The supply chain and consumer behavior of medicinal and aromatic plant products: Challenges and perspectives

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Introduction

In recent years, Romania has witnessed an increasing trend in the consumption of products derived from medicinal and aromatic plants (MAPs) (Oncioiu, 2017), a trend that is also observed internationally. However, there is a significant gap in the specialized literature, with few studies examining consumer behavior regarding these products (Garcia-Alvarez et al., 2014). Additionally, research on the supply chain of products derived from medicinal and aromatic plants is extremely scarce, focusing only on certain stakeholders (Chiurciu, 2018).

Given this context, the present doctoral research aims to analyze the supply chain of products derived from medicinal and aromatic plants and to identify the profile of MAP product consumers, including their perceptions, attitudes, beliefs, needs and the main factors influencing the purchase and consumption of these products. The objectives derived from the aim of this doctoral thesis are as follows:

Objective 1: Analyze the supply chain of products derived from medicinal and aromatic plants to understand the associated risks and benefits, with the following key components:

- Investigate the transformation process of medicinal and aromatic plants from raw material to finished product, evaluating the impact of each stage on the quality and safety of the final product;
- Assess specialists' opinions on quality and safety assurance to minimize associated risks;
- Evaluate consumers' opinions regarding the use of MAP products.

Objective 2: Investigate consumer behavior regarding products derived from medicinal and aromatic plants with the following components:

- Identify the profile of MAP product consumers and their preferences based on age, gender, quality/price ratio, education level, and raw material origin;
- Determine the reasons consumers resort to MAP products;
- Identify the factors that influence the consumption of MAP products;
- Identify consumers' knowledge and practices concerning the use of MAP products;
- Identify the sources of information that consumers rely on and the trust they place in these sources;
- Identify the potential correlation between the consumption of MAP products and the interest in a healthy lifestyle;
- Identify the potential correlation between the consumption of MAP products and the interest in sustainability-related aspects, such as environmental protection and the preservation of endangered plant species.

General Methodology

This doctoral research employed two complementary research methods. The first method, qualitative in nature, was the hybrid forum, and the second method, quantitative in nature, was the sociological survey conducted via a questionnaire.

The hybrid forum facilitated the exploration of controversial topics specific to the supply chain of products derived from medicinal and aromatic plants, such as their quality, safety and efficacy from harvesting, processing, distribution, to final consumption. Participants in the hybrid forum included local stakeholders: producers, processors, distributors, retailers, researchers, academics and consumers.

The results of the qualitative research, corresponding to the first study presented in the summary, were published in the article: Cadar, R.L., & Pocol, C.B. (2020). Safety and efficacy assessment of medicinal and aromatic plants derived products. A qualitative research. Bulletin UASVM Horticulture, 77(2), DOI:10.15835/busvmcn-hort:2020.0032.

The quantitative research involved using a sociological survey, with the questionnaire serving as the research instrument. It began with a question seeking participants' consent for processing their personal data for statistical purposes, followed by two filter questions designed to select only those individuals who reside in Cluj-Napoca and use products derived from medicinal and aromatic plants.

The questionnaire covered the following aspects:

- Frequency of consumption of products derived from medicinal and aromatic plants: teas, essential oils, tinctures, macerates, capsules with dry extracts or plant powders/tablets/gels with volatile oils, floral waters, juices/syrups, creams/ointments/balms with plant-based ingredients, cosmetic products (soap, shampoo, balms, creams, perfumes, etc.) with plant-based ingredients, and spices;
- Use of medicinal and aromatic plant products for phytotherapeutic purposes;
- Use of medicinal and aromatic plant products for cosmetic and personal care purposes;
- Information sources used by consumers and the trust placed in these sources;
- Purchase locations;
- Dietary habits, lifestyle, and sustainability;
- Environmental protection and the conservation of endangered medicinal and aromatic plant species;
- Socio-demographic characteristics: gender, age, education, occupation and income.

