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EVALUATION OF THE ORGANOLEPTIC CHARACTERISTICS AND PHENOLIC COMPOUNDS OF AROMATIC/MEDICINAL PLANTS FROM URBAN HORTICULTURE

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Abstract

Cultivation of aromatic/medicinal plants (MAPs) is major part of urban horticulture and landscape architecture, several of MAPs also being widespread in the medical industry due to their nutrient content. In this work, an organoleptic evaluation of infusions and condiments from 25 MAPs was carried out, with the participation of 45 different tasters. The bioactive compounds in the infusion of some MAPs were then evaluated. The selected plants were grown in a greenhouse, through urban co-cultivation, in Bucharest and Thessaloniki. The appearance, smell, taste and aroma were assessed from the organoleptic characteristics, and the obtained results were processed with the SPSS statistical program. The DPPH and Folin-Ciocalteu methods were used to measure antioxidant and total phenolic concentration. The purpose of the work is to examine the relationship between the organoleptic characteristics and the nutritional elements of some MAPs. Also, it is sought to form an objective image regarding the role and the way of the use of MAPs so that they become acceptable to consumers, in their daily diet. The results confirm that the co-cultivation of some MAPs is an activity with significant prospects in urban horticulture and healthy nutrition.

***Key words**: Aromatic/medicinal plants, organoleptic evaluation, bioactive compounds, urban horticulture.*

INTRODUCTION

It is an undisputed fact that MAPs play an important role in human well-being, while their cultivation in the urban fabric also contributes to the goals of sustainable urban horticulture (Maknea et al., 2023). The analysis of medicinal plants has a long history in assessing the quality of a plant and the first analyses performed were organoleptic (Fitzgerald et al., 2020). Aromatic/medicinal plants have been used since ancient times for various purposes, such as treating infectious diseases, producing perfumes, preserving food (protection against pathogenic micro-organisms and deterioration, protection of organoleptic characteristics), etc. (Sakkas & Papadopoulou, 2017). However, in terms of their use, plants are more appreciated in the food sector than in the pharmaceutical sector (de Medeiros et al., 2021).

Today, there is also growing interest in MAPs as natural alternatives to synthetic preservatives in food. This is because herbs are an excellent source of antioxidants and antimicrobial's (Nieto, 2020) and because of their role in the Mediterranean diet. This is confirmed and reinforced by the fact that in 2010 the Mediterranean Diet was included in UNESCO's Representative List of the Intangible Cultural Heritage of Humanity. The aim is to safeguard the cultural value of the Mediterranean Diet and to share and disseminate its values and benefits, internationally (Serra-Majem et al., 2012). It has also been noted that the use of MAPs has increased in some geographical areas during COVID-19, due to the characteristics of MAPs (Khadka et al., 2020).

However, little research has been carried out on the effect of the microenvironment on plant adaptation, phenolic composition and sensory control (Kabtni et al., 2020). This control includes the evaluation of appearance, smell, taste, and aroma performed by the human sensory system, which enables the perception of taste and smell and transmits information about sensory properties (Renna et al., 2017).

In the case of MAPs, the most common form of consumption is tea. Its consumption is influenced by many factors, especially those related to cultivation, health and sensory properties (Rocha et al., 2020). In general, consumer acceptance and the development of sustainable, healthy and tasty products are closely linked (Pointke et al., 2022).

This paper presents a multifaceted approach to 25 species of medicinal aromatic plants (MAPs), grown in covered areas in different cities. In order to give consumers a wide choice of plants to grow and consume, it was decided to showcase many plants. These MAPs can be grown together or with vegetables in pots, urban gardens, etc. (urban horticulture), contributing both nutritionally and ornamentally through their aromatic and medicinal properties. They also contribute to the protection of beneficial insects such as bees in urban areas where environmental conditions permit their cultivation. Furthermore, urban horticulture is an alternative strategy for sustainable development and urban enhancement (Maknea et al., 2022). In this context, some questions are raised, which are the purpose of this paper. Specifically, what are the benefits to the customer of finding the plant attractive from an organoleptic point of view, and how? Also, whether their antioxidant properties change depending on the form of consumption and in which form the properties are retained, more.

