Vigilância Sanitária em Debate
ISSN: 2317-269X
INCQS-FIOCRUZ

Lopes, Juliana Pereira; Soares Neto, Julino Assunção Rodrigues; Mendes, Fúlvio Rieli
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Vigilância Sanitária em Debate, vol. 10, no. 4, 2022, pp. 79-89
INCQS-FIOCRUZ

DOI: https://doi.org/10.22239/2317-269x.02066

Available in: https://www.redalyc.org/articulo.oa?id=570575686010

ARTICLE
https://doi.org/10.22239/2317-269x.02066

Psychotropic substances of natural origin: What do users find on the internet?

Substâncias psicotrópicas de origem natural: o que os usuários encontram na internet?

Juliana Pereira Lopes[I,*]

Julino Assunção Rodrigues Soares Neto[II]

Fúlvio Rieli Mendes[III]

[I] Universidade Federal do ABC (UFABC), Santo André, SP, Brasil

[II] Centro de Estudos e Pesquisas de Direito Sanitário, Universidade de São Paulo, São Paulo, SP, Brasil

[III] Centro de Ciências Naturais e Humanas, Universidade Federal do ABC, São Bernardo do Campo, SP, Brasil

*** E-mail:** fulviorm@hotmail.com

Received: 29 abr 2022
Approved: 21 set 2022

How to cite: Lopes JP, Soares Neto JAR, Mendes FR. Psychotropic substances of natural origin: What do users find on the internet? Vigil Sanit Debate, Rio de Janeiro. 10(4):79-89, 2023, November 2022. https://doi.org/10.22239/2317-269X.02066

ABSTRACT

Introduction: The internet is one of the main means for sharing information, besides being a platform with resources for online commerce. Recently, an increase interest and consumption of psychotropic substances of natural origin has been observed, whether in a religious, cultural, or hedonistic context. **Objective:** To evaluate whether the information about psychotropic substances of natural origin, available on websites published in Portuguese, is based on scientific literature, whether it presents distorted or biased content in order to stimulate consumption, and whether there are indications that the page is being used as a platform for clandestine sale of these products. **Method:** Google searches were conducted using the popular names of the substances or of plants and preparations that contain them (eg marijuana, ayahuasca, etc.), and the information available on the visited pages was classified and tabulated. **Results:** Of the 328 websites analyzed, approximately 55% were classified as informative pages and 60% of the analyzed content was in agreement with the scientific literature and was considered to be reliable. Approximately a quarter of the websites encouraged directly or indirectly the consumption of these substances, and nearly 25% presented the commercialization of products containing some of the substances researched. **Conclusions:** The results suggest that a user who searches online for natural psychotropic substances based on their popular names is predominantly exposed to information that can be supported by the scientific literature. However, the number of websites that offer products that contain these substances for sale or that share methods for consumption is also significant, often without presenting warnings about the incorrect use of such products, characterizing a risk to the user's health.

KEYWORDS: Psychotropic Substances; Psychedelics; Hallucinogens; Natural Products; Internet

RESUMO

Introdução: A internet é um dos principais meios para o compartilhamento de informações, além de ser uma plataforma com recursos para o comércio *on-line*. Recentemente tem-se observado um aumento no interesse e consumo de substâncias psicotrópicas de origem natural, seja em um contexto religioso, cultural ou hedonístico. **Objetivo:** Avaliar se as informações sobre psicotrópicos de origem natural disponíveis em *sites* publicados em português estão embasadas na literatura científica, se apresentam conteúdo distorcido ou tendencioso de forma a estimular o consumo e se há indícios de que a página está sendo usada como plataforma de venda clandestina desses produtos. **Método:** Foram realizadas buscas no Google utilizando os nomes populares das substâncias ou de plantas e preparações que as contêm (por exemplo: maconha, ayahuasca) e as informações disponíveis nas páginas visitadas foram classificadas e tabuladas. **Resultados:** Dos 328 *sites* analisados, aproximadamente 55% foram classificados como páginas informativas e 60% do conteúdo analisado estava de acordo com a literatura científica, sendo considerado como confiável. Aproximadamente um quarto dos *sites* incentivavam o consumo dessas substâncias, seja

direta ou indiretamente, e cerca de 25% apresentavam a comercialização de produtos contendo alguma das substâncias pesquisadas. **Conclusões:** Os resultados sugerem que um usuário que busca de forma *on-line* por substâncias naturais psicotrópicas a partir de seus nomes populares é exposto predominantemente a informações que podem ser respaldadas pela literatura científica. Entretanto, a quantidade de *sites* que disponibilizam produtos que contêm essas substâncias para venda ou que compartilham métodos para o consumo também é significativa, muitas vezes sem apresentar advertências quanto ao uso incorreto dos produtos, caracterizando um risco à saúde do usuário.

PALAVRAS-CHAVE: Substâncias Psicotrópicas; Psicodélicos; Alucinógenos; Produtos Naturais; Internet

INTRODUCTION

Psychotropic substances have been used by man since the beginning, whether for the treatment of illnesses or to alter the mind[1]. Marijuana (*Cannabis sativa* L.) has been widely used both medicinally and recreationally and is possibly the most consumed natural psychotropic in the world. Despite being an exotic plant, its popularization took place quickly and, today, marijuana is the most consumed illicit substance in Brazil, according to the 3rd National Survey on Drug Use by the Brazilian Population[2].

