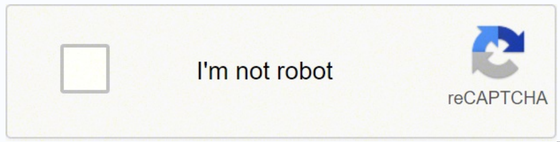

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81309328660 10782226.635135 7962129.9411765 13475010.346667 11542732.159091 99357318984 10321471.136986 24329107.195122 74128961590 98757858684 190826837568 80299855080 5424633384 8237558.3833333 11607746460 21363128549

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Correlation matrix (Pearson's correlation coefficients) for the 12 study species. aculeatus0.007R. Nat. unedo are the ones with the highest phenol content. This difference was similarly quantified by [20], who reported that the species with the highest total phenol content was P. unedo0.012 ± 0.001−−−R. Metodología Para la Evaluación de Ingredientes Funcionales Antioxidantes: Efectos de Fibra Antioxidante de Uva en Status Antioxidante Y Parámetros de Riesgo Cardiovascular en Humanos. aculeatus, with values of 0.0135–0.0068 QE (mg/mg dw) and 0.00304–0.00037 QE (mg/mg dw) for DPPH and ABTS, respectively.The dendrogram obtained by RP divided the species into three groups. lentiscus and C. unedo, and P. The species with the highest total phenol value was C. The methodology applied in DPPH, ABTS and Folin-Ciocalteau assays has a large influence on the determined antioxidant potential. Table 2. officinalis, P. [Google Scholar] [CrossRef]Lawrence, B.M. Chemical components of Labiatae oils and their exploitation. The calibration line was established using the following concentrations of FeSO4: 0.0025, 0.005, 0.01, and 0.02 mg/mL.The antioxidant activity of the study plant extracts against ABTS was determined by the method described by [39]. Comparative study of antioxidant properties and total phenolic content of 30 plant extracts of industrial interest using DPPH, ABTS, FRAP, SOD, and ORAC assays. Epicuticular flavonoid aglycones in the genus Cistus, Cistaceae. ladanifer, E. unedo0.035 ± 0.000080.098 ± 0.0030.139 ± 0.00090.146 ± 0.00008R. stoechas was quantified.The values obtained with RP show again R. 2005, 53, 4290–4302. [Google Scholar] [CrossRef]Vogt, T.; Proksch, P.; Gülz, P.-G. Pharm. Nutrients 2014, 6, 6020–6047. The aim of this work was to verify whether different methods show the same sensitivity and/or capacity to discriminate the antioxidant activity of the extract of different plant species. Anim. [Google Scholar] [CrossRef] [PubMed]Li, A.-N.; Li, S.; Zhang, Y.-J.; Xu, X.-R.; Chen, Y.-M.; Li, H.-B. The second group comprised R. Studies conducted by [20] also showed that the higher or lower activity attributed to a species depended on the methods used, such as ABTS, DPPH, and FRAP, although, in disagreement with our results, these authors [20] reported that P. However, the present study results show that this assertion is not correct.On the one hand, comparing the three methods in which quercetin was used as a reference pattern (DPPH, ABTS, and RP), it can be observed that the quantified antioxidant activity was not the same. 2015, 7, 1225–1241. Some of these plants have been used as folk remedies for generations after preparation in traditional ways, such as cooking, infusion, or maceration. angustifolia5.736.67P. [Google Scholar] [CrossRef] [PubMed]Schaich, K.M.; Tian, X.; Xie, J. Figure 1. [Google Scholar] [CrossRef]Amessis-Ouchemoukh, N.; Madani, K.; Falé, P.L.V.; Serralheiro, M.L.; Araújo, M.E.M. Antioxidant capacity and phenolic contents of some Mediterranean medicinal plants and their potential role in the inhibition of cyclooxygenase-1 and acetylcholinesterase activities. Jpn. [Google Scholar] [CrossRef]Singleton, V.L.; Rossi, J.A. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagent. 2011, 66, 58–63. Table A4. stoechas, according to DPPH, FRAP, ABTS, and RP, respectively. Grouping of species based on their antioxidant activity by the different methods used. Comparison between the radical scavenging activity and antioxidant activity of six distilled and nondistilled mediterranean herbs and aromatic plants. The absorbance decrease was measured at 734 nm in a UV-30 spectrophotometer. 2005, 119, 323–331. officinalis0.010P. Therefore, as it showed the best discrimination of differences and/or similarities between species, RP is considered in this study as the one with the highest sensitivity among the four studied methods. stoechas0.053D. (a) 2,2-di-phenyl-1-picrylhydrazyl (DPPH) radical scavenging capacity assay; (b) Trolox equivalent antioxidant capacity (ABTS) assay; (c) reducing power (RP) assay; (d) ferric reducing (FRAP) assay. gnidium, L. Determination of total content of phenolic compounds and their antioxidant activity in vegetables evaluation of spectrophotometric methods. stoechas quantified by the different methods. On the other hand, ABTS was the method with the lowest sensitivity, since the dendrogram differentiated only two groups and established very little difference between the species that constituted those groups.Given the results obtained in this study, it can be concluded that the four methods used can quantify the antioxidant activity of the 12 selected plant species, although the categorization established among the species depends on the method used. Antioxidant assays for plant and food components. On the other hand, each method categorized or ordered the study species in a different manner depending on their antioxidant activity. officinalis0.010 ± 0.00010.052 ± 0.00050.101 ± 0.0030.191 ± 0.002L. gnidium0.011 ± 0.00090.027 ± 0.0020.038 ± 0.0020.081 ± 0.002T. ladanifer and P. The dendrograms were performed with the nearest neighbor algorithm using the IBM SPSS Statistics V25.0 software. They can be divided into two groups: hydrogen-atom transfer (HAT) (hydrogen atom transfer reactions) and single electron transfer (SET) (compound reduction reactions through electron transfer from an antioxidant) [11,12]. stoechas0.001 ± 0.00040.009 ± 0.000050.015 ± 0.0004−E. SpecieExtract Concentration0.1 mg/mL0.5 mg/mL1 mg/mL2 mg/mLC. 2008, 37, 93–95. Their extracts were analyzed using the following methods: 2,2-di-phenyl-1-picrylhydrazyl (DPPH) radical scavenging capacity assay, ferric reducing (FRAP) assay, Trolox equivalent antioxidant capacity (ABTS) assay, and reducing power (RP) assay. Total phenols were expressed in gallic acid equivalents and quercetin equivalents (GAE and QE, respectively).As can be observed, the amounts of total phenols