indol-3-yl)-*N*,*N*-dimethylpropan-2-amine	-8.75	-6.29	-7.1	-9.02	-7.89	-8.82
23	(*S*)-1-(2-bromo-1*H*-indol-3-yl)-*N*,*N*-dimethylpropan-2-amine	-9.23	-7.13	-7.44	-9.31	-6.66	-8.8
24	(*S*)-1-(2-bromo-1*H*-indol-3-yl)propan-2-amine	-9.27	-6.85	-7.2	-8.27	-8.3	-8.14
25	(*S*)-1-(2-bromo-1*H*-indol-3-yl)-*N*-methylpropan-2-amine	-9.06	-7.01	-7.48	-8.12	-7.7	-9.09
26	2-(2-chloro-1*H*-indol-3-yl)-*N*,*N*-diethylethan-1-amine	-10.49	-7.5	-7.53	-9.91	-8.49	-8.93

27	*N*-(2-(2-chloro-1*H*-indol-3-yl)ethyl)-*N*-isopropylpropan-2-amine	-9.68	-7.61	-6.39	-8.91	-9.5	-9.44
28	*N*-(2-(2-chloro-1*H*-indol-3-yl)ethyl)-*N*-vinylethenamine	-9.46	-6.84	-7.1	-9.33	-8.52	-8.76
29	2-(2-bromo-1*H*-indol-3-yl)-*N*,*N*-diethylethan-1-amine	-9.59	-7.57	-7.63	-8.88	-9.63	-9.5
30	*N*-(2-(2-bromo-1*H*-indol-3-yl)ethyl)-*N*-isopropylpropan-2-amine	-7.42	-7.92	-6.01	-9.25	-9.75	-9.4
31	*N*-(2-(2-bromo-1*H*-indol-3-yl)ethyl)-*N*-vinylethenamine	-9.22	-7.27	-7.75	-9.34	-8.5	-8.98

The present disclosure has been described in connection with certain embodiments and examples; however, unless otherwise indicated, the claimed invention should not be unduly limited to such specific embodiments and examples.

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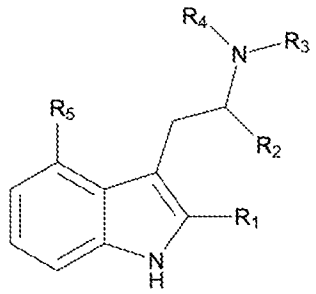
CLAIMS

1. A compound of the formula:

Structure (2)



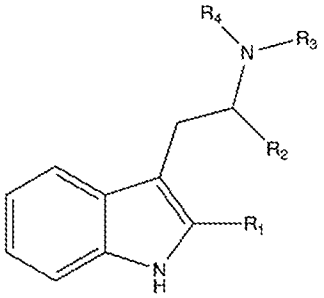
wherein R_1 is selected from the group consisting of H, F, Cl, Br, I, or CF_3 ; R_2 is H, or CH_3 ; R_3 and R_4 are each independently optionally selected from the group consisting of H, CH_3, C_2H_5, $(H_3C)_2CH$, or $H_2C=CH-CH_2$; wherein R_5 is selected from the group consisting of OCH_3, $OCOCH_3$, O-phosphate, O-polyethylene glycol (PEG), $O-(CH_2)_2(COOH)_2$ (succinate), $O-(CH_2)_2(COOH)$ (hemi-succinate), and $CH_2SO_2NHCH_3$ (sulfonamide); wherein when R_1 is H then R_5 is $CH_2SO_2NHCH_3$ and pharmaceutically acceptable salts or solvates thereof.

2. The compound of claim 1 selected from the group consisting of 2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl acetate, 2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl acetate, 2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl hydrogen phosphate, 2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl hydrogen phosphate, 2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-ol,2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-ol, 2-(2-chloro-4-methoxy-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine, 2-(2-bromo-4-methoxy-1H-indol-3 yl)-*N,N*-dimethylethan-1-amine,

1-(2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl)-*N*-methylmethanesulfonamide, 1-(2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl)-*N*-methylmethanesulfonamide, and 1-(3-(2-(dimethylamino)ethyl)-1H-indol-4-yl)-*N*-methylmethanesulfonamide.

