PLANT SCIENCE RESEARCH AND PRACTICES

Cacti

Ecology, Conservation, Uses and Significance

Marianna Rodrigues Santos
Editor

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ECOLOGY, CONSERVATION, USES AND SIGNIFICANCE

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NOTICE TO THE READER

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To our families who for years have lived with our absences due to various commitments to events and trips related to plants, especially cacti.

"Now, there remain faith, hope and love, these three, but the greatest of these is love."

1 Corinthians 13:13

CONTENTS

PREFACE

Cactaceae is a botanical family composed of arborescent, shrub, climbing, globose, discoid or epiphytic species, being almost all endemic to the Americas. Cactaceae occurs between latitudes 35º North and South, both at sea level and up to over 5000 m altitude. In this way, their species have the capacity to grow in different ecosystems. However, the greatest diversity is found in arid and semi-arid regions, where they are important sources of resources for several species of vertebrates and invertebrates, mainly in the drought season, when there is a great shortage of resources.

In addition, some species of cacti represent an important source of food resources for humans and their herds, as well as having enormous ornamental value. Thus, cacti have always aroused the because of their morphological peculiarities and chemical properties. Due to this, cacti have now been the subject of diverse studies. This book brings studies of several areas of plant biology, ecology, conservation and uses of cacti.

The first four chapters compose the part related to ecology and conservation. Several species of Cactaceae in Brazil and the world are seriously endangered, with about 31% of the family categorized as threatened. Chapter 1 discusses the importance and how the ex situ conservation of cacti is carried out in the Botanical Garden of Rio de Janeiro in Brazil. In Chapter 2, the authors carried out population studies of two species of endemic cacti of Chapada Diamantina, Brazil, in order to

evaluate the population structure of the species for decision-making in relation to their conservation. In Chapter 3, authors studied the biogeography and conservation of Discocactus species that are endemic to South America. In Chapter 4, the authors discuss the floral morphology and the ecological interactions highlighting the importance of conservation of cacti for ecosystems maintenance.

Chapters 5 to 10 address issues related to the uses and significance of cacti. Chapter 5 discusses cacti of the genus *Pereskia* with a healthy diet alternative due to its nutritional properties. The toxicological evaluation, antinociceptive and anti-inflammatory effects of plant extracts is discussed in Chapter 6, specifically, roots of Cereus jamacaru.

In Chapter 7 the use of fibers from Opuntia species in the manufacture of Agave juice is evaluated, due to the importance of including fibers in human consume, because dietary fiber may contribute in the prevention of chronic diseases such as diabetes, cancer and cardiovascular illnesses. The antioxidant activity of prickly pear of Opuntia is discussed in Chapter 8, because besides betalains, prickly pear contains vitamins and phenolics. In Chapter 9, the research describes the industrial applications of the berry as well as key points for future research. And in Chapter 10, bioactive compounds of Opuntia oligacantha were determined, as well as their antioxidant capacity, antimicrobial activity and shelf life.

All the studies presented in this book are of great importance and serve as a basis for further research to be carried out to make the species of the Cactaceae family be seen beyond their ornamental value.

Chapter 1 - Several species of Cactaceae in Brazil and the world are seriously endangered, with about 31% of the family categorized as threatened. In the target 8 of the Global Strategy for Plant Conservation, it is recommended that 75% of threatened species be conserved in *ex situ* collections until 2020. In this context, the collection of cacti and succulents of the Botanical Garden of Rio de Janeiro (JBRJ) has been establishing strategies and developing specific actions, such as the definition of priority species, mapping of the remaining populations in the in situ areas and systematic search of propagules in expeditions specially related to conservation *ex situ*.