The study population consisted of individuals from Cluj-Napoca who consume products derived from medicinal and aromatic plants, with a convenience sample selected based on accessibility and willingness to participate. The questionnaire was administered both face-to-face and online, using the "snowball" sampling method. A total of 1050 individuals expressed interest in completing the questionnaire, resulting in 620 valid responses. The difference was due to participants who responded negatively to the first two filter questions: either not residing in Cluj-Napoca or not being consumers of medicinal and aromatic plant products. The resulting database was utilized to explore multiple perspectives and address specific research questions, culminating in three distinct studies. Each study focused on a specific research problem, contributing uniquely to the advancement of the specialized literature by offering different perspectives and conclusions.

- **Cadar, R.L.,** Amuza, A., Dumitraș, D.E., & Pocol, C.B. (2021). Consumer behaviour of products obtained from medicinal and aromatic plants: a segmentation based on frequency and purpose of their use. Scientific Papers Series Management, Economic Engineering in Agriculture & Rural Development, 21(2), 127-136.

- **Cadar, R.L.,** Amuza, A., Dumitraș, D.E., Mihai, M., & Pocol, C.B. (2021). Analysing clusters of consumers who use medicinal and aromatic plant products. Sustainability, 13(15), 8648., Factor Impact 3.2510
- **Cadar, R.L.,** Šedík, P., Predanócyová, K., & Pocol, C.B. (2024) From field to consumer: a comprehensive analysis of medicinal and aromatic plant product preferences through generations. Scientific Papers Series Management, Economic Engineering in Agriculture & Rural Development, 24 (2), 229-238, Factor Impact 1.

Study 1 – Safety and efficacy assessment of medicinal and aromatic plants derived products. A qualitative research

1. Introduction

The aim of this study was to understand the risks and benefits of products derived from medicinal and aromatic plants, as well as to gather information on their quality and safety, from the perspective of three key components: the manufacturing process from raw material to finished product; ensuring safety and quality; consumer perceptions and the biomedical framework (Cadar & Pocol, 2020).

2. Materials and methods

The research method used was qualitative, specifically the hybrid forum. By employing the hybrid forum, the authors aimed to create an effective dialogue addressing the critical points and limitations encountered in the field of products derived from medicinal and aromatic plants from the perspective of all stakeholders involved in the supply chain, from producer to consumer, highlighting aspects related to quality, safety and efficacy of these products. The hybrid forum was conducted in two parts, the first addressed to researchers and supply chain stakeholders and the second to the general public, including consumers and non-consumers of MAP products (Cadar & Pocol, 2020).

3. Results and discussion

Aspects resulted from the interventions of the specialists

Specialists identified critical points in the technological process of obtaining products derived from medicinal and aromatic plants, from raw material to finished product. A significant issue highlighted was the poor collaboration between producers, processors, distributors and researchers, with the observation that "*there is no connection from the grower to the consumer*". Regarding products derived from medicinal and aromatic plants (dietary supplements, natural cosmetics), there are European regulations ensuring the quality of these products, with "*very strict controls for the honest ones*", as falsification can lead to severe consequences, such as laboratory closure and production halts. A problem identified during the forum discussions was the lack of quality monitoring and because there are not enough personnel to conduct field inspections, some producers evade scrutiny, introducing non-compliant products (counterfeit, adulterated, with false or unproven claims on labels) to the

market. The existence of rigorous testing of products for their quality and safety was a key point addressed by specialists. "*Unfortunately, in Romania, there is not much support from authorities when it comes to natural products or supplements*", the costs of these tests are high and many producers cannot afford them. These tests are necessary to certify product quality. The consumption of MAP products is recommended to be under the advice of a specialist, but some patients do not trust specialists, resorting to "*the advice of the neighbor from the second floor*". Moreover, "*many products are now found in supermarkets (...) the patient does not even encounter a specialist anymore*", aggressive marketing, expensive consultations and limited time favor self-medication, increasing the risk of interactions and adverse reactions (Cadar & Pocol, 2020).

Aspects resulted from the intervention of the public

The majority of participants at the hybrid forum stated that they have difficulties in obtaining accurate information about these products, as the abundance of advertisements on social media and TV creates much confusion and uncertainty. A desire expressed was to educate consumers in this regard, as "*an uneducated person is easily influenced*" and to improve access to concrete and valid information. Distrust in pharmacists, due to the commercial aspect of the profession and aggressive advertisements in this field, was heavily debated and accepted by many attendees, while others view pharmacists as specialists, accepting their advice. Regarding non-consumption, some do not use these products either because they do not need them or do not trust their efficacy, while others have used them but experienced allergic reactions, thus discontinuing their use (Cadar & Pocol, 2020).

