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RESEARCH ARTICLE

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ETHNOBOTANICAL STUDY OF MEDICINAL PLANTS USED BY SOUTHERN COMMUNITY OF SAN ANDRÉS IN THE ECUADORIAN AMAZON

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ABSTRACT

The rescue of ancestral knowledge on the use of medicinal plants, through local ethnobotanical studies, is emerging as an alternative in its rescue. The objectives of this study are: i) to identify the medicinal plant species that are part of the cultural heritage of some families; ii) to determine the uses and applications of medicinal species; iii) to propagate the species of greatest medicinal use and importance, to strengthen ancestral knowledge in the community. To this end, information was collected from 25 families in the area. For the ethnobotanical tables, part of the plant used, route of administration, preparation, categories of use, among others, were established. Twenty-two species of medicinal plants were identified, the most used plant organ is the leaf, the form of preparation is infusion (64%) and the most used route of administration is the beverage. Based on the use value indexes and the level of significant use TRAMIL, two plant species were identified. The species used in propagation were Ginger (*Zingiber officinale*); Escancel (*Aerva sanguinolenta* L.); Lemon verbena (*Cymbopogon citratus*); Aloe (*Aloe vera* L.).

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INTRODUCTION

Medicinal plants constitute a valuable resource in the health systems of developing countries (Süntar, 2019). Their use is based on the knowledge and experience of each population, forming an important part of their cultural heritage (Tinitana, 2016). In many countries, ethnobotanical research on medicinal plants is scarce and can be catalogued as basic studies, whose final product are ethnofloristic lists (Rivero-Guerra, 2021). In addition, most of them have been carried out in aboriginal communities, which have preserved their ancestral knowledge by transmitting it from generation to generation. However, the existing reality is that there has been a loss of this knowledge, partly due to the migration of indigenous populations to urban areas (Rodríguez Guerra *et al.*, 2019). Ecuador is a multicultural country with multiple ancestral cultures of each ethnic group, which have compensated the traditional knowledge. It has been preserved and transmitted from one generation to another (Rivero-Guerra, 2021; Rodríguez Guerra *et al.*, 2019; Andrade, 2017). In this context, the province of Zamora-Chinchipe is very diverse. It has different ecosystems, where there is an ample vegetation of medicinal plants. These plants have been traditionally consumed in different ways by the local population, as remedies for the treatment of illnesses and ailments (Andrade, 2017; Toscano Gonzalez, 2006).

The objective of this study is: i) to identify the species of medicinal plants that are part of the cultural heritage of some families that constitute the Community of San Andres; ii) to determine the uses and applications of the medicinal species reported by the community, and finally iii) to propagate the species of greater use and medicinal importance, through family gardens in order to enhance the ancestral knowledge in the Community of San Andres located in the Southern Amazon of Ecuador.

MATERIALS AND METHOD

Description of the experimental area: The research was carried out in the San Andres Community of El Guismi parish, on the Amazonian Troncal via Gualaquiza-Morona Santiago, canton El Pangui, Zamora Chinchipe Province in southern Ecuador. It is geographically located at 3°33'37" south latitude and 78°33'9" west longitude at 760-2040 m.a.s.l (Bayón *et al.*, 2020). The San Andrés community covers an area of 14,729 m² and is made up of 30 families with a total of 70 inhabitants, both men and women, who maintain customs and traditions such as hunting, fishing and gathering wild fruits, among others (Peñaherrera Cabezas, 2016). The study area has a tropical rainforest, with constant rainfall ranging from 1500 to 2000 mm per

year. Temperatures here range from 17° C to 22° C (Bayón *et al.*, 2020).

Vegetation and economic activity in the sector: There has been a great loss of primary forest in the community, which has led to a change in land use (Peñaherrera Cabezas, 2016; Sánchez Vázquez, 2017). In San Andrés, there is an important economic activity oriented towards the cultivation of *Zea mays*, *Carica papaya*, musaceae and various citrus fruits. There is a large amount of degraded soil and crops of *Brachiaria dictioneura*, ducks and chickens (Bermúdez, 2002). It is worth mentioning that few people own land in the sector, which causes inconveniences for the inhabitants who lease land to their neighbors for economic sustenance (Rodríguez Guerra *et al.*, 2019).