Chapter 2 - The efforts for the conservation of Cactaceae, in Brazil, were systematized in the PAN Cactaceae (National Plan for Cactaceae Conservation), including two species endemic from the Chapada Diamantina: *Micranthocereus hofackerianus*, cited to a single site, near the city of Piatã; and *Arrojadoa bahiensis* N. P. Taylor & Eggli. an endangered species with a relatively broad but sparse distribution in the Chapada Diamantina. The authors made two excursions to the site of description of *M. hofackerianus*, and based on the edaphic and vegetative characteristics of the site, and on information of residents on nearby areas, the authors conducted an intensive search in the neighboring region, recording the points where the species occurred. The authors evaluated the population density using eight transects with 2,500 m² each (250 x 10m) randomly demarcated on the area where the species was previously recorded on the first excursion. The population structure of *Arrojadoa bahiensis* was sampled in areas from Mucugê and Piatã using 54 plots of 25 m^2 (5 x 5m) randomly distributed recording all individuals found. The occurrence of *M. hofackerianus* was recorded in an area of about 26 Km in a north-south direction and about 11 Km in the east-west, or about 18 km². In the whole area where it was found, *M. hofackerianus* occurs on sandy soils or, to a lesser extent, on yellow latosols. The number of individuals per transect ranged from 2 to 16 (7.38 ± 5.85). The mean density obtained was 29.5 ± 23.42 ind/ ha^{-1}. The authors found 118 individuals of *A. bahiensis* in the plots (2.76 ± 2.04 per plot). The populations are small and scattered in all sites, and the intensive sample efforts did not allows the improvement of the number of individuals sampled. The stems are nearly cylindrical and had 5.62 ± 1.98 cm of Diameter at Ground Level (DGL) and 6.24 ± 2.33 cm of Larger Diameter Measured (LDM), and an average length of 18.22 ± 13.93 cm. The length / LDM ratio indicates that the stems tend to thicken initially, stretching later. In branched individuals, the number of branches varied from 2 to 19 branches. There was no significant correlation between LDM and number of branches ($r = 0.23$, $p = 0.14$). The data obtained from the field works of this study showed that this species has intermediate characteristics between globular species and columnar species of Cactaceae. The authors found 69.23% of the individuals were unbranched,

being 56.41% seedings (SE) and 12.82% fertile unbranched (FU). The remainder 30.77% of individuals were branched, 10.25% branched infertile (BI) and 20.51% branched fertile (BF).

Chapter 3 - *Discocactus* is a genus of Cactaceae endemic to South America, with 11 species and two heterotypic subspecies recognized, many of them considered threatened, occurring in *Cerrado*, *Caatinga* and *Pantanal* biomes. The aims of this study were characterize the biogeographic patterns, richness, diversity and endemism of *Discocactus* spp.; compare their distribution with Full Protected Conservation Units (FPCUs) and priority areas for biodiversity conservation; and determine conservation status, indicating important areas for conservation. For analysis of the biogeography of the genus studies of herbarium records, field work, parsimony analysis and geographic information systems were undertaken. The conservation status was defined according to IUCN categories. The majority of the species are known from less than ten sites, and two taxa are micro-endemics, being founded in only one place. Almost all species were considered Critically Endangered, Vulnerable or Endangered, but, unfortunately, most of them are not protected in FPCUs. The highest richness and diversity of *Discocactus* is concentrated in the northern region of Bahia (near the Chapada Diamantina and Morro do Chapéu) including *D. bahiensis* and taxa of *D. zehntneri*, and in the Middle of the Espinhaço mountain range (Planalto de Diamantina and Grão Mogol) where *D. placentiformis*, *D. horstii* and *D. pseudoinsignis* are found. The local and regional endemism of *Discocactus* species needs further study, especially in relation to the creation of new protected areas or amplification of the existing Conservation Units.

Chapter 4 - Flowers of Cactaceae have a peculiar structure. As in all Angiosperms, their flowers are modified shoots, but in this family the shoot is more complex: it is externally covered by stem tissue. The cactus flowers show a wide variety of forms, sizes and structural characters related to the evolutionary history of their lineages. This richness in morphology provides a wide spectrum of pollination syndromes and, therefore, flowers are important food resources for bats, bees, birds, and other fauna components, providing pollen and nectar. These ecological

interactions highlight the importance of conservation of cacti for ecosystems maintenance.

