





# Two *Onosma* Species (*Onosma microcarpum* and *O. nana*) as an Alternative Source of Multifunctional Agents: Biological and Phytochemical Evaluation

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**Abstract:** Phytochemicals have significant biological effects. This study aimed to investigate the chemical composition, antioxidant and inhibitory activities of methanol (MeOH) extracts obtained from the aerial parts of *Onosma microcarpum* DC. and *O. nana* DC. on enzymes that play a critical role in digestive and cholinergic systems and melanogenesis process. The chemical compositions of the extracts were determined by using spectrophotometric and chromatographic methods. The biological activities of the extracts were determined by using antioxidant and enzyme inhibitory test systems. According to spectrophotometric analysis, both phenolic and flavonoid concentrations of *O. nana* were found higher than *O. microcarpum* (44.63 mg GAEs/g and 27.86 mg QEs/g, respectively). Chromatographic analysis shows that *O. nana* contains a high amount of hesperidin (53412.37 µg/g). In comparison, *O. microcarpum* has rosmarinic acid (13181.91 µg/g), apigenin 7-glucoside (11693.97 µg/g), luteolin 7 -glucoside (8632.03 µg/g) and pinoresinol (1014.26 µg/g) as the main compounds. In the ferrous ion chelating activity test, extracts exhibited almost similar activities. In contrast, radical scavenging (DPPH and ABTS), reducing power (CUPRAC and FRAP), and phosphomolybdenum tests resulted in the superiority of *O. nana* (229.98, 243.58, 327.46, 189.69, and 783.14, mg TEs/g, respectively). In the  $\alpha$ -amylase inhibitory activity test, *O. microcarpum* showed higher activity (406.31 mg ACEs/g). In comparison,  $\alpha$ -glucosidase (958.23 mg ACEs/g) and acetylcholinesterase (AChE) (2.80 mg GALAEs/g), butyrylcholinesterase (BChE) (2.59 mg GALAEs/g), and tyrosinase (200.43 mg KAEs/g) inhibitory activity of *O. nana* was found to be stronger than the other sample. (4) Conclusions: The chemical compositions and biological activities of the mentioned *Onosma* species were brought to the literature for the first time with this study. It is thought that *O. nana* can be an alternative source of phytochemicals in the food, pharmaceutical, and cosmetic industries due to its biological activity potential.

**Keywords:** *Onosma microcarpum*; *Onosma nana*; chemical composition; antioxidant activity; Enzyme inhibitory activity

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## 1. Introduction

Reactive oxygen species (ROS) perform essential biological functions in organisms (e.g., signal molecules for the cell). However, the imbalance between ROS production and the inactivation of these molecules by biological systems causes oxidative stress. These compounds interact with critical biological molecules, causing the formation of toxic compounds and impairing metabolic processes [1,2]. These free radicals also play a primary role in the pathology of many diseases [3]. The organism uses antioxidant enzymes to limit harmful effects caused by free radicals. However, the antioxidant defense system sometimes is insufficient to combat free radicals [4]. In this case, the organism should be supported with additional antioxidants taken from outside. Plants are known to be rich sources of natural antioxidants [5,6].

Phytochemicals also have significant biological effects on digestive enzymes. Therefore, their potential to be used in the treatment of diabetes is relatively high. Diabetes is a chronic disease caused by high blood glucose levels (hyperglycemia) worldwide. Millions of people suffer from this disease [7,8]. Today, some synthetic hypoglycemic drugs such as biguanides,  $\alpha$ -amylase/ $\alpha$ -glucosidase inhibitors, and sulfonylureas are used to treat this disease. However, their long-term use causes some side effects (headache and dizziness, nausea, the tendency to obesity, hypoglycemia, etc.) in patients [9,10]. Therefore, discovering more effective and safe molecules that can be used to treat diabetes is needed [11]. With some evidence that phytochemicals are safer than synthetic drugs, researchers have begun to scrutinize herbs to discover new compounds for use in the treatment of diabetes [7,12,13].

Like diabetes, Alzheimer's disease is significantly common worldwide and generally affects the elderly [14]. Although different approaches are used to treat this disease, cholinesterase inhibitors are generally preferred [15,16]. Some synthetic drugs are already used to treat this disease, as in diabetes (e.g., donepezil, galantamine, rivastigmine, etc.) [17]. However, the most effective treatment can be achieved by using compounds that exhibit antioxidant activity and inhibitory effects on acetylcholinesterase (AChE) and butyrylcholinesterase (BChE). Although rivastigmine has an inhibitory effect on both enzymes, it does not have antioxidant activity. Therefore, researchers have also scrutinized plants to discover new compounds with antioxidant activity and inhibitory effects on the enzymes in question [18].