The proposed research goals have been achieved through two separate phases (organoleptic and qualitative evaluation). Firstly, consumer preference was tested in terms of organoleptic (sensory) characteristics of the MAPs. These characteristics reflect the specific profile of a plant. This was followed by analysis of specific quality parameters such as polyphenols and antioxidant capacity in 15 samples of infusions.

MATERIALS AND METHODS

Plant materials

For this research, 15 MAPs cultivated in Romania, including 13 in Bucharest-B and 2 in Buzău-Bz, and 10 MAPs cultivated in Greece (Thessaloniki-SKG) were chosen, as shown in Table 1. For growing the MAPs (apart from the plants grown in Buzău), plant material derived from traditional Greek varieties was used, which is part of a research monitoring their adaptation to climate change in the Balkan countries. The 25 samples used in the event were leaves of MAPs, collected and dried in rooms with controlled heating (22°C).

Table 1. Description of the material used for organoleptic evaluation

Code	Plants	Family	City	Food group
1	*Aloysia citrodora*	Verbenaceae	B	1
2	*Aloysia citrodora*	Verbenaceae	SKG	1
3	*Origanum dictamnus*	Lamiaceae	SKG	1
4	*Syderitis syriaca-malotira*	Lamiaceae	B	1
5	*Syderitis syriaca-malotira*	Lamiaceae	SKG	1
6	*Sideritis scardica-Domnesc*	Lamiaceae	BZ	1
7	*Mentha spicata*	Lamiaceae	B	1
8	*Mentha piperita*	Lamiaceae	B	1
9	*Origanum majorana*	Lamiaceae	B	1
10	*Origanum majorana*	Lamiaceae	SKG	1
11	*Rosmarinus officinalis*	Lamiaceae	B	1
12	*Salvia officinalis*	Lamiaceae	B	1
13	*Lophantus anisatus*	Lamiaceae	BZ	1
14	*Origanum vulgare*	Lamiaceae	B	2
15	*Origanum onites*	Lamiaceae	SKG	2
16	*Satureja thymbra*	Lamiaceae	B	2
17	*Satureja thymbra*	Lamiaceae	SKG	2
18	*Origanum majorana*	Lamiaceae	B	3
19	*Origanum majorana*	Lamiaceae	SKG	3
20	*Satureja thymbra*	Lamiaceae	B	3
21	*Satureja thymbra*	Lamiaceae	SKG	3
22	*Thymus vulgaris*	Lamiaceae	B	4
23	*Thymus citrodorus*	Lamiaceae	B	4
24	*Thymus citrodorus*	Lamiaceae	SKG	4
25	*Crithmum maritimum*	Apiaceae	SKG	5

Sensorial evaluation

For the organoleptic evaluation, a free tasting event was organized at the USAMV Bucharest premises to evaluate the selected MAPs and to promote the Mediterranean diet. For this, we selected several MAPs that are most commonly used in Mediterranean cuisine. Afterwards, they were presented and offered in different forms and ways (tasting proposals) with criteria, their role in Mediterranean cuisine, creating 5 food groups (1=tea, 2=cheese & olive oil, 3=focaccia & olive oil, 4=olives & olive oil, 5=pickles) according to Table 1.

During the event, leaflets with information on the characteristics and consumption patterns of MAPs were distributed. Tasting suggestions (samples) were presented at stands. These were grouped by food group and homogenized in terms of container shape, quantity, and temperature.

Questionnaires were then distributed to collect information on consumers' acceptance of the food samples and their perception of sensory attributes.

The descriptive sensory evaluation was carried out using a group of testers of different ages and not experts. This was done to provide an objective basis, as reported in a related study by Drake (2022). The questionnaires were divided into five sections according to the food group to which each sample was assigned. For the evaluation, participants were asked to rate the smell, taste, appearance and aroma of each of the 25 samples using a structured 5-point Likert scale, with 1 indicating "I don't like it very much" and 5 "I like it very much" (Bhandari & Nikolopoulou, 2023). 45 questionnaires were answered for the processing of which statistical software packages (IBM SPSS Statistics and Microsoft Excel) were used. Questionnaires were grouped in 4 age groups (20-30, 30-45, 45-65, over 65) (Table 2). For each age group, descriptive statistical analysis (mean number, standard deviation) and frequency distribution (frequency, percent, valid percent, cumulative percent) were performed.

