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THE USE AND HALLUCINATORY PRINCIPLES OF A PSYCHOACTIVE BEVERAGE OF THE CASHINAHUA TRIBE (AMAZON BASIN)[1]

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Ethnobotany

The Cashinahua (also referred to in the literature as Cashinawa, Cachinaua, Kachinaua, Caxinaua, Kaxinawa, etc.) constitute a small tribe of the tropical rain forest, Amazon drainage basin of eastern Peru and western Brazil. They are classified as members of the Panoan language family (*1*) and of the Jurua-Purus culture area (*2*). The Peruvian Cashinahua live in six semi-permanent villages along the Curanja River, Alto Purus district, Province of Coronel Portillo, Department of Loreto in south-eastern Peru, with a population of approximately 500 persons. An unknown number of Cashinahua live along the upper reaches of the Embira, Muru, Tarauaca, Jordao, Jurua, and Breu Rivers in the Brazilian state of Acre.

Their nearest neighbors are the Marinahua, Sharanahua, and Yaminahua, to the east near the confluence of the Curanja River with the Purus River, and the Amahuaca who live to the west at the head waters of the Curanja, Inuya, Curiuja, and Embira Rivers. Contact with their eastern neighbors is sporadic; they have no contact with the Amahuaca.

Although contact between Cashinahua villages is sporadic (and in some cases non-existent, *e.g.*, between the Peruvian group and some of the Brazilian groups), the Cashinahua consider themselves to be a single unit bound together by a common ethnic identity, by patrilineal moieties, by extension of kinship terminology to include all Cashinahua, and by common language. They call themselves *huni kuin*, "the real men," in contrast to *nawa*, "outsiders" or "foreigners."

The Cashinahua depend about equally on hunting and horticulture (sweet manioc, maize, plantains, bananas, peanuts, watermelon, chili peppers, squash, several varieties of unidentified tubers) for subsistence. Fishing with spear, arrow, and two varieties of poison (barbasco and an unidentified cultivated shrub) and gathering of palm nuts, fruits, bamboo shoots and fungi provide variety in the diet, especially during the dry season when hunting is more difficult and when the old gardens have been exhausted and the new ones have not yet begun to produce.

The Cashinahua extensively exploit the flora of the region. Houses consist of a heavy wooden frame, usually of cedar, rosewood, or mahogany, thatched with palm leaves. Floors and walls are made of palm bark. Most of the utensils used in their daily lives involve locally produced plant products. In addition, the Cashinahua use a large number of plants for medicinal purposes. During a field study in the summer of 1966 data were collected

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from the major herbalist on the use of approximately 300 different plants he regularly prescribed for his patients.

Of major importance among the non-food plants used by the Cashinahua are several species of the genus *Banisteriopsis,* which, along with several species of *Psychotria,* is used to prepare a brew called *nixi pae,* "vine drunkenness," and known to the local Peruvians as *ayahuasca. Banisteriopsis* is considered by the Cashinahua to be the basic ingredient. However, all informants were agreed that without the addition of *Psychotria* the resultant hallucinations will be shorter and considerably less vivid.

Ayahuasca is drunk by the Cashinahua in order to gain information not available through the normal channels. The hallucinations are thought to be the experiences of one's dream spirit; they are portents of the future or reminders of the past, and through them the drinkers are able to learn of things, persons, and events removed from them by time and/or space. Of particular importance to the community are those things which could affect the society, either as a whole or its individual members. The shaman's use of *ayahuasca* is similar to the more general usage; when neither he nor the herbalist is able to cure a sickness, he along with other men prepare and drink *ayahuasca* (the brew is never taken by a person alone). During his trip, the shaman then consults with spirits, other than those spirit familiars he normally uses, who hopefully will reveal to him the cause of the illness, a new chant to be used while massaging or sucking out the intrusive causative agent, or warning that the person is incurable.