3. A compound of the Formula:

Structure (3)



wherein R_1 is selected from the group consisting of F, Cl, Br, I, or CF_3; R_2 is CH_3; R_3 and R_4 are each independently optionally selected from the group consisting of H, CH_3, C_2H_5, $(H_3C)_2CH$, or $H_2C{=}CH{-}CH_2$

4. The compound of claim 3 selected from the group consisting of 2-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine, 2-(2-chloro-1H-indol-3-yl)-N,N-dimethylethan-1-amine, (R)-1-(2-chloro-1H-indol-3-yl)propan-2-amine, (R)-1-(2-chloro-1H-indol-3-yl)-*N*-methylpropan-2-amine, (R)-1-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-chloro-1H-indol-3-yl)propan-2-amine, (S)-1-(2-chloro-1H-indol-3-yl)-N-methylpropan-2-amine, (R)-1-(2-bromo-1H-indol-3-yl)propan-2-amine, (R)-1-(2-bromo-1H-indol-3-yl)-N-methylpropan-2-amine, (R)-1-(2-bromo-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-bromo-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-bromo-1H-indol-3-yl)propan-2-amine, (S)-1-(2-bromo-1H-indol-3-yl)-*N*-methylpropan-2-amine, 2-(2-chloro-1H-indol-3-yl)-*N,N*-diethylethan-1-amine, N-(2-(2-chloro-1H-indol-3-yl)ethyl)-*N*-

isopropylpropan-2-amine, N-(2-(2-chloro-1H-indol-3-yl)ethyl)-*N*-vinylethenamine, 2-(2-bromo-1H-indol-3-yl)-N,N-diethylethan-1-amine, N-(2-(2-bromo-1H-indol-3-yl)ethyl)-*N*-isopropylpropan-2-amine, or N-(2-(2-bromo-1H-indol-3-yl)ethyl)-*N*-isopropylpropan-2-amine.

5. A pharmaceutical composition comprising an active pharmaceutical ingredient wherein said active pharmaceutical ingredient is a compound selected from the group consisting of a compound of Structure (2) a compound of Structure (3) or a psilocybin analogue.

6. The composition as claimed in claim 5, wherein the psilocybin analogue is selected from the group consisting of psilocybin, psilocin, 4-hydroxy-indole-3-acetic acid, 4-hydroxytryptophol, 4-hydroxytryptophan, norpsilocin, aeruginascin, baeocystin, norbaeocystin, 4-hydroxy-N-methyl-N-ethyltryptamine (4-OH-MET), 4-hydroxydiethyltryptamine (4-OH-DET), 4-hydroxy-*N,N*-dipropyltryptamine (4-OH-DPT), 4-hydroxy-N,N-diisopropyltryptamine (4-OH-DiPT), *N,N*-dimethyltryptamine (DMT), indole-3-acetic acid, *N,N*-dimethyltryptamine-N-oxide (DMT-NO), 5-methoxy-*N, N*-dimethyltryptamine (5-MeO-DMT) , bufotenine(5-OH-DMT) , 4-acetoxy-*N,N*-dimethyltryptamine (4-AcO-DMT), lysergic acid diethylamide (LSD), 4-acetoxy-*N,N*-dimethyltryptamine (4-AcO-DMT), ibogaine, and combinations thereof

7. The composition as claimed in claim 5, wherein the compound is selected from the group consisting of 2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl acetate, 2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl acetate, 2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl hydrogen phosphate, 2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl hydrogen phosphate, 2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-ol,2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-ol, 2-(2-chloro-4-methoxy-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine, 2-(2-bromo-4-methoxy-1H-indol-3- yl)-*N,N*-dimethylethan-1-amine, 1-(2-chloro-3-(2-(dimethylamino)ethyl)-1H-indol-4-

yl)-*N*-methylmethanesulfonamide, 1-(2-bromo-3-(2-(dimethylamino)ethyl)-1H-indol-4-yl)-*N*-methylmethanesulfonamide, or 1-(3-(2-(dimethylamino)ethyl)-1H-indol-4-yl)-*N*-methylmethanesulfonamide.