Chapter 5 - Several species of Non-Conventional Food Plants are still under-exploited and can be an alternative source of food and income, especially in family agriculture. Currently, vegetables of this category are not commercially produced. These plants can be included in diversification of agricultural production mainly by low-income groups, since they present reduced hydric and agricultural inputs requirements, contributing to generation of healthier foods. In recent years, cacti of genus *Pereskia* have attracted increasing interest from food and pharmaceutical industries, mainly due to their high protein content with high digestibility, mucilage type fibers, and calcium and iron minerals. The *Cactaceae* family is composed by four subfamilies: *Maihuenioideae, Cactoideae, Opuntioideae* and *Pereskioideae*, latter being considered less evolved. *Ora-pro-nobis*, the popular name of *Pereskia aculeata* Miller and *Pereskia grandifolia* Haword species, is consumed by rural and urban populations, mainly in the mining regions of Minas Gerais state, Brazil, and contribute to complement feeding and family economy. These cacti have been used since ancient times by indigenous peoples, and are currently being employed as antibiotics, analgesics and diuretics, in combating diarrhea, burns treatment, ulcers healing, and in the control of cardiac and nervous pathologies. In addition, in previous decades, the effect of several compounds of these plants in the prevention and/or treatment of obesity, diabetes *mellitus*, dyslipidaemias, osteoporosis and iron-deficiency anemia have been studied. This chapter will approach the general characteristics of these plants, their metabolic effects already studied, highlighting the importance of their consumption for improve nutritional status and income of economically disadvantaged people, in urban and rural environment of different regions in Brazil and the world, especially in those areas where climate and soil are more favorable to cultivation of these cacti known as non-conventional vegetables.

Chapter 6 - *Cereus jamacaru*, popularly known as “mandacaru”, is used by communities in Brazilian semiarid regions to treat kidney diseases, respiratory problems and haemorrhoids. This study investigated the acute

toxicity, antinociceptive and anti-inflammatory effects of methanol extract of *Cereus jamacaru* root (MECJ). MECJ was obtained by Maceration. Acute toxicity testing was performed according to OECD Guideline 420/2001. Experimental pharmacological screening to assess possible changes in neurological behaviour and the rota-rod test to evaluate the influence of MECJ on motor coordination were also carried out.

Acetic acid-induced writhing, formalin and carrageenan-induced paw oedema tests were conducted to evaluate the antinociceptive and anti-inflammatory potential of MECJ. Animals treated with MECJ showed no signs of serious toxicity and no deaths were recorded, nor was there a difference in weight gain compared to the control group. From a macroscopic perspective, organs exhibited no anatomical alterations and no significant difference in average organ weight between the control and experimental groups. In sessions on the rota-rod treadmill, MECJ did not cause abnormal behaviour in the animals or alter their motor performance. Oral administration of MECJ decreased acetic acid-induced writhing, producing a significant antinociceptive effect. It also reduced carrageenan-induced paw oedema and the time mice spent licking and biting the paw during the neurogenic and inflammatory phases of the formalin test. MECJ has low toxicity and caused no behaviour change, nor did it affect the animals' motor coordination. In addition, results suggest that the extract has antinociceptive and anti-inflammatory potential.

