Chapter 156

Teaching about medicinal plants at school: Following in the footprints of Frei Veloso

https://doi.org/ 10.56238/devopinterscie-156

Maria das Graças Lins Brandão
Retired Professor at the Faculty of Pharmacy and Ceplamt, Federal University of Minas Gerais (UFMG), Belo Horizonte. President of the Cayapiá Institute for the culture, defense and conservation of native plants used by Brazilians, based in Tiradentes (MG)

Rômulo dos Santos Fonseca
History teacher for primary and secondary education, former director of the EE Basílio da Gama, in Tiradentes

Juliana de Paula Souza
Department of Botany, Federal University of Santa Catarina (UFSC), Florianópolis

Aparecida Celia dos Santos
Retired Professor, Department of Natural Sciences, Federal University of São João del Rei (UFSJ), São João del Rei

Fernando Antônio Mencarelli
Former coordinator of the cultural campus of the Federal University of Minas Gerais (UFMG) in Tiradentes, Pro-Rector of Culture, UFMG, Belo Horizonte

Marina Scopel
Department of Pharmaceutical Products, Faculty of Pharmacy and Coordinator of Ceplamt, UFMG

1 INTRODUCTION

Brazil is home to the richest, most important and diverse flora in the world. This fact reveals the great plant potential of the country in the development of medicines, cosmetics, nutraceuticals and other innovative products (NEWMAN & CRAGG, 2012). In addition to the vast biodiversity, Brazil also has a rich socio-diversity, built over the centuries by the miscegenation of Amerindian, African and European cultures (VALLI & BOLZANI, 2019). However, despite its recognized potential, native vegetation in Brazil is undergoing an intense process of destruction, caused by a sequence of highly impactful economic cycles, which began with the exploitation of pau-brasil, in the 16th century (DEAN, 1996). Currently, only 7% of the Atlantic Forest is preserved, while other ecosystems such as the Amazon, the cerrados and the caatinga are being rapidly replaced by monocultures of eucalyptus, sugar cane, soy and cattle raising. The consequences of these processes on useful and medicinal native plants are dramatic: a study carried out by the Center Specialized in Aromatic, Medicinal and Toxic Plants Ceplamt/UFMG (supported by FAPEMIG) between 2004-2005, with the population of the mining area of Estrada Real, in Minas Gerais, showed that, even among the elderly inhabitants of rural areas, knowledge about the medicinal applications of native plants was forgotten (BRANDÃO & MONTEMOR, 2008). As a consequence, most of the plants used today as medicines are exotic species, that is, native to other continents, but which have been introduced here since the beginning of Portuguese colonization (FERRÃO, 2004).

On the other hand, in the 1970s, the World Health Organization (WHO) began to recognize medicinal plants as an important therapeutic resource and instituted a program to encourage the use of validated species, through their inclusion in public health systems. Validating a plant means evaluating its pharmacological potential and confirming the absence of toxicity. Only then can they be transformed into medicines, with the same efficacy, safety and quality requirements demanded for synthetic products. Validated plant remedies are called herbal medicines (FM) and they are being developed all over the world. Since 2002, the WHO has also considered the development of medicinal plant products based on their traditional nature (WHO, 2011). It is considered, in these cases, that the secular use of a plant, in the same way and for the same purpose, can attest to its effectiveness. The products of this approach are traditional herbal medicines (FT). In this context, validating Brazilian native plants represents an important way of valuing culture and conserving biodiversity.

In the context presented, there is no doubt about the importance of training young people for this new reality, in which a bioeconomy is developed. For this reason, almost two decades ago, the team at the Specialized Center for Aromatic, Medicinal and Toxic Plants, headquartered at the Museum of Natural History and Botanical Garden of the Federal University of Minas Gerais (Ceplamt-UFMG), began the line of work of recovering information on useful and medicinal plants native to Brazil. As of 2021, these studies will be carried out by Cayapiá - Institute for the culture, defense and conservation of native plants used by Brazilians, based in the municipality of Tiradentes, created specifically for this purpose. The studies are concentrated on collecting data on the traditional uses present in bibliography and other documents produced until the 1950s. , replacing the remedies prepared with plants. In parallel with the recovery and organization of data, didactic and scientific dissemination materials are prepared, with historical and technical-scientific information about the plants. Among the materials prepared and distributed are panels and posters with self-explanatory information, books, booklets, CDs, documentaries, all available at www.ceplamt.org.br. The web series "Teaching about medicinal plants at school", with five chapters, is aimed at students and teachers. It presents the scientific methods used to transform plants into products with a cast consisting only of university students. A mini-laboratory was also created and is distributed, with which it is possible to carry out, in the classroom, simple experiments to detect the presence of the active principles of plants. The materials are distributed in schools in the interior of Minas Gerais, accompanied by activities with teachers and students. Several projects along this line were developed with financial support from Fapemig and CNPq (https://www.ufmg.br/mhnjb/ceplamt/).

