

## Research

# Use of medicinal plants and pharmaceuticals by indigenous communities in the Bolivian Andes and Amazon

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**Objective** To investigate, by means of household surveys, the use of medicinal plants and pharmaceuticals in Apillapampa, a large Andean community of Quechua peasants, and in six small communities of Yuracaré-Trinitario "slash-and-burn" cultivators of the National Park Isiboro-Sécure (the NPIS) in the Bolivian Amazon.

**Methods** A total of 12% of households in Apillapampa and nearly all households in the NPIS were interviewed about their use of medicinal plants and pharmaceuticals for treating illnesses. Informants were also asked to name any medicinal plants they knew.

**Findings** In spite of the presence of a primary health care service (PHC) with medical doctor in Apillapampa, an equal number of informants used medicinal plants and pharmaceuticals. In the NPIS, the prevalent use of medicinal plants or pharmaceuticals in any community depended on the distance of the community from the nearest village and from a PHC with medical doctor ( $r = 0.85$  and  $r = -0.96$ ; both  $P = 0.05$ ). The NPIS communities' knowledge of plants expressed as the average number of medicinal plants mentioned correlated positively and negatively with distance from the nearest village and use of pharmaceuticals, respectively ( $r = 0.95$ ,  $P < 0.005$  and  $r = -0.90$ ,  $P < 0.05$ , respectively).

**Conclusion** The cultural importance of traditional medicine and the physical isolation of communities, both in general and from PHCs, are factors that influence the use of and knowledge about medicinal plants.

**Keywords** Plants, Medicinal; Ethnobotany; Pharmaceutical preparations/therapeutic use; Primary health care; Health services accessibility; Geography; Social isolation; Health knowledge, attitudes, practice; Ethnic groups: Bolivia (source: MeSH, NLM).

**Mots clés** Plantes médicinales; Ethnobotanique; Préparations pharmaceutiques/usage thérapeutique; Programme soins courants; Accessibilité service santé; Géographie; Isolement social; Connaissance, attitude, pratique; Groupes ethniques; Bolivie (source: MeSH, INSERM).

**Palabras clave** Plantas medicinales; Etnobotánica; Preparaciones farmacéuticas/uso terapéutico; Atención primaria de salud; Accesibilidad a los servicios de salud; Geografía; Aislamiento social; Conocimientos, actitudes y práctica sanitarias; Grupos étnicos; Bolivia (fuente: DeCS, BIREME).

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## Introduction

The presence of primary health care, including Western primary health-care services (PHCs), in rural areas of developing countries is considered by international organizations and policy-makers to be a universal solution for improving human health (1). In these remote and/or impoverished areas, Western

health care is often part of a pluralistic medical system in which it coexists with traditional medicine (TM) that includes both self-care with medicinal plants and consultation with specialized traditional healers. Health-care institutions in developing countries consist of governmental health services, nongovernmental organizations (NGOs), traditional healers, and private

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practice (1). The coexistence of traditional and Western medicine does not imply that they work together well, and Western health care does not necessarily satisfy its end-users. Therefore, integration of Western medicine into local communities faces some obstacles. In terms of Western PHCs, the cost of consultation, high travel distance, perception of illness by patients as non-serious, and impersonal treatment of patients by the medical staff all counteract the use of Western PHCs (1–3). Furthermore, local health beliefs can interfere with the use of pharmaceuticals. For example, it is a common belief in Viet Nam that antibiotics should be used only minimally for someone with a “hot” body (i.e. suffers from fever) because these medicines are considered to be “hot” also, and hence will not have the desired cooling effect (4). Women in periurban Brazil preferred medicinal plants to pharmaceuticals because of the low cost, and because they were perceived to be better medicines than pharmaceuticals, more effective and without the side effects of the latter (3). Hence, in local communities, medicinal plants may be more acceptable culturally and for primary health-care than Western medicine (1).

According to WHO, up to 90% of the population in developing countries uses TM, including medicinal plants, to help meet their primary health care needs (5). WHO's strategy for TM 2002–05 has four main objectives: framing policy; enhancing safety, efficacy, and quality; ensuring access; and promoting the rational use of TM. Among the expected outcomes of this strategy are: integration of TM within PHCs, increased governmental support and recognition of TM, increased recording and preservation of traditional medical knowledge, safety monitoring of herbal medicines (6), increased availability of TM, sustainable use of medicinal plant resources, and basic training in commonly used traditional medical practices for Western health-care providers (5).

