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# Resource Use of the Flora of the Brushwood Vegetation in Cocal County, Piauí, Brazil

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## ABSTRACT

Knowledge of a flora's potentials as food, forage, wood, medicine, honey, and energy production is fundamental to the design of conservation plans and sustainable extraction activities. This study aims to identify the resources of the flora of the brushwood in Cocal county, Piauí (03° 24′ 53.9″S 41° 40′ 03.9″W and 03° 25′ 44.9″S 41° 21′ 27.6″W) and to calculate the values of specific uses. Fifty interviews with people knowledgeable about uses of the local flora were conducted. The testimony materials are kept in the Herbarium Graziela Barroso (TEPB) of the University Federal of Piauí. Among the 60 species with demonstrated ethnobotanical value, categories included medicinal use (35 species), wood (28), food (27), energy production (24), honey (23), and forage (14). The greatest values of use were for *Croton blanchetianus* Müll.Arg. (1.92), *Mimosa caesapiniaefolia* Benth. (1.70) and *Rollinia leptopetala* (R.E.Fr.) Staff. (1.66). The most prevalent medicinal uses were to treat problems of the digestive and respiratory systems, and particularly for inflammation of the ovaries, uterus, kidneys, liver, throat, and stomach.

**Keywords:** deciduous vegetation, economic botany, value of use

## INTRODUCTION

The *caatinga* biome, situated in the hot and dry regions of Brazil and surrounded by mountains, creates unique landscapes over an expanse that covers approximately 1,000,000 km$^2$. In some areas, there are small to large rocky outcrops or exposed expanses of bedrock, which produce not only extreme water stress but above all dominate the landscape in its rocky aridness (Ab'Sáber 1974; Ferri 1980; Veloso *et al*. 2002).

Piauí has about 93,379.86 km² (37%) of its area within a semi-arid climate. As it is also sitting atop the Bacia Sedimentar do Meio Norte, the deciduous vegetation that occurs there has peculiar characteristics (Mendes 2003).

Eighty-two areas have been identified as priorities for the conservation of the biodiversity of the semi-arid region. These cover 436,000 km$^2$, with 42% of them classified as being of extreme biological importance (MMA 2002). Some studies have made information about the use of the species in these areas available in an attempt to better understand this vegetation, to increase the range of options for the use of its resources and/or to record traditional knowledge. Among these studies are included those that treat the Caatinga and associated formations or mix them with other biomes such as that by Sampaio (2002) and the synthesis of information on traditional botanical knowledge (Albuquerque e Andrade 2002). More research is of fundamental importance to have data that are trustworthy and applicable to guide bioprospecting studies and to create management plans that can succeed in conserving these natural resources (Albuquerque e Andrade 2002). Deciduous, non-spiny vegetation of the semi-arid region, known locally as *carrasco* (brushwood) and covering extensive areas of the Ibiapaba Highlands, has been treated in some studies of the floristic and phytosociological composition of the community (Araújo *et al*. 1998a, 1998b; Araújo *et al*. 1999; Araújo and Martins 1999; Araújo *et al*. 2002). However, there has not been, until this current study, any systematization of information about resource use and the value of use of plants of this area. In order to surmount this lack of data, an ethnobotanical study was realized in order to analyze the resource use and the value of use of the brushwood vegetation by the community of Cocal County, Piauí, which will permit the recording of the relative importance of species and resources. Additional aims were to help preserve this vegetational type while also improving the quality of life of the local population and help secure man in the landscape.

## MATERIALS AND METHODS

### Description of the study area

The study was conducted in Cocal County, PI, in the Área de Proteção Ambiental da Serra da Ibiapaba, 372 km north of the capital Teresina. Cocal County (**Fig. 1**) has an area of 1,269 km² at a mean altitude of 160 m and lies between the coordinates of 03° 24′ 53.9″S 41° 40′ 03.9″W and 03° 25′ 44.9″S 41° 21′ 27.6″W (IBGE 2002). The mean annual temperature and precipitation are 27.4°C and 900 mm, respectively, with the highest rainfall in the months of March to May, when they exceed 436.0 mm, and the least rainfall, with a deficit of 728.0 mm, in the months of July to December (IBGE 1998). The county is situated atop the Serra Grande formation, which occupies a north-south band of land with a width varying from 20 to 60 km. This formation is composed of conglomerates and course sandstones, interspersed with fine, layered sandstones, which create ridges with a steep incline toward Ceará and a gentler incline toward Piauí (IBAMA 1998). To the north of the Ibiapaba Highlands sand-quartzite solos predominate (Jacomine *et al*. 1973). The vegetation is a picture postcard that changes with each season, from very green with diverse flowers to brownish tones and apparently without life. During the rainy season, the Pirangi River and small intermittent streams form waterfalls and rapids that fall from the highlands. The county has 26,201 inhabi-

