



Artículo Original | Original Article

## Are hallucinogenic plants efficacious in curing diseases?

[¿Son eficaces las sustancias alucinógenas en la curación de enfermedades?]

Washington Soares FERREIRA JÚNIOR<sup>1</sup>, Margarita Paloma CRUZ<sup>1</sup>, Fábio José VIEIRA<sup>1</sup> & Ulysses Paulino de ALBUQUERQUE<sup>1\*</sup>

<sup>1</sup>*Laboratório de Etnobotânica Aplicada, Departamento de Biologia, Universidade Federal Rural de Pernambuco, Recife, PE, Brazil.*

---

### Abstract

The ethnobotanical, anthropological and ethnopharmacological literature has shown a strong relationship between hallucinogenic plants and medical efficacy. Despite evidence from previous studies, many issues have not been discussed clearly enough to enable acceptance of this relationship. This study uses a literature survey to track how different authors have dealt with the issue and what future research opportunities may emerge.

**Keywords:** psychoactive; enteogen; medicinal plants; rituals.

### Resumen

La literatura etnobotánica, antropológica y etnofarmacológica ha señalado una fuerte relación entre las plantas alucinógenas y su efectividad como medicamento. A pesar de todas las pruebas e informes, hay muchas cuestiones que no están claramente discutidas para permitir la aceptación de esta idea. En este trabajo, a partir de una investigación bibliográfica, nos proponemos investigar cómo diferentes autores se han ocupado de la cuestión y cuáles son las posibilidades de investigación que puedan emerger de esto.

**Palabras Clave:** psicoactivo; enteógeno; plantas medicinales; rituales.

---

**Recibido | Received:** May 23, 2010

**Aceptado en versión corregida | Accepted in revised form:** June 23, 2010

**Publicado en línea | Published online:** July, 2010.

**Declaración de intereses | Declaration of interests:** the authors have no competing interests.

**Financiación | Funding:** TO CNPQ FOR THE FINANCIAL SUPPORT AND PRODUCTIVITY GRANT TO U.P. ALBUQUERQUE

**This article must be cited as:** Washington Soares FERREIRA-JUNIOR, Margarita Paloma CRUZ, Fábio José VIEIRA, Ulysses Paulino de ALBUQUERQUE 2010. Are hallucinogenic plants efficacious in curing diseases? Bol Latinoam Caribe Plant Med Aromat 9 (4):292–301. {EPub July 2010 }.

**\*Contactos | Contacts:** upa@db.ufrpe.br

## INTRODUCTION

Hallucinogens have been used by human communities since ancient times. For example, records of the use of the plant *Sophora secundiflora* (Gomez-Ortega) Lag. ex DC. dating from between 8440 and 8129 BC have been found in the state of Texas, in the southern United States (Furst, 2004). According to some authors, psychoactive drugs are capable of causing not only visual hallucinations but also auditory, tactile and gustatory ones. Because of these characteristics, they are often believed to mediate communication with gods or spirits (Schultes & Hofmann, 1993; Rodrigues, 2001; De Feo, 2004), earning them the name "entheogens." This term was coined by Gordon Wasson (Wasson *et al.*, 1992) and means "god within me," a reference to the fact that when such substances are ingested they establish a closer connection between the person who consumes them and the gods.

Aside from their use as hallucinogens, plants or fungi with these properties have varied uses. For example, the plant *nutmeg* (*Myristica fragrans* Houtt.) is used as a seasoning (Weil, 1965), and *marijuana* (*Cannabis sativa* L.) is used as a source of textile fiber (Schultes & Hofmann, 1993). However, perhaps no other use has been so often reported as the medicinal use of these plants (Bruhn & Bruhn, 1973; Dunn, 1973, Souza *et al.*, 2008; Rodrigues *et al.*, 2008).

In an article entitled "Mescaline Cactus Used in Folk Healing", Dobkin de Rios (1968) reports the hallucinogenic and medicinal use of *San Pedro* cactus (*Trichocereus pachanoi* Britton & Rose) in a rural community in Peru, suggesting that psychoactive substances are effective in treating diseases. However, the author showed that although the use of hallucinogenic plants in curing disease was mentioned by several authors, the use of such plants in medicinal contexts had not been adequately discussed.