Some 30% of the Bolivian population does not receive Western medical care. Moreover, human medical capital is limited, with only one medical doctor for 1000 and 7000 inhabitants in urban and rural areas, respectively (7, 8). Although there has been a threefold increase in the number of clinics and medical staff over the past 30 years, the use of PHCs has gone up by only 13%. The most important reason for the limited use of Western health care in Bolivia is the lack of trust in modern medicine due to financial, psychological, physical, and cultural barriers (9). For example, Andeans perceive the causes of certain illnesses as a disturbed interrelation between themselves, their land, and/or relatives. Therefore, healing should include rituals to restore these imbalances (7). However, Bolivian doctors and nurses often believe that Western medicine is superior to and should even replace TM. This attitude aggravates the fragile relationship between Western PHCs and end-users. All these findings point to an underrepresentation and underutilization of Western health care in Bolivia.

In view of the importance of primary health care for people living in remote areas in Bolivia, and the problems associated with a pluralistic medical system, we evaluated the use of pharmaceuticals and medicinal plants for the treatment of general illness by indigenous community members in the Bolivian Andes and Amazon. One of the questions we asked was whether the presence/absence of Western PHCs influences the use of and/or knowledge about medicinal plants. Furthermore, the relationship between the physical access to Western PHCs and the use of medicinal plants and Western medicines was investigated in the Amazon study region.

## Research sites

### Andes

Apillapampa is a community of 430 families (2625 inhabitants) of Quechua-speaking peasants. It is situated at 3250 m above sea level in the Capinota province, Cochabamba department at 17° 51' S and 66° 15' E. Public transport reaches Apillapampa twice a week in private cargo trucks from the nearest village of Capinota, a 29 km journey. The climate is semi-arid (steppe) according to Köppen's classification (10). The vegetation consists of xerophytic, deciduous, and evergreen herbs, shrubs (*matorrales*), small trees (*chaparrales*), and open woodlands (11).

Subsistence is based on the pre-hispanic exploitation of multiple ecological zones along steep mountainsides. Only one-third of the land is arable (Fundación Ecuémica Para el Desarrollo, unpublished, 1998). The main crops are potato, wheat, and maize, and only 25 % of the total crop production is commercialized. Most of it is used for food, fodder, and planting. Cattle (cows, donkeys, goats, and sheep) are considered a savings fund. Animal protein is consumed only in cases of low crop yield. Because of the weak economic situation, villagers engage in temporary or permanent migration. In spite of the general loss of traditional practices, some practices are maintained in Apillapampa, such as *ayni* (labour exchange), *k'owa* (the worshipping of Mother Earth), and respect for traditional healers (Fundación Ecuémica Para el Desarrollo, unpublished, 1998). Traditional healers are consulted for medical problems and are advisers on health, family, cattle, crops, and travel. Eight healers from Apillapampa are united in a semiformal healers' organization, called AMETRAC (*Asociación de Médicos Tradicionales*). A PHC operated by a local NGO is also present and deals with nutritional deficiencies, small injuries, parasitic and bacterial infections, birth problems, diarrhoea, and respiratory and musculo-skeletal disorders (Fundación Ecuémica Para el Desarrollo, unpublished, 1998). At the time of research, the PHC was staffed on weekdays by a medical doctor and nurse who spoke the local language. At weekends, one of the traditional healers, who is also a health care worker, attended. Consultation is free, but medicines have to be paid for. In cases of severe illness, patients are referred to the nearby clinic of Capinota.

### Amazon

The National Park Isiboro-Sécure (the NPIS) covers an area of 12 000 km<sup>2</sup> and was declared a National Park in 1965. Since 1992, part of the NPIS is also official indigenous territory for semi-nomadic Yuracaré, Trinitario (also called Mojeños or Moxenos) and Chimane indigenous groups (Centro de Investigación y Educación Popular, unpublished, 1998). The climate varies between tropical wet (rainforest) and tropical wet and dry (savannah). The vegetation consists of humid rainforest, seasonal but mostly evergreen forest, and floodplains (12).

The six communities of Yuracaré and Trinitarios studied are dispersed throughout the NPIS along the banks of the rivers Isiboro, Moletto, and Ichoa. They are relatively young in existence (2–24 years) because of the semi-nomadic nature of their inhabitants who move in groups along the same river to found new communities in response to conflicts or resource scarcity. Communities typically consist of 6 to 16 huts inhabited by Yuracaré, Trinitario, or mixed — predominantly Yuracaré or Quechua — indigenous people (Table 1).

The communities can be divided into two groups on the basis of their geographical position (Table 2). The first

Table 1. Overview of communities in the National Park Isiboro-Sécure (NPIS) that participated in the household survey

Community	Geographical coordinates (south, east)	Ethnic group	Age of the community (years of existence)	Total no. of families	No. of people interviewed	
					Men	Women
Limo	16°40', 65°41'	Yuracaré	8	8	7	8
Santa Fe	16°40', 65°39'	Quechua-Trinitario	2	12	6	6
Villa San Juan	16°32', 65°31'	Yuracaré	<4	6	6	5
San José	16°25', 65°54'	Trinitario	11	8	6	6
San Antonio	16°24', 65°54'	Yuracaré-Trinitario	7–8	9	8	6
Carmen	16°23', 65°57'	Trinitario	24	16	7	7