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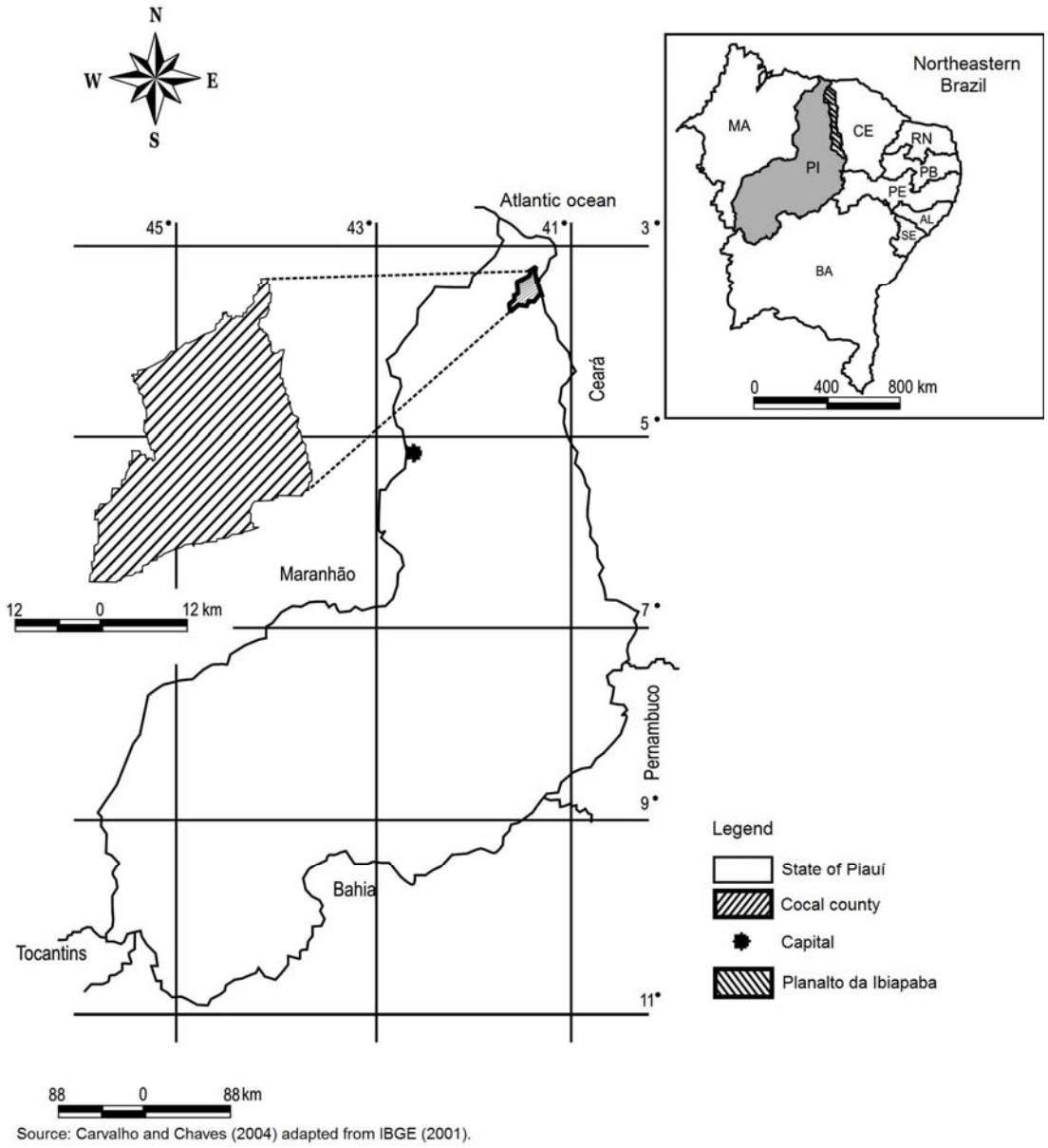


**Fig. 1 Map of the location of Cocal county, Piauí, Brazil.**

tants (IBGE 2007) and more than 50% of the population lives in rural communities where the economic activities include sustenance agriculture, small animal husbandry and extractivism.

## Floristic inventory

An inventory was realized throughout the county, where botanical samples were collected according to appropriate field techniques (Mori *et al*. 1989). Collections were made every 15 days during the rainy season and monthly during the dry season over the years 2003 to 2004.

During expeditions to the study area, data were recorded concerning bee visitation to flowers and the common name and popular uses of species while voucher specimens were collected for identification. The information on use in these cases was provided by field guides. All of this information was carefully recorded to help guide future collections. Visits to local vegetable markets were done and publications relating to other ecosystems and/or biomes of Brazil were consulted to gather data on the use of species collected from the *carrasco*.

Following drying and processing, the material was incorporated into the archives of the Herbarium Graziela Barroso (TEPB), of the Universidade Federal do Piauí, and duplicates were sent to the Herbarium Afrânio Fernandes (HAF) of the Universidade Estadual do Piauí and Prisco Bezerra (EAC) of the Universidade Federal do Ceará.

The morphological analysis of the material was done at the Herbarium TEPB, according to standard taxonomical methodology. The identification of specimens was made possible by a detailed study of their morphology in comparison with material deposited in the Herbaria EAC, HAF, IPA and TEPB, in addition to confirmation by specialists, when necessary. The classification system of Cronquist (1981) was adopted, except for the Leguminosae which followed that of Judd *et al.* (1999). The name and/or abbreviation of species author's names are based on Brummitt and Powell (1992).