Although any initiated Cashinahua male may drink *ayahuasca,* usage varies widely; some men never drink it, while others imbibe every time a brew is available. In general, drinking bouts occur only once or twice a month. They begin after dark, generally about 8 p.m., and continue until two or three in the morning.

Although all the men know how to prepare the beverage, it normally falls to one or two men from each village to make the preparations. The host goes to the jungle and without any ritual or ceremony selects and cuts one to two meters of *Banisteriopsis* and three to five branches of *Psychotria.* On returning to his house, he cuts the vine into 6- to 8-inch segments, which he pounds lightly with a rock and places in a clay cooking pot with a 2- to 4-gallon capacity. The leaves and buds of the *Psychotria* are stripped from the branches and added to the pot, which is then filled with water. A fire is lit around the base of the pot and allowed to burn until the water nearly reaches a boil. The brew is steeped for about an hour, after which it is ladled off into smaller pots to cool.

As the hour for the affair approaches, the host places some stools and logs near the hearth. Each man, when he arrives, goes to the pots and dips out about one pint of the liquid. He sings or chants several phrases over the brew asking it to show him many things and then gulps it down. He then joins the others and talks or chants quietly while waiting for the effects of the drug to begin. After fifteen minutes he may drink another pint, particularly if he wishes to hallucinate freely, or as they say "to have a good trip."

Once the drug "begins to shake them," chanting begins in earnest. Each man sings independently. Chants often involve conversations with the spirits of *ayahuasca;* at other times, they merely consist of the rhythmic repetition of the monosyllabic *'e 'e 'e' 'e 'e 'e.* Those who do not know the chants sit next to someone who does and sway their bodies in time with the rhythm.

Although each man operates on his own, the group is very important, as it provides him a contact with the real world, without which the terrors of the spirit world through which he is traveling would be overwhelming. Frequently, a group of men will line up on a log, each one wrapping his arms and legs around the man ahead of him. Only the men who are "strong," *i.e.,* those who have had many years of experience with *ayahuasca,* will not maintain physical contact with at least one other person.

The volume of the chanting rises and falls, punctuated by shrieks of terror, wretching,

and vomiting. No attempt is made to coordinate either the rhythm or the pitch of the chants. Each man devotes his attention to what he is experiencing and his own search for knowledge.

In spite of the individual nature of the hallucinogenic experience, there is a high degree of similarity in the content and frequency of occurrence of particular hallucinations from individual to individual during any one night of drinking. Certain themes also recur every time they drink *ayahuasca*. The most frequent of these are: (1) brightly colored, large snakes, (2) jaguars and ocelots, (3) spirits, both of *ayahuasca* and others, (4) large trees, often falling trees, (5) lakes, frequently filled with anacondas and alligators, (6) Cashinahua villages and those of other Indians, (7) traders and their goods, and (8) gardens.

Hallucinations generally involve scenes which are part of the Cashinahua's daily experience but have on occasion reported seeing things far removed from their world, such as visits in stores in Manaus and Pucallpa—places they have neither seen nor visited.

All informants speak of a sense of continual motion and rapid change, or, as they say, transformation. Particular hallucinations wax and wane, interspersed by others in a very fluid manner. There is a sense of darkness interrupted often by flashing bright colors or brightness when the horizon seems to collapse. Time and space perceptions are distorted.

The following is an excerpt from a longer tape-recorded report by one of the men who drank *ayahuasca* on August 27, 1966. (It was from this batch that the liquid specimen which has been analyzed was obtained.)

"We drank *nixi pae*. Before starting to chant, we talked a bit. The brew began to move me and I drank some more. Soon I began to shake all over. The earth shook. The wind blew and the trees swayed . . . . The *nixi pae* people began to appear. They had bows and arrows and wanted to shoot me. I was afraid but they told me their arrows would not kill me, only make me more drunk . . . . Snakes, large brightly colored snakes were crawling on the ground. They began to crawl all over me. One large female snake tried to swallow me, but since I was chanting she couldn't succeed . . . . I heard armadillo tail trumpets and then many frogs and toads singing. The world was transformed. Everything became bright. I moved very fast. Not my body but my eye spirit . . . . I saw lots of gardens full of manioc and plantains. The storage sheds were full of corn. The peanut racks were full . . . . I came down the trail to a village. There was much noise, the sound of people laughing. They were dancing *kacha*, the fertility dance. Everybody was laughing. Many of the women were pregnant. I was happy. I knew we would be well and have plenty to eat."

