

Medical uses of ayahuasca



Many plants, from many different families, have been shown to contain valuable chemical properties that humans have utilized medicinally for centuries. Traditional medicine systems relied on these plant properties to treat physical, mental, and spiritual injury. Specialists within a community had knowledge of which plants would effectively treat or sooth which ailments. In ancient cultures, medical practice and religion were often intertwined. Many people attributed illness to supernatural forces or to an imbalance between the universe and the body, mind, or spirit. Therefore, indigenous peoples viewed spiritual health to be just as important as physical health. The indigenous tribes of the Upper Amazon, (more specifically the tribes that occupy the northwestern region of the Amazon Basin where Colombia, Peru, Ecuador, and Brazil come together), have a long history of utilizing plants for ritualistic purposes. One such supplement used by almost 100% of the tribes in this area is Ayahuasca (Sachahambi, 2008). Ayahuasca is a mixture consisting of *Banisteriopsis caapi* vine with the leaves of *Psychotria viridis*, these two components are boiled together into a tea which is then consumed for medicinal purposes, often used to make contact with supernatural realms to aid in spiritual healing. Both of these plant species contain psychoactive compounds that cause the consumer to experience auditory and visual hallucinations. This paper starts with a discussion of the two plant species used in the preparation of ayahuasca and how the combination of the two work together to produce the observed effects in humans. In addition, we will look at the potential use of ayahuasca for therapeutic purposes, and what role it may play in future medicine.

Banisteriopsis caapi is a vine of the Malpighiaceae family, preferring a moist tropical environment (Morton, C. V.). The plant is a large climbing shrub, with woody stems that can reach up to thirty meters in length, supporting itself by twining around neighboring plants or trees. Its natural range includes much of northern and western South America. The bark of the vine contains several β -carboline alkaloids, primarily harmine and tetrahydroharmine (THH) with lesser amounts of harmaline (Riba et al., 2003). These alkaloids are reversible monoamine-oxidase-A inhibitors (MAO-AI). MAO-AIs work to prevent the breakdown of serotonin and norepinephrine, which allows the levels of these molecules to increase in the brain, thus many antidepressants act as MAO inhibitors, working to restore mental balance in individuals with low levels of serotonin (Antidepressant Agents, 11: 40-11: 55). In 2010, Samoylenko et al., confirmed that *B. caapi* contained two antioxidant flavanols, epicatechin and procyanidin B2. These proanthocyanidins together with harmine and harmaline (β -carboline alkaloids) inhibit monoamine oxidase B (MAO-B) (Samoylenko et al., 2010). Recent literature suggests that the previously mentioned active compounds present in *B. caapi* contribute to neurogenesis, improved memory/learning function, and increased dopamine secretion (Dos Santos & Hallak, 2017; Morales-García et al., 2017; Schwarz et al., 2003). While the use of *Banisteriopsis caapi* in the preparation of ayahuasca is wide-spread, the Piaroa people of southern Venezuela use the vine alone for other “extra-shamanic” purposes. For example, during hunting trips men chew bits of the stem as it is believed to provide strength and energy, improve night vision, and suppress hunger (Rodd, 2008). However, according to Voogelbreinder, *Banisteriopsis caapi*, taken alone, “is a hypnotic sedative with relatively

little vision-inducing capacity other than dancing colours behind closed eyes, and slight perceptual shifts.” Therefore it can be concluded that the majority of the effects experienced when consuming *B. caapi* are a result of increased serotonin levels, as the impact described by the Piaroa people’s correlates with symptoms associated with moderate serotonin toxicity (Volpi-Abadie et al., 2013). The plant species, *Banisteriopsis caapi* has aided Amazonian tribes for thousands of years, alone, and in combination with another unique species, *Psychotria viridis*.