## Analysis of resource use and the value of use of the flora

To allow for the application of a mathematical model in the compilation of data referring to use of this vegetation, 50 questionnaires were applied to 50 residents of the area, a number which corresponds to 100% of the people between the ages of 40 and 80 years who have been residents in the area for at least 20 years and who have considerable popular knowledge based on their long association with the local flora. During the interviews, uses of the flora were investigated in such categories as food, wood, forage, medicine, honey, and energy production. In addition, socio-economic data were collected on level of education, income, living conditions, and sanitation.

For calculation of Value of Use, the formula used was pro-

posed by Phillips and Gentry (1993a, 1993b); Phillips *et al*. (1994) and modified by Rossato *et al*. (1999), where the following formula applies:

$VU = \sum U / n$

where:
VU = value of use;
U = number of citations (or uses) of the ethnospecies according to the respondent;
n = number of respondents that cited the ethnospecies or species.

### Data analysis

The data obtained were tabulated and a list was compiled of species used by the community with their respective common names, categories and specific values of use, and a description of the socio-economic profile of the respondents. The results were discussed in order to determine the importance of these data for the sustainable use of this vegetation and for local development.

## RESULTS AND DISCUSSION

Sixty species used by the studied community were collected, distributed in 25 families and 50 genera (**Table 1**). The families with the largest number of cited species were Leguminosae (17), followed by Rubiaceae (4), Anacardiaceae, Apocynaceae, Euphorbiaceae, and Myrtaceae (3). In total, 11 families, for example Capparaceae, Bromeliaceae, Malpighiaceae, Meliaceae, and Olacaceae, only had one indicated species. The genera with the largest number of species were *Aspidosperma* Mart. & Zucc. (3) followed by *Acacia* L., *Croton* L., *Hymenaea* L., *Mimosa* L. and *Tabebuia* Gomes ex DC. (2), and the rest were represented by only one species. Among the six categories of use inventoried, the most cited species were *Bauhinia ungulata*, *B. cheilantha*, *Campomanesia aromatica*, *Croton blanchetianus*, *Mimosa caesalpiniaefolia*, and *Piptadenia moniliformis* with five categories each and 17 species received only one indication. Within each category of use, the number of cited species had this profile: medicinal (35), wood (28), food (27), energy production (24), honey (23), and forage (14). The species used by the population were generally trees or shrubs: data similar to those found by Almeida *et al*. (2006) in investigating popular uses of plants in the Xingó region and by Albuquerque and Andrade (2002) in an area of *caatinga* in the State of Pernambuco. This can be related to the fact that in the *caatinga* trees and shrubs are available year round as opposed to herbs, which are of limited availability during the period of less precipitation.

The category of medicinal use had the largest number of indicated species (58.33%), agreeing with the findings of Rossato *et al*. (1999), Albuquerque and Andrade (2002), Silva and Andrade (2002) for other regions of the country. Among species considered medicinal, the most frequently used parts are bark, inner bark, roots, seeds and then leaves. The preferred preparations are *garrafada*, medical bath, bandage, *lambedor* or tea. According to Oliveira *et al*. (2007), perennial structures such as bark, inner bark, and roots are commonly more frequently used than parts that are not perennial such as leaves, flowers, and fruits. Monteiro *et al*. (2006) reported the preferential use of barks of plants by two communities in the Northeast of Brazil and suggested that these parts must have more polyphenolic compounds than the other tissues of the plants. Many species cited in the category have wide use in the studied community, for example *Ximenia americana* and *Myracrodruon urundeuva* were referred to by several respondents. This information supports the results found by Albuquerque (2006) that people prefer the native vegetation to collect products for medicinal use. Many of these products extracted from the brushwood are sold in the public market of the county such as, for example, the fruits of *coronha* (*Acacia farnesiana*), seeds and bark of *imburana-de-cheiro* (*Amburana cearensis*), bark of *ameixa* (*Ximenia americana*) and of *aroeira* (*Myracrodruon urundeuva*). A large volume of "bark" extraction from individuals of *Myracrodruon urundeuva* over decades, in addition to the dissemination of information that it could cure cases of cancer in the 1980's, accelerated its overuse in an extractive rush by people lacking commitment and/or unknowledgeable about appropriate techniques for obtaining the sought-after products, decimating populations. This species is among those that Albuquerque and Andrade (2002) cited as having widespread extractive use in the State of Pernambuco. These authors listed five factors that they consider capable of compromising the future existence of plants submitted to this level of pressure: "intense consumption; absence of cultivation or at least some form of propagation; use by a local traditional market as well as by companies marketing phytotherapies; poor understanding of the distribution and amplitude of natural populations; and the absence of studies that evaluate the impact of extractive techniques on the structure and biology of the populations". For Amoroso (1996), the "frequency and consistency of the use of one species for similar purposes" are good indicators that it contains some sort of active compound that justifies that use, guiding pharmacological and phytochemical research, in addition to also orienting specific conservation priorities. Almeida *et al.* (2005), in investigating habit and chemical composition as predictors for selection of medicinal plants of the *caatinga*, cited as being of greater relative importance among trees and shrubs species such as *Bauhinia cheilantha*, *Caesalpinia ferrea* and *Ziziphus joazeiro*, which also have an important value of use by the population investigated in this work. *Amburana cearensis*, *M. urundeuva* and *Z. joazeiro* cited (**Table 1**) for various uses were reported by Silva *et al*. (2006) as having the largest number of uses among the Fulni-ô in the Northeast of Brazil. Among the uses of this category, those for inflammation of various organs such as ovaries, uterus, kidneys, liver, throat, and stomach were the most often cited. Among indications by system, digestive and respiratory uses were apparent, with the most common means of administration being oral. Published data of Amoroso (2002), for Santo Antônio do Leverger, Mato Grosso, revealed similar trends in reference to use for body systems, differing only in that a larger number of citations for diseases of the digestive system were given.