Physicochemical evaluation

Dry matter content

The dry matter (DM) content was determined using the gravimetric method - removing water by evaporation and weighing - and the results were expressed as percentages. In particular, the total dry matter was determined by weighing 1 g of the sample and then drying it at 105°C with the aid of a MAC 50 PARTNER thermobalance (Badea et al., 2022).

Bioactive compound extraction

To assess the total polyphenol content and the antioxidant activity of the MAPs, two extraction methods have been used on 15 samples of MAPs. The first method was water hot extraction (infusion) of the MAPs dried samples using specific mass, volume, and extraction time (Table 4). Immediately after the extraction was completed, the sample extracts were cooled on an ice bath and subjected to analysis. For the second extraction, a 70% methanol solution was used. Approximately 0.2 g of the material is weighed, and 30 mL of a 70% methanol solution was added. The extraction procedure was similar to that described by Ion et al. (2020).

Determination of total polyphenols content

To quantify the total polyphenols content, the Folin-Ciocalteu method was used, according to a protocol adapted from Stan et al. (2021). Briefly, 2.5 mL of Folin-Ciocalteu reagent (the reagent was diluted 10 times) and 2 mL of 7.5% sodium carbonate were added to 500 μL of the sample. It was incubated for 15 minutes at 50 C in a water bath, allowed to cool on an ice bath and read at a wavelength of 760 nm.

DPPH method for the determination of antioxidant activity

To measure the antioxidant activity, 200 μL of the extracts solution were mixed with 2 mL of DPPH solution (0.2 M) in methanol. The mixture was agitated for 30 minutes in the dark by magnetic shaking. After the incubation, the absorbance was measured at a wavelength of 515 nm (Ion et al., 2020).

Statistical analysis

All results obtained from measuring both types of samples were processed using MS EXCEL and Open Document.

RESULTS AND DISCUSSIONS

The data obtained from the study and from processing the results of the questionnaires and qualitative analyses are presented in tables and graphs.

MAPs organoleptic evaluation

For the sensory analysis, the grouping of participants by age was chosen because it is a criterion for objective assessment of smell, taste and vision, and because it is known that the sensory sensitivity of older people varies as they lose part of their sense of smell and taste over time (Cain & Steven, 1989). Therefore, the statistical analysis was based on 4 variables: number of completed questionnaires, age of testers, samples (taste suggestions) and scores.

The 45 completed questionnaires collected are considered a satisfactory number (Caracciolo et al., 2020), which reinforces the objectivity of the conclusions. In terms of age, of the 45 participants, 35.5% were aged 20-30, 26.6% were aged 30-45, 31.3% were aged 45-65 and 6.6% were over 65 (Table 4). The general results of the sensory evaluation show (Figure 1) that the criterion "appearance" received the highest score (5) with 52.3% of the respondents, while "taste" and "aroma" received the lowest score (1) with 2.3% of the respondents.

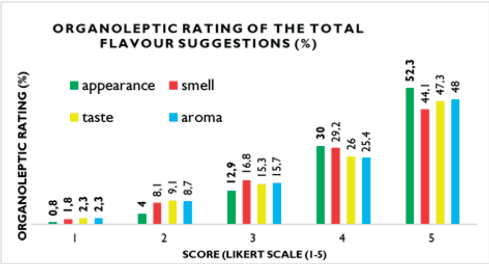

Figure 1. Total sensory evaluation of samples by rating scale

To continue the statistical treatment of the data, it was considered that the results should be grouped by sensory characteristic. Therefore, Figure 2 shows the complete "appearance" rating of the flavor proposals based on the MAPs. As can be seen, the highest preference was expressed for sample (18) with 70.3%, while sample (9) received the lowest preference (5.3%).