The present study also focused on the tyrosinase inhibitory activities of plants. Enzymatic browning is one of the crucial reasons that cause deterioration of the taste and quality of foods and significant commercial losses in the post-harvest period in vegetables and fruits [19]. Therefore, researchers are trying to inhibit polyphenol oxidases, which are the leading cause of enzymatic browning, to protect the quality of foods and prevent commercial losses. Tyrosinase is one of the enzymes in this group [19-21]. Tyrosinase inhibitors are significant for fruit and vegetable processing industries [22,23]. Therefore, it is necessary to use the rich phytochemical pool offered by plants to identify new and effective tyrosinase inhibitors [24].

This study aimed to investigate the chemical composition, antioxidant,  $\alpha$ -amylase/ $\alpha$ -glucosidase, cholinesterase (ChE), and tyrosinase inhibitory activities of methanol (MeOH) extracts obtained from two different *Onosma* (*O. microcarpum* DC. and *O. nana* DC.) species collected from Kahramanmaraş and Niğde (Turkey), respectively.

## 2. Materials and Methods

### 2.1. Plant material.

The aerial parts of *O. microcarpum* (470 m., 37°43'22" N 36°41'48" E, Herbarium number: OC.5060) and *O. nana* (2200 m., 37°48'42"N 35°07'02"E, Herbarium number: Binzet 201950) were collected from the 35th km of Kahramanmaraş-Göksun highway (Turkey) and south and southeast of Demirkazık village, Yarpuz valley, Niğde (Turkey), respectively. The plants were identified and deposited by Dr. Rıza Binzet from the Department of Biology, Mersin University, Mersin-Turkey.

### 2.2. Preparation of the extracts

The extraction processes of *O. microcarpum* and *O. nana* were carried out using the methods specified in the literature [25,27-31].

### 2.3. Determination of the phenolic compositions of the extracts.

Chemical compositions of *Onosma* extracts were determined using spectrophotometric and chromatographic methods as specified by Zengin *et al.* [25] and Cattan and Çelik [26].

### 2.4. Determination of antioxidant and enzyme inhibitory activity.

The extracts' antioxidant and inhibitory enzyme activities were determined using the methods specified in the literature [25,27-31].

### 2.5. Statistical analysis.

Statistical analysis applied to the data obtained from the current study was carried out using the methods specified in the literature [25,27-31].

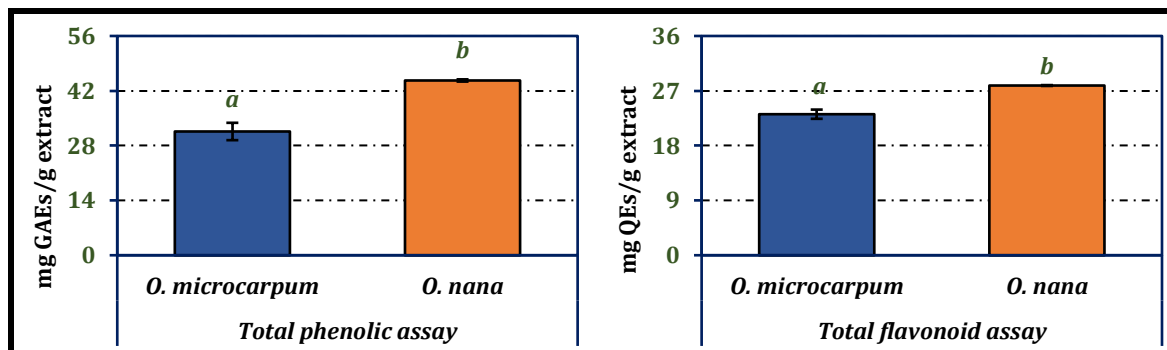
## 3. Results and Discussion

### 3.1. Phytochemical composition

Total phenolic and flavonoid contents of the MeOH extracts of *O. microcarpum* and *O. nana* were given in Figure 1. Concentrations of phenolic compounds were higher than flavonoids in both plant species. *O. nana* was richer in both phenolics and flavonoids than *O. microcarpum*. *O. nana*'s total phenolic and flavonoid compound concentrations of *O. nana* were determined as 44.63 mg GAEs/g and 27.86 mg QEs/g, respectively, while *O. microcarpum* was 31.61 mg GAEs/g and 23.16 mg QEs/g, respectively. The phenolic and flavonoid compound concentrations of both plant species were statistically different from each other.