Since the vegetation of this study is composed of few trees with adequate girth for use as boards or beams, the wood category relates principally to use in the construction of fences and gates (**Fig. 2**), in addition to roofs of houses. *Mimosa caesalpiniaefolia* is responsible for placing Piauí in second place in the *caatinga* in the production of posts, after only Ceará, according to Sampaio (2002). For the supports (*caibros*) of ceilings, doorways (*porteiras*) (**Fig. 2A**) and fence gates (**Fig. 2B**) the most widely used species are *Aspidosperma subcanum*, *A. pyrifolium*, *A. cuspa* and *Tabebuia impetiginosa*, in that order. For laths and lines (*linhas*), the most common are *Copernicia prunifera*, *Tabebuia impetiginosa* and *Hymenaea courbaril*. For the construction of fences (**Fig. 2C**), *Copernicia prunifera* and *Astrocaryum vulgare* are used. A large part of the wood obtained came from deforestation during land-clearing, and is called locally *madeira branca*, understood to be of little durability and used to enclose plantations, goat corrals, and backyards. Fracelino *et al*. (2003) recorded applications which corroborate these findings in studying the contribution of the *caatinga* to the sustainability of *assentamentos* projects in the *sertão* region of Rio Grande do Norte, and affirmed that there are "forest recources of the *caatinga* fundamental to the survival of those who do not have many alternatives to occupation by labor". According to the author, wood is used in the construction of houses and fences around backyards and lots.

In the food category the consumption of fruits in their natural state and sometimes in the form of thick juices called locally *simberebas* or *cambicas* were most prevalent. Species such as *Anacardium occidentale*, *Campomanesia*

**Table 1** List of the families, species and common names (CN) of the ethnospecies cited by residents of Cocal county, Piauí.Categories: A: alimentary use; B: forage; C: wood; D: medicinal; E: honey; F: energy production; VU: value of use of the species; NC: number of the collector.