Table 2. Distance (km) between communities the National Park Isiboro-Sécure (NPIS), the nearest village, last stop of public transport system, and primary health care services

Community	Isinuta <sup>a</sup>	Last truck stop	Primary health care service	
			With nurse	With medical doctor
Limo	6	0	2	2
Santa Fe	8	3	3	3
Villa San Juan	25	4	18	18
San José	44	13	6	17
San Antonio	46	15	9	20
Carmen	50	18	12	23

<sup>a</sup> Nearest village.

group comprises three communities (Limo, Santa Fe, and Villa San Juan) that are situated close to the edge of the Park (Villa San Juan along the eastern border) and have a good connection with Isinuta, the nearest village outside the NPIS. From Isinuta, a gravel road leads into the NPIS which is used by camiones for public transport to Quechua settlements. Since 1970, Quechua peasants have emigrated from the highlands to colonize part of the NPIS that lies outside official Yuracaré and Trinitario indigenous territory. The second group consists of three communities deep into the Park (San José, San Antonio, and Carmen) that can be reached after journeys on foot of more than 10 km from the last truck stop.

Yuracarés and Trinitarios are “slash-and-burn” cultivators of rice, cassava, and banana. Subsistence agriculture is supplemented with hunting, fishing, and gathering (Centro de Investigación y Educación Popular, unpublished, 1998). Western PHCs do not exist in the entire indigenous territory; sporadically, the communities are visited by medical doctors for free vaccinations against yellow fever. Yuracaré-Trinitario people can visit PHCs in some of the nearby Quechua peasant settlements. Traditional health care is provided in four of the six Yuracaré-Trinitario communities studied by six *naturistas* (people knowledgeable about medicinal plants) and one *curandero*. A *curandero* also heals patients with medicinal plants but represents a higher hierarchical level than a *naturista* because he is considered to have supernatural powers.

## Methods

The research took place between July 2000 and May 2002. It was part of an ongoing study on the knowledge and use of medicinal plants by traditional healers. After prior informed consent was obtained, acceptance of the research project by the

indigenous leaders, the individual healers, and their communities was formalized by a written agreement between researchers and indigenous representatives. Subsequently, a copy of this agreement and details of the research were sent to the Bolivian Government (*Directorio General de Biodiversidad, Ministerio de Desarrollo Sostenible y Planificación*). The local institute *Centro de Biodiversidad y Genética* from the *Universidad Mayor de San Simon*, Cochabamba, provided help in obtaining the research permit.

## Apillapampa

One member from each of 50 households (or 12% of the families) was interviewed. Selection of the interviewee — that is, the mother or father — was done by tossing a coin. Informant selection was random, as described by Martin (13). First, a street map of the community was constructed by means of a global positioning system receiver (GPS) (Garmin 12XL). Paths were numbered according to the trajectory walked with the GPS and were visited in chronological order. The beginning (east or west) and side (left or right) of each path was determined by tossing a coin. The fourth house along the path was then selected for the survey. If the fourth house was not inhabited, then the seventh, second, or first house was chosen, in that order of preference. The sex of the interviewee was tossed for again. All paths with houses were surveyed. A traditional healer of AMETRAC assisted with the interviews by introducing those involved and translating. Three main structured questions were asked: “when you are ill, do you use medicinal plants?”; “do you know how to prepare medicinal plants yourself?”; and “when you are ill, do you use Western medicine like antibiotics, aspirin, etc.?” Informants were also asked to provide local names of medicinal plants they knew. The most popular

plants were collected during field trips with traditional healers from AMETRAC. Plants were identified in the local herbaria of Cochabamba (Herbario Forestal Martin Cardenas) and La Paz (Herbario Nacional de Bolivia) where voucher specimens were deposited.

### The NPIS

Both parents of each household were interviewed in communities with fewer than 10 families (Table 1). Where possible, the person was interviewed without the partner being present, to avoid bias. In communities of more than 10 families, only one randomly-selected parent was interviewed. The seven traditional healers who cooperated in the study were not interviewed. In total, 40 men and 40 women were interviewed (Table 1). The ethnic affiliation of informants was 37 Yuracarés, 34 Trinitarios, and 9 Quechuas. The interview questions were the same as in Apillapampa.

### Data analysis

The distances between communities and reference points (Isinuta, PHCs, truck stops) represent the shortest distance (straight line) between GPS coordinates. Interview data are expressed as the number of male and female informants who use medicinal plants or pharmaceuticals for health care. Communities at the edge and deep into the NPIS were compared by means of a  $\chi^2$  test. Pearson correlation was used to analyse relationships between the distance from reference points, and the use of medicinal plants or pharmaceuticals by a community, as well as medicinal plant knowledge (total number of different plants and average number of plants mentioned).