There are dozens of plants and fungi that contain psychoactive substances used by indigenous peoples or in ritualistic contexts. An example is the use of the ayahuasca brew by groups such as *Santo Daime* and *União do Vegetal*, which recently migrated to urban centers due to the search for its medicinal properties by users outside the traditional context of use[3]. The hallucinogenic sage (*Salvia divinorum* Epling & Játiva) is another example of a psychoactive plant that has gained popularity in recreational use, mainly through videos published on the YouTube platform by users in their experiments. *S. divinorum* is a perennial herb native to the mountains of Oaxaca, Mexico, which can be grown domestically in humid environments of semitropical climate, as well as marijuana, which contributes to the accessibility of the plant, mainly being found on general product retail websites, such as eBay.com[4].

The internet is one of the main means for sharing and consulting information, in addition to offering tools for contact between users and the sale of various products. However, users still lack mechanisms that allow assessing whether the accessed content is reliable, since all individuals can transmit knowledge over the network in an anonymous, personalized, or personal way[5], the information about those responsible for the pages and the operations carried out on the network being difficult to trace.

Several studies have evaluated the quality of medical information available on the internet. Some authors identified as problematic the induction of the off-label use of drugs based on an appealing discursive strategy with the use of expressions such as "intelligence pill" on internet pages that convey information about drugs for cognitive improvement[6]. Others used similar strategies for selling products for weight loss, combating anxiety and depression[6]. Thus, it is noted that users are exposed to the stimulation of substance use through personal reports and distorted information.

The availability for purchase of products with psychoactive compounds on the superficial internet (surface web) constitutes another problem. It is believed that many websites take advantage of situations not contemplated in the different regulations to promote the illegal trade in natural products that alter consciousness, which is also facilitated by the difficulty of monitoring online trade.

Considering the importance of studies that support health actions and sanitary surveillance in the area, the objective of this study was to carry out a survey on the general characteristics of the content available on the internet about psychotropic drugs of natural origin in order to demonstrate the contents to which users are exposed when they search for this subject.

METHOD

Substance selection and internet search method

This work consisted of a descriptive and exploratory study with mixed methods. The study evaluated websites with information on psychotropic substances of natural origin (obtained from plants, animals, or mushrooms/fungi). The best-known and most popular hallucinogens in Brazil were included, while stimulants and narcotic substances of natural origin, such as cocaine and morphine, were not studied. The following substances were selected to survey the information available on the internet: N,N-dimethyltryptamine, bufotenine, 5-methoxy-N,N-dimethyltryptamine (5-MeO-DMT), psilocybin, ibogaine, mescaline, tropane alkaloids (atropine and scopolamine), muscimol, Δ9-tetrahydrocanabinol (THC), salvinorin A, and myristicin.

As these substances are not usually obtained in pure form but in plants or preparations that contain them, the research was carried out based on the popular names of the species and preparations. This strategy also had the objective of bringing the result closer to that of a survey carried out by a real user.

The substances were searched individually on Google (www.google.com.br). Google is a hierarchical search engine that ranks results according to relevance and popularity, comparing information such as the text on the page with the search made by the user, prioritizing the display according to the proximity of the searched terms[7], in addition to being one of the main national and international search engines[8].

The Chart contains all descriptors (popular names) used during each search. As in most cases there was more than one descriptor per search, the "OR" search refinement mechanism was used between terms for those substances with more than one associated descriptor. For example, for research on DMT, present in the preparation of the ayahuasca drink, the following search was performed: 'Ayahuasca' OR 'chacrona' OR 'santo-daime' OR 'daime' OR 'hoasca'".

Inclusion criteria for accessed websites

The content of the first 100 results generated by Google for each substance was previously evaluated and only those that met the following criteria were included in the search: (i) pages in Portuguese and (ii) pages with information on at least one natural psychotropic substance and/or species that contain it.

Government domain pages and educational pages such as *Info Escola* and *Mundo Educação* were excluded from the sample, as they could occupy a large part of the results and the focus of this study were publications not subject to review. Pages with news of apprehension, criminalization, or decriminalization of substances, pages of articles or scientific studies and websites with duplicate content, in addition to publications only on synthetic drugs, were also excluded.

Website classification and content analysis

To enable the subsequent tabulation and evaluation of the results, the included websites were analyzed by categories and classified into subcategories:

Regarding the format and content: informative pages, institutional blogs, personal blogs, chat forums, social networks, or commercial websites.

Informative pages were considered as those whose content is merely descriptive, such as reports. Blogs were identified as personal, journal, or business diaries available online. Chat

Chart. Complete list with all descriptors (popular names) used in the 142 searches for each substance.

