# Ethnobotanical approach in the treatment of kidney diseases: A comparative study in Peruvian indigenous communities

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**Ethnobotany Research and Applications 31:36 (2025)** - http://dx.doi.org/10.32859/era.31.36.1-12
Manuscript received: 08/04/2025 - Revised manuscript received: 26/07/2025 - Published: 27/07/2025

## Research

## Abstract

*Background*: Kidney problems are common and often neglected due to limited access to medical care in indigenous communities. As a result, the use of medicinal plants has become a practice deeply rooted in traditional medicine. Identifying the main plants used for this purpose, along with their routes of administration and dosage, provides valuable insight into indigenous therapeutic practices for kidney-related ailments.

*Methods*: A cross-sectional study was conducted between 2024 and 2025 in the indigenous communities of Supayaku and Yamakey in Peru. Sociodemographic data and information on the use of medicinal plants were collected through surveys of indigenous individuals over 18 years of age who had knowledge of plant use for treating kidney problems. Descriptive statistics and logistic regression models were used to analyze the data.

*Results*: The use of medicinal plants differed significantly in Supayaku and Yamakey. *Bixa orellana* L. was more abundant in Supayaku than in Yamakey, and *Equisetum arvense* L. was more prominent in Yamakey than in Supayaku (p = 0.02). Administration duration also differed significantly being longer in Yamakey (23.61 days) than in Supayaku (20.46 days) (p = 0.04). In both communities, plants were mainly field collected (78.57% in Supayaku; 98.21% in Yamakey) and mostly used in infusions (98% in Yamakey and 86% in Supayaku).

*Conclusions*: The study documents the diversity of traditional indigenous medicinal practices for treating kidney problems, highlighting significant differences in species, preparation, and administration of medicinal plants.

*Keywords*: Medicinal Plants; Kidney Diseases; Indigenous Peoples; Latin America

## Background

The use of medicinal plants is an important practice in the traditional medicine of various cultures around the world (Budiapsari *et al*., 2024). Today, in countries across Asia, Africa, and Latin America, these practices are widely accepted by the populations of indigenous communities (Herrera-Añazco *et al*. 2019, Srivastava *et al.* 2024). The utilization of medicinal plants is based on several advantages, such as their low cost, greater accessibility, and lower incidence of adverse reactions compared to modern pharmaceutical treatments (Muhakr *et al*. 2024). This, combined with the traditional knowledge passed down within indigenous communities, has allowed medicinal plants to continue playing a key role in healthcare and, in many cases, complement modern medicine (Bencheikh *et al*. 2024).

In indigenous communities, access to healthcare facilities and specialized medical personnel is limited or non-existent, posing a critical challenge (Mon *et al*., 2024). As a result, the population focuses on treating visible symptoms without addressing the underlying causes (Reilly *et al*. 2016). In this context, kidney conditions stand out as a common and neglected issue (Atamari-Anahui *et al*. 2020, Herrera-Añazco *et al*. 2017), with manifestations including persistent fatigue, fluid retention, changes in urine, lower back pain, nausea, and vomiting (Ralte *et al*. 2024). Furthermore, the lack of interventions can lead to severe complications such as hypertension, anemia, and neurological damage (Nguanchoo *et al*. 2023). These conditions not only represent a serious threat to the health and overall well-being of the population (Merchant & Vathsala, 2022), but they also exacerbate their vulnerability due to limited access to timely and effective treatments (Laldingliani *et al*. 2022).

Early identification and the integration of traditional knowledge with modern medicine may be key to improving kidney health in indigenous communities. Previous investigations suggest that these communities use several medicinal plants to treat kidney problems (Bencheikh *et al*. 2021, Guimarães *et al*. 2022, Herrera-Añazco *et al*. 2019), highlighting the frequent use of *Bixa orellana* L. and *Phyllanthus niruri* L. as treatment options (Chandana *et al*. 2021, Molina-Romani *et al*. 2023). However, despite the available information, there is still a considerable need to conduct deeper research to identify different types of plants and how their use varies among communities. In this context, the present study aims to identify the main medicinal plants used, the administration routes, and the doses employed by indigenous communities to alleviate kidney problems.

## Materials and Methods

### Design, Population, and Sampling

This is a cross-sectional study conducted in the communities of Supayaku and Yamakey, which are part of the indigenous community of Supayaku in the Cajamarca Department, Peru. Data was collected using a convenience sampling method between 2024 and 2025 in communities located approximately 7 hours away by public transport, followed by 3 hours by motorcycle and 4 hours by public transport from the province of Chachapoyas. Among them, Supayaku is the largest indigenous community, while Yamakey is a smaller community. The two are separated by a distance of 5.5 km, which can be traveled in just 15 minutes by public transport. Both communities offer primary and secondary education to their residents; however, only Supayaku has a health center. This facility makes it a strategic point for medical care in the region, providing services to both its own residents and those of Yamakey (Figure. 1).