Chapter 7 - Cactus pears (xoconostles) are fruits from Opuntia joconostle, which are cultivated in the central Mexico area. The cactus pear from *Opuntia joconostle* is widely used as a condiment in Mexican cuisine, and in the elaboration of candies, jellies, beverages, jam, marmalades, sauces and has traditionally been used for alternative treatments of diabetes mellitus. The *Agave salmiana* is a plant of Agavaceae family growing in high plateaux semiarid and cold of Mexico. Agave juice (aguamiel) is a fluid obtained from agave. The aguamiel is produced in adult plants and accumulates in the low zone of plant. The aguamiel is rich in carbohydrates as inuline, sucrose and fructose, and contains small amounts of aminoacids and vitamins. The inulin and fructooligosaccharides (FOS) and they are naturally occurring carbohydrates, considered as a fiber in

many countries. Still, inulin and FOS act as soluble fiber, and both substances contribute fewer calories than sugar or starch, so that they can be used in the formulation of low carbohydrate beverages. Dietary fiber may contribute in the prevention of chronical diseases such as diabetes, cancer and cardiovascular illnesses. Variety of candies is enormous; it changes with time and countries, and even across regions and religions. There is no limitation as to the preparation of sweets, all depends on the baker's imagination so that have been spreading in almost independent sections. Considering that there are traditional candies, such as crystallized fruit, which are manufactured using sucrose. This carbohydrate can be replaced for aguamiel to produce a crystallized cactus pear with functional properties and low calories.

Chapter 8 - *Opuntia* cacti, which have been known since the fifthteent century, are commonly found in America and the Mediterranean. This genus is best known to man because of its economical importance and its capacity to flourish in poor soils and arid places. The most widely studied plants are *Opuntia ficus-indica* called prickly pear or Indian fig. The colorants present in *Opuntia* plants are normally found in the flowers and fruit, these colorants are betalains (also found in beet root, amaranth, and all cacti), which are divided in two groups: betacyanins that have red or purple color, or betaxanthins with yellow or orange color. The main betalains in prickly pear are betanin and indicaxanthin, and in less quantity, vulgaxanthin, miraxanthin, portulaxanthin, and neobetanin can be present. Besides betalains, prickly pear contains vitamins and phenolics. All these compounds have characteristics such as antioxidant, anti-inflammatory, antimicrobial, and anticarcinogenic. Although prickly pear is consumed fresh, there are some products based on its juice such as wine and candies. Since only juices are used, seeds and peel are considered as wastes. In this work, the content of betalains, phenolics and antioxidant activity (DPPH ans TEAC) were evaluated in four varieties of prickly pear seeds and peel (Amarilla Montesa, Blanca Cristalina, Roja Lisa, and Esmeralda). Betacyanins were more abundant in reddish prickly pear seeds and peels, while betaxhantins in green and yellow varieties. Phenolics in peels were higher in red and yellow varieties. Phenolics contents in seeds averaged

344, 170 and 45 mg/100 g for Total phenolics, Tannins and Flavonoids, respectively. The DPPH scavenging capacity was higher in seed extracts (53% DPPH discoloration) than peel (40%). ABTS showed the similar behavior in both materials. Results showed that not only betalains but also phenolics can contribute to in vitro antioxidant capacity, making prickly pear a potential source not only of food colorants but also nutraceuticals due to their bioactive characteristics.

Chapter 9 - *Myrtillocactus* is an endemic cactus from semi-arid regions of central Mexico; it is characterized by its arborescent-tree like appearance and for its white flowers and red-spherical fruits resembling berries. The fruit has been consumed by native Mexicans for thousands of years; however it is until now that it has attracted attention due to its nutraceutical potential.

This research focuses on different aspects of the berry. It describes its botanical and agronomic characteristics while exploring with attention its nutritional composition and bioactive compounds. Additionally, this research describes the industrial applications of the berry as well as key points for future research.

Chapter 10 - Bioactive compounds, antioxidant capacity and antimicrobial activity of four xoconostle sauces were determined; S1: Sauce of cooked xoconostle with heat treatment in kettle, S2: sauce of cooked xoconostle with heat treatment in autoclave, S3: Sauce of roasted xoconostle with heat treatment in kettle and S4: sauce of roasted xoconostle with heat treatment in autoclave. The variables studied were: pH, total soluble solids (TSS), color, content of polyphenols, oxygen radical absorbance capacity (ORAC) and carotenoids. Four storage times of 0, 30, 60 and 300 days were evaluated. The sauce of roasted xoconostle with heat treatment in kettle, presented the best physicochemical values (3.15% carbohydrates, 5.16% Ashes, 18.89% moisture and providing 61.99 kcal/100 g of energy). The pH values were similar throughout the storage time (0 to 300 days), ranging from 3.06 to 4.59. The TSS (° Brix) was higher in the sauces of roasted xoconostle with respect to the sauces of cooked xoconostle through the storage time. The sauces of roasted xoconostle were those that presented a darker color with respect to the