Chemical group	Psychotropic substance of natural origin	Representative species	Search descriptors
Indoleamines	N,N-Dimethyltryptamine (DMT)	*Psychotria viridis* Ruiz & Pav. *Psychotria carthagenensis* Jacq.	"ayahuasca" OR "chacrona" OR "santo daime" OR "daime" OR "hoasca"
		Mimosa tenuiflora Benth. *Mimosa hostilis* Benth. *Mimosa verrucosa* Benth.	"jurema" OR "jurema mansa" OR "jurema branca" OR "jureminha" OR "vinho da Jurema" OR "chá de Jurema Preta"
	Bufotenine	*Bufo alvarius* Girard *In Baird*	"gosma alucinógena de sapo" OR "gosma de sapo" OR "muco de sapo"
	5-methoxy-N,N-dimethyltryptamine (5-MeO-DMT)	*Anadenanthera peregrina* Speg. *Anadenanthera colubrina* (Vell.) Brenan	"yopó" OR "cohoba" OR "angico" OR "angico-vermelho" OR "angico-jacaré" OR "angico-branco" OR "rapé paricá/pariká" OR "rapé epená"
		Virola theiodora Warb. *Virola calophylla* Warb.	"rapé virola"
	Psilocybin	*Psilocybe cubensis* (Earle) Singer *Panaeolus cyanescens* (Berk. & Broome) Sacc.	"teonanacatl" OR "cogumelos mágicos" OR "cogumelos alucinógenos" OR "trufas mágicas"
	Ibogaine	*Tabernanthe iboga* Baill.	"iboga" OR "ibogaína" OR "chá de ibogaína"
Phenylethylamines	Mescaline	*Lophophora williamsii* (Lem. Ex Salm-Dyck) *Echinopsis pachanoi* (Britton & Rose) *Echinopsis peruviana* (Britton & Rose)	"peiote" OR "peyote" OR "cacto San Pedro" OR "tocha peruana" OR "tocha boliviana"
Isoxazole	Ibotenic acid muscimol	*Amanita muscaria* (L.) Lam.	"cogumelos mágicos" OR "cogumelos alucinógenos" AND "amanita"
Tropane alkaloids	Atropine scopolamine	*Atropa belladonna* L.	"beladona" OR "erva midriática"
		Brugmansia suaveolens (Wild.) Bercht. & J. Presl	"burundanga" OR "chá de trombeta" OR "trombeta de anjo" OR "trombeteira" OR "saia-branca"
		Datura stramonium L.	"estramônio" OR flor do diabo" OR "figueira do inferno" OR "erva do diabo"
		Mandragora officinarum L.	"mandrágora"
Cannabinoids	Δ9-tetrahidrocanabinol (THC)	*Cannabis sativa* L. *Cannabis sativa* var. *indica* (Lam.) Wehmer *Cannabis sativa* var. *ruderalis* (Janisch)	"maconha" OR "cannabis" OR "marijuana" OR "skunk" OR "haxixe" OR "hemp" OR "bud flor" OR "kief"
Diterpene	Salvinorin A	*Salvia divinorum* Epling & Játiva	"sálvia alucinógena" OR "ska pastora" OR "erva Maria pastora" OR "sally-D" AND "salvia"
Phenylpropene	Myristicin	*Myristica fragrans* Houtt.	"noz-moscada alucinógena"

Source: Elaborated by the authors, 2022.

forums are spaces for virtual interaction, where discussions with questions and answers are often promoted. Social networks are platforms that connect people or organizations, with tools such as sharing content through posts or private messages. Websites classified as commercial were those whose main objective was to sell products to other network users.

Regarding the incentive to consumption: directly encouraging consumption, indirectly encouraging consumption, does not encourage consumption, or it is not evident if there is an incentive to consumption.

A page was classified as "directly encouraging consumption" when there were testimonials and/or positive advertising about the use of psychoactive products of natural origin, as well as the use of appealing or biased language about the beneficial consumption of substances. A page classified as "indirectly encouraging consumption" disclosed information that can be considered as facilitating tools for use, such as methods of growing psychotropic plants, forms of consumption, "recipes", dosages, tips for use and/or for a good experience.

Regarding the degree of reliability of technical information: reliable, partially reliable, unreliable, or missing information.

The term "reliability" was adopted to indicate whether the disclosed information is based on the scientific literature. However, this work was limited to evaluating only the technical information about the substances, such as: chemical characteristics, mechanisms of action, side effects, adverse reactions of use, risks of dependence after consumption, warnings or risks of use, given the impossibility of analyzing personal reports from a scientific point of view.

Contents considered "reliable" were those in which all available technical information was based on the consulted scientific literature. "Partially reliable" were those who provided both correct and incorrect or partially correct information in the same text. Contents considered "unreliable" were those in which most or all of the available technical information did not agree with the consulted scientific literature. Pages that did not convey any technical information were classified as "missing information".

Regarding the country of the website's domain: Brazil, abroad, or not identified.

The domain country of a website was identified using the WHOIS database, hosted on the hostinger.com.br platform, by entering the domain name or internet protocol (IP) in the search field. Platforms like *Hostinger* offer a privacy feature where personal data is disguised and replaced with proxy server details. When a website has an active privacy feature, it is often not possible to identify their country of origin.

Finally, it was also evaluated whether the websites had authorship identification, whether person or entity responsible for the publication; whether they indicated access links to trade in the substance addressed; and access statistics of visitors to the page were published.

Data tabulation

The content of the internet pages that met the established inclusion criteria was analyzed according to the methodology explained above. The content of each page was evaluated by the authors and each category (format/content, incentive, reliability, etc.) was registered according to the evaluation, adapting to the subcategories established and described in the item "Website classification and content analysis". The tabulation of data occurred both quantitatively (type of content, information reliability, country of domain, and presence of authorship, statistics, and links for sale) and qualitatively (analysis of incentives for consumption and the presence of indications that the platforms are used for the sale or clandestine supply of psychoactive substances). The results of each individual search, by substance, were grouped in Excel tables with the electronic address (uniform resource locator – URL) and the title of the included page, followed by columns with the classification for each analyzed criterion.

The results were described in absolute number (number of websites in each subcategory) and the frequency was calculated in percentage (ratio between the absolute number and the total number of websites included per individual sample of substances).