The following inclusion criteria were used to determine the sample: indigenous individuals over 18 years of age, belonging to the Supayaku and Yamakey communities, who had knowledge of the use of medicinal plants. Additionally, individuals who were unable to complete the entire survey and those with noticeable neurological issues were excluded. This research was conducted with prior authorization from the APU (a resident who assumes a leadership role, acting as a mediator between the indigenous community members and the external population), as well as the assistance of an Awajún interpreter (a person who serves as both translator and cultural mediator).

The research was approved by the Research Ethics Committee of the "Universidad Nacional Toribio Rodríguez de Mendoza de Amazonas" (CIEI-N° 00147). All procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki (Issue Information 2023, Sawicka-Gutaj *et al*. 2022), ensuring the protection of participants' rights, dignity, and well-being. Participation was entirely voluntary, and written informed consent was obtained from all individuals prior to the interviews, following a clear explanation of the study objectives. Furthermore, it is important to emphasize that this study did not involve the collection or direct manipulation of genetic resources, nor was any commercial product derived from the information obtained. However, compliance with the principles of the Nagoya Protocol is highlighted (Government of Peru 2023), recognizing the rights of indigenous communities over their knowledge. Additionally, the study's contribution is emphasized through the revaluation of ancestral knowledge, creating opportunities for future conservation, education, and local development projects while respecting the identity and rights of indigenous communities.

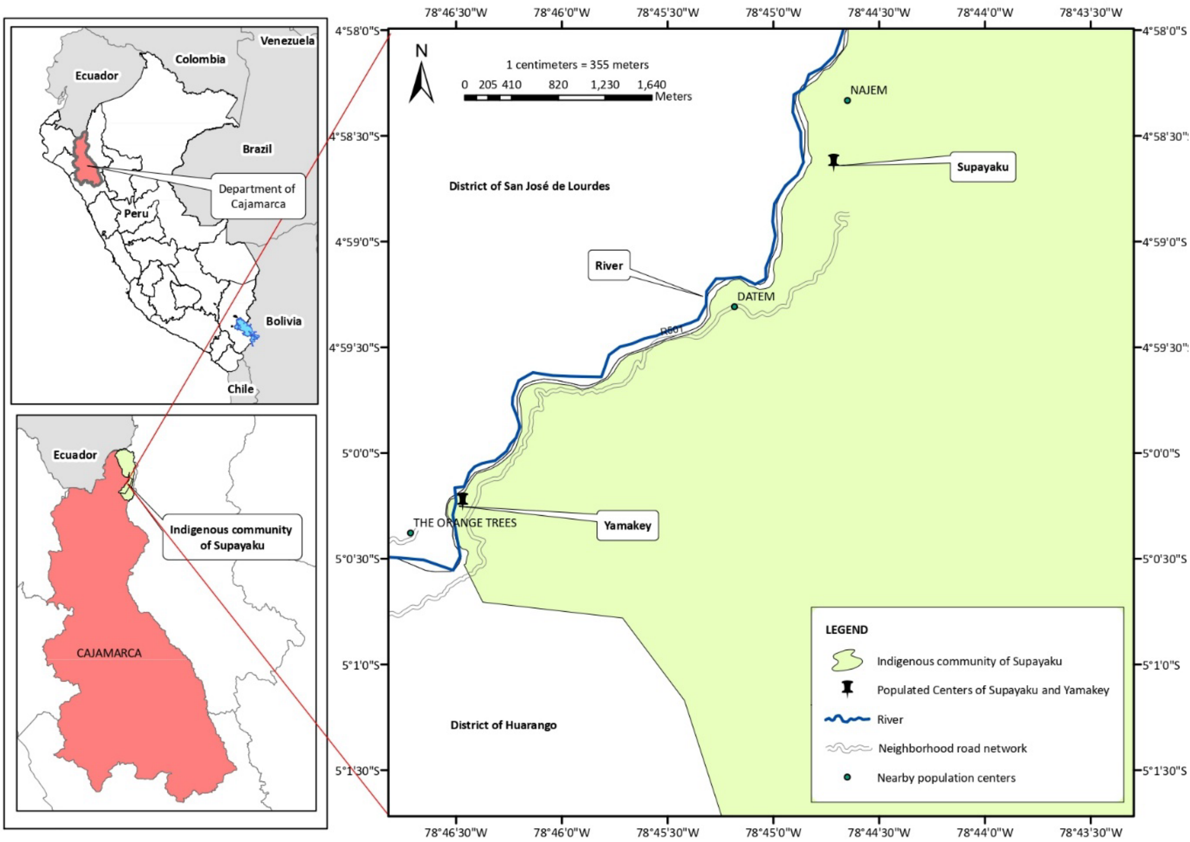


Figure 1. Map of the Indigenous Communities of Supayaku and Yamakey in the Cajamarca Department, Peru. The map shows the location of the indigenous communities of Supayaku and Yamakey in the Cajamarca department, near the border with Ecuador, within the districts of San José de Lourdes and Huarango. It highlights the territory of Supayaku (marked in green), the main river that runs through the region, and the two main settlements: Supayaku to the north and Yamakey to the south, connected by a network of local roads. It also identifies nearby settlements and provides a reference to their location within Peru.

