



COMPARATIVE EVALUATION BETWEEN EMPIRICAL AND SCIENTIFIC KNOWLEDGE ABOUT THE USE OF MEDICINAL PLANTS AND THEIR COMPOUNDS

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ABSTRACT

Objective: to evaluate the empirical use of medicinal plants for the treatment of bacterial infections, compared to the theoretical-scientific foundations, according to the literature.

Theoretical framework: medicinal plants play a very important role in human history. Through empiricism, many lives were saved and in this process Science evolved, transforming popular knowledge into scientific fact. Resistance of microorganisms, especially bacteria, to conventional drugs is a recurring problem that can be solved with the use of active principles present in vegetables that provide the same environmental pressure as microorganisms and, therefore, may be a viable option.

Method: from a qualitative and quantitative approach, using the interview as a data collection method, the research approached respondents in three municipalities, present in three states (RS, SC and PR) that represent the southern region of the country. The method used is known as snowball sampling, or "snowball". The data obtained were compared with the scientific literature, in order to justify or rectify the information provided by the interviewees.

Results and conclusion: the research on the use of medicinal plants for the treatment of bacterial infections resulted in a large number of species mentioned by the interviewees. These were grouped and statistically analyzed in order to understand the importance they represent for the population of the studied states. In addition, comparing the data from the interviews with the knowledge already discovered by science, it was found that popular and cultural knowledge has a scientific basis and that technology can be used in this area so that alternative treatments can be obtained in the future for the most diverse symptoms and symptoms. human health problems. The analyzes showed that the most mentioned plants throughout the study were: Boldo (*Plectranthus ornatus*), Plantain (*Plantago major*), Malva (*Malva sylvestris* L.) and Macela (*Achyrocline satureioides*).

Research implications: the structure and composition of the work involve a series of issues related to the population, its values, customs and refer directly to the environmental factors that shape and support human life. The social space, in addition to being respected, must constantly evolve and add technology as a facilitator to the essence of knowledge. The expansion of the open science model is essential for these discussions to be expanded and open space for evolution. Brazil is a large country and this makes the logistics of research that cover the entire territory difficult. Thus, partnerships are needed that involve institutions from different states that can support data collection.

Originality/value: this scientific production approached, in an innovative way, relevant facts that can provide a healthy discussion between scientists and the population. The article brings original data, which brings together practical and theoretical research, the universe of popular and scientific knowledge to give evidence to knowledge that is forgotten and goes unnoticed by the academic community. From this debate, there is an attempt to promote

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more research that adds to this publication and increasingly deepens the scientific facts about the therapeutic potential of bioactives. In addition, ancient knowledge, which has transcended generations and still saves lives, needs to be respected and improved so that scientific institutions return values to citizens, in the form of knowledge, as a way to gratify the role that each person has in managing the environment. Social.

Keywords: Empirical Knowledge, Active Principles, Medicinal Plants, Snowball Method.

AVALIAÇÃO COMPARATIVA ENTRE O CONHECIMENTO EMPÍRICO E CIENTÍFICO SOBRE O USO DE PLANTAS MEDICINAIS E SEUS COMPOSTOS

RESUMO

Objetivo: avaliar o uso empírico de plantas medicinais para o tratamento de infecções bacterianas, em comparação com os fundamentos teórico-científicos, de acordo com a literatura.

Estrutura teórica: as plantas medicinais desempenham um papel muito importante na história da humanidade. Através do empirismo, muitas vidas foram salvas e, neste processo, a ciência evoluiu, transformando o conhecimento popular em fato científico. A resistência dos microorganismos, especialmente bactérias, às drogas convencionais é um problema recorrente que pode ser resolvido com o uso de princípios ativos presentes nos vegetais que proporcionam a mesma pressão ambiental que os microorganismos e, portanto, pode ser uma opção viável.

Método: a partir de uma abordagem qualitativa e quantitativa, utilizando a entrevista como método de coleta de dados, a pesquisa se aproximou dos entrevistados em três municípios, presentes em três estados (RS, SC e PR) que representam a região sul do país. O método utilizado é conhecido como amostragem de bola de neve, ou "snowball". Os dados obtidos foram comparados com a literatura científica, a fim de justificar ou retificar as informações fornecidas pelos entrevistados.

Resultados e conclusão: a pesquisa sobre o uso de plantas medicinais para o tratamento de infecções bacterianas resultou em um grande número de espécies mencionadas pelos entrevistados. Estas foram agrupadas e analisadas estatisticamente para compreender a importância que representam para a população dos estados estudados. Além disso, comparando os dados das entrevistas com os conhecimentos já descobertos pela ciência, verificou-se que o conhecimento popular e cultural tem uma base científica e que a tecnologia pode ser utilizada nesta área para que tratamentos alternativos possam ser obtidos no futuro para os mais diversos sintomas e problemas de saúde humana. As análises mostraram que as plantas mais mencionadas ao longo do estudo foram: Boldo (*Plectranthus ornatus*), Plantain (*Plantago major*), Malva (*Malva sylvestris* L.) e Macela (*Achyrocline satureioides*).