## Results

### Use of medicinal plants and pharmaceuticals in Apillapampa and the NPIS

In Apillapampa, an equal number of informants used medicinal plants and pharmaceuticals for treating illness ( $\chi^2 = 1.4$ , not significant (NS)) (Fig. 1). The majority of pharmaceuticals were obtained from the PHC in the community (27 responses),

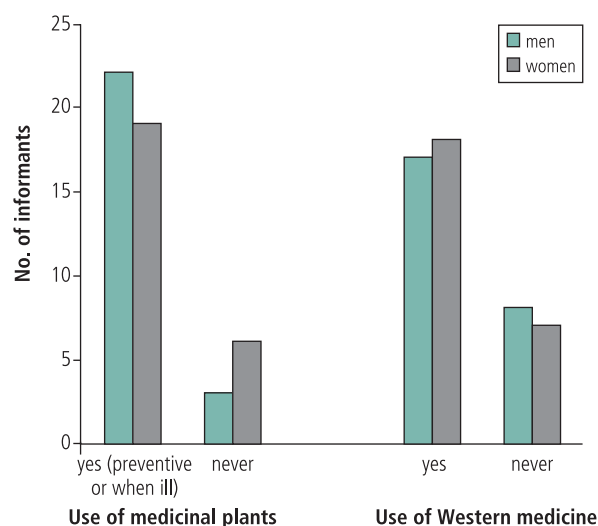
the city of Cochabamba (8 responses), or the nearby village of Capinota (5 responses). Four informants reported using medicinal plants preventively for improving their general health. Fig. 2 shows cumulative data on the use of medicinal plants and pharmaceuticals by all communities in the NPIS. Significantly more community members used medicinal plants compared with pharmaceuticals ( $\chi^2 = 8.6$ ;  $P = 0.003$ ).

In both regions there were no significant differences between men and women in the use of medicinal plants and pharmaceuticals. All informants who used medicinal plants in Apillapampa, as well as in the NPIS, were also able to prepare at least some of them. In Apillapampa, a total of 36 different medicinal plants were mentioned, and the average number of medicinal plants mentioned by an informant was 1.6. Among the three most frequently mentioned medicinal plants by community members were *payqo blanco* (*Chenopodium ambrosioides* L.), *aya muña* (*Mintostachys andina* (Britton ex Rusby) Epling), and *wira wira* (*Achyrocline ramosissima* Britton ex Rusby) (11, 9, and 8 responses, respectively). These plants were also popular among the eight healers of Apillapampa. Seven healers used *aya muña* for treating malnutrition and all healers used *payqo blanco* and *wira wira* against colic and cough, respectively. In the NPIS, the average number of medicinal plants and the total number of different plants mentioned in a community varied from 2.1 to 7.1 (average) and from 18 to 38 (different plants). The three most popular medicinal plants were *jengibre* (*Zingiber officinale* Roscoe), *malva* (*Sida rhombifolia* L.), and *karé* (*Chenopodium ambrosioides* L.). These plants were mentioned by 41, 33, and 30 community members, respectively. *Jengibre* and *karé* were popular remedies with the healers for stomach ache and abdominal pain (mentioned by seven and five healers, respectively) and *malva* is named in complete consensus for the treatment of fever.

### Use of medicinal plants and pharmaceuticals in the six study communities in the NPIS

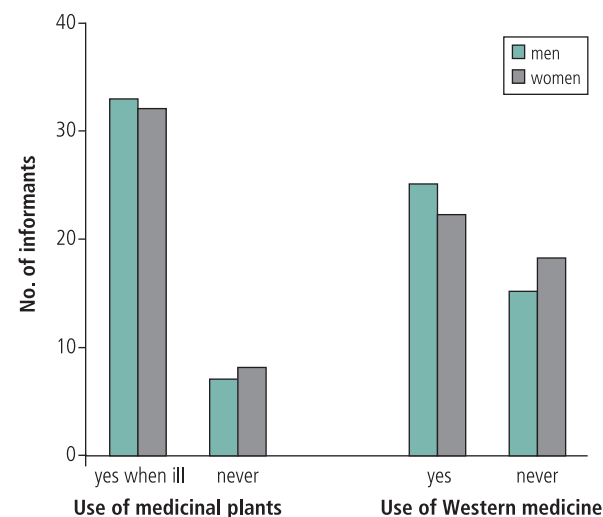
Although overall the data for the six communities indicate that significantly more informants use medicinal plants than pharmaceuticals, this result cannot be generalized for indi-

Fig. 1. Number of informants from Apillapampa (25 men and 25 women) who use medicinal plants and pharmaceuticals for treating general illness



WHO 04.29

Fig. 2. Number of informants from the National Park Isiboro-Secure (NPIS) (40 men and 40 women) who use medicinal plants and pharmaceuticals for treating general illness



WHO 04.30

vidual communities. The distance from the nearest village (Isinuta), and hence the physical isolation of communities, had a profound influence on the use of medicinal plants and pharmaceuticals for health care (Table 2, Fig. 3). At the edge of the NPIS, significantly more community members used pharmaceuticals than medicinal plants ( $\chi^2 = 41.6$ ;  $P < 0.001$ ), whereas communities deep in the Park used medicinal plants over pharmaceuticals ( $\chi^2 = 13.4$ ;  $P < 0.001$ ). There is a strong negative correlation between distance from Isinuta and the use of pharmaceuticals in a community ( $r = -0.96$ ;  $P = 0.002$ ), whereas medicinal plant use is positively correlated with this distance ( $r = 0.85$ ;  $P = 0.03$ ).