**Symptomatology of Kidney Problems**

The symptomatology of kidney problems was self-reported by each participant following the administration of the data collection instrument, covering common symptoms according to the literature such as: edema and shortness of breath (Kalantar-Zadeh *et al*. 2022), muscle pain, weakness (Kalantar-Zadeh *et al*., 2022), fatigue (Clark-Cutaia, 2022), and dry skin (Jacob *et al*. 2024).

**Use of Medicinal Plants**

The data collection instrument included an initial section for sociodemographic information (gender, age, and educational level). This was followed by 10 questions regarding the use of medicinal plants for the symptoms of kidney problems, including: frequency of use, plant identification, plant parts used (root, stem, leaves, flowers, fruits, bark), preparation methods (infusion, poultice, juice, decoction, maceration, among others), administration routes (oral, rectal, topical, parenteral, vaginal), dosage, duration of treatment, plant sourcing (garden, market, field, herbarium), and state of use (dried or fresh).

The reliability of the instrument was evaluated using Cronbach's alpha coefficient, resulting in a value of 0.83, indicating good internal consistency. Additionally, validation was carried out through the judgment of five experts, who reviewed the instrument and confirmed its high validity.

***Data Analysis***

For data analysis, descriptive statistics were used. The Kolmogorov-Smirnov test was performed to determine the normality of the data. Additionally, to assess the use of medicinal plants for treating the symptoms of kidney problems, frequencies and percentages were presented based on the plants used. Logistic regression models were also conducted to explore associations between the use of medicinal plants and demographic data such as age, gender, and education level. The results were presented using means, standard deviations, and p-values <0.005. All analyses were performed using SPSS version 26 and Jasp 0.19.1.0 software.

## Results

**Demographic Characteristics of the Study Population**

The demographic data from the indigenous communities of Supayaku (n=28) and Yamakey (n=56) showed that the average age was 47.04 years (SD=20.50) in Supayaku and 47.13 years (SD=19.58) in Yamakey. The proportion of men was 57.14% in Supayaku and 53.57% in Yamakey, with no significant differences (p=0.76). Regarding educational level, in Supayaku, 25% of participants had primary education, and another 25% were illiterate; in Yamakey, 23.21% had primary education, and 50% were illiterate, with no statistically significant differences (p=0.08). (Table 1)

Table 1. Demographic data of the inhabitants of the indigenous communities.

| Variables | Indigenous Communities | | P |
|---|---|---|---|
| | Supayaku (n=28) | Yamakey (n=56) | |
| Age years, x̄ (SD) | 47.04 (20.50) | 47.13 (19.58) | 0.97 |
| Masculine, n (%) | 16 (57.14%) | 30 (53.57%) | 0.76 |
| **Educational Level, n (%)** | | | |
| Primary | 7 (25%) | 13 (23.21%) | 0.08 |
| Secundary | 7 (25%) | 10 (17.86%) | |
| Higher Education | 7 (25%) | 5 (8.93%) | |
| Illiterate | 7 (25%) | 28 (50%) | |

**Legend:** x̄ = Mean, SD = Standard Deviation; **p:** significance of 0.05

**Diversity and Frequency of Medicinal Plant Use**

The results obtained in the study on plants in both communities revealed the following observations. In the case of Supayaku, the most represented species were *Bixa orellana* L. (achiote) with 17.86% (n=5), followed by *Annona muricata* L. (guanábana), *Equisetum arvense* L. (cola de caballo), and *Phyllanthus niruri* L. (chanca piedra), each with 10.71% (n=3). Other species recorded included *Melocactus bellavistensis* Rauh & Backeb. (piña silvestre), *Sonchus oleraceus* L. (cerraja), *Bidens pilosa* L. (cadillo de flor blanca), *Ilex guayusa* Loes. (guayusa), and *Schkuhria pinnata* (Lam.) Kuntze ex Thell. (canchalagua), each with 3.57% (n=1). Additionally, a combination of plants was observed in 10.71% (n=3) (Table 2).