The *Psychotria* genus was first described by Linneaus in 1759, and today includes around 1000 species. Several species in this genus have been shown to contain valuable medicinal compounds presenting antiviral, antifungal, and anti-inflammatory attributes, many of such species are used in traditional medicine as treatment for a variety of disorders (Soares et al., 2016). This provides insight as to how the species *P. viridis* came to be used ritualistically by indigenous tribes of the Amazon. The species *P. viridis* is an ingredient used in the preparation of ayahuasca. The plant is a member of the Rubiaceae family, described as a shrub growing naturally in wet lowland tropical forest areas around Central and South Central America (Blackledge & Taylor, 2003). The leaves of this plant contain N, N-dimethyltryptamine (DMT) an indole alkaloid that, when ingested, causes visual hallucinations (Carbonaro & Gatch, 2016). These hallucinogenic effects are believed to be caused by the ability of DMT to act as an agonist to the 5-HT_{2A} receptors. DMT is structurally related to the neurotransmitter serotonin and the 5-HT_{2A} receptors are part of the serotonergic pathway where serotonin is synthesized, stored, and released by specific neurons in the pathway.

Serotonin is involved in many complex neural functions including: the regulation of mood, emotional processing, aggression, sleep, memory, and perception, among others. When ingested orally, DMT is inactive, as the peripheral tissues rapidly convert the molecule to inactive metabolites before it is able to integrate into the bloodstream. The most common method of consumption is smoking, upon which the psychoactive effects can be felt almost immediately (under a minute), but the psychoactive experience is short-lived, lasting anywhere between 15 and 45 minutes, and with all psychotropic effects ceasing within one hour following consumption (Barker, 2018). While the leaves contain the highest concentration of the DMT alkaloid, overall alkaloid content is variable between plants, even ones growing side-by-side in the same environment. *P. viridis* leaves contain 0.11-0.34% alkaloids, of which the main constituent is DMT, some *P. viridis* plants additionally contain trace amounts of NMT (N-Methyltryptamine) and 2-methyl-THC. Other species of *Psychotria* have shown to produce DMT as well, albeit in less amounts, while other species contain no alkaloids at all (Voogelbreinder, 2009). Voogelbreinder notes that shamans are able to identify *Psychotria* species containing DMT by the presence of “ a double line of tiny spine-like swollen glandular structures on the midrib of the underside of the leaf”, subsequent testing showed that this structure is indicative of DMT containing strains of *P. viridis* .

After the hallucinogenic effects of DMT were discovered in 1956, researchers began trying to elucidate the mechanism of action, observations led to hypotheses relating psychosis to a disruption in metabolism that caused the delusions characteristic of severe mental disorders, such as schizophrenia.

This prompted a surge of research dedicated to elucidating the compounds mechanism of action, biosynthesis (small amounts of DMT are produced endogenously), and metabolism (Barker, 2018). While scientists continue to search for answers involving endogenous DMT production, ayahuasca studies have provided newer data on DMT metabolism and its potential for therapeutic use.

Ayahuasca has been used for healing and divination among the mestizo and native Indian shamans of Peru, Columbia, and Ecuador for thousands of years. Originating from Quechua, a South American language (spoken primarily in the Andes), Ayahuasca roughly translates to “vine of the dead,” “vine of the souls,” or “vine of the spirits” (Metzner, 1999). The beverage is typically consumed after dark, in a ceremonial way, led by a shaman, a curandero (healer who uses folk remedies) or an ayahuasquero (a man who administers or uses ayahuasca). These experienced healers often maintain strict diets, and regimens, cultivating their shamanistic powers, opening themselves up to the knowledge and expressions the plants are providing. Unanimous among ayahuasqueros, is the contention that the plant is the teacher, and the healing is provided by the spirit that embodies its ‘essence’, being adept in this knowledge the ayahuasqueros act as a mediator between realms, guiding the participants in their journey (Baker, 2005). The shamans employ medicinal chants or songs, called icaros, to summon the spirits necessary for healing, for harm, or for prophecy. Each plant or spirit has an icaro that the shaman has learned through his journeys, by intoning these he is able to, “invoke specific shamanic powers or spirits”, to induce a state of healing, consciousness, and admiration (Pratt, 2007).