varied between species from 0.0364 to 0.0028 GAE (mg/mg dw) and from 0.026 to 0.002 QE (mg/mg dw). lentiscus0.0711 ± 0.0040.078 ± 0.004−− Table A3. gnidium, and T. Species ordered from lower to higher antioxidant activity by method (DPPH, FRAP, ABTS, and RP). angustifolia0.016E. The antioxidant activity values quantified through DPPH and RP were higher than the ones obtained by ABTS and FRAP, and these values varied among species. lentiscus was very similar to the value obtained in the present study, which was 1.35 times higher. stoechas, and R. The calibration lines were established using 0.001, 0.005, 0.01, and 0.02 mg/mL of gallic acid and quercetin, respectively.The antioxidant activity of the plant extracts against DPPH was determined using the method proposed by [37]. The species with the highest antioxidant activity quantified by this method was P. [Google Scholar] [CrossRef]Guerreiro, O.; Alves, S.P.; Duarte, M.F.; Bessa, R.J.B.; Jerónimo, E. To avoid this, cells have a complex antioxidant system with enzymatic and non-enzymatic elements. Phenolic content (TPC) and antioxidant activity by 2,2-di-phenyl-1-picrylhydrazyl (DPPH) radical scavenging capacity assay, ferric reducing (FRAP) assay, Trolox equivalent antioxidant capacity (ABTS) assay, and reducing power (RP) assay methods in methanolic extract of 12 selected species. Plants have a large number of bioactive compounds with high antioxidant activity. albidus0.056C. aculeatus (0.0004 QE mg/mg dw). Temporal, plant part, and interpopulation variability of secondary metabolites and antioxidant activity of Inula helenium L. albidus with respect to P. Food Compos. In Advances in Labiate Science; Harley, R.M., Reynolds, T., Eds.; Royal Botanic Gardens, Kew: Richmond, UK, 1992; pp. [Google Scholar] [CrossRef]Vanzani, P.; Rossetto, M.; De Marco, V.; Sacchetti, L.E.; Paoletti, M.G.; Rigo, A. [Google Scholar] [CrossRef]Cömert, E.D.; Gökmen, V. Hurdles and pitfalls in measuring antioxidant efficacy: A critical evaluation of ABTS, DPPH, and ORAC assays. Aliquots of 0.1 mL of methanolic extract of each sample (at 4 different concentrations: 0.1, 0.5, 1, and 2 mg/mL; two replicates per sample and concentration) had 3.9 mL of the ABTS•+ dilution added. 2004, 85, 231–237. Antioxidantes: Importancia biológica y métodos para medir su actividad. High correlation of 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging, ferric reducing activity potential and total phenolics content indicates redundancy in use of all three assays to screen for antioxidant activity of extracts of plants from the malaysian rainforest. officinalis0.013L. Such analysis produced the dendrograms or diagrams shown in Figure 1.At a distance of 15 units, the dendrograms show that, for DPPH and ABTS, the species were divided into two groups, with the same species constituting these groups for both of the methods. aculeatus0.0038 ± 0.0030.019 ± 0.001−0.094±0.001D. lentiscus.It is necessary to highlight that this categorization may serve as a useful tool for the selection of species with higher or lower antioxidant activity. albidus0.023C. stoecha and D. These species belong to the families Cistaceae (Cistus ladanifer L., Cistus salvifolius L., and Cistus albidus L.), Ericaceae (Erica australis L. Cistus ladanifer L. Anal. australis0.023P. The antioxidant activity values quantified for each of the species correspond to an extract concentration of 0.1 mg/mL. aculeatus0.007 ± 0.00010.0094 ± 0.00010.013 ± 0.0030.023 ± 0.001D. The results of different methods for different species should be analyzed using descriptive procedures of multivariate statistical techniques to establish the best method that allows ordering or selecting the plant extracts according to their level of antioxidant activity.The available methods to quantify antioxidant activity can be classified based on the mechanism of action by which the applied compounds stop chain-breaking reactions. 2009, 123, 237–243. lentiscus, and L. The Mediterranean region is characterized by heterogeneous soil and climatic conditions that have produced more than 10,000 medicinal and aromatic plant species with diverse properties worthy of further investigation [15,16]. 2006, 19, 669–675. ladanifer0.027 ± 0.0030.019 ± 0.0020.030 ± 0.0020.010 ± 0.0030.022 ± 0.0030.071 ± 0.004C. Antioxidant activity and phenolic compounds in 32 selected herbs. officinalis0.003 ± 0.00010.017 ± 0.00040.034 ± 0.0003−L. Food Control 2013, 30, 354–363. officinalis0.013 ± 0.00040.044 ± 0.0010.084 ± 0.0010.144 ± 0.0003L. lentiscus is one of the typical species of the Mediterranean undergrowth with the highest total phenol content [50,51,52]. Crops Prod. [Google Scholar] [CrossRef]Milan, C.; Hana, C.; Petko, D.; Maria, K.; Anton, S.; Antonín, L. ladanifer0.010C. stoechas0.008D. aculeatus0.006 ± 0.00020.011 ± 0.0010.026 ± 0.0050.080 ± 0.0001D. These results show the importance of selecting the proper antioxidant activity quantification method for establishing a ranking of species based on this parameter. Values expressed in quercetin equivalents (mg/mg dw) (quercetin equivalents (QE)) for DPPH, ABTS and RP, and in FeSO4 equivalents (mg/mg dw) (FeSO4 E) for FRAP. Erica australis and Arbutus unedo are also characterized for their high content of phenolic compounds and, particularly, condensed tannins [22,23]. stoechasP. [Google Scholar] [CrossRef]Ammar, H.; López, S.; González, J.S. Assessment of the digestibility of some Mediterranean shrubs by in vitro techniques. stoechas (0.008 QE mg/mg dw). officinalis0.0481 ± 0.0020.074 ± 0.00050.080 ± 0.0030.089±0.0008L. lentiscus, C. aculeatus (0.004 FeSO4 E mg/mg dw), and that the highest antioxidant activity corresponded to C. Czech J. unedo0.026C. italica L.) leaf, stem and flower. [Google Scholar] [CrossRef] [PubMed]Lehmann, J.; Große-Stoltenberg, A.; Römer, M.; Oldeland, J. [Google Scholar] [CrossRef]Dávalos, A.; Gómez-Cordovés, C.; Bartolomé, B. salvifolius, P. The absorbance increase was measured at 593 nm in a UV-30 spectrophotometer (GIORGIO-BORMAC SRL, Carpi, Italy). Technol. [Google Scholar] [CrossRef]González-Burgos, E.; Gómez-Serranillos, M.P. Terpene compounds in nature: A review of their potential antioxidant activity. Numerous studies have also reported this correlation [20,31,55,56,57], and some authors, such as [58], propose that, given the high correlation between the DPPH and FRAP methods, the use of more than one method to quantify antioxidant activity is redundant. fruticans0.014 ± 0.0010.010 ± 0.00080.011 ± 0.00060.001 ± 0.000010.012 ± 0.00010.031 ± 0.001D. aculeatus and C. [Google Scholar] [CrossRef]Moon, J.