RESULTS

General analysis

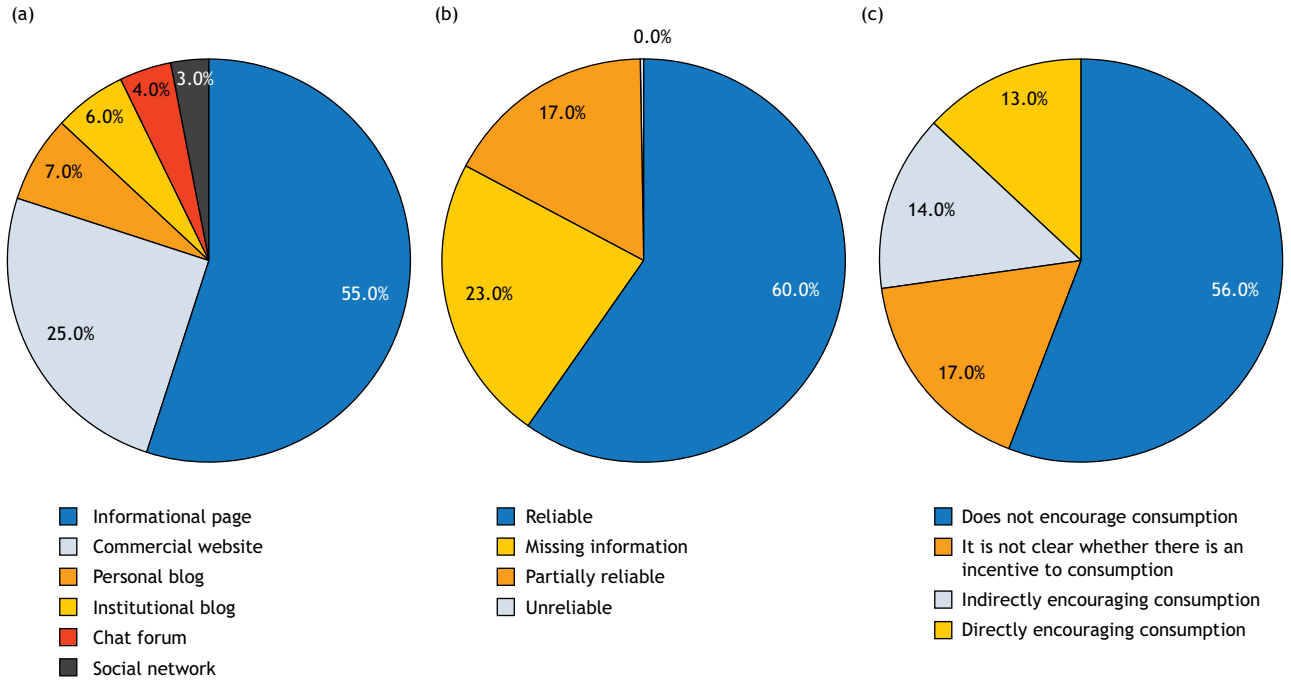
A total, 328 internet pages were included in the study, and only three substances had at least 40 websites that met the inclusion criteria, namely: ibogaine, psilocybin, and salvinorin A. For myristicin, 39 pages were included in the analysis, 35 for THC, 33 for muscimol, while the other substances had less than 30 pages included in the analyzed results.

Most websites were classified as informative pages, followed by commercial websites and personal or institutional blogs (Figure 1a). Although many pages disclose only superficial information about the cited substances, the analysis also revealed that most have reliable content (Figure 1b) and that more than half do not encourage consumption (Figure 1c). It was also observed that 87.2% of the pages identified the authorship, either the person responsible for the website or the author of the text, and that 63.1% had a domain in Brazil, with 5.2% disclosing some link to an external page. On the other hand, 75.9% did not point any reference to the information provided and only 3.0% disclosed visitor access statistics.

Analysis of results according to categories

Regarding the format and content

Most searches for substance returned informative pages (Table 1), whose content was merely descriptive, such as reports and dissemination of scientific studies aimed at the "lay" public. Dimethyltryptamine was the substance with the highest number of pages in this category (85.7%), which mainly addressed



Source: Elaborated by the authors, 2022.

Figure 1. Proportion between the different categories of websites (A), degree of reliability of the information conveyed (B) and regarding the incentive to consume (C) natural psychotropic substances (n = 328).

the historical and ritualistic use of ayahuasca. In the case of THC, 77.1% of the pages had informative content, often disclosing information about the release of medical marijuana use, describing its therapeutic effects and/or differences between cannabidiol (CBD) and THC. Similarly, the search for ibogaine predominantly returned information on therapeutic use, along with online platforms of rehabilitation clinics that offer the substance as an intervention method for drug addiction.

As regards bufotenin, the psychoactive substance from the toad *Bufo alvarius* Girard *In Baird* [sin. *Incilius alvarius* (Girard, 1859)], the analyzed content was divided into two groups: the first with scientific information about the therapeutic potential of bufotenin and the other predominantly commercial, with the offer of "toad medicine".

The search for mescaline resulted in mostly commercial websites (44.0%), including: gardening websites (or with a specific department of ornamental plants) selling the peyote cactus [*Lophophora williamsii* (Lem. Ex Salm-Dyck)], *smartshops* (virtual establishments specializing in the sale of psychoactives, usually hosted in countries where the substances are legal), and websites of a spiritual nature, selling "sacred plants". Several publications were also found about the ritualistic use of peyote, both on informative pages and on blogs, addressing its history, appearance, and effects, as well as ways of use, recommended doses, and reports with personal experiences on cactus consumption in a religious context. It is noteworthy that only one analyzed blog warned users about the risks of ingesting the Peruvian torch [*Trichocereus peruvianus* Britton & Rose or *Echinopsis peruviana* (Britton & Rose)] and instructions in cases of poisoning.