Statistical design and ethnobotanical analysis: The following research followed a descriptive, ethnographic design with a mixed approach. The community is made up of a total of 50 families, of which 25 family units were randomly selected and an ethnobotanical inventory was carried out (Bermúdez, 2002). A diagnosis of the most frequent health problems in the community studied was made, using information from the Land Management Plan (11) and Health District 19D04. The pharmacological information, as well as its applications on different food used by the community of San Andrés to combat their different ailments, was recorded through household interviews with the oldest men and women, using the TRAMIL structured survey (Bermúdez, 2002). Twenty-five randomly selected households were visited, and 25 people (15 men and 10 women) were interviewed. With the help of local informants, the plants that were most representative for the community and most used were identified by common names. Each sample was collected in triplicate. Herbarium specimens were prepared and authenticated using reference literature (Rivero-Guerra, 2021; Laffita *et al.*, 2020; Dorregaray-Llerena, 2020). The identified species were compared with another research conducted in the region (Rivero-Guerra, 2021; Bayón, 2020; Dorregaray-Llerena, 2020).

Use of medicinal species: The ethnopharmacological data provided by community informants were organized in a database using Microsoft Excel. Two indexes were used to determine the percentages and frequency of use of the different medicinal plant species: 1) Level of significant use TRAMIL (1) and 2) Index of Use Value of the species (2). These indices made it possible to determine the level of importance and cultural value of the plants mentioned by the inhabitants of the studied area (Rodríguez Guerra, 2019). Level of significant use TRAMIL (1): expresses those medicinal uses that present a frequency greater than or equal to 20%, by the surveyed informants who use medicinal plants as the main resource for treatment of diseases, ailments, or illnesses. These can be considered highly significant from the point of view of their cultural acceptance, and therefore deserve an evaluation and scientific validation (Yamith, 2006; Navas-Flores, 2021). This methodology is calculated with the following expression:

$$UST = UST = \frac{Uspecies(s)}{n_{is}} * 100 \quad (1)$$

Where, use species(s) = number of citations for each species, nis = number of informants surveyed.

Species Use Value Index (2): reflects the importance or cultural heritage of the species established by the community informants (10). The following formula is used to calculate the index for each botanical species:

$$IVU_{is} = \frac{\sum UV_{is}}{n_s} \quad (2)$$

Where, UV is = number of uses determined by each informant (i) for each species (s). ns = number of informants.

After establishing the species that are most used in the community, we proceeded to the propagation of the most used medicinal species selected in the community.

Propagation of the most used species selected in the community: According to the reports of the interviews, the most commonly used medicinal plant species to preserve asexual propagation was carried out to obtain genetically identical individuals while maintaining the characteristics of the mother plant (Rodríguez Guerra, 2014; Yamith, 2016). The propagation of the plants was conducted by means of beds of dimensions 1 m² by 30 cm high. Two beds were established near family nuclei, for which 6 families were considered, with a total of 12 propagation beds. Subsequently, the beds were filled with typical sandy loam soil of the area, homogenized, free of stones, foreign objects, weeds and/or roots, without the use of fertilizers, pesticides, or fungicides. A total of 96 plants were planted, distributed in 4 rows of the 4 most relevant specimens in the community. Labels were carefully placed in each of the rows, identifying them with the common and scientific name so that those responsible for each family were empowered in the propagation process.

RESULTS

In the community studied, 22 species of medicinal plants belonging to 21 genera and 16 botanical families were identified through the surveys conducted with community informants (Table 1). According to the data obtained in Table 1, 61% of the informants acquired knowledge about the application and use of medicinal plants from their relatives; 17% from an acquaintance and 11% because they have studied the subject, or out of family tradition. It should also be mentioned that 44% of the inhabitants consume them because their symptoms or ailments are mild. That is, when a member of the family gets sick, most (78%) people resort to the medicinal plants they have in their gardens or farms, and in the last cases, if the symptoms persist, they go to the doctor. On the other hand, the most common illnesses affecting the inhabitants of the Community are three: the flu, 61%, followed by diarrhea, 22%, and finally fever, with 17%. Based on the information obtained, it was determined that the most used plant organ to prepare natural medicines are the leaves, with 48%, followed by the fruit (14%), the branches (10%), the whole plant (10%), the bulb (7%), the stem (3.5%), the glass (3.5%) and the bark (4%). The inhabitants of the community present diverse forms of preparation of the medicine. The most used form is the infusion, with 64%, followed by crushed, with 22%, and poultice, with 14%. Based on the information gathered, fresh plants are used to prepare the medicines, and the most used route of administration at the time of consumption is drinking.