In Yamakey, the most prominent species were *Equisetum arvense* L. (cola de caballo) with 32.14% (n=18), followed by *Phyllanthus niruri* L. (chanca piedra) with 23.21% (n=13) and *Annona muricata* L. (guanábana) with 14.29% (n=8). Other species, such as *Bixa orellana* L. (achiote), *Melocactus bellavistensis* Rauh & Backeb. (piña silvestre), and *Buddleja globosa* Hope (matico), were present in smaller proportions, with 8.93% (n=5), 8.93% (n=5), and 7.14% (n=4), respectively (Figure 2).

**Ethnobotanical Use and Administration Patterns**

In the renal treatment of indigenous communities, various significant medicinal plants and combinations were identified. Among the species used, *Baccharis latifolia* (Ruiz & Pav.) Pers. (carqueja) stood out in the Supayaku community, where the entire plant was used in an infusion (250 ml/day for 10 days). *Sonchus oleraceus* L. (cerraja) was consumed in both infusion and juice (3 times/day for 10 days), while *Annona muricata* L. (guanábana) was used in both contexts, being more frequent in Yamakey with leaves in infusion (2-3 times/day for 25-30 days). Additionally, *Bixa orellana* L. (achiote) and *Equisetum arvense* L. (cola de caballo) were common in both groups, with daily infusions and usage times ranging from 10 to 30 days. In combinations, the mix of *Uncaria tomentosa* (Willd. ex Schult.) DC. (uña de gato) and *Phyllanthus niruri* L. (chanca Piedra) was applied in both communities, with an infusion of bark or the entire plant (250 ml, up to 3 times/day, for 10-25 days).

Table 2. Ethnobotanical Use of Medicinal Plants for Kidney Problem Treatment in Indigenous Communities