Study 2 - Consumer behavior of products obtained from medicinal and aromatic plants: A cluster-based segmentation based on frequency and purpose of their use

1. Introduction

The aim of this study was to perform a cluster segmentation of consumers of products derived from medicinal and aromatic plants in Cluj-Napoca, based on the motives and frequency of their usage as well as their socio-demographic characteristics (Cadar et al., 2021a).

2. Materials and methods

The study was conducted by administering a questionnaire among the population of Cluj-Napoca, resulting in 620 valid responses. The questionnaire assessed the frequency and reasons for using medicinal and aromatic plant products and included socio-demographic questions. Data analysis employed descriptive statistics and the K-means clustering method to segment consumers into multiple clusters (Cadar et al., 2021a).

3. Results and discussion

Three consumer clusters were identified: Cluster 1-"Heavy users", Cluster 2 – "Rarely users" and Cluster 3 – "Occasional users"(Figure 1).
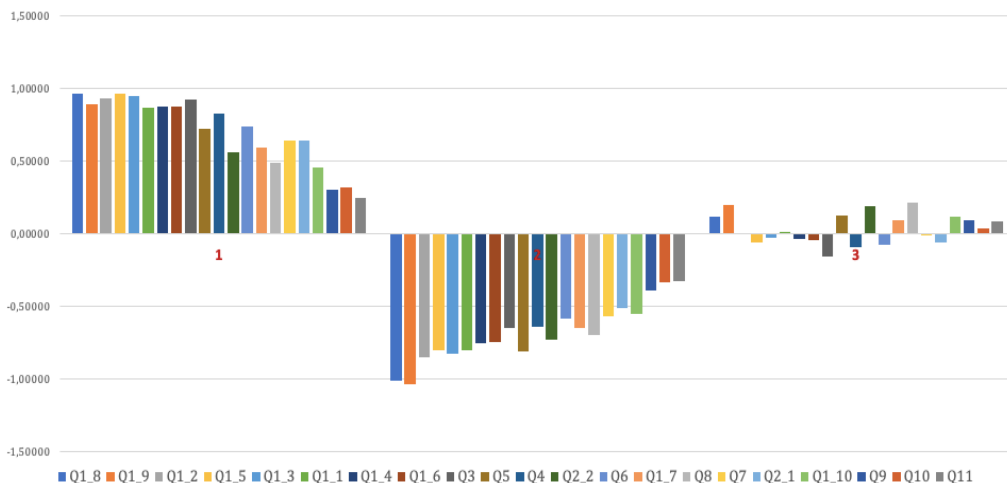
Figura 1. Clustering results
Sursa: own calculation

Cluster 1 - "Heavy user": These individuals use medicinal and aromatic plant products most frequently, i.e., weekly or more often. The products are used for both phytotherapeutic and cosmetic purposes. They are largely used for preventing health issues, personal care, cosmetics, treating health problems and slowing the aging process. Members of this cluster report using these products for cosmetic and personal care purposes more than those in the other clusters and even more so for preventing and/or treating specific conditions. Generally, they are women with higher levels of education and relatively higher incomes.

Cluster 2 - "Rarely users": These individuals use medicinal and aromatic plant products the least frequently or not at all, with usage being seasonal or even rarer. They are generally men with lower levels of education and lower incomes.

Cluster 3 - "Occasional user": These individuals use medicinal and aromatic plant products occasionally. The more frequently used products include creams/ointments/balms with plant-based ingredients and soaps. These products are used more often for personal care and cosmetic purposes and less frequently for treating health issues. Consumers in this cluster are generally of both genders, with medium levels of education and income (Cadar et al., 2021a).

Study 3 – Clustering consumers who use products derived from medicinal and aromatic plants for phytotherapeutic, cosmetic and personal care purposes

1. Introduction

This study aimed to identify the factors influencing the purchase of products derived from medicinal and aromatic plants for phytotherapeutic, cosmetic and personal care purposes among the population of Cluj-Napoca. Additionally, it sought to create distinct consumer clusters based on the purpose of product usage (Cadar et al., 2021b).