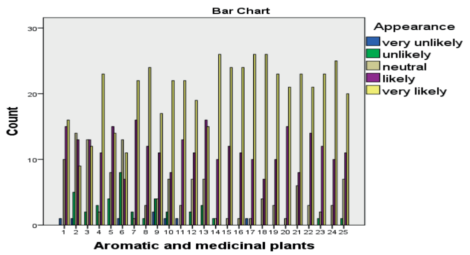

Figure 2. Evaluation of the "appearance" of the samples

Similarly, the visualization of the evaluation of "smell" (Figure 3) showed that sample (8) received the highest score with 65%, while sample (9) received the lowest score with 7.9%. In the evaluation of "taste" (Figure 4), sample (9) received the highest percentage (12.8%) with the lowest score, while only 7.4% of the testers rated sample (14) as excellent. Finally, in Figure 5, sample (9) received the lowest score for "aroma" with 10.5% and the highest for sample (15) with 75.7%.

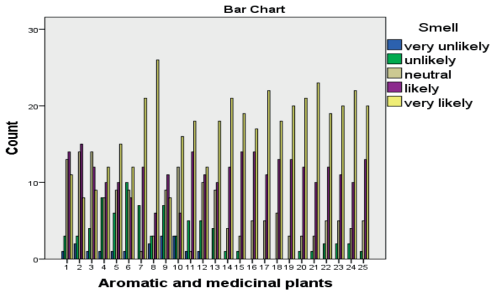

Figure 3. Evaluation of the "smell" of the samples

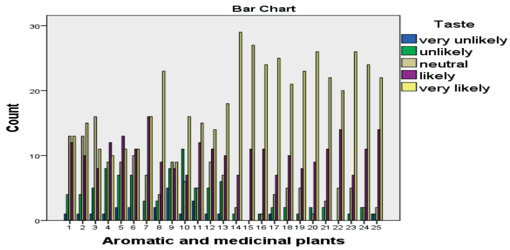

Figure 4. Evaluation of the "taste" of the samples

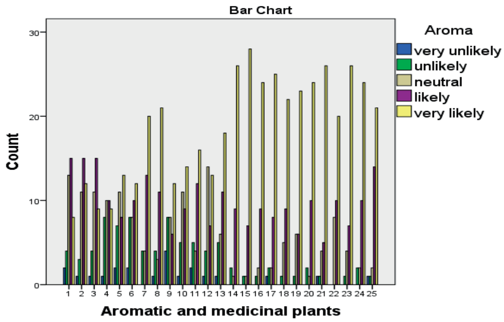

Figure 5. Evaluation of the "aroma" of the samples

As a continuation of the study of the response of the testers to the characteristics of the sample, the criterion of age was considered as a key factor in the evaluation. It was therefore decided to distribute the results of the statistical analysis by age group (Table 2) and to interpret them in terms of maximum and minimum scores. Considering the very low participation rate in the 65+ age group, it was decided to ignore some of the scoring data. The table shows that a very high percentage (84.9%) of the sample (18) were visually assessed by the testers in the 20-30 age group. At the same time, they rated the sample (9) negatively in terms of smell, taste and aroma. Or the age group (30-45), the highest percentage (90%)

with the highest rating gave the sample (8) for "smell". Finally, the results show that 92.3% of the age group (45-65) preferred sample (16) for taste and sample (15) for aroma, while 8.3% did not like the appearance of sample (9) at all. Note that the bold values in Table 2 indicate the samples with the highest sensory preference.

Table 2. Record evaluation results of tasting proposals with minimum (1) and maximum (5) scores