8. The composition as claimed in claim 5, wherein the compound is selected from the group consisting of 2-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine, 2-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylethan-1-amine, (R)-1-(2-chloro-1H-indol-3-yl)propan-2-amine, (R)-1-(2-chloro-1H-indol-3-yl)-*N*-methylpropan-2-amine, (R)-1-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-chloro-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-chloro-1H-indol-3-yl)propan-2-amine, (S)-1-(2-chloro-1H-indol-3-yl)-*N*-methylpropan-2-amine, (R)-1-(2-bromo-1H-indol-3-yl)propan-2-amine, (R)-1-(2-bromo-1H-indol-3-yl)-*N*-methylpropan-2-amine, (R)-1-(2-bromo-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-bromo-1H-indol-3-yl)-*N,N*-dimethylpropan-2-amine, (S)-1-(2-bromo-1H-indol-3-yl)propan-2-amine, (S)-1-(2-bromo-1H-indol-3-yl)-*N*-methylpropan-2-amine, 2-(2-chloro-1H-indol-3-yl)-*N,N*-diethylethan-1-amine, *N*-(2-(2-chloro-1H-indol-3-yl)ethyl)-N-isopropylpropan-2-amine, *N*-(2-(2-chloro-1H-indol-3-yl)ethyl)-*N*-vinylethenamine, 2-(2-bromo-1H-indol-3-yl)-*N,N*-diethylethan-1-amine, *N*-(2-(2-bromo-1H-indol-3-yl)ethyl)-*N*-isopropylpropan-2-amine, or N-(2-(2-bromo-1H-indol-3-yl)ethyl)-*N*-isopropylpropan-2-amine.

9. The pharmaceutical composition of claim 5, wherein the composition is for oral delivery, nasal delivery, or transdermal delivery of the active pharmaceutical ingredient.

10. The pharmaceutical composition of claim 5, wherein the transdermal composition is selected from the group consisting of a sprayable liquid, a gel, a cream, a lotion, an ointment, or a transdermal patch.

11. The pharmaceutical composition of claim 5, wherein the oral composition is a tablet, a capsule, a wafer or a strip.

12. The pharmaceutical composition of claim 5, wherein the nasal composition is selected from the group consisting of a gel, a sprayable liquid, an emulsion, or an ointment.

13. A method of treating or preventing a disease which comprises administering to a patient in need of such treatment a therapeutically effective amount of a compound selected from the group consisting of Structure (2), Structure (3) or a psilocybin analogue.

14. The method of claim 16, wherein the disease is a neurological, mood or abuse disorders.

15. The method of claim 16, wherein the disease is selected from the group consisting of depression, central nervous system inflammation, addiction, headache, or dementia, or disorders of cognition and memory.

16. The method of claim 7, wherein the disease is selected from the group consisting of epilepsy, headache, dementia, traumatic disorders, substance abuse, multiple sclerosis or Parkinson's disease.

