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Ritual Use of Plants with Possible Action on the Central Nervous System by the Krahô Indians, Brazil

Eliana Rodrigues* and E. A. Carlini

Department of Psychobiology, Universidade Federal de São Paulo, Rua Botucatu, 862 – 1° andar Edifício Biomédicas CEP 04023-062, São Paulo, SP, Brazil

The aim of the present study was to document the use of plants, probably acting on the central nervous system (CNS), in rituals carried out by the Krahô Indians, who occupy the cerrado biome in the central region of Brazil. The 2 years of fieldwork were guided by methods of anthropology and botany. The local shamans have indicated 286 formulas, consisting of 138 plant species in 50 uses that could be associated with some type of action on the CNS; of which 98 formulas, 87 plants and 25 uses, appear to involve psychoactive properties, such as: 'to get slow', 'stimulant effect', 'to calm down', 'to enhance memory', 'to reduce anxiety' and 'to induce sleep'. Phytochemical and pharmacological literature data were queried to establish any correlation between indigenous knowledge and scientific indications, for each one of the 138 plant species. Studies were available for 11 of these plants; and for two of them, scientific data coincided with indigenous information.

Keywords: ethnopharmacology; central nervous system; psychoactive plants; medicinal plants; healers; shamanism.

INTRODUCTION

The retrieval of knowledge on the use of medicinal plants among populations that live in the Brazilian wilderness may serve as a valuable tool in the discovery of new drugs, due to high biodiversity and endemism in its five main biomes [amazonian forest, cerrado, atlantic rainforest, stunted sparse forest (caatinga), and pantanal]. These environmental aspects are moreover associated with a process of intensive cultural mixing, involving Indigenous, European and African ethnic groups, which has resulted in an enhanced richness of folk knowledge. Psychoactive plants, those that have the ability to affect aspects of the mind and behaviour, including patterns of thought, humour, anxiety, cognitive performance and well-being (Bertolote and Girolamo, 1993), are commonly utilized by indigenous cultural groups and by African descendants, mainly during healing ceremonies.

Several surveys have been developed among South and Central American indigenous cultures concerning the use of plants in rituals, mainly the psychoactive ones during shamanism (Schultes, 1973; Coelho, 1976; Díaz, 1977; Schultes, 1979a; Dobklin, 1989; Dobklin and Winkelman, 1989; Schultes, 1990; Schultes and Raffauf, 1990; Bennett, 1992; Schultes and Hofmann, 1993; Shepard, 1998). Despite innumerable contributions in the field of psychoactive plants, there are almost no similar studies among tribal Indian groups inhabiting the cerrado biome in Brazil. Therefore, the aim of the present study was to conduct an ethnopharmacological survey among the Krahô Indians, concerning plants claimed to act on the central nervous system (CNS) used during rituals for the purpose of curing pathologies and altering the mind.

The Krahô are known for their rich knowledge of medicinal plants, their complex methods of healing, striking fascination with rituals (Melatti, 1967; 1978) and for their relative isolation from conventional medical treatment. About 1700 Krahô occupy an area of 302 533 hectares of the cerrado, close to the Tocantins River, in Tocantins State (Fig. 1) and are distributed among 16 villages. They speak the Timbira language and Portuguese.

The cerrado, consisting originally of an area of 1.5 million km^2 is the second largest biome in South America, and is almost exclusively Brazilian (Proença *et al.*, 2000) (Fig. 1). Today, the cerrado domain has been reduced to a third of its original area (Paiva, 2000).

In the Krahô area, there are about 58 healers (shamans known as *wajacas*) who are sought for the treatment of various illnesses.

BACKGROUND AND METHODS

The fieldwork was undertaken by one of the authors (ER) from July 1999 to July 2001, by utilizing methods from anthropology and botany. A total of ten trips, each of 20 days duration were made to three Krahô villages. Prior consent was obtained during meetings in each village in the beginning of the fieldwork.

