Journal of Medicinal Plants Studies
www.PlantsJournal.com

ISSN (E): 2320-3862
ISSN (P): 2394-0530
www.plantsjournal.com
JMPS 2024; 12(4): 407-413

Received: 06-07-2024
Accepted: 05-08-2024

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Quality of medicinal plants extracts sold in the city of Goiânia, Goiás, Brazil

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DOI: https://doi.org/10.22271/plants.2024.v12.i4e.1734

Abstract
Quality control of herbal medicines is essential to ensure treatments' efficacy and safety. Therefore, this study evaluated 64 samples of dried and crushed extracts of *Cymbopogon citratus*, *Equisetum arvense*, *Matricaria chamomilla*, *Maytenus ilicifolia*, *Mentha piperita*, *Pimpinella anisum*, *Rosmarinus officinalis* and *Salvia officinalis*, sold as tea in their original packaging from commercial establishments in the city of Goiânia, Goiás, Brazil, between July and December 2023. Label and package insert, authenticity, purity, heavy metals, minerals, and microbiological analyses were carried out according to official national and international regulations, revealing disparities in labels and package inserts, low approval rates for authenticity and purity, variability in potassium, iron, zinc, and lead concentrations, with some exceeding safe levels and presenting microbiological contamination (p<0.05). Stringent sanitary control according to pharmacopeial and scientific standards is needed to ensure safety and efficacy in the use of medicinal plants.

Keywords: Quality control, Phytotherapeutics, Tea extracts, Goiânia, Goiás, Brazil

Introduction
Mediterranean shrubs called capers are prized for their salt and vinegar-pickled fruits and delicious flower buds. This species is a good candidate for domestication to sustain and improve agriculture in places susceptible to significant climate change and severely affected by drought since it possesses great adaptations to regions experiencing climate swings [1, 2].
Plants have played a crucial role in human health since the dawn of civilization, being used as the basis to produce herbal medicines that act in the prevention and prophylaxis of various diseases [1]. Studies show that the use of plants with therapeutic properties is an ancestral practice, documented in various cultures throughout history, highlighting their value in health maintenance and disease treatment [2-4]. Herbal medicine is an effective and safe alternative to many synthetic drugs, especially in the context of preventing chronic and degenerative diseases [5]. This preventive action of herbal medicines is attributed to the presence of bioactive compounds, such as flavonoids, alkaloids, and terpenes, which possess various biological properties [6].
The quality control of herbal medicines is essential to ensure treatments' efficacy and safety based on medicinal plants [7]. The lack of standardization in the acquisition, handling, and commercialization of these products can result in significant variations in the concentration of active compounds, increasing the risk of toxic, adverse, and side effects. Studies indicate that the absence of rigorous standards can lead to contamination by microorganisms, heavy metals, or adulteration with other substances, compromising consumer safety [8, 9]. Additionally, the natural variability of plants, influenced by factors such as climate, soil, and cultivation methods, can alter the phytochemical profile of herbal medicines, resulting in therapeutic inconsistencies [10]. Thus, establishing robust quality control protocols, including precise botanical identification, quantification of active principles, and conducting purity and potency tests, is essential to minimize the risks associated with the use of medicinal plants and ensure that therapeutic benefits are achieved safely and effectively [11, 12].
The regulation of the production and commercialization of herbal drugs in Brazil is governed by a robust regulatory framework, which includes the Brazilian Pharmacopoeia, 6th edition [13], and resolutions from the Brazilian Health Regulatory Agency (ANVISA).

Such as RDC No. 14 of March 31, 2010 [14] and RDC No. 13 of March 14, 2013 [15]. The Brazilian Pharmacopoeia establishes quality standards for herbal drugs, covering analytical methods and technical specifications necessary to ensure the efficacy, safety, and quality of the products. RDC No. 14/2010 defines the requirements for registering herbal medicines and herbal drugs, including the obligation to prove the safety and efficacy of the products, as well as specific criteria for quality control, such as standardization of extracts and identification of active substances. Complementarily, RDC No. 13/2013 regulates the notification of herbal drugs, simplifying the procedures for regularizing traditional products, as long as they follow established safety and quality parameters. This set of regulations aims to ensure that herbal drugs marketed in the country meet international quality standards, promoting public health protection and the competitiveness of the national industry.