sauces of cooked xoconostle. The highest content of polyphenols was found in the sauce of roasted xoconostle with heat treatment in kettle and in the sauce of roasted xoconostle with heat treatment in autoclave, at 0, 60 and 300 days of storage. The highest ORAC value was observed in the sauce of roasted xoconostle autoclaved and in the sauce of roasted xoconostle with heat treatment in kettle along the storage time. The sauce of roasted xoconostle autoclaved and the sauce of cooked xoconostle with heat treatment in kettle presented the highest values of carotenoids at zero time with values of 119.47 and 119.17 µg/g respectively. In order to determine the antimicrobial activity in xoconostle sauces, three sauce formulations were made; sauce A: xoconostle-chili, sauce B: xoconostle-tomato and sauce C: tomato-chili. Microbiological analyses concluded that the use of xoconostles as an ingredient in sauces could contribute to improve or preserve the innocuity in sauces. Heat treatment did not affect the antimicrobial activity of xoconostle-based sauces. It would be appropriate to carry on more studies evaluating other varieties of xoconostle to determine if any variety of this fruit possess higher antimicrobial capacity for its potential use as a source of natural antimicrobials with application in the food industry.

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Chapter 1

THE IMPORTANCE OF *EX-SITU* CONSERVATION: THE CHALLENGES OF THE CACTARIUM AT BOTANICAL GARDEN OF RIO DE JANEIRO

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ABSTRACT

Several species of Cactaceae in Brazil and the world are seriously endangered, with about 31% of the family categorized as threatened. In the target 8 of the Global Strategy for Plant Conservation, it is recommended that 75% of threatened species be conserved in *ex situ* collections until 2020. In this context, the collection of cacti and succulents of the Botanical Garden of Rio de Janeiro (JBRJ) has been establishing strategies and developing specific actions, such as the

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definition of priority species, mapping of the remaining populations in the in situ areas and systematic search of propagules in expeditions specially related to conservation *ex situ*.

Keywords: Cactaceae, conservation, GSPC, JBRJ

1. INTRODUCTION

Cactaceae is one of the most diverse families of the Neotropics and is considered an important component of arid and semiarid environments [1], presenting three centers of diversity and endemism [2], the third one located in the eastern region of Brazil, where it occurs in different habitat types [3]. Several species of Cactaceae in Brazil and in the world are seriously endangered, with about 31% of the family categorized as threatened [4]. In Brazil there are 39 genera, of which 14 are endemic, with 261 species and 92 subspecies [5]. The family has a great economic importance for its use in human food, popular medicine, as forages, ornamental plants, among other uses. Most of its species are highly sensitive to habitat alterations due to their slow rates of development and low recruitment rates [6, 7].

In 2010 a new modified and updated version of the Global Strategy for Plant Conservation (GSPC) was signed. This document, which aims to halt the continued and accelerated loss of global plant diversity, sets out five objectives, subdivided into 16 targets, to be achieved by 2020 (https://www.cbd.int/gspc/strategy.shtml) [8].

Among these targets, the target 8 is responsible for the ex-situ conservation of endangered species, a document established at the United Nations Organization (ONU) during the COP 6 biological diversity conference and updated at COP 10, where it is recommended that 75% of endangered species be conserved in *ex situ* collections by 2020. On September 25, 2003, the Brazilian government published the CONAMA Resolution nº 339, which established, among other things, that the

Brazilian Botanical Gardens formally accredited should be, per excellence, the responsible agency for compliance with this GSPC target 8.