With the objective of contributing in this line of action, for more than a decade our group has been developing activities in public schools in the interior of Minas Gerais: municipalities of Estrada Real, Rio das Velhas, Bacia do Rio Pandeiros (PRATES et al., 2020) and, more recently, in the municipality of Tiradentes and surroundings. The objective of this text is to share the experience gained over the years, especially with the activities developed in Tiradentes, carried out with funds raised from CNPq in the Science at School public notice.

2 METHODS AND RESULTS

The works described here were developed in the municipality of Tiradentes (MG). Despite being located in a municipality with a high HDI, but like most public schools throughout the country, the Schools of Tiradentes have a low IDEB. This confirms the need for actions that improve their activities with students.

2.1 OBTAINING HISTORICAL RECORDS ON THE USES OF LOCAL NATIVE PLANTS

The work began with the search for information on local native plants, cited in the works of naturalists who traveled through Brazil in the 19th century, and passed around Tiradentes. Among them, the Frenchman Auguste de Saint-Hilaire (1779–1853) (SAINT-HILAIRE, 2014), the German Karl von Martius (1794–1868) (MARTIUS, 2023), the Englishmen George Gardner (1812–1849) (FAGG et al., 2015) and the botanist Friar Mariano da Conceição Veloso (1741-1811)(BRANDÃO, 2019). The use of information collected by these naturalists in the development of activities and products allows the theme to be treated in a multidisciplinary way: historical aspects (context of the time in which each naturalist recorded the uses of plants), geographic aspects (different ecosystems visited by them), linguistic (original names of plants: indigenous and/or African and/or European), chemical (characteristics of each class of active substances in plants) and biological (effects of active substances in the body) are addressed together. In addition, using information about plants recorded by naturalists is important because it is information collected and systematized by scientists at the time. The records made by them are also primary, that is, collected at a time when native vegetation was still preserved and the population used primarily medicinal species from Brazilian biodiversity. Currently, this picture is very different, with exotic plants, that is, native from other continents and introduced here, the most known and used. All information collected in this vast historical review is included in Dataplamt - a bibliographic database on native plants used by Brazilians (www.dataplamt.org.br).

2.2 GUIDANCE OF TEACHERS FOR WORK WITH MEDICINAL PLANTS

The importance of training young Brazilians for a future in which sustainability and the bioeconomy are a reality is unquestionable. However, despite this importance, the theme “medicinal plants” is not well addressed in Brazilian schools, most of the time due to the little knowledge on the subject by the teachers themselves. No textbook distributed in schools adequately addresses the topic. For this reason, training was offered to teachers during which updated information on the subject was passed on. The training begins with the transfer of information about the validation methods used by the scientists to transform the plant into a product. They are: (i) Ethnobotanical studies: For the works in Tiradentes, the origins of the plants were considered (Amerindian, African or European) according to what was mentioned by Frei Veloso, contemplating the diversity of the modalities of teaching quilombola education and indigenous education. (ii) Botanical studies: They start with the collection of the used part of the plant and