In Brazilian commerce, and specifically in Goiás, it is common to market *Cymbopogon citratus* (Poaceae), popularly known as Lemongrass, primarily used for its calming and digestive properties [16]; *Equisetum arvense* (Equisetaceae), or Horsetail, valued for its diuretic and anti-inflammatory properties [17]; *Matricaria chamomilla* (Asteraceae), known as Chamomile, widely used as a sedative and anti-inflammatory [18]; *Maytenus ilicifolia* (Celastraceae), popularly called Espinheira-santa, employed in the treatment of gastric ulcers [5]; *Mentha piperita* (Lamiaceae), or Peppermint, recognized for its carminative and antispasmodic effects [19]; *Pimpinella anisum* (Apiaceae), Fennel, used to relieve digestive and respiratory symptoms [20]; *Rosmarinus officinalis* (Lamiaceae), known as Rosemary, used for its stimulating and antioxidant properties [21]; and *Salvia officinalis* (Lamiaceae), or Sage, valued for its anti-inflammatory and antioxidant actions [22]. In this context, this work aimed to evaluate the quality of these medicinal plants sold in the city of Goiânia, Goiás, Brazil.

Methodology

Sampling

This qualitative laboratory research analyzed 64 samples of dried and crushed extracts of Lemongrass (*Cymbopogon citratus*), Horsetail (*Equisetum arvense*), Chamomile (*Matricaria chamomilla*), Espinheira-santa (*Maytenus ilicifolia*), Peppermint (*Mentha piperita*), Fennel (*Pimpinella anisum*), Rosemary (*Rosmarinus officinalis*) and Sage (*Salvia officinalis*), purchased as tea in their original packaging from commercial establishments in the city of Goiânia, Goiás, Brazil, between July and December 2023. Experiments were performed at the Laboratory of Pharmacotechnics and Pharmaceutical Technology from the Centro Universitário Alves Faria (UNIALFA) and at the Microbiology Laboratory from the State University of Goiás (UEG - UnU Itumbiara). Tests were conducted in triplicate, and all analyses and drug reference standards were carried out according to the recommendations of Brazilian Pharmacopoeia, 6th edition [13], the Brazilian Society of Pharmacognosy (2020) [23] and other Brazilian national regulations.

Label and Package Insert Analyses

In accordance with the recommendations of national regulations RDC No 10 of March 9, 2010 [24], RDC No. 14 of March 31, 2010 [14] and RDC No. 13 of March 14, 2013 [15], all 64 acquired samples were subjected to label and package insert analysis, as well as average weight verification.

Authenticity and Purity

The evaluation of sample authenticity and purity tests, including moisture content, foreign elements, organoleptic characteristics, total ash, and acid-insoluble ash, were conducted according to official methodology [13].

Identification of Heavy Metals and Minerals

For the analysis of the occurrence and identification of heavy metals and minerals such as lead, potassium, iron, and zinc, samples were digested in an acidic medium (nitric acid) and diluted in a 50 mL volumetric flask. Subsequently, ions were quantitatively determined by atomic absorption spectrophotometry and flame photometry. Results were then compared to the values of the daily recommended and tolerated intakes by the World Health Organization (WHO) [25] and the Recommended Dietary Allowances (RDA) [26].

Microbiological Analyses

For the investigation and numerical determination of total and fecal coliforms, the counting of filamentous fungi and yeasts, *Escherichia coli*, *Salmonella sp*. and *Staphylococcus sp*., procedures followed the guidelines of the official pharmacopoeial compendium [13] and specific regulations [14, 24].

Statistical analysis

Statistical evaluations were carried out using the Windows platform of GraphPad Prism 5.01 software. Comparative data analysis was executed through one-way ANOVA, followed by post-hoc tests, with statistical significance established at $p<0.05$.

Results and Discussion

For the evaluation of medicinal plants sold in the city of Goiânia, Goiás, Brazil, in 2023, eight samples of each species (*Cymbopogon citratus*, *Equisetum arvense*, *Matricaria chamomilla*, *Maytenus ilicifolia*, *Mentha piperita*, *Pimpinella anisum*, *Rosmarinus officinalis*, and *Salvia officinalis*) were acquired. Initially, analyses of the labels and packages insert were conducted (Table 1).

The analysis reveals a significant disparity in meeting the regulatory requirements from RDC No. 10 of March 9, 2010 [24], and RDC No. 14 of March 31, 2010 [10]. Of the 64 products evaluated, 100% displayed the trade name, the CNPJ number, and the identification of the responsible pharmacist, indicating full adherence to these criteria. However, only 45.31% of the labels included the description of the active ingredient, which represents a critical failure in communicating essential product components to the consumer.