Half of the analyzed pages about psilocybin were informative, while 32.5% presented the commercialization of products that contain the substance. Among the informative pages, there were several quotes from scientific studies about its therapeutic effects, in addition to the disclosure of a survey carried out by the Global Drug Survey in 2016 accompanied by the jargon that psilocybin would be "the safest illegal drug in the world". The market that trades species and preparations containing psilocybin is characterized by diversification. The internet offers the sale of different portions in grams of dried *Psilocybe cubensis* (Earle) Singer, spore stamps, liquid spore culture, microdoses of psilocybin, magic truffles, magic mushroom cultivation kits, laboratory tools for cultivation, and smart supplements. Of the 13 websites that sold any of the items mentioned above, nine made alerts such as: "this product is not sold for human consumption, only for research and collection purposes; being the sole responsibility of the user for any other purpose given to it". Furthermore, it was identified that blogs and forums disseminate extensive content for the "psychonaut" culture, such as guides for the identification of *Psilocybe* and *Amanita* mushrooms in the wild, techniques for indoor cultivation, and the sharing among users of links to websites that offered the sale of these mushrooms.

In the case of hallucinogenic sage, it was verified that there is the possibility of private contact with sellers on social networks, as well as the presence of foreign smartshops that offer

Table 1. Classification of websites by category regarding format and content, in absolute number and percentage.

Substance	Informative page	Institutional blog	Personal blog	Chat forum	Social network	Commercial website
5-MeO-DMT	4 (14.3%)	-	2 (7.1%)	-	2 (7.1%)	20 (71.4%)
Tropane alkaloids	10 (62.5%)	-	-	-	-	6 (37.5%)
Bufotenine	11 (61.1%)	1 (5.6%)	2 (11.1%)	-	1 (5.6%)	3 (16.7%)
Dimethyltryptamine	12 (85.7%)	-	-	-	-	2 (14.3%)
Ibogaine	29 (72.5%)	1 (2.5%)	-	4 (10.0%)	-	6 (15.0%)
Mescaline	7 (28.0%)	-	1 (4.0%)	4 (16.0%)	2 (8.0%)	11 (44.0%)
Myristicin	28 (71.8%)	4 (10.3%)	-	-	1 (2.6%)	6 (15.4%)
Muscimol	21 (63.6%)	1 (3.0%)	3 (9.1%)	3 (9.1%)	-	5 (15.2%)
Psilocybin	20 (50.0%)	2 (5.0%)	2 (5.0%)	3 (7.5%)	-	13 (32.5%)
Salvinorin A	12 (30.0%)	4 (10.0%)	12 (30.0%)	4 (10.0%)	3 (7.5%)	5 (12.5%)
THC	27 (77.1%)	-	-	2 (5.7%)	-	6 (17.1%)

Source: Elaborated by the authors, 2022.
THC: Δ9-tetrahydrocannabinol.

potentiated extracts, dry leaves, and seedlings, in addition to powdered sage.

Of the entire sample, the search for 5-MeO-DMT was the one that returned the highest number of websites aimed at marketing (71.4%). Four websites retailing general products and another 14 with products classified as "esoteric" or "shamanic" that sold species or preparations containing 5-MeO-DMT were found. There is also an emphasis on social networks, such as *Gramho* (Instagram viewer), which acted as tools for publicizing the sale of a snuff preparation containing this substance.

Regarding encouraging consumption

The study identified that a quarter of the pages analyzed encourage the consumption of natural psychotropic substances, either directly or indirectly (Figure 2). Among those who showed direct incentives for consumption, personal reports were found that were considered positive and encouraging about the use of the peyote cactus, *Psilocybe* mushrooms, *S. divinorum* and *B. alvarius* secretion. The use of appealing and/or biased language was also present in blogs and advertisements, as in the description: "The holy grail, food of the gods, key to hyperawareness *Amanita muscaria*. Feel yourself in the mind of God, the energy is fluid, it is glorious, vibrant, extreme!", accompanying the sale of *Amanita muscaria* (L.) Lam. mushrooms.