| Family | Scientific Name | Local name | C | Use, n (%) | Parts used, n (%) | Ethnobotanical Preparation, n (%) | Amount Used, n (%) | Frequency of use, n (%) | Duration of Use in Days, n (%) |
|---|---|---|---|---|---|---|---|---|---|
| Asteraceae | *Baccharis latifolia* (Ruiz & Pav.) Pers. | Carqueja | **C1** | Yes, 1 (3.57) | Wp, 1 (3.57) | I, 1 (3.57) | 250 ml, 1 (3.57) | Wd, 1 (3.57) | 10, 1 (3.57) |
| | | | **C2** | No | - | - | - | - | - |
| | *Sonchus oleraceus* L. | Cerraja | **C1** | Yes, 2 (7.14%) | L, 2 (7.14) | I, 1 (3.57)<br>J, 1 (3.57) | 250 ml, 2 (7.14) | 3 t/d, 2 (7.14) | 10, 2 (7.14) |
| | | | **C2** | No | - | - | - | - | - |
| | *Bidens pilosa* L. | Cadillo de flor blanca | **C1** | Yes, 1 (3.57) | Wp, 1 (3.57) | I, 1 (3.57) | 250 ml, 1 (3.57) | Wd, 1 (3.57) | 29, 1 (3.57) |
| | | | **C2** | No | - | - | - | - | - |
| | *Schkuhria pinnata* (Lam.) Kuntze ex Thell. | Canchalagua | **C1** | Yes, 1 (3.57) | Wp, 1 (3.57) | I, 1 (3.57) | 250 ml, 1 (3.57) | Wd, 1 (3.57) | 30, 1 (3.57) |
| | | | **C2** | No | - | - | - | - | - |
| Annonaceae | *Annona muricata* L. | Guanábana | **C1** | Yes, 3 (10.71) | L, 3 (10.71) | I, 3 (10.71) | 1 - 2 F, 3 (10.71) | 3 t/d, 2 (7.14) | 30, 2 (7.14) |
| | | | **C2** | Yes, 8 (14.29) | L, 8 (14.29) | I, 8 (14.29) | 1 - 5 L, 7 (12.50) | 2 t/d, 7 (12.50) | 25, 5 (8.93) |
| Aquifoliaceae | *Ilex guayusa* Loes. | Guayusa | **C1** | Yes, 1 (3.57) | L, 1 (3.57) | I, 1 (3.57) | > 11 L, 1 (3.57) | 2 t/d, 1 (3.57) | 25, 1 (3.57) |
| | | | **C2** | No | - | - | - | - | - |
| Bixaceae | *Bixa orellana* L. | Achiote | **C1** | Yes, 5 (17.86) | L, 5 (17.86) | I, 4 (14.29)<br>P, 1 (3.57) | 1 - 5 L, 3 (10.71) | 1 t/d, 5 (17.86) | 10, 3 (10.71) |
| | | | **C2** | Yes, 5 (8.93) | L, 5 (8.93) | I, 5 (8.93) | 1 - 5 L, 5 (8.93) | 1 t/d, 5 (8.93) | 10, 4 (7.14) |
| Buddlejaceae | *Buddleja globosa* Hope | Matico | **C1** | Yes, 1 (3.57) | L, 1 (3.57) | I, 1 (3.57) | 250 ml, 1 (3.57) | 3 t/d, 1 (3.57) | 30, 1 (3.57) |
| | | | **C2** | Yes, 4 (7.14) | L, 4 (7.14) | I, 4 (7.14) | 1 - 5 L, 2 (3.57) | Wd, 4 (7.14) | 10, 4 (7.14) |
| Cactaceae | *Melocactus bellavistensis* Rauh & Backeb. | Piña silvestre | **C1** | Yes, 1 (3.57) | F, 1 (3.57) | I, 1 (3.57) | 1 - 2 F, 1 (3.57) | 3 t/d, 1 (3.57) | 30, 1 (3.57) |
| | | | **C2** | Yes, 5 (8.93) | F, 5 (8.93) | I, 5 (8.93) | 1 - 2 F, 5 (8.93) | Wd, 5 (8.93) | 30, 5 (8.93) |
| Equisetaceae | *Equisetum arvense* L. | Cola de caballo | **C1** | Yes, 3 (10.71) | Wp, 3 (10.71) | I, 3 (10.71) | 250 ml, 3 (10.71) | Wd, 3 (10.71) | 25, 3 (10.71) |
| | | | **C2** | Yes, 18 (32.14) | Wp, 18 (32.14) | I, 18 (32.14) | 250 ml, 18 (32.14) | Wd, 14 (25.00) | 25, 17 (32.14) |
| Phyllanthaceae | *Phyllanthus niruri* L. | Chanca piedra | **C1** | Yes, 3 (10.71) | Wp, 3 (10.71) | I, 3 (10.71) | 250 ml, 3 (10.71) | 3 t/d, 2 (7.14) | 30, 1 (3.57) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | **C2** | Yes, 13 (23.21) | Wp, 13 (23.21) | I, 13 (23.21) | 250 ml, 13 (23.21) | 3 t/d, 10 (17.86) | 25, 13 (23.21) |
| Rosaceae | *Rubus glaucus* Benth. | Zarzamora | **C1** | Yes, 2 (7.14) | L, 1 (3.57)<br>R, 1 (3.57) | I, 2 (7.14) | 250 ml, 2 (7.14) | 3 t/d, 1 (3.57) | 15, 2 (7.14) |
| | | | **C2** | No | - | - | - | - | - |
| Zingiberaceae | *Zingiber officinale* Roscoe | Kión de la selva | **C1** | Yes, 1 (3.57) | F, 2 (7.14) | I, 1 (3.57) | 3 - 5 F, 1 (3.57) | 2 t/d, 1 (3.57) | 10, 1 (3.57) |
| | | | **C2** | Yes, 1 (1.79) | F, 1 (1.79) | I, 1 (1.79) | 3 - 5 F, 1 (1.79) | 2 t/d, 1 (1.79) | 10, 1 (1.79) |
| Plant combination | *Equisetum arvense* L. + *Linum usitatissimum* L. + *Annona muricata* L. + *Bixa orellana* L. | Cola de caballo + linaza + Guanábana + achiote | **C1** | Yes, 1 (3.57) | L, 1 (3.57) | I, 1 (3.57) | 6 - 10 L, 1 (3.57) | 3 t/d, 1 (3.57) | 15, 1 (3.57) |
| | | | **C2** | No | - | - | - | - | - |
| | *Equisetum arvense* L. + *Bixa orellana* L. + *Annona muricata* L. | Cola de caballo + achiote + guanabana Carl Linnaeus | **C1** | Yes, 1 (3.57) | Wp, 1 (3.57) | I, 1 (3.57) | 6 - 10 L, 1 (3.57) | Wd, 1 (3.57) | 30, 1 (3.57) |
| | | | **C2** | No | - | - | - | - | - |
| | *Uncaria tomentosa* (Willd. ex Schult.) DC. + *Phyllanthus niruri* L. | Uña de gato + chanca piedra | **C1** | Yes, 1 (3.57) | B, 1 (3.57) | I, 1 (3.57) | 250 ml, 1 (3.57) | 2 glasses on an empty stomach + 2 glasses before bed, 1 (3.57) | 10, 1 (3.57) |
| | | | **C2** | Yes, 2 (3.57) | Wp, 2 (3.57) | I, 2 (3.57) | 250 ml, 2 (3.57) | 3 t/d, 2 (3.57) | 25, 2 (3.57) |

**Legend:**
**C:** C1 = Indigenous Community of Supayaku**, C2 =** Indigenous Community of Yamakey; **Parts used:** Wp = Whole plant, L = Leaf (s), F= Fruit (s), R = Root, B = Bark;
**Ethnobotanical Preparation:** I = Infusion, J = Juice, P = Plaster; **Amount Used:** ml = Mililitros; **Frequency of use:** Wd = Water daily, t/d = times/day.