In addition, in the document "National Biodiversity Targets for 2010," the Ministery of Environment of Brasil (MMA) reiterated its adherence to the GSPC and set specific targets for the Brazilian reality. Based on these resolutions, several Brazilian institutions began to engage in projects and activities aimed at the conservation of the national threatened flora, where the Botanical Gardens have being the main organizers and catalysers of these various initiatives.

2. THE CACTARIUM

The Botanical Garden of Rio de Janeiro is located in the municipality of Rio de Janeiro, RJ. Today, its arboretum occupies an area of 54 hectares, of which the largest portion comprises the green area and presents six thematic collections (Cactus, Orchid, Bromeliads, Insectivores, Medicinal Plants and Shade Collection) [8]. The cactarium occupies an area of about 3000 m² and includes external beds, some with specific themes such as "Cerrado and Caatinga" or "Restinga," and also greenhouses, some opened to visitation and others destined for plants of the closed technical reserve. There are also pergolas protected by polycarbonate cover and equipped with an automated irrigation system, where they shelter newly germinated plants, plants under study, as well as the collection of pendant cacti.

The cactarium comprises a collection of native and exotic, currently represented by 236 species, between cacti and succulents. Of the Brazilian species in the collection, the largest volumes come from southeastern Brazil, mainly from the states of Minas Gerais and Rio de Janeiro, with emphasis on the Espinhaço and Mantiqueira ranges. The most representative genera in the collection are *Arthrocereus* A. Berger, *Cipocereus* Ritter, *Discocactus* Pfeiff., *Opuntia* Mill., *Pilosocereus* Byles & Rowley, *Rhipsalis* Gaertn., *Tacinga* Britton & Rose e *Uebelmannia* Buining, among others (Figure 1).

Figure 1. A. *Arthrocereus rondonianus* Backeb. & Voll; B. *Uebelmannia gummifera* (Backeb. & Voll) Buining; C. *Discocactus placentiformis* (Lehm.) K. Schum.; D. *Cipocereus minensis* (Werderm.) Ritter; E. *Schlumbergera opuntioides* (Loefgr. & Dusén) D. R. Hunt; F. *Pilosocereus aurisetus* (Werderm.) Byles & G. D. Rowley.

As for the species categorized into some level of threat present in the collection, that number went from 11 in 2014 to 42 in 2017 (Table 1). This increase is due to the directed efforts of the Coordination of Living Collections of the JBRJ, in order to prioritize the careful collection of endangered species in order to achieve GSPC's *ex situ* conservation goals. Within this Coordination, the Curatorship of the Cacti and Succulents Thematic Collection designed and implemented a formal program of systematic search and acclimatization of these priority species, within

important conservation areas of Rio de Janeiro and Minas Gerais. This program was supported by ICMBIO and had two annual expeditions from 2014 to 2016.

Table 1. Brazilian species of Cactaceae categorized as threatened present in cactarium at Botanical Garden of Rio de Janeiro – Out/2017

Endangered species	**Official Lists**	
	MMA 2014 [9]	**Goettsch et al. 2015 [4]**
Arrojadoa eriocaulis Buining & Brederoo	EN	EN
Arthrocereus glaziovii	EN	EN
Arthrocereus melanurus subsp. *melanurus*	EN	VU
Arthrocereus melanurus subsp. *magnus*	EN	-
Arthrocereus melanurus subsp. *odorus*	EN	-
Arthrocereus rondonianus	EN	LC
Brasilicereus markgrafii	EN	VU
Cipocereus bradei	VU	VU
Cipocereus laniflorus	EN	EN
Cipocereus minensis	VU	LC
Coleocephalocereus braunii	-	CR
Discocactus bahiensis	VU	VU
Discocactus catingicola	VU	LC
Discocactus ferricola	-	EN
Discocactus petr-halfari	-	CR
Discocactus pseudoinsignis	CR	EN
Discocactus zehntneri	VU	NT
Echinopsis calochlora	CR	LC
Espostoopsis dybowskii	EN	VU
Melocactus violaceus	VU	VU
Micranthocereus auriazureus	EN	EN
Micranthocereus violaciflorus	EN	EN
Pilosocereus arrabidae	-	NT
Pilosocereus fulvilanatus	EN	NT
Pilosocereus ulei	-	EN
Rhipsalis agudoensis	-	DD
Rhipsalis cereoides	CR	NT
Rhipsalis clavata	-	NT
Rhipsalis crispata	-	EN