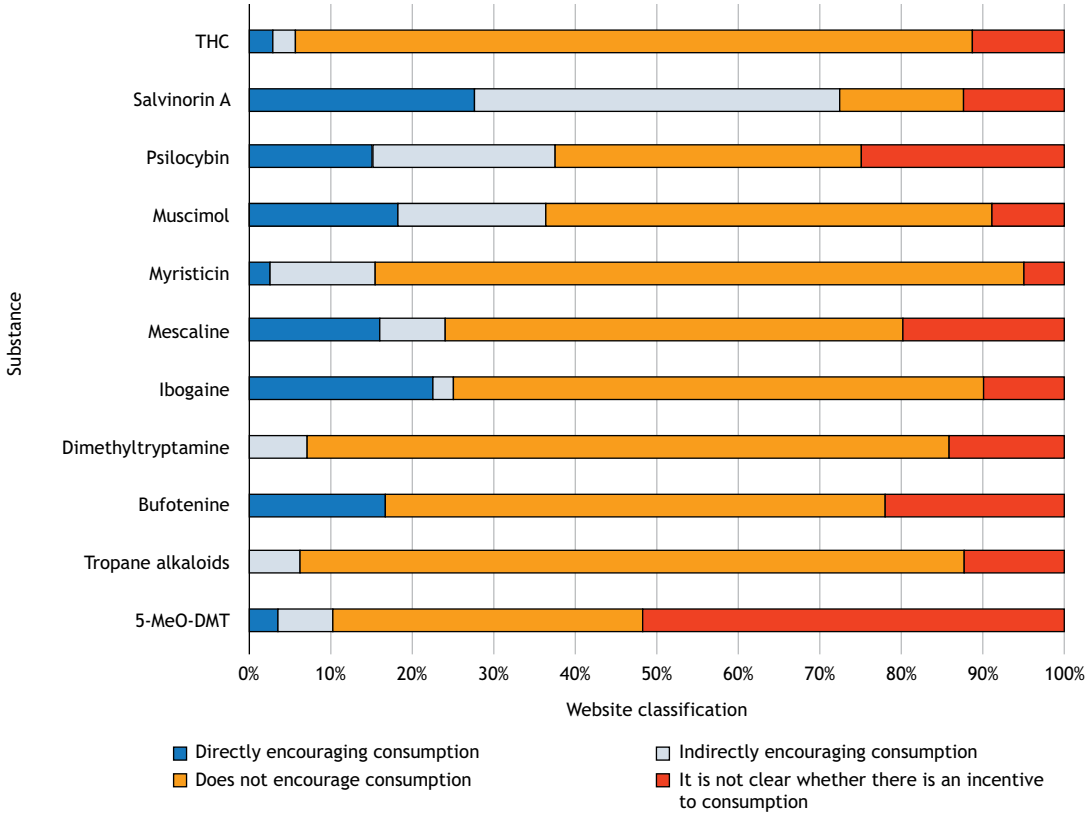
Sites classified within the indirect consumption incentive category generally disclosed techniques and methods of consumption of the researched substances. There was a broadcast of a "forest recipe", with all the steps to prepare the ayahuasca drink; information on methods of using iboga root in African rituals; how to identify in nature, prepare, consume and cultivate hallucinogenic mushrooms (*Psilocybe* ssp., *Panaeolus* ssp. and *Amanita* ssp.); different ways of using *S. divinorum* for low, moderate, and high intensity effects, in addition to specific dosages, such as the number of leaves used, drops consumed, and the number of "puffs"; and even a detailed tutorial for making homemade hashish. Many pages also instructed users with tips for a "good experience".

Among those where it is not clear whether there is an incentive to consumption, there are commercial websites and social networks whose content is focused on esotericism/shamanism. It is important to point out that some pages had some of the selected incentive indicators, however they did not induce recreational use but medical use. Research on ibogaine, for example, resulted in ten websites that encouraged its use (directly or indirectly) for the treatment of drug addiction, with four more cases in which it was not evident. Encouraging consumption to obtain the medicinal effects of substances was also observed in the search for 5-MeO-DMT (7.1%), myristicin (12.8%), and THC (2.9%) (Figure 2)

Regarding the degree of reliability and the presence of references

More than half of the analyzed content was classified as reliable (Figure 1b). Salvinorin A, ibogaine, and tropane alkaloids showed the highest rates in this category (Table 2).

It can be observed that there were cases in which partially reliable content constituted the largest portion of the analyzed websites, as in the search for mescaline; or with missing technical information, as in the search for 5-MeO-DMT and N,N-dimethyltryptamine. Although many pages presented information based on the scientific literature, most did not indicate the references or consulted bibliography. The search for bufotenine was the only one that generated results in which at least half of the pages (50.0%) had references.



Source: Elaborated by the authors, 2022.
THC: Δ⁹-tetrahydrocannabinol.

Figure 2. Percentage of websites classified in the different consumption incentive categories for each researched substance.

Table 2. Number of websites, in absolute number and percentage, with degrees of reliability of the information conveyed along with the presence/absence of references.

Substance	Reliable	Partially reliable	Unreliable	Missing information	With references	Without references
5-MeO-DMT	10 (35.7%)	2 (7.1%)	-	16 (57.1%)	2 (7.1%)	26 (92.9%)
Tropane alkaloids	12 (75.0%)	2 (12.5%)	-	2 (12.5%)	1 (6.2%)	15 (93.8%)
Bufotenine	10 (55.5%)	5 (27.8%)	-	3 (16.7%)	9 (50.0%)	9 (50.0%)
Dimethyltryptamine	6 (42.9%)	2 (14.3%)	-	6 (42.9%)	4 (28.6%)	10 (71.4%)
Ibogaine	31 (77.5%)	7 (17.5%)	1 (2.5%)	1 (2.5%)	9 (22.5%)	31 (77.5%)
Mescaline	3 (12.0%)	12 (48.0%)	-	10 (40.0%)	2 (8.0%)	23 (92.0%)
Myristicin	25 (64.1%)	14 (35.9%)	-	-	10 (25.6%)	29 (74.4%)
Muscimol	23 (69.7%)	4 (12.1%)	-	6 (18.2%)	6 (18.2%)	27 (81.8%)
Psilocybin	21 (52.5%)	4 (10.0%)	-	15 (37.5%)	11 (27.5%)	29 (72.5%)
Salvinorin A	34 (85.0%)	1 (2.5%)	-	5 (12.5%)	13 (32.5%)	27 (67.5%)
THC	23 (65.7%)	-	-	12 (34.3%)	12 (34.3%)	23 (65.7%)

Source: Elaborated by the authors, 2022.
THC: Δ9-tetrahydrocannabinol.

Of the entire sample, only one website was classified as unreliable. This disclosed that ibogaine does not pose a risk to the health of the user and did not convey any other technical information that could be analyzed.

