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Breakthrough Analysis of Chemical Composition and Applied Chemometrics of European Plum Cultivars Grown in Norway

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Abstract: The aim of this study was to find the chemical parameters for the differentiation of plum cultivars grown along the fjord areas of Western Norway and Eastern Norway, having specific agroclimatic conditions. Chemical analysis of the fruits confirmed the contents of 13 quantified elements, 22 sugar compounds, 11 organic acids, 19 phenolic compounds, and antioxidant activity in 68 plum cultivars. Dominated contents were noted for nitrogen (with the maximum mean value of 3.11%), potassium (8055.80 mg/kg), and phosphorous (7878.88 mg/kg). Averagely, the highest level of sugars was determined for glucose (244.46 g/kg), fructose (197.92 g/kg), sucrose (208.25 g/kg), and sorbitol (98.02 g/kg), organic acids for malic acid (24.06 g/kg), and for polyphenol compounds were 5-*O*-caffeoylquinic acid (66.31 mg/kg), and rutin (58.06 mg/kg). Applied principal component analysis has been useful for distinguishing the plum cultivars from three areas in Norway where copper, iron, potassium, magnesium, manganese, and sodium; sucrose, ribose, maltose, and raffinose; *p*-hydroxybenzoic acid, rutin, ferulic acid, kaempferol 7-*O*-glucoside, *p*-coumaric acid, and 5-*O*-caffeoylquinic acid were the most influential. In regard to human health and future breeding work that will have the aim to produce functional food with high health-related compounds, the plum cultivar 'Mallard' should be underlined due to the high level of elements, 'Valor' due to high sugar content, 'Helgøyplomme' due to content of organic acids, and 'Diamond' due to the content of phenolic compounds.

Keywords: *Prunus domestica* L.; sugar; organic acid; polyphenols; minerals; antioxidant activities; principal component analysis

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1. Introduction

European plum (*Prunus domestica* L.) belongs to the section *Euprunus*, subgenus *Prunophora*, subfamily *Amygdaloideae*, and family *Rosaceae* [1]. Although it has a controversial genetic origin, it is widely accepted that myrobalan and sloe played a major role in the genesis of these plum species [2]. Most probably, the hybridization took place in the Caucasus Mountains, but none of the wild forms were found [3]. It is one the most important temperate fruit species, especially in Europe and southwest Asia, and it is widely distributed worldwide [4]. China is the leading producer with ~53% of world production (but produces exclusively Japanese plum, *Prunus salicina*), with Romania (6.2%) in second place and Serbia (4.7%) in third [5]. Plum fruits are very attractive due to their color and taste and are consumed fresh, but are also dried or prepared into brandy, preserves, compotes, mousse, pulp, candied fruit, frozen fruit, wine, jams, and jelly products.

Within taste, sugars and organic acids are important determinants of sweetness perception, and thus, fruit quality is directly associated with palatability and market acceptance [6]. Plums contain three dominant sugars, which are glucose, fructose, and sucrose, and the sugar alcohol sorbitol, which can reach up in total to 15 g/100 g in prunes [7,8]. In addition to these, it also stores sugars that are present in significantly lower concentrations, including galactose, galactinol, raffinose, and trehalose [9]. Malic acid, citric acid, shikimic acid, fumaric acid, quinic acid, and oxalic acid are important organic acids in *Prunus domestica* fruits [10,11].

Plums have numerous bioactive compounds such as phenolic acids, anthocyanins, carotenoids, flavanols, and various other aromatic compounds, and then tannins, enzymes, minerals (K, P, Ca, Mg, Na, B, Se, Fe, Zn, Mn, Cu) and vitamins A, B, E, C, K [12–14]. The total fiber in prunes (hemicellulose, pectin, and cellulose), independent of the country of origin, varies from 8.4 g/100 g (from France) up to 12.0 g/100 g (from the USA) [8]. Benzaldehyde, linalool, ethyl nonanoate, methyl cinnamate, and γ-decalactone contribute to plum aroma [15]. In contrast to fruit, leaves [16], flowers [17], bark [18], heartwood [19], pruning wood residue [20], gum [21], and seeds [22] are rich sources of polyphenols too.

The most abundant phenolic compounds are chlorogenic acid, neochlorogenic acid, ferulic acid, caffeic acid, *p*-hydroxybenzoic acid, gallic acid, naringin, resveratrol, catechin, rutin, kaempferol, myricetin, and quercetin, [23–27]. The major anthocyanins are cyanidin 3-rutinoside, cyanidin 3-glucoside, peonidin 3-rutinoside, cyanidin 3-xyloside, and peonidin 3-glucoside [7]. Plum fruits demonstrated very good scavenger activity against oxygen-derived free radicals, such as hydroxyl and peroxyl radicals [28]. Due to the high content of bioactive compounds, plum fruit exhibits strong antioxidant, anticancer, antihyperglycemic, antihypertensive, anti-allergic, and laxative properties, and its consumption has been linked to bone health and lower cholesterol [29,30]. Igwe et al. [31] showed that plum's phenolic compounds improve cognition, especially spatial memory and learning, as well as reduce age-related cognitive deficits. Leukorrhea, irregular menstruation, and debility following a miscarriage are medicinally treated with fruits of *Prunus domestica* [20]. The quality and the content of the phytochemicals in plum fruits depend on the cultivar, maturity, soil, habitat, production techniques, and growing season [14,32].

The antibacterial activity of *Prunus domestica* fruits on both Gr (+) and Gr (–) bacteria was also proved in many studies. [33–35]. In addition, plum wine shows a significant cytotoxic effect on the growth of three cancer cell lines, i.e., Hep2c, RD, and L2OB [36].

To the best of our knowledge, this is the first comprehensive survey of such a large number of plum genotypes from Norway. This study aimed to identify and quantify elements, sugars, organic acids, phenolics and antioxidant activities and differentiate numerous plum cultivars grown in this Nordic country in three localities in three consecutive years. The obtained results will help us underline the cultivars with the highest quality and suitable for growing in a cool climate, producing functional food, or being used in future breeding work.

2. Materials and Methods

2.1. Chemicals and Standards

Reagents such as acetonitrile (MS grade), formic acid (MS grade), nitric acid (65 wt. %), and hydrogen peroxide were from Merck (Darmstadt, Germany); methanol (HPLC grade), sodium hydroxide (50 wt. %), were from Sigma-Aldrich (Steinheim, Germany). Additionally, for the required preparation of the solutions, we also used ultrapure water (0.055 mS/cm) prepared using the water purification system (TKA MicroPure, Thermo fisher). Standards used for chemical analysis were: 18 standards of sugars (such as glucose, fructose, sucrose, arabinose, maltose, isomaltose, maltotriose, isomaltotriose, trehalose, turanose, galactose, xylose, ribose, rhamnose, raffinose, panose, melibiose, stachyose) purchased from Tokyo Chemical Industry (TCI, Zwijndrecht, Belgium); 4 standards of sugar alcohols (glycerol, galactitol, mannitol, sorbitol); 11 standards of organic acids (butyric, citric, fumaric, lactic, malic, maleic, oxalic, propionic, pyruvic, quinic, and shikimic acid), standards for antioxidant tests (gallic acid, and Trolox standard); and 19 standards of phenolic compounds (3-*O*-caffeoylquinic acid, acacetin, aesculetin, caffeic acid, ferulic acid, isorhamnetin 3-*O*-glucoside, isorhamnetin 3-*O*-rutinoside, kaempferol 3-*O*-glucoside, kaempferol 7-*O*-glucoside, *p*-coumaric acid, *p*-hydroxybenzoic acid, protocatechuic acid, phloretin, phlorizin, quercetin, quercetin 3-*O*-glucoside, quercetin 3-*O*-rhamnoside, rutin, syringic acid) purchased from Sigma-Aldrich (Steinheim, Germany). Multi-element plasma standard solution was from Alfa Aesar GmbH & Co KG (Kandel, Germany), and ILM 05.2 ICS Stock 1 was from VHG Labs, Inc-Part of LGC Standards (Manchester, NH, USA). The additional laboratory equipment that was used for sample preparation were syringe filters (15 mm, 0.45 µm, and 22 µm) from Supelco (Bellefonte, PA, USA) and solid-phase extraction (SPE) cartridges (Strata C18-E type, 500 mg per 3 mL) purchased from Phenomenex (Torrance, CA, USA).

2.2. Plant Materials

2.2.1. Locations of Plant Material

The plums used for this study were cultivated at two locations in Western Norway (Figure 1) and one location in Eastern Norway. Western locations were: The experimental farm at Njøs Fruit and Berry Centre, Leikanger (at latitude 61°10′43.2″ N, longitude 6°51′34.3″ E), along the Sognefjord, and at the Norwegian Institute of Bioeconomy Research, NIBIO Ullensvang (at latitude 60°19′8.03″ N, longitude. 6°39′14.31″ E) (Figure 1). These fjord areas are the main production areas for European plums in Norway. The Eastern Norwegian location was at The Norwegian University of Life Sciences—NMBU at latitude 59°66′87.6″ N, longitude 10°76′82.4″ E (Figure 1).

Figure 1. Sampling sites of plum cultivars grown in Norway: The experimental farm at Njøs Fruit and Berry Centre-Njøs, Norwegian Institute of Bioeconomy Research-NIBIO Ullensvang, The Norwegian University of Life Sciences-NMBU.

2.2.2. Weather Conditions

Fruit samples were harvested in 2019 and 2021 at Njøs and Ullensvang and in 2019 and 2020 at NMBU. In 2020, the weather in western Norway during flowering was wet and cool, and almost no fruit set and yields were on the different fruit cultivars. These fjord areas have a marinated climate and are influenced by the Gulf Stream. The summers are relatively cool, and the winters are mild. That means that frost damage to the fruit trees during the winter or during blossom time rarely occurs. The snow-covered mountains in the west protect from high amounts of rain. Unfavorable environmental conditions, especially low temperatures, and rain, can often occur during spring and inhibit and reduce the fruit set. Njøs and NIBIO Ullesvang have about the same temperature regimes during the year. However, Njøs has about half the amount of precipitation during the year. The driest periods are from May through to August in both locations.

The annual average temperatures of those two years of study (2019/2021) at Leikanger were 8.1 °C and 8.0 °C, respectively. The lowest temperature was recorded on 6 February (−6.6 °C) and the highest on 28 July (32.5 °C) in 2019. In 2021, the lowest temperature was recorded on 13 February (−11.1 °C) and the highest on 26 July (29.8 °C). The total rainfalls in these two years were 1019 mm and 813 mm, respectively, with April and July as the driest months. The annual average temperature in both years of study (2019/2021) at Ullensvang was 8.2 °C. In 2019, the temperatures varied as usual, where the lowest temperature was recorded on 28 January (−5.4 °C) and the highest on 28 July (33.5 °C). For the second year, the lowest temperature was recorded on 5 February (−10.1 °C) and the highest on 26 July (28.5 °C). The total rainfall in these two years was 1542 mm and 1552 mm, respectively, with April and May as the driest months. NMBU has a more inland climate with colder winters and warmer summers. In this area, winter frost and blossom frost can happen and damage the fruit trees. The average temperature was 6.6 °C in 2019 and 7.9 °C the year after. The lowest temperature was recorded on 29 January (−19.2 °C), and the highest occurred on 28 July (31.2 °C) in 2019. The year after, the coldest day was 5 February (−11.5 °C), and the warmest day was 18 August (30.3 °C). The amount of rainfall during the year was 593 mm in 2019 and 659 mm in 2020.

2.2.3. Cultivation Conditions

All cultivars were grafted on the rootstock 'St. Julien A' and the trees were trained as slender spindle trees with a maximum of 2.5 m height. Grass in the alleyways and a 1 m wide vegetation-free strip in the intra-row space were used for orchard floor management. The trees were managed according to the commercial practice for the areas related to supplies of fertilizers and pest management. Each cultivar was picked at commercial harvest time for the areas. All locations had sandy soil easily drained, and trickle irrigation was provided. Hand thinning was carried out at all locations at the end of June in order to achieve optimum crop loads of good fruit quality (5–7 cm apart between fruitlets).

In total, 68 plum cultivars (Table 1) were analyzed. Among them, 7 cultivars were the same in Njøs area and NIBIO ('Edda', 'Jubileum', 'Opal', 'Mallard', 'Reeves', 'Valor', and 'Victoria'), while 9 cultivars were the same at Njøs and NMBU ('Czar', 'Edwards', 'Excalibur', 'Herman', 'Mount Royal', 'Reine Claude Noire', 'Reine Claude Souffriau', 'Rivers Early Prolific', and 'Sviske frå Tveit') (Table 1).

Table 1. Assigned samples of 68 Norwegian plum cultivars from Njøs Fruit and Berry Centre (42 samples) and from the Norwegian Institute of Bioeconomy Research-NIBIO Ullensvang (8 samples) collected in 2019 and 2021, and from the Norwegian University of Life Sciences-NMBU (18 samples) collected in 2019 and 2020.