Age group / percent tasters	Scores Min / Max	Appearance % of tasters	Appearance Samples(code)	Smell % of tasters	Smell Samples(code)	Taste % of tasters	Taste Samples(code)	Aroma % of tasters	Aroma Samples (code)
All testers	1	5.3	9	7.9	9	12.8	9	10.5	9
	5	**70.3**	14;17; 18	**65.0**	8	**74.4**	14	**75.7**	15
20-30 35.5%	1	7.1	9;10;11	14.3	9.10	28.6	9	21.4	9
	5	**84.6**	18	60.0	8	73.3	14	**84.6**	21
30-45 26.6%	1	**8.3**	1;2	8.3	1;2	8.3	1;2	8.3	1;2
	5	80.0	4	**90.0**	8	75.0	14.15	70.0	23
45-65 31.3%	1	**8.3**	9	8.3	9	8.3	9	8,3	9
	5	75.0	21	76.9	16;24	**92.3**	16	**92.3**	15
Up to 65 6.6%	1	50.0	4;6;7;8;9;10	50.0	4;6;7;9;12	33.3	4;6;7;9;12;13	50.0	4;6;7;9;1 2;13
	5	100.0	17	100.0	17	100.0	24;25	100.0	25

The results show that *Origanum majorana* (RO), presented with bread and olive oil, is among the samples with the highest preference, both in the age group (20-30 years) and in all tasters, based on visual inspection. On the other hand, the same MAP, when presented in the form of tea, was the least preferred. This shows that the way the food is used and presented is an important criterion for its selection. This conclusion is supported by the fact that the characteristic "appearance" was rated as the most important criterion in the sensory analysis, followed by aroma, taste and appearance. Moreover, it is documented in the literature that the appearance of food products strongly influences consumer choice (Caracciolo et al., 2020). It should be noted that this herb performed quite well in the other sensory tests. However, it didn't perform very well in the qualitative analysis scoreboard (dry sample), based on antioxidant capacity and total phenolics.

Another interesting point is the fact that there are common preferences between the groups (20-30) and (30-45), which makes it possible to highlight some proposals. There is a joint evaluation with the maximum degree of *Mentha piperita* (RO) for its smell in tea and *Origanum vulgare* (RO) for its taste combined with cheese and olive oil. This result is confirmed by data from the grey literature, where analyses of the sample "cheese with *Origanum vulgare* extract 6%" showed very high levels of nutrients (Kallipoliti & Christodoulou, 2021).

The age group (45-65) preferred *Satureja thumbra* (RO) with bread and olive oil based on taste and smell. In general, different results per age group confirm that there is a variation in sensory sensitivity of people of different ages, as the senses change over time (Cain & Steven, 1989).

Furthermore, the fact that tea from *Aloysia citrodora* received the highest percentage of negative ratings for all sensory characteristics by the group (30-45) does not make it popular with the Romanian public. A review of the grey literature reinforces the view that a similar organoleptic study in Mediterranean countries would yield different results. Moreover, cultural criteria influence sensory evaluation (Pearcey& Zhan, 2018).

MAPs qualitative evaluation

The application of the Folin-Ciocatleu method determined the total phenolic content and the application of the DPPH method resulted in the antioxidant capacity values of the dried leaf samples and the MAPs infusion samples. Specifically, Table 3 presents the results of qualitative analyses of 15 samples of dried MAPs leaves, observing that the dried leaves of *Sideritis syriaca-malotira* (Romania) contain the highest antioxidant components (1025.60±7.61 mg TE/g) and total phenolics (80.56 ±1.25 mg GAE/g), while *Mentha piperita* (Romania) has the lowest antioxidant capacity (364.49±24.32 mg TE/g) and the least total phenolics (26.81±0.31 mg GAE/g). Table 4 shows the results of the qualitative analyses of 14 infusions of dried leaves of MAPs, due to the insufficient number of samples for *Origanum majorana* (Romania). Among them, the tea with *Thymus citrodorus* (Romania) showed the highest value in antioxidant capacity (1273.71±11.26 mg TE/200 mL tea) and total phenolics (72.93±2.67 mg GAE/ 200 mL tea), while the lowest value for antioxidant components (23.52±2.79 mg TE/200 mL tea) and total polyphenols (2.54±0.09 mg GAE/200 mL tea) was found in *Sideritis syriaca-malotira* (Greece).