preparation of specimens for taxonomic identification (= definition of the family, genus and species). This identification is made by observing characteristics specific to each species, such as the arrangement of leaves on the stem, petals and sepals, among other morphological characteristics. Currently, identifications are also being made by characterizing the DNA obtained from plants. New and undescribed species receive, together with their scientific names, the name of the botanist responsible for the first description. Hundreds of plants were first described by Frei Veloso, and can be identified by the existence of the "Vell." next to the scientific name. (iii) Chemical studies: The parts of the plant used for the preparation of medicines are dehydrated at low temperature (so that there is no loss or degradation of bioactive substances, especially volatile ones) and ground in mills until they are transformed into powder. In this form, the material is called plant drug. The probable bioactive substances of the plants are then extracted from the plant drug with solvents (alcohol, for example). There are several methods for carrying out extractions: one of them is percolation, which consists of passing a succession of solvents through the vegetable drug, which will carry the chemical substances. These liquids are then evaporated at low temperature, until dry extracts are obtained. To purify and identify the bioactive substances, chromatographic methods are used. Several active substances, such as flavonoids, saponins, volatile oils or polyphenols, for example, have already been identified in the plants mentioned by Frei Veloso. (iv) Pharmacological and toxicological studies: These are carried out through in vitro tests, in which the extracts are placed in direct contact with disease-causing agents, such as viruses, bacteria or parasites; or in vivo, in which laboratory animals (guinea pigs) are used, and later in humans through clinical trials. Several biological activities were determined for the plants registered by Veloso, the most frequent being antioxidants, antimicrobials and anti-inflammatories.

With this knowledge in hand, teachers are then trained to reproduce laboratory experiments in the classroom. The experiments are part of the laboratory kit with which it is possible to detect the presence of the active principles of the plants. Through the available glassware, and easily accessible materials such as cotton swabs, coffee filters, steel wool, it is possible to develop curious experiments such as the formation of foam due to the presence of saponins in the plant, or the blue coloration with a reagent prepared with straw of steel, indicating the presence of tannins, or even swelling of the botanical material, due to the presence of mucilage. From a candle, a dispenser of drinks and guarana powder, caffeine can be sublimated and transformed into crystals. Saponins are present in various plants such as sarsaparilla, eggplant or mate tea, and they are responsible for a "blood purifying" action, which can currently be classified as reducing cholesterol and triglycerides. Tannins are astringent and present in numerous plants such as pomegranate fruit peels, widely used to treat sore throats, for example. The mucilages are present in flax seeds and have a moisturizing and laxative effect. Guarana has a stimulating effect due to the presence of caffeine. These and other experiments are described in chapter 3 of the Web-series "Teaching ....", previously described. The laboratory kit consists of a box containing items such as laboratory glassware and some reagents needed to perform experiments. Samples of the dried plants to be tested are also included. A tutorial for the development of experiments is available on the Ceplamt page (http://www.ceplamt.org.br/plantas-

medicinais-na-escola/). Dozens of laboratory kits have already been distributed to municipal schools in different municipalities in Minas Gerais, as well as Tiradentes and other surrounding municipalities.

During the training, guidelines are also passed on for the development of works that promote the interaction of students with their families and/or experts in the local native flora. It is proposed that interviews be carried out, in which the questionnaires contain questions related to (i) the importance of Brazilian biodiversity and sociodiversity; (ii) medicinal plants and their traditional uses; (iii) occurrence of plants: native, exotic, imported, ruderal and substitutes; (iv) uses and preparation of plant remedies. The games and other didactic activities present in the books of the "Velosinho & Joaquim" collection also favor this interaction between different generations. The set of activities promotes an enrichment of teaching about Brazilian plants by teachers.

2.3 CREATION OF SPACES IN SCHOOLS AND SURROUNDINGS FOR WORK WITH PLANTS

This is the most difficult stage of work with medicinal plants in schools, since resources are needed for its implementation and authorizations for the insertion of spaces. Despite having financial resources, as it is a historic city, in Tiradentes these insertions are even more difficult, since all buildings and their associated spaces are protected by IPHAN.

Two spaces are important, but not fundamental, for the development of works with medicinal plants in schools:

(i) Garden of useful and medicinal plants: species with different uses can be grown in the gardens, such as food, medicine or dyeing, for example. Adapting species brought by students and selected with guidance from family members is important, as it brings families closer to schools. It is important to separate the plants according to their origins, leaving the native ones in the spotlight. Holding events with families, in which tea or other delicacies prepared by students are distributed, according to the technology learned at school, is exquisite.