In addition to the above analyzes performed to reveal the chemical composition of the extracts, chromatographic analyzes were performed to determine the concentration of some selected phytochemicals in the extracts (Table 1). As a result of chromatographic analysis, it was determined that the concentrations of rosmarinic acid (13181.91 µg/g), apigenin 7-glucoside (11693.97 µg/g), luteolin 7-glucoside (8632.03 µg/g), and pinosresinol (1014.26 µg/g) were higher in *O. microcarpum* extract compared to other phytochemicals. According to the data in Table 1, hyperoside was relatively high in *O. nana* extract (53412.37 µg/g). Some

phenolic acid concentrations were higher in *O. nana* extract than in *O. microcarpum*. In the extract in question, chlorogenic acid (4554.44 µg/g), *p*-coumaric acid (4255.13 µg/g), rosmarinic acid (2846.22 µg/g), caffeic acid (2480.93 µg/g), hyperoside (2399.72 µg/g), pinoresinol (1197.23 µg/g) and protocatechuic acid (1013.42 µg/g) were present in significant amounts.



**Figure 1.** Total phenolics and flavonoids of the MeOH extracts of *O. microcarpum* and *O. nana* (GAEs: Gallic acid equivalent, QEs: quercetin equivalent). There is no statistical difference between the values marked with the same superscripts on the bars.

**Table 1.** Concentration (µg/g extract) of selected phytochemicals in the MeOH extracts of *O. microcarpum* and *O. nana*<sup>1</sup>.

Compounds	<i>O. microcarpum</i>	<i>O. nana</i>
Gallic acid	5.79 ± 0.04 <sup>b</sup>	48.71 ± 0.06 <sup>a</sup>
Protocatechuic acid	92.39 ± 3.91 <sup>b</sup>	1013.42 ± 4.31 <sup>a</sup>
3,4-Dihydroxyphenylacetic acid	5.66 ± 0.29 <sup>b</sup>	63.66 ± 1.44 <sup>a</sup>
(+)-Catechin	nd	nd
Pyrocatechol	nd	73.57 ± 4.00
Chlorogenic acid	2172.22 ± 34.23 <sup>b</sup>	4554.44 ± 66.60 <sup>a</sup>
2,5-Dihydroxybenzoic acid	359.99 ± 22.64 <sup>a</sup>	263.07 ± 0.76 <sup>b</sup>
4-Hydroxybenzoic acid	1184.30 ± 27.37 <sup>a</sup>	982.82 ± 7.65 <sup>b</sup>
(-)-Epicatechin	nd	15.36 ± 1.04
Caffeic acid	421.44 ± 1.52 <sup>b</sup>	2480.93 ± 2.24 <sup>a</sup>
Vanillic acid	761.03 ± 37.45 <sup>a</sup>	225.51 ± 15.48 <sup>b</sup>
Syringic acid	80.70 ± 1.53 <sup>b</sup>	128.33 ± 3.20 <sup>a</sup>
3-Hydroxybenzoic acid	21.55 ± 0.34 <sup>a</sup>	22.37 ± 1.14 <sup>a</sup>
Vanillin	134.64 ± 0.73 <sup>a</sup>	54.95 ± 2.44 <sup>b</sup>
Verbascoside	nd	6.18 ± 0.17
Taxifolin	nd	32.94 ± 1.41
Sinapic acid	36.42 ± 2.73 <sup>b</sup>	62.96 ± 0.52 <sup>a</sup>
<i>p</i> -Coumaric acid	152.09 ± 3.47 <sup>b</sup>	4255.13 ± 17.83 <sup>a</sup>
Ferulic acid	266.37 ± 5.27 <sup>b</sup>	895.68 ± 18.53 <sup>a</sup>
Luteolin 7-glucoside	8632.03 ± 369.10	nd
Hesperidin	33.42 ± 8.34 <sup>b</sup>	53412.37 ± 369.13 <sup>a</sup>
Hyperoside	45.34 ± 1.20 <sup>b</sup>	2399.72 ± 14.48 <sup>a</sup>
Rosmarinic acid	13181.91 ± 277.34 <sup>a</sup>	2846.22 ± 5.05 <sup>b</sup>
Apigenin 7-glucoside	11693.97 ± 285.83	nd
2-Hydroxycinnamic acid	nd	3.56 ± 0.09
Pinoresinol	1014.26 ± 86.74 <sup>a</sup>	1197.23 ± 49.32 <sup>a</sup>
Eriodictyol	nd	41.90 ± 1.05
Quercetin	4.72 ± 0.17 <sup>b</sup>	520.35 ± 2.75 <sup>a</sup>
Luteolin	517.19 ± 11.60	nd
Kaempferol	nd	nd
Apigenin	997.63 ± 2.87	nd

<sup>1</sup> There is no statistical difference between values marked with the same superscripts on the same row. nd, not detected.