* Correspondence to: Dr E. Rodrigues, Department of Psychobiology, Universidade Federal de São Paulo, Rua Botucatu, 862 – 1° andar Edifício Biomédicas CEP 04023-062, São Paulo, SP, Brazil.
E-mail: elirodri@psicobio.epm.br
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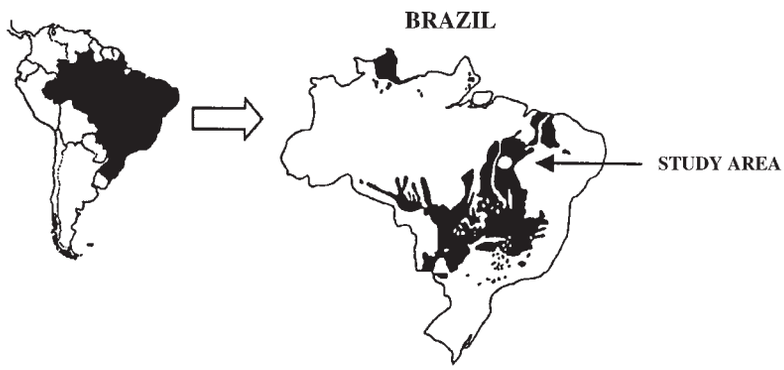

Figure 1. Location of the Krahô domain in Tocantins State (shown in white dot on the map; see arrow), in an original area of cerrado biome in Brazil (shown in black on the map on the right) (Ferri, 1969).

At the beginning of the fieldwork, while becoming acquainted with the area, informal interviews (Alexiades, 1996) were performed among 200 adult inhabitants of the three villages. Seven individuals were selected to participate in the study, as they were identified as *wajacas* by the others. Once selected, the knowledge of these seven *wajacas* regarding their methods of diagnosis and healing, and their beliefs, were obtained through interviews and participant observations (Bernard, 1988). Personal and ethnopharmacological aspects of the interviewees were obtained with the use of questionnaires with open questions in semi-structured interviews (Martin, 1995) where the following topics were addressed: line of descent, age, level of schooling and the status of each interviewee in his/her community (personal data); composition of a given formula, its respective therapeutic indication, doses, method of preparation and counterindications (ethnopharmacological data). The same interviewees were repeatedly queried during different field trips to confirm the information provided by them previously (Bhandary *et al.*, 1995).

During the interviews, it was possible to learn and to document the use of plants for many therapeutic purposes. This information was used to select the plants and their medicinal formulas with possible CNS activity, the focus of this study.

It was necessary to establish a translation system with the help of Krahô teachers, since, despite utilizing rudimentary Portuguese to communicate with the '*no Indian people*', the interviewees also had their own language, which they used most of the time. Through this process, correlations were made between the indications by the Krahô and those according to conventional medicine. Translation permitted the understanding of certain beliefs linked to the cause of some illnesses. For example, in Krahô medicine there are three types of fever, each having a different origin, symptomatology and name. A similar categorization of febrile illnesses was also observed in an African culture (Ajaiyeoba *et al.*, 2003).

Three samples of each plant were obtained based on the alcohol-preserved method, suggested by Alexiades (1996), by the interviewees. Species were collected considering the following information; blooming, fruiting, origin and location at the time of collection, as recommended by Lipp (1989) and Hedberg (1993). Pictures of the collected materials were also taken. The plant material collected was identified by taxonomists at the Botanical Institute of São Paulo State (IBt-SP) and a voucher sample deposited at that Institute. A search was made with regard to the origin of each identified species (native or exotic), based on consultation with the Missouri Botanical Gardens website (2004) and the reference books by Pio Corrêa (1926).

Phytochemical and pharmacological searches were also conducted in the following databanks: *Chemical Abstracts* (CA); *International Pharmaceutical Abstracts* (IPA); *Literatura Latino-Americana e do Caribe em Ciências da Saúde* (LILACS); *Analytical Abstracts* (ANAB); OLDMEDLINE and MEDLINE, to verify the existence of published reports during the past 35 years for the species cited in the present study.

As with former publications (Rodrigues, 2001; Rodrigues and Carlini 2003a; 2003b; 2004) and in accordance with a recent Brazilian law (Brasil, Medida Provisória n. 2.186-16, 2001), the scientific names of plants indicated by the interviewees have not been included in this manuscript with a view to safeguarding traditional knowledge. In this way, in case of any future pharmacological investigation that might lead to commercializing of new medication, those populations interviewed would be able to participate in the benefits from the same. However, the plants are referenced by their respective names in the Timbira language, noted in bold italics throughout the text. Our decision, is part of a trend in global conduct utilized by investigators developing projects with medicinal plants associated with traditional knowledge, with the intention of guaranteeing ethnic groups their rights in a possible patent (Greaves, 1994; Cunningham, 1996; Clement and Alexiades, 2000; Laird *et al.*, 2002). It is certain that the Krahô deserve to obtain adequate compensation for their knowledge, since as for any other Brazilian searcher they have contributed information that may decrease the efforts needed in the studies for new drug development. Therefore, in this article, only 11 of 138 species identified were revealed, since they have already been published in the scientific literature. The indigenous uses associated with these species were not identified (Table 1).