2. Materials and methods

The study used the database obtained from the quantitative research. Due to the inclusion of two filter questions in the questionnaire, two groups of users of medicinal and aromatic plant products were identified from the total sample: the first group comprised 231 respondents who use the products for phytotherapeutic purposes and the second group comprised 297 respondents who use them for cosmetic and personal care purposes. Descriptive statistics were employed to analyze the data for the entire sample and for the two distinct groups of respondents. Subsequently, the K-means clustering analysis was applied to identify distinct consumer clusters (Cadar et al., 2021b).

3. Results and discussion

3.1. Clusters of consumers using medicinal and aromatic plant products for phytotherapeutic purposes

Among consumers using medicinal and aromatic plant (MAP) products for phytotherapeutic purposes, two consumer clusters were identified: "Curious" and "Knowledgeable".

Cluster 1 - "Curious": these consumers occasionally use MAP products to prevent and/or treat various conditions. Their usage largely depends on immediate needs, indicating a lower preference for natural therapies and traditional and complementary medicine. The primary factors influencing their purchase decisions are promotions, discounts and advantageous pricing. Their trust in information sources is primarily vested in health store staff or pharmacists, with minimal differentiation from other sources.

Cluster 2 - "Knowledgeable": these consumers use MAP products to prevent and/or treat a wide range of conditions, essentially for any ailment. Their positive responses to all queried items suggest a favorable attitude toward these products. Their usage habit appears preventive due to the broad range of applications. This cluster values eco-certification and quality over low prices, demonstrating knowledge about product composition and traceability. Like sommeliers, they are well-informed about the field, emphasizing the origin of raw materials. They primarily obtain information from medical specialists or direct relationships with producers (Cadar et al., 2021b).

3.2. Clusters of consumers using medicinal and aromatic plant products for cosmetic and personal care purposes

Similarly, two consumer clusters were identified among those using MAP products for cosmetic and personal care purposes: "Curious" and "Knowledgeable".

Cluster 1 - "Curious": these consumers have tried MAP products for cosmetic and personal care purposes or use them less extensively. They are less interested in specific product attributes and often select products based on fragrance, scientifically proven benefits, appearance and a preference for Romanian products. They rely somewhat more on specialized books for information than other sources and trust pharmacists, specialists, store personnel and books. They are less willing to pay more for 100% natural MAP-based cosmetic and personal care products.

Cluster 2 - "Knowledgeable": these consumers generally prefer MAP-based cosmetics and personal care products, considering them safer and more effective. They are selective, focusing on raw material quality, origin and eco-certification. They prefer products free from synthetic ingredients. When choosing or deciding to use MAP-based cosmetics and personal care products, they exhibit a strong trust in producers and medical specialists. They consider themselves environmentally conscious and concerned about endangered medicinal and aromatic plant species. They are willing to pay a premium for 100% natural MAP-based cosmetic and personal care products (Cadar et al., 2021b).

Study 4 - From field to consumer: A comprehensive analysis of medicinal and aromatic plant product preferences through generations

1. Introduction

In Romania, there are no studies analyzing the consumption behavior of various generations regarding products derived from medicinal and aromatic plants (MAP), nor the trust consumers place in different sources of information about these products. Recognizing this gap in the scientific literature, the authors aimed to conduct an analysis of the consumption behavior of different generations for MAP products in Romania and their sources of information (Cadar et al., 2024).

2. Materials and methods

The study analyzed 375 responses from the quantitative research database of doctoral research, grouped into three categories based on respondent age: 125 responses from Generation Z (18-26 years), 125 responses from Generation Y (27-42 years) and 125 responses from Generation X and Baby Boomers (43-72 years). Multiple correspondence analysis, the Chi-square test and the Kruskal-Wallis test were employed to explore the differences among the selected generations. Additionally, the Friedman test and the Nemenyi method were used to identify statistically significant differences in consumer evaluations regarding information sources and factors influencing the purchase of MAP products (Cadar et al., 2024).