Although several authors have already suggested this hypothesis, it is a topic deserving of further attention. Therefore, we performed a literature review on research that addresses the use of hallucinogens. We conducted searches of the databases JSTOR, Scopus, Science Direct and Web of Science and magazines like the Journal of Ethnopharmacology and Economic Botany using the

keywords: *psychoactive plants, hallucinogenic plants, psychedelic plants, central nervous system, entheogen, entheogenic, and narcotic*, in combination with the keywords *medical, medicine, heal, healing and therapeutic*.

In this paper, we present some considerations for developing the hypothesis, which often do not appear clearly in the literature. We then present previous findings on the treatment of diseases using hallucinogens, including the different actions of psychoactive drugs and other elements that can interact in the treatment of diseases.

## HALLUCINOGENS AND THEIR EFFECTIVENESS IN CURING DISEASES: INITIAL THOUGHTS

### Considerations about hallucinogenic and medicinal uses

The use of hallucinogenic substances as medicine has been recognized in traditional communities, but little academic study has been done on this relationship. Many studies combine medicinal and hallucinogenic properties of plants into the same category, recognizing hallucinogens as a secondary feature of some species used in traditional medicine (see Schultes, 1938; Rodríguez & Cavin, 1982). For example, Weiner (1971), working in a rural community in Tonga (a country located east of Australia), wondered about a strange absence of hallucinogenic plants in traditional medicine, which shows a close relationship between the hallucinogenic and medicinal uses for this author.

We believe that this strong relationship between hallucinogenic and medicinal uses may be due to something Paracelsus had already noted in the sixteenth century, the fact that different concentrations of a substance alter its effect on those who ingest it. Thus, the same substance could be used for medical, narcotic or poisonous purposes depending on the dosage (Schultes & Hofmann, 1993). Similar examples can be found in Souza *et al.* (2008) on the use of the plant *Jurema* (*Mimosa tenuiflora*) by the indigenous people in Brazil and Rodrigues *et al.* (2008) in the study of the hallucinogenic cigarette "Tira-capeta" used by the Quilombolas (Afro-Brazilian slaves descendants) communities in Brazil.

Many authors have shared this idea (Weil, 1965; Rodríguez & Cavin, 1982; Etkin, 1988; Brussell, 2004), proposing that the hallucinogenic effects of plants were discovered subsequent to their medical applications when users of these drugs took higher doses than recommended. This seems to have been the case with *nutmeg*, according to a report by Weil (1965). Rodríguez & Cavin (1982) suggested that many hallucinogenic plants were initially used for treatment of diseases due to their emetic properties, with the understanding that these properties would induce a purification of the body. Subsequently, according to the authors, the hallucinogenic properties indicated the appropriate doses for the medicine to have an effect.

Given the evidence, there seems to be a belief among researchers that these substances may alter the mind, not just in terms of their hallucinogenic effects, but also in a medicinal context (Randolph, 1905). However, we must separate the two perspectives that seem to emerge from the works of these authors. The cure can be interpreted from the perspective of the researcher (the biomedical model) or from the perspective of the culture studied. For example, if an investigator witnesses a shamanic ritual including the ingestion of a psychoactive substance and records testimony that it healed the patient, we must distinguish whether the cure was actually achieved at a physiological level or in the sphere of "cultural diseases," those related to the worldview and beliefs of a particular people. Often these distinctions do not appear in the texts. Thus, there are different concepts of illness and healing.

### **Difference in the concept of disease in traditional and modern communities**

Determining the moment when it began to consider medicinal plants to also be hallucinogens is no easy task, because the concept of disease for traditional cultures often differs from what "disease" means to Westernized or modern people (Hurrell, 1991; Herndon et al., 2009). However, if our goal is to investigate whether hallucinogens are effective in the treatment of diseases, we must first define what a disease is (La Barre, 1979). We will adopt an approach based on the biomedical model to evaluate the effectiveness for both medicinal and hallucinogenic applications.

This subject has been extensively studied (Coelho, 1976; Monod, 1976; Rodríguez & Cavin, 1982; Fackelmann, 1993; Menéndez, 1994; Agosta, 1997; Rodrigues, 2001; Shepard Jr., 2002; De Feo, 2004; Toledo, 2006; Bourbonnais-Spear *et al.*, 2007). Most of these authors indicate that, in addition to recognizing what we might call physiological diseases (diseases that would be accepted by modern medical science), many traditional communities also recognize diseases caused by supernatural agents (see, for example, Garro, 2000).