The distance of a community from a PHC varied from 2 to 23 km (Table 2). However, the presence of a public transport system reduces the distance that has to be covered on foot (Table 2). There was no correlation between the use of pharmaceuticals in a community and distance from a PHC with a nurse or assistant nurse. The same is true for medicinal plant use. However, distance from a PHC with a medical doctor had a significant positive effect on the use of medicinal plants ( $r = 0.87$ ;  $P = 0.02$ ) and a negative effect on the use of pharmaceuticals ( $r = -0.81$ ;  $P = 0.05$ ). The distance between the last truck stop and a community was negatively correlated with the use of pharmaceuticals ( $r = -0.98$ ;  $P = 0.0006$ ). Hence, the greater the distance that people have to walk on foot, the less likely they will be to use Western medicines for health care.

### Knowledge of medicinal plants in the NPIS

The knowledge that inhabitants have about medicinal plants depends on distances from reference points, such as the nearest village, the last truck stop, or PHCs. Fig. 4 shows that community members deep in the NPIS can name more medicinal plants on average, and they know more species of medicinal plants in total, than communities situated at the edge of the NPIS ( $r = 0.95$ ;  $P = 0.003$  for both). Both variables of medicinal plant knowledge are also positively correlated with distance from the last truck stop ( $r = 0.89$ ;  $P = 0.02$  and  $r = 0.96$ ;  $P = 0.002$  for the average number of plants and for the total number of different plants mentioned, respectively). The average number of medicinal plants mentioned increased significantly with distance from a PHC with medical doctor ( $r = 0.89$ ;  $P = 0.02$ ). However, the use of pharmaceuticals is negatively correlated with the average ( $r = -0.90$ ;  $P = 0.016$ ) and total number of medicinal plants mentioned ( $r = -0.99$ ;  $P < 0.0005$ ). There was no difference between the sexes in the number of responses; men mentioned an average of 5.5 medicinal plants and women mentioned 4.2.

### Influence of distance and ethnicity on knowledge about popular medicinal plants

Members of communities living deep in the NPIS could name significantly more popular medicinal plants (plants named more than 20 times in total during the household survey) compared with communities living at the edge of the NPIS ( $\chi^2 = 9.7$ ;  $P = 0.046$ ). However, Yuracaré and Trinitario informants did not differ in the number of responses on these plants ( $\chi^2 = 3.1$ ; ns). Hence, medicinal plant knowledge varies more according to distance than ethnic affiliation.

### Discussion

In Apillapampa, an equal number of informants used medicinal plants and pharmaceuticals, whereas their use in the NPIS

Fig. 3. Use of medicinal plants and pharmaceuticals among communities situated at the edge (group 1, 38 respondents) or deep into the National Park Isiboro-Sécure (NPIS) (group 2, 42 respondents). Communities of group 1: Limo del Isiboro, Santa Fe del Isiboro and Villa San Juan del Isiboro; communities of group 2: San José de la Angosta, San Antonio and Carmen de la Nueva Esperanza

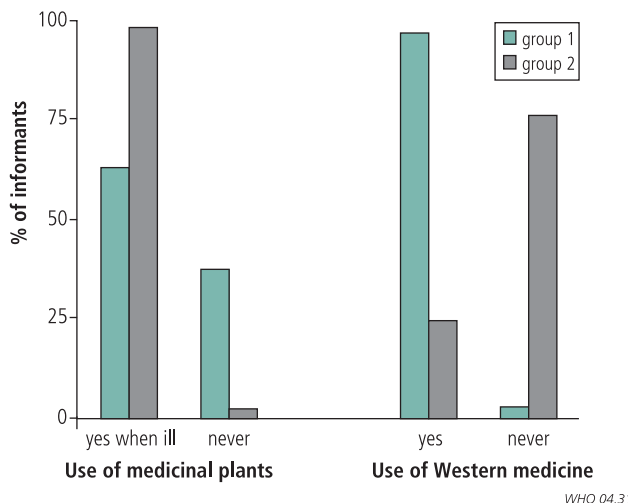
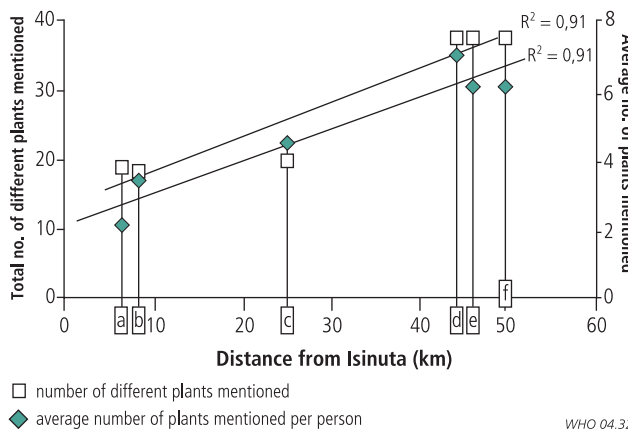