Only 17.18% of the products displayed the registration number with the Brazilian Health Regulatory Agency (ANVISA), a vital piece of information for ensuring legal compliance and product safety. The absence of such information may undermine consumer confidence and product traceability. Therapeutic indications and information on dosage and risks were present in only 21.87% and 14.06% of the products, respectively, suggesting a potential public health risk, as this information is crucial for the safe use of medicinal plants.

Proper storage conditions were indicated in 62.5% of the products, and 75% provided information on the part of the plant used, demonstrating a greater commitment to quality and the preservation of plants therapeutic properties.

Table 1: Frequency of the required data on labels and packages insert of medicinal plants sold in the city of Goiânia, Goiás, Brazil, from July to December 2023, according to RDC No. 10 of March 9, 2010, and RDC No. 14 of March 31, 2010. **P*<0.05. One-way ANOVA and Bonferroni post-tests.

	N	%
Trade name	64	100
Active ingredient description	29	45.31
Brazilian Health Regulatory Agency (ANVISA) registration number	11	17.18
Brazilian Business Register Number (CNPJ)	64	100
Responsible Pharmacist and number at the Regional Pharmacy Council	64	100
Batch, expiration date and manufacturing date	64	100
Weight or volume	64	100
Therapeutic indication	14	21.87
Dosage and risks	9	14.06
Adverse reactions and/or contraindications	9	14.06
Conservation care	40	62.5
Part of the plant used	48	75
Pharmaceutical form and route of administration	40	62.5
Presence of the package insert	-	-
Complete package insert	-	-

However, the absence of complete or any package inserts is alarming, indicating a serious failure in communicating the necessary information for the safe use of the products. Statistical analyses indicate significant differences ($p<0.05$) in the frequency of regulatory information provided, highlighting the need for stricter oversight to ensure compliance with established standards.

Braghini *et al*. (2015) [27] analyzed 56 samples of medicinal plants sold by pharmacies and independent vendors in Maringá - PR, verifying that 40 of these samples included the commercial name, laboratory information (name, address, CNPJ), the responsible pharmacist with registration in the professional council, batch number, expiration and manufacturing date, weight, and the botanical nomenclature of the products, indicating progress in complying with Brazilian regulations. On the other hand, Narita *et al*. (2003) [28] found in their study that only 48.9% of the analyzed samples had the responsible pharmacist and 93.6% the botanical nomenclature on the labels of medicinal plants. Similarly, Copetti *et al*. (2005) [29] reported the presence of botanical nomenclature in only 84% of the samples analyzed.

The analysis of the authenticity and purity of medicinal plants regarding moisture content, foreign elements, organoleptic characteristics, total ash, and acid-insoluble ash, revealed varied results (**p*<0.05) in relation to compliance with the standards established by the Brazilian Pharmacopoeia, 6th edition (Table 2). Of the 64 samples evaluated, only 28 were approved. Regarding *Cymbopogon citratus*, it was observed that of the eight samples analyzed, only four were approved, with samples from establishments 1, 3, 7, and 8 meeting the criteria of authenticity and purity. These results suggest significant variability in the quality of this medicinal plant among different suppliers. In relation to *Equisetum arvense*, five of the eight samples were approved, highlighting establishments 3, 4, 5, 7, and 8 as compliant with Pharmacopoeia standards. Comparatively, this species showed better overall performance in terms of approval, indicating possible greater uniformity in quality control among suppliers of this specific plant.

Table 2. Authenticity and purity of medicinal plants sold in the city of Goiânia, Goiás, Brazil, from July to December 2023, according to the Brazilian Pharmacopoeia, 6th Edition. **p*<0.05. One-way ANOVA and Bonferroni post-tests.

Medicinal Plants	Samples approved for each commercial establishment *							
	1	2	3	4	5	6	7	8
Cymbopogon citratus	•		•				•	•
Equisetum arvense			•	•	•		•	
Matricaria chamomilla	•	•	•	•			•	
Maytenus ilicifolia			•		•			
Mentha piperita			•	•		•		•
Pimpinella anisum		•					•	•
Rosmarinus officinalis			•		•			
Salvia officinalis	•		•		•	•		

Matricaria chamomilla showed one of the highest approval rates, with six of the eight samples meeting the established criteria, from establishments 1, 2, 3, 4, 7, and 8. This high compliance rate suggests greater homogeneity in product quality across different points of sale. This pattern may indicate that this medicinal plant has a more standardized production and commercialization process, minimizing variabilities that could compromise its authenticity and purity. On the other hand, plants such as *Maytenus ilicifolia* and *Rosmarinus officinalis* showed lower performance, with only two of the eight samples being approved for each species. These results, obtained from establishments 3 and 7 for *Maytenus ilicifolia* and from establishments 4 and 7 for *Rosmarinus officinalis*, raise concerns about the consistency of quality and compliance with regulatory standards.