RESULTS AND DISCUSSION

Melatti (1978) describes 40 rites observed among the Krahô Indians, most of them using plants and animals; there are rites of passage (Van Gennep, 1978), such as:

Table 1. Eleven plant species present in the therapeutics of the Krahô that have been previously published in the scientific literature, indicating some effects and actions

Scientific names (family) Voucher	Actions and effects described by science
1. *Himatanthus obovatus* (Muell. Arg.) Woods. (Apocynaceae) Rodrigues 627	Antifungal (Harumi *et al.*, 1994)
2. *Piper tuberculatum* Jacq. (Piperaceae) Rodrigues 781	Hypotensive (Duarte *et al.*, 1999)
3. *Brosimum gaudichaudii* Trécul (Moraceae) Rodrigues 1013	Mutagenic (Varanda *et al.*, 2002)
4. *Hymenaea stigonocarpa* Mart. ex Hayne (Fabaceae) Rodrigues 1015	Anticholinergic (Sena *et al.*, 1996)
5. *Vernonia herbacea* (Vell.) Rusby (Asteraceae) Rodrigues 1017	Increase glomerular filtration (Dias *et al.*, 1996)
6. *Tabebuia ochracea* (Cham.) Standley (Bignoniaceae) Rodrigues 827	Antimalarial (Perez *et al.*, 1997)
7. *Casearia sylvestris* Sw. (Flacourtiaceae) Rodrigues 846	Antiinflammatory (Ruppelt *et al.*, 1991)
8. *Cochlospermum regium* (Mart.) Pilger (Cochlospermaceae) Rodrigues 754	Antinociceptive (Castro *et al.*, 1998)
9. *Byrsonima crassifolia* (L.) Kunth. (Malpighiaceae) Rodrigues 977	CNS depressor (Cifuentes *et al.*, 2001)
10. *Kielmeyera coriacea* Mart. (Clusiaceae) Rodrigues 708	Antifungal (Cortez and Cortez, 1998)
11. *Pterodon emarginatus* Vogel (Fabaceae) Rodrigues 734	Antiinflammatory (Carvalho *et al.*, 1999)

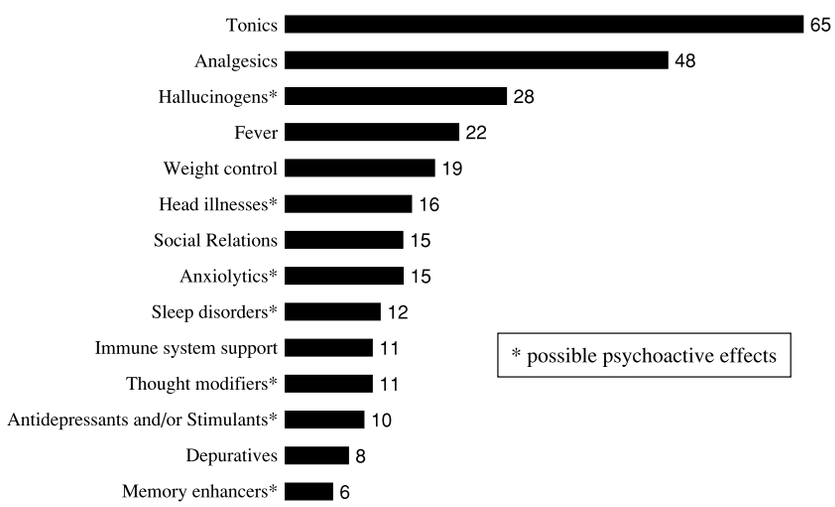

Figure 2. The 14 categories of use (left) of the 138 identified plants with which 286 formulas (right) are prepared and used by the Brazilian Krahô ***wajacas*** to treat different CNS ailments. The seven categories of uses with asterisk (*) appear to have some relation to psychoactive effects, and a total of 98 formulas.

of birth, of puberty and of initiation; and a particular rite of initiation 'to be race champion' in a certain way, explains the great number of plants used as tonics (see Fig. 2). There is also the rite of healing (Mauss, 1974) that will be described below.