Table 3. Chemical composition of died plant samples

Code	Name of medicinal/aromatic plants	Cultivation Country	SU %	CTP (mg GAE/g)	AA (mg TE/ g)
1	*Aloysia citrodora*	Romania	92.34 ± 0.32	57.49 ± 1.48	757.58 ± 23.62
2	*Thymus vulgaris*	Romania	92.53 ± 0.68	63.52 ± 2.87	693.55 ± 30.53
3	*Thymus citrodorus*	Romania	92.76 ± 0.16	70.13 ± 1.03	936.12 ± 7.99
4	*Salvia officinalis*	Romania	91.12 ± 0.08	61.61 ± 10.00	876.32 ± 5.83
5	*Mentha spicata*	Romania	90.75 ± 0.57	38.83 ± 1.08	469.40 ± 33.61
6	*Rosmarinus officinalis*	Romania	91.83 ± 0.45	69.30 ± 1.08	932.04 ± 27.44
7	*Mentha piperita*	Romania	91.36 ± 0.55	26.81 ± 0.31	364.49 ± 24.32
8	*Origanum vulgare*	Romania	91.07 ± 0.28	62.52 ± 2.86	692.01 ± 9.48
9	*Sideritis syriaca-malotira*	Romania	93.83 ± 0.25	80.56 ± 1.25	1025.60 ± 7.61
10	*Satureja thymbra*	Romania	93.23 ± 0.12	66.15 ± 5.17	820.55 ± 90.40
11	*Origanum majorana*	Romania	93.25 ± 0.30	53.64 ± 1.33	545.35 ± 16.22
12	*Satureja thymbra*	Greece	91.17 ± 0.13	72.78 ± 1.15	923.78 ± 41.39
13	*Origanum onites*	Greece	91.52 ± 0.29	60.41 ± 1.94	604.40 ± 19.79
14	*Sideritis syriaca-malotira*	Greece	93.33 ± 0.16	34.75 ± 0.46	411.46 ± 17.23
15	*Aloysia citrodora*	Greece	93.03 ± 0.08	54.73 ± 1.08	897.88 ± 33.81

Table 4. Chemical composition of tea samples

Code	Name of medicinal/aromatic plants	Cultivation	Plant weight (g)	V of water (mL)	Tea extraction time (min)	CTP (mg GAE/ 200 mL tea)	AA (mg TE/ 200 mL tea)
1	*Aloysia citrodora*	Romania	0.5	200	10	12.28 ± 0.15	193.38 ± 10.58
2	*Thymus vulgaris*	Romania	1	200	10	36.14 ± 2.58	533.81 ± 46.10
3	*Thymus citrodorus*	Romania	2	200	10	72.93 ± 2.67	1273.71 ± 11.26
4	*Salvia officinalis*	Romania	1.35	200	10	24.21 ± 1.02	347.84 ± 16.42
5	*Mentha spicata*	Romania	1.5	200	10	7.74 ±1.68	130.73 ± 29.11
6	*Rosmarinus officinalis*	Romania	1.4	200	20	6.91 ± 0.27	93.82 ± 4.75
7	*Mentha piperita*	Romania	1.5	200	10	18.35 ± 1.75	293.13 ± 17.68
8	*Origanum vulgare*	Romania	1.5	200	10	35.43 ± 1.53	521.86 ± 21.49
9	*Sideritis syriaca-malotira*	Romania	1	200	10	7.56 ± 1.41	111.95 ± 3.38
10	*Satureja thymbra*	Romania	0.8	200	10	33.09 ± 1.06	527.88 ± 59.80
11	*Origanum majorana*	Romania	-	-	-	-	-
12	*Satureja thymbra*	Greece	0.8	200	10	10.21 ± 0.32	121.13 ± 22.75
13	*Origanum onites*	Greece	0.7	200	10	12.88 ± 0.51	136.21 ± 10.29
14	*Sideritis syriaca-malotira*	Greece	1	200	10	2.54 ± 0.09	23.52 ± 2.79
15	*Aloysia citrodora*	Greece	0.5	200	10	3.75 ± 0.30	33.13 ± 3.34

Figure 6 shows the relationship between DPPH and TPC measurements in the dried MAPs leaf samples before and after their use as a decoction. Specifically, the data from Tables 3 & 4 have been used in the graph, in percentages, with the positive axis (+Y) chosen for the distribution of the percentages of nutrient reduction of MAPs from the spice form to the tea form. As can be seen, in the sample (3) the percentage change is -36.06% for DPPH and -3.99% for TPC. For the other samples, the rate of change is between (+19.58% - +96.31%) for the DPPH and (+31.54% - +93.15%) for the TPCs.