Implicações da pesquisa: a estrutura e composição do trabalho envolve uma série de questões relacionadas à população, seus valores, costumes e referem-se diretamente aos fatores ambientais que moldam e sustentam a vida humana. O espaço social, além de ser respeitado, deve evoluir constantemente e acrescentar tecnologia como um facilitador da essência do conhecimento. A expansão do modelo científico aberto é essencial para que estas discussões sejam ampliadas e abram espaço para a evolução. O Brasil é um grande país e isto dificulta a logística da pesquisa que cobre todo o território. Assim, são necessárias parcerias que envolvam instituições de diferentes estados que possam apoiar a coleta de dados.

Originalidade/valor: esta produção científica abordou, de forma inovadora, fatos relevantes que podem proporcionar uma discussão saudável entre os cientistas e a população. O artigo traz dados originais, que reúnem pesquisas práticas e teóricas, o universo do conhecimento popular e científico para dar evidência ao conhecimento que é esquecido e passa despercebido pela comunidade acadêmica. A partir deste debate, há uma tentativa de promover mais pesquisas que se somam a esta publicação e aprofundam cada vez mais os fatos científicos sobre o potencial terapêutico dos bioativos. Além disso, o conhecimento antigo, que transcendeu gerações e ainda salva vidas, precisa ser respeitado e melhorado para que as instituições científicas devolvam valores aos cidadãos, na forma de conhecimento, como forma de gratificar o papel que cada pessoa tem na gestão do meio ambiente. Social.

Palavras-chave: Conhecimento empírico, Princípios ativos, Planos Medicinais, Método Bola de Neve.

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1 INTRODUCTION

The use of medicinal plants in the treatment of diseases is a practice carried out since ancient times by mankind, often being the only form of therapy available to a population (Bourhia; Abdelaziz Shahat; Mohammed Almarfadi; Ali Naser; Mostafa Abdelmageed; Ait Haj Said and Khlil, 2019; Atanasov; Zotchev and Dirsch, 2020).

In chronological terms, plants existed long before mankind, and according to Reid *et al.* (2018), in ancient times, the etiologic agents of disease were unknown to man. Thus, the use of a particular plant was defined by trial and error. This has resulted, at present, in popular knowledge about plants with medicinal use, passed on from generation to generation.

The first records of plants used in medicine go back 5.000 years, found on a Sumerian clay tablet that describes 12 recipes for preparing medicines, referring to more than 250 plants. Even more interesting, it describes plants still commonly used in modern times, such as poppy and mandrake (Petrovska, 2012).

The use of plants in medicine by specific ethnic groups is called ethnobotanical medicine (Farnsworth, 1994). Ethnobotany is classically defined as the science that studies the knowledge and conceptualizations developed by any society regarding the plant world, encompassing both the way the social group classifies plants and the purpose for which they are used (Amorozo, 1996).

In line with the recommendations of the World Health Organization - WHO, in 2006, the National Policy for Integrative and Complementary Practices (PNPIC) in the Brazilian Unified Health System - SUS, was approved in Brazil, contemplating, among others, institutional guidelines and responsibilities for the implementation/adequacy of actions and services of traditional Chinese medicine/acupuncture, homeopathy, medicinal plants, and phytotherapy, besides establishing health observatories for social thermalism/crenotherapy and anthroposophic medicine in the SUS (Brasil, 2012).

Furthermore, the approval of the PNPIC triggered the development of actions and measures for the institutionalization of these practices in the SUS. The National Policy of Medicinal Plants and Herbal Medicines also approved in 2006 by presidential decree, with guidelines and actions for the entire production chain of medicinal plants and herbal medicines, stands out (Brasil, 2012).

Also according to Brasil (2012), medicinal plants and their derivatives are among the main therapeutic resources of traditional medicine and complementary alternative medicine that have long been used by the Brazilian population in their health care, both in Traditional/Popular Medicine and in public programs of phytotherapy in the SUS, and some with more than 20 years of existence. Regarding Integrative and Complementary Practices - PICs, medicinal plants and phytotherapy represent the most present use in the System, according to the diagnosis of the Ministry of Health, and most of the experiences occur in primary health care.

Popular observations on the use and efficacy of medicinal plants contribute in a relevant way to the dissemination of the therapeutic virtues of plants; often prescribed for the medicinal effects they produce (Li and Weng, 2017; Gonçalves and Pasa, 2015).