Schultes & Hofmann (1993) argue that non-industrialized cultures do not differentiate between physiological and supernatural causes for disease. Rather, disease is the result of "interference with the spiritual world." Therefore, the best medicine to treat diseases would be entheogens, which enable contact with the spiritual world where an effective cure for the disease can be identified. This complex process is difficult to explain without systematic and specific case studies. A hallucinogenic plant may have medicinal properties that treat some (but not all) physical infirmities. If a particular healing ritual always uses the same plants to treat a complex of several diseases, it would be reasonable to assume that the cure operates not at a physical level, but at a supernatural level, according to the worldview of the culture. Considering the cause of a disease to be other than physiological, or even to be supernatural, usually means the cure is also not "conventional," and that it does not fit the types of treatments recognized by modern medical science.

### **ARE HALLUCINOGENS EFFECTIVE IN TREATING DISEASE?**

From the bibliographical material examined, we classified the treatment of diseases using psychoactive drugs into three groups, according to the role of hallucinogens the treatment.

#### **Indirect action of hallucinogens in the treatment of diseases**

Agosta (1997), in a review of plant compounds used as medicinal, noted that in traditional communities, diseases are often thought to be caused by evil spirits. Therefore, healers should administer psychotropic drugs and use their influence to communicate with the spirit world and achieve the patient's healing. According to Schultes (1979),

healers and shamans take hallucinogens to make contact with deities through visions or dreams. These visions provide knowledge about the disease afflicting the patient and tell the healers the proper treatment of the condition (see also Rodrigues, 2001; De Feo, 2004). In this case, the entheogen becomes a vehicle that allows the healer to explore aspects of the disease and treat the patient. Thus, the hallucinogen has an indirect effect, because it is ingested by the healer and not by the patient.

In other situations, the treatment is indirect not because the hallucinogens allow contact with the gods to determine the cure for the disease, but because healers can use hallucinogens to confront and combat diseases through symbolic battles with cause of the disease (Rivier & Lindgren, 1972).

#### **Direct use of hallucinogens in the treatment of diseases**

In the case presented by Dobkin de Rios (1968), the *San Pedro* cactus is used to cure diseases through an indirect ritual treatment in which the healer drinks the entheogen and receives information about the cause of the disease. However, Dobkin de Rios explains in his description of the ritual that both, the patient and the healer, drink the infusion from the *San Pedro* cactus, an act that leads to hallucinations and vomiting in the patient who ingested the substance. Both Dobkin de Rios and Rodríguez & Cavin (1982) suggest that this may have a curative effect.

This example shows that sometimes the treatment can produce indirect contact between the deities and the healer who ingests the drink, as well as a direct effect on the patient, who also ingests the drink. A similar report can be found in Rodrigues *et al.* (2008) on the hallucinogenic cigarette *tira-capeta*, used in healing rituals in Maroon communities in Brazil. According to the authors, the cigarette is used by both the healer and the patient, which may exert a direct effect on the latter in the treatment of disease. The key issue in these examples is that the act of vomiting or smoking may have more of a symbolic effect than a strictly physiological effect in fighting a specific disease.

This is a direct treatment because the patient came into direct contact with the hallucinogenic substance, which could have an effect in curing the disease. Healing through direct treatment is in agreement with Western biomedical concepts. That is, the patient takes the hallucinogen, which has one

or more bioactive compounds with medicinal properties. In addition, the vehicle used (e.g., powder, beverage or cigarette) and how the substance is consumed contribute to the effect of the active principle in the body.

As weak evidence for direct treatment, some studies have isolated and identified substances with hallucinogenic and medicinal properties in the same plant, which corroborates the idea that plants with hallucinogenic properties also have medicinal properties. However, we must discern whether these substances can actively treat targeted diseases. For example, Mackie *et al.* (1955) proved the efficacy of the substance *thujone*, a constituent of essential oils from various plants, as an anthelmintic. This substance was also reported by Albert-Puleo (1978) to be a hallucinogen, demonstrating that a substance may in fact have both hallucinogenic and medicinal properties.

Table 1 presents species of plants and fungi with compounds that have proven hallucinogenic and/or medicinal pharmacological properties. As shown in the table, there are substances that have confirmed hallucinogenic properties, but where no studies have demonstrated their medicinal properties, for example, muscimol and ibotenic acid in the *Amanita muscaria* species. Other substances, however, have already been proven to have both medicinal and hallucinogenic properties (see Table 1). Indeed, this evidence seems to indicate that the initial consumption of a plant for medicinal purposes could lead to the discovery of its use as a hallucinogen.