3. Results and discussion

The study investigated the influence of information sources on consumer choices and decisions regarding the use of cosmetic and personal care products containing ingredients from medicinal and aromatic plants (Figure 1) (Cadar et al., 2024).
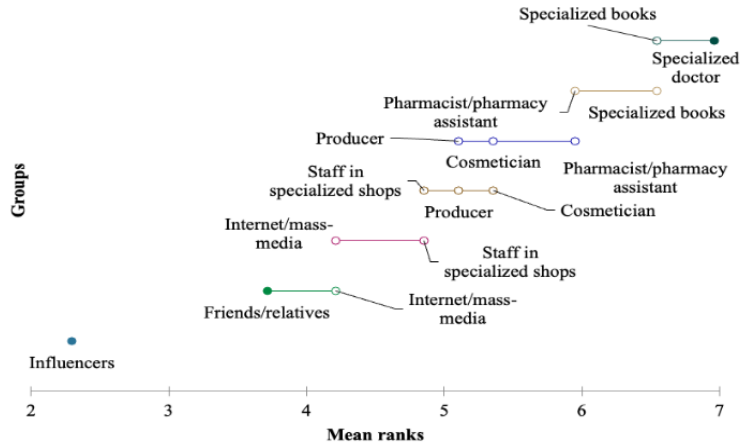
Figure 1. Confidence in sources of information based on which consumers make decisions about MAP products for cosmetic and personal care purposes
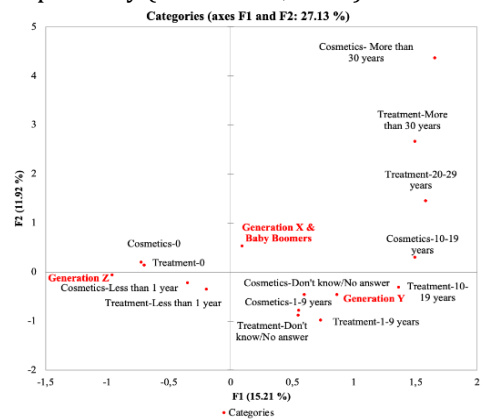Source: own calculation

Research findings and mean values revealed that the most important factors influencing the purchase of the examined products include: product quality (mean = 4.40), product composition (mean = 4.25), information on the label (mean = 3.95), scientifically proven therapeutic properties (mean = 3.92), the origin of raw materials (wild or cultivated) (mean = 3.61), the use of organic raw materials (mean = 3.50), organic certification of the product (mean = 3.48) and whether the product is Romanian (mean = 3.39). In contrast, less importance is attributed to aspects such as brand (mean = 2.87), benefits offered including promotions or discounts (mean = 2.91), use of recyclable packaging (mean = 2.98), information about product traceability (mean = 3.23) and advantageous product price (mean = 3.26).

The differences between the various generations regarding the purpose and duration of MAP product use are presented in Figure 2 and Figure 3, respectively (Cadar et al., 2024).
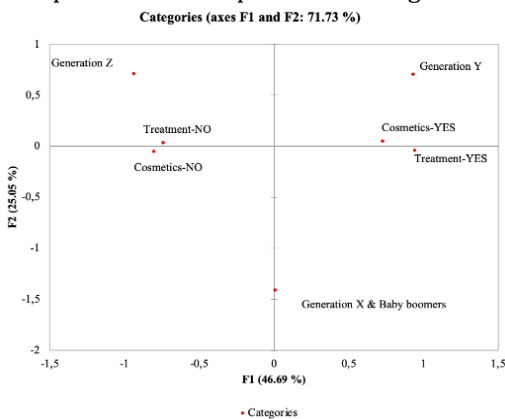
Figure 2. Use of MAP products for cosmetic and personal care purposes, and for the prevention and treatment of various illnesses across different age generations
Source: own calculation

Figure 3. Duration of using MAP products for cosmetic and personal purposes, as well as for the prevention and treatment of various illnesses, varies across different age generations
Source: own calculation

Conclusions and recommendations

In this doctoral research, we conducted an analysis of the supply chain for products derived from medicinal and aromatic plants (MAP), identifying the profiles of their consumers.