17. A process for preparing the compounds of claim 2.

18. A process for preparing the compounds of claim 4.

Figure 1

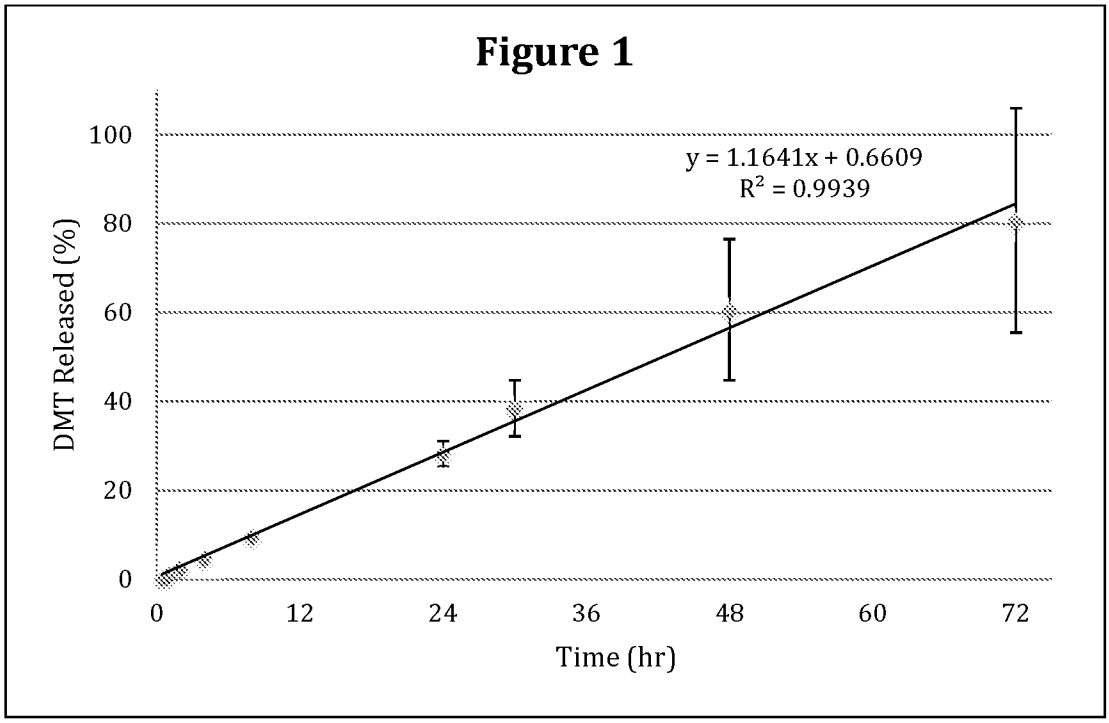
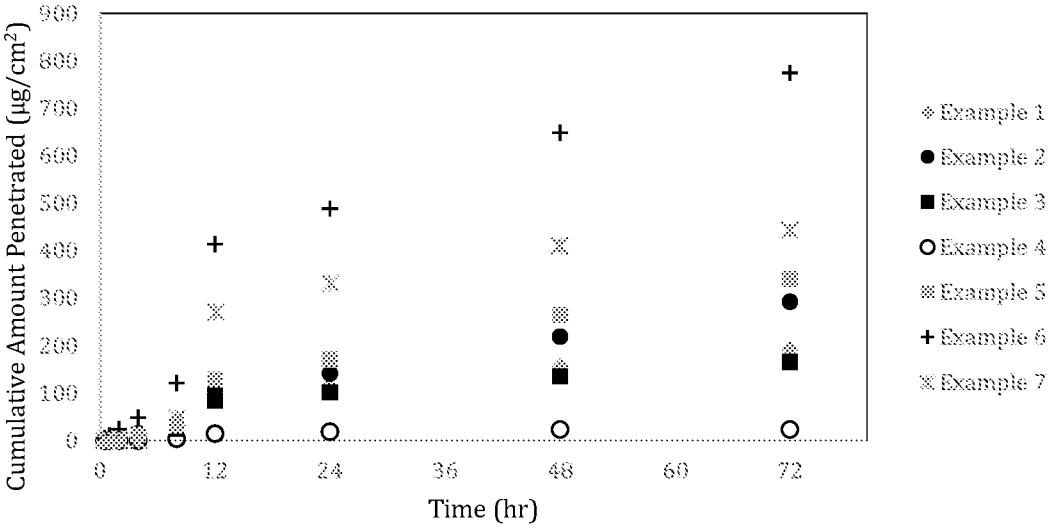

y = 1.1641x + 0.6609
R² = 0.9939
DMT Released (%)
100
80
60
40
20
0
0
12
24
36
48
60
72
Time (hr)

Figure 2


Cumulative Amount Penetrated (µg/cm²)
900
800
700
600
500
400
300
200
100
0
0
12
24
36
48
60
72
Time (hr)
Example 1
Example 2
Example 3
Example 4
Example 5
Example 6
Example 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 21/31215

A. CLASSIFICATION OF SUBJECT MATTER

IPC - A61K 31/4045; A61K 31/455; A61K 31/675 (2021.01)