During the course of the ethnobotanical and anthropological study, the second author gained sufficient rapport with the tribe for them to allow him to participate in the *ayahuasca* ceremony. Although he did not see all the same visions as those reported for the tribe, he did verify the potent hallucinatory effects of the beverage. Some overlap of visions was noted, perhaps owing to the cultural and environmental context. Generally, the same airy sensations were felt with time and space perceptions markedly altered. In addition, flashing bright colors of varying intensity were experienced. Intense nausea and vomiting are common experiences (within 5–20 minutes) prior to the onset of hallucinations. The longer the liquid is retained the more intense the psychotomimetic activity.

Botany and Pharmacognosy

When the plant materials and liquid beverage (*nixi pae*) were made available for botanical and photochemical study, it became necessary to identify them accurately. The woody stem (liana) or vine pieces were presented as cut at both ends with dimensions ranging from ½ to ¾ inch in width by 1 to 1½ feet long. Gross morphological examination revealed the characteristic brownish irregular bark and wood cross section of the genus *Banisteriopsis* (*3*). These were later verified by specialists in the genus at the Harvard Botanical Museum.

The leaf material was presented as two closely related species and referred to by the native names, "nai kawa" and "matsi kawa." At first glance they appeared to be *Banisteriopsis Rusbyana* species (Malpighiaceae) because this plant was known from previous reports to be used in admixture with the vine, in the preparation of ayahuasca (*4*). However, on closer examination they were revealed to be in the genus *Psychotria* (Rubiaceae). They showed the characteristic opposite arrangement of leaves with entire margin and characteristic stipules of the Rubiaceae. Again, two specialists in the Malpighiaceae (Dr. Morton, Smithsonian Institution, Washington, D.C.) and Rubiaceae (Dr. Fosberg, Smithsonian Institution) respectively were consulted. Their examinations confirmed our results. Unfortunately, the leaf material presented was sterile with no flowers or fruits, and a definitive identification of the species could not be made at this time. However, reference to specimens at local herbaria (Academy of Natural Sciences, Philadelphia, Pennsylvania, and New York Botanical Garden Herbarium, New York) indicated the possibility that "nai kawa" could be either *Psychotria horizontalis* Sw., *P. carthaginensis* Jacq., *P. marginata* Sw., or *P. alba* R. et P. All of these have been previously reported to be species commonly found in the region inhabited by the Cashinahua tribe.

Another species of this genus, *Psychotria psychotriaefolia* (Seem.) Standley, was made available to us through the cooperation of another ethnobotanist who has studied related tribes in the same region of the Amazon (*5*). This species is also similarly used by the Kofán tribe. It was possible to rule this out as the species in question on pharmacognostical and phytochemical evidence. The results of microscopic examination revealed that we were dealing with two distinct species and that the *Psychotria psychotriaefolia* was a third. Reference to Table 1 shows a difference in the shape and size of the epidermal cells, a similar palisade ratio, the presence of similar (Rubiaceous) stomata, a difference in stomatal number, and a marked difference in vein islet number.