According to Badke; Budó; Alvim; Zanetti and Heisler. (2012), medicinal plants continue to serve as an alternative health treatment for people, even with the introduction of synthetic drugs. According to Johnson (1998), local knowledge, which comprises a series of empirical observations of the local environment rooted in the past, can be considered an autonomous system of cumulative and dynamic knowledge. Thus, users of medicinal plants around the world maintain the practice of herbal medicine consumption, making valid therapeutic information that has been accumulating for centuries (Da Costa and Da Silva, 2014). This statement is also justified by the low cost and few side effects, which makes herbal



medicines increasingly popular (Silveira; Bandeira and Arrais, 2008). On the other hand, the popular use does not take into account the active principles of each plant.

Brazil is a country rich in biodiversity, and studies related to therapeutic sources must be triggered to have a broader notion of the species that inhabit it. The country has a large and diverse flora, but it is estimated that less than 15% of the species have been studied for use in medicine (Conservation International, 2010).

These surveys become fundamental to the extent that the younger generations, for various reasons, are not getting in touch with this knowledge because they underestimate it and end up always using conventional treatments as a solution to any strange reactions of the body, seen as a disease. In addition, the negative effects of the indiscriminate use of synthetic medicines are widely discussed, including when it comes to antibiotics, a problem that has been increasing the resistance of microorganisms due to this constant environmental pressure. The phenomenon of microbial resistance has drawn the attention of the scientific community to the considerable increase of bacteria that do not respond to conventional treatment, becoming a global public health problem (World Health Organization, 2021).

In this sense, the present study gains support to the extent that it aims to systematically investigate and analyze the popular knowledge about the use of plants and their forms of use to rescue the knowledge about medicinal plants. Furthermore, to generate a comparison of data with the scientific literature, in search of data that confirm or refute the empirical knowledge, demonstrating active principles present in the plants studied that have already been recorded in scientific articles.

According to the National Health Surveillance Agency - ANVISA (2021), an active ingredient can be considered an active chemical substance, pharmaco, drug, or raw material that has pharmacological properties with medicinal purposes, used for diagnosis, relief, or treatment, employed to modify or explore physiological systems or pathological states for the benefit of the person to whom it is administered.

Plants, as well as other organisms, suffer constant changes and acquire resistance, by developing metabolic systems that produce large amounts of specialized metabolites as a way of surviving hostile environments (Weng; Lynch; Matos and Dudareva, 2021). Thus, it is indispensable that this culture of using extracts, essential oils, and teas continues and is strengthened by the scientific community with concrete data that offers support to the general population (Espinoza, 2019).

In order to assess the level of assertiveness of popular knowledge regarding the use of plants for medicinal purposes, the data collected from the interviews were organized, compared and discussed according to the scientific literature. In addition, the purpose of carrying out the research with data from three different states was to understand the relationship of the most used plants for medicinal purposes and whether there is a correlation between their use among the studied places, which have a similar culture and represent the southern region of the state Brazil.

2 METHODOLOGY

The study was conducted in three municipalities, each located in one of the three Southern States (Rio Grande do Sul, Santa Catarina, and Paraná), aiming to observe the dynamics of medicinal plant use according to geographic location, folk knowledge, and types of infectious symptoms.

The research had a qualitative nature to collect data on the knowledge and perceptions of the population about the use of medicinal plants. According to Minayo (2000), the qualitative approach considers the deeper levels of social relations, aiming to understand aspects of the cultural values of communities and representations of their history. In addition, the research also had a quantitative bias to make it possible to develop correlations between the factors



addressed (geographical location, medicinal plants, and symptoms). According to Minayo (1993), it is considered that these two approaches complement each other since there are always metric actions, quantifiable in graphs, tables, and charts, just as there is always a subjective implication in all human actions, requiring a qualitative look.

According to Pasa (2007), it is pertinent to collect information from communities regarding the use of plants, since they have been revalued and, in many cases, are the most accessible way of curing the population's diseases. In addition, it is possible to analyze the data collected and compare them with proven scientific facts, generating reliable data and guaranteeing the population greater safety when using this type of treatment.

Due to the fact that the research group explores the phytochemical potential of plant extracts with bactericidal and bacteriostatic potential, interviews were carried out based on popular knowledge, in order to obtain data to prospect the development of future practices. The interviews took place with open questions, where the questions were presented and the interviewees answered freely and orally, about which plants they used to treat different symptoms related to bacterial infections. In order to write the questionnaire correctly, a consultation was carried out in the Brazilian Pharmacopoeia. According to the symptoms addressed in the work, the answers were computed and the data were later processed, with the help of software.

For each state, the first interviewee was chosen randomly and the others were indicated by the previous interviewee, according to the snowball sampling adopted in this research.

One way to conduct research and fieldwork in communities is the methodological snowball technique, also known as snowball sampling. This technique is a form of non-probability sampling used in social research where the initial participants in a study referred to new participants, who in turn referred to new participants, and so on, until the proposed objective is reached (the "saturation point"). The saturation point is reached when new interviewees start repeating the content already obtained in previous interviews, without adding new information relevant to the research (Atkinson and Flint, 2001).