| Families | Species | *CN* | *Categories of Use* | | | | | | VU | NC |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | A | B | C | D | E | F | | |
| Anacardiaceae | *Anacardium occidentale* L. | Cajuí | X | | | X | X | | 1.22 | 514 |
| | *Myracrodruon urundeuva* (Engl.) Fr.Al. | Aroeira | | | X | X | | X | 1.40 | 106 |
| | *Spondias lutea* L. | Cajá | X | | | | X | | 1.14 | 500 |
| Annonaceae | *Ephedranthus paviflorus* S.Moore | Conduru | X | X | X | | X | | 1.55 | 216 |
| | *Rollinia leptopetala* (R.E.Fr.) Saff. | Ata-de-urubu | X | | X | | | X | 1.66 | 143 |
| Apocynaceae | *Aspidosperma cuspa* (Kunth) Blake | Pereiro-branco | | | X | X | | | 1.00 | 489 |
| | *A. pyrifolium* Mart. | Pereiro-preto | | | X | | | X | 1.18 | 169 |
| | *A. subincanum* Mart. | Piquiá | | | X | | | X | 1.25 | 342 |
| Arecaceae | *Astrocaryum vulgare* Mart. | Tucum | X | | X | | X | | 1.00 | 632 |
| | *Copernicia prunifera* (Miller) H.E.Moore | Carnaubeira | X | X | X | X | | | 1.23 | 497 |
| Capparaceae | *Cleome aculeata L.* | Muçambê | | | | X | | | 1.42 | 157 |
| Bignoniaceae | *Tabebuia impetiginosa* (Mart.) Standl. | Pau-d'arco-roxo | | | X | X | X | X | 1.25 | 449 |
| | *T. serrratifolia* (Vahl) G.Nicholson. | Pau-d'arco-amarelo | | | X | X | X | X | 1.00 | 492 |
| Boraginaceae | *Cordia rufescens* A.DC. | Grão-de-galo | X | | | | | | 1.00 | 117 |
| | *Heliotropium polyphyllum* DC. | Sete-sangrias | | | | X | | | 1.50 | 577 |
| Bromeliaceae | *Encholirium erectiflorum* L.B.Sm. | Macambira-de-flecha | | X | | | | | 1.00 | 376 |
| Combretaceae | *Combretum leprosum* Mart. | Mofumbo | | | X | X | X | X | 1.36 | 201 |
| | *Terminalia fagifolia* Mart. & Zucc. | Cascudo | | | X | X | | X | 1.10 | 377 |
| Euphorbiaceae | *Croton blanchetianus* Müll. Arg. | Marmeleiro | | X | X | X | X | X | 1.92 | 138 |
| | *C. zehntneri* Pax. & K.Hoffm. | Canela-de-cunhã | X | | | X | | | 1.00 | 119 |
| | *Phyllanthus niruri* Müll.Arg. | Quebra-pedra | | | | X | | | 1.25 | 160 |
| Lamiaceae | *Hyptis suaveolens* (L.) Poit. | Bamburral | | | | | X | | 1.00 | 618 |
| Leguminosae | | | | | | | | | | |
| Caesalpinioideae | *Bauhinia cheilantha* Steud. | Mororó | | X | X | X | X | X | 1.58 | 329 |
| | *B. ungulata* L. | Mororó | | X | X | X | X | X | 1.58 | 483 |
| | *Caesalpinia bracteosa* Tul. | Catingueira | | X | X | | | X | 1.05 | 398 |
| | *C. ferrea* Mart. ex Tul. | Jucá | | X | X | X | | X | 1.36 | 626 |
| | *Copaifera martii* Hayne | Podoi | X | | | X | | | 1.25 | 383 |
| | *Hymenaea martiana* Hayne | Jatibaí | X | | X | X | | | 1.11 | 498 |
| | *H. courbaril* L. | Jatobá | X | | X | X | | X | 1.19 | 517 |
| Mimosoideae | *Acacia farnesiana* Benth. | Coronha | | | | X | | | 1.00 | 175 |
| | *A. glomerosa* Benth. | Espinheiro-preto | | | X | X | X | X | 1.20 | 196 |
| | *Mimosa caesalpiniaefolia* Benth. | Sabiá | | X | X | X | X | X | 1.70 | 359 |
| | *M. hostilis* (Mart.) Benth. | Jurema | | | X | X | X | X | 1.25 | 358 |
| | *Piptadenia moniliformis* Benth. | Catanduva | | X | X | X | X | X | 1.58 | 441 |
| Papilionoideae | *Amburana cearensis* (Allemão) A.C.Sm. | Imburana-de-cheiro | | | X | X | | | 1.19 | 634 |
| | *Bowdichia virgilioides* Kunth | Sucupira | | | | X | X | | 1.00 | 473 |
| | *Macherium acutifolium* Vogel | Rabuja | | | X | | | X | 1.00 | 205 |
| | *Pterocarpus vilosus* Mart. | Pau-sangue | | X | X | | X | X | 1.22 | 567 |
| | *Swartzia flamingi* var. *psilonema* (Harms) Cor. | Jacarandá | X | X | | | | | 1.08 | 543 |
| Loranthaceae | *Psittacanthus robustus* Mart. | Erva-de-passarinho | | X | | | | | 1.00 | 510 |
| Malpighiaceae | *Byrsonima gardneriana* A.Juss. | Murici-de-chapada | X | | | | | | 1.00 | 409 |
| Meliaceae | *Cedrela odorata* L. | Cedro | | | X | | | | 1.00 | 174 |
| Myrtaceae | *Campomanesia aromatica* (Aubl.) Griseb. | Guabiraba | X | | X | X | X | X | 1.36 | 154 |
| | *C. flavescens* DC. | Maria-preta | X | | | | | X | 1.06 | 503 |
| | *Eugenia punicifolia* (Kunth) DC. | Farinha-seca | X | | | | | | 1.00 | 502 |
| Olacaceae | *Ximenia americana* L. | Ameixa-amarela | X | | | X | | | 1.59 | 469 |
| Passifloraceae | *Passiflora cincinnata Mart.* | Maracujá-do-mato | X | | | | | | 1.00 | 226 |
| Rhamnaceae | *Ziziphus joazeiro* Mart. | Juazeiro | X | X | | X | X | | 1.00 | 524 |
| Rubiaceae | *Genipa americana* L. | Genipapo | X | | | X | | | 1.00 | 565 |
| | *Guettarda virbunoides* Cham. & Schldl. | Angelca | | | | | | X | 1.00 | 130 |
| | *Randia armata* (Sw.) DC. | Taturapé | X | | | | X | X | 1.11 | 570 |
| | *Tocoyena formosa* K. Schum. | Jeniparama | | | | X | | | 1.00 | 562 |
| Sapindaceae | *Talisia sculenta* Radlk. | Pitomba-de-macaco | X | | | | X | | 1.09 | 499 |
| Sapotaceae | *Richardella macrophylla* (Eyma) Aubl. | Tuturabá | X | | | X | | | 1.00 | 593 |
| | *Pouteria ramiflora Radlk.* | Pitomba-de-leite | X | | | | X | | 1.00 | 574 |
| Solanaceae | *Physalis angulata* L. | Canapum | X | | | | | | 1.00 | 162 |
| | *Solanum paniculatum* L. | Jurubeba-branca | | | | X | | | 1.00 | 124 |
| Tiliaceae | *Luheae candicans* Mart. | Açoita-cavalo | | | | X | | | 1.02 | 132 |
| Verbenaceae | *Vitex cuspidata* Spreng. | Tarumã | X | | | | X | | 1.00 | 505 |
| | *Lantana camara* L. | Chumbinho | X | | | X | | | 1.50 | 112 |