Regarding the domain

In 63.1% of the websites included for analysis, Brazil was identified as the domain country. Brazilian domain websites were predominant for almost all substances, except for mescaline

and salvinorin A. The analysis showed that 23.8% of websites were hosted in other countries and that, in 13.1% of cases, it was not possible to identify the country of domain. A crossing of the data between the variables was carried out to produce a more detailed analysis. Among the pages with domain in Brazil, 19.8% directly or indirectly encouraged consumption. This number increases among those with a domain abroad, with 29.5% presenting direct or indirect encouragement, and more than doubles among those websites that did not have their domain identified (53.5%).

Regarding the presence of authorship, external links, and access statistics

The search for salvinorin A was the one that most returned websites without authorship (45.0%), since all other substances had less than 25% of content without author indication. The indication of links that led to pages selling psychoactive products was observed for almost all substances, with the exception of pages about 5-MeO-DMT, tropane alkaloids, and N,N-dimethyltryptamine. Finally, only 3.0% of the websites visited made the visitor access statistics feature visible, found in searches for 5-MeO-DMT, bufotenine, ibogaine, mescaline, muscimol, and salvinorin A. Of these, most had a high number of hits per page. A website that commercialized the sale of *Tabernanthe iboga* Baill seeds had 7,623 views and 60 comments, a newsletter about "magic mushrooms" presented 16,161 views and a record on *S. divinorum* on a personal blog reached 232,618 views at the time of analysis.

DISCUSSION

The present study sought to evaluate the general characteristics of the content available on the internet about psychotropic drugs of natural origin, in particular regarding the type of website, the degree of reliability of the information conveyed, and whether the pages directly or indirectly encourage the use of these substances. In general, the results obtained indicated that the websites surveyed were mostly informative pages, although several commercial websites were found. Mostly, the content of the analyzed pages proved to be reliable and the consumption incentive was observed with some frequency, either directly or indirectly. Although some websites were classified as commercial, the sale of such products was not always explicitly announced, and in many cases devices were used to possibly circumvent current legislation. Within the context of Brazilian health legislation, the SVS/MS Ordinance No. 344, of May 12, 1998[9] stands out, which approves the Technical Regulation on substances and medicines subject to special control, establishing the general requirements for trade, transport, prescription, storage, control, and inspection of controlled substances. Controlled substances (or substances subject to special control) are those with action on the central nervous system and capable of causing physical or psychological dependence, substances that can originate psychotropic drugs, inputs used in the manufacture of narcotics and psychotropic drugs, plants used in the manufacture of narcotics, among others. Substances and special drugs are arranged in lists that are published through updates to Annex I of the Ordinance, the most current being the Resolution of the Collegiate Board of Directors (RDC) No. 607, of February 23, 2022[10].

List E describes prohibited plants that can originate narcotic and/or psychotropic substances and list F, substances prohibited in Brazil. Included in list E are some of the species containing psychotropic substances that were the subject of this study: *Cannabis sativa*, *Datura suaveolens* Willd. [sin. *Brugmansia suaveolens* (Wild.) Bercht. & J. Presl], *Lophophora williamsii*, and *Salvia divinorum*, and for the substances on this list, their import, export, trade, handling, and use are prohibited[10]. In the F2 list, there are some of the psychotropic substances themselves, among which are: psilocybin, psilocin, DMT, mescaline, salvinorin A, and 5-MeO-DMT[10]. There are some exceptions provided for in the regulation, such as when a drug is approved containing these substances or about *Cannabis* products authorized in Brazil that contain THC.

All mentioned proscribed plants and substances were found being sold on Brazilian and/or foreign websites in Portuguese. It should be noted that the importation of substances and plants subject to special control is only authorized by requesting an Import Authorization (AI) and failure to comply with this requirement constitutes a sanitary infraction (art. 4, item II and art. 70)[11].

Previous studies related to the collection and analysis of data from internet pages about psychoactive products identified the presence of notices, on commercial websites, that the products "are not intended for human consumption"[12,13,14] or that are sold in plastic bags labeled with phrases such as "for laboratory use only"[12]. A frequent case observed in our analysis was the sale of *P. cubensis* mushrooms, in grams or spores, under the heading that it would have exclusively "purpose of research, collection or ethnobotanical sample", even though it is mandatory to request a Simplified Special Authorization for an Education and Research Institution (AEP) for such use (art. 53)[11]. This type of indication can be framed in what will be called "marketing strategies", since this act aims to transfer the responsibility for consumption to the buyer, with the aim of exempting the person responsible for the sale from possible punitive measures. It is important to emphasize that, even so, such activity remains illegal, both for those who buy and for those who sell, according to the aforementioned health legislation.

Another strategy observed was the sale of plants under the pretext of being intended for gardening, found on websites selling peyote, San Pedro, and Peruvian torch cacti. Although they are, in fact, exotic species with added landscape value, the aforementioned sanitary legislation in force prohibits their trade and use. The availability of psychoactive products in esoteric/shamanic virtual stores also seems to be another adopted sales method, since these pages are often used by real users for recreational purposes. For instance, within blogs and forums links are shared between users, with platforms such as "divine nature" being cited for obtaining

salvinorin A and "alternative nature websites out there" for purchasing *A. muscaria*.

Studies on illegal drug trafficking over the internet, focusing on special control drugs, observed the use of Instagram and Facebook with sales promotion posts or with contact information for the alleged seller[15,16]. The present study also found posts on social networks that directed to marketing pages or that provided contact for sales of natural origin hallucinogens.