Njøs Fruit and Berry Centre				**NIBIO Ullensvang**		**NMBU**	
1	Admiral Rigny	22	Ontario	43	Edda *	51	Blue Rock
2	Reine Claude d'Althanns	23	Opal *	44	Jubileum *	52	Czar #
3	Anita	24	Reine Claude d'Oullins 'Henjum	45	Čačanska lepotica	53	Diamond
4	Avalon	25	Prosser 84	46	Mallard *	54	Edwards #
5	Bleue de Belgique	26	R5	47	Opal *	55	Emil
6	Czar #	27	Raud Eplevik	48	Reeves *	56	Excalibur #
7	Diana	28	Reeves *	49	Valor *	57	Experimentalfältets sviskon
8	Edda *	29	Reine Claude Althanns	50	Victoria *	58	Herman #
9	Edwards #	30	Reine Claude Noire #			59	Ive
10	Excalibur #	31	Reine Claude Souffriau #			60	Mount Royal #

Table 1. *Cont.*

Njøs Fruit and Berry Centre				NIBIO Ullensvang		NMBU	
11	Frostaplomme	32	Rivers Early Prolific #			61	Reine Claude Noire #
12	Grand Duke	33	Rød Victoria			62	Reine Claude d'Oullins
13	Haganta	34	Ruth Gerstetter			63	Reine Claude Souffriau #
14	Helgøyplomme	35	Sanctus Hubertus			64	Rivers Early Prolific #
15	Herman #	36	Sviske frå Tveit #			65	Sinikka
16	Jefferson	37	Thames Cross			66	Søgne
17	Jubileum *	38	Valor *			67	Sviske frå Tveit #
18	Kirkes	39	Victoria *			68	Traneplommer
19	Mallard *	40	Vinterplomme				
20	Mount Royal #	41	Washington				
21	Njøs II	42	Yakima				

* Samples cultivated at both Njøs and NIBIO; # Samples cultivated at both Njøs and NMBU.

2.3. Sample Preparation

Firstly, plum seeds were removed, and the remaining fruit samples were cut into smaller pieces, dried in an oven at 40 °C for ~10 days, and then pulverized in an analytical mill (A 10 basic analytical mill; IKA-Werke GmbH & Co.). The results were expressed on the dry weight (dw) of the sample. For each analysis, samples were measured in duplicate. Further preparation of sample extracts was in accordance with the procedures for each method's measurements, previously described in our recent studies [37,38].

2.4. Methods and Instrumentations

Inductively coupled plasma with optic emission spectrometry (ICP-OES) was used for the determination of elements in sample extracts [37,38]. The instrument consisted Thermo Scientific iCAP 6500 Duo ICP (Thermo Fisher Scientific, Cambridge, United Kingdom) spectrometer equipped with RACID86 Charge Injector Device (CID) detector. High-performance anion-exchange chromatography with pulsed amperometric detection (HPAEC-PAD) was used for sugars and organic acids determination using ICS 3000 DP liquid chromatograph (Dionex, Sunnyvale, CA, USA) and analytical columns Carbo Pac PA100 (4 × 250 mm) and IonPac AS15, 4 × 250 mm, respectively (Dionex, Sunnyvale, CA, USA) [35,36]. Ultra-high-performance liquid chromatography system with diode array detection and mass spectrometry (UHPLC-DAD MS/MS) was used for quantification of phenolic compounds in sample extract by using equipment Dionex Ultimate 3000 UHPLC, TSQ Quantum Access Max triple quadruple (QqQ) mass spectrometer (Thermo Fisher Scientific, Bremen, Germany) [37,38]). Ultraviolet-visible spectrophotometry was used for the measurement of the antioxidant activity of sample extracts. Antioxidant activity was observed through the total phenolic content (TPC) and relative scavenging activity (RSA, which was performed through the activity of 2,2-diphenyl-1-picrylhydrazyl radical, DPPH) using a UV-Vis spectrophotometer (Thermo Scientific Evolution 600; Thermo Fisher Scientific Inc.). Procedures of the method's measurements for each instrumental technique were previously described in our recent studies [37,38].

2.5. Chemometric Analysis

Principal component analysis (PCA) was applied in order to provide information about specific variables that interact similarly. PCA data observed for 68 samples were presented in biplots and dendrograms according to analytical variables such as elements, sugars, organic acids content, total phenolic content (TPC), radical scavenging activity (RSA), and phenolic content. The software StatSoft Statistica 12 (StatSoft Inc., Tulsa, OK, USA) was used for data analysis.

3. Results and Discussion

3.1. ICP-OES Results of Element Content

Quantified elements in plum cultivar samples from Norway include the content of seven macroelements (calcium (Ca), potassium (K), magnesium (Mg), sodium (Na), phosphorus (P), sulfur (S), and nitrogen (N)), and six microelements (aluminum (Al), boron (B), copper (Cu), iron (Fe), manganese (Mn), zinc (Zn)), which descriptive analysis (minimum, maximum, mean value, and standard deviation) was given in Table 2. The predominant content for Njøs, NIBIO, and NMBU plums was noted for N (averagely 3.10%, 3.11%, and 3.07%, respectively), then P (with the mean value of 7054.28 mg/kg, 6394.22 mg/kg, and 7878.88 mg/kg, respectively) and for K (4177.48 mg/kg, 8055.80 mg/kg and 2194.73 mg/kg, respectively). The next by the abundance were S, Mg, Ca, and then Na (Table 2). A much lower result of N content was determined in seven promising plum hybrids [39]. By comparing these three areas, the maximum values (mean and maximum) of most elements were noted for cultivars in the NIBIO area. A different trend was observed for several values, such as P, Al, B, and Zn (Table 2). Çalişir et al. [40] and Motyleva et al. [41] got different results and reported that K was a dominant mineral, followed by Ca and Mg. Jaroszewska [42] studied the 'Čačanska rana' cultivar and determined that under different water and fertilization regimes, macronutrient amounts were K > N > P > Ca > Mg. The level of Na in this experiment was up to 101.33 mg/kg, which is lower than other authors obtained in their studies (84.21 to 260.81 mg/kg) [43].

Table 2. Descriptive analysis of the content of nutrients (mg/kg) in 68 Norwegian plum cultivars from Njøs (42 samples) and NIBIO Ullensvang (8 samples) collected in 2019 and 2021, and from NMBU (18 samples) collected in 2019 and 2020.

Norwegian Area	Njøs				NIBIO Ullensvang				NMBU			
Parameter	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**
Al	2.65	35.52	9.80	6.24	4.73	24.38	14.22	6.77	5.38	42.77	15.23	11.33
B	0.68	15.56	5.70	4.01	0.56	6.58	2.21	2.21	4.15	12.70	7.56	2.47
Ca	42.70	482.97	172.50	109.02	120.27	540.67	356.06	130.79	56.71	280.22	111.19	54.02
Cu	1.50	6.23	3.26	1.03	1.44	5.81	3.80	1.40	1.28	2.96	2.27	0.48
Fe	2.58	41.26	12.31	10.76	3.17	54.72	22.97	15.42	2.98	13.78	7.60	2.44
K	1503.75	11,545.75	4177.48	2626.83	2745.22	11,696.62	8055.80	3287.93	1562.42	3118.25	2194.73	413.38
Mg	76.76	513.84	173.49	96.55	121.49	547.76	367.31	144.64	63.57	137.99	99.70	21.18
Mn	0.69	9.42	2.86	2.51	1.79	9.48	5.77	2.75	0.64	1.52	1.10	0.26
Na	0.50	101.24	42.86	27.82	37.23	101.33	72.07	20.49	15.35	50.10	28.09	9.63
P	4563.32	10,225.25	7054.28	1436.21	3312.55	8540.89	6394.22	1885.68	5581.36	12,198.01	7878.88	2025.18
S	124.00	367.56	252.83	63.44	74.26	404.39	242.07	117.90	130.50	385.43	203.98	61.07
Zn	2.71	24.60	8.41	4.02	2.56	11.70	6.92	3.06	4.90	23.99	8.94	4.12
N (%)	2.68	3.65	3.10	0.17	2.95	3.21	3.11	0.09	2.96	3.29	3.07	0.08

The average amounts of microelements in plums followed a decreasing order: Fe > Al > Zn > B > Cu > Mn in Njøs, Fe > Al > Zn > Mn > Cu > B in NIBIO and Al > Zn > Fe > B > Cu > Mn in NMBU (Table 2). These results agree with other authors [40] who reported that wild plums contained more Fe than B. Oppositely, in some other studies [12,39,44], B was a dominant microelement and emphasized that plums could be a good source of this mineral. Differences between results from this study regarding macro- and microelements and those obtained by other authors are probably due to different environmental conditions and cultivars that were analyzed. The discrepancy could be connected to different soil types, precipitation, plum rootstock, and fertilizer application, as already proved [45,46].

In this study, cultivars 'Mallard' from Njøs, and 'Mallard', 'Edda' and 'Reeves' from NIBIO could be used as sources of macroelements, especially of K (11,545.75, 11,696.62, 11,575.99 and 11,456.59 mg/kg, respectively), Mg (513.84, 529.53, 547.76 and 470.71 mg/kg respectively) and Ca (482.97, 500.89, 540.67 and 348.76 mg/kg, respectively) (Table A1). However, cultivars 'Helgøyplomme' and 'Reeves' from Njøs and 'Reeves' from NIBIO should be distinguished due to the highest level of Fe (41.26, 40.29, and 54.72 mg/kg, respectively). Among six plum cultivars that were common for Njøs and NIBIO (Table A1), 'Edda', 'Mallard', and 'Reeves' from NIBIO stored maximum values of these nutrients. Furthermore, 'Edda' from NIBIO had a higher level of nutrients than the same cultivar from Njøs (Table A1). Otherwise, among nine plum cultivars common for Njøs and NMBU, only 'Rivers Early Prolific' grown in Njøs stood out (Table A1).

3.2. IC Results of Sugar Content

Table 3 presents a descriptive analysis of the quantification of sugar compounds, with 4 sugar alcohols and 18 sugars, of which four are trisaccharides and one is tetrasaccharide. The most dominant were monosaccharides and then non-reducing disaccharides due to the high content of sucrose. The sugar distribution showed glucose, fructose, and sucrose in the decreasing following order (Table 3). The next was sorbitol, with the noted differences between plum cultivars, followed by galactose, turanose, and maltose (Table 3). The sugar content showed a variation between individual plum cultivars, especially in some ratios of sugar compounds. However, it did not significantly affect the plums' differences in the three cultivated areas. According to authors who analyzed Serbian plum cultivars [47], the share of glucose, fructose, and sorbitol was also dominant.

Table 3. Descriptive analysis of sugar content (g/kg dw) in 68 Norwegian plum cultivars from Njøs (42 samples) and NIBIO Ullensvang (8 samples) collected in 2019 and 2021 and from NMBU (18 samples) collected in 2019 and 2020.

Norwegian Area	**Njøs**				**NIBIO Ullensvang**				**NMBU**			
Parameter	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**
Sorbitol	4.16	164.54	81.98	31.42	67.79	114.32	92.53	16.19	52.47	144.01	98.02	25.12
Trehalose	0.10	9.70	1.59	1.79	0.29	34.66	7.09	11.60	0.32	5.15	1.88	1.47
Arabinose	0.05	3.34	0.94	0.70	0.37	1.51	0.76	0.40	0.30	3.28	1.08	0.68
Glukose	156.69	349.79	229.91	41.90	223.43	278.16	244.46	18.73	138.26	319.13	222.53	43.44
Fructose	60.95	275.64	173.66	34.07	150.04	244.51	192.98	28.43	142.18	285.38	197.92	37.17
Sucrose	76.78	227.29	157.38	42.28	97.03	279.02	208.25	58.47	67.43	233.16	136.52	57.38
Turanose	2.31	31.55	13.09	6.96	6.75	29.90	19.22	9.04	1.47	29.30	12.33	6.77
Glycerol	0.25	7.20	1.17	1.12	0.22	2.15	1.27	0.64	0.24	2.18	0.90	0.58
Galactitol	0.75	6.85	2.63	1.23	1.54	9.80	3.88	2.67	0.48	7.62	2.42	1.66
Galactose	16.17	39.07	27.92	6.89	20.48	45.58	33.80	8.06	11.65	37.62	24.86	7.23
Ribose	0.60	11.82	4.89	2.76	2.44	13.12	8.73	3.88	0.42	7.98	3.39	2.41
Isomaltose	0.26	4.66	1.73	1.11	1.17	3.68	2.27	0.78	0.22	3.50	1.47	1.00
Isomaltotriose	0.23	4.48	2.14	0.99	0.62	4.65	3.01	1.23	0.21	3.42	1.93	0.91
Maltose	1.56	32.12	10.78	8.51	2.86	37.54	18.26	12.91	1.12	12.87	5.58	3.36
Maltotriose	0.17	1.59	0.53	0.28	0.33	1.33	0.69	0.32	0.12	0.81	0.36	0.20
Mannitol	0.07	7.81	2.08	1.66	1.21	3.70	2.37	0.84	0.06	6.28	1.94	2.07
Xylose	0.24	12.23	5.03	2.11	2.50	11.56	6.82	3.01	2.11	13.36	5.46	2.78
Melibiose	1.96	10.46	5.97	1.92	4.58	7.11	5.97	0.99	2.06	9.46	5.78	2.11
Panose	0.04	20.56	3.55	3.94	0.17	6.66	2.00	2.23	1.33	15.76	6.17	4.36
Rhamnose	0.93	18.51	5.20	3.46	2.24	9.51	5.02	2.41	1.07	14.68	5.78	4.59
Raffinose	0.53	4.34	2.02	0.90	1.54	3.38	2.54	0.61	1.96	6.55	3.55	1.40
Stachyose	0.33	10.37	1.87	1.62	0.87	3.98	1.71	0.98	1.00	11.17	4.19	2.97
Sum of sugars	435.13	757.08	648.21	71.87	694.56	830.55	763.56	46.99	532.55	760.83	640.77	65.22
Sum of sugar alcohols	15.45	168.85	87.85	31.04	72.75	128.03	100.05	17.61	61.52	147.83	103.29	24.02

Cultivars 'Herman' (164.54 g/kg) and then 'Jubileum' (144.19 g/kg dw) from Njøs, as well as 'Herman' (144.01 g/kg dw) from NMBU, had the highest level of sorbitol, a natural sugar alcohol that increases water volume in the intestine and contributes to the laxative effects for which prunes and plum juice are known [47]. Sorbitol is slowly absorbed into the body from the gastrointestinal tract and metabolized by the liver mainly as fructose, a carbohydrate that is highly tolerated by people with diabetes [48]. For that reason, cultivars 'Frostaplomme' (from Njøs), 'Rivers Early Prolific' and 'Trågeplommer' (from NMBU) should also be underlined because all three have high sorbitol content (133.85, 124.95, and 134.36 g/kg dw, respectively) with a low sum of glucose and sucrose (319.85, 316.25 and 327.00 g/kg dw, respectively). These types of cultivars should be recommended for a low glycemic index diet. In addition, in the plums, Edda', 'Mallard', 'Reeves', and 'Valor' from NIBIO, as well as plums 'Reeves' and 'Mallard' from Njøs, we found a higher content of ribose. Among all plum samples, 'Čačanska lepotica' (from NIBIO) was found to have the highest content of trehalose. A high content of xylose was found in 'Čačanska lepotica', 'Bleue de Belgique', and 'Experimentalfältets sviskon' (Table A2).