The analysis of *Mentha piperita* and *Pimpinella anisum* revealed mixed results. *Mentha piperita* was approved in five establishments (3, 4, 5, 7, and 8), while *Pimpinella anisum* was approved in only three (4, 7, and 8). Although there is some variation in quality among suppliers, these data suggest that some establishments manage to maintain a higher quality standard compared to the others.

In the case of *Rosmarinus officinalis*, out of the eight establishments evaluated, only two samples were approved,

coming from establishments 4 and 7. This result, representing a 25% approval rate, indicates a low compliance of this medicinal plant with the required authenticity and purity criteria. The disparity in quality among the establishments suggests a lack of standardization in production and quality control processes. In contrast, *Salvia officinalis* showed better performance, with four out of the eight samples approved, representing a 50% approval rate. The approved samples came from establishments 1, 3, 5, and 7, demonstrating greater uniformity in the quality of this medicinal plant compared to *Rosmarinus officinalis*. This difference in approval rates between the two plants may be attributed to factors such as agricultural practices, processing methods, or differences in market demand that influence quality control. The implementation of stricter standards and continuous oversight is essential to ensure that medicinal plants consistently meet the authenticity and purity standards, guaranteeing the efficacy and safety of the products offered to consumers.

The detailed analysis for the 36 failed medicinal plant samples revealed concerning rates (P<0.05), based on the parameters established by the 6th edition of the Brazilian Pharmacopoeia [13] (Table 3). The total ash parameter was the most prevalent, with 83.33% of the samples (N=30) showing values outside acceptable standards. Next, acid-insoluble ash also stood out, with 80.55% (N=29) of the samples failing, suggesting a significant correlation between these two parameters, possibly due to contamination by non-volatile materials. The presence of foreign organic matter and dirt was identified in 69.44% of the samples (N=25), emerging as one of the main causes of failure, followed by macroscopic differences, present in 47.22% of the samples (N=17). The organoleptic characteristics and moisture content, at 36.11% (N=13) and 22.22% (N=8), respectively, were less frequent but no less relevant. Data comparison suggest that contamination and adulteration are the main contributing factors to sample failure, highlighting the need for significant improvements in the collection, storage, and handling processes of medicinal plants in the region. This detailed analysis underscores the importance of strict quality control to ensure the safety and efficacy of medicinal plants available in the goiano market.

Table 3: The main causes for failure of medicinal plants sold in the city of Goiânia, Goiás, Brazil, from July to December 2023, according to the Brazilian Pharmacopoeia, 6th edition. *p<0.05. One-way ANOVA and Bonferroni post-hoc tests.

Parameters	N=36 *	
	N	%
Foreign organic matter and dirt	25	69.44
Macroscopic differences	17	47.22
Moisture content	8	22.22
Organoleptic characteristics	13	36.11
Total ash	30	83.33
Acid-insoluble ash	29	80.55

Another crucial aspect in the composition, plant metabolism, and consequent therapeutic efficacy of these plants is the presence of minerals in the soil, which are absorbed by the plants [30]. Therefore, the risk of contamination through the absorption of micro and macronutrients by plants makes it increasingly essential to conduct analyses that detect the presence of ions such as potassium, iron, zinc, and even heavy metals like lead [31]. Minerals such as potassium, iron, and zinc play vital roles in various functions of the human body but can be harmful in elevated concentrations. Lead, on the other hand, is a toxic metal regardless of concentration, offering no biological benefit and posing risks both to the medicinal plant, affecting its quality and metabolite composition, and to humans, potentially causing serious health damage [32, 33].