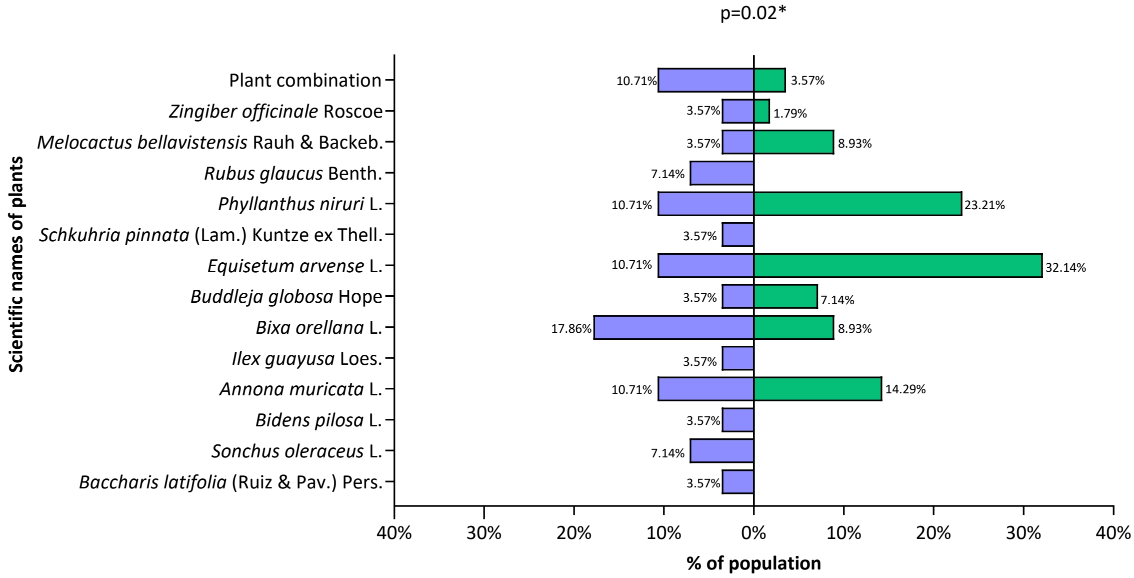


Figure 2. Plants used for kidney problems by plant family type and community. The figure shows a comparative analysis of the percentage of plant use in the communities of Yamakey (green bar) and Supayaku (purple bar). Each row corresponds to the scientific name of a plant or a combination of plants evaluated.

**Characteristics of Plant Use and Treatment Administration**

Regarding the use of plants in the communities, the administration time was longer in Yamakey ($\bar{x}$: 23.61 days) than in Supayaku ($\bar{x}$: 20.46 days), with a significant difference (p=0.04). The majority of the plants used were fresh in both communities (92.86% in Supayaku and 98.21% in Yamakey); however, in Supayaku, leaves predominated (50%), while in Yamakey, the whole plant was more commonly used (58.93%). Regarding the source of plant collection, Supayaku primarily obtains them from the field (78.57%), while in Yamakey, although the majority also collects them from the field (98.21%), a small group collects them from the garden (21.43%). Additionally, in terms of frequency, 42.86% in Supayaku administer the plants three times a day, compared to 16.07% in Yamakey (p=0.01) (Table 3).

Table 3. Plant parts used, application form and origin of medicinal plants.

| Variables | Supayaku (n=28) | Yamakey (n=56) | p |
|---|---|---|---|
| Time of Use days $\bar{x}$ (SD) | 20.46 (8.48) | 23.61 (5.44) | 0.04* |
| **Plant State, n (%)** | | | |
| Dried | 2 (7.14) | 1 (1.79) | 0.21 |
| Fresh | 26 (92.86) | 55 (98.21) | |
| **Plant Parts Used, n (%)** | | | |
| Stem | 1 (3.58) | 0 | 0.11 |
| Leaf | 14 (50) | 17 (30.36) | |
| Fruit | 2 (7.12) | 5 (8.87) | |
| Bark | 1 (3.58) | 1 (1.79) | |
| Whole plant | 10 (2.6) | 33 (58.93) | |
| **Source of Plant Collection, n (%)** | | | |
| Field | 22 (78.57) | 55 (98.21) | 0.002* |
| Garden | 6 (21.43) | 1 (1.79) | |
| **Routes of Administration, n (%)** | | | |
| Oral | 27 (96.42) | 55 (98.21) | 0.61 |
| Topical | 1 (3.58) | 1 (1.79) | |
| **Frequency of Administration, n (%)** | | | |
| 1 time/day | 5 (17.84) | 6 (10.71) | 0.01* |
| 2 time/day | 3 (10.72) | 8 (14.29) | |
| 3 time/day | 12 (42.86) | 9 (16.07) | |
| Daily water | 7 (25) | 33 (58.93) | |
| 2 glasses on an empty stomach + 2 glasses before bed | 1 (3.58) | 0 | |