In Study 1 (Chapter 5), through discussions held in a hybrid forum, critical points were identified within the supply chain for MAP products, spanning from the technological process of obtaining these products to the final consumer. This method allowed the identification of aspects related to the quality, safety and efficacy of products throughout the supply chain, from harvesting to consumption. Specialist interventions highlighted significant deficiencies in the application and enforcement of existing legislation. Despite the legal framework, the lack of effective monitoring by competent institutions affects product quality and safety. Additionally, specialists noted the low level of public awareness regarding the effects and proper use of MAP products. Public interventions revealed a relatively low interest in consuming these products, especially in the absence of medical conditions. This interest is even lower among young people, who find it challenging to identify quality products mainly due to inadequate information. Furthermore, these products are often consumed without consulting specialists, under the influence of media marketing, which significantly impacts consumption decisions. Even when consumers seek safe and effective products, they are hesitant to follow pharmacists' advice.

In Study 2 (Chapter 6), a cluster analysis of MAP product consumers in Cluj-Napoca identified three distinct consumer clusters, each with specific characteristics and behaviors: Cluster 1 - "Heavy users", Cluster 2 – "Rarely users" and Cluster 3 – "Occasional users". These clusters were grouped based on the purpose and frequency of MAP product use, as well as socio-demographic characteristics. The results show that the purpose and frequency of MAP product use are influenced by socio-demographic factors (gender, education, income). Women with higher education and higher incomes are the most frequent users of these products for both therapeutic and cosmetic/personal care purposes. Those who rarely or never use MAP products are generally men with lower education and modest incomes. The third cluster comprises individuals with medium education and income from both genders who use MAP products mainly for cosmetic and personal care purposes. Understanding consumer behavior and preferences across different segments allows for a more effective and targeted approach, ensuring the correct and responsible use of MAP products.

In Study 3 (Chapter 7), cluster analysis identified consumer groups in Cluj-Napoca who use MAP products for therapeutic and cosmetic purposes, based on the reasons and factors influencing their consumption practices, as well as their information sources and the trust they place in these sources. Two consumer clusters were identified in both therapeutic and cosmetic/personal care groups: "Curious" and "Knowledgeable". In the therapeutic use group, Cluster 2 – "Knowledgeable" consumers choose MAP products due to their preference for natural therapies and trust in specialists when seeking information. Their consumption habit is prevention-oriented, using MAP products for a wide range of health issues. On the other hand, Cluster 1 – "Curious" consumers use MAP products only when there is a specific need.

They trust pharmacists and staff in specialized stores for information. A significant observation is that "Knowledgeable" consumers are positively influenced by health and environmental protection concerns. They prefer certified organic products and pay attention to the quality, composition and traceability of the products they purchase. In the cosmetic and personal care use group, "Knowledgeable" consumers are concerned with sustainability, reflected in their consumption behavior: they use organic products and are interested in protecting endangered species. They pay particular attention to health, checking the ingredients in the cosmetic and personal care products they purchase and their possible effects on the skin. Thus, when choosing products, they focus on the raw materials used, their origin and quality, ensuring that the products do not contain synthetic ingredients and are certified organic. Product quality is a crucial factor influencing the frequency of MAP product consumption in both therapeutic and cosmetic/personal care use groups.

In Study 4, consumer behaviors in using MAP products were examined across different generations: Generation Z (18-26 years), Generation Y (27-42 years), Generation X and Baby Boomers (43-72 years). Multiple correspondence analysis revealed significant differences in the reasons and duration of MAP product use (number of years of use). Generation Z showed a tendency not to use these products for cosmetic/personal care or therapeutic purposes, or to use them for short periods (less than a year). In contrast, Generation Y consumers use them for both therapeutic and cosmetic/personal care purposes for periods ranging from 1 to 9 years or 10 to 19 years. Generation X and Baby Boomers display a diversity in their use, including short or long periods depending on individual needs and preferences. Some have been using MAP products for less than a year, while others have used them for many years (1 to 9 years or 10 to 19 years). The most important factors influencing purchasing decisions include product quality, composition, label information and scientifically proven therapeutic properties. The study elucidates the significant role of information sources in consumer choices and decisions regarding MAP product use for cosmetic and personal care purposes. Medical specialists, books, pharmacists and cosmetologists are the most trusted information sources, while influencers, friends, relatives and the media are perceived as less reliable. Regarding consumer knowledge about the risks associated with MAP product use, Generation Y, X and Baby Boomers are aware of health risks such as adverse, allergic or toxic reactions and possible interactions with other medications or foods. In contrast, Generation Z consumers do not perceive these risks similarly. In this context, Generation Y consumers inform doctors about using these products with prescribed medications, while only half of Generation X and Baby Boomers do the same. Generally, consumers from all generations expressed concerns about health risks associated with MAP product use for cosmetic and personal care purposes, particularly due to possible allergic reactions.