The beverage itself is treated as a sacrament, something to be revered, participants pray to the spirits, stating their intentions for their journey, so that they may be granted good visions (Voogelbreinder, 2009). The harvester typically prepares the ayahuasca beverage by boiling the bark or macerated liana of *B. caapi* with the crushed leaves of *P. viridis*, for anywhere from 2 to 15 hours (Kennedy, 2007). While the previously mentioned plant species are the most well-known ingredients used to prepare ayahuasca, recipes vary regionally. For example, in some places, *Banisteriopsis inebrians* is used in place of *B. caapi*, similarly *P. viridis* can be substituted by *Diplopterys cabrerana* of the Malpighiaceae family, which too, produces DMT as a secondary metabolite (Riba et al., 2003). In any case, the effects are the same, by combining these two plants and their active compounds, the user is granted the ability to see beyond the natural world and is provided with an opportunity to attain a higher state of consciousness.

Boiling the plants effectively extracts their active compounds. As mentioned previously, the DMT found in the *Psychotria viridis* leaves, is orally inactive due to monoamine oxidase (MAO) enzymes in the gut that effectively degrade the exogenous amine (N, N-Dimethyltryptamine or DMT), before it is able to reach the bloodstream. However, when ingested along with *Banisteriopsis caapi*, the β -carboline alkaloids found in the *B. caapi*'s bark act as monoamine oxidase inhibitors (MAOIs), and thus prevent the degradation of DMT in the intestines, allowing its absorption into the bodies central nervous system (Domínguez-Clavé et al., 2016). In contrast to the rapid onset and the relative brevity of visions when pure DMT is smoked, the

psychoactive effects of ayahuasca generally require 30-45 mins to set in, and last for 4-6 hours, with visual stimuli peaking around 1.5-2 hours (Dos Santos et al., 2017). Although not explicitly stated in any text relevant to this subject, it is presumed that the increased duration of the ayahuasca experience is associated with the MAO inhibitory action of the β -carboline alkaloids. Additionally, the psychotropic effects produced by ayahuasca compared to those of DMT alone, are reported, overall, to be less intense. Callaway et al., (1999) suggests that the β -carbolines may play a part in modulating the effects of DMT by impeding MAO activity in the brain and minorly preventing serotonin reuptake, this amalgam results in an overall increase of neurotransmitter levels leading to the more temperate visuals observed in ayahuasca use.

Physically, ayahuasca typically induces purging, with most users vomiting within 30 minutes of ingestion, this is considered by many to be a necessary cleansing process (Voogelbreinder, 2009). In addition, users often experience mydriasis, sweating, malaise, and slight increases in blood pressure and heart rate. Generally speaking, drugs classified as hallucinogens provide consumers with alterations of consciousness, producing shifts in mood, affect, cognition and perception. These are often manifested as, “ changes in the sense of time and space, synesthesia, derealization (feelings of unreality), depersonalization (changes in body image), loosening of ego boundaries, and impaired concentration” (Halberstadt & Geyer, 2013). Experienced psychedelic adherents, or “ psychonauts” oftentimes place the ayahuasca experience in a class of its own, noting the many profound subjective effects such as, deep introspective

insight, intellectual ideation, and complex spirituality gained from the journey. Guillermo, a shaman in Iquitos, Peru describes ayahuasca as, “ a means for a man to get to the different realms of existence. The source of all creation, makes us see where man comes from, that he comes from space where energy comes in the form of light. We are all formed through a relationship of nature, energy and light.” (*Ayahuasca: Vine of the Soul*).

While each individuals experience is unique many report a general feeling of being in harmony with the universe, and a feeling of being connected to something larger. The visuals generated by ayahuasca draw from the real world, in that, they may be derived from a memory, or may resemble family, friends or past acquaintances, or may be related to a particular issue of the individual. This being said, the experience itself and any visuals experienced are decidedly not of this world. Benny Shanon, an emeriti professor of psychology at the Hebrew University of Jerusalem and author of *Antipodes of the Mind: Charting the Phenomenology of the Ayahuasca Experience* , describes the atmosphere surrounding ayahuasca intoxication:

It seems that the world is no longer the same. Even when drinkers do not have any visions in the strict sense of the word they usually discover that the world has altered in a very fundamental fashion...The feeling is that things are not as they used to be and one has the sense of entering into another heretofore unknown, reality.