In all, seventeen people took part in the study. The questions were open, where the interviewees were able to expose their knowledge regarding the use of medicinal plants for treating symptoms and bacterial infections.

The information collected was processed in auxiliary software to make the data processing and plotting more evident, with the help of a direct statistical approach.

Among the species emphasized by the interviewees, analyses were made within the scientific literature of chemical compounds and active principles present in the plants that justified or disapproved the citations regarding the use of plants by the population to treat diseases and symptoms caused by bacterial infections.

3 RESULTS AND DISCUSSION

In total from the interviews, it was observed that 70 different plants were cited for the treatment of 6 factors related to bacterial infections, symptoms, and diseases, these being: Food Intoxication, Diarrhea, Stomach Pain, Urinary Infection, Pneumonia, Intestinal Infection, and Throat Infection. Table 1 represents 70 plants reported in the interviews. The total number of citations for these 70 plants was 236, and some of the plants were cited for more than one symptom by the interviewees. Of these, 4 plants stood out, and together they totaled approximately 25% of the popular citations.



Table 1 - Medicinal plants, defined by their popular names, indicated by the interviewees for the different symptoms addressed in the survey.

	RIO GRANDE DO SUL	SANTA CATARINA	PARANÁ
URINARY INFECTION	Pig's hair tea, holy hawthorn, equisetum, teaweed, mallow, cow's paw tea, walleye, leafflower, parsley, plantain	Corn hair, carqueja (morel bush), caruru tea, chapéu de couro tea, pariparoba, leafflower, elderberry, parsley, cat's claw tea	Aranto, chamomile, mallow, cow's paw tea, leafflower, parsley, plantain, cat's claw tea
FOOD INTOXICATION	Artichoke, burdock, boldo, chamomile, holy hawthorn, carqueja (morel bush), Winter's cinnamon, boldo, ginger, lemon, anthemis, cinchona, parsley	Artichoke, arnica, burdock, boldo, caledonia tea, carqueja (morel bush), fennel, gervao, bitterwood, chinchona, cat's claw tea	Boldo, camphor, anthemis
PNEUMONIA	Watercress, garlic, angico, arnica, maidenhair, babosa, banana tree, chamomile, guaco, pariparoba, pulmonaria, elderberry, plantain	Garlic, angico, burdock, marigold, catuaba, guaco, mint, lemon, papaya	Banana tree, caraguata, echinacea, garlic
DIARRHEA AND STOMACH PAIN	Ariticum, potato, boldo, chamomile, lemongrass, carqueja (morel bush), thousand-man vine, fennel, guava, jaboticaba, lemon, snake apple, anthemis, bitterwood, red Brazilian berry, pomegranate	Boldo, carqueja, Catuaba, copaiba, cabbage, holy hawthorn, gabirola, guava, jaboticaba, daisy, pariparoba, bitterwood, red Brazilian berry, santos filho tea, cat's claw tea	Boldo, prickly pear, holy hawthorn, gervao, guava, anheim, red Brazilian berry
INTESTINAL INFECTION	Anise, araçá, chamomile, cinnamon, thousand-man vine, fennel, guava, jaboticaba, red Brazilian berry, pomegranate	Artichoke, mulberry, marigold, chamomile, carqueja (morel bush), gabirola, gervao, mint, anthemis, papaya, walleye, chinchona, ambrosioides, agripalma tea, plantain, taruma tea	Guava, wormseed, red Brazilian berry
THROAT INFECTION	Mulberry, ginger, lemon, anthemis, mallow, pomegranate, salvia, plantain	Beterraba, capuchinha, ginger, gervao, lemon, mallow, plantain, cat's claw tea	Echinacea, mallow, plantain

Source: Prepared by the author, 2021.

The scientific literature reports data confirming the use of Boldo, Plantain, Mallow, and Anthemis as bactericidal and bacteriostatic agents (Araújo; Alves; Pinto; Oliveira; Siqueira; Ribeiro and Lima, 2014; Bacilio-Amaranto, 2019; Razavi; Zarrini; Molavi and Ghasemi, 2011; Maciel 2017, Joray; del Rollán; Ruiz; Palacios and Carpinella, 2011). These data can be observed as per the references arranged after Figure 1. In the case of popular understanding, as depicted in Figure 1, there is great relevance of these plants, considering the high amount of 57 times (approximately 25%) that they were cited during the interviews.