By combining qualitative and quantitative research methods, this research provided a comprehensive perspective on the supply chain and consumer behavior of MAP products, highlighting current issues and offering directions for future interventions.

Given the results obtained, it is essential to strengthen the capacity of institutions to monitor and implement existing legislation to ensure the quality and safety of medicinal and aromatic plant products. Additionally, biodiversity conservation is necessary through the adoption of sustainable agricultural practices and public education in the spirit of environmental protection. These practices include promoting organic farming, diversifying

medicinal and aromatic plant crops, developing environmentally friendly cultivation technologies, as well as the sustainable exploitation of medicinal plants from wild flora. Furthermore, it is recommended to conduct public awareness campaigns to educate consumers about the benefits, risks and proper use of these products and to develop marketing strategies tailored to each type of consumer.

Originality and innovative contributions of the thesis

In Romania, there are few studies analyzing the supply chain stages from cultivation and harvesting to processing, distribution and final use of medicinal and aromatic plant (MAP) products. Similarly scarce are studies investigating the consumer behavior of these products based on socio-demographic characteristics or those analyzing the reasons and factors influencing consumption and consumer knowledge in the field of medicinal and aromatic plants. No research has been identified that examines the information sources used by consumers and the trust placed in these sources.

Identifying this gap in the scientific research field and considering the necessity of promoting MAP products safely and effectively within the Romanian market context, we identified critical points in the supply chain as well as the profile of the Romanian MAP product consumer.

The originality of this thesis lies in the complementary research methods used: the qualitative method represented by the hybrid forum and the quantitative method represented by the sociological survey. The use of the hybrid forum led to a better understanding of the aspects related to the quality, safety and efficacy of MAP products from the perspective of all stakeholders involved in the supply chain, from producer to consumer.

The questionnaire-based sociological survey enabled the investigation of a sample of 620 MAP product consumers, which was subsequently subjected to cluster analysis. The cluster segmentation of participants allowed the identification of consumer profiles, as well as the characteristics and behaviors specific to each cluster.

The contributions of this research extend beyond the medicinal and aromatic plant industry and have important implications for consumer health. The research highlights both the risks and benefits associated with MAP product use, emphasizing the importance of an informed and balanced approach. On one hand, the benefits of these products are multiple, including natural ingredients, beneficial therapeutic effects in preventing and treating certain conditions, and advantageous properties in personal care and cosmetics. On the other hand, the associated risks are not negligible, particularly those related to adverse reactions, allergies, toxicity and interactions with other medications or foods. The research underscores the need for adequate education of both consumers and medical personnel regarding the correct and safe use of MAP products.

By bridging the gap between theory and practice, this doctoral thesis significantly advances knowledge in the field of supply chain and consumer behavior of medicinal and aromatic plant products. It facilitates the implementation of better-founded strategies tailored to the real needs of consumers, ensuring greater efficiency and relevance of health interventions.

Economically, the research suggests opportunities for developing new products and marketing strategies adapted to the specific needs of different consumer segments. Socially, this integration enhances public trust in MAP products, educating consumers on their correct and safe use. It also contributes to improving quality of life by promoting informed and responsible consumption practices. The doctoral research results encourage the adoption of sustainable practices in the MAP product supply chain, reducing environmental impact, promoting the conservation of natural resources and ensuring social equity and economic growth in the sector.

These strategies, supported by rigorous monitoring and partnerships between professionals in the agricultural, food, cosmetic and health fields, can create an ecosystem of informed and responsible producers and consumers, thus promoting the sustainable and healthy development of the medicinal and aromatic plant product sector.

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