*aromatica*, *C. flavescens*, *Eugenia punicifolia*, *Hymenaea martiana*, *H. courbaril*, *Spondias lutea* and *Ximenia americana* constituted important items in the necessary daily intake of vitamins and minerals. Franco (1989) documented, for example, for every 100 g of *cajá* 4.7 mg of ascorbic acid; for an equal mass of *cajuí*, 62 mg of thiamine, 50 mg calcium, 12.20 mg of sodium and 143.5 mg of potassium; and for the same quantity of *jatobá*, 30 mg de retinol, 40 mg of thiamine, 40 mg of riboflavin, 0.50 mg of niacin and approximately 31.10 mg of ascorbic acid. Sampaio (2002), in studying the use of plants of the *caatinga*, listed some of the note-worthy species of this study and reported that various parts of the plants can be used as human food, but the fruits as they are the most significantly consumed, are the


**Fig. 2 Fences and gates used by the population of Cocal County, Piauí, Brazil.** (**A**) *Porteira*, (**B**) gate, (**C**) passageway fence (fence of *passagem*), (**D**) fence of *cama*, (**E**) fence of *fachina*, (**F**) barbed wire fence.

only to be tallied on the list of extractive resources of the Northeast. Lorenzi and Matos (2003) wrote about *H. courbaril* and *S. lutea* in a most reverent manner, exhalting the importance that these species possess in the diet of rural populations of this region.

The fruits of most of the cited species do not possess commercial value and are collected in the canopy or from the forest floor, principally by women and children. This information was corroborated by Mendes (1997), when he affirmed that "the *caatinga* possesses native plants that bear fruit even in the most severe droughts", helping to keep alive both native animals and man.

In energy production, the majority of species indicated is collected from clearings during deforestation or are twisted branches of trees cut down for timber. There is no selection of species for firewood, despite some, such as *Croton blanchetianus* and *Piptadenia moniliformis*, being noted for providing better flame than others. For charcoal, selection is a bit more rigorous as, according to respondents, some wood only produces ashes, such as *Anacardium occidentale*, or the charcoal produces sparks, such as *Mimosa caesalpiniaefolia*. Curious, however, is the position taken in relation to *Bowdichia virgilioides*, whose wood cannot be burned because the "smoke causes blindness".

In the honey category, it was only possible to diagnose which plants are visited by bees, such as *Campomanesia aromatica*, *Hyptis suaveolens*, *Pterocarpus vilosus*, *Tabebuia impetiginosa*, *T. serrratifolia*, among many others, without however, indicating with precision from which species they collect nectar, pollen, or other products. During some field trips that aimed to observe how some of the species cited by the respondents are used and to collect information on the commercialization of products and the generation of income, it was possible to collect and identify species and register uses not mentioned by the respondents. The species *Croton campestris*, *Hyptis atrorubens*, *Mitracarpus hirtus*, *Spermacoce densiflora* and *S. verticillata* form numerous populations in low-lying areas close to small, intermittent water-courses fed by rainfall and natural springs and runoff from exposed bedrock of mountains. These species contribute to maintain the food base of the bees between harvests, a time when most species are vegetative. As such, they contribute and stabilize honey production in the apiary Atalaia and in the Associação de Agricultores Familiares de Birindibinha, recently founded in the study area and still with few beehives, but already demonstrating viability and encouraging investments necessary for the construction of required installations for the production of organic honey. The potential to maintain a volume of honey produced throughout the year is one of the reasons that, according to apiculturalists of the region, indicates Cocal County as one of the most favorable locations in Piauí for the production of honey. At the same time, it permits the installation of permanent hives, avoiding the measures taken with migratory hives, thereby facilitating management and reducing the cost of the final product.

Carvalho and Marchini (1999) recorded some species in common with those indicated by the respondents in this study when they studied plants visited by *Apis mellifera* Linnaeus, 1758 in the valley of the Paraguaçu River, Castro Alves County, Bahia. They cited *Bowdichia virgilioides*, *Ziziphus joazeiro* and others that were collected and identified in the study area, and even those that had not been cited for this category of use, for example *Cordia rufescens*, *Crataeva tapia* and *Piriqueta racemosa.* Lima-Verde and Freitas (2002), to investigate reports by farmers on stingless bees known in Ceará as *uruçu-de-chão*, conducted fieldtrips to areas where this species might possibly occur and confirmed its presence in the *cerrado*, *cerradão*, and *carrasco* of the Chapada do Araripe. They also found the species in restricted areas of *carrasco* in the Ibiapaba Highlands, due possibly to the reduction of vegetative cover, indiscriminate use of agrotoxins and predatory extraction of honey and wax, indications that a better understanding of the vegetation and of the potentials of the *carrasco* is necessary.