The categories of the human body system on which medicinal plant species are used for the treatment of different diseases are the gastrointestinal system (34%), followed by the other category (28%), the respiratory system (18%), the skin category (11%), the musculoskeletal system (7%), and the blood system category, (2%). To relief gastrointestinal system ailments, the following are used: ginger, escancel, lemon verbena, mint, aritaco, guava, mortillo, apay, orange, ayahuasca, lemon, lemon balm, plantain, chamomile, and basil. For respiratory system problems, the most used plants are ginger, verbena, rue, mint, aloe, garlic, lemon, and lemon balm. The frequency of use according to each of the ailments can be seen in Figure 1. Diseases of the blood system, especially cholesterol, are treated with guayusa; as for the musculoskeletal system, the plants used to counteract joint pain are lemon verbena, aloe and guanto. For skin treatments, escancel, matico and aritaco are used, mostly for external use. For the category of others, the most commonly used plants were ginger, escancel, rue, lemon verbena, mint, matico, aloe, guava, guayaba, guayusa, guanto, and ayahuasca.

Table 1. Ethnopharmacological information of the medicinal plants used by the Community of San Andres located in the Southern Amazon of Ecuador

Scientific name	Preferred Common Name	Family	Category of use	Local utility	Part used	Mode of preparation	Route of administration	N°C	UST(%)
<i>Zingiber officinale</i>	Jengibre	Zingiberaceae	1, 2, 6	Cough, sore throat, flu, stomach ache, diarrhea, dizziness	B	I	Be	13	72%
<i>Aerva sanguinolenta (L.) Blume</i>	Escancel	Amaranthaceae	1, 5, 6	Diarrhea, fever, stomach infection, wound healing	H, R	Tr, Em	Be, Ue	6	33%
<i>Verbena officinalis</i>	Verbena	Verbenaceae	2	Cough, flue	H	I, Tr	Be	2	11%
<i>Ruta graveolens</i>	Ruda	Rutaceae	2, 6	Cough, fever	H, R	I	Be	1	6%
<i>Cymbopogon citratus</i>	Hierba luisa	Poaceae	1, 4, 6	Stomach ache, chills, menstrual cramps, inflammation, fever	Pl	I	Be	3	17%
<i>Menta arvensis</i>	Menta	Lamiaceae	1, 2, 6	Stomach ache, bad breath, gas expulsion	H	I	Be, In	1	6%
<i>Piper aduncum L.</i>	Matico	Piperaceae	5, 6	Infections, healing, headache, headache	H	I	Be, In	1	6%
<i>Vernonanthura patens</i>	Aritaco	Asteraceae	1, 5	Gastritis, skin rash	H	Tr, Em	Be, Ue	1	6%
<i>Aloe vera (L.) Burm.f.</i>	Sábila	Asphodelaceae	2, 4, 5, 6	Cough, joint pain, body inflammations, infections, fever	H, Cr	Tr, Em	Be, Ue	3	17%
<i>Psidium guajava</i>	Guayaba	Myrtaceae	1, 6	Diarrhea, dizziness, headache	H, Fr	I	Be	2	11%
<i>Solanum americanum</i>	Mortiño	Solanaceae	1	Stomach pain, stomach infections, stomach infections	H, Fr	I	Be	1	6%
<i>Ilex guayusa</i>	Guayusa	Aquifoliaceae	3, 6	Cholesterol, body pain, headache	H	Tr, I	Be	2	11%
<i>Grias neubertii</i>	Apay	Lecythidaceae	1	Gastritis, stones	Fr, Ct	I	Be	1	6%
<i>Citrus X sinensis</i>	Naranja	Rutaceae	1	Lowering stomach temperature	H	I	Be	1	6%
<i>Allium sativum</i>	Ajo	Amaryllidaceae	2	Cough	B	I	Be	1	6%
<i>Brugmansia arborea (L.) Lagerh</i>	Guanto	Solanaceae	4, 6	Inflammation, body ache, fever	H, R	Tr, Em	Ue	2	11%
<i>Banisteriopsis caapi</i>	Ayahuasca	Malpighiaceae	1, 6	Stomach cleanse, fever, body discomfort	T	I	Be	2	11%
<i>Citrus limon</i>	Limón	Rutaceae	1, 2	Stomachache, cough	Fr	I	Be	2	11%
<i>Melissa officinalis L.</i>	Torongil	Lamiaceae	1, 2	Stomach ache, bad breath, gas expulsion	H	I	Be	2	11%
<i>Plantago major</i>	Llanten	Plantaginaceae	1, 6	Diarrhea, headache	Pl	I	Be	1	6%
<i>Chamaemelum nobile</i>	Manzanilla	Asteraceae	1, 5	Stomach cleanse, fever, body discomfort	Pl	I	Be	1	6%
<i>Ocimum basilicum</i>	Albahaca	Lamiaceae	1	Stomach ache	H	I	Be	1	6%

N°C: number of citations. UST: level of significant use. Category of use: 1=Gastrointestinal; 2=Respiratory; 3=Blood; 4=Osteomuscular; 5=Skin; 6=other. Part used: T (stem), B (bulb), H (leaves), R (branches), Pl (whole plant), Cr (crystal), Fr (fruit), Ct (bark). Mode of preparation: I (infusion), Tr (crushed), Em (poultice). Route of administration: Be (beverage), Ue (external use), In (inhalation).