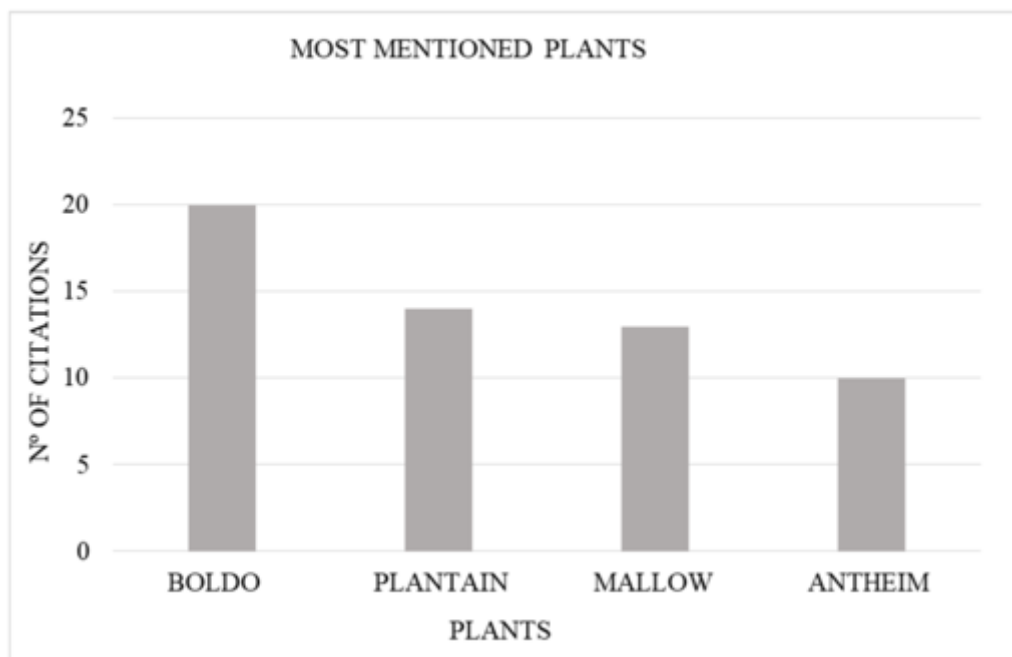


Figure 1 - Plants that received the most emphasis and were most cited for different uses by the interviewees. * Boldo - *Plectranthus ornatus*; *Plantain - *Plantago major*; *Mallow - *Malva sylvestris*; * Anthem - *Achyrocline satureoides*.
Source: Prepared by the author, 2021.

The most cited plant for the same disease was the boldo (*Plectranthus ornatus*). Boldo stands out for being the most commonly used plant for therapeutic purposes, traditionally used as an analgesic and appetite stimulant and mainly in cases of liver and stomach disorders (Do Carmo e Nascimento, 2003). Thus, it is justified, as observed in Table 1, that its use was restricted to Food Intoxication, Diarrhea, and Stomach Pains.

Among the symptoms of Food Intoxication, Diarrhea and Stomach Pain, Urinary Infection, Pneumonia, Intestinal Infection, and Throat Infection, the plants were mentioned in such a way that some were indicated for the treatment of more than one type of symptom.

The plants that presented the greatest variation in their purpose were *P. major* and *A. satureoides*, each one being related to 4 types of symptoms, with a symptom x plant relationship between them in 50% of these citations.

The symptom that presented the greatest variability of options for treatment among the plants emphasized in this study was Throat Infection, where *P. major*, *M. sylvestris*, and *A. satureoides* were indicated.

Table 2 shows the most commonly cited plants for treating the different types of symptoms/infections caused by bacteria.

Table 2 - Symptoms/Diseases x Plants. The popular use of the 4 most indicated plants.

Symptoms/Diseases	<i>Plectranthus ornatus</i>	<i>Plantago major</i>	<i>Malva sylvestris</i>	<i>Achyrocline satureoides</i>
Urinary Infection		X	X	
Food Intoxication	X			X
Pneumonia		X		
Diarrhea and stomach pain	X			X
Intestinal infection		X		X
Throat infection		X	X	X

Source: Prepared by the author, 2021.



The leaves of *P. ornatos* contain substances that exhibit analgesic activity, causing no side effects. Mild sedative, bactericidal and fungicidal activity has also been observed (Mauro; Silva; Missima; Ohnuki; Rinaldi and Frota, 2008). Compounds found in this plant inhibited bacterial growth of *Bacillus cereus*, *Streptococcus pyogenes*, and *Enterococcus faecalis*.

According to Nascimento; Albuquerque; Oliveira; Pizziolo; Brasileiro; Diaz and Diaz, (2017), the active extracts of *P. ornatos* can inhibit biofilm formation. Using dichloromethane extracts, there was approximately 100% inhibition of biofilms formed by four ATCCs of *Staphylococcus aureus*.

P. major is a herbaceous perennial plant with unbranched underground stems and is widely marketed for its anti-inflammatory, antibacterial, astringent, anti-hemorrhagic, and healing properties (Bacilio-Amaranto, 2019; Rodríguez, 2014; Blanco, 2008).

In addition, it has several active ingredients, such as mucilage, pectin, flavonoids, tannins, an iridoid chromogenic glycoside called aucubin, catalpol, acteroside, plantamajoside, baicalein, allantoin, hispidulin, ursolic acid and oleanolic acid, salicylic acid, and mineral salts of potassium and zinc (Blanco, 2008; Tlili, 2021).