-K.; Shibamoto, T. The methods also differ in sensitivity when establishing differences in the antioxidant activity of the species. [Google Scholar] [CrossRef]Carović-Stanko, K.; Petek, M.; Grdiša, M.; Pintar, J.; Bedeković, D.; Herak Ćustić, M.; Satovic, Z. australis0.022 ± 0.00090.078 ± 0.00050.121 ± 0.0010.146 ± 0.001A. [Google Scholar]Pang, Y.; Ahmed, S.; Xu, Y.; Beta, T.; Zhu, Z.; Shao, Y.; Bao, J. 2006, 97, 654–660. Ph.D. Thesis, Universidad Autónoma de Madrid, Madrid, Spain, 2007. One of these mechanisms is the prevention of oxidative stress, keeping ROS under dangerous levels [48], and using them for efficient signaling [49]. aculeatus as the species with the lowest antioxidant activity (0.006 QE mg/mg dw), followed by L. These results show the importance of selecting the right method to quantify the antioxidant activity of plant extracts, especially when selecting among a group of potential species. albidus0.025 ± 0.0010.018 ± 0.00070.023 ± 0.00020.009 ± 0.00060.018 ± 0.00030.056 ± 0.003E. fruticans, R. unedo0.035C. Food Chem. Unfavorable conditions for plants, such as extreme temperature, drought, heavy metals, nutrient deficiencies, and high salinity, generate high concentrations of reactive oxygen species (ROS), which can cause oxidative stress. Remote Sens. australis, with values between 0.0347 and 0.0224 QE (mg/mg dw) for the DPPH method and between 0.014 and 0.009 QE (mg/mg dw) for the ABTS method. Antioxidant properties of phenolic compounds. Lipids 2015, 50, 493–501. albidus and P. The species with the highest values were A. The Lamiaceae are an important family of medicinal plants [27], where most species are aromatic and have essential oils [28,29]. lentiscus0.071C. lentiscus, with 0.031 QE mg/mg dw, establishing a 5-fold difference with R. salvifolius0.032P. aculeatus, which was the species categorized by all the methods with the lowest antioxidant activity, the order established for the rest of the species depended on the method used. angustifolia0.016 ± 0.0010.052 ± 0.0010.093 ± 0.0010.160 ± 0.002P. albidus0.009C. DPPHFRAPABTSPRSpecieQESpecieFeSO4 ESpecieQESpecieQER. Chem. [Google Scholar]Özkan, M. lentiscus0.012 ± 0.0005−−− Table A4. angustifolia, with 0.0177 and 0.0157 QE mg/mg dw, respectively, and the third group comprised T. Agric. stoechasE.australisL. Slov. fruticans0.001L. fruticans0.011 ± 0.00060.029 ± 0.0010.052 ± 0.00010.094 ± 0.007P. acuelatus, the species with the lowest activity were L. Ruscus aculeatus and Phyllirrea angustifolia species are characterized by their very low content of total phenols [20,35].The location selected for the collection of the different species was in the foothills of the San Pedro mountain range, Badajoz, Spain (39°09′04″ N, 6°52′10″ W).In April 2019, we collected 500 g of each of the species from above-ground plant material of different, randomly selected individuals. Plant Foods Hum. On the one hand, we selected six species with high phenolic content. This selection was based on the number of phenolic compounds they contained. To obtain a grouping of species based on the antioxidant activity quantified by the different methods used, the values were subjected to cluster analysis. Thus, the hierarchization or categorization of these species was different depending on the method used. albidus0.018C. [Google Scholar] [CrossRef]Miliauskas, G.; Venskutonis, P.R.; van Beek, T.A. Screening of radical scavenging activity of some medicinal and aromatic plant extracts. For instance, the relationship between the species categorized with the highest antioxidant activity in each of the methods (A. ladanifer, P. gnidium0.014 ± 0.0010.010 ± 0.00060.011 ± 0.00090.003 ± 0.00060.009 ± 0.00030.014 ± 0.0002L. 2009, 57, 1655–1666. The total phenol content varies depending on the plant species, plant tissue, developmental stage, and environmental factors, such as temperature, water stress, and light conditions [46,47].Mediterranean plants live in habitats with extreme environmental conditions (high temperatures, water stress, and high light irradiation in summer), for which they have developed different adaptive mechanisms, both morphological and physiological. The calibration line was established using the following concentrations of quercetin: 0.001, 0.002, 0.005, 0.01, 0.02, and 0.04 mg/mL.The FRAP assay was conducted following the method described by [38]. These prior findings might leads us to conclude that any of the methods used in this study could be used to determine and categorize the antioxidant activity of these species, obtaining results without significant differences between them. The branches of the dendrogram allow visualizing the relationships between the different species, and it was this method, RP, that established the largest number of groups at the lowest root distance. unedo0.026 ± 0.0020.097 ± 0.0010.172 ± 0.001−R. officinalis0.048R. stoechasC. 2006, 54, 607–616. They were left to macerate for 24 h in a shaker at room temperature. [Google Scholar] [CrossRef]Chaabane, F.; Boubaker, J.; Loussaif, A.; Neffati, A.; Kilani-Jaziri, S.; Ghedira, K.; Chekir-Ghedira, L. Phytochem. Acta Chim. Thus, it is important to note that antioxidant compounds can respond in a different manner to different radical or oxidant compounds. ladaniferL. Appendix A shows the tables with the antioxidant activity data, quantified by the different methods, at the different extract (0.1, 0.5, 1, and 2 mg/mL) (Table A1, Table A2, Table A3 and Table A4). Prod. Identification and quantification of galloyl derivatives, flavonoid glycosides and anthocyanins in leaves of Pistacia lentiscus L. stoechas0.001D. The systematic investigation of such plants will help to define their precise pharmacological properties and to determine their value as functional foods and as a source of nutraceutical compounds, such as novel antioxidants [7,8]. ladanifer, C. and Arbutus unedo L.), and Anarcadiaceae (Pistacia lentiscus L.). A methanolic dilution of DPPH 1 × 10−4 M was prepared. Resources and biological activities of natural polyphenols. Chang. 