Table 2. Table 2. Quantitative analysis of species recorded in the San Andres community with the frequency greater than or equal to 20 UST%

Species reported	<i>Zingiber officinale</i>	<i>Aerva sanguinolenta (L.) Blume</i>
Common name	Ginger	Escancel
Family	Zingiberaceae	Amaranthaceae
Category of use	1, 2, 6	1, 5, 6
Utility	Utility Cough, sore throat, flu, stomachache, diarrhea, dizziness	Diarrhea, fever, stomach infection, wound healing
Part used	B	H, R
Mode of preparation	I	Tr, Em
Administration via	Be	Be, Ue
N° citations	13	6
N° uses	6	4
IVU	0, 33	0, 22
UST (%)	72%	33%

Category of use: 1=Gastrointestinal, 2=Respiratory, 3=Blood, 4=Osteomuscular, 5=Skin, 6=Other. Part used: T (stem), B (bulb), H (leaves), R (branches), Pl (whole plant), Cr (crystal), Fr (fruit), Ct (bark). Mode of preparation: I (infusion), Tr (crushed), Em (poultice). Route of administration: Be (beverages), Ue (external use), In (Inhalation).

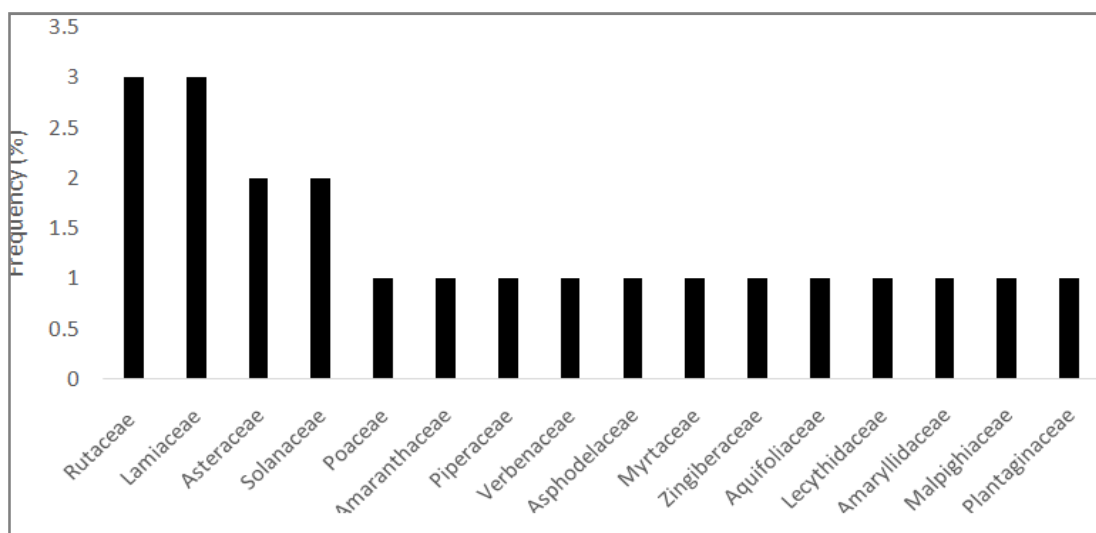


Figure 1. Diversity of botanical families of medicinal plants used by the inhabitants of the San Andrés Parroquia el Guismi community

The families with the highest number of medicinal species found in the study area are Rutaceae, Laminaceae (3 species each - 13.63 %), followed by Asteraceae, Solanaceae (2 species each - 9 %) and the other families (1 species each, with 5 %). Relative knowledge of the species by the members of the community of San Andres Parroquia el Guismi. The index of knowledge of the value of use of the species (IVU) and the level of significant use (UST), allowed determining the importance of the cultural heritage of each of the 22 species of medicinal plants that were reported by the inhabitants of the study area (Table 2). According to the indexes above, the most frequently used botanical species by the inhabitants of the San Andrés community are ginger (*Zingiber officinale*; IVU: 0.33; UST: 72%), escancel (*Aerva sanguinolenta* (L.) Blume; IVU: 0.22; UST: 33%). Both the index of knowledge of the value of use of the species (IVU) and the level of significant use (UST) were two variables used to determine which species were most frequently used by the community, thus establishing the propagation in the beds. A total of 96 plants were planted, 24 individuals of each species, that is, 24 specimens of *Zingiber officinale* (rhizome); *Aerva sanguinolenta* L. (cuttings); *Cymbopogon citratus* (layering) and *Aloe vera* L. (shoots), which were the most used by the San Andres Community.