**Legend:**$\bar{x}$ = Mean, SD = Standard Deviation; **p:** significance of 0.05

**Preparation Methods of Medicinal Plants**

In the Yamakey community, the majority of preparations were made in the form of an infusion, with 98% (n=55), while in Supayaku, this method reached 86% (n=24). Other preparation methods, such as poultices, were used by 2% (n=1) in Yamakey and 11% (n=1) in Supayaku. Additionally, juice was only used in Supayaku, with 3% (3), whereas no use of this method was reported in Yamakey. (Figure 3)

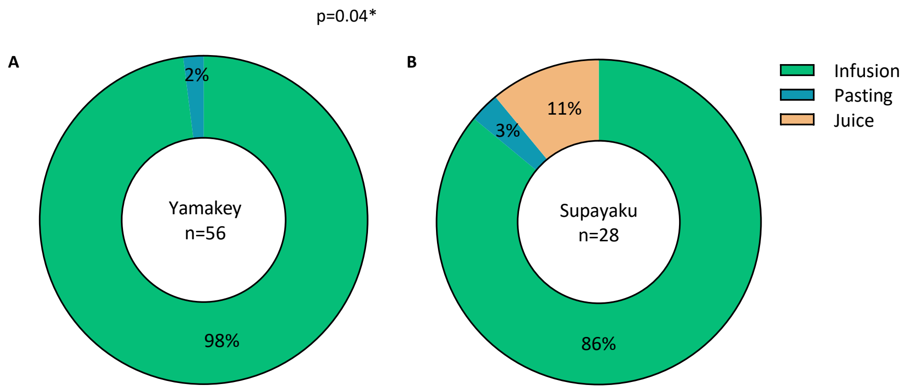


Figure 3: Distribution of Preparation Methods in Native Communities. The figiure presents a comparison of the plant preparation methods used by the Yamakey and Supayaku communities, indicating a percentage distribution and differences in usage forms such as infusion (green), juice (orange), or poultice (light blue).

## Discussion

Knowledges and attitudes about the use of medicinal plants for kidney disorders among two Peruvian indigenous communities. The results show differences in plant species used, duration of administration, frequency of use, and collection methods in the Supayaku and Yamakey communities. Despite their close proximity to one another, they reflect the cultural and ecological diversity of these communities.

The results show variations in the plants used to treat kidney problems from one community to another. For example, in the Yamakey community, horsetail (*Equisetum arvense* L.) is more commonly used, while in Supayaku, annatto (*Bixa orellana* L.) is more commonly utilized. These differences may be influenced by not only traditional knowledge (Palchetti *et al.* 2023), but also by ecological factors specific to each locality (Camacho-Hernández *et al*. 2022, Singh *et al*. 2025). Previous studies conducted in Latin America have identified different plants for treating symptoms of kidney problems (Guimarães *et al*. 2022, Herrera-Añazco *et al*. 2019). Species such as *Equisetum arvense* L. are known in Bolivia and Brazil for aiding the elimination of toxins and dissolving kidney stones (Alves & Thomazi, 2023, Bussmann *et al*. 2015), while *Bixa orellana* L. is noted for its richness in antioxidants like carotenoids, which protect against oxidative damage (Molina-Romani *et al*. 2023). Similarly, in countries like Chile and Argentina, *Buddleja globosa* Hope is renowned for containing iridoids (Pastene-Navarrete & Torres-Vega, 2021), which act as healing agents, promoting the recovery of kidney lesions (Houghtion, 2003). The toxicology and adverse reactions of these species remain largely unclear, with *Equisetum arvense* L. demonstrating a safety profile without evidence of genotoxicity (Dormousoglou *et al.* 2022). However, the lack of human studies on the toxicity of plants such as *Bixa orellana* L. and *Buddleja globosa* Hope represents a significant limitation for the use of these species in alternative and traditional medicine. These factors suggest that knowledge is adapted according to each community's experience and the utilization of natural resources, often neglecting the scientific rigor necessary to validate the use of these species for kidney health.

Regarding the preparation methods, it is observed that infusion predominates as the method of administration. This method reflects the simplicity with which infusions allow the extraction and concentration of the active principles of plants (Jenkins *et al*. 2009), making them an accessible option, especially in indigenous communities (Nirmal *et al*. 2018). Additionally, previous studies also show a preference for the preparation of juices, particularly because they contain a higher number of soluble compounds (Ephrem *et al*. 2018, Jepson et al. 2012). This variability could be related not only to cultural preferences (Alemu *et al*. 2024) but also to the availability of resources and knowledge of therapeutic effects (Rivera *et al*. 2017). However, although infusions and juices are the most relevant methods (Jenkins *et al*. 2009, Reilly *et al*. 2016), they depend on water for their preparation, a resource that is scarce and limited in many indigenous communities (Herrera-Añazco *et al.* 2019). The scarcity of potable water, coupled with biological contaminants (Torres-Slimming *et al*. 2023), increases the likelihood of gastrointestinal diseases and threatens the effectiveness of traditional preparation methods (Redmon *et al*. 2021), as untreated water can pose a health risk to the population.