Fig. 4. Relationship between distance from Isinuta, the nearest village to the National Park Isiboro-Sécure (NPIS), and the number of medicinal plants mentioned in a community.

a = Limo del Isiboro, b = Santa Fe del Isiboro, c = Villa San Juan del Isiboro, d = San José de la Angosta, e = San Antonio, f = Carmen de la Nueva Esperanza



depended on the distance of the community from the nearest village and from a PHC with medical doctor. The NPIS communities that had the greatest knowledge of medicinal plants were more likely to be furthest from the nearest village and PHCs and to use medicinal plants rather than pharmaceuticals for treating illness.

Our results confirm evidence on the importance of medicinal plants for primary health care in rural and isolated areas (3, 14). Even in the presence of a PHC, as in Apillapampa, a similar proportion of informants used medicinal plants as compared to Western medicines for treatment of illness in general. However, on average, informants could name only 1.6 medicinal plants, whereas during field trips with traditional healers from Apillapampa, more than 180 medicinal plant species were collected that are used to cure more than 70 different physical, as

well as spiritual, ailments. A similar observation was made in the NPIS (15). This suggests that knowledge of medicinal plants is almost exclusively the domain of specialized healers and not part of the general knowledge of community members.

### Andean culture

According to Bastien, the Andean sociopolitical, economic, and health system is characterized by specialization, verticality, and reciprocity (14). Hence, Andeans specialize in extracting natural resources at certain altitudes of mountain zones (verticality) and then exchange them for those produced by people living at other altitudes (reciprocity). Because of this specialization, Andean healers excel in the practice of TM, which has enabled people to adapt to an adverse environment with hypoxia, hypothermia, malnutrition, and epidemics (14). Andean medical cosmology is full of images of human vulnerability to a hostile and unpredictable environment, as reflected, for example, by the *wayras* (airborne or windborne diseases) (16). The superb knowledge of traditional healers about medicinal plants was also observed in Apillapampa. Furthermore, a comparison of two age-related groups of traditional healers from Apillapampa and the NPIS shows that, although healers in the NPIS were initiated in TM earlier in life than those in Apillapampa, the latter were more knowledgeable about local medicinal plants (15). Because TM is one of the keystones of Andean society, and hence part of a larger social system (17), this might explain the popularity of medicinal plant use for health care by Andean community members that is observed in the present study.

### Physical isolation

Although Western primary health care coexists in Apillapampa with medicinal plant use, the use of pharmaceuticals or medicinal plants in the NPIS depends on physical isolation expressed as the distance between a community and the nearest village. Hence, the more that people are isolated, the more they depend on traditional rather than Western medicine. Several authors have observed a relationship between distance and use of Western PHCs (1, 2, 18, 19). For basic curative care, most people will not travel more than 5 km (18). In Kenya, children who died without admission to a hospital tended to live further away from the nearest bus stop and had made greater use of traditional healers (19). In the NPIS, community members living deep in the Park have to cover distances on foot to the last bus stop of more than 10 km. Hence, it can be expected that these communities will make only scarce use of pharmaceuticals for treating illness. Our data show that 15–30% of informants from these communities use pharmaceuticals, illustrating the shortage of Western primary health care for isolated Yuracaré-Trinitario settlements.

In the NPIS, there is no correlation between distance from a PHC with (assistant) nurse and use of pharmaceuticals or medicinal plants. Instead, both Western and traditional medicine are correlated with distance from a PHC with medical doctor. Hence, it is the quality of the Western health care provided that influences its use. A similar observation was made in Nigeria, where the impact of distance on utilization of Western PHCs was found to vary according to the perceived quality (number of staff and drug supply) of the available service (18).

### Migration

The migratory nature of communities represents a problem for policy-makers in providing Western health care to Yuracarés and Trinitarios in the NPIS. When soils are exhausted, forest resources

become scarce, conflicts arise, or a community becomes too large, part of the community or the entire community decides to settle elsewhere. This makes spatial projections for the insertion of PHCs difficult. Another factor is the cost of treatment. The more isolated communities have no means of marketing their agricultural products because there are no roads in their territory. Hence, their inability to pay for pharmaceuticals may prevent them from using a Western PHC, even if these PHCs were in close proximity to their communities.