From the descriptive analysis (Table 3), it could be noted that in plums from the NIBIO area, the maximum mean values of the most sugar compounds were found (similar as for nutrients), whereas the sum of sugars was also the highest. Although the sugar accumulation is affected by cultivars, weather conditions, and agricultural conditions [49], no considerable effect could be noted for these plum cultivars (Table 3). Nevertheless, a positive correlation was shown between the August and September temperature and the flowering in the subsequent year for plums also grown in these areas [50]. The average temperatures for Norway areas included in the current study agree with the weather conditions previously mentioned by other authors [37,50].

When the results for sugars found in the same plum cultivars grown in different areas are compared, some cultivars stand out. The maximum values of the most sugar compounds were found in the plums 'Edwards', 'Mount Royal', and 'Rivers Early Prolific' from Njøs (Table A2). Moreover, 'Mount Royal' could be highlighted due to the higher values of almost all sugar components compared to the same cultivar from NIBIO (Table A2). Among all quantified sugar compounds for seven cultivars common for Njøs and NIBIO, glucose and fructose were the highest, especially those grown in the NIBIO area. On the other hand, among sugars in nine cultivars from Njøs and NMBU, higher values for trisaccharide raffinose were detected in NMBU cultivars (Table A2).

3.3. IC Results of Organic Acid Content

The results of the quantification of 11 organic acids are presented in Table 4. Of all organic acids, malic acid was the most abundant (more than 30% relative to the sum of quantified organic acids). However, the lowest values of malic acid were noted for 'Frostaplomme' and 'Prosser 84' from Njøs. The second was quinic acid but with a lower share (about 7% of the sum). The mean content of malic acid for Njøs, NIBIO, and NMBU samples was 21.52, 23.66, and 24.06 g/kg dw, respectively (Table 4). This is in accordance with the reports from other authors [51] for orange plums from South Korea, which showed a much higher content of citric acid. The predominant content of malic acid was also found for other plum samples [27,52,53] and other fruits such as apples [37,53]. The differences between quantified organic acids in the Njøs, NIBIO, and NMBU samples were not significant (Table 4), except the higher maximum values of quinic acid for 'Grand Duke' and oxalic acid for 'R5', from Njøs (Table A3). The same trend is observed for some varieties of Serbian plums [27], in which the quinic acid values stood out. In addition, the highest values of other organic acids (fumaric, citric, butyric, propionic, lactic, shikimic, and pyruvic acids) were also noted for Njøs plums (Table 4).

Table 4. Descriptive analysis of organic acids content (g/kg dw) in 68 Norwegian plum cultivars from Njøs (42 samples) and NIBIO Ullensvang (8 samples) collected in 2019 and 2021, and from NMBU (18 samples) collected in 2019 and 2020.

Norwegian Area	**Njøs**				**NIBIO Ullensvang**				**NMBU**			
Parameter	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**
Citric	0.13	2.56	1.01	0.48	0.16	1.78	0.99	0.66	0.09	1.64	0.90	0.41
Maleic	0.26	2.33	1.06	0.42	0.69	2.23	1.03	0.50	0.24	1.22	0.91	0.25
Malic	6.70	31.59	21.52	6.67	17.68	32.52	23.66	4.56	15.61	31.39	24.06	4.80
Pyruvic	0.26	2.63	1.02	0.45	0.69	2.18	1.04	0.48	0.24	1.22	0.91	0.25
Shikimic	0.08	0.37	0.15	0.06	0.10	0.30	0.15	0.06	0.08	0.20	0.12	0.03
Lactic	0.08	0.27	0.12	0.05	0.08	0.11	0.10	0.01	0.07	0.10	0.08	0.01
Propionic	0.001	0.01	0.002	0.002	0.001	0.003	0.002	0.001	0.0003	0.002	0.001	0.001
Butiric	0.07	0.42	0.13	0.08	0.08	0.10	0.09	0.01	0.07	0.09	0.08	0.01
Quinic	2.28	9.06	4.73	1.88	2.59	5.50	4.01	0.85	1.64	6.17	4.35	1.40
Oxalic	0.05	10.19	1.53	2.60	0.11	1.92	0.49	0.61	0.04	0.22	0.12	0.06
Fumaric	0.01	2.25	0.44	0.47	0.07	0.32	0.18	0.09	0.07	0.66	0.28	0.14

The content of organic acids in fruits affects fruit taste, as well as the quality. According to some authors [54], Norwegian plum cultivars are characterized by specific taste and aroma. As previously stated [27], sweet fruits generally contain low levels of organic acids, especially malic acid. Thus, a higher level of malic acid in Norwegian plums (Table 4) is most probably the consequence of specific climatic conditions where it is grown. This is in accordance with other fruits cultivated in Norway, where malic acid content was found to be dominant, such as apples [37]. Furthermore, the differences caused by altitude were found to be statistically significant for many parameters, as well as for malic acid content [52].

By comparing seven cultivars grown in both, Njøs and NIBIO, 'Victoria' from NIBIO and 'Mallard' from Njøs could be highlighted due to the highest content of several organic acids (Table A3). In addition, 'Herman' from Njøs stood out from nine plum cultivars grown in Njøs and NMBU (Table A3).

3.4. Phenolic Quantification

In total, 19 phenolic compounds were identified in the Norwegian plum cultivars, which descriptive analysis is presented in Table 5. Results of UHPLC-DAD MS/MS analysis showed a higher content of phenolic compounds in the NMBU samples (mean values, as well as most of the maximum values) than in Njøs and NIBIO (Table 5). In plum cultivars from Njøs and NMBU, the most dominant phenolic compounds were 5-*O*-caffeoylquinic acid and rutin, with a share of around 30% of the total sum of phenols (Table 5). Similar was noted in another study [55], where even higher levels of these compounds were found. Hydroxycinnamic acids were noted as dominant (calculated on fresh weight, fw) in Serbian plum cultivars [27] and other Norwegian plum cultivars (calculated on fw) [23], while in this study, the average content was about 5% of the total sum of phenols (Table 5). Results of quercetin glycosides content in plum cultivars 'Avalon', 'Excalibur', 'Jubileum', 'Reeves', and 'Valor' (Table A4) were comparable with the results obtained by others [23].

Table 5. Descriptive analysis of the content of phenolic compounds (mg/kg), total phenolic content (TPC, g GAE/kg dw), and relative scavenging activity (RSA, mmol TE/kg dw) in 68 Norwegian plum cultivars from Njøs (42 samples) and NIBIO Ullensvang (8 samples) collected in 2019 and 2021, and from NMBU (18 samples) collected in 2019 and 2020.

Norwegian Area	**Njøs**				**NIBIO Ullensvang**				**NMBU**			
Parameter	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**
Protocatechuic acid	0	12.82	0.86	2.30	1.40	173.61	32.71	58.30	2.06	24.16	7.10	5.03
5-*O*-Caffeoylquinic acid	0	161.84	24.94	43.11	13.50	54.89	23.11	14.10	18.33	137.53	66.31	33.39
p-Hydroxybenzoic acid	0	8.48	1.01	2.15	1.63	11.49	4.83	3.53	0.00	20.77	8.15	5.63
Caffeic acid	0	7.67	2.52	1.85	0.93	3.58	1.51	0.86	1.21	13.13	5.26	3.21
Rutin	0.57	122.38	21.33	33.59	7.37	33.75	17.36	9.43	15.39	132.82	58.06	30.42
p-Coumaric acid	0	2.18	0.33	0.63	0.48	4.72	2.56	1.67	0.22	17.56	3.88	4.36
Quercetin 3-*O*-glucoside	0.24	22.35	4.60	5.04	0.58	5.78	2.68	1.62	2.11	20.99	10.67	5.42
Isorhamnetin 3-*O*-rutinoside	0	35.92	1.71	5.79	1.08	27.68	8.43	8.71	0	28.94	8.42	7.14
Ferulic acid	0	3.99	0.60	1.20	0	2.41	0.30	0.85	0	4.89	2.65	1.27
Isorhamnetin 3-*O*-glucoside	0	4.93	0.15	0.76	0	1.13	0.31	0.38	0	3.27	1.07	1.06
Quercetin 3-*O*-rhamnoside	0	1.20	0.04	0.19	0.14	0.75	0.33	0.20	0	19.06	1.63	4.70
Kaempferol 7-*O*-glucoside	0	1.14	0.16	0.33	0.16	1.73	0.72	0.48	0	3.98	0.86	0.86
Phlorizin	0	1.13	0.15	0.32	0.57	1.40	0.94	0.29	0	102.16	6.43	23.90
Quercetin	1.89	16.47	6.59	2.59	4.54	6.81	5.55	0.83	1.97	26.01	5.20	5.79
Phloretin	0	0.47	0.04	0.11	0	0.25	0.21	0.08	0	0.83	0.17	0.19
Acacetin	0	0.91	0.05	0.16	0	0.71	0.28	0.26	0	10.02	0.73	2.33
Syringic acid	0	9.46	0.37	1.73	0	11.03	1.38	3.90	0	14.81	6.69	5.06
Aesculetin	0	5.28	0.90	0.96	0.30	1.72	0.66	0.44	0	7.48	2.65	2.58
Kaempferol 3-*O*-glucoside	0	1.21	0.27	0.28	0.03	0.58	0.18	0.21	0	0	0	0
Sum of phenolic compounds	8.24	305.00	66.63	85.11	42.14	234.42	104.07	63.80	89.83	383.11	195.93	85.93
TPC (g GAE/kg)	3.47	17.09	8.71	2.93	4.77	20.59	9.39	4.99	4.30	13.84	7.77	4.99
RSA (mol TE/kg)	12.14	103.52	42.72	20.74	18.11	39.13	31.10	7.30	22.33	58.48	36.48	7.30

Rutin was found in the range of 0.57–122.38 mg/kg for the Njøs samples, 7.37–33.75 mg/kg for the NIBIO samples, and 15.39–132.82 mg/kg from the NMBU samples (Table 5). The content of rutin was mainly higher than the results of other plum cultivars from Serbia (expressed on fw) [27] but lower than plums from Lithuania (expressed on dw), whereas some genotypes were the same as in this study [53]. Quercetin was detected in all plum cultivars (1.89–16.47 mg/kg range for Njøs samples, 4.54–6.81 mg/kg for NIBIO samples, and 1.97–26.01 mg/kg for NMBU samples) (Table 5). However, other authors [53] found quercetin in only three plum samples but in lower amounts. The highest values of isorhamnetin 3-*O*-rutinoside were found in 'Czar' from Njøs and 'Sinikka', 'Herman', and 'Diamond' from NMBU (Table 5). In addition, the amount of the isorhamnetin 3-*O*-rutinoside was significantly influenced by the cultivar [55].

Notably, phenolic compounds are mostly affected by environmental conditions compared to other parameters. Moreover, the differences caused by altitude, as stated by others [53], sometimes could have an influence. In general, the lowest diversity of phenolic compounds was noted for plums from the Njøs area (Table A4). For plums samples from Njøs, many phenolic acids (protocatechuic acid, *p*-hydroxybenzoic acid, ferulic acid, *p*-coumaric acid, and syringic acid) and other polyphenols (isorhamnetin 3-*O*-rutinoside, isorhamnetin 3-*O*-glucoside, quercetin 3-*O*-rhamnoside, kaempferol 7-*O*-glucoside, phlorizin, phloretin, and acacetin) were not found. Exceptions were noted for several samples (such as 'Reine Claude d'Althanns', 'Czar', 'Edda', 'Haganta', 'Njøs II', 'Opal', 'Prosser 84', 'Rivers Early Prolific', 'Rød Victoria', 'Sanctus Hubertus' and 'Victoria'), in which some of these compounds were found (Table A4). For plum samples from NIBIO, only ferulic acid and syringic acid were not found (Table A4).