The beverage ("nixi pae") was presented in a two-quart glass container sealed by a screw-top cap around which adhesive tape was wrapped. The container was filled to the top, with little or no air at the top. Apparently this kept the liquid well preserved as there was no evidence of decomposition or mold growth. It was golden rust-orange in color and showed a fine, easily suspendable residue of finely divided pulverized scrapings of the vine. It had been kept at room temperature for at least two years. It had no characteristic odor but a slightly bitter flavor. This

Table 1—RESULTS OF MICROSCOPIC ANALYSIS OF THE LEAF MATERIAL

	Psychotria psychotriaefolia	"Matsi kawa"	"Nai kawa"
1. Epidermal cells	Cells are small, irregular in shape, cell wall is thin and the margin is straight	Slightly larger cells, cubical or pentagonal in shape, thin walled and margin straight	Larger cells, mostly hexagonal in shape, cell wall is thick and the margin straight
2. Palisade ratio	5 to 6 palisade cells under each epidermal cell	4 to 6 palisade cells	4 to 6 palisade cells
3. Stomata	Rubiaceous type	Rubiaceous type	Rubiaceous type
4. Stomatal number	86 to 87 per sq. mm.	97 to 100 per sq. mm.	73 to 79 per sq. mm.
5. Vein islet number	10 to 11 per sq. mm.	26 to 29 per sq. mm.	14 to 20 per sq. mm.

was subjected directly to chemical and pharmacological analysis.

Chemistry

Plant Materials Used. The *Banisteriopsis* vine stem and two *Psychotria* spp. leaf and stem material and beverage prepared from these were collected by K. Kensinger during a field study in the summer of 1966. The data and specimens on which this study is based were collected at Balta, at the point where the streams known to the local Cashinahua as the Xumuya and Inuya enter the Rio Curanja, latitude 10° 08'S., longitude 71° 13'W., elevation approximately 300 meters. Voucher specimens were deposited at the herbarium of the Botanical Museum at Harvard University, Cambridge, Massachusetts.

Chemicals Used. Harmine and harmaline, as bases, were purchased from Mann Laboratories, Inc., New York. The N,N-dimethyltryptamine was obtained from K & K Laboratories, Inc., New York. Since melting-point determinations and infra-red spectral data gave agreement with literature values, these were used without further purification.

Procedure. All plant material was air-dried and ground to 20 mesh using a laboratory model Wiley Mill. The beverage (500 mls.) was concentrated to ca. 100 mls. *in vacuo* using a Buchler flash evaporator (Model #FE2) prior to extraction. The extraction procedure for alkaloids used was a modification of a method previously reported by Genest (*6*). It consisted essentially of defatting the samples with petroleum ether and, after air drying, wetting them with 10% ammonium hydroxide. The alkaloids, as bases, were then extracted into diethyl ether until the marc tested alkaloid free with both Ehrlich's and Dragendorff's reagents. For the chromatographic experiments, the diethyl ether was evaporated off and the residue taken up in chloroform, which was the solvent used for spotting. In the quantitative analysis experiments the total residue of the plant extract was taken up in O,IN H_2SO_4 and reacted with 0.1% paradimethylaminobenzaldehyde (PDAB) at room temperature for one hour, after which time 0.1 ml. of 0.1% $NaNO_2$ solution was added prior to assaying by color spectrophotometric assay (*4*). The absorbance was read at 600 mμ based on the maximum absorption of N,N-dimethyltryptamine (DMT) predetermined under the same conditions. Readings were taken on several aliquots of each extract from separate experiments, and the calculations were based on Beer's Law lines for varying concentrations of pure DMT. Results of the quantitative analysis are shown in Table 2. In some cases, it was possible to extract sufficient purified alkaloid material to weigh these directly.

Table 2—RESULTS OF SPECTROPHOTOMETRIC AND ISOLATION ANALYSIS OF THE ALKALOIDS PRESENT IN LEAF MATERIAL AND BEVERAGE

Plant Material	N,N-dimethyltryptamine	Harmine	Harmaline
1. *Psychotria* sp.			
("nai kawa")	0.165%[1]		
	0.196%		
Leaves	0.192%		
	0.222%		
Stems	0.066%[1]		
	0.075%		
	0.108%		
2. Beverage			
("nixi pae")	0.012%[1]		
	0.015%	0.007%	0.011%

[1] These values are calculated on the basis of actual weight of materials isolated. All other figures are obtained by spectrophotometric analysis.