CPC - A61K 31/4045; A61K 31/455; A61K 31/675; A61K 36/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2013/063492 A1 (Board Of Regents, The University Of Texas System) 02 May 2013 (02.05.2013); p54	1, 5, and 9-12
A	Pubmed Compound Record for CID 84056101, '2-(2-Chloro-4-methoxy-1H-indol-3-yl)ethanamine', U.S. National Library of Medicine, 20 October 2014 (20.10.2014), pages1-7 (https://pubchem.ncbi.nlm.nih.gov/compound/84056101); p2	1, 5, and 9-12
A	Pubmed Compound Record for CID 123606, 'Almotriptan', U.S. National Library of Medicine, 08 August 2005 (08.08.2005), pages1-40 (https://pubchem.ncbi.nlm.nih.gov/compound/123606); p3	1, 5, and 9-12
A	Pubmed Compound Record for CID 184058691 '1-(2-Chloro-4-methoxy-1H-indol-3-yl)propan-2-amine' U.S. National Library of Medicine, 20 October 2014 (20.10.2014), pages1-7 (https://pubchem.ncbi.nlm.nih.gov/compound/84058691); p2	1, 5, and 9-12
A	US 2019/0345103 A1 (Nova Targ, Inc.) 14 November 2019 (14.11.2019); entire document	1, 5, and 9-12
A	WO 2018/081456 A1 (University Of Florida Research Foundation, Incorporated) 03 May 2018 (03.05.2018); entire document	1, 5, and 9-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 August 2021	OCT 01 2021
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Kari Rodriquez Telephone No. PCT Helpdesk: 571-272-4300

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 21/31215

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1(in part), 5(in part), and 9-12

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 21/31215

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I+: Claims 1-12 directed to a compound of the formula: Structure (2), Structure (3), or pharmaceutically acceptable salts or solvates thereof. The compound will be searched to the extent that it encompasses the compound of the formula: Structure (2), wherein R1 is H; R2 is H; R3 and R4 are H; wherein R5 is CH2SO2NHCH3, wherein when R1 is H then R5 is CH2SO2NHCH3 and pharmaceutically acceptable salts or solvates thereof. It is believed that claims 1(in part), 5(in part), and 9-12 read on this first named invention, and thus these claims will be searched without fee. Applicant is invited to elect additional compounds of claim 1 or 3, wherein each additional compound elected will require one additional invention fee. Applicants must specify the claims that encompass any additionally elected compound. Applicants must further indicate, if applicable, the claims which encompass the first named invention, if different than what was indicated above for this group. Failure to clearly identify how any paid additional invention fees are to be applied to the '+' group(s) will result in only the first claimed invention to be searched. Additionally, an exemplary election wherein different actual variables are selected is suggested. An exemplary election would be the compound of the formula: Structure (3), wherein R1 is F; R2 is CH3; R3 and R4 are H (i.e., claims 3(in part), 5(in part), and 9-12).

Group II: claims 13-16 directed to a method of treating or preventing a disease which comprises administering to a patient in need of such treatment a therapeutically effective amount of a compound selected from the group consisting of Structure (2), Structure (3) or a psilocybin analogue.

Group III: claims 17-18 directed to a process for preparing the compounds of claim 2 or 4.

The group of inventions listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features:

Group I+ includes the technical feature of a unique compound of the formula: Structure (2), Structure (3), or pharmaceutically acceptable salts or solvates thereof, containing the same, which is not required by any other invention of Group I+.

Group II includes the technical feature of a method of treating or preventing a disease, not required by Group I+ and III.

Group III includes the technical feature of a process for preparing the compounds, not required by Group I+ and II.

Common technical features:

The inventions of Group I+ share the technical feature of a compound of the formula: Structure (2), Structure (3), or pharmaceutically acceptable salts or solvates thereof containing the same.

Groups I+, II and III share the technical feature of a compound of the formula: Structure (2), Structure (3), or pharmaceutically acceptable salts or solvates thereof.

These shared technical features, however, do not provide a contribution over the prior art, as being anticipated by PubChem CID 84058691 (hereinafter 'CID'). CID discloses a compound of the formula: Structure (2), wherein R1 is Cl; R2 is CH3; R3 and R4 are H; wherein R5 is OCH3 (p2, "Compound").

As said compound and compositions were known in the art at the time of the invention, these cannot be considered special technical features that would otherwise unify the inventions of Groups I+, II and III.

The inventions of Group I+, II and III thus lack unity under PCT Rule 13.

Note:
Method claims 14-16 improperly depending from claim 16 or 7. For the purposes of completing this ISR, claims 14-16 are assumed to depend from claim 13.