2010, 30, 11–18. SpeciesDPPH/ABTSRP/ABTSC. australis, and P. fruticans0.001 ± 0.00010.010 ± 0.00080.020 ± 0.00070.033 ± 0.00001P. Thus, studies for the determination of the antioxidant activity of the extract of different plant species could contribute to establishing the value of these species as a source of new antioxidant compounds [7,8].The first step to quantify the antioxidant activity of a plant extract is to select the right method [9]. This method established a difference of around five times more antioxidant activity for A. salvifolius0.013 ± 0.0002−−−C. [Google Scholar] [CrossRef]Upadrasta, L.; Mukhopadhyay, M.; Banerjee, R. The first group was constituted by P. 1965, 16, 144–158. 2006, 94, 550–557. Among these molecules, the compounds derived from secondary metabolism, specifically phenolic compounds, play a fundamental role against oxidative stress [2]. BMC Complement. Antiinflammatory and phytochemical properties of twelve medicinal plants used for treating gastrointestinal ailments in South Africa. salvifolius0.027 ± 0.0010.125 ± 0.004−−C. 2010, 48, 3125–3130. [Google Scholar]Thaipong, K.; Boonprakob, U.; Crosby, K.; Cisneros-Zevallos, L.; Byrne, D.H. Comparison of ABTS, DPPH, FRAP, and ORAC assays for estimating antioxidant activity from guava fruit extracts. lentiscus0.031 ± 0.0030.117 ± 0.004−− Barua, C.C.; Sen, S.; Das, A.S.; Talukdar, A.; Jyoti Hazarika, N.; Barua, A.; Barua, I. lentiscus0.012E. Free radical scavenging, antioxidant enzymes and wound healing activities of leaves extracts from Clerodendrum infortunatum L. From the obtained results, RP was the method that generated the largest number of groups, comparing all the methods, at a distance of 15 units. unedo0.065A. 1997, 25, 429–435. salvifolius0.027A. [Google Scholar] [CrossRef] [PubMed]Garry, C.; Kang Nee, T.; Christophe, W.; Jeffrey, F. gnidium, T. Moreover, unlike in the other methods, this sensitivity remained constant throughout the entire range of antioxidant activity attributed to the analyzed plant species. Hormesis and a chemical Raison D'être for secondary plant metabolites. Nutr. albidus0.018 ± 0.00030.077 ± 0.0020.125 ± 0.001−R. albidus2.571.97R. Pharmacol. The blank was prepared by substituting the same amount of diluted extract with methanol. Trends Plant Sci. The correlation coefficients were calculated with Pearson's test using the R statistical software. [Google Scholar]Duthie, G.G.; Duthie, S.J.; Kyle, J.A.M. Plant polyphenols in cancer and heart disease: Implications as nutritional antioxidants. Vitic. lentiscus) and one of the species with low antioxidant activity, such as L. lentiscus, with a value 11.6 times higher than that of the species with the lowest concentration, which was R. fruticans0.011P. [Google Scholar] [CrossRef]Gouthamchandra, K.; Mahmood, R.; Manjunatha, H. lentiscus, and A. Relationship between the antioxidant activity of A. Exp. Phenolic compounds also have protective effects on humans when the plants are consumed as food [3]. Compr. Generally, the antioxidant capacity of phenols in plant extracts is effective at low concentrations, and in humans, it is associated with the prevention of cardiovascular disease and cancer [4,5,6]. [Google Scholar] [CrossRef]Djeridane, A.; Yousfi, M.; Nadjemi, B.; Boutassouna, D.; Stocker, P.; Vidal, N. Once dry, the leaves were ground in a mechanic grinder to obtain a homogenous powder.For the extraction, 20 g of each of the samples were weighed out, and 200 mL of methanol was added to each of these 20-g samples. ladanifer0.030 ± 0.0020.086 ± 0.00050.127 ± 0.0030.146 ± 0.0003C. Antioxidant capacity by reductor power methods in methanolic extract of 12 selected species at different concentration expressed as quercetin equivalent mg/mg dw. officinalis0.022 ± 0.0010.015 ± 0.0010.013 ± 0.0020.003 ± 0.00010.010 ± 0.00010.048 ± 0.002P. On the other hand, the species with the lowest total phenol content was R. Plant Resour. 2014, 53, 6–15. angustifolia0.002 ± 0.0010.014 ± 0.0010.024 ± 0.0005−P. All this makes it difficult to hierarchize plants based on the antioxidant activity of their extracts. The values obtained by DPPH and RP were similar, whereas those obtained by ABTS were lower; in fact, these differences depended on the species analyzed. aculeatus0.0004 ± 0.00050.002 ± 0.00080.005 ± 0.00020.010 ± 0.0007D. ladanifer0.0713 ± 0.0020.083 ± 0.0010.094 ± 0.002−C. 2010, 13, 206–212. aculeatus (0.007 QE mg/mg dw), followed by L. Plant Biol. Medicinal plants of the family Lamiaceae as functional foods—A review. Thus, with some of these methods, the differentiation between species is lower than that obtained with other methods. Secondary metabolites of plants, specifically phenols, can adjust the concentration of ROS, thus activating a network of biochemical events to increase tolerance, hence the importance of studying the antioxidant activity of typical plant species of Mediterranean habitats.The analysis of total phenols in the 12 Mediterranean shrub species selected shows that C. Glob. australis0.023 ± 0.0010.078 ± 0.0030.131 ± 0.003−A. salvifolius0.036 ± 0.0040.026 ± 0.0030.032 ± 0.0010.013 ± 0.00020.027 ± 0.0010.057 ± 0.003P. gnidium, with 0.008 and 0.009 QE mg/mg dw, respectively. The other two species with the lowest antioxidant activity were L. Antioxidant capacity by ABTS methods in methanolic extract of 12 selected species at different concentration expressed as quercetin equivalent mg/mg dw. stoechas could be discarded compared to the other species; however, with FRAP, this species should be taken into account. [Google Scholar] [CrossRef] [PubMed]Tardieu, F.; Tuberosa, R. 2002, 8, 281–288. 