Medical practice of the Krahô

The *wajaca* is the individual recognized by the Krahô people as the keeper of the knowledge on herbal remedies and healing processes, for which they receive instructions and help from their respective ***pahis***. The *pahis* are spiritual guides, generally represented by the spirits of animals, plants, minerals, objects or even the deceased. He may heal or kill another, acting respectively as a *wajaca* or a sorcerer. Each *wajaca* is a specialist in one or more illnesses, such as fever, diarrhoea, snakebites, those brought by the wind, or even spells cast by other *wajacas*.

The healing process involves two parts: the first is a ceremony conducted by the *wajacas*, mainly at night. During this practice they smoke tobacco, marijuana, or some other native plants, such as ***caprankohiré***; ***pjejapac, ahkrô*** and ***mãputréhô*** (see more details in section on Hallucinogens), for which a special pipe is used, called a ***cót***. The act of smoking could help in communicating with the *pahi* or in furnishing more power at the moment of the healing, according to the interviewees. The exhaled smoke is blown at the patient, spreading out the illness to be able to 'be more clearly diagnosed'; or, even, to 'gather' the illness which is spread throughout the body of the patient to a single point so that it can then be 'aspirated' by the shaman, 'removing' the illness from the patient's body.

In the second part, after the ceremony, the *wajaca* chooses one plant to be utilized in the treatment and returns several times to the patient's home to follow up on the effects of the remedy administered.

Plants

The Krahô shamen indicated a total of 255 plants utilized for all kinds of diseases and complaints; 145 of these plants were indicated by more than one shaman. From those 255 plants, 108 were used exclusively for CNS effects and/or for mental problems; 82 other plants were employed for either CNS/mental effects or for problems affecting other organs and systems, comprising 190 plants (74.5% of all the 255 plants utilized). From those 190 plants, 138 were identified to the level of species; 20 to the genus level; and the remaining 32, only to the family level. Among other reasons, the high

number of unidentified species could be explained by either the lack of earlier botanical studies in the Krahô area, or to the possibility that some of these plants could be new species, and therefore should be under investigation.

With the exception of only two plants, all the others collected in this study belong to the division Magnoliophyta which, in a certain way, tends to optimize new drug locations. In fact, as reported by Soejarto *et al.* (2001), 85% of the many species which produce drugs of natural origin belong to that division. All of the 138 plants (indicated for their CNS/mental effects) identified to the species level, are native of the Brazilian flora and belong to 63 taxonomic families, mostly Fabaceae (16 species recorded), Caesalpiniaceae (11), Euphorbiaceae (8), Bignoniaceae (6), Sterculiaceae (5), Asteraceae (4), Malpighiaceae (4), Mimosaceae (4), Orchidaceae (4) and Rubiaceae (4). Besides these families, two other families were reported by three species each; 15 families by two species, and 36 by one species, totaling the 138 species.

Uses

The 138 identified plants are used to treat 50 different complaints and/or ailments which might suggest that they may be in some way active on the CNS. These uses were further grouped into 14 categories according to similarities among their expected effects on the CNS, as can be seen in Table 2. For example, uses 1–4 (category 1 – **tonics**) comprised a total of 57 plants employed to improve physical and mental strength; uses 34–39 (11 plants) were included within the category 9 – **sleep disorders**. In some instances the same species was cited for more than one use. For example, the species known as ***wrywry cahàcré***, was cited by different interviewees for various uses, belonging to the categories: **thought modifiers**, **tonics** and **memory enhancers**. Another species, known as ***cuhty***, appears in the categories: **tonics**, **fever**, **analgesics**, **immune system support** and **depuratives**.

Seven of the 14 categories of use of the plants seem to deal, mostly if not exclusively, with the mental domain; for this reason, it is suspected the plants involved have psychoactive effects; these seven categories are: category 3 – **hallucinogens** (4 uses; 23 plants); category 6 – **for head illnesses** (4 uses; 15 plants); category 8 – **anxiolytics** (2 uses; 14 plants); category 9 – **for sleep disorders** (6 uses; 11 plants); category 11 – **thought modifiers** (4 uses; 8 plants); category 12 – **antidepressants and/or stimulants** (3 uses; 10 plants); category 14 – **memory enhancers** (2 uses; 6 plants). In conclusion, for the 25 above mentioned uses, the *wajacas* utilize as much as 87 plants, in other words, for some complaints/ailments there are several plants available.