Malva sylvestris has antimicrobial activity against several bacterial and fungal species. The disc diffusion method showed the antimicrobial effect of *M. sylvestris* extracts (Cheng; Wang, 2006). De Souza; Haas; Von Poser; Schapoval and Elisabetsky, (2004), studied the antimicrobial activity of *M. sylvestris* aerial extracts against *C. Albicans*, *S. aureus*, *M. luteus*, *Bacillus subtilis*, *S. epidermidis*, *E. coli* e *S. cerevisiae*. The study reported that ethanolic extracts of *M. sylvestris* were active against *P. aeruginosa*, *B. subtilis*, and *E. coli*, while the methanol extracts showed activity only against *S. cerevisiae*.

In a study conducted by Razavi; Zarrini; Molavi and Ghasemi, (2011), it was found that the methanolic extract of *M. sylvestris* inhibited the growth of *Escherichia coli* and *Staphylococcus aureus*. At the same time in that study, the methanolic extract of *M. sylvestris* inhibited the growth of *Escherichia coli* e *Staphylococcus aureus*.

Extracts of *Achyrocline satureioides* showed antimicrobial activity against several standard Gram-positive bacteria (Wiest; Carvalho; Avancini and Gonçalves, 2009; Mota; Carvalho and Wiest, 2011; Joray *et al.*, 2011).

Moreira, (2021), showed inhibitory results in *Staphylococcus aureus* methicillin-resistant (MRSA). In the case of Gram-negative bacteria, Da Rocha Sperotto; Murari; da Silva; Possenti; Wiest and Avancini, (2012) about *Escherichia coli*, *Klebsiella sp.* and *Pseudomonas aeruginosa* isolated in mastitis.

According to Maciel (2017), in research on *Salmonella spp.* the extract inactivated all antibiotic-resistant strains isolated in animal products (swine and poultry).

It was found that, among the plant families discussed in this study, the one with the largest number of individuals was the *Asteraceae*, with 11 plants reported in the interviews (Chart 2). According to Cronquist (1988), the evolutionary success of the *Asteraceae* can be attributed in part to the development of a chemical defense system that includes the combined production of secondary compounds such as *polyacetylenes* and *sesquiterpene lactones*. The latter has a broad spectrum of biological activity (Macías, 1992), thus justifying their wide use in folk medicine.

The 4 plants (*P. ornatos*, *P. major*, *M. sylvestris*, and *A. satureioides*) that received greater emphasis from the interviewees belong to the families shown in Figure 2. These families represented a sum total of 41.10% of the total population reported by respondents in the survey.

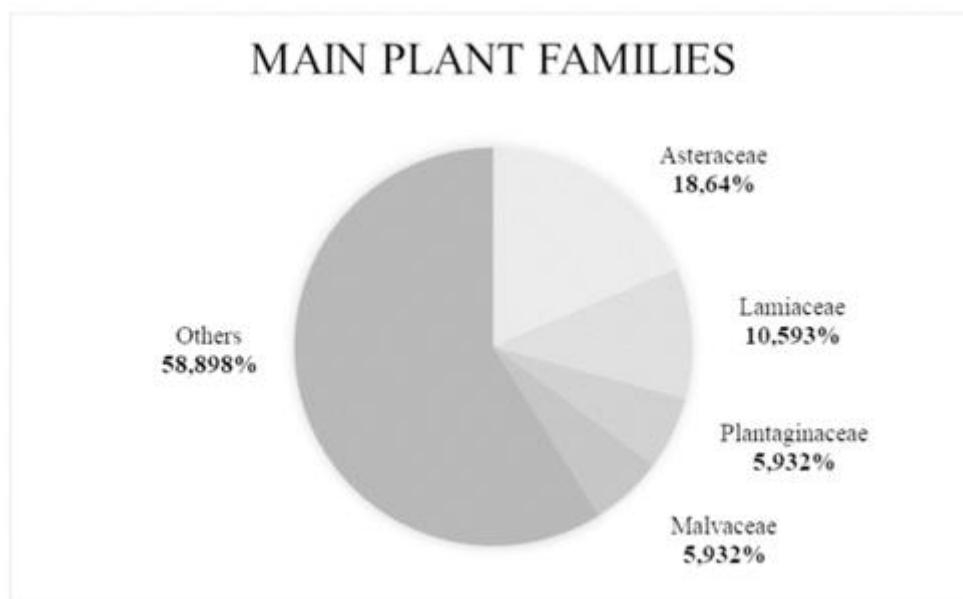


Figure 2 - Plant families that received the highest number of citations in the study.

Source: Prepared by the author, 2021.

The plants emphasized in this study present an extensive quantity of chemical compounds. Many of them are repeated, appearing in more than one species; in other cases there is also a variety of compounds, demonstrating the particularity of each organism.