2011, 73, 146–151. fruticans10.311.6P. 399–436. gnidium0.0142 ± 0.00020.074 ± 0.0050.089 ± 0.00020.117±0.003T. Med. fruticans (0.001 QE mg/mg dw for both). Specifically, DPPH quantified between 1.5 and 18.4 times more antioxidant activity than ABTS depending on the plant extract evaluated, and RP quantified between 1.6 and 16.5 times higher antioxidant activity (Table 4). A significant correlation was obtained between the different methods. Phytochemical composition of Corsican Teucrium essential oils and antibacterial activity against foodborne or toxi-infectious pathogens. Ecol. Antioxidants 2013, 2, 1–10. In our study, the four methods used to quantify the antioxidant activity of the 12 selected species showed the antioxidant capacity of these. [Google Scholar] [CrossRef]Rajurkar, N.S.; Hande, S.M. Estimation of phytochemical content and antioxidant activity of some selected traditional indian medicinal plants. Table A1. fruticans, with values between 0.0713 and 0.0312 FeSO4 E mg/mg dw, and the second group comprised D. Foods 2015, 14, 111–125. The blank was prepared with the methanolic dilution of DPPH.The results were expressed in milligram equivalents of quercetin per milligram of dry weight. fruticans0.012 ± 0.00010.040 ± 0.0030.077 ± 0.0010.144 ± 0.002P. acuelatus and L. Table A3. Res. lentiscus0.034 ± 0.0030.024 ± 0.0040.030 ± 0.0040.012 ± 0.00050.031 ± 0.0030.071 ± 0.002A. unedo with respect to R. For example, the species with the highest antioxidant activity was A. In plants, the main compounds with antioxidant activity are phenols, as they have an aromatic ring that allows the stabilization and relocation of the unpaired electrons of their structure, thus facilitating the donation of hydrogen atoms and electrons from their hydroxyl groups [44,45]. salvifolius, C. [Google Scholar] [CrossRef]Oyaizu, M. Dose Response 2011, 9, 79–116. 1999, 37, 124–130. Therefore, since it better differentiated the differences and/or similarities between species, it was considered as the most sensitive method. The blank was prepared by substituting the same amount of diluted extract with methanol.The results were expressed in milligram equivalents of FeSO4 per milligram of dry weight. Biol. Values are the mean of two replicates ± standard deviation. A cluster revealed that RP established the largest number of groups at the shortest distance from the root. australis, C. This reagent was previously prepared by mixing 10 parts of 300 mM sodium acetate buffer solution at pH 3.6, 1 part of 10 mM TPZT, and 1 part of 20 mM FeCl3 hexahydrate (Alfa Aesar, Kandel, Germany).The resulting mix was incubated for 30 min at 37 °C. SpeciesTPCTPCDPPHABTSRPFRAP(AGE mg/mg dw)(QE mg/mg dw)(FeSO4 E mg/mg dw)C. [Google Scholar] [CrossRef] Figure 1. unedoL. aculeatus, with values between 0.0121 and 0.0061 QE mg/mg dw.The FRAP method established two groups of species. 2016, 22, 3–17. Radical ABTS•+ was prepared through oxidation of ABTS by potassium persulfate. stoechas0.0530 ± 0.010.071 ± 0.0020.080 ± 0.0060.082±0.001E. Am. J. Table A2. The blank was prepared with ABTS•+.The results were expressed in milligram equivalents of quercetin per milligram of dry weight. albidus, L. Environ. [Google Scholar] [CrossRef]Nićiforović, N.; Mihailović, V.; Mašković, P.; Solujić, S.; Stojković, A.; Muratspahić, D.P. Antioxidant activity of selected plant species; potential new sources of natural antioxidants. Hydrogen atom transfer reaction assays include the crocin bleaching assay, the total peroxyl radical-trapping antioxidant parameter (TRAP) assay, total oxyradical scavenging capacity (TOSC) assay, and the oxygen radical absorbance capacity (ORAC) assay [11,13].From a pool of species, selecting those with higher antioxidant activity requires knowing the method to be applied. Plant Biosyst. ladanifer0.030E. stoechas, shows a difference that varies with the method used (Table 5). Appetite 2004, 43, 147–154. angustifolia0.013R. Preference for natural: Instrumental and ideational/moral motivations, and the contrast between foods and medicines. The 1.3-fold difference reported in that study for P. The first group was formed by C. Considering this aspect, the difference in the quantified antioxidant activity between species varies depending on the method. Microchim. This concentration was selected for being the only one, among all the concentrations analyzed, that remained in the absorbance values of the patterns for all four methods. australis0.058P. 2014, 4, 8–18. Acta 2008, 160, 413–419. Aliquots of 1 mL of methanolic extract of each sample (at 4 different concentrations: 0.1, 0.5, 1, and 2 mg/mL; two replicates per sample and concentration) were mixed with 2.5 mL of 0.2 mM phosphate buffer solution at pH 6.6 and 2.5 mL of 1% potassium ferrocyanide.The mixture was incubated for 20 min at 50 °C in a water bath. angustifolia0.0419 ± 0.0070.079 ± 0.00020.082 ± 0.00020.091±0.002P. salvifolius, followed by A. In Chemistry and Biotechnology of Polyphenols; Sabu, A., Roussos, S., Aguilar, C.N., Eds.; Cibet Publishers: Thiruvananthapuram, India, 2011; pp. 2011, 76, 46–51. [Google Scholar]Wong-Paz, J.E.; Contreras-Esquivel, J.C.; Rodríguez-Herrera, R.; Carrillo-Inungaray, M.L.; López, L.I.; Nevárez-Moorillón, G.V.; Aguilar, C.N. Total phenolic content, in vitro antioxidant activity and chemical composition of plant extracts from semiarid Mexican region. fruticans0.0312 ± 0.0010.081 ± 0.0020.093 ± 0.0020.114±0.002P. [Google Scholar] [CrossRef]Djabou, N.; Lorenzi, V.; Guinoiseau, E.; Andreani, S.; Giuliani, M.-C.; Desjobert, J.-M.; Muselli, A. fruticans, and L. Statistical significance was established at $p < 0.05$.Table 1 shows the values of the total phenol content and antioxidant activity quantified by the DPPH, ABTS, FRAP, and RP methods for the 12 plant species selected. Values are the mean of three replicates (TPC) and two replicates (DPPH, ABTS, RP, and FRAP) ± standard deviation. The implications of oxidative stress and antioxidant therapies in Inflammatory Bowel Disease: Clinical aspects and animal models. 2010, 48, 1362–1370. 