Data from different medicinal plants sold in the city of Goiânia reveals significant information about the presence of minerals and heavy metals (Table 4). The concentrations of potassium, iron, zinc, and lead were measured in mg/mL, and results show notable variations among the studied species (p<0.05). *Cymbopogon citratus* had the highest concentration of potassium (6.18 mg/mL), followed by *Equisetum arvense* (2.64 mg/mL) and *Mentha piperita* (3.24 mg/mL), while *Matricaria chamomilla* had the lowest concentration (0.9 mg/mL). Regarding iron, *Matricaria chamomilla* stood out with the highest concentration (1.4 mg/mL), while *Maytenus ilicifolia* showed the lowest (0.3 mg/mL). For zinc, *Cymbopogon citratus* also showed the highest concentration (1.21 mg/mL), while *Rosmarinus officinalis* had the lowest (0.05 mg/mL). Lead levels were concerning, with *Matricaria chamomilla* presenting 1 mg/mL, which may indicate contamination or environmental accumulation.

Table 4. Occurrence and identification of heavy metals and minerals at medicinal plants sold in the city of Goiânia, Goiás, Brazil, from July to December 2023, according to WHO and RDA. *p<0.05. One-way ANOVA and Bonferroni post-tests.

Medicinal Plants *	Potassium (mg/mL)	Iron (mg/mL)	Zinc (mg/mL)	Lead (mg/mL)
Cymbopogon citratus	6.18	0.7	1.21	0.01
Equisetum arvense	2.64	0.8	0.8	0.1
Matricaria chamomilla	0.9	1.4	0.3	1
Maytenus ilicifolia	1.33	0.3	0.2	0
Mentha piperita	3.24	0.5	1.02	0.01
Pimpinella anisum	1.81	0.3	0.1	0
Rosmarinus officinalis	1.55	0.5	0.05	0.1
Salvia officinalis	1.2	0.8	0.1	0

When comparing the obtained results with the parameters established by WHO [25] and the RDA [26], some inconsistencies and concerns are observed. The WHO recommends specific limits for the presence of heavy metals in medicinal plants, considering that exposure to lead should be minimized, as it can cause toxicity. The lead concentrations found in *Matricaria chamomilla* (1 mg/mL) exceed acceptable levels, representing a health risk.

Regarding iron, the RDA for adults is approximately 8 mg/day for men and 18 mg/day for women. The concentration of iron in *Matricaria chamomilla* (1.4 mg/mL) suggests that an infusion of this plant could significantly contribute to daily intake, but the other plants had concentrations that might be considered insufficient to meet criteria. The presence of zinc in the analyzed plants, especially in *Cymbopogon citratus* (1.21 mg/mL), is beneficial, as the RDA is 11 mg/day for men and 8 mg/day for women. However, the variation in zinc concentrations among the plants indicates that a diverse diet is essential to meet nutritional needs. Thus, although some medicinal plants present adequate amounts of beneficial minerals, contamination by lead in one of them is a critical concern, highlighting the need for strict quality control of medicinal plant materials.

The comparison of microbiological results among the analyzed plants indicates that *Rosmarinus officinalis* and *Salvia officinalis* were the most contaminated, with a higher number of samples testing positive for coliforms, *Salmonella sp*., and *Staphylococcus sp*. In contrast, *Equisetum arvense* and *Matricaria chamomilla* showed the lowest levels of contamination, suggesting a relatively lower microbiological risk (p<0.05, Table 5).

Table 5: Microbiological analyses of medicinal plants sold in the city of Goiânia, Goiás, Brazil, from July to December 2023, according to the Brazilian Pharmacopoeia 6th edition; RDC No. 10 of March 9, 2010, and RDC No. 14 of March 31, 2010. *P<0.05. One-way ANOVA and Bonferroni post hoc tests.

Medicinal Plants *	N samples analyzed	Total coliforms	Fecal coliforms	Filamentous fungi	Yeasts	*Escherichia coli*	*Salmonella sp.*	*Staphylococcus sp.*
Cymbopogon citratus	8	2	2	2	2	1	1	3
Equisetum arvense	8	0	0	1	1	1	2	1
Matricaria chamomilla	8	1	0	0	0	1	1	2
Maytenus ilicifolia	8	4	2	1	1	3	0	2
Mentha piperita	8	2	1	0	0	1	1	1
Pimpinella anisum	8	0	0	2	2	2	2	1
Rosmarinus officinalis	8	4	4	2	2	1	3	2
Salvia officinalis	8	2	1	1	1	3	3	3
Total	64	15	10	9	9	13	13	15

Specifically, microbiological analyses conducted on eight samples of *Cymbopogon citratus* revealed the presence of total and fecal coliforms in two samples, in addition to filamentous fungi and yeasts in similar quantities. The detection of *Escherichia coli* in one sample and *Salmonella sp*. in another indicates possible fecal contamination, while *Staphylococcus sp*. was identified in three samples, suggesting a potential health risk. In contrast, *Equisetum arvense* samples exhibited a less concerning microbiological profile. No total or fecal coliforms were detected, and the presence of filamentous fungi and yeasts was limited to one sample each. *Escherichia coli* was identified in one sample, and *Salmonella sp*. was detected in two. *Staphylococcus sp*. was found in a single sample, demonstrating a relatively low level of contamination [13].