When comparing seven samples grown both in Njøs and NIBIO, 'Edda' and 'Victoria' from Njøs, and 'Mallard', 'Reeves', and 'Valor' from NIBIO had higher sums of phenolic compounds (Table 5). Comparing nine plum samples from Njøs and NMBU, the sums of phenolic compounds were higher in NMBU samples, except for 'Rivers Early Prolific' from Njøs, in which contents of rutin and quercetin 3-*O*-glucoside were also higher (Table A4).

3.5. Antioxidant Activity

Antioxidant activity was expressed through the total phenolic content (TPC), presented as a gram of gallic acid equivalents per kilogram of the dried sample (g GAE/kg dw), and relative scavenging activity (RSA), presented as a gram of Trolox standard equivalents per kg of the dried sample (g TE/kg dw), where the descriptive analysis is presented in Table 5. The ranges for TPC were 3.47–17.09 g GAE/kg, 4.77–20.59 g GAE/kg, and 4.30–13.84 g GAE/kg for Njøs, NIBIO, and NBMU, respectively, while for RSA, they were 12.14–103.52 mol TE/kg, 18.11–39.13 mol TE/kg and 7.30–22.33 mol TE/kg for the Njøs, NIBIO, and NBMU samples, respectively (Table 5).

The TPC and RSA results are cultivar dependent, but no significant differences between the same plums from two cultivated areas could be noticed. It was stated that the 'Jubileum' and 'Valor' plum cultivars are dominant in the view of phenolics and antioxidant activity [22]. In relation to that, from the results of this study, it could be noted that 'Jubileum' (from NIBIO) had the highest TPC value (20.59 g GAE/kg dw) and 'Reeves' (from Njøs) had the highest RSA (103.52 mol TE/kg dw) among other 68 plum cultivars.

According to a study where apple and plum samples were compared [56], the higher antioxidant activity of apples could be due to the presence of procyanidins. However, when we compare our results for apples [37] and plums (Table 5), both from Norway (Njøs and NIBIO), a great similarity between the TPC values could be noted. Otherwise, RSA values were higher for apple samples [37], and more significant differences were found for the NIBIO samples. On the contrary, comparing TPC and RSA values for raspberries from Njøs and NMBU [36] showed lower antioxidant activity in plum cultivars.

3.6. Chemometric Analyses

The PCA allows the detection of a structure relationship and a considerable reduction in the number of variables between observed experimental parameters that give complimentary information [57,58]. All samples having different chemical composition contents are shown by descriptive analysis in the preceding section (Tables 2–5) and predicted by the PCA score plots presented in this chapter. The min-max normalization method was used as Statistica's default coordinate transformation performed on the dataset prior to conducting the PCA.

Min-max normalization (also called auto scale or feature scale) performs a linear transformation on the original data, transforming it to scaled data in the range of values between 0 and 1. This transformation is based on dividing (x-min) by (max-min), where x represents an observed parameter in the experimental database.

3.6.1. Chemometric Analysis of the Results of Element Content

The PCA of the element content in plum samples (Figure 2) illustrated that the first three principal components outlined 69.18% of the total variance in the 13 parameters (P, Zn, S, N, Cu, Ca, Mg, K, Mn, Fe, Na, Al, and B). According to the results of the PCA, the content of K (which contributed 16.9% of the total variance, established on correlations), Cu (7.56%), Fe (10.84%), K (15.45%), Mg (14.03%), Mn (15.07%), and Na (12.50%) revealed positive influences on the first principal component (PC1). The content of B (13.07% of the total variance, based on correlations), Cu (10.22%), P (19.87%), S (12.34%), and Zn (35.75%) exerted a positive influence on the second principal component (PC2). In comparison, the Al (13.87%) and P content (32.27%) displayed a positive influence on the third principal component (PC3) calculation, while N content showed a negative influence on PC3 (39.49%).

Statistically significant correlations ($p \leq 0.05$) were found between several element contents in the observed plum samples (Figure A1). The highest positive correlations were found between K and Mn, K and Mg contents (r = 0.955, r = 0.932, respectively; $p \leq 0.01$), Ca and Mg content (r = 0.879; $p \leq 0.01$), K and Na content (r = 0.867; $p \leq 0.01$), Na and Mn (r = 0.863; $p \leq 0.01$). However, a strong relationship between K and Ca was noticed in another study and between other macro- and microelements in plum [42]. Similarly, Reig et al. [59] found significant correlations of leaf nutrients, such as those between Cu and K, between Mg and Ca, and between K and Ca in two 'Greengage' plum cultivars. Generally, the elemental compositions of plum fruit depend on environmental conditions such as soil type and texture, the content of soil nutrients and their ratio, amounts of rainfall, field water capacity, air temperature, horticultural practices, and others [39].

Chemometric data of the element content suggests that the samples from the Njøs area differed mainly in the Cu, Fe, K, Mg, Mn, and Na content. However, it seems that plums from NMBU stood out from the other two areas.

3.6.2. Chemometric Analysis of the Results of Sugar Content

The PCA of the sugar content results of plum samples (Figure 3) explained that the first three principal components summarized 44.73% of the total variance in the 22 parameters (sorbitol, trehalose, arabinose, glucose, fructose, sucrose, turanose, glycerol, galactitol, galactose, ribose, isomaltose, isomaltotriose, maltose, maltotriose, mannitol, xylose, melibiose, panose, rhamnose, raffinose, and stachyose). Furthermore, the results of the PCA revealed that the content of ribose (which contributed 8.75% of the total variance, based on correlations) showed a positive influence on the first principal component (PC1), while the content of fructose (8.79%, of the total variance, based on correlations), galactitol (12.48%), xylose (16.03%), and raffinose (8.86%) positively affected the second principal component (PC2). The content of isomaltose (17.39%), maltose (8.92%), maltotriose (11.04%), and mannitol (18.46%) positively influenced the third principal component calculation (PC3).

Color correlation analysis for the results of sugar compounds in plum samples is shown in Figure A2. The correlation coefficient value defines the circle's color, while the *p*-value of the correlation defines the circle's size. The highest positive correlations for sugar content were found between trehalose and galactitol (r = 0.573; $p \leq 0.01$), panose and arabinose (r = 0.549; $p \leq 0.01$), stachyose and arabinose (r = 0.459; $p \leq 0.01$), maltose and ribose (r = 0.672; $p \leq 0.01$), mannitol and isomaltose (r = 0.550; $p \leq 0.01$), rhamnose and isomaltose (r = 0.472; $p \leq 0.01$), panose and mannitol (r = 0.611; $p \leq 0.01$), rhamnose and mannitol (r = 0.663; $p \leq 0.01$), rhamnose and panose (r = 0.793; $p \leq 0.01$) and stachyose and panose (r = 0.584; $p \leq 0.01$).

In other studies [60,61], glucose, fructose, and sorbitol contents were highly and positively correlated, which was not the case in our study. However, in peach cultivars, no correlations between glucose, fructose, sucrose, and sorbitol were determined [62]. Similar results, with some exceptions, were determined in apricot, plum, and plumcot fruits [63].

The results of the applied statistical analysis on sugar compounds showed that plum samples from the NIBIO Ullensvang area stand out mainly due to sucrose, ribose, and maltose, while plums from NMBU in the content of raffinose.

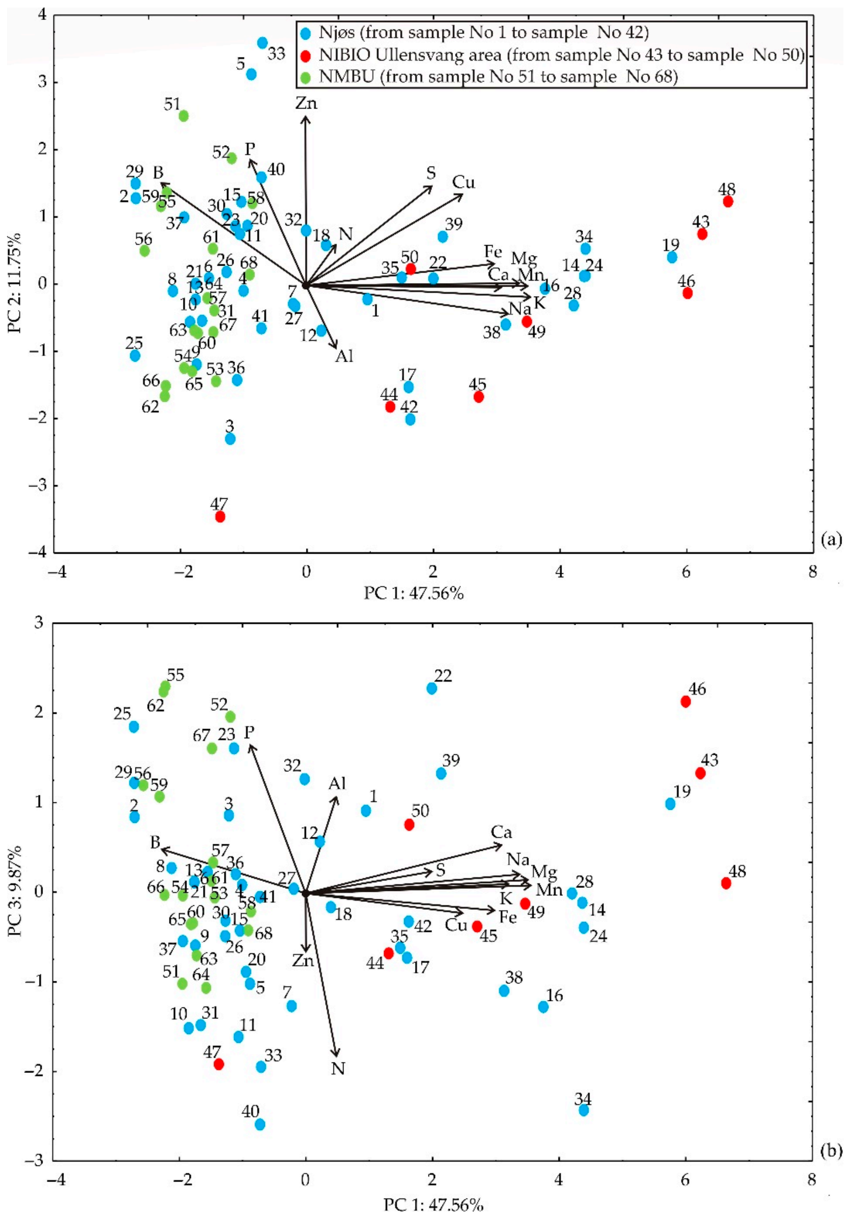

Figure 2. PCA ordination of element content variables: (**a**) projection in the PC1-PC2 plane; (**b**) projection in the PC1-PC3 plane.

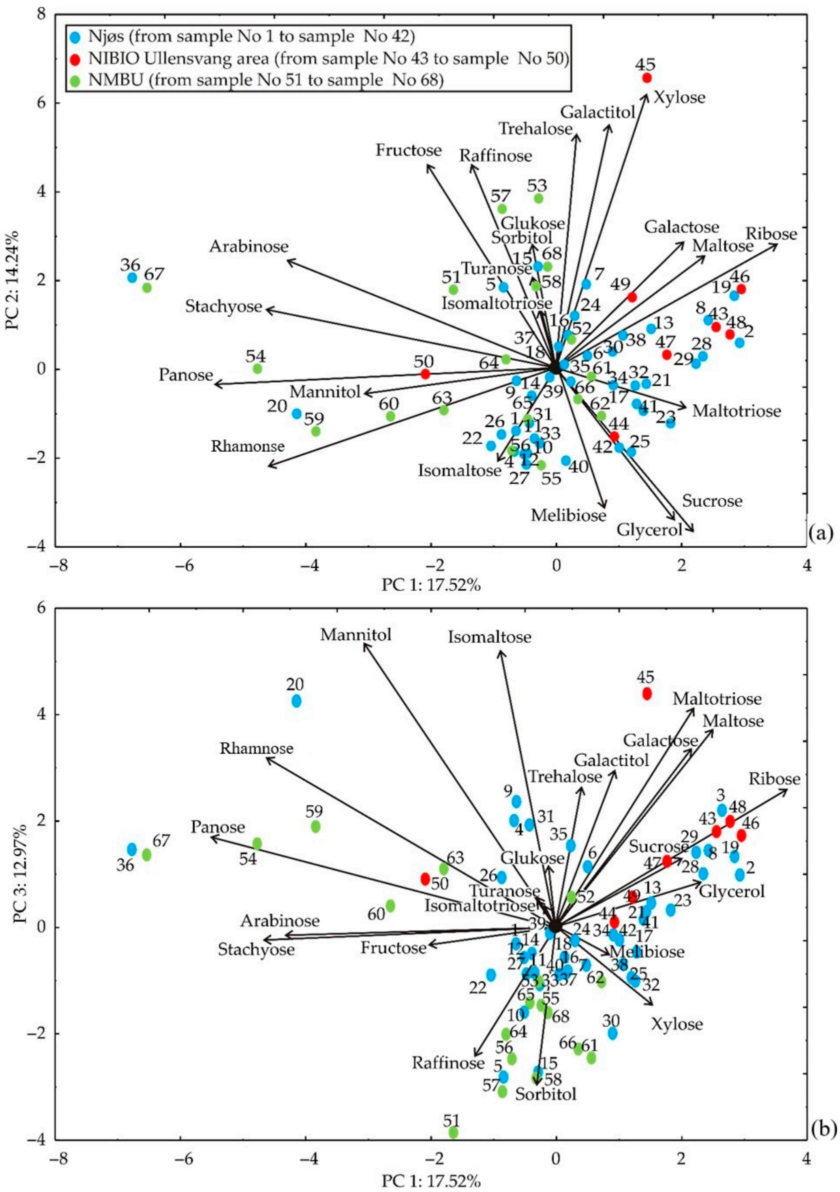

Figure 3. PCA ordination of sugars content variables: (**a**) projection in PC1-PC2 plane; (**b**) projection in PC1-PC3 plane.