According to the literature data, the chemical composition of both *Onosma* species examined in the present study has not been investigated before. Only a study investigating the chemical composition of the essential oil obtained from *O. microcarpum* could be reached in <https://biointerfaceresearch.com/>

the literature [32]. Our research group has previously investigated the chemical composition of many *Onosma* species. Most of the compounds mentioned above were found in many *Onosma* species examined by our research group (*O. sieheana*, *O. stenoloba*, *O. aucheriana*, *O. frutescens*, *O. sericea*, *O. pulchra*, *O. ambigens*, *O. tauricum* var. *tauricum*, *O. gigantea*, and *O. heterophyllum*) has also been found in high amounts [29,33-38].

### 3.2. Antioxidant activity

The activity results of the extracts obtained from different antioxidant activity tests are given in Figure 2 and Table 2. As will be remembered, according to the data in Figure 1, *O. nana* extract was richer in terms of both phenolics and flavonoids than the *O. microcarpum*. It was determined that the antioxidant activities of the extracts and the data presented in Figure 1 were compatible with each other. In all antioxidant test systems, except ferrous ion chelating assay, *O. nana* exhibited higher activity than *O. microcarpum*. Although *O. microcarpum* exhibited more potent activity than *O. nana* in the ferrous ion chelating assay (28.66 and 28.60 mg EDTAEs/g, respectively), it was understood that the activity potentials of both extracts were almost equal. According to Figure 2, the extracts exhibited higher scavenging activity on ABTS than DPPH. The scavenging activity of *O. nana* on DPPH and ABTS free radicals was 229.98 and 243.58 mg TEs/g, respectively. In CUPRAC and FRAP tests in which the reducing power activities of the extracts were investigated, *O. nana* showed an activity of 327.46 and 189.69 mg TEs/g, respectively. The results obtained from the phosphomolybdenum test in which total antioxidant activity was investigated consistent with the results of the radical scavenging and reducing power assays. *O. nana* extract exhibited 783.14 mg TEs/g activity in this test system. The results obtained from all antioxidant activity tests except the ferrous ion chelating activity showed that the *Onosma* species in question showed statistically different activity profiles from each other.