Furthermore, a variation in the frequency of administration is observed, with patterns ranging from daily use with no specific limit to a more structured administration, such as three times a day. This may be related to local perceptions of the effectiveness of treatments (Herrera-Añazco *et al*. 2019), influenced by previous experiences and the belief that more frequent treatments could provide better results (Olalekan *et al*. 2024). Likewise, in the present study, the reported dosages included liquid quantities as well as the number of leaves or fruits, highlighting the diversity in dosage practices. Previous research has emphasized this variability, showing that traditional practices prevail more strongly than scientific calibration (Busia 2024, Limenh *et al*. 2023). However, the lack of standardization in administration procedures and dosage calibration can also be adapted to healthcare practices according to cultural (Arjona-García *et al*. 2021), social, and environmental (Adhikari *et al*. 2018) realities. This underscores the importance of ancestral knowledge within each community, as it enables the management and adaptation of herbal treatments to meet individual and social needs and perceptions (González-Rivera *et al*. 2025).

Both indigenous communities studied have primary and secondary schools, but they differ significantly in several aspects. Supayaku, as the larger community, has access to a health post that facilitates medical care and offers training programs, while Yamakey depends on Supayaku for these services. This centralization impacts not only access to farming land (Eidt *et al*. 2020, Hackfort, 2021), but also the social dynamics (Altschuler & Mann, 2023), with a higher concentration of activities and programs in Supayaku. Additionally, it has been observed in both communities that most plants are primarily collected from the field; however, in Supayaku, there is a more notable population that collects plants from the garden, which could be related to the educational programs and training offered by the health center (Altschuler & Mann, 2023). Despite being geographically close, the realities tend to differ more significantly in terms of access to resources, adaptation to new practices, and cultural preservation (Fatorić & Seekamp, 2017).

Despite the findings presented, this study has several limitations. First, the cross-sectional design prevents the establishment of causal relationships between the observed phenomena. Additionally, the sample used was not representative, which may have introduced bias due to a primary focus on participants with prior knowledge of the benefits of these plants. This limits the possibility of conducting more in-depth statistical analyses, as the demographic characteristics of this target population may differ from those without such knowledge. Furthermore, the absence of a medical diagnosis to validate symptoms as kidney-related problems limits the ability to establish a specific correlation between medicinal plants and renal symptoms. Moreover, research in Indigenous contexts faces logistical and cultural challenges that may influence the interpretation and applicability of the results. Therefore, it is crucial to conduct further studies exploring the impact of medicinal plants on kidney health, with greater scientific and medical validation to confirm their efficacy and safety, aiming to develop interventions and public policies better suited to the specific needs of these populations.

## Conclusion

In conclusion, this study highlighted significant differences in traditional practices related to the use of medicinal plants for treating kidney problems in indigenous communities. The species used, preparation methods, and frequency of administration vary notably between both communities, reflecting the cultural and ecological richness of these practices.

## Declarations

**List of abbreviations:** C- Community; C1- Indigenous Community of Supayaku; C2- Indigenous Community of Yamakey; Wp-Whole plant; L- Leaf (s); R- Root; F- Fruit (s); I- Infusion; Wd- Water daily; t/d- times/day; d- days; J- Juice; ml- Mililitros; B-Bark; P- Plaster; SD- Standard Deviation; $\bar{x}$ - Mean; p - significance of 0.05.

**Ethics approval and consent to participate:** Before we conducted the interviews, signed informed consent was obtained from all participants after providing a detailed explanation of the study objectives. The study was approved by the Research Ethics Committee of the Universidad Nacional Toribio Rodríguez de Mendoza de Amazonas (CIEI-N° 00147). All the data collected from informants during the study is included in this manuscript.

**Consent for publication:** Not applicable

**Availability of data and materials:** Not applicable

**Competing interests:** The authors confirm that they have no competing interests.

**Funding:** This research was self-funded, and we did not receive any financial support from any agency.

**Author contributions:** T.Y.Q.S handled data collection, developed the methodology, analyzed the results, and wrote the first draft. M.E.C reviewed the methodology, while W.A.S.L took care of redacting and correcting the results analysis.

## Acknowledgements

The residents of the native communities of Supayaku and Yamakey are grateful for their collaboration in sharing their knowledge and experiences. Likewise, thanks are extended to the professionals and collaborators who supported the various stages of the project.

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