3.6.3. Chemometric Analysis of the Results of Organic Acid Content

The PCA of the results for the organic acid in plums samples (Figure 4) demonstrated that the first three principal components summarized 67.99% of the total variance in the 11 parameters (citric, maleic, malic, pyruvic, shikimic, lactic, propionic, butiric, quinic, oxalic, and fumaric). The content of maleic (20.40% of the total variance, based on correlations), malic (8.74%), pyruvic (16.54%), shikimic (17.04%), lactic (18.20%), and butyric acid (13.14%) content influenced positively to PC1 calculation. The content of fruit acid contents, including quinic (7.04% of the total variance, depended on correlations), oxalic (37.40%), and fumaric (22.81%), positively affected the PC2 coordinate. Malic acid (19.74) negatively affected the PC2 calculation. The content of citric (48.93%) and propionic acids (42.79%) had a negative influence on the PC3 coordinate.

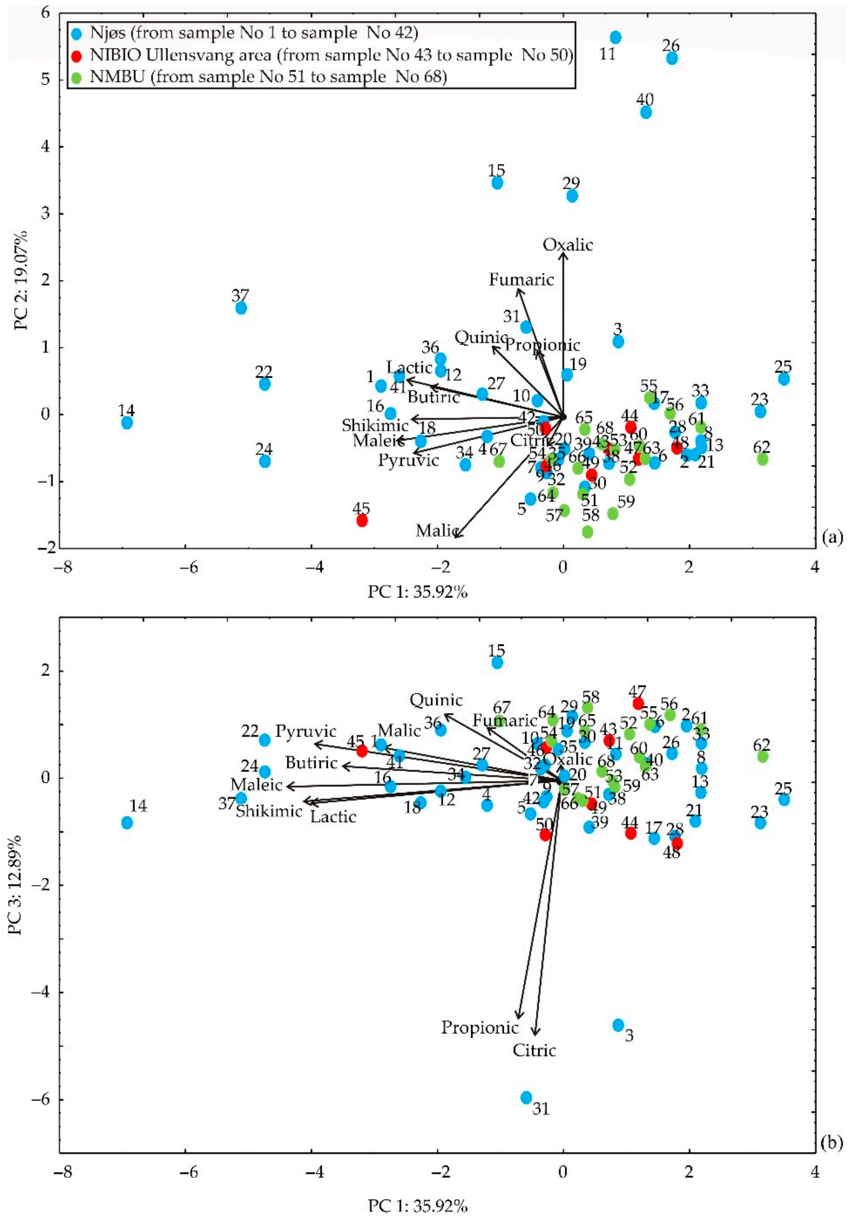

Figure 4. PCA ordination of fruit acids content variables: (**a**) projection in PC1-PC2 plane; (**b**) projection in PC1-PC3 plane.

The highest positive correlations in fruit acid (Figure A3) content was found between pyruvic and maleic acid (r = 0.854; $p \leq 0.01$), lactic and butyric acid (r = 0.753; $p \leq 0.01$), lactic and shikimic acid (r = 0.682; $p \leq 0.01$), shikimic and maleic acid (r = 0.662; $p \leq 0.01$), malic and maleic acid (r = 0.654). A negative correlation was noticed between oxalic and malic acid (r = −0.433; $p \leq 0.01$). According to Bae et al. [63], oxalic acid and malic acid were strongly correlated in apricot and plumcot. Oxalic acid and quinic acid were highly related in plumcot (r = 0.89) and plum (r = 0.96). Citric acid was significantly correlated with fumaric acid only in plum (r = 0.98).

From the results of the applied statistical analysis results on the organic acids content, the samples differed the most in the content of malic and quinic acids. The plums from NMBU could be clustered (Figure 4).

3.6.4. Chemometric Analysis of the Results of Phenolic Content, TPC, and RSA

The PCA of the content of polyphenolic compounds in plum samples (Figure 5) showed that the first three principal components summarized 58.08% of the total variance in the

21 parameters (protocatechuic acid, 5-*O*-caffeoylquinic acid, *p*-hydroxybenzoic acid, caffeic acid, rutin, *p*-coumaric acid, quercetin 3-*O*-glucoside, isorhamnetin 3-*O*-rutinoside, ferulic acid isorhamnetin 3-*O*-glucoside, quercetin 3-*O*-rhamnoside, kaempferol 7-*O*-glucoside, phlorizin, quercetin, phloretin, acacetin, syringic acid, aesculetin, kaempferol 3-*O*-glucoside, TPC, and RSA).

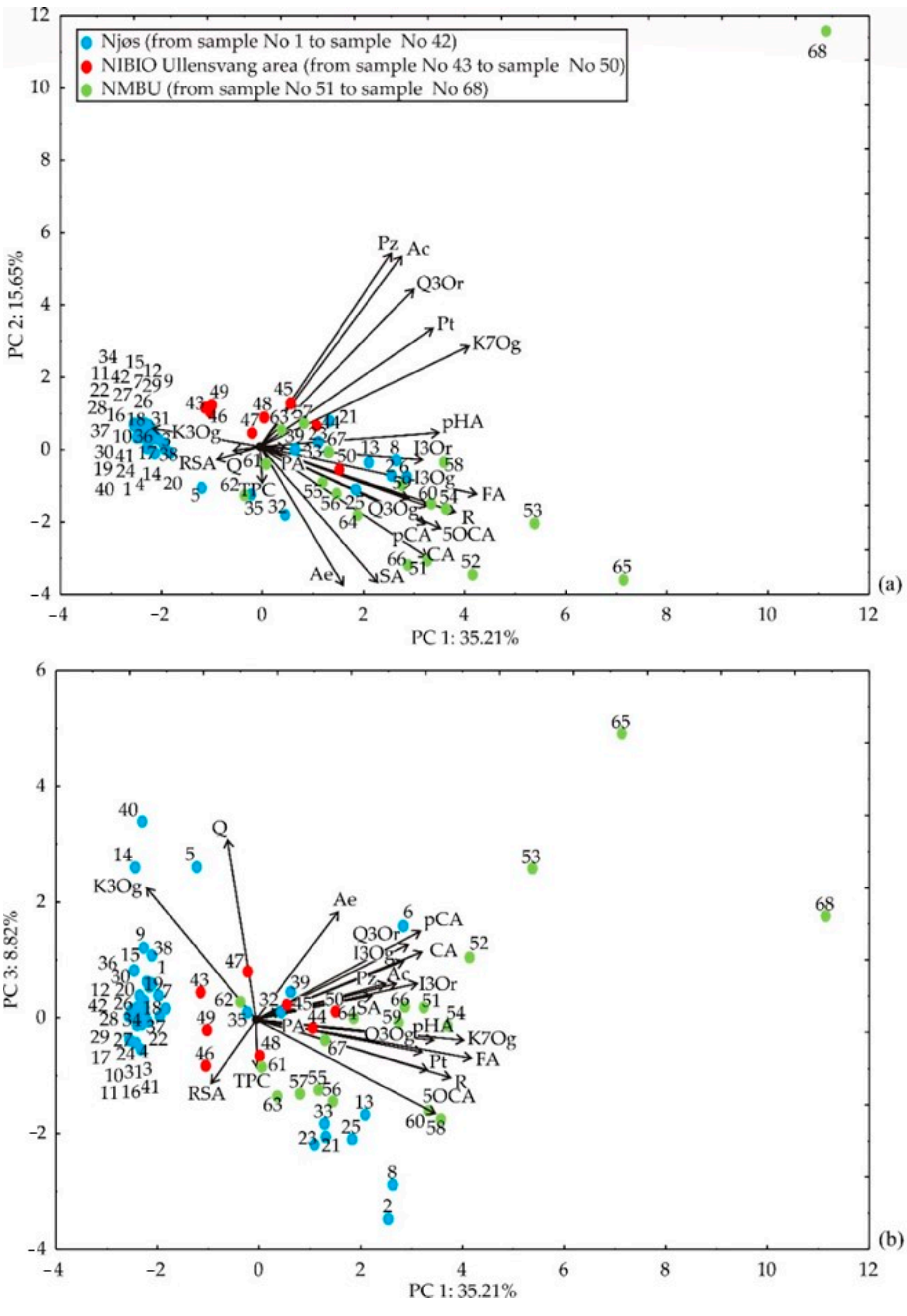

Figure 5. PCA ordination of phenolic content, TPC, and RSA variables: (**a**) projection in PC1-PC2 plane; (**b**) projection in PC1-PC3 plane (PA—protocatechuic acid, 5OCA—5-*O*-caffeoylquinic acid, pHA—*p*-hydroxybenzoic acid, CA—caffeic acid, R—rutin, pCA—*p*-coumaric acid, Q3Og—quercetin 3-*O*-glucoside, I3Or—isorhamnetin 3-*O*-rutinoside, FA—ferulic acid, I3Og—isorhamnetin 3-*O*-glucoside, Q3Or—quercetin 3-*O*-rhamnoside, K7Og—kaempferol 7-*O*-glucoside, Pz—phlorizin, Q—quercetin, Pt—phloretin, Ac—acacetin, SA—syringic acid, Ae—aesculetin, K3Og—kaempferol 3-*O*-glucoside, TPC—total phenolic content, RSA—radical scavenging activity).

Furthermore, the content of 5-*O*-caffeoylquinic acid (7.16% of the total variance, according to correlations), *p*-hydroxybenzoic acid (7.12%), rutin (8.51%), ferulic acid (10.34%), and kaempferol 7-*O*-glucoside (9.68%) revealed a positive impact on the PC1 coordinate. The content of quercetin 3-*O*-rhamnoside (12.28%), phlorizin (18.41%), and acacetin (17.84%) demonstrated a positive influence on PC2 coordinate calculation, while syringic acid (9.34%) and aesculetin (9.80%) affected negatively to the PC2 coordinate. Additionally, the content of *p*-coumaric acid (7.08%), quercetin (28.88%), aesculetin (10.53%), and kaempferol 3-*O*-glucoside (15.46%) displayed a positive impact on PC3 coordinate calculation. The content of 5-*O*-caffeoylquinic acid (7.67%) showed a negative impact on the PC3 calculation.