These examples show that hallucinogens can have both a direct and an indirect role in curing diseases while also facilitating communication with deities, thus allowing healers to decipher the origins of diseases or to symbolically battle diseases. In contrast to the types of treatments already mentioned, Schultes & Hofmann (1993) have discussed a ritual in which only the patient drinks a hallucinogenic substance while the shaman observes the behaviours and responses to the drink and diagnoses the patient's maladies. This example presents a third type of disease treatment involving hallucinogens, but does not suggest any medicinal properties. Thus, there may be a cultural placebo effect in which particular cultural expectations cause a member of the culture to attain the desired effect even without

**Table 1.** List of species recorded in hallucinogen use and their substances with hallucinogenic and/or medicinal properties proven from pharmacological studies.

Species	Substances	Properties	References
<i>Amanita muscaria</i> (L.: Fr.) Lam.	<i>Muscimol</i>	Hallucinogenic	Perry & Perry (1995); Satora <i>et al.</i> (2005)
	<i>Ibotenic acid</i>	Hallucinogenic	Satora <i>et al.</i> (2005)
<i>Atropa belladonna</i> L.	<i>Atropine</i>	Medicinal and hallucinogenic	Rates (2001); Shultes & Hofmann (1993)
	<i>Hiosciamine; hyoscyne</i>	Hallucinogenic	van Dongen & Groot (1995); Schultes & Hofmann (1993)
<i>Brugmansia arborea</i> (L.) Lagerh.	<i>Tropane alkaloids (atropine and scopolamine)</i>	Hallucinogenic	van der Donck <i>et al.</i> (2004)
<i>Cannabis sativa</i> L.	<i>Cannabinoids ("arachidonylethanol amide"; "2-arachidonoyl glycerol"); bioactive fatty acids ("palmitoylethanolamide" and "oleamide")</i>	Medicinal	Petrocellis <i>et al.</i> (2000)
	<i>Canabinoids ("4-acetoxy-2-geranyl-5-hydroxy-3-n-pentylphenol"; "8-hydroxycannabinol" and "5-acetyl-4-hydroxycannabigerol")</i>	Medicinal	Radwan <i>et al.</i> (2009)
	<i>Cannabinoids (Cannabicromano)</i>	Medicinal	Ahmed <i>et al.</i> (2008)
	<i>Cannabinoids</i>	Medicinal and hallucinogenic	Velasco <i>et al.</i> (2004); Beaulieu & Rice (2002) Ashton (2001); Honório <i>et al.</i> (2006); Bonfá <i>et al.</i> (2008); Ameri (1999)
<i>Claviceps purpurea</i> (Fr.) Tul.	<i>Ergot alkaloids (ergotamine and ergometrine)</i>	Medicinal	Komarova & Tolkachev (2001); Lorenz <i>et al.</i> (2009)
	<i>Ergot alkaloids</i>	Medicinal and	Eadie (2003)

	<i>(ergolines)</i>	hallucinogenic	
	<i>Ergot alkaloids (ergotamine)</i>	Medicinal and hallucinogenic	van Dongen & Groot (1995)
<b><i>Datura spp.</i></b>	<i>Tropane alkaloids (atropine and scopolamine)</i>	Hallucinogenic	Perry & Perry (1995)
<b><i>Datura stramonium L.</i></b>	<i>Atropine</i>	Medicinal	Irambakhsh <i>et al.</i> (2010)
	<i>Atropine</i>	Medicinal and hallucinogenic	Rates (2001)
<b><i>Digitalis spp.</i></b>	<i>Digoxine</i>	Medicinal	Rates (2001)
<b><i>Nicotiana sp.</i></b>	<i>Harmine</i>	Hallucinogenic	Davis <i>et al.</i> (1969).
<b><i>Papaver somniferum L.</i></b>	<i>Codeine</i>	Medicinal	Rates (2001)
<b><i>Psilocybe spp.</i></b>	<i>Psilocybin</i>	Hallucinogenic	Schultes (1998); Huhn <i>et al.</i> (2005)
<b><i>Salvia divinorum Epling &amp; Játiva</i></b>	<i>Salvinorin A</i>	Medicinal and hallucinogenic	Capasso <i>et al.</i> (2006)
<b><i>Tabernanthe iboga Baill.</i></b>	<i>Ibogaine</i>	Hallucinogenic	Kubiliené <i>et al.</i> (2008); Sheppard (1994)
	<i>Ibogaine</i>	Medicinal and hallucinogenic	Popik & Wróbel (2001)
<b><i>Trichocereus pachanoi Britton &amp; Rose</i></b>	<i>Mescaline</i>	Hallucinogenic	La Barre (1979)
<b><i>Trichocereus williamsii (Lem. Ex Salm-Dyck) Coult.</i></b>	<i>Mescaline</i>	Hallucinogenic	La Barre (1979)