The thin-layer chromatography experiments were conducted using 20- x 20-cm plates coated with silica gel and run in the ascending fashion. The solvent systems used and the R_f values obtained are given in Table 3. All plates were observed, after development, under short- and long-wave ultraviolet light (Chromatocab, Model #C–5), then marked. Following this they were separately sprayed with both Ehrlich's reagent and Dragendorff's reagent. Quantitative assays were also run using zones scraped from the thin-layer plates.

Table 3—RESULTS OF THE THIN-LAYER CHROMATOGRAPHY EXPERIMENTS ON ALKALOIDS EXTRACTED FROM PLANT MATERIAL AND BEVERAGE

Plant material	Solvent Systems		
	Chloroform: methanol (8:2)	Chloroform: methanol: ammonia (8:2:0.2)	Chloroform:diethylamine (9:1)
1. *Psychotria psychotriafolia* leaves	0.14 0.22[1]	0.59[2] 0.69 0.75[1]	0.18[1] 0.37
2. *Psychotria* spp. ("nai kawa")			
Leaves	0.14	0.69	0.37
Stems	0.14	0.69	0.37
3. Beverage ("nixi pae")	0.09	0.59	0.12
	0.14	0.69	0.20
	0.43	0.79	0.37
4. Controls			
Harmaline	0.09	0.59	0.12
Harmine	0.43	0.79	0.20
DMT	0.14	0.69	0.37

[1] Yellow fluorescence under U.V. light. Dragendorff's reagent positive, Ehrlich's reagent negative.
[2] No fluorescence under U.V. light. Dragendorff's reagent positive. Ehrlich's reagent negative.
DMT—No fluorescence under U.V. light. Dragendorff's reagent positive and Ehrlich's reagent positive.
Harmine—Blue fluorescence under U.V. light. Ehrlich's reagent negative, but Dragendorff's reagent positive.
Harmaline—Greenish yellow fluorescence under U.V. light. Dragendorff's reagent positive, but Ehrlich's reagent negative.

Gas chromatographic analysis data were obtained using a Unilab 400 (Glowall Corp., Willow Grove, Pennsylvania) fitted with siliconized support column packed with 1% OV–17. The column temperature was 180° and the nitrogen carrier gas pressure was 20 psi. In the case of the "nai kawa" leaves and stem, the major alkaloid noted was DMT with a very small peak having the same retention time as dehydro-DMT. Scanning these peaks with the mass spectrometer (LKB–9000) as they came off the column confirmed these results.

The same procedure applied to the beverage ("nixi pae") showed only DMT, much harmaline, and a little harmine.

Gas chromatography of the alkaloidal extract of *Psychotria psychotriaefolia* leaf showed a two-to-one mixture of DMT and dehydro-DMT, also confirmed by mass spectroscopy of the peaks as they came off the column. The dehydro-DMT may be a product of air oxidation.

Preliminary Pharmacology

An anesthesized cat was used to observe the gross pharmacological effects of the beverage ("nixi pae"). Intravenous injection of 0.1, 0.15, or 0.2 mls. per kg. produced a transient but significant bradycardia within 20 seconds. Mean blood pressure was slightly elevated owing to decreased diastolic pressure and increased systolic pressure. Oral administration of the beverage via an oral feeding tube (1 or 2 mls. per kg.) produced no observable effect upon blood pressure or heart rate.

Attempts to simulate the intravenous effects of the beverage by administering an artificially prepared solution containing the amounts of alkaloids (DMT, harmine, and harmaline) found by analysis were unsuccessful. No observable changes in cardiovascular activity were noted with the artificial beverage by the I.V. route.

Results

This report is the third account of the use of hallucinogens by the Cashinahua, one being reported by the second author (*7*) and the first by Friedberg (*8*).

The botanical and phytochemical evidence shows that the *Banisteriopsis* spp. stem material contains both harmine and harmaline (but no DMT) as previously reported and serves as the source for these psychotomimetic principles in the beverage.