Table 1. (Continued)

Endangered species	**Official Lists**	
	MMA 2014 [9]	**Goettsch et al. 2015 [4]**
Rhipsalis dissimilis	-	EN
Rhipsalis hoelleri	-	DD
Rhipsalis mesembryanthemoides	-	CR
Rhipsalis pacheco-leonis	EN	EN
Rhipsalis pentaptera	-	CR
Rhipsalis pilocarpa	-	VU
Rhipsalis russellii	-	VU
Rhipsalis triangularis	-	CR
Schlumbergera kautskyi	EN	EN
Schlumbergera truncata	-	VU
Tacinga subcylindrica	-	EN
Uebelmannia pectinifera	CR	EN
Uebelmannia buiningii	EN	CR

This same Curatorship has extended its relationship with some undergraduate and postgraduate courses, notably with Masters and Doctoral students of the National School of Tropical Botany/JBRJ, in order to provide logistical and material support for its studies involving cacti, and to provide the Cactarium and its collection for related didactic-scientific activities.

The maintenance of this material in cultivation, especially in the case of specimens still little known or little documented for science, has provided subsidies for taxonomic and conservation studies, also contributing to the enrichment of the collection of Cactaceae exsicates in the herbarium of the JBRJ.

The humidity of the Atlantic forest present all around in the environment of the cactarium is the most challenging limiting factor for the maintenance of the collection, since most of these plants originate in xeric environments, therefore they are sensitive to excess soil and air moisture, in many cases not resisting the climate of the municipality of Rio de Janeiro. In this sense, protected cultivation in structures such as greenhouses is absolutily necessary, as well as the application of fertilizers,

pesticides and other inputs specifically aimed at creating barriers and resistance against fungi and bacteria.

The cactarium of the JBRJ has been involved in this activity of sheltering species of Brazilian flora since the last century, when Albert Loefgren in 1912 organized and systematized the cactus specimens that were in the institution, focusing on the registration of species of the genus *Rhipsalis* from different places of Brazil, keeping them in cultivation and presenting several species unknown to science [10, 11]. This practice is followed by several researchers in subsequent administrations. Several specimens from scientific expeditions and flora rescues are in the cactarium, with endangered plant diversity restricted to research in closed greenhouses, and some species that have ornamental potential are in the areas of visitation, allowing the contact of visitors with a large quant features the morphology of the Cactaceae.

In this context, the collection of cacti and succulents of the Botanical Garden of Rio de Janeiro has been establishing strategies and developing specific actions, such as the definition of priority species, mapping of the remaining populations in the in-situ areas and systematic search of propagules in expeditions specially directed to conservation. By becoming a faithful depository of endangered species, and committed to maintaining research and efforts to multiply these species, always with an emphasis on Brazilian species, we are contributing decisively to the conservation of the flora, making samples available for research and reducing the incidence of collections in the in-situ areas.

Morphological and molecular studies have been developed through partnerships with different laboratories in the department of structural botany of the JBRJ. The seed bank and the DNA bank also represent a new approach to preserving the genetic diversity of species, as well as the collection of flowers in a liquid environment. The collection preserves these organisms for current and future studies as well as for eventual use in the recomposition of environments, industry or related activities.

Each species collected has its ecological, botanical and population information cataloged and recorded. Cactarium partnerships with other collections of scientific importance, mainly aimed at the exchange of