pharmacological elements. For example, Albuquerque & Chiappeta (1994) describe a ritual with the plant *Jurema* in which one of the them consumed the drink offered, but did not have the same reactions that the others had (cult practitioners).

In addition to the situations presented above, there are other cases, as documented by Dobkin de Rios (1968), Rivier & Lindgren (1972), Rodriguez & Cavin (1982) and Albuquerque & Chiappeta (1994), where both the healer and the patient (and even other people in the ritual) took the plant to hallucinate. In addition to other factors, the combination of various elements of the ritual (songs and dances, for example) can cause a synergism that leads to the patient's "cure."

### **The role of rituals in healing diseases using psychoactive plants**

Some authors have suggested that healing in rituals is accomplished through a combination of plants with entheogenic properties, songs and prayers (Monod, 1976; Bourbonnais-Spear *et al.*, 2007). This idea is supported by Albuquerque and Andrade's (2005) study of African-Brazilian cults. They argued that for the remedies to be complete, their administration must be accompanied by an enchantment to facilitate the healing process. Thus, one must consider the complete set of ritual elements that create a contagious atmosphere among participants, leading to emotional states that can produce states of trance (Camargo, 1998).

One of the most striking elements in rituals is music, whether whistling or magical songs that accompany the entire ritual. Katz & Dobkin de Rios (1971) made a great contribution in this area with their analysis of the role of whistling in ayahuasca healing rituals of Peruvian Amazon natives. They concluded that the ingestion of hallucinogenic plants and the whistles produced by healers during the period of intoxication was the method for invoking the forces of nature and the guardian spirits. Later, Dobkin de Rios & Katz (1975) elaborated on their findings and established a link between musicality, religious rites and healing. They questioned the importance of music in ceremonies with hallucinogenic plants in Western societies, finding that different types of music can evoke particular moods and may regulate the hallucinogenic effect of the drug administered. Monod (1976), studying the Piaroa Indians in South America, believed that the songs sung during the rituals had curative and preventive effects. Other authors corroborate the assertion that music is essential to ritual divination of diagnoses and healing. Mentally, the rhythmic singing with the drumbeat seems to support the flow of visions and minimize fear (see Albuquerque & Chiappeta, 1994). Metzner (1998) reports that Western psychotherapy and the healing systems of shamanic indigenous peoples use plants or psychoactive drugs to cure or obtain knowledge, and that these are invariably essential to the success of healing.

## CONCLUSIONS

According to the discussions raised by this work, we can conclude the following points:

1. There is a strong association between the use of hallucinogenic and medicinal substances. This association is related to the properties of these substances, which may be hallucinogenic or medical depending on the dosage. However, no systematic study linking ethnographic data with pharmacological uses has been found. For example, have hallucinogenic substances been used pharmacologically in healing ritual activity for all diseases?

2. When substances have different properties depending on dosage, researchers tend to assume that the medicinal effects were discovered before the hallucinogenic effects. This idea has been suggested by different studies, but to the best of our knowledge it has not been studied and tested. Thus, there is a tendency among researchers to consider the hallucinogenic effects to be secondary to the medical effects.

3. The different disease treatments using hallucinogens can be grouped into three types. In the indirect treatment, only the healer takes the hallucinogen and receives contact with deities and insights about the causes of diseases to diagnose and/or obtain treatment for the patient. In the second type, direct treatment, the patient takes the hallucinogen, which may have active ingredients with the desired properties to have a direct effect in curing the disease. In the third type, the patient takes the hallucinogen, but it does not have active compounds for the treatment of the disease in question. Thus, healing can be considered a case of "cultural placebo."

4. In addition to hallucinogens, the other elements present in rituals also serve an important function in the healing process. Hallucinogenic substances may have the ability to influence the kinds of visions experienced. In this sense, all these elements can have a decisive role in the treatment of "cultural diseases."