Table 3 - Main plants mentioned in the interviews, followed by their main chemical compositions and active ingredients.

PLANT	CHEMICAL COMPOUNDS	REFERENCES
<i>Plectranthus ornatus</i>	Flavonoids, tannins, coumarins, boldine, isoboldine, laurotetanine, lauroitsine, eucalyptol, cineol, ascaridol, p-cymene, linalool, eugenol, terpineol, ramnetol, isoramnetol.	(Vilar, 2019); (Grandi, 2014); (Farmacópeia Brasileira, 2019)
<i>Plantago major</i>	Mucilages, glucides, tannins, essential oils, mineral salts, and sulfur. Organic acids: chlorogenic and ursolic. Silicic acid, glycosides, alkaloids, resins, choline, vitamin C, and potassium salts.	(Grandi, 2014); (Garlet, 2019);
<i>Malva sylvestris</i>	Mucilages, vitamins A, B1, B2, C, and carotenes, essential oils (oleic, palmitic, and stearic acids), coumarinic, chlorogenic, and caffeic acids, flavonoids, and tannins.	(Vilar, 2019); (Grandi, 2014); (Farmacópeia Brasileira, 2019).
<i>Achyrocline satureioides</i>	Flavonoids, calerianin esters, caffeic acid, protocathechuic acid, essential oil, and triterpenic saponins.	(Vilar, 2019); (Grandi, 2014); (Garlet, 2019); (Farmacópeia Brasileira, 2019).

Source: Prepared by the author, 2021.

Table 4 - Active principles, their purposes, and main uses, according to the scientific literature.

ACTIVE INGREDIENT	DESCRIPTION	REFERENCES
Organic Acids	It has important functions in the plant's primary metabolism such as photosynthesis and respiration. The most common are malic, citric, tartaric, and oxalic acids. They are widely used in foods to prevent colonization by microorganisms.	(Garlet, 2019); (Alves <i>et al.</i> 2021); (Henrichs, 2017)
Alkaloids	They act on the central nervous system as a tranquilizer, sedative, stimulant, analgesic, and anesthetic. Some can be toxic or carcinogenic, and some, in turn, antitumor.	(Garlet, 2019); (Ventura <i>et al.</i> 2016)
Phenols	For some phenolic acid derivatives (such as chlorogenic acid, caffeic acid, and ferulic acid), antioxidant activity has	(Garlet, 2019); (Ventura <i>et al.</i> 2016)



	been reported. They also have antibacterial and antiviral activity.	
Coumarins	They exhibit bronchodilating, antimycobacterial, anticoagulant, vasodilating, spasmolytic, and antithrombotic activity. Some coumarins can sensitize the skin under the action of the sun's ultraviolet rays and cause skin burns, as in Citrus species.	(Garlet, 2019); (Franco <i>et al.</i> 2021); (Hussain; Qamar Abbas; Reigosa, 2018)
Flavonoids	The main biological activities are anti-inflammatory, antiviral (strengthens capillary vessels), antisclerosis, antiedematous, antispasmodic, antioxidant, antiviral, antimicrobial, antifungal, antitumor, anti-hepatotoxic, choleretic, diuretic, and hormonal.	(Garlet, 2019); (Barbieri <i>et al.</i> 2017); (Ventura <i>et al.</i> 2016); (Rodrigues <i>et al.</i> 2016)
Mucilages	They are derived from the oxidation of sugars and can be precipitated in alcoholic solvents. They decrease local irritation of the skin and mucous membranes by covering them with a protective layer.	(Garlet, 2019); (De Prado, 2018); (Araújo, 2012); (De Menezes Filho <i>et al.</i> 2020).
Saponins	Glycosides of steroids or triterpenes. They have detergent, healing, hypocholesterolemic, mild laxative, diuretic, expectorant properties, and improved blood circulation.	(Garlet, 2019);
Tannins	They serve to ease diarrhea, due to the formation of a protective layer with the precipitated proteins. They also act as antimicrobial, antiviral, hypoglycemic, and antispasmodic agents.	(Garlet, 2019); (Simões <i>et al.</i> 2017); (Araújo, 2012); (De Menezes Filho <i>et al.</i> 2020).
Terpenes	The monoterpenes and sesquiterpenes are commonly found in essential oils; the triterpenes, linked to sugars, form the triterpene saponins; the tetraterpenes form the carotenes, precursors of vitamin A.	(Garlet, 2019); (barbieri <i>et al.</i> 2017).
Essential Oils	They have antimicrobial, anti-inflammatory, analgesic, antispasmodic, eupeptic, carminative, cicatrizant, expectorant, relaxing, and vermifuge properties, among others.	(Garlet, 2019); (Alves <i>et al.</i> 2021).

Source: Prepared by the author, 2021.