Formulas

The formulas represent the ways in which parts of the plants (leaves, seeds, flowers, roots, and so on) are manipulated for a particular use. Thus, the 138 species have 248 citations (Table 2) for the 50 uses with possible effects on CNS, organized into 14 categories. Those 138 plants are utilized in the preparation of the 286

Table 2. The 50 uses of 138 identified plant species by the Brazilian Krahô *wajacas* to treat different CNS ailments, grouped in 14 categories

Uses for CNS complaints (number of plants cited)[a]	Category
1. *Leg strengtheners* (21)	1 Tonics
2. *General strengtheners* (29)	
3. *Strengtheners for babies' legs* (5)	
4. *Aphrodisiacs* (2)	
5. *Headaches* (14)	2 Analgesics
6. *Toothache* (3)	
7. *Joint pain* (4)	
8. *Backpain* (2)	
9. *Leg pain* (3)	
10. *Ankle pain* (1)	
11. *Body aches in general* (13)	
12. *To modifying mind* (16)	3 Hallucinogens[b]
13. *To talk to pahis (spirits)* (4)	
14. *Smoking substituted by tobacco* (1)	
15. *To get slow* (2)	
16. *Fever* (19)	4 Fever
17. *To lose weight* (7)	5 Weight control
18. *To not fatten* (1)	
19. *To suppress appetite* (2)	
20. *To stimulate appetite* (6)	
21. *To fatten* (2)	
22. *To prevent going crazy* (1)	6 Head illnesses[b]
23. *Illnesses of the karõ (soul)* (5)	
24. *For tremors* (1)	
25. *Craziness* (8)	
26. *To prevent matrimonial separation* (1)	7 Social relations
27. *To attract someone* (3)	
28. *To steal a man from his wife* (1)	
29. *To marry* (2)	
30. *To divorce* (2)	
31. *To fall in love* (4)	
32. *Anxiety* (2)	8 Anxiolytics[b]
33. *To calm* (12)	
34. *To stop snoring* (2)	9 Sleep disorders[b]
35. *To sleep longer* (1)	
36. *To have premonition dreams* (1)	
37. *To sleep more lightly* (1)	
38. *To have good dreams* (1)	
39. *To induce sleep* (5)	
40. *To enhance immune system* (9)	10 Immune system support
41. *To help thinking* (5)	11 Thought modifiers[b]
42. *To rest the head* (1)	
43. *To have an open mind* (1)	
44. *To clear one's thoughts* (1)	
45. *For being happy* (6)	12 Antidepressants and/or Stimulants[b]
46. *To remove sadness from the body* (1)	
47. *Stimulant* (3)	
48. *To purify the blood* (5)	13 Depuratives
49. *To enhance memory* (5)	14 Memory enhancers[b]
50. *To remember dreams* (1)	

[a] Although the total number of plant species indicated for the CNS is 138 (belonging to the 14 categories), there are a total of 248 citations of plants – in parentheses – once, in some cases, the same species was cited for more than one use.

[b] Categories of uses that appear to have some relation to psychoactive effects.

formulas indicated to the 14 categories. Of these, 98 formulas are indicated in the seven categories that may be related to psychoactive effects (Fig. 2). One of these formulas is accomplished by placing the leaves of a plant in a bottle with sugar and water. After being stoppered and sealed, the bottle must be submerged in a river for 3 days. It is then exposed to the sun for an other 3 days, after which the medicine is ready to be consumed. Besides knowledge on how to compound the formulas (parts of the plant utilized and methods of preparation), the Krahô medicine also has notions on the doses required (distinctly for adults and children), observations on the effects and contraindications (generally made for children, olderly and pregnancy) for each of the formulas.

Below is a description of the plants and their uses belonging to five of the categories listed in Table 2.