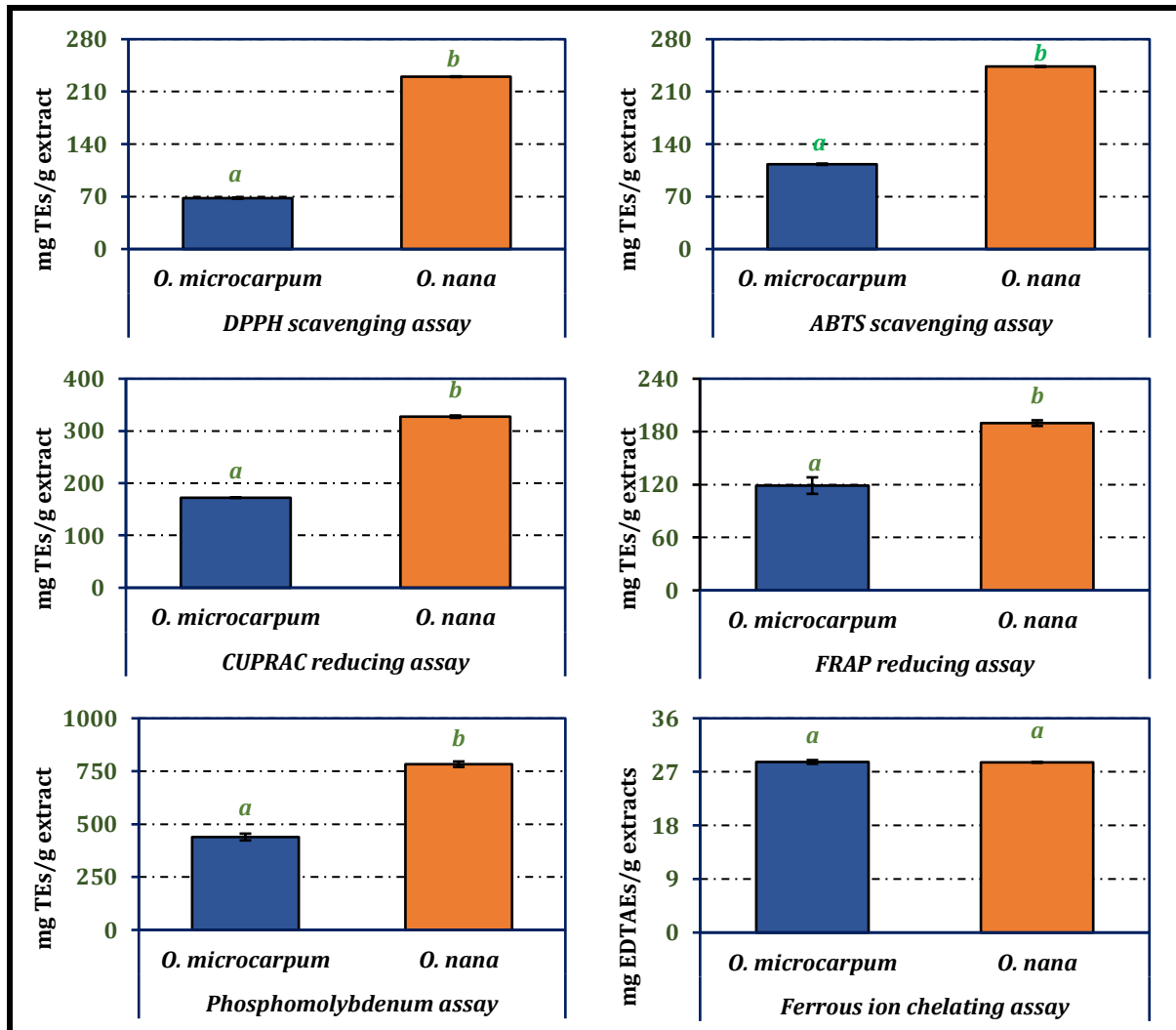
**Table 2.** Antioxidant capacities of the MeOH extracts of *O. microcarpum* and *O. nana*<sup>1</sup>

Assays	<i>O. microcarpum</i>	<i>O. nana</i>	Trolox	EDTA
Phosphomolybdenum (EC <sub>50</sub> : mg/mL)	2.45 ± 0.09 <sup>c</sup>	1.37 ± 0.02 <sup>b</sup>	1.08 ± 0.04 <sup>a</sup>	-
CUPRAC reducing power (EC <sub>50</sub> : mg/mL)	1.63 ± 0.01 <sup>c</sup>	0.86 ± 0.01 <sup>b</sup>	0.28 ± 0.03 <sup>a</sup>	-
FRAP reducing power (EC <sub>50</sub> : mg/mL)	1.01 ± 0.08 <sup>c</sup>	0.63 ± 0.01 <sup>b</sup>	0.12 ± 0.03 <sup>a</sup>	-
DPPH radical scavenging (IC <sub>50</sub> : mg/mL)	3.83 ± 0.05 <sup>c</sup>	1.13 ± 0.01 <sup>b</sup>	0.26 ± 0.03 <sup>a</sup>	-
ABTS radical scavenging (IC <sub>50</sub> : mg/mL)	2.78 ± 0.02 <sup>c</sup>	1.29 ± 0.01 <sup>b</sup>	0.32 ± 0.04 <sup>a</sup>	-
Ferrous ion chelating (IC <sub>50</sub> : mg/mL)	1.78 ± 0.02 <sup>b</sup>	1.78 ± 0.01 <sup>b</sup>	-	0.051 ± 0.004 <sup>a</sup>

<sup>1</sup> There is no statistical difference between values marked with the same superscripts on the same row.