In conclusion, we believe that further studies are needed from the perspectives of ethnobotany, ethnopharmacology, phytochemistry and anthropology to evaluate the role of these plants in the healing systems of different human groups. Furthermore, studies in bioprospecting can benefit from understanding these systems, which may provide new and interesting candidates for the development of new medicines.

## ACKNOWLEDGEMENTS

To CNPq for the financial support and productivity grant to U.P. Albuquerque.

## REFERENCES

Agosta WC. 1997. Medicines and Drugs from Plants. *J Chem Educ* 74: 857 - 860.

- Ahmed SA, Ross SA, Slade D, Radwan MM, Khan IA, ElSohly MA. 2008. Structure determination and absolute configuration of cannabichromanone derivatives from high potency *Cannabis sativa*. *Tetrahedron Lett* 49: 6050 - 6053.
- Albert-Puleo M. 1978. Mythobotany, pharmacology, and chemistry of Thujone-containing plants and derivatives. *Econ Bot* 32: 65 - 74.
- Albuquerque UP, Andrade LHC. 2005. As plantas na medicina e na magia dos cultos afro-brasileiros, pp. 51 - 75. In Albuquerque UP, Almeida CFCBR, Marins JFA: Tópicos em conservação, etnobotânica e etnofarmacologia de plantas medicinais e mágicas. Ed. NUPEEA, Recife, Brasil.
- Albuquerque UP, Chiappeta AA. 1994. O uso de plantas e a concepção de doença nos cultos Afro-Brasileiros. *Ciência e Trópico* 22: 197 - 210.
- Ameri A 1999. The effects of cannabinoids on the brain. *Prog Neurobiol* 58: 315 - 348.
- Ashton CH. 2001. Pharmacology and effects of cannabis: A brief review. *Brit J Psychiat* 178: 101 - 106.
- Beaulieu P, Rice ASC. 2002. Pharmacologie des derives cannabinoïdes: Applications au traitement de la douleur? *Ann Fr Anesth Reanim* 21: 493 - 508.
- Bonfá L, Vinagre RCO, Figueiredo NV. 2008. Uso de canabinóides na dor crônica e em cuidados paliativos. *Rev Bras Anestesiologia* 58: 267 - 279.
- Bourbonnais-Spear N, Awad R, Merali Z, Maquin P, Cal V, Arnason JT. 2007. Ethnopharmacological investigation of plants used to treat susto, a folk illness. *J Ethnopharmacol* 109: 380 - 387.
- Bruhn JG, Bruhn, C. 1973. Alkaloids and ethnobotany of Mexican Peyote cacti and related species. *Econ Bot* 27: 241 - 251.
- Brussell DE. 2004. Medicinal plants of Mt. Pelion, Greece. *Econ Bot* 58: 202 - 204.
- Camargo MTLA. 1998. Plantas medicinais e de rituais afro-brasileiros II: estudo etnofarmacobotânico. Editora Ícone, São Paulo, 232p.
- Capasso R, Borrelli F, Capasso F, Siebert DJ, Stewart DJ, Zjawiony JK, Izzo AA. 2006. The hallucinogenic herb *Salvia divinorum* and its active ingredient salvinorin; A inhibit enteric cholinergic transmission in the guinea-pig ileum. *Neurogastroent Motil* 18: 69 - 75.
- Coelho VP. 1976. Os alucinógenos e o mundo simbólico: o uso dos alucinógenos entre os índios da América do Sul. EPU, São Paulo, 176 p.
- Davis, E. A.; Paseman, J. F.; Janiger, S. O.; Demerescu, M. 1969. Effects of Harmine on the Cat's visual system. *American Association of Anatomists Abstract, Anatomical Record* 163: 175.
- De Feo V. 2004. The ritual use of *Brugmansia* species in traditional Andean medicine in northern Peru. *Econ Bot* 58(Supplement): S221 - S229.
- Dobkin de Rios M. 1968. Mescaline cactus used in folk healing. *Econ Bot* 22: 191 - 194.
- Dobkin de Rios M, Katz F. 1975. Some Relationships between Music and Hallucinogenic Ritual: The "Jungle Gym" in Consciousness. *Ethos* 3: 64 - 76.
- Dunn E. 1973. Russian Use of *Amanita muscaria*: A Footnote to Wasson's Soma. *Curr Anthropol* 14: 488 - 492.
- Eadie, M. J. 2003. Convulsive ergotism: Epidemics of the serotonin syndrome? *Lancet Neurol* 2: 429 - 434.
- Etkin NL. 1988. Ethnopharmacology: Biobehavioral approaches in the anthropological study of indigenous medicines. *Annu Rev Anthropol* 17: 23 - 42.
- Fackelmann KA. 1993. Food, drug, or poison? Cultivating a taste for 'toxic' plants. *Sci News* 143: 312 - 314.
- Furst PT. 2004. Visionary Plants and Ecstatic Shamanism. *Expedition* 46: 26 - 29.
- Garro LC. 2000. Cultural Meaning, Explanations of Illness, and the Development of Comparative Frameworks. *Ethnology* 39(4, Special Issue): 305 - 334.
- Herndon CN, Uiterloo M, Uremaru A, Plotkin MJ, Emanuels-Smith G, Jitan J. 2009. Disease concepts and treatment by tribal healers of an Amazonia forest culture. *J Ethnobiol Ethnomedicine* 5: 27.
- Honório KM, Arroio A, Silva ABF. 2006. Aspectos terapêuticos de compostos da planta *Cannabis sativa*. *Quim Nova* 29: 318 - 325.
- Huhn C, Pütz M, Martin N, Dahlenburg R, Pyell U. 2005. Determination of tryptamine derivatives in