Hallucinogens (23 plants)

In an attempt to acquire, as near as possible, the effects of the drugs consumed as hallucinogens, the interviewees were asked to compare the effects of their plants with those produced by marijuana (whose effects are well known by the Krahô, and is referred to as ***iamhô***). In this category, 16 plants were cited for 'modifying the mind' substituting for marijuana in therapeutic and social contexts. The *wajaca* considered these plants as dangerous, since according to them, they stay longer than marijuana in the body, and their abuse could result in mental disturbances. Among these plants, one known as ***pjejapac*** was described as having stronger effects than marijuana, another plant, also known as ***pjejapac***, was utilized by former *wajacas* to dream about diagnoses and remedies. Three other native plants, ***caprãnkohiréhô kohihti***, ***ahkrôré*** and ***cumxê***, possessed effects similar to that of marijuana. Some *wajacas* use the leaves of the former and of marijuana to go into the forest in search of a plant for a certain remedy. Other plants known as ***caprãnkohiré***, ***ahkro***, ***mãputréhô*** and ***tingui*** are weaker in relation to marijuana. 'They are equivalent to a draft of marijuana, causing one to move slowly, making one think deeply, and leaving the head cold'. The manner in which these plants are prepared varies: decoctions, teas and cigarettes.

Anxiolytics (14 plants)

The roots and leaves of two plants are chewed before walks in the forest to prevent the fear of encountering certain animals, such as jaguars and snakes. This fear was related to the indication 'anxiety'. Twelve other plants, ingested in the form of a tea, are utilized 'to calm down' individuals in particular situations.

Sleep disorders (11 plants)

Among the uses in this category, two of them deserve attention, such as: 'to stop snoring' and 'to sleep more lightly'. The latter refers to the situation when someone sleeps in an area with wild animals, and he/she needs to stay alert. The majority of these formulas are prepared as teas and administered acutely.

Antidepressants and/or stimulants (10 plants)

Some uses included in this category optimize a person's state of mind, such as indications 'for being happy' and 'to remove sadness from the body'. Generally, they involve the consumption of teas. However, extracts of the plants could also be used to do body paintings with the same aim. Another indication included in this category is the 'stimulant', which was so defined because the interviewees referred to some of these plants as having been substituted by the introduction of coffee.

Thought modifiers (8 plants)

This category includes various uses that are related to modifying, in the hope of improving of the mind. Five plants were cited to 'help thinking' that is, they believed that by consuming such plants the person becomes able to solve problems. Another was to 'clear one's thoughts', a remedy utilized when a person wishes to relieve himself of a persistent thought, and one plant 'to rest the head', in the case of a person who uses his faculty of reasoning for hours non-stop. A certain formula is used to 'have an open mind', in which after drinking a tea prepared with this plant, many thoughts enter the head rapidly, almost simultaneously. Generally, these uses are acute, in the form of teas.

Phytochemical and pharmacological studies

Of the 138 identified species investigated (those indicating effects on the CNS), only 11 had been the subject of phytochemical and pharmacological studies (Table 1). In these limited studies, there were two cases in which the indigenous indication agreed with the scientific data. The indication for ***p æhkôtycre*** – *Cochlospermum regium* (Mart.) Pilger (Cochlospermaceae) – which is a headache treatment, agrees with the antinociceptive effect cited in the literature (Castro *et al.*, 1998). *Casearia sylvestris* Sw. (Flacourtiaceae), known as ***amcokor jrehhô***, has as one of its indigenous indications, conjunctivitis, which is in agreement with a study by Ruppelt *et al.* (1991) showing its antiinflammatory effect. It is also relevant to mention that six other species, indicated by the Krahô Indians in this work, have been used therapeutically by other Brazilian peoples, at least since the 19th century, although with different usages, according to d'Oliveira (1854), they are: *Anacardium occidentale* L. (Anacardiaceae), *Copaifera martii* Hayne (Fabaceae), *Erythroxylum suberosum* A. St.-Hil. (Erythroxylaceae), *Helicteres brevispira* A. St.-Hil. (Sterculiaceae), *Hymenaea stigonocarpa* Mart. ex Hayne (Fabaceae) and *Platonia insignis* Mart. (Clusiaceae).

CONCLUSIONS

The data in this initial work show that the cerrado biome, like the Amazon forest (Schultes, 1979b), may also have potential for psychoactive drug development. Moreover, the correlation between the Krahô indications and experimental research documented in the

literature (phytochemical and pharmacological data) indicate that further pharmacological investigation on these plants deserve to be performed. For example, two of the eleven species listed in Table 1 have already been shown to possess pharmacological properties that match the Krahô indications.

At present, a plan is being made to investigate these plants, and a Term for Collaboration is being negotiated with the Krahô Indians, wherein a share of royalties is guaranteed in the event of commercialization of their traditional medicine knowledge.

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