As stated in Section 3.1, in addition to the chemical composition of the *Onosma* species analyzed in the present study, there is no data in the literature regarding their biological activities. The most rational way to understand the nature of the antioxidant activity exhibited by these species is to establish a relationship between the chemical composition of the extracts and their activities. As detailed above, *O. nana* exhibited higher antioxidant activity than other *Onosma* species. According to the data in Table 1, it was determined that the hesperidin content of *O. nana* was by far higher than other phytochemicals. This situation suggests that the underlying power of the antioxidant activity of *O. nana* is hesperidin. There are some interesting examples in the literature that hesperidin can contribute to antioxidant activity. In a

study by Tian *et al.* [39], hesperidin successfully reduced oxidative stress induced by high glucose in LO2 cells. In another study by Kucukler *et al.* [40], it was reported that hesperidin protects rats against chronic hepato-renal toxicity by reducing oxidative stress. Similar findings were also obtained in the studies conducted by Hager-Theodorides *et al.* [41] and Zheng *et al.* [42]. There are also reports in the literature that protocatechuic acid [43], chlorogenic acid [44], caffeic acid [45], *p*-coumaric acid [46], and hyperoside [47] can contribute to antioxidant activity.



**Figure 2.** Antioxidant capacities of the MeOH extracts of *O. microcarpum* and *O. nana* [TEs: trolox equivalent, EDTAEs: ethylenediaminetetraacetic acid (disodium salt) equivalent]. There is no statistical difference between the values marked with the same superscripts on the bars.

### 3.3. Enzyme inhibitory activity.

In the present study, the effects of MeOH extracts obtained from *Onosma* species on digestive and cholinergic systems and melanogenesis process in addition to their antioxidant activities were examined, and the results were given in Figure 3 and Table 3.

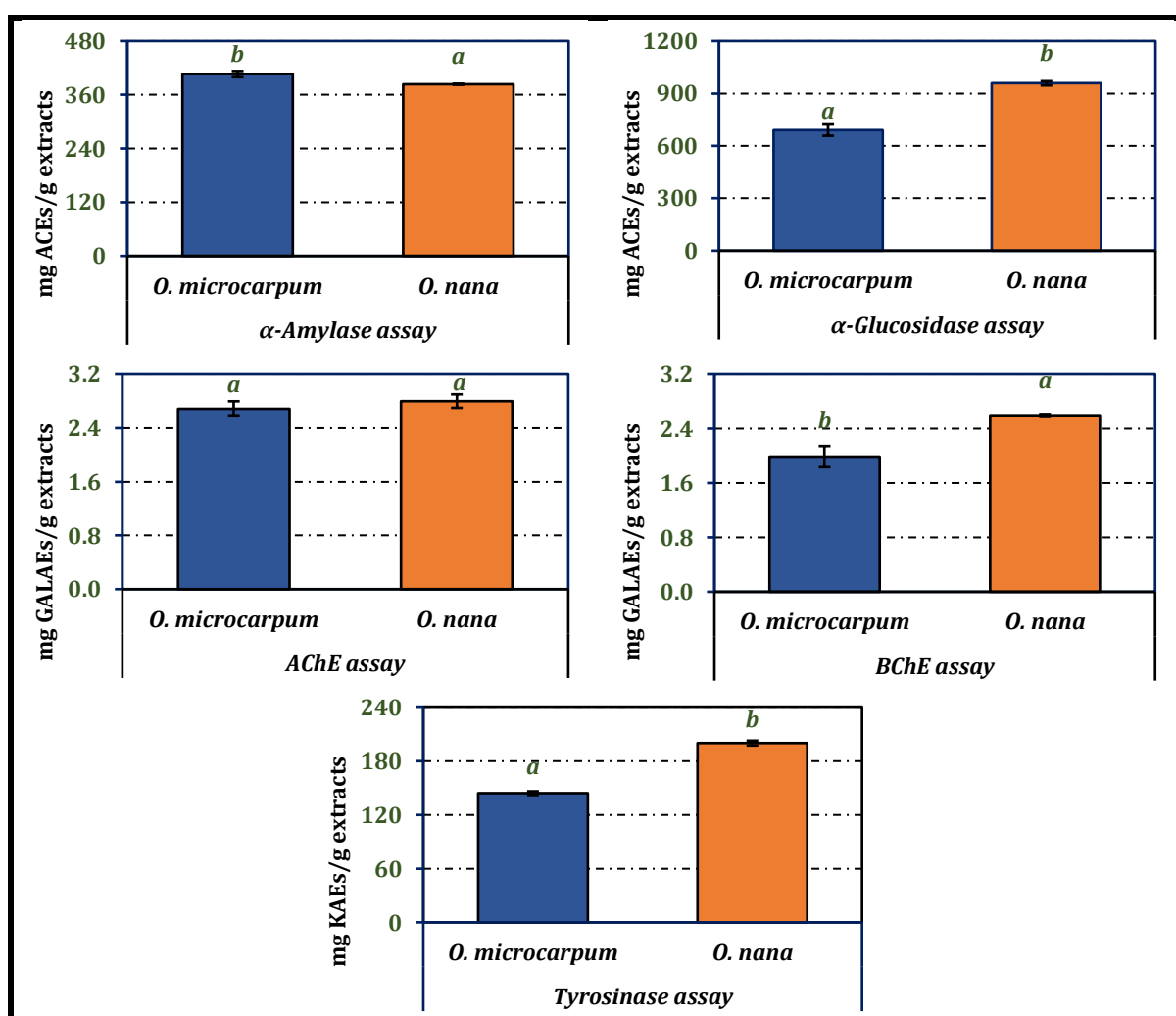
**Table 3.** Enzyme inhibitory activities of the MeOH extracts of *O. microcarpum* and *O. nana*<sup>1</sup>