- illicit synthetic drugs by capillary electrophoresis and ultraviolet laser-induced fluorescence detection. *Electrophoresis* 26: 2391 - 2401.
- Hurrell JA. 1991. Etnomedicina: Enfermedad y adaptación en Iruya y Santa Victoria (Salta, Argentina). *Rev Mus La Plata* 9: 109 - 124.
- Irambakhsh A, Ebadi M, Bayat M. 2010. The inhibitory effects of plant methanolic extract of *Datura stramonium* L. and leaf explant callus against Bacteria and Fungi. *Global Veterinaria* 4: 149 - 155.
- Katz F, Dobkin de Rios M. 1971. Hallucinogenic music: An analysis of the role of whistling in peruvian ayahuasca healing. *J Am Folklore* 84: 320 - 327.
- Komarova EL, Tolkachev ON. 2001. The chemistry of peptide ergot alkaloids. Part I. Classification and chemistry of ergot peptides. *Pharm Chem J* 35: 37 - 45.
- Kubiliené A, Marksiené R, Kazlauskas S, Sadauskiené I, Razukas A, Ivanov L. 2008. Acute toxicity of ibogaine and noribogaine. *Medicina (Kaunas)* 44: 984 - 988.
- La Barre W. 1979. Peyote and mescaline. *J Psychedelic Drugs* 11: 33 - 39.
- Lorenz N, Haarmann T, Pazoutová S, Jung M, Tudzynski. 2009. The ergot alkaloid gene cluster: Functional analyses and evolutionary aspects. *Phytochemistry* 70: 1822 - 1832.
- Mackie A, Marjorie Stewart, G, Cutler AA, Misra AL. 1955. In vitro tests of chemical compounds on *Ascaris lumbricoides* and *Fasciola hepatica*. *Br J Pharmacol* 10: 7 - 11.
- Menéndez E. 1994. La enfermedad y la curación. ¿Qué es medicina tradicional? *Alteridades* 4: 71 - 83.
- Metzner R. 1998. Hallucinogenic Drugs and Plants in Psychotherapy and Shamanism. *J Psychoactive Drugs* 30: 333 - 341.
- Monod J. 1976. Os Piaroa e o mundo invisível, pp. 7 - 28. In Coelho VP: Os alucinógenos e o mundo simbólico: o uso dos alucinógenos entre os índios da América do Sul. Ed. EPU, São Paulo, Brasil.
- Perry EK, Perry RH. 1995. Acetylcholine and hallucinations: disease-related compared to drug-induced alterations in human consciousness. *Brain Cognition* 28: 240 - 258.
- Petrocellis LD, Melck D, Bisogno T, Marzo VD. 2000. Endocannabinoids and fatty acid amides in cancer, inflammation and related disorders. *Chem Phys Lipids* 108: 191 - 209.
- Popik P, Wróbel M. 2001. Anxiogenic action of ibogaine. *Alkaloids Chemical Biology* 56: 227 - 233.
- Radwan MM, ElSohly MA, Slade D, Ahmed SA, Khan I. A, Ross SA. 2009. Biologically active cannabinoids from high-potency *Cannabis sativa*. *J Nat Prod* 72: 906 - 911.
- Randolph CB. 1905. The mandragora of the ancients in folk-lore and medicine. *Proc. Am. Acad. Arts Sc.* 40: 487 - 537.
- Rates SMK. 2001. Plants as source of drugs. *Toxicon* 39: 603 - 613.
- Rivier L, Lindgren JE. 1972. "Ayahuasca," the South American hallucinogenic drink: An ethnobotanical and chemical investigation. *Econ Bot* 26: 101 - 129.
- Rodrigues E. 2001. Usos rituais de plantas que indicam ações sobre o Sistema Nervoso Central pelos índios Krahô, com ênfase nas psicoativas. Doctoral thesis, Universidade Federal de São Paulo, Brasil, 166 p.
- Rodrigues E, Gianfratti B, Tabach R, Negri G, Mendes FR. 2008. Preliminary investigation of the Central Nervous System effects of "Tira-Capeta" (removing the devil), a cigarette used by some Quilombolas living in Pantanal wetlands of Brazil. *Phytother Res* 22: 1248 - 1255.
- Rodríguez E, Cavin JC. 1982. The possible role of Amazonian psychoactive plants in the chemotherapy of parasitic worms - A hypothesis. *J Ethnopharmacol* 6: 303 - 309.
- Satora L, Pach D, Butryn B, Hydzik P, Balicka-Slusarczyk B. 2005. Fly agaric (*Amanita muscaria*) poisoning, case report and review. *Toxicon* 45: 941 - 943.
- Schultes RE. 1938. The Appeal of Peyote (*Lophophora williamsii*) as a Medicine. *Am Anthropol, New Series*, 40, Part 1: 698 - 715.
- Schultes RE. 1979. Índícios de riqueza etnofarmacológica do noroeste da Amazônia. *Acta Amazônica* 9: 209 - 215.
- Schultes RE, Hofmann A. 1993. Plantas de los Dioses. Orígenes Del uso de los alucinógenos. 192 p. Fondo de Cultura Económica, México.
- Schultes RE. 1998. Antiquity of the use of new world hallucinogens. *The Heffter Rev. Psychedelic Res.* 1: 1 - 7.