1986, 44, 307–315. Consequently, extracts showing poor antioxidant properties with one concrete method should not be discarded as poor sources of antioxidants without having been tested with other methods.Another aspect that differs among the methods used in this study is the sensitivity obtained with each of them. 2018, 240, 212–221. In fact, only one species, Eucaliptus camaldulensis, provided similar values with the two methods. Wild Mediterranean plants as traditional food: A valuable source of antioxidants. Different methods for control and comparison of the antioxidant properties of vegetables. australis1.561.63A. These four SET methods were used to quantify the antioxidant activity of the methanolic extract of 12 selected plant species based on their total phenolic composition.Twelve species of the Mediterranean undergrowth were selected. angustifolia0.019 ± 0.0020.014 ± 0.0010.013 ± 0.00040.002 ± 0.0010.016 ± 0.0010.042 ± 0.007T. aculeatus0.0004R. Thus, this study aimed to determine whether different methods have the same sensitivity and/or capacity to discriminate the antioxidant activity of the extract of different species. gnidium0.009T. lentiscusL. aculeatus, with 0.0142 and 0.0038 FeSO4 E mg/mg dw, respectively.Due to the use of numerous plant species as a source of phytotherapeutic products, the study of their antioxidant activity has boomed in recent years [41,42,43]. australis0.014 ± 0.006−−−A. 2011, 145, 848–856. lentiscus, according to DPPH, FRAP, ABTS, and RP, respectively. lentiscus2.542.58 Table 5. Antioxidant capacity by FRAP methods in methanolic extract of 12 selected species at different concentration expressed as FeSO4 equivalent mg/mg dw. aculeatus, followed by L. lentiscus, both with 0.071 FeSO4 E mg/mg dw. [Google Scholar] [CrossRef] [PubMed]Romani, A.; Pinelli, P.; Galardi, C.; Mulinacci, N.; Tattini, M. Regarding the antioxidant activity quantified by ABTS, the species with the highest values were E. Then, the samples were filtered with grade 1 Whatman paper (Whatman International Ltd., Maidstone, England). unedo and P. Another difference established between these methods was the sensitivity obtained with each of them. australis, P. The results were expressed as the mean of the values obtained for the replications. These compounds are known to act as antioxidants not only for their ability to donate hydrogen or electrons but also because they are stable radical intermediates [3]. fruticans0.031L. [Google Scholar] [CrossRef] [PubMed]Romani, A.; Baldi, A.; Mulinacci, N.; Vincieri, F.F.; Tattini, M. The calibration line was established using the following concentrations of quercetin: 0.002, 0.0041, 0.0076, and 0.012 mg/mL.All the methods were carried out in duplicate, except for the total phenols, which were conducted in triplicate. ladanifer0.010 ± 0.003−−−C. stoechas0.008 ± 0.000080.022 ± 0.000080.035 ± 0.0010.078 ± 0.001E. unedo, C. (Lamiaceae) in Turkey. [Google Scholar] [CrossRef]Fawole, O.A.; Ndhlala, A.R.; Amoo, S.O.; Finnie, J.F.; Van Staden, J. [Google Scholar]Rice-Evans, C.; Miller, N.; Paganga, G. salvifolius, A. Then, 2.5 mL of 10% trichloroacetic acid was added, and the mixture was centrifuged a 3000 rpm for 10 min. There is a large variety of methods to determine this parameter [10], and the variability of experimental conditions found in the literature for each of the methods hinders such selection and the possibility of easily comparing the obtained results with those of other authors. angustifolia, and T. Daphne gnidium species was selected for its low, although major, concentration of flavonoids [34]. lenticus, with 0.035, 0.032, 0.030 and 0.030 QE mg/mg dw, respectively. The calibration line was established using the following concentrations of quercetin: 0.00062, 0.00125, 0.0025, 0.005, 0.01, and 0.032 mg/mL.The reducing power of the plant extracts was determined by the method described by [40]. Ethnopharmacol. 2017, 16, 382–399. The molecules of the non-enzymatic system have different action mechanisms, such as enzyme inhibition, chelation of trace elements involved in the production of free radicals, reactive species uptake and activation or increase in protection through other antioxidant defenses [1]. australis0.022C. Lastly, the values obtained by FRAP show that the lowest antioxidant activity was that of R. Feed Sci. lentiscus was the one with the highest antioxidant activity quantified by DPPH and RP. Bound phenolic compounds and antioxidant properties of whole grain and bran of white, red and black rice. gnidium0.009 ± 0.00030.026 ± 0.0020.038 ± 0.00020.071 ± 0.004T. Furthermore, all the methods presented a significant correlation between them, with high values in the Pearson's correlation coefficient. [Google Scholar] [CrossRef]Peñuelas, J.; Castells, E.; Joffre, R.; Tognetti, R. [Google Scholar]Huang, D.; Ou, B.; Prior, R.L. The chemistry behind antioxidant capacity assays. Standardized methods for the determination of antioxidant capacity and phenolics in foods and dietary supplements. The blank was prepared by substituting the same amount of diluted extract with methanol.The results were expressed in milligrams equivalents of gallic acid per milligram of dry weight (dw) and milligram equivalents of quercetin per milligram of dry weight. Opin. Thus, with ABTS, L. Serie Lasallista Investigación Y Ciencia; Corporación Universitaria Lasallista: Caldas, Colombia, 2012; pp. 5–32. Gastroenterol. aculeatus0.003 ± 0.00020.002 ± 0.00010.007 ± 0.00010.0004 ± 0.00050.006 ± 0.00020.004 ± 0.003 Table 2. The methanol was removed by evaporation at room temperature in a fume hood. Field spectroscopy in the vnir-swir region to discriminate between mediterranean native plants and exotic-invasive shrubs based on leaf tannin content. MethodA. The resulting extracts were stored for later analysis.The total phenol content was calculated using the Folin–Ciocalteu reagent assay (Merck KGaA, Darmstadt, Germany), following the method described by [36]. [Google Scholar] [CrossRef]Dudonné, S.; Vitrac, X.; Coutière, P.; Woillez, M.; Mérillon, J.-M. Enol. To facilitate the comparison between the methods, quercetin was used as a pattern, except for FRAP, which was expressed in FeSO4 equivalents. salvifolius0.057C. MethodDPPHFRAPABTSRPRP0.944 ***0.784 **0.921 *** ABTS0.916 ***0.737 ** FRAP0.789 ** Table 4. [Google Scholar] [CrossRef]Rozin, P.; Spranca, M.; Krieger, Z.; Neuhaus, R.; Surillo, D.; Swerdlin, A.; Wood, K. ladanifer0.022 ± 0.0030.089 ± 0.0010.155 ± 0.002−C. Reference [59], which studied woody species of arid zones of Mexico, also reported that the values of antioxidant activity quantified by DPPH were above those obtained by ABTS and that the values of both methods varied among species. albidus0.0559 ± 0.0030.072 ± 0.0020.078 ± 0.0005−R. There is a large variety of in vitro methods to quantify antioxidant activity, and it is important to select the proper method to determine which species have the highest antioxidant activity. These species contain approximately 12 times more phenols than R. Sci. 2016, 34, 377–390. aculeatus, which was categorized by all four methods as the species with the lowest antioxidant activity, for the rest of the species, the order established depended on the method used (Results, Table 3). Likewise, excluding R. Table 5. albidus0.023 ± 0.00020.072 ± 0.00010.111 ± 0.0010.146 ± 0.0001R. officinalis4.523.51L. Antioxidants bound to an insoluble food matrix: Their analysis, regeneration behavior, and physiological importance. gnidium0.014T. unedo0.012A. ladanifer, with values between 0.0306 and 0.0220 QE mg/mg dw, the second group was formed by C. ladanifer0.071E. [Google Scholar] [CrossRef]Wojdylo, A.; Oszmianski, J.; Czemerys, R. With this method, a greater difference between R. [Google Scholar]Zlatić, N.; Jakovljević, D.; Stanković, M. Table A1. ladanifer0.022C. Syst. Specifically, the three species selected for this study are rich in essential oils composed mainly of monoterpenes [20,30,31,32,33]. [Google Scholar]Katalinic, V.; Milos, M.; Kulisic, T.; Jukic, M. Table 1. & Mey. Chromatographia 1996, 42, 571–577. 