Some of the chemical compounds mentioned in Table 3, and discussed in Table 4, are active principles in the antibacterial and anti-inflammatory action. Besides having vitamins and minerals that are important for the maintenance of human health, the plants cited have scientific support concerning their positive effect in the treatment of symptoms and diseases discussed in this work, thus justifying their popular use.

Among these chemical compounds, flavonoids, tannins, and coumarins can be highlighted, and the antimicrobial action exerted by flavonoids has been proven by research that reveals efficacy thorough knowledge of the chemical structures present in this compound that have antibacterial activity (Ventura; Jesus; de Souza Nogueira and Galdos-Riveros, 2016).

Tannins are phenolic compounds found in various parts of plants in which their antimicrobial properties present in most foods of plant origin have been reported acting affecting bacterial and viral growth in several ways such as the inhibition of extracellular enzymes and oxidative phosphorylation (Simões; Schenkel; de Mello; Mentz and Petrovick, 2016).

Zuo; Wang; Han; Li and Wang, (2016), evaluated the in vitro antibacterial activities of four natural coumarins that showed different degrees of synergism with a total of eight conventional antibacterial agents and against ten clinical strains of MRSA (Methylcycline Resistant *Staphylococcus aureus*). Coumarins showed high potentiating effects of antibacterial agents against multi-drug resistant *Staphylococcus aureus*.



Other compounds that can be listed are organic acids, which act as antibacterials and modulators of the intestinal microbiota. In addition, they can be used as food preservatives, energy sources, enhancers of mineral and nutrient utilization, stimulators of endogenous enzyme secretion and intestinal development, antioxidants, anti-inflammatory and palatability enhancers (this promotes feed intake), with subsequent results in the improvement of digestibility, feed conversion and nutrient metabolism (Papatsiros; Christodouloupoulos and Filippopoulos, 2012; Dhifi; Bellili; Jazi; Bahloul and Mnif, 2016; Chouhan; Sharma; Guleria, 2017; Long; Xu; Pan; Wang; Wang; Wu and Piao, 2018; Omonijo; Ni; Gong; Wang; Lahaye and Yang, 2018; Simitzis, 2017).

In addition, mucilages, tannins, coumarins essential oils, perform different pharmacological activities such as anti-inflammatory, bronchodilator, expectorant, analgesic, and antipyretic (Araújo, 2012; De Menezes Filho; de Sousa; de Sousa and de Souza Castro, 2020).

Regarding the biological activity of the essential oil components, Jurgens *et al.* (2011) reported that 1,8-cineole showed anti-inflammatory activity, being a strong inhibitor of TNF- α and IL-1 β , while Estanislau; Barros; Peña; Santos; Ferri and Paula, (2001) concluded that eucalyptol was responsible for the antiseptic activity.

For a long time, plants were considered harmless due to the absence of studies on their side effects or toxicity. Even if there is a naturalistic view on the subject, caution is needed when using species considered medicinal, since many of these have a great teratogenic and abortifacient potential when used in the gestational period (Oliveira and Aires, 2016). According to Duarte; da Costa Martins; Miguel and Miguel, (2018), data on the teratogenic and embryotoxic effects of plants are scarce and often contradictory.

In addition, the low cost and easy access to plant material are also associated with the use by much of the population, especially those with lower purchasing power (Goril; Jacomassi; Junior; Dalsenter; Junior and Lourenço, 2016).

The use of medicinal plants can present a risk of adverse effects, toxicity, and even interactions with synthetic drugs, and their administration can show more risks than benefits (Pedroso, 2021). However, its use is traditional and is part of the empirical culture to counter infectious symptoms caused by bacteria, being, as mentioned earlier, indicated by official bodies as integrative and complementary practices. Thus, the research must seek to inform with a higher level of certainty which plants are indicated and for which use, remaining to be clearly defined which would be the main forms of preparation and dosages.

3 FINAL CONSIDERATIONS

It was inherent to the course of the interviews to see how closely the plants mentioned are connected to the people and their customs. From the data processing it was observed that despite the geographical distance, there is no significant difference in the plant species used for the symptoms researched, demonstrating that, even empirically, the active ingredients are used for the same infections.

The most cited plant family was the *Asteraceae*, which is confirmed by the literature due to a large number of species present and their ability to adapt selectively. Therefore, many of these species are used to combat bacteria or symptoms of toxicity.

The plants discussed in this paper with greater emphasis have scientific support for medicinal use in the treatment of diseases and symptoms caused by bacterial infections. However, it is necessary to be cautious and seek professional help to evaluate in which situations the plants can be adopted as a safe treatment, as reported in the discussions.

Furthermore, considering that Brazil is a large country, there are logistical limitations to develop this method. However, it is intended to replicate the method for the other states and



make a correlation between the different regions (South, Southeast, Midwest, Northeast and North).

As a way to facilitate future research, it is recommended to use some means of carrying out these researches online or to establish partnerships with other researchers and universities in other regions of the country, so that logistics costs are reduced.

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