The applied color correlation analysis on the results of polyphenolic content and TPC and RSA is shown in Figure A4. The highest positive correlations were found between phlorizin and acacetin (r = 0.989; $p \leq 0.01$), quercetin 3-*O*-rhamnoside and acacetin (r = 0.935; $p \leq 0.01$), and phlorizin (r = 0.929; $p \leq 0.01$), 5-*O*-caffeoylquinic acid and rutin (r = 0.856; $p \leq 0.01$), quercetin 3-*O*-glucoside and rutin (r = 0.834; $p \leq 0.01$). At the same time, the highest negative correlations were found between ferulic acid (r = −0.422), 5-*O*-caffeoylquinic acid (r = −0.421; $p \leq 0.01$), rutin (r = −0.365; $p \leq 0.01$) and kaempferol 3-*O*-glucoside. Numerous positive correlations between polyphenolic compounds were also determined for 'Čačanska lepotica' grafted on many rootstocks [64], Japanese plums [61], and fruits of *Prunus domestica* L., *Prunus cerasifera* Ehrh., and *Prunus spinosa* from Turkey [65].

In the literature data, some of the mentioned plum cultivars were well characterized by their color, fruit size, taste, and other quality parameters [22,52]. Considering all their differences, variations between individual plum cultivars are expected. Some observations could be noted based on the chemical analysis of investigated plum cultivars from Njøs, NIBIO, and NMBU. Therefore, in addition to the content of some nutrients and sugar compounds, NMBU samples proved to be richer in polyphenols, both in individual phenolic compounds and in the sum of the quantified polyphenols (Tables 2, 3 and 5). In plum samples from NIBIO, higher nutrient, sugar contents, and TPC values were found (Tables 2, 3 and 5), while Njøs samples had higher values of several organic acids and RSA values (Tables 4 and 5).

When the results for the same cultivars from Njøs and NIBIO (seven samples) and from Njøs and NMBU (nine samples) were compared (Tables A1–A4), some cultivars stood out. In 'Mount Royal' from Njøs, higher values of the most sugar compounds were found compared to the same cultivar from NIBIO (Table A2). Cultivar 'Mallard' grown in Njøs showed the highest content of several organic acids (Table A3), while in the same cultivar from the NIBIO area, the maximum values of nutrients (Table A1) and higher content of phenolic compounds were noted (Table A4). 'Edda' showed maximum values of observed nutrients when it was grown in NIBIO but a higher sum of phenolic compounds when quantified when grown in Njøs. In 'Victoria' from NIBIO had the highest content of several organic acids (Table A3), but in this cultivar from Njøs, higher sums of phenolic compounds were found (Table A4). 'Reeves' from NIBIO showed maximum values of observed nutrients (Table A1) and higher sums of phenolic compounds (Table A4) than in the same cultivar grown in Njøs. In 'Rivers Early Prolific' from Njøs, the maximum values of observed nutrients (Table A1), most of the sugar compounds (Table A2), higher content of rutin, quercetin 3-*O*-glucoside, and the sum of phenolic compounds (Table A4) were found than in this cultivar from NMBU.

Considering the results of these chemical analyses, there was not enough information for further separation of the plum samples. Otherwise, additional chemometric analyses performed on all results (element (Figures 2 and A1), sugar (Figures 3 and A2), organic acid (Figures 4 and A3), phenolic content, and antioxidant activity (Figures 5 and A4) provide valuable data for different plum cultivar samples, as well as differentiation by growing area. The PCA analysis confirmed the chemical composition differences between the plum cultivars from three areas. Parameters that distinguished plum samples from the Njøs area were the content of elements Cu, Fe, K, Mg, Mn, and Na. Plum samples from NIBIO Ullensvang stood out mainly due to the sucrose, ribose, and maltose content, while NMBU samples had the highest content of raffinose, *p*-hydroxybenzoic acid, rutin, ferulic acid, kaempferol 7-*O*-glucoside, *p*-coumaric acid, and 5-*O*-caffeoylquinic acid. Similar sugar and organic acid content observations were noted in other studies [27].

In addition, plums from NMBU formed obvious clusters in the content of elements, sugars, organic acids, and polyphenols. For plums from the NIBIO area, whereas the smallest number of samples was analyzed, clusters are noted only in the content of polyphenolic compounds. For sugar content, the exceptions were 'Čačanska lepotica' and 'Victoria', and for organic acids content only 'Čačanska lepotica'.

Finally, it could be interesting to indirectly compare the obtained results for plums from these three areas with the results of apples and raspberries from the same areas. Thus, in comparison with our previously published paper [35], which refers to Norwegian apples from Njøs and NIBIO areas, more differences could be noted between plums than between apple cultivars. Plumber cultivars seemed more dependent on the location than apple cultivars. By comparing the results for raspberries grown in Norway (in the area of Njos and NMBU) [36], plum varieties were observed to have less obvious differences than raspberries.

Soil influences the absorption of the elements by the plant [66,67]. Hence, observed results for different fruits from the same areas in Norway suggested that there is a much greater influence on the type of growing fruit. For example, it was suggested that raspberries adopt more iron from the soil [68], which is in accordance with our observations. Bearing this in mind, as well as observed differences, many environmental factors influence the composition and quality of fruits [47,69,70]. However, the results of this and other studies about Norwegian fruits [37,38] have shown that the specific climatic conditions of Norway, with a limited period of fruit vegetation, still provide favorable regions for fruit growth.

4. Conclusions

This study provides a comparative analysis of elements, sugars, sugar alcohols, organic acids, phenolic compounds, and antioxidant capacity of 68 plum cultivars grown in three locations in Norway. High amounts of these phytochemicals suggest a significant nutritional value of Norwegian plums, comparable with well-known valuable plum cultivars grown in other countries. Furthermore, the results of chemometric analyses confirmed the difference in chemical compositions between the plum cultivars and provided more detailed information related to the influence of growing area, whereas plums from NMBU formed an obvious cluster and stood out in the content of elements, sugars, organic acids, and polyphenols. Among all plum cultivars grown in Norway, which were analyzed in this comprehensive study, 'Mallard' (from NIBIO) was distinguished by the content of elements, 'Valor' (NIBIO) by the content of sugar compounds, 'Helgøyplomme' (Njøs) by the content of organic acids, and 'Diamond' (NMBU) by the content of phenolic compounds. In addition, the cultivars 'Mount Royal', 'Mallard' 'Edda', 'Victoria', 'Reeves', and 'Rivers Early Prolific', grown in different Norwegian locations, showed obvious differences. The mentioned cultivars could be used to produce functional food or in breeding programs to create new genotypes with even more improved content of bioactive compounds.

Author Contributions: Conceptualization: I.Ć., M.K. and Ž.T.; methodology: Ž.T., M.F.A. and M.M.; formal analysis: U.G., T.T., L.P., M.K., B.D. and B.L.; writing, M.F.A., I.Ć., M.K., L.P. and B.L.; review and editing: I.Ć., M.F.A., Ž.T. and M.M.; supervision: Ž.T.; project administration, M.M. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Additional Figures

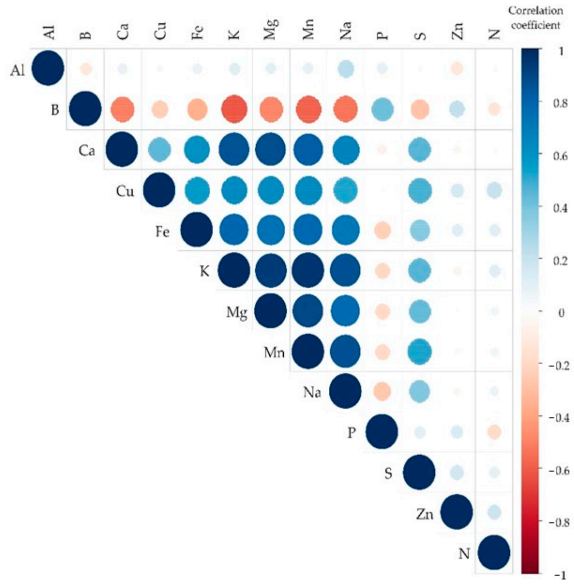

Figure A1. Color correlation graph between element content in plum samples.

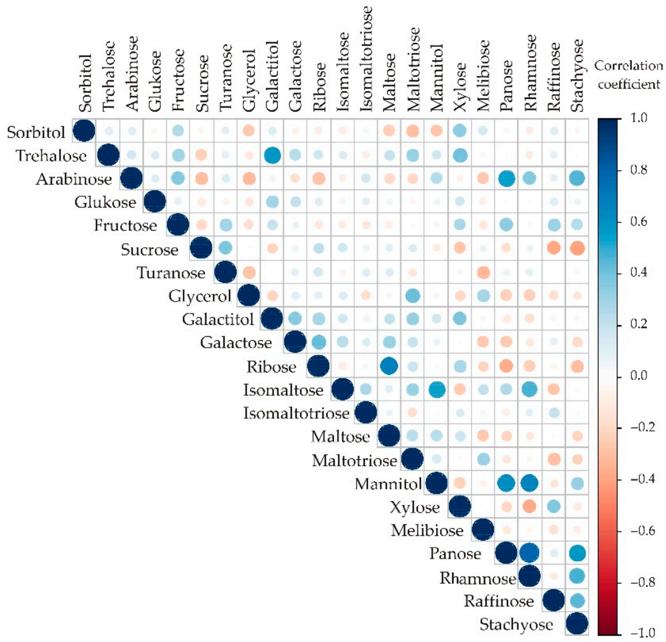

Figure A2. Color correlation graph between sugar content in plum samples.

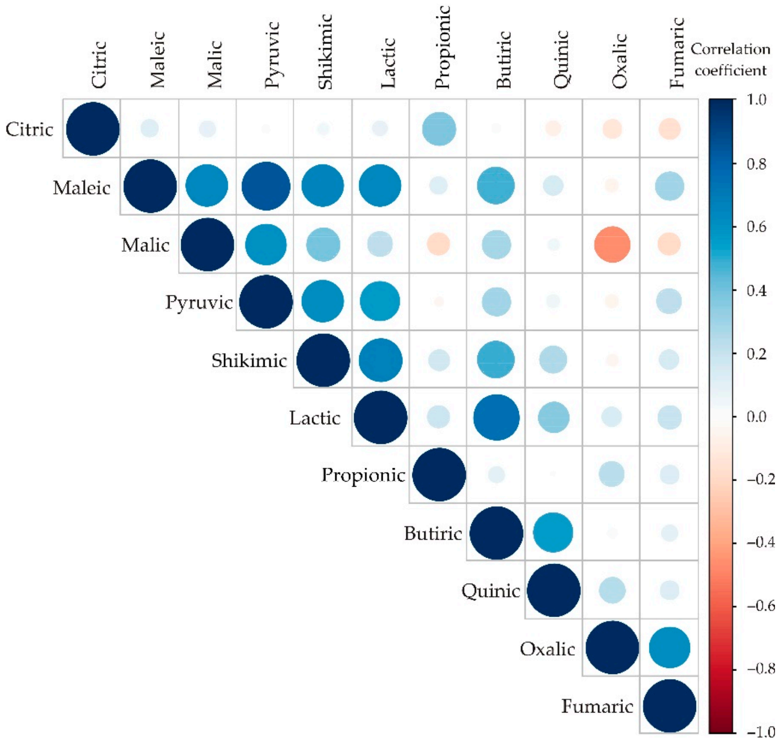

Figure A3. Color correlation graph between fruit acids content in plum samples.

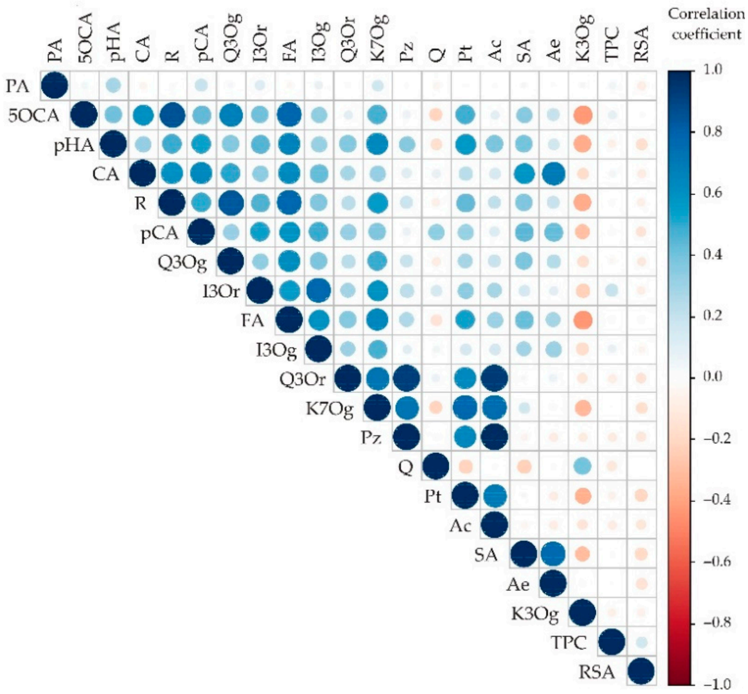

Figure A4. Color correlation graph between phenolic content in plum samples (PA—protocatechuic acid, 5OCA—5-*O*-caffeoylquinic acid, pHA—*p*-hydroxybenzoic acid, CA—caffeic acid, R—rutin, pCA—*p*-coumaric acid, Q3Og—quercetin 3-*O*-glucoside, I3Or—isorhamnetin 3-*O*-rutinoside, FA—ferulic acid, I3Og—isorhamnetin 3-*O*-glucoside, Q3Or—quercetin 3-*O*-rhamnoside, K7Og—kaempferol 7-*O*-glucoside, Pz—phlorizin, Q—quercetin, Pt—phloretin, Ac—acacetin, SA—syringic acid, Ae—aesculetin, K3Og—kaempferol 3-*O*-glucoside, TPC—total phenolic content, RSA—radical scavenging activity).