(ii) science laboratory: in which materials and equipment are installed for the development of botanical and chemical activities. In the impossibility of having the space, a simple closet can supply the need. It was due to this difficulty that we created the laboratory kit that allows the execution of experiments in the classroom. The cabinet can represent the "science corner", where laboratory materials are kept, as well as specimens and plant drug samples in vials.

2.4 INTERVENTION IN THE CITY AND/OR SURROUNDINGS OF THE SCHOOLS

To complement the work, it is interesting to create maps of the surroundings of the school with observation trails of the worked plants. Students will be assigned the location of these species, based on information from family members and the local population. The plants will be photographed by the students and the images will be worked on in groups, based on data available on reliable internet sites. From the mapping of plants in the city, a trail for plant observation will then be created. The observation trail will be

highlighted by means of plaques with historical and technical-scientific information. It is possible to foresee the insertion of new paths and plans every semester. In Tiradentes, the Frei Veloso plant path was created.

2.5 FOLLOWING IN THE FOOTSTEPS OF FREI VELOSO

Since 2019, the work has been concentrated in the municipality of Tiradentes (MG), birthplace of the first Brazilian botanist, Frei Mariano da Conceição Veloso. Friar Veloso was born in 1741 and died in Rio de Janeiro in 1811. His biographers say that, while he lived in Tiradentes, he studied Latin and, as a hobby, wandered around examining and picking plants, indicating his interest in botanical studies. . In 1755 he began his religious life in Rio de Janeiro and in 1771 he moved to São Paulo. In 1786 he assumed the chair of Master in Natural History, when he found his true vocation as a naturalist. In compliance with the Governor of the captaincy, he increased his studies and collections in the surroundings of Vila de São Paulo. His activity in the area aroused the esteem of the rulers of the time, and it was then determined that he toured the captaincy of Rio de Janeiro, and that he gathered his botanical investigations in a joint work. This is how Florae Fluminensis was born, commissioned by the Viceroy of Brazil, Luis de Vasconcelos e Souza. Despite having been organized in 1790, the work was only published in 1825, after the author's death. After several setbacks in his career, including unfulfilled official promises, a trip to Portugal and a return to Brazil, the originals of the work disappeared until 1824. The work was printed by order of Emperor Pedro I, who saw in the dissemination of the work of a naturalist Brazilian a form of affirmation of the new nation, which had become independent from Portugal. Florae Fluminensis is a grandiose work. It consists of a volume containing the botanical description of 1639 species of plants, native and exotic, and eleven volumes with prints. Florae also describes precious and strategic information about the use of plants in the 18th century. Information and images, old and current about 130 species were recovered and published in the catalog “Useful and medicinal plants in the work of Frei Veloso”, which was used to select the plant species for the works in Tiradentes (BRANDÃO, 2019).

One of the most important products of all the works is the production of a collection of children's books entitled “Velosinho & Joaquim” (resources raised in the public notice “Ciência na Escola” by CNPq)(BRANDÃO, 2022 a,b,c). The books consist of a comic strip (HQ), in which the characters Velosinho (Frei Veloso) and his cousin Joaquim (Tiradentes, hero of the Inconfidência Mineira) still young, travel through time and through different places and biomes, in search for plants native to Brazil. In addition to the comics, the books bring games and other educational/recreational activities, inserted in each one, with the aim of complementing learning and encouraging interest in plants. Among the activities included are coloring boards extracted from Flora Fluminesis, word searches, crossword puzzles, among others. Students in the 4th and 5th years (9 to 12 years old) benefited most from the collection because, according to teachers from Tiradentes, in this age group: (i) students still maintain ties with their families, enabling the construction of dialogues about the uses of plants; (ii) parents are still present in their children's school

life and are also interested in medicinal plants and (iii) students are very curious about aspects related to science.

3 CONCLUSIONS

In Minas Gerais, elementary and middle school teachers in the interior usually address the theme "medicinal plants", using only references to the popular use of plants (folklore), they are cultivated in gardens (exotic species). This is caused, among other factors, by the absence of teaching materials that value Brazilian biodiversity and biotechnological potential, including in textbooks. Thus, our work aims to fill these gaps, creating materials with historical and technical-scientific information about Brazilian plants, as well as guiding teachers in approaching topics such as biodiversity, sociodiversity and bioeconomy with their students. With the materials developed, it is possible to transform simple day-to-day activities for students, such as preparing tea, into an interesting science class. For teachers, knowing the scientific methodology used in the development of pharmaceuticals, nutraceuticals and cosmetics also promotes an improvement in the quality of science teaching.