The promotion of product consumption through social networks is notorious when analyzing the impact caused by digital influencers in digital marketing, who play an important role in consumers' purchasing decisions, influencing the behavior and opinion of followers through digital media[17]. Therefore, in addition to the hypothesis that social networks act as a vehicle for the sale of illegal substances, as well as commercial websites, there is a possibility that the influence on the consumption and/or purchase of these products is enhanced when disclosed through these tools, as they are currently used for these purposes. It is also likely that other technological means will be used for this purpose, such as chat applications (such as WhatsApp), since such applications make it possible to reach numerous people simultaneously, in real time, and with encrypted technology.

Together with the availability of purchase of psychoactive products, there is the sharing of methods of consumption of these substances, a fact that was verified mainly in the searches for salvinorin A, psilocybin, and muscimol. As the search methodology did not use any specific purchase descriptor, it is possible to assume that even individuals who conduct research on such substances out of "curiosity" can be influenced to use them, especially if we take into account the presence of user reports about positive personal experiences with natural drugs.

The analysis of the domain of the websites also opens space for discussion. Consumption-inducing pages often have active data protection factors, making it difficult for those responsible for the content to track them, and online stores with a foreign domain can claim that they are under the legislation of another country – usually one that allows the sale of a substance considered illegal in Brazil. It is important to mention that in Brazil there are mechanisms for denouncing the illegal sale of products, such as Fala.BR – Integrated Platform for Ombudsman and Access to Information[18].

The tacit and erroneous knowledge that "what is natural is not harmful" encourages the use of this class of substances. However, it is important to remember that psychoactive plants and fungi, in general, are highly toxic. Adverse reactions that can be experienced range from euphoria and aggressive excitement to convulsions, coma, and death[19,20,21,22]. Cases of accidental severe poisoning have been reported, due to erroneous attempts to collect *A. muscaria*[23], which characterizes an alert, considering that one can learn how to cultivate, identify in nature, and prepare psychotropic species through the internet. Furthermore, products available online, often of unknown origin, may contain contaminants or be adulterated[24], making it difficult to predict possible side effects and adverse reactions.

On the other hand, the internet has also proved to be a source of information about the therapeutic use of natural psychotropic substances, often associated with the dissemination of scientific studies in the area. Results of an analysis evaluating the effectiveness of iboga root use in drug users[25] were commonly associated with information about rehabilitation clinics in Brazil that offer ibogaine as a treatment option. Contents were also found in language accessible to the lay public reporting scientific studies on the use of the secretion of the toad *B. alvarius* to improve cognition and affection[26], on the therapeutic potential of the ayahuasca brew for the treatment of psychiatric and neurological diseases[27,28], and on the use of psilocybin for the treatment of depression[29].

There are some limitations inherent to the analysis carried out and the results obtained that must be mentioned. The main one refers to the changing nature of the internet: the content available on the network is constantly changing and these results reflect only one point in time: from January to June 2021. The use of popular names and street names of substances in the research carried out may characterize another possible limitation. This strategy was used in order to simulate how a lay user would search the internet without knowing the scientific names of psychotropic plants or their psychoactive substances. However, in some cases, the name of the hallucinogenic chemical present in plants, animals or fungi/mushrooms is widely used among laypeople, as is the case with DMT, THC, and psilocybin. It is also important to emphasize that specific purchase descriptors were not used, as the interest was to evaluate the content of pages that would be found in a simple search using popular names of substances or plants that contain them. Furthermore, it is emphasized that the analysis of the content of the evaluated websites was subject to a certain subjectivity, due to the use of terms and expressions with different connotations. This was a limiting factor for the encouraging category, therefore, cases in which it was not possible to state that the authors encouraged consumption, it was chosen to represent with the classification "it is not evident".

Finally, the choice of browser, as well as its settings, personal history, and geographic location can also influence the results, that is, individuals who have previously purchased these products on the internet would possibly have more commercial websites as a result, even using the same descriptors used in this study.

CONCLUSIONS

It is concluded that the internet can be useful in the search for reliable information on natural psychotropics, since most of the content available on the network was presented in accordance with the scientific literature consulted. Scientific dissemination

content about the therapeutic potential of psychoactive substances, aimed at the lay public, is also easily accessible. However, a portion of the results show that users are also exposed to partial content and personal reports regarding the consumption of these substances, often encouraging the use, directly or indirectly.

Of the 82 websites identified as commercial, 51 offer substances whose use is prohibited in Brazil. In addition to purchasing power, users can easily find guides on "how to use" these products in their own home, considering that there is sharing of methods of use and cultivation on informative pages, blogs, and forums, mostly without accompanying warnings about the inherent risks. Therefore, the study indicates the need for monitoring and inspection of Brazilian websites whose content is focused on psychotropic substances of natural origin and/or plants that contain them. Social networks should also be monitored, as they act as facilitating tools for illegal online trade.

The analysis of the connotation of publications is also necessary, since it has been demonstrated that there are marketing strategies adopted by those responsible for virtual platforms in order to circumvent the legislation, transferring responsibility for use to the buyer, although trade is prohibited in the country for any unregulated purpose.

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Acknowledgment

We thank Ana Cecília Bezerra Carvalho, from the Brazilian National Health Surveillance Agency (Anvisa), for reviewing the text and providing valuable comments, as well as the Federal University of ABC (UFABC) for the scholarship granted to Lopes JP.

Author's Contributions

Mendes FR – Conception, planning (study design), analysis, data interpretation, and writing of the work. Lopes JP – Acquisition, analysis, data interpretation, and writing of the work. Soares Neto JAR – Writing of the work. All authors approved the final version of the work.

Conflict of Interests

The authors inform that there is no potential conflict of interest with peers and institutions, politicians, or financial in this study.