DISCUSSION

In the present study, 22 species of medicinal plants were cited, belonging to 21 genera and 16 botanical families, a figure similar to that reported in another ethnobotanical study in Ecuador (Cerón, 2000), specifically in the Limoncocha Biological Reserve, where 25 species of plants with medicinal properties were reported. Other studies (Fernández-Cusimamani, 2019) have reported higher numbers, reaching 59 species of medicinal plants in three cantons of the Province of Imbabura. In the Kutukú Scientific Station in the province of Morona-Santiago (Ballesteros *et al.*, 2016), most of the medicinal species found in the study area are Rutaceae and Laminaceae with 3 species each, followed by Asteraceae and Solanaceae with 2 species each. It should be noted that of the species reported by the communities, the leaf is used in greater proportion and roots to a lesser extent. On the other hand, in the communities of the provinces of Azuay, Cañar and Loja, 43 families were found with chemical components that are used by the communities using their ancestral knowledge for the treatment of gastrointestinal diseases, through different uses for the extraction of the active principles, such as infusion from the leaves, and in other ailments the whole plant is used. In the San Andrés community, the most used plant organ for medicinal use is the leaf (Table 1), which coincides with those of other studies, where it is mentioned that the leaf accumulates a large amount of secondary metabolites with varied

biological activity (Jerves-Andrade, 2014; Zhiminaicela-Cabrera, 2020; Muñoz-Acevedo, 2021), which depending on the method of extraction, as well as the doses, are used by different communities and ethnic groups for the treatment of different ailments (Ruiz, 2021; Jerves-Andrade, 2014). The most common form of preparation for medicinal use, reported by the informants is in the form of infusion (Table 1), these results are similar to other studies, where it is mentioned that it is the most popular method of extraction of active principles. The general doses are approximately 1g of plant per 10g of water, in order to achieve the dissolution of the active principles (Valarezo, 2021), it is worth mentioning that the substances extracted by this method are water-soluble, indicated for the plant organs, such as flowers, leaves and green stems (Yamith, 2006; Zhiminaicela-Cabrera, 2020; Espinosa, 2020). Likewise, the most commonly used route of administration when consuming the medicines is by drink, which coincides with the data collected in other regions of the Amazon (Laffita, 2020; Cruz Coca, 2020). Based on the data collected, the most frequent category of use in the San Andrés community corresponds to gastrointestinal pathologies; this result coincides with other data collected where this is one of the most frequent, possibly associated with conditions in the treatment of water for human consumption in rural settlements (Jerves-Andrade, 2014; Zhiminaicela-Cabrera, 2020; Muñoz-Acevedo, 2021; Zambrano Intriago, 2015). With respect to the quantitative analysis of the different species used according to the index of knowledge of the value of use of the species by the informants (IVU) and the level of significant use (UST), two species were reported with a frequency higher than 20%. Although among the plants that presented higher indexes were *Zingiber officinale*, with a UVI: 0.33 and UST: 72% and *Aerva sanguinolenta* (L.) Blume with a UVI: 0.22 and UST: 33%, there were others that are also widely reported in the sector so that when talking with the communities they agreed to participate in their multiplication, these were the cases of *Cymbopogon citratus* and *Aloe vera* L. however, both UST% are below 20%. These figures are lower than those cited in the literature (32), who in their experiences have reported percentages higher than 20%. However, the value found in the community of San Andres in the Southern Amazon of Ecuador is an excellent indicator of the relative importance that the population gives to plants. This may reflect in turn a high degree of popular beliefs in the different healing qualities of medicinal plants, as well as the transfer of ancestral knowledge for their local use.

Conclusion

All the ethnobotanical information presented constitutes one of the few records of medicinal plants that are used locally in the community of San Andres in the Southern Amazon of Ecuador, where there is an important diversity of plants with medicinal properties.

These plants are distributed in 22 species, belonging to 21 genera and 16 botanical families. The family with the highest number of medicinal species found were Rutaceae and Lamiaceae. It is important to establish the existence and use of local medicinal plants, considering ancestral knowledge. They constitute one of the cultural assets, so mechanisms for their sustainable use should be promoted, favoring their reproduction in family gardens. The participation of native communities in the research should also be encouraged, as they are the ones who use them permanently as alternative and/or complementary medicine.

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