The analyses of *Matricaria chamomilla* showed that one sample tested positive for total coliforms, but none showed fecal coliforms, filamentous fungi, or yeasts. Nonetheless, *Escherichia coli* and *Salmonella sp*. were found in one sample each, and *Staphylococcus sp*. in two, suggesting a lower but still significant contamination risk (P<0.05). The absence of fungal contamination is a positive aspect, but the presence of pathogenic bacteria requires attention [18]. *Maytenus ilicifolia* presented concerning results, with four samples showing total coliforms, two with fecal coliforms, and one sample contaminated with filamentous fungi and yeasts. The presence of *Escherichia coli* in three samples is alarming, given its pathogenic potential [34]. However, *Salmonella sp*. was not detected, while *Staphylococcus sp*. was found in two samples. These data suggest significant contamination, particularly regarding coliforms, highlighting the need for more rigorous hygiene practices [35].

Mentha piperita showed moderate contamination, with two samples positive for total coliforms and one for fecal coliforms. Filamentous fungi or yeasts were not found. However, *Escherichia coli*, *Salmonella sp*., and *Staphylococcus sp*. were detected in one sample each, indicating the presence of pathogens, albeit at lower levels compared to other plants analyzed (P<0.05). Meanwhile, *Pimpinella anisum* samples presented a more uniform contamination profile, with no total or fecal coliforms detected, but filamentous fungi and yeasts were found in two samples each. *Escherichia coli* was detected in two samples, as well as *Salmonella sp*., suggesting a non-negligible microbiological risk. The presence of *Staphylococcus sp*. in one sample indicates a moderate level of bacterial contamination.

Rosmarinus officinalis showed the most concerning results among the plants analyzed [13, 14, 24]. Four samples exhibited contamination by total and fecal coliforms, as well as two samples with filamentous fungi and yeasts. *Escherichia coli* was detected in one sample, *Salmonella sp*. in three, and *Staphylococcus sp*. in two, indicating an elevated level of microbiological contamination (P<0.05). These results emphasize the need for sanitary control in the production and sale of this medicinal plant [36].

Finally, *Salvia officinalis* samples showed contamination in two samples for total coliforms, one for fecal coliforms, and one sample each with filamentous fungi and yeasts. However, *Escherichia coli* was detected in three samples, *Salmonella sp*. in three, and *Staphylococcus sp*. in three, placing this plant among the most contaminated in the study (p<0.05). The high frequency of bacterial contamination indicates a significant health risk, requiring immediate corrective measures [37].

Conclusion

Despite the existence of regulations for medicinal plants commercialization, samples analyzed and sold in the city of Goiânia, Goiás, Brazil, from July to December 2023 revealed disparities in labels and package inserts. There were low approval rates for authenticity and purity across several species, with total ash and acid-insoluble ash being the most problematic parameters. Mineral analysis revealed significant variability in potassium, iron, zinc and lead concentrations, with some exceeding safe levels. Additionally, microbiological analyses showed significant contamination, particularly in *Rosmarinus officinalis* and *Salvia officinalis*, with elevated levels of coliforms, *Escherichia coli*,

Salmonella sp. and *Staphylococcus* sp. *Cymbopogon citratus* and *Maytenus ilicifolia* also showed concerning fecal contamination. Data highlight health risks and underscore the need for stringent sanitary control. The lack of compliance with legislation and the absence of quality according to pharmacopeial and scientific standards for each of the eight-species studied demonstrate inadequate quality control and poor oversight of the products sold. It is suggested that good practices be adopted from cultivation to the manufacturing of medicinal plants, as well as stricter enforcement in the marketing of these products to ensure safety and efficacy in the use of medicinal plants.

Acknowledgement
Authors acknowledge Universities for material support.

Declaration of interest statement
Authors declare no conflicts of interest.

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