### Training

The promotion of TM and training of traditional healers in Western primary health care techniques seems a plausible means for improved primary health care among Yuracaré-Trinitario communities. The Chiang Mai declaration of WHO, IUCN (International Union for Conservation of Nature and Natural Resources) and WWF (World Wide Fund for Nature) (*Saving lives by saving plants*) recognizes that medicinal plants are essential for primary health care (20). However, because the use of medicinal plants is not free of dangers from possible toxic plant biochemicals, the promotion of TM has to be done in collaboration with ethnopharmacological screening programmes for standardization of medicinal plant extracts and toxicity testing. Ethnopharmacology is an interdisciplinary science that combines methods from anthropology and pharmacology–phytochemistry to investigate the biological effects of plant remedies and to identify the chemical structure of bioactive plant constituents. Two current challenges for today's ethnopharmacological research are: first, to carry out pharmacological studies on medicinal plants, taking into account detailed ethnographic information about these plants (for example, plant parts used, traditional mode of plant preparation, and administration); and second, application of the pharmacological research findings for the benefit of local communities (feedback information of potential adverse or harmful effects of certain medicinal plants, creation of a catalogue of promising lead molecules from plants and sustainable cultivation of those plants) (21).

The training of local people in Western health care is already practised in Bolivia. In Andean communities, a resident is elected by its community for this purpose (7). One advantage of including healers in the training is that they can learn to recognize illnesses that are preferably treated by Western PHCs. In Apillapampa, one of the traditional healers of AMETRAC was trained by a local NGO to attend the PHC on weekends when the medical staff was not present. Training in Western health care should also include education in the appropriate use of pharmaceuticals (22). In the PHC of Apillapampa, for instance, it was observed that antibiotics were sold per tablet in response to the poor economic situation of patients. Developing countries face inappropriate prescribing, dispensing, and use of pharmaceuticals. Although local governments are interested in ensuring availability and access to pharmaceuticals, improving the adequate use of Western medicines remains a low priority. When inappropriately used, pharmaceuticals lose their therapeutic value, are an economic burden (waste of resources), and can have serious negative health effects (22).

### Conclusion

Medicinal plants play an important role in primary health care in both study areas — in the Andes because of their importance

within the local cultural context and in the Amazon because of lack of Western PHCs. To what extent the use of medicinal plants and pharmaceuticals in the study areas differs according to specific diseases has yet to be investigated. The present research contributes to scientific understanding of the pluralistic medical system, showing that not only use of but also knowledge about medicinal plants is influenced by physical isolation of communities and the use of pharmaceuticals. ■

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## Résumé

### Utilisation des plantes médicinales et des produits pharmaceutiques par les communautés autochtones dans les Andes et l'Amazonie boliviennes

**Objectif** Etudier, au moyen d'enquêtes dans les ménages, l'utilisation des plantes médicinales et des produits pharmaceutiques à Apillapampa, une vaste communauté andine de paysans Quechua, et dans six petites communautés de cultivateurs Yuracaré-Trinitario pratiquant la culture sur brûlis dans le Parc national d'Isiboro-Sécure (NPIS), en Amazonie bolivienne.

**Méthodes** Au total, 12 % des ménages d'Apillapampa et la quasi-totalité des ménages du NPIS ont été interrogés au sujet de l'utilisation des plantes médicinales et des produits pharmaceutiques pour le traitement des maladies. Il était également demandé aux personnes enquêtées de nommer les plantes médicinales qu'elles connaissaient.

**Résultats** Malgré la présence d'un service de soins de santé primaires disposant d'un médecin à Apillapampa, le nombre d'utilisateurs de plantes médicinales et de produits

pharmaceutiques était le même. Dans le NPIS, l'utilisation prédominante de plantes médicinales ou de médicaments dans une communauté dépendait de sa distance au village le plus proche ( $r = 0,85$ ;  $p = 0,05$ ) et de la présence d'un service de soins de santé primaires avec médecin ( $r = -0,96$ ;  $p = 0,05$ ). La connaissance des plantes médicinales par les communautés du NPIS, exprimée par le nombre moyen de plantes médicinales mentionnées, présentait une corrélation positive avec la distance au village le plus proche ( $r = 0,95$ ;  $p < 0,005$ ) et négative avec l'utilisation de produits pharmaceutiques ( $r = -0,90$ ;  $p < 0,05$ ).

**Conclusion** L'importance culturelle de la médecine traditionnelle et l'isolement physique des communautés, d'une façon générale et par rapport aux services de soins de santé primaires, sont des facteurs qui influent sur l'utilisation et sur la connaissance des plantes médicinales.