Assays	<i>O. microcarpum</i>	<i>O. nana</i>	Acarbose	Galanthamine	Kojic acid
$\alpha$ -Amylase inhibition (IC <sub>50</sub> : mg/mL)	2.58 ± 0.04 <sup>b</sup>	2.73 ± 0.01 <sup>b</sup>	1.05 ± 0.07 <sup>a</sup>	-	-
$\alpha$ -Glucosidase inhibition (IC <sub>50</sub> : mg/mL)	2.47 ± 0.12 <sup>b</sup>	1.77 ± 0.02 <sup>a</sup>	1.70 ± 0.03 <sup>a</sup>	-	-

Assays	<i>O. microcarpum</i>	<i>O. nana</i>	Acarbose	Galanthamine	Kojic acid
AChE inhibition (IC <sub>50</sub> : mg/mL)	1.28 ± 0.05 <sup>b</sup>	1.23 ± 0.04 <sup>b</sup>	-	0.0035 ± 0.0005 <sup>a</sup>	-
BChE inhibition (IC <sub>50</sub> : mg/mL)	2.86 ± 0.22 <sup>c</sup>	2.19 ± 0.01 <sup>b</sup>	-	0.0057 ± 0.0003 <sup>a</sup>	-
Tyrosinase inhibition (IC <sub>50</sub> : mg/mL)	2.08 ± 0.03 <sup>c</sup>	1.50 ± 0.02 <sup>b</sup>	-	-	0.30 ± 0.03 <sup>a</sup>

<sup>1</sup> There is no statistical difference between values marked with the same superscripts on the same row.

It was determined that the inhibitory activity of the extracts on  $\alpha$ -glucosidase was higher than on  $\alpha$ -amylase. The extracts exhibited different activity profiles on  $\alpha$ -amylase and  $\alpha$ -glucosidase enzymes. Although the activities of *O. microcarpum* and *O. nana* extracts were close to each other in the  $\alpha$ -amylase inhibitory activity test, *O. microcarpum* extract exhibited higher inhibitory activity (406.31 mg ACEs/g). However, in the  $\alpha$ -glucosidase inhibitory activity test, *O. nana* extract was a more effective inhibitory agent (958.23 mg ACEs/g). The extracts exhibited statistically different activities in both test systems.



**Figure 3.** Enzyme inhibitory capacities of the MeOH extracts of *O. microcarpum* and *O. nana* (GALAEs: galanthamine equivalent, KAEs: kojic acid equivalent, ACEs: acarbose equivalent). There is no statistical difference between the values marked with the same superscripts on the bars.

According to the literature data, the inhibitory activity of *O. microcarpum* and *O. nana* on digestive enzymes has not been investigated before. Although there is no clear information about the phytochemicals that contribute to the inhibitory activities of the extracts in the present study, it is possible to reach some literature data on which compounds in the extracts in question

contribute to the activity. The data in Table 1 showed that *O. nana* contains a high amount of hesperidin. However, *in silico* and *in vitro* data in the literature indicate that this compound is not an effective  $\alpha$ -amylase inhibitor [48,49]. The literature data are consistent with the results of previous *in silico* studies conducted by our research group [37]. In the study in question, it was found that the affinity of hesperidin to  $\alpha$ -amylase was relatively weak (-3.69 kcal/mol). Additionally, there is no data on the inhibitory activity of this compound on  $\alpha$ -glucosidase. It is thought that more detailed chromatographic and enzyme inhibitory activity tests should be performed to determine the phytochemicals responsible for the activity in this extract. On the other hand, it has been suggested that rosmarinic acid, flavonoid glycosides (apigenin 7-glucoside and luteolin 7-glucoside), and pinoselinol itself, or extracts containing high amounts of these compounds, may be effective or contribute to the inhibitory activity of *O. microcarpum* on digestive enzymes [50-56].