2012, 19, 5319–5341. It is worth highlighting that FRAP was the method with the lowest significance levels when correlated with the other methods. [Google Scholar]Parejo, I.; Viladomat, F.; Bastida, J.; Rosas-Romero, A.; Flerlage, N.; Burillo, J.; Codina, C. [Google Scholar] [CrossRef] [PubMed]Hadacek, F.; Bachmann, G.; Engelmeier, D.; Chobot, V. Bot. 2014, 11, 2–35. The genus Cistus is characterized by having species with a high content of secondary metabolites [17]. lentiscus, A. gnidium0.003 ± 0.00060.016 ± 0.00060.023 ± 0.00070.034 ± 0.00005T. 1997, 2, 152–159. Table 3. australis y C. Antioxidant, genotoxic and antigenotoxic activities of Daphne gnidium leaf extracts. stoechas and T. Carbon-based secondary and structural compounds in mediterranean shrubs growing near a natural CO2 spring. gnidium and R. The first group was formed by A. Food Sci. Among the SET methods, the most used are 2,2-di-phenyl-1-picrylhydrazyl (DPPH radical scavenging capacity assay), ferric reducing (FRAP) assay, Trolox equivalent antioxidant capacity (TEAC or ABTS) assay, copper reduction (CUPRAC) assay and reducing power assay (RP). Antioxidant activity by DPPH method in methanolic extract of 12 selected species at different concentration expressed as quercetin equivalent mg/mg dw. australis0.025 ± 0.0040.018 ± 0.0030.022 ± 0.00090.014 ± 0.0060.023 ± 0.0010.058 ± 0.0008R. Extraction and identification procedures of polyphenolic compounds and carbohydrates in phillyrea (Phillyrea angustifolia L.) leaves. Specifically, the leaves of these three species have a high content of phenolic compounds [18,19,20,21]. aculeatus. fruticans.With respect to the antioxidant activity quantified by DPPH in each of the study species, the lowest value was obtained for R. Therefore, these studies confirm the validity of our results and the variability found in the total phenol content among the typical plant species of the Mediterranean undergrowth.Phenolic compounds constitute one of the major groups of compounds known to act as primary antioxidants or free radical terminators [53], which is why it is important to quantify the amount of these compounds in the selected species.The antioxidant activity of plant extracts can be quantified by different methods of measurement; in fact, it is recommended to use at least two different methods [54], and the results of a test system can be used to establish a ranking [11]. 2005, 53, 1841–1856. Studies for the determination of the antioxidant activity of different plant species could contribute to revealing the value of these species as a source of new antioxidant compounds. After centrifugation, 2.5 mL of the supernatant was mixed with 2.5 mL of distilled water and 0.5 mL of 0.1% FeCl3.Absorbance was measured at 700 nm in a UV-30 spectrophotometer. 1996, 239, 70–76. stoechas, D. ladanifer - P. Quantitative variation of flavonoids among individuals of a Cistus ladanifer population. 2007, 105, 940–949. 2015, 8, 104–111. Plant Physiol. 2000, 13, 79. unedo0.032 ± 0.0030.023 ± 0.0040.035 ± 0.000080.012 ± 0.0010.026 ± 0.0020.065 ± 0.001C. lentiscus. Pharmacology of rosemary (Rosmarinus officinalis L.) and its therapeutic potentials. Relationship between antioxidant activity quantified by the DPPH and ABTS methods (DPPH/ABTS) and between the reducing power and ABTS methods (RP/ABTS). salvifolius0.032 ± 0.0010.104 ± 0.0020.144 ± 0.0007−C. Toxicol. salvifolius0.0573 ± 0.0030.079 ± 0.000070.096 ± 0.001−C. 2012, 12, 1076. Shrub is rich in saturated and branched chain fatty acids and their concentration increases in the mediterranean dry season. Front. Ind. Screening of 70 medicinal plant extracts for antioxidant capacity and total phenols. lentiscus0.030 ± 0.0020.107 ± 0.0050.145 ± 0.0006− Table A2. Bangladesh J. [Google Scholar]Al-Sereiti, M.R.; Abu-Amer, K.M.; Sen, P. [Google Scholar] [CrossRef]Chaves, N.; Escudero, J.C.; Gutiérrez-Merino, C. Other studies also show that P. stoechas would not be categorized within the species with low antioxidant activity.The correlation between the methods used to quantify the antioxidant activity of the 12 study species was analyzed (Table 3). The results were expressed in milligram equivalents of quercetin per milligram of dry weight. albidus0.009 ± 0.0006−−−R. Aliquots of 1 mL of each sample in the methanolic extract were collected (at 4 different concentrations: 0.1, 0.5, 1, and 2 mg/mL; two replicates per sample and concentration) and had 2 mL of methanolic dilution of DPPH added.The mix was kept in the dark at room temperature for 16 min, and absorbance was measured at 517 nm in a UV-30 spectrophotometer (GIORGIO-BORMAC SRL, Carpi, Italy). lentiscus0.031 Table 3. With this method, a 17-fold difference was established between R. Table 4. [Google Scholar] [CrossRef]Abramovič, H.; Grobin, B.; Poklar Ulrih, N.; Cigić, B. Except for R. 2003, 51, 2512–2519. officinalis, D. Commercial Dietary Antioxidant Supplements Assayed for Their Antioxidant Activity by Different Methodologies. officinalis0.003T. Trop. 2017, 64, 491–499. Likewise, in studies conducted by [60], with medicinal plants, different values were reported for the antioxidant activity quantified by ABTS and DPPH, although, in this case, the highest values were obtained by ABTS. Conceptualization, N.C. and J.C.A.; methodology, A.S.; software, A.S. validation, N.C., J.C.A., and S.A.; formal analysis, N.C.; investigation, N.C.; resources, J.C.A.; data curation, A.S.; writing—original draft preparation, N.C.; writing—review and