## Resumen

### Uso de plantas medicinales y preparaciones farmacéuticas por comunidades indígenas en los Andes y la Amazonia bolivianos

**Objetivo** Investigar, por medio de encuestas domiciliarias, el uso que hacen de las plantas medicinales y las preparaciones farmacéuticas los habitantes de Apillapampa, una gran comunidad andina de campesinos quechua, y de seis pequeñas comunidades de yuracaré-trinitarios, dedicados al cultivo de tala y chamicera, del Parque Nacional Isiboro-Sécure (PNIS), la Amazonia boliviana.

**Métodos** Se entrevistó en total a un 12% de las familias de Apillapampa y a casi todas las familias del PNIS a fin de averiguar el uso que hacían de las plantas medicinales y las preparaciones farmacéuticas para tratar las enfermedades. Se pidió además a los encuestados que nombraran todas las plantas medicinales que conociesen.

**Resultados** Pese a la existencia de un servicio de salud básico (SSB) dotado de médico en Apillapampa, el número de personas que usaban plantas medicinales era semejante al de

quienes usaban preparaciones farmacéuticas. En el PNIS, el recurso prioritario a las plantas medicinales o las preparaciones farmacéuticas en cualquiera de las comunidades dependía de la distancia hasta el pueblo más cercano y hasta un SSB provisto de médico ( $r = 0,85$ , y  $r = -0,96$ ,  $P = 0,05$  en los dos casos). Los conocimientos de las comunidades del PNIS acerca de las plantas, expresados como el número promedio de plantas medicinales mencionadas, estaban correlacionados positivamente con la distancia al pueblo más cercano y negativamente con el uso de preparaciones farmacéuticas ( $r = 0,95$ ,  $P < 0,005$  y  $r = -0,90$ ,  $P < 0,05$ , respectivamente).

**Conclusión** La importancia cultural de la medicina tradicional y el aislamiento físico de las comunidades, tanto en general como respecto a los SSB, son factores que influyen en el uso de las plantas medicinales y en los conocimientos sobre ellas.

## ملخص

## استخدام النباتات الطبية والأدوية من قِبل المجتمعات المحلية في مناطق الأمازون وجبال الإنديز في بوليفيا

الطبية أو الأدوية يتوقف على بُعد المسافة بين المجتمع وأقرب قرية (معامل الارتباط = ٠,٨٥، عند معامل دقة = ٠,٠٥) أو بُعد المسافة بين المجتمع ومرفق الرعاية الصحية الأولية الذي يعمل به طبيب (معامل الارتباط = -٠,٩٦، عند معامل دقة = ٠,٠٥). وقد تبين وجود علاقة ارتباط إيجابية بين مستوى معارف مجتمعات حديقة ايزيبورو سكيور الوطنية، الذي يعبر عنه بالعدد المتوسط للنباتات الطبية التي يتم ذكرها، وبين بُعد المسافة عن أقرب قرية (معامل الارتباط = ٠,٩٥، عند معامل دقة أقل من ٠,٠٥)، كما تبين وجود علاقة ارتباط سلبية بين مستوى معارف هذه المجتمعات واستخدامها للأدوية (معامل الارتباط = -٠,٩٠، عند معامل دقة أقل من ٠,٠٥).

**الخلاصة:** تعتبر الأهمية الثقافية للطب الشعبي، والانعزال المكاني للمجتمعات بشكل عام أو بُعدها عن مرافق الرعاية الصحية الأولية، من العوامل التي تؤثر في استخدام النباتات الطبية والمعرفة بها.

**للغرض:** استهدفت هذه الدراسة، التي أُجريت من خلال مسوحات منزلية، بحث نمط استخدام النباتات الطبية والأدوية في منطقة أيبيلابامبا، وهي أحد مجتمعات الأنديز الكبيرة التي يقطنها مزارعون يتحدثون لغة الكواتشوا، وفي ستة مجتمعات أخرى صغيرة يقطنها مزارعون في حديقة ايزيبورو سكيور الوطنية الواقعة في منطقة الأمازون في بوليفيا.

**الطريقة:** أُجريت مقابلات مع ١٢٪ من الأسر في منطقة أيبيلابامبا ومع معظم الأسر في حديقة ايزيبورو سكيور الوطنية، وذلك لاستبيان نمط استخدامهم للنباتات الطبية والأدوية لمعالجة الأمراض. وطلب من مقدمي المعلومات أثناء المقابلة ذكر أسماء أية نباتات طبية يعرفونها.

**الموجودات:** على الرغم من وجود مرفق للرعاية الصحية الأولية يعمل به طبيب في منطقة أيبيلابامبا، إلا أن عدد المُستجوبين الذين يستخدمون النباتات كان متساوياً مع عدد من يستخدمون الأدوية. أما في المجتمعات الواقعة في منطقة حديقة ايزيبورو سكيور الوطنية، فكان استخدام النباتات

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