In order to assess the suitability and reliability of the methods used, linear regression and correlation analyses were carried out on the values, total antioxidant capacity and total phenolics, of the dried leaf samples of MAPs (Figure 8) and their infusion samples (Figure 9). The correlation of the percentages (Figure 6) representing the changes in the values of DPPH and TPC in the dry and wet samples is evaluated in Figure 7.

The coefficients of correlation (r) and coefficients of determination (r^2) were calculated using Microsoft Excel 2000. All (r) values are positive (r/tea = 0.99, r/dried plant = 0.89, r/change = 0.99), as are the (r^2) values (r^2/tea = 0.99 and r^2/dried plant = 0.80, r^2/change = 0.99). Therefore, we can easily conclude that the positive values and the linear correlation demonstrate, firstly, the relationship between total phenolics and antioxidant capacity and, secondly, the fact that phenolic compounds contribute significantly to the antioxidant properties of the selected plants (Tusevski et al., 2014).
The MAPs, *Thymus citrodorus* (RO), *Thymus vulgaris* (RO), *Origanum vulgare* (RO), used in the form of tea (infusion), appeared in the first 3 positions with the highest values of total phenolics and antioxidant capacity. In spice form (dried leaves), the highest bioactive compounds were measured in the samples of *Sideritis syriaca-malotira* (RO), *Satureja thumbra* (GR), *Thymus citrodorus* (RO) and *Rosmarinus officinalis* (RO). Although *Origanum vulgare* (RO), when used as a spice, received the highest score for taste, it did not rank among the best when tested for quality. It is worth mentioning that in studies with dry leaf samples, *Origanum vulgare* (from the region of Northern Macedonia) had twice as much phenolics (Tusevski et al., 2014), while the same plant from the region of Turkey (Kırca & Arslan, 2008) had 30% more than the sample of the present study.
Meanwhile, a study published in 2020 confirmed the significant contribution of *Rosmarinus officialis* to human health as one of the spices with the highest antioxidant content and antibacterial and anticancer activity (Kloy et al., 2020).
An academic study of MAP from the Pilion (Greece) found that the native *Thymus citrodorus*, followed by *Mentha spicata*, had the highest total phenolic content, with values of 56.33 and 33.53 mg GAE/g (Vengopoulos, 2020), while the corresponding values for the samples of this study are higher (70.13 and 38.83 mg GAE/g).
Our results are also consistent with those obtained in a study carried out with herbal infusions, which they wanted to highlight because they are considered one of the most consumed beverages in the world and are rich in polyphenolic compounds. In particular, the ratio between the antioxidant capacity values and the total phenolic content of *Mentha piperita* and *Aloysia citrodora* from the region of Argentina (Rodríguez et al., 2010) is the same as the corresponding ratio of the tea samples in this study, with different absolute values.
From the figures and tables of results, conclusions can be drawn for further research, as for example for *Aloysia citrodora*, which, according to the results, seems to be influenced, in addition to the environmental conditions, by the way in which it is cultivated. This can be deduced from the fact that the same herb cultivated in Thessaloniki has a lower antioxidant capacity and a lower total phenolic value than the corresponding one cultivated in Bucharest. Therefore, the method of cultivation (in rows or in a potting arrangement) is another topic for further research.
It was also observed that in a sample to which a combination of extracts of different MAPs was added, the antioxidant capacity was significantly higher than in the sample to which an extract of a single MAP was added (Kallipoliti & Christodoulou, 2021).
Another approach to the results of this study concerns the relationship between sensory and qualitative characteristics. For example, based on the results of the organoleptic analysis, *Origanum vulgare* (RO) received the highest percentage of positive taste ratings in tea form, while in the qualitative analysis, it was among the top MAPs with the highest total phenolics and antioxidants.