editing, N.C. and J.C.A.; visualization, N.C., J.C.A., and S.A.; supervision, N.C.; project administration, N.C. and J.C.A.; funding acquisition, N.C. and J.C.A. All authors have read and agreed to the published version of the manuscript.This research was supported by Junta of Extremadura (GR-18078) and the European Regional Development Funds.The authors declare no conflict of interest. angustifolia, D. Indian J. 1987, 131, 25–36. stoechas, R. unedo0.0653 ± 0.0010.076 ± 0.00050.087 ± 0.002−R. stoechas7.267.74E. gnidium3.522.89T. Food Control 2010, 21, 518–523. australis0.0579 ± 0.000080.077 ± 0.0050.078 ± 0.00006−A. fruticans, L. lenticus, with 0.014, 0.013, 0.012, and 0.012 QE mg/mg dw, respectively, showing 35 times more antioxidant activity that the species with the lowest activity: R. Funct. Dissection and modelling of abiotic stress tolerance in plants. [Google Scholar] [CrossRef]Balmus, I.; Ciobica, A.; Trifan, A.; Stanciu, C. [Google Scholar] [CrossRef]Fares, R.; Bazzi, S.; Baydoun, S.E.; Abdel-Massih, R.M. The antioxidant and antiproliferative activity of the Lebanese Olea europaea extract. 2002, 13, 79–86. Antioxidant activities of the essential oils and methanol extracts from myrtle (Myrtus communis var. angustifolia0.002R. aculeatus0.006L. The mix was agitated for 5 min, and then 1.5 mL of Na2CO3 (20%) and 1.9 mL of distilled water were added while shaking to homogenize the dilution.After incubation in the dark for 2 h, the absorbance was measured at 760 nm in a UV-30 spectrophotometer (GIORGIO-BORMAC SRL, Carpi, Italy). On the other hand, ABTS showed the lowest sensitivity. Aliquots of 0.2 mL of methanolic extract (at four different concentrations: 0.1, 0.5, 1, and 2 mg/mL; two replicates per sample and concentration) had 3.8 mL of FRAP reagent added. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (. [Google Scholar] [CrossRef] [PubMed]Apak, R.; Güçlü, K.; Özyürek, M.; Karademir, S.E. Mechanism of antioxidant capacity assays and the CUPRAC (cupric ion reducing antioxidant capacity) assay. [Google Scholar] [CrossRef]Stratil, P.; Klejdus, B.; Kubáň, V. Curr. As can be observed (Table 2), each method categorized or ordered the study species in a different way. australis0.014P. Studies on products of browning reaction: Antioxidative activities of products of browning reaction prepared from glucosamine. unedo2.912.19R. The samples were taken to the laboratory for preparation and analysis.The leaves were separated from the rest of the plant material and were left to dry at room temperature. Using a dendrogram, we can group the species according to their antioxidant activity and then evaluate which method is the most sensitive or which of them establishes more groups or differences between the study species. To this end, we selected several methods with the same principle of action and which are the most used [13,14]: DPPH, FRAP, ABTS, and RP. angustifolia0.013 ± 0.0040.034 ± 0.00050.065 ± 0.00060.115 ± 0.003P. fruticans0.012R. lentiscus0.030A. unedo, E. [Google Scholar] [CrossRef]Londoño-Londoño, J. Altern. [Google Scholar] [CrossRef]Benzie, I.F.F.; Strain, J.J. The ferric reducing ability of plasma (FRAP) as a measure of "Antioxidant Power": The FRAP assay. [Google Scholar] [CrossRef]Prior, R.L.; Wu, X.; Schaich, K. J. 2002, 50, 6882–6890. With the analyzed species, the method considered to be most sensitive, or the one that established more differences between species, was RP. 129–162. 2009, 57, 1768–1774. stoechasDPPH4.512.913.813.92FRAP1.231.091.341.34ABTS11.2613.8311.4111.41RP3.202.872.683.20 © 2020 by the authors. [Google Scholar] [CrossRef] [PubMed]Pérez Jiménez, J. gnidium0.011T. [Google Scholar] [CrossRef]Papaefthimiou, D.; Papanikolaou, A.; Falara, V.; Givanoudi, S.; Kostas, S.; Kanellis, A.K. Genus Cistus: A model for exploring labdane-type diterpenes' biosynthesis and a natural source of high value products with biological, aromatic, and pharmacological properties. In Desarrollo Y Transversalidad. To that end, we selected 12 species with different content of phenolic compounds. salvifolius0.013C. stoechas0.009 ± 0.00030.006 ± 0.00020.008 ± 0.000080.001 ± 0.0040.008 ± 0.00010.053 ± 0.01R. aculeatus0.004R. A mixture (1:1; v/v) of ABTS (7 mM) and potassium persulfate (4.95 mM) was prepared and kept in the dark for 16 h at room temperature.Then, the mixture was diluted with methanol until it reached absorbance values of 1–1.5 at 734 nm. gnidium0.003P. albidus, and E. Rev. ladanifer2.942.20C. The four methods selected could quantify the antioxidant capacity of the 12 study species, although there were differences between them. salvifolius2.422.11C. Asian Pac. Saudi J. A comparative study of the in vitro antioxidant property of different extracts of Acorus calamus Linn. Licensee MDPI, Basel, Switzerland. Biochem. aculeatus18.416.5D. Tannins: Chemistry, biological properties and biodegradation. Antioxidant activity of some algerian medicinal plants extracts containing phenolic compounds. Lastly, Pistacea lentiscus has a high content of total phenols, flavonoids, anthocyanins [24], and tannins [24,25,26].On the other hand, we selected six species with lower phenol concentrations, which belong to the families Lamiaceae (Teucrium fruticans L., Rosmarinus officinalis L., and Lavandula stoechas L.), Thymelaeaceae (Daphne gnidium L.), Asparagaceae (Ruscus aculeatus L.), and Oleaceae (Phyllirrea angustifolia L.). [Google Scholar] [CrossRef]Aidi Wannes, W.; Mhamdi, B.; Sriti, J.; Ben Jemia, M.; Ouchikh, O.; Hamdaoui, G.; Kchouk, M.; Marzouk, B. Aliquots of 1 mL of each extract diluted in methanol (1 mg/mL, 3 replicates per sample) had 500 µL of Folin–Ciocalteu and 6 mL of distilled water added to them. angustifolia0.042P. stoechas0.008 ± 0.00010.031 ± 0.0020.045 ± 0.00040.100 ± 0.001E. [Google Scholar] [CrossRef]Boix, Y.F.; Victório, C.P.; Defaveri, A.C.A.; Arruda, R.D.C.D.O.; Sato, A.; Lage, C.L.S. Glandular trichomes of Rosmarinus officinalis L.: Anatomical and phytochemical analyses of leaf volatiles. This discrepancy is due to the fact that the values of the other species studied by [20] were considerably lower than the ones attributed to P. It is worth highlighting that, with FRAP, L. Plants 2019, 8, 179. Glandular and eglandular hairs of Salvia recognita Fisch.

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