- Sheppard SG. 1994. A preliminary investigation of Ibogaine: Case reports and recommendations for further study. *J Subst Abuse Treat* 11: 379 - 385.
- Shepard Jr. GH. 2002. Three Days for Weeping: Dreams, Emotions, and Death in the Peruvian Amazon. *Med Anthropol Q* 16: 200 - 229.
- Souza RSO, Albuquerque UP, Monteiro JM, Amorim ELC. 2008. Jurema-preta (*Mimosa tenuiflora* [Willd.] Poir.): A review of its traditional use, phytochemistry and pharmacology. *Braz Arch Biol Tech* 51: 937 - 947.
- Toledo BA. 2006. Aspectos cuantitativos, cualitativos y simbólicos de la medicina tradicional de los pobladores criollos de Cerro Colorado (Córdoba, Argentina). *PINACO – Investigaciones sobre Antropología Cognitiva IV*: 105 - 115.
- van der Donck I, Mulliez E, Blanckaert J. 2004. Angel's trumpet (*Brugmansia arborea*) and mydriasis in a child – A case report. *Bull Soc Belge Ophthalmol* 292: 53 - 56.
- van Dongen PWJ, Groot ANJA. 1995. History of ergot alkaloids from ergotism to ergometrine. *Eur J Obstet Gynecol Reprod Biol* 60: 109 - 116.
- Velasco G, Galve-Roperh I, Sánchez C, Blázquez C, Guzmán M. 2004. Hypothesis: Cannabinoid therapy for the treatment of gliomas? *Neuropharmacology* 47: 315 - 323.
- Wasson RG, Kramrisch S, Ott J, Ruck CAP. 1992. La búsqueda de Perséfone. Los enteógenos y los orígenes de la religión. 339 p. FCE, México.
- Weil AT. 1965. Nutmeg as a Narcotic. *Econ Bot* 19: 194 - 217.
- Weiner MA. 1971. Ethnomedicine in Tonga. *Econ Bot* 25: 423 - 450
-