Appendix B. Additional Tables

Table A1. Content of nutrients (mg/kg) in 68 Norwegian plum cultivars from Njøs (42 samples) and NIBIO Ullensvang (8 samples) collected in 2019 and 2021 and from NMBU (18 samples) collected in 2019 and 2020.

No	Plum Cultivar	Al	B	Ca	Cu	Fe	K	Mg	Mn	Na	P	S	Zn	N (%)
1	Admiral Rigny	11.27	2.05	312.65	2.54	8.65	5123.33	158.92	4.03	45.70	8523.65	345.70	4.90	3.09
2	Reine Claude d'Althanns	5.09	12.19	49.84	2.74	3.43	1503.75	94.99	0.98	14.54	9766.32	209.15	8.59	3.03
3	Anita	28.65	1.55	63.33	2.86	2.89	2114.12	105.65	1.00	38.99	5421.26	187.54	5.65	2.87
4	Avalon	6.59	1.65	198.26	2.99	5.62	3147.66	92.65	2.15	15.65	8523.62	189.65	8.66	3.06
5	Bleue de Belgique	8.13	6.79	142.70	3.67	5.88	2568.04	154.21	1.38	31.89	7930.17	246.96	24.60	3.12
6	Czar	7.14	7.38	159.01	2.98	6.41	2496.32	126.12	0.98	9.75	7493.81	227.78	6.89	3.03
7	Diana	7.22	3.66	63.59	4.22	7.05	3874.27	123.54	2.52	52.65	6536.66	195.36	6.86	3.22
8	Edda	4.51	13.24	116.84	2.56	5.71	1902.43	165.90	1.48	13.15	6333.46	187.57	6.04	2.96
9	Edwards	8.90	5.53	61.08	2.24	5.29	3291.22	76.76	0.99	31.19	6294.38	171.64	5.32	3.11
10	Excalibur	7.09	9.13	82.71	2.01	6.97	2598.22	96.95	1.56	18.80	5253.15	201.62	6.74	3.26
11	Frostaplomme	7.65	3.26	108.98	3.26	8.96	2562.69	110.53	1.32	9.65	8112.65	256.33	8.65	3.42
12	Grand Duke	4.65	1.02	263.13	1.89	7.89	4256.33	135.66	3.16	41.37	7856.63	325.27	4.66	3.02
13	Haganta	4.88	9.76	102.63	2.82	3.53	1830.21	108.32	0.86	46.12	5972.07	192.67	8.79	2.90
14	Helgøyplomme	2.65	1.66	283.33	2.66	41.26	8536.99	278.65	8.96	101.24	5985.62	365.33	10.25	2.98
15	Herman	10.29	5.65	115.44	2.70	5.70	2578.84	118.91	1.30	15.88	7550.90	367.56	11.26	3.17
16	Jefferson	11.26	2.65	285.37	4.66	29.62	8523.62	245.62	6.33	85.33	4965.32	301.27	8.26	3.24
17	Jubileum	9.92	4.15	277.09	2.62	16.71	5915.36	300.74	4.01	69.08	5275.34	194.33	4.52	3.20
18	Kirkes	8.01	4.26	71.99	5.21	8.24	4125.65	153.65	3.05	64.56	8321.51	232.57	7.13	3.12
19	Mallard	14.80	0.70	482.97	3.93	23.19	11,545.75	513.84	9.42	84.71	7852.33	355.62	9.28	3.11
20	Mount Royal	7.99	6.62	127.52	2.85	8.27	3340.60	106.08	1.03	40.96	8844.27	258.83	8.00	3.38
21	Njøs II	6.64	8.55	280.36	2.11	3.35	2261.36	111.49	0.75	29.53	7079.04	124.00	12.07	3.00
22	Ontario	18.65	3.65	257.99	3.65	7.99	4889.32	201.51	6.66	85.33	9001.65	365.26	5.93	2.89
23	Opal	9.46	14.98	146.15	4.56	14.03	1700.97	199.10	1.20	17.57	8084.77	272.83	2.71	2.90
24	Reine Claude d'Oullins 'Henjum	6.99	3.26	326.33	3.89	36.66	9652.32	268.95	7.22	95.33	5213.32	352.65	9.13	3.05
25	Prosser 84	5.38	5.72	101.29	1.70	2.58	1884.16	110.74	0.69	0.50	8230.53	163.45	5.55	2.68
26	R5	6.11	3.85	103.33	3.12	6.85	2456.62	99.65	1.00	7.65	7412.36	301.24	6.25	3.14
27	Raud Eplevik	12.66	2.65	185.66	2.65	8.96	3658.66	105.65	2.66	32.65	6985.65	305.67	7.41	3.08
28	Reeves	16.05	0.78	262.89	4.70	40.29	9155.97	353.11	6.75	78.38	6196.64	227.10	9.54	3.03
29	Reine Claude Althanns	5.24	12.68	52.10	2.78	3.50	1574.34	99.37	0.94	15.14	10,225.25	218.89	8.91	2.98
30	Reine Claude Noire	7.15	7.34	58.18	3.27	3.56	2438.93	124.44	0.69	36.46	7227.61	309.69	10.94	3.07

Table A1. *Cont.*

No	Plum Cultivar	Al	B	Ca	Cu	Fe	K	Mg	Mn	Na	P	S	Zn	N (%)
31	Reine Claude Souffriau	5.37	6.98	88.97	2.13	7.21	2030.02	112.23	1.40	24.72	5582.01	201.02	7.34	3.23
32	Rives Early Prolific	16.92	6.30	180.60	4.14	10.06	2865.71	142.26	2.43	38.48	8190.41	327.09	8.53	2.94
33	Rød Victoria	5.43	15.56	106.26	3.57	32.29	1972.94	148.09	1.42	34.77	6235.81	252.27	22.60	3.25
34	Ruth Gerstetter	10.26	3.26	209.66	6.23	21.66	9259.33	326.33	8.65	91.26	4563.32	257.65	9.99	3.42
35	Sanctus Hubertus	14.72	5.04	147.83	4.64	19.56	5111.60	248.67	4.60	49.60	6098.21	256.24	7.69	3.17
36	Sviske frå Tveit	35.52	4.87	42.70	1.50	5.19	2779.32	78.27	0.72	75.42	6850.72	229.06	7.78	3.24
37	Thames Cross	5.02	12.66	97.27	2.84	4.05	2432.24	144.49	1.15	17.71	6345.55	225.97	11.38	3.08
38	Valor	9.43	0.68	343.41	3.99	28.06	6571.50	325.85	4.70	57.15	4788.37	288.74	7.26	3.18
39	Victoria	11.87	7.30	404.86	4.31	17.59	7044.10	303.06	4.30	54.31	9120.75	254.36	6.26	3.08
40	Vinterplomme	8.26	4.67	125.65	4.02	7.65	2896.33	121.65	1.04	10.26	8014.55	288.65	9.65	3.65
41	Washington	9.82	3.42	58.62	3.89	6.02	4128.66	92.33	1.82	45.62	7124.26	185.26	6.33	3.01
42	Yakima	7.85	2.33	296.33	1.99	18.65	6853.21	301.26	2.86	71.26	4896.33	198.65	4.96	3.04
43	Edda	19.85	0.60	540.67	5.21	15.20	11,575.99	547.76	8.46	90.65	7706.97	404.39	9.33	3.10
44	Jubileum	9.13	3.87	263.83	2.37	14.64	5723.61	292.51	3.79	66.45	4928.48	186.23	4.32	3.15
45	Čačanska lepotica	11.22	3.43	365.27	3.73	23.74	8180.19	367.17	5.04	67.77	5848.60	93.18	4.38	3.16
46	Mallard	24.38	0.91	500.89	3.97	27.53	11,696.62	529.53	9.48	88.75	7864.60	333.32	8.90	2.95
47	Opal	4.73	0.56	120.27	1.44	3.17	2745.22	121.49	1.79	37.23	3312.55	74.26	2.56	3.15
48	Reeves	20.45	1.00	348.76	5.81	54.72	11,456.59	470.71	8.61	101.33	7965.93	300.57	11.70	3.21
49	Valor	9.49	0.69	369.20	4.02	29.88	6827.79	343.46	4.88	62.85	4985.72	316.59	7.64	2.99
50	Victoria	14.53	6.58	339.60	3.82	14.88	6240.41	265.89	4.10	61.50	8540.89	227.98	6.49	3.16
51	Blue Rock	7.28	7.14	132.40	2.31	5.27	1860.78	110.13	1.07	23.45	8416.16	170.04	23.99	3.15
52	Czar	10.68	9.75	280.22	2.78	9.16	3118.25	129.14	1.52	19.97	11,895.27	247.72	9.99	3.04
53	Diamond	31.98	6.50	172.91	1.28	4.64	2489.74	122.37	1.36	29.02	6398.91	190.01	6.99	3.29
54	Edwards	11.18	4.70	72.82	2.07	9.47	2677.96	63.57	0.84	26.24	6878.40	137.65	6.60	3.01
55	Emil	11.91	12.25	117.08	2.33	8.00	2680.04	100.89	0.87	36.14	12,198.01	187.64	8.33	2.98
56	Excalibur	10.23	12.70	80.60	1.92	8.78	1904.59	78.71	1.11	31.31	10,005.00	161.84	6.76	3.05
57	Experimentalfältets sviskon	17.67	6.34	164.64	2.36	2.98	2206.17	90.77	1.43	37.55	6808.62	187.87	10.89	3.01
58	Herman	9.58	6.61	149.58	2.83	5.98	2369.52	137.99	1.34	16.83	7215.14	385.43	10.43	3.13
59	Ive	7.22	10.50	76.96	2.61	8.31	1840.81	76.34	0.92	26.30	10,397.93	202.13	8.74	3.03
60	Mount Royal	8.73	6.05	96.26	2.40	7.59	2317.29	83.97	0.86	24.73	6922.51	185.52	6.16	3.10
61	Reine Claude Noir	12.56	7.58	56.71	2.96	8.14	2085.00	106.75	0.79	31.64	7414.57	269.62	9.76	3.04

Table A1. *Cont.*

No	Plum Cultivar	Al	B	Ca	Cu	Fe	K	Mg	Mn	Na	P	S	Zn	N (%)
62	Reine Claude d'Oullins	42.77	9.09	93.32	2.26	9.80	1562.42	72.26	0.64	21.00	7893.83	130.50	4.90	2.96
63	Reine Claude Souffriau	5.38	6.99	88.96	2.14	7.22	2031.29	112.49	1.41	24.69	5581.36	201.47	7.37	3.05
64	Rivers Early Prolific	6.14	5.85	112.69	2.59	6.13	1778.97	109.44	1.06	21.78	5861.86	216.47	9.23	3.13
65	Sinikka	17.58	4.15	81.06	1.49	9.53	2359.34	93.99	1.33	15.35	6060.25	177.30	8.26	3.09
66	Søgne	8.79	4.88	76.27	1.70	5.48	1612.86	89.90	0.94	21.89	6355.70	148.00	5.82	2.97
67	Sviske frå Tveit	40.28	8.75	75.20	1.90	13.78	2557.94	88.84	0.99	47.56	8956.24	189.50	7.17	3.15
68	Traneplommer	14.20	6.33	73.67	2.85	6.58	2052.23	126.99	1.37	50.10	6559.98	282.97	9.49	3.13

Table A2. Content of sugar compounds (g/kg dw) in 68 Norwegian plum cultivars from Njøs (42 samples) and NIBIO Ullensvang (8 samples) collected in 2019 and 2021 and from NMBU (18 samples) collected in 2019 and 2020.