The extracts also exhibited remarkable activity on AChE and BChE, critical enzymes of the cholinergic system. The inhibitory activities of the extracts on AChE were higher than on BChE. Although the activity values of the extracts were close to each other in AChE inhibitory activity test, *O. nana* extract exhibited the highest activity on both enzymes. The inhibitory activities of this extract on ACE and BChE were 2.80 and 2.59 mg GALAEs/g, respectively. While the activities of the extracts on AChE were not statistically different from each other, there was a significant difference between their activities on BChE.

It is, of course, possible to correlate the cholinesterase inhibitory activities of the extracts with their chemical composition. The above data show that *O. nana* is effective on both cholinesterases. According to Table 1, *O. nana* extract contained higher hesperidin than the other sample. The first thing that comes to mind is that this compound may have contributed significantly to activity. As a matter of fact, there are some supporting reports in the literature that plant species rich in hesperidin have high cholinesterase inhibitory activities [57,58]. However, some opposing views have been put forward in the literature. In a study conducted by Yilmaz *et al.* [59], it was reported that acetone and MeOH extract were obtained from *Chenopodium album* subsp. *album* var. *microphyllum* exhibited moderate cholinesterase inhibitory activity despite a high amount of hesperidin (9769.13  $\mu$ g/g). In another study carried out by Senol *et al.* [60], it was suggested that hesperidin exhibits weak cholinesterase inhibitory activity. The last two studies support each other. Therefore, it is thought that there may be other phytochemicals that can contribute to both AChE and BChE inhibitory activities of *O. nana*. The compounds likely to contribute to the AChE inhibitor activity of *O. microcarpum* should also be mentioned here. The data in Table 1 showed that rosmarinic acid, flavonoid glycosides (apigenin 7-glucoside and luteolin 7-glucoside), and pinoselinol were found in high amounts in the extract obtained from this plant. There are some reports in the literature that these compounds themselves or extracts containing high amounts of these compounds exhibit significant AChE inhibitory activity [61-63]. Although it is not completely logical to make a definitive judgment with the available data, it is considered that these compounds may contribute to ChE inhibitory activity.

Tyrosinase inhibitory activity test was used to evaluate the effect of the extracts on the melanogenesis process. As with  $\alpha$ -glucosidase, AChE, and BChE enzymes, *O. nana* extract exhibited higher inhibitory activity than *O. microcarpum* in this test system. The tyrosinase inhibitory activity of *O. nana* extract was determined to be 200.43 mg KAEs/g. In this test system, the inhibitor activity of *O. microcarpum* remained at 144.38 mg KAEs/g. As can be



understood from the data above, the tyrosinase inhibitory activities of the extracts were statistically significantly different from each other.

There is no data in the literature regarding the tyrosinase inhibitory activity of *O. microcarpum* and *O. nana*. Some reports in the literature show that hesperidin itself exhibits significant inhibitory activity on both human and mushroom tyrosinase [64,65]. In addition, in studies conducted by our research group, it was found that plant extracts rich in hesperidin exhibit substantial tyrosinase inhibitory activities [35-38,66]. In addition, *in silico* data reported by Sarikurkcu *et al.* [37] show that the binding negative energy between hesperidin and tyrosinase is relatively high (-5.89 kcal/mol). These data show that *O. nana*'s tyrosinase inhibitor activity may be due to hesperidin.

#### 4. Conclusions

This study investigated the chemical compositions antioxidant and inhibitory enzyme activities of the MeOH extracts obtained from *O. microcarpum* and *O. nana*. Spectrophotometric and chromatographic data showed that *O. nana* is richer in phenolics and flavonoids. This was notably consistent with the data obtained from antioxidant activity tests. Therefore, it was concluded that the biological activity potential of this plant is closely related to its chemical composition and can be considered a source of new and alternative phytochemicals in the food, pharmaceutical, and cosmetic industries. However, since it is not possible to clarify the whole chemical composition of the plant, it is thought that more detailed analyzes should be carried out to reveal some other compounds that may contribute to the activity.

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#### Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the study's design, in the collection, analyses, or interpretation of data, in the writing of the manuscript, or in the decision to publish the results.

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