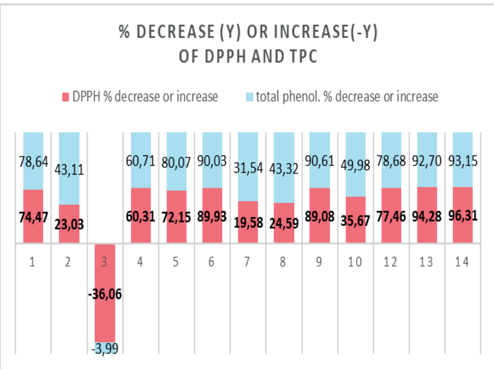

Figure 6. Change in AA & TPC values

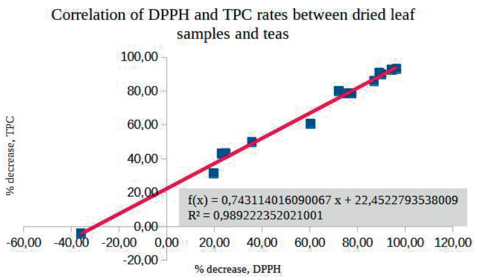

Figure 7. Correlation of AA & TPC

Many factors could explain the difference between the results of this study and those in the literature, such as the growing conditions of MAPs, the season and method of harvesting (Lemos et al., 2017), and even the way the leaves are dried. This is an issue that has been of interest to the scientific community, and the result of a study, mentions the fact that fresh *Origanum vulgare* has a higher content of total phenolics than the dried plant. It is also reported that the corresponding commercial samples have lower prices of bioactive ingredients than the dried ones grown in a personal space. In addition, using different Lamiaceae herbs has been shown to increase antioxidant and antibacterial activity (Chan et al., 2012).

It seems that Rababah et al. (2015) considered drying to be an important factor in altering the bioactive compounds, as he studied the phenomenon and showed that the selected MAPs had higher levels of bioactive compounds in fresh form than in dried form. He even showed that natural drying of the plants in a room was better than oven drying.

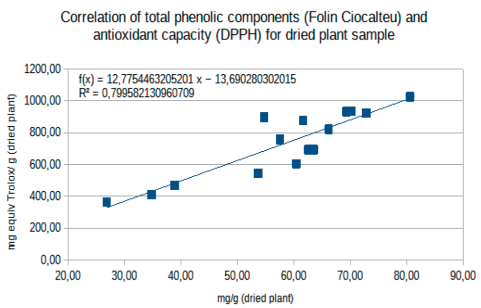

Figure 8. Correlation of values DPPH & TPC (dried plant)

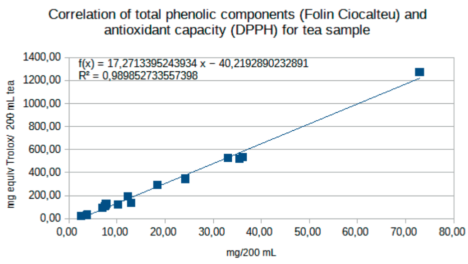

Figure 9. Correlation of values DPPH & TPC (tea)

CONCLUSIONS

The MAPs approach adopted in this study is a contribution to the research field of the evaluation of Mediterranean MAPs, using 5 different flavour propositions belonging to the Mediterranean diet.

The results obtained show that the methods used have the potential to highlight to a large extent the organoleptic and bioactive characteristics of the selected plant species. It is concluded that the combination of these methods can categorise MAPs with a view to their use in urban horticulture. Furthermore, the results showed that some MAPs are an important source of phenolic compounds with high antioxidant capacity and with pleasant acceptance by consumers. Therefore, the consumer can take advantage of these properties by growing the plant in a private space to use it fresh or with controlled drying.

The criteria influencing the organoleptic and quality characteristics of MAPs are discussed in this study. It provides a framework for future research to deepen the multifaceted role that herbs should have in human daily life, urban horticulture, urban planning, and healthy eating. In conclusion, the results of the study offer urban dwellers the opportunity to choose the combination of aromatic/medicinal plants for home cultivation and consumption according to their nutritional and sensory needs.

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