The two *Psychotria* spp. were found to be different, both by classic microscopic methods, and on the basis of the presence of DMT in "nai kawa" and the total absence of alkaloids in "matsi kawa." This does not, however, preclude the possibility that "matsi kawa" contributes some pharmacological activity since attempts to simulate the cardiovascular effects of the beverage ("nixi pae"), using the alkaloids found (*i.e.*, DMT, harmine, and harmaline), were not successful.

Thin-layer and gas chromatographic evidence for the presence of DMT in "nai kawa"

has been presented. In addition DMT has been isolated from the "nai kawa" (*Psychotria* spp.) leaf material. Sufficient beverage allowed for the separation of crystalline DMT and harmine from it also. The DMT has been authenticated by melting point, thin-layer and gas chromatography, and infra-red and mass spectrosopy analysis. The infra-red spectra of the isolated crystalline DMT and harmine from the beverage were superimposable over the spectra of authentic controls.

The concentrations of DMT in the "nai kawa" ranged from 0.165% to 0.222% in the leaf and from 0.066% to 0.108% in the stem. The beverage was found to contain 0.023% (W/V) to 0.015% (W/V) of DMT, 0.007% (W/V) of harmine, and 0.01% (W/V) of harmaline. Some of these percentages are based on the colorimetric assay, while others are based on weights of alkaloids actually extracted. These are noted in Table 2.

While it is difficult to know exactly how much beverage was consumed in each case (considerable variability in dose was noted during the ethnobotanical study, as was a wide range in potency of beverages prepared at different times by different members of the tribe), these percentages are well within the dosage range needed to produce hallucinatory effects (DMT: 0.05–0.07 g; harmine and harmaline: 0.1–0.4 g). If one consumed eight ounces of the beverage, he would receive a dose of about 0.03 g of DMT and about 0.02 g of harmine or harmaline. Frequently two or three times this dose is consumed.

Another point to consider is the note by the natives that the addition of these leaves increases or heightens the color perception and intensity of the beverage. This has been noted before with these admixtures (*4*). However, DMT is supposedly not psychotomimetic by the oral route and has been shown to be active only when injected I.V. or I.M. This poses an interesting question. Is monoamine oxidase, which normally inactivates DMT in the stomach, inactivated by the harmine or harmaline so as to allow absorption by this route? More work is indicated before this can be answered accurately. As Holmstedt (*9*) and others have pointed out, the β-carbolines (*e.g.*, harmine and harmaline) are monoamine oxidase inhibitors (MAO) and could potentiate the action of the simple indoles. Pharmacological activity of the β-carbolines unrelated to MAO inhibition has also been shown to exist (*10*). It is interesting to note that Schultes (*11*) has reported on an orally administered hallucinogen (*Virola* spp.) which contains only DMT and closely related tryptamine derivatives and no β-carboline compounds. It certainly points out the need for more work and specifically focuses on the need to pay strict attention to these admixtures alluded to in the ethnobotanical literature. Drug-drug, food-drug, and other interractions are only now being scrutinized in pharmacology, and many unusual intereffects have been noted. Ethnobotanists would certainly do well to pay heed to this point.

An interesting and unusual side benefit from this study was the demonstration that *Psychotria psychotriaefolia* (later correctly identified as *Psychotria viridis*) also contained DMT and possibly dehydro DMT. It also is used as "nai kawa" by the Kofán tribe and has been reported on by Pinkley (*5*). As far as we have been able to determine by a careful search of the literature, this is the first report of the occurrence of N,N-dimethyltryptamine in the Rubiaceae family. This interesting find may have important chemotaxonomic significance which is not now apparent.

Current studies are being continued on the definitive identification of the *Psychotria* spp. ("nai kawa").

Finally, it should be noted that these materials apparently are quite stable even in solution as long as decomposition or oxidation does not occur.

Unfortunately, the small amounts of material available for this study preclude further detailed analysis, particularly on the full pharmacological effects of the beverage.

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