A simple Google search yields numerous testimonials from people recounting the healing power of the ayahuasca beverage, many saying that the experience inspired them to make drastic personal transformations, changing the way they lived their life. Researchers characterize these

disturbances of self-consciousness or,” the dramatic breakdown of one’s self” (Millière, 2017) as “ drug-induced ego dissolution” (DIED). This phenomenon is brought on by the indolealkylamine’s (DMT and beta-carbolines) agonist activity at the serotonin 2A (5-HT_{2A}) receptor highly expressed in the default mode network (DMN) which is shown to be especially active during metacognitive thinking employed when examining one’s own thoughts and feelings or when remembering past events (Millière, 2017). Psychedelics that have shown to activate the 5-HT_{2A} receptors, such as ayahuasca, decrease the activity of the DMN (Palhano-Fontes et al., 2015), subsequently causing the subjective feeling of “ losing one’s sense of self” or “ ego dissolution”. Interestingly, changes in DMN functionality are associated with several neurodegenerative diseases such as Alzheimer’s and Parkinson’s Disease (Jones et al., 2011; Tessitore et al., 2012). New and ongoing research suggests that ayahuasca may be a source of treatment for patients living with such diseases.

Patients with Alzheimer’s disease show reduced glucose metabolism in key areas of the DMN, compared to healthy individuals of the same age.

Furthermore, the reduction in glucose metabolism progresses with the disease and with the associated mental decline of people affected by the disease (Buckner et al., 2008). In addition, Alzheimer’s disease is also characterized by reductions in the activity of choline acetyltransferase (ChAT), the enzyme that synthesizes acetylcholine, a neurotransmitter important in learning and memory (Francis, 2005). The beta-carboline, harmine, present in *B. caapi* bark effectively inhibits acetylcholinesterase and has shown to improve memory in memory impaired mice (He et al.,

2015). Mennenga et al., also showed that old rats treated with harmine in varying doses, demonstrated an improvement in short-term working and recent memory, although the study did not evaluate the mechanism of action responsible for the observed improvements. The specific targets of harmine, relevant to cognition are still an area of on-going research.

Another area of on-going research involves ayahuasca administration for the treatment of drug addiction. Drug addiction is caused by external influence of the dopaminergic pathways in the brain that recognize reward and pleasure. The beta-carboline, harmine, found in *B. caapi* has shown to increase dopamine release in a MAO-independent manner, (Brierley & Davidson, 2012), which could be useful in treating cocaine for which no pharmaceutical treatment currently exists. Fernández et al., observed the therapeutic effects of ayahuasca on drug dependence at a treatment program in Brazilian Amazonas State. His study showed significant reductions in: personality traits significant to drug-related disorders as measured by the Temperament and Character Inventory-Revised, scores of the Symptom Check-List-90-Revised, scores of the Frontal Systems Behavior Scale measuring apathy, disinhibition, and executive dysfunction. The therapeutic effects of ayahuasca in relation to drug addiction and depression are thought to be a result of the visions experienced during its use (Bouso and Riba, 2013). Grob et al., supports these findings in which the authors state, " A common theme was the perceived belief while in the induced altered state of consciousness that they were on a self-destructive path that would inevitably lead to their ruin and even demise unless they radically changed their personal conduct and orientation." It seems that the personal

journey, and the novel introspective insights gained throughout it, are key in attenuating withdrawal symptoms as well as incidence to relapse in drug addicts. More importantly, ayahuasca itself shows no evidence of being addictive (Pérez and Mota, 2008) as the experience is reported to “transcend the merely perceptual or recreational aspects of psychoactive drug effects” (Bouso and Riba, 2013). In all studies assessing the validity of ayahuasca for drug-addiction treatment it is recognized that the observed improvements could be a result of the religious or social aspects involved with its use. In relation to the pharmacology of ayahuasca and drug addiction, further research is needed to determine if the active components of ayahuasca have the potential to successfully treat addiction.


There are many intriguing and almost unbelievable aspects of the ayahuasca beverage, that may prove to be useful in future medicine or at the very least contribute to further research attempting to determine how the brain functions in response to external stimuli. In my opinion, the ayahuasca brew and its traditional contextual use *are* the main healing components. From my research it's easy to see that the subjective effects experienced after ingestion of ayahuasca are profoundly eye-opening to, “the big picture”, *per se*, allowing users to gain an understanding of personal priorities and how those personal priorities or goals align with the universe and other living beings. I am thoroughly convinced that if ayahuasca was taken before any international summit meeting, the world would be a much better place.

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