In the forage category, the most usual situation was the consumption of species by herds of goats and cattle. Worthy of distinction are *Bauhinia cheilantha*, *Croton blanchetianus*, *Mimosa caesalpinaeifolia* and *Ziziphus joazeiro*, which were also placed in this category of use by Lima (1996) when he studied the uses and potential of forage plants of the *caatinga*. Carvalho *et al.* (2001) considered *C. blanchetianus* as the principal colonizing shrub of successional *caatingas* of the Northeast of Brazil, having a low forage value and a great capacity for invasion. These authors understood that "the increase in availability and the improvement in the quality of forage of the *caatinga* necessarily depend on the management of its woody vegetation"

with the aims to promote its needed *raleamento* and increase the production of standing plant biomass. In the understanding of Francelino *et al*. (2003), despite the better development of the herbaceous stratum and pasture following deforestation, areas with native forest cover maintain a more stable animal production in times of prolonged drought.

Some species stand out in one category of use and were cited by many respondents, for example *Campomanesia aro-matica* (41) in the food category; *Piptadenia moniliformis* (30) for energy production; *Hyptis suaveolens* (25) as honey; and *Swartzia flamingi* var. *psilonema* (23) in forage. These data show that while a species may have a low value of use (1.0), such as in the last entry in **Table 1**, yet can have an isolated use of significant value for the local population and is therefore included among the resources routinely used in ithe region.

Many species recorded in this study have also been referenced in the literature under other use categories and/or under diverse uses. An example of this is the work of Silva and Andrade (2002), who investigated the mystical use of plants by the Xucuru Indians, where *Croton blanchetianus* was cited as having leaves used as a raw material in the manufacture of cigarettes, probably in the search for hallucinogenic properties, and where the fruits of *Anacardium occidentale* are seen as a preventative amulet against snakebite. Moura and Agra (1989) in their studies of toxic and medicinal Apocynaceae found in the States of Pernambuco and Paraíba, cited *Aspidosperma pyrifolium* as having toxins and constituents with pharmacological actions in all plant parts.

For the species *Astrocaryum vulgare* (*tucum*) and *Copernicia prunifera* (*carnaúba*), in addition to the categories of use mentioned in the interviews, in visits to the public market in the county, it was possible to observe others. *Tucum* is used in a craft manner in the production of rope and hammocks with *embiras* extracted from the leaves of the apical bud of the plant and its nut, as it is oily, is used to increase the caloric value of animal feed for pigs and chickens. From *canaúba* are used the fibers of the leaves for the production of handcrafts, such as animal blankets, baskets, sacks, rugs, mats, objects to fan oneself, hats, hammocks, and ropes. Products made from the two species, among other things, include wooden spoons of *piquiá* (*Aspidosperma subincanum*), which are frequently used by the local community and are sold in the market of the county seat on Sundays.

Among values of use, several species are notable: *Croton blanchetianus* (1.92), *Mimosa caesalpiniaefolia* (1.70), *Rollinia leptopetala* (1.66), *Ximenia americana* (1.59), *Piptadenia moniliformis* (1.58) and *Bauhinia ungulata* (1.58) (**Table 1**). Among these species, some stand out for their range of uses, such as in the case of *Croton blanchetianus* which has been indicated for treating "itches", flu, allergy, stomach aches; for the construction of fence of *cama* (**Fig. 2D**), and for energy production as firewood and charcoal. Lorenzi and Matos (2003) corroborated this information and also noted its use in the construction of traps for lobster fishing, thanks to the resistance of the wood when submerged in water. *Mimosa caesalpiniaefolia* also is used in a great variety of ways, among the most common are as a treatment for hemorroids; as a source for the production of a honey with a higher viscocity than typical honey and slightly acid, called *saborá*; as livestock feed for cattle and goats where its leaves are eaten as frequently fresh as dried in the form of hay, even the fruits are widely appreciated by itinerant goats. Additional uses of *M. caesalpiniaefolia* include for construction of *fachina* fences (**Fig. 2E**), whose vertical posts are juxtaposed in order to impede access of small animals into the enclosures, for barbed-wire fences (**Fig. 2F**) in which the posts and/or *mourões de porteiras are* threaded vertically and which have a durability of approximately 10 to 15 years depending on the degree of maturation of the wood and the humidity of the soil; in addition to being widely consumed in the form of firewood or charcoal, being used the parts of the trees not used for posts, such as forks and branches. These data are in accord with those of Mendes (1989), who added that in the Northeast of Brazil this species is widely used in the form of an ointment to promote scarring and also for illnesses of the stomach and respiratory tracts. According to Sampaio (2002), the fact that this wood has high durability for various uses has lead to its exploitation and already threats to native populations. Pereira *et al*. (2003) assigned this species to forage, medicinal and ornamental categories and corroborates the information presented here. *Rollinia leptopetala* was indicated as a "forest snack", to stave off the hunger of children and rural workers; for the construction of fence of cama (**Fig. 2A**), often used in clearings and backyards, with durability sufficient to collect the products of the clearing for two years; and even in the form of firewood and charcoal. For the following species, no records in the literature could be found concerning their use by populations of the study areas. *Ximenia americana* is preferred by the community as a cure of disease, where it is noteworthy in promoting scarring and against flu, gastritis, anemia, general inflammation, kidney pain and liver ailments. The fruits of this species are also widely used, being consumed fresh and in juices. Sampaio (2002) related this species to other fruit species of the *caatinga*. *Piptadenia moniliformis* is considered an antihemorragic and is used to promote scarring; is appreciated as feed principally by cattle and thus receiving the common name "calf-branch"; and is considered raw material of excellent quality for the production of charcoal and firewood. Nascimento *et al*. (1996) characterized this species in a form compatible with the information detailed here and listed it among the forage crops of great importance in the Bacia do Parnaíba because it remains green during the dry season. *Bauhinia ungulata* was indicated as effective treatment of inflammation; in obtaining firewood and charcoal; as a source of honey in producing a good-quality product; as feed for goats and as wood for the construction of fences. Nascimento *et al*. (1996), in studying some species of this genus, found results similar to those reported in this work.