The theme "useful and medicinal plants" is multidisciplinary, and it is possible to address historical aspects (origin of plants and their uses), geographic (occurrence), biological (effects of plants), chemical (laboratory experiment), among others. In the Velosinho & Joaquim collection, the theme of Brazilian medicinal plants is approached in a playful and very didactic way, and has caused a great impact among students and the population of Tiradentes. The publication of six new issues is planned. Thousands of people are affected by the information conveyed and they make a strong contribution to spreading a culture of valuing native plants and local culture. In fact, from the school to the community, knowledge about plants can also be transmitted, as science, culture and the environment find common ground when it comes to medicinal plants. The works thus contribute to the dissemination and rooting in Brazilian society of a culture that values science, technology and innovation.

REFERENCES

Brandão mgl. 2019 plantas úteis e medicinais, na obra de frei vellozo. 3i editora: belohorizonte. 150p.

Brandão mgl, montemor rlm. 2008. Sabedoria antiga em risco. Ciência hoje 42:77-79.

Brandão mgl. 2022a. Velosinho & joaquim e o portal do tempo. 3i editora: belo horizonte.

Brandão mgl. 2022b velosinho & joaquim e a biodiversidade brasileira. 3i editora: belo horizonte.

Brandão mgl. 2022c velosinho & joaquim e a independência do brasil. 3i editora: belo horizonte.

Dean, w. 1996. A ferro e fogo: a história e a devastação da mata atlântica brasileira. Sãopaulo: companhia das letras.

Fagg cw, lughadha en, milliken w, hind djn, brandão mgl, 2015. Useful brazilian plants listed in the manuscripts and publications of the scottish medic and naturalist george gardner (1810-1849). Journal of ethnopharmacology, 161, 18-29.

Ferrão jem, 2004. A aventura das plantas e os descobrimentos portugueses (2ª ed.).Lisboa: instituto de investigação científica tropical. 286p.

Martius kfp von, 2023. Plantas usadas pelos brasileiros e suas substâncias medicinais. Fino Traço, belo horizonte, 2023, 244 p.

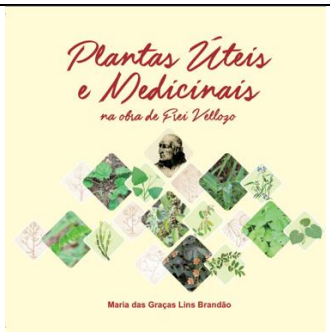
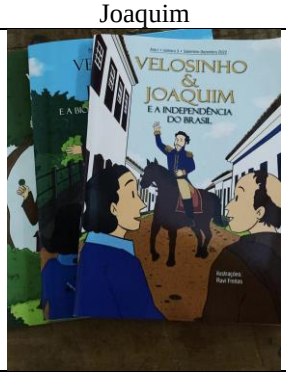
Newman dj, cragg gm, 2012. Natural products as sources of new drugs over the 30years: from 1981 to 2010. Journal of natural products 75 (3): 311-335.

Prates sms, mugge flb; souza jp; brandão mgl. Potencial econômico das plantas Usuais dos brasileiros: espécies da bacia do rio pandeiros. A flora, v. 1, p. 8-13, 2020.

Saint-hilaire a, plantas usuais dos brasileiros. Fino traço, belo horizonte. 2014, 348 p.

Valli m, bolzani v, 2019. Natural products: perspectives and challenges for use of brazilian Plant species in the bioeconomy. Anais da academia brasileira de ciências, 91(suppl. 3) E20190208.

Who. World health organization (2014) traditional medicine strategy 2014–2013. Who, geneva.

	
Horta vertical	Trabalhos dos alunos sobre as plantas do Velosinho e Joaquim
	
Livro usados nos trabalhos em Tiradentes	Livros infanto-juvenis Velosinho & Joaquim
	
Kit de experimentos em laboratório	Teste para verificar presença de saponinas
	
Microsublimação da cafeína	Cristais de cafeína observados em lupa manual