During the interviews, it was possible to perceive that the indication for use of the species had a tight connection with the emotional bond that the respondent maintained with them and/or with the quantity or accessibility of the resource. Therefore, the rarer species in the study area, or those encountered at great distances from the homes, are only widely used if they already had a use consecrated and irreplaceable in the conception of the respondents. Similar data were observed by Albuquerque and Andrade (2002), where the degree of use of plants of the semi-arid region is as much related to the temporal availability of the resource and to the degree of interest an individual demonstrates in a particular product – resulting in a difference in behavior and management among different biomes or vegetative formations – as it is to variations in humidity and aridity.

The habit of collecting fruits from the forest in order to improve the diet of large families of the rural zone or to resolve illnesses of the body and spirit with infusions, baths, and poltices, is a well-known custom. In the areas studied, this secular use, without any type of planned management, has left marks. In many areas of the county, there are reports that species once commonly used are already rare. These data are corroborated by those of Sampaio (2002), and among other ends, "human beings have always used plant species in their diet" and in other categories such as the production of energy and the construction of shelters. As the sophistication of these uses has increased, due to advances in knowledge, so too have the accumulated risks of manipulating the environment.

Some species with high use values, such as *Ximenia americana*, have undergone reductions in population size, due to the removal of its bark from apparently the entire trunk, and sometimes, even from the branches, by those motivated to collect larger quantities for use and/or for commercial ends. As was also stated by Albuquerque and Andrade (2002), "many of the natural resources of the

*caatinga* suffer high extractivist pressure, not only because of their local use, but also because of the wider consumer market. This formal and informal market causes serious risks to the populations of these plants".

It is important to say that in areas furthest from urban centers and with the least influence from them, in which families take their basic sustenance from cultivation of the land, extraction, and livestock, there is a greater number of the indicated species, as well as of uses mentioned. The closer the communities are to the urban center and the more they are influenced by other customs, the less the products of the flora are used. Data that corroborate these findings were cited by Silva and Andrade (2004) in their study of the cultural significance of botanical species among indigenous tribes of Pernambuco. They observed that "the use of allopathic remedies by the Xucuru has caused a decrease in the use of medicinal species, and consequently, the loss of botanical knowledge".

As for socio-economic aspects, 80% of the respondents did not finish basic education, while 20% are illiterate; 50% have a family income greater than one but less than two minimum salaries, 28% total between two and three minimum salaries, 14% have income less than one minimum salary, while only 8% earn salaries greater than three minimum salaries; 100% live in houses covered by tile roofs, of which 96% are constructed of bricks with plaster, 2% are brick houses without plaster and 2% are mud brick houses; 80% of the respondents supply their homes with well water and the 20% remaining get their water from various sources, such as natural springs, cisterns, rivers and streams that depend on availability; 60% have septic systems, 38% have no sanitation whatsoever, leaving wastes exposed to open air and 2% use a latrine.

From this profile, some registered data stand out, such as for example, the level of education, a fact that is certainly reflected in the ability to generate production methods and resources for the family. Probably, this is one of the reasons causing most of the families to practice unaided sustenance agriculture at the mercy of vagaries, in a situation that is common today in the rural, semi-arid zone. It is a situation that accumulates various factors over time, such as the crisis of traditional agriculture as a result of seasonality, migration and environmental alterations resulting from inadequate agricultural practices and/or predatory extrativism. These observations corroborate those of Llorens (2001) who wrote on the local economic development and analyzed several interrelated negative factors.

Faithful to the thinking of Rossato *et al*. (1999), who affirmed that "the use value of plants indicates the importance of these species for the communities", it is possible to conclude from the results of this analysis that the brushwood flora of Cocal county, Piauí, possesses considerable value of use and that the population knows many uses for these species and/or resources in various categories.

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