No	Sorbitol	Trehalose	Arabinose	Glukose	Fructose	Sucrose	Turanose	Glycerol	Galactitol	Galactose	Ribose	Isomaltose	Isomaltotriose	Maltose	Maltotriose	Mannitol	Xylose	Melibiose	Panose	Rhamnose	Raffinose	Stachyose
1	101.27	1.02	1.57	245.65	211.27	219.33	17.96	0.63	1.79	21.40	2.01	1.65	1.99	4.13	0.74	1.88	2.86	8.11	4.33	5.89	1.03	1.41
2	34.11	0.81	0.05	245.62	181.11	211.49	16.97	1.11	3.54	31.69	11.82	0.58	0.47	19.94	0.68	2.61	8.31	5.11	1.21	1.98	2.09	0.74
3	4.16	0.63	0.32	183.62	179.73	155.03	2.31	7.20	0.75	31.22	3.94	2.34	0.68	1.62	1.59	3.34	0.24	8.48	3.06	0.93	0.72	0.96
4	84.26	1.00	1.57	226.33	178.65	199.65	10.66	1.00	1.99	35.66	3.26	4.66	2.14	2.89	0.86	1.90	2.65	5.21	6.33	8.57	0.89	0.98
5	119.15	2.84	1.65	245.12	213.56	140.97	14.43	0.89	2.63	16.17	1.98	0.57	4.48	1.56	0.30	0.34	12.23	7.14	6.00	2.27	2.80	3.01
6	92.34	1.84	0.66	256.28	193.86	156.97	15.57	0.96	3.93	29.35	7.27	1.88	1.48	11.95	0.61	3.26	5.22	4.82	4.27	6.38	1.47	0.77
7	100.45	4.11	1.94	244.94	183.54	102.50	6.81	0.77	6.85	28.57	7.21	0.75	2.61	2.25	0.38	0.41	7.01	5.58	4.14	1.47	0.96	1.61
8	69.06	0.17	0.24	326.42	158.68	170.06	10.50	0.87	4.32	34.78	8.69	2.02	1.76	24.40	0.68	2.18	7.08	4.90	0.88	2.57	2.40	0.86
9	85.19	2.36	1.02	241.02	171.01	83.11	8.66	1.06	5.14	33.67	1.59	4.51	3.03	13.74	0.19	7.68	3.39	7.60	1.88	1.71	1.37	1.76
10	114.53	0.82	0.89	211.44	178.17	227.29	15.38	0.45	1.36	16.49	1.78	1.29	1.35	4.08	0.28	2.10	5.41	9.48	4.47	6.63	0.93	1.36
11	133.85	0.14	0.36	205.75	141.50	114.10	7.38	2.29	2.39	21.61	4.63	1.92	1.41	4.07	0.57	2.17	6.00	10.46	5.27	8.40	2.75	4.55
12	91.65	0.99	1.15	235.69	201.33	225.33	16.99	0.59	1.33	19.89	1.94	1.55	1.66	3.79	0.66	1.53	2.33	7.86	4.13	6.13	0.99	1.89
13	103.54	0.52	0.47	308.74	151.66	106.14	4.88	1.01	4.00	32.03	6.66	2.30	2.41	17.08	0.59	1.78	5.95	4.93	0.56	3.53	2.73	1.07
14	71.65	0.91	2.33	175.33	145.67	112.26	8.32	0.57	1.88	21.33	3.26	0.87	3.26	14.26	0.72	2.00	4.65	3.53	1.99	4.33	1.10	1.96
15	164.54	1.35	1.00	210.19	275.64	127.16	20.57	1.03	3.21	33.29	2.74	0.26	0.23	5.86	0.17	0.07	6.48	3.05	4.04	1.48	2.99	2.52
16	84.65	1.26	0.90	194.65	175.65	135.65	18.65	0.36	2.45	24.65	4.65	0.95	3.60	14.67	0.48	1.99	6.65	4.33	1.02	4.65	3.14	2.65
17	144.19	0.10	0.47	231.01	126.85	199.17	18.44	2.26	1.77	35.73	5.46	2.52	3.07	7.67	0.27	1.49	5.48	6.24	0.04	6.14	2.73	1.61
18	82.33	5.32	1.65	258.66	171.56	152.33	5.23	1.00	2.33	32.36	5.63	0.92	1.99	4.33	0.33	0.59	4.33	4.37	2.15	5.67	1.25	2.14
19	85.88	9.70	0.30	241.60	176.85	129.00	6.20	1.49	2.57	37.92	11.07	1.25	0.50	29.88	0.61	2.60	8.18	5.07	1.18	2.00	2.07	0.75
20	118.28	2.84	1.89	221.39	196.93	180.54	15.95	0.30	1.88	21.68	7.81	4.21	2.72	23.08	0.55	7.81	4.63	6.38	20.56	18.51	0.53	1.31
21	61.54	0.51	0.42	294.95	160.89	127.51	4.37	1.54	1.91	34.80	5.76	2.24	2.95	16.76	0.35	1.02	3.58	4.09	0.10	4.00	2.32	1.10
22	88.65	1.25	1.79	204.67	198.37	201.33	13.66	0.73	1.70	22.33	2.26	1.77	2.01	4.33	0.25	1.63	2.57	9.00	5.32	5.66	1.15	1.65
23	52.04	0.78	0.12	304.57	94.49	193.01	5.78	1.29	2.30	36.51	5.19	2.00	2.90	7.54	0.35	1.19	4.17	4.72	0.14	4.61	2.14	1.28
24	91.66	0.86	1.05	201.67	155.66	145.62	9.66	0.37	3.53	25.62	5.63	1.00	4.13	19.82	0.65	2.65	7.89	5.62	1.66	5.62	4.33	3.00
25	102.71	0.32	0.30	166.51	60.95	135.74	3.84	0.78	2.18	32.12	4.25	1.67	2.45	6.70	0.30	1.34	4.25	5.77	1.34	4.88	1.97	1.76
26	61.03	0.42	0.32	167.38	182.10	115.31	11.26	1.09	3.58	27.78	1.64	3.23	2.08	3.64	0.79	2.48	5.10	7.80	7.52	9.93	2.66	1.92

Table A2. *Cont.*

No	Sorbitol	Trehalose	Arabinose	Glukose	Fructose	Sucrose	Turanose	Glycerol	Galactitol	Galactose	Ribose	Isomaltose	Isomaltotriose	Maltose	Maltotriose	Mannitol	Xylose	Melibiose	Panose	Rhamnose	Raffinose	Stachyose
27	85.33	0.95	0.93	223.26	192.36	214.66	15.27	0.53	1.54	18.33	1.85	1.36	1.48	3.26	0.52	1.14	1.26	6.76	3.85	6.33	0.96	1.63
28	57.35	0.82	0.55	202.63	173.21	203.85	26.01	1.21	1.92	34.38	11.43	1.72	3.24	32.12	0.40	0.95	3.37	3.87	0.08	3.75	2.84	1.03
29	42.05	1.01	0.08	222.74	173.23	169.68	20.92	1.38	4.37	39.07	4.58	0.73	0.59	24.59	0.85	3.23	5.25	6.30	1.50	2.45	2.59	0.92
30	73.35	2.00	0.65	220.33	188.63	207.80	29.45	0.60	1.28	20.09	6.16	0.33	1.26	5.16	0.30	0.19	6.81	2.90	3.88	1.42	2.83	0.33
31	97.54	0.75	1.00	238.79	193.77	226.27	15.17	0.70	4.02	32.08	0.60	3.83	2.47	3.38	1.02	2.37	5.63	7.00	5.99	10.00	0.67	0.70
32	77.52	1.02	0.68	200.83	172.88	151.28	16.19	0.75	1.88	26.93	4.60	0.78	2.14	13.20	0.61	0.54	5.77	6.29	2.54	2.36	1.96	1.01
33	28.33	0.22	0.48	349.79	136.61	139.12	6.75	0.97	1.16	16.43	2.42	1.01	1.23	3.11	0.33	1.68	4.63	8.03	3.67	5.66	2.32	2.71
34	48.96	3.26	0.84	205.65	163.66	131.33	11.26	1.65	1.96	31.26	5.62	1.00	2.33	9.65	0.37	2.02	5.03	3.21	1.53	4.65	2.05	0.56
35	47.74	1.00	0.66	156.69	206.32	131.11	14.35	1.10	2.90	35.52	7.20	2.72	2.77	19.75	0.71	2.25	5.04	7.22	4.49	6.73	2.42	4.02
36	54.64	5.29	3.34	257.68	225.38	76.78	17.71	0.32	2.82	30.67	2.57	1.01	1.49	8.36	0.31	6.16	3.62	1.96	16.53	14.63	4.34	10.37
37	89.66	1.12	1.87	215.33	155.37	102.36	11.02	0.43	2.33	18.66	4.70	1.02	2.15	25.33	0.33	1.86	5.90	4.22	1.57	3.25	2.02	1.74
38	121.06	0.93	0.61	225.13	184.48	191.22	21.86	0.25	2.97	39.04	9.28	0.80	2.90	2.29	0.25	1.34	5.03	5.64	0.84	5.47	2.08	1.46
39	77.28	1.94	1.45	261.52	149.43	131.19	31.55	1.21	2.42	24.38	3.46	2.41	2.96	10.43	0.36	1.39	4.40	5.99	1.33	5.24	2.02	1.81
40	54.96	0.21	0.42	186.60	178.15	112.51	2.80	2.17	1.67	20.86	4.27	1.37	1.37	3.09	0.59	1.76	5.03	8.85	3.82	6.08	2.30	2.86
41	68.95	2.36	0.79	235.63	165.66	178.65	7.32	1.12	4.33	21.66	4.33	0.89	1.24	12.66	1.09	0.69	2.22	6.54	3.37	2.27	2.04	1.12
42	75.65	0.83	0.57	204.33	168.95	175.66	11.74	2.99	1.43	24.52	4.11	2.98	3.01	6.52	0.37	1.70	5.69	6.35	0.59	4.22	1.89	1.64
43	89.04	2.54	0.46	232.49	200.33	238.20	12.60	1.30	4.82	20.48	11.59	2.18	2.82	28.19	0.90	2.92	9.29	6.33	1.27	3.18	1.54	1.16
44	104.84	0.29	0.61	231.39	150.04	269.02	16.24	2.15	1.70	31.13	4.91	2.40	2.87	6.87	0.42	1.49	5.00	5.67	3.97	5.59	1.94	1.58
45	114.32	34.66	1.10	248.94	244.51	97.03	22.67	0.22	9.80	40.28	5.67	3.68	2.08	16.94	1.33	3.70	11.56	7.11	1.71	2.71	2.97	1.13
46	91.11	10.49	0.39	247.11	186.28	168.41	6.75	1.67	2.85	34.57	11.84	1.44	0.62	32.29	0.74	2.92	8.88	5.59	1.33	2.24	2.33	0.87
47	76.03	4.18	0.37	230.89	168.50	198.71	10.06	1.75	4.38	26.58	9.45	2.51	3.55	13.41	0.74	2.17	7.22	6.98	0.59	5.93	3.08	1.82
48	67.79	1.00	0.73	223.43	182.09	279.02	29.76	1.47	2.28	39.61	13.12	2.04	3.87	37.54	0.54	1.21	4.01	4.58	0.17	4.39	3.38	1.29
49	109.45	1.28	0.95	278.16	205.84	219.73	25.75	0.53	3.68	45.58	10.80	1.17	3.58	2.86	0.52	1.79	6.07	6.80	0.31	6.60	2.64	1.89
50	87.65	2.24	1.51	263.24	206.28	195.91	29.90	1.08	1.54	32.16	2.44	2.73	4.65	7.95	0.33	2.74	2.50	4.75	6.66	9.51	2.42	3.98
51	94.47	2.17	1.24	211.27	195.99	67.43	11.38	0.62	2.02	12.70	1.48	0.36	3.38	1.12	0.14	0.17	9.71	5.60	4.70	1.70	5.32	5.71
52	92.03	1.65	0.56	196.36	190.54	175.61	15.47	0.89	4.12	30.13	7.53	1.84	1.38	12.87	0.59	2.90	5.56	4.94	3.71	5.82	3.61	3.41
53	112.46	4.37	1.94	319.13	204.78	96.51	7.14	0.71	7.62	31.86	7.98	0.70	2.81	2.42	0.30	0.29	7.35	5.79	4.32	1.44	4.08	4.34
54	62.10	1.85	0.86	257.24	209.89	86.71	6.54	0.88	3.97	25.20	1.29	3.50	2.35	10.31	0.23	4.95	2.25	5.76	12.60	12.10	3.90	11.17
55	120.33	0.61	0.96	170.31	142.18	227.09	12.33	1.64	2.24	14.95	3.31	1.74	0.96	3.61	0.33	1.69	4.56	8.17	4.09	5.74	2.17	3.11
56	108.59	1.13	0.71	207.93	148.36	198.15	14.44	0.24	0.98	11.65	1.26	0.88	0.96	2.92	0.12	1.49	3.99	7.17	3.28	5.55	2.12	2.44
57	109.06	2.03	1.23	286.11	270.94	78.37	9.28	0.25	1.43	27.74	0.97	1.28	3.42	6.39	0.25	0.19	13.36	6.75	5.12	2.11	6.55	1.07
58	144.01	0.98	0.80	211.16	285.38	118.70	17.94	0.93	2.83	29.37	2.45	0.24	0.21	5.16	0.15	0.06	5.85	2.72	3.64	1.31	2.66	2.30
59	64.64	0.74	1.04	221.99	189.58	185.07	19.54	0.34	1.31	24.93	2.21	3.04	2.55	3.63	0.24	6.28	2.83	2.33	15.57	14.68	2.46	1.18
60	75.96	1.35	0.80	220.85	167.64	136.24	9.94	0.90	1.33	18.52	4.99	2.18	1.74	10.88	0.43	4.01	4.36	6.86	10.25	10.81	3.39	6.93
61	78.13	2.00	0.56	138.26	175.92	195.01	29.30	0.51	1.17	20.11	5.83	0.22	1.16	5.16	0.18	0.07	5.66	2.85	3.96	1.35	2.78	1.95
62	102.10	0.32	0.30	165.52	160.59	134.93	3.82	0.78	2.16	31.92	4.23	1.66	2.44	6.66	0.30	1.34	4.23	5.74	1.33	4.85	1.96	1.75
63	85.62	0.58	0.83	240.05	198.05	233.16	14.03	0.54	3.53	29.08	0.42	3.33	2.21	2.91	0.81	2.30	4.17	6.22	7.16	9.12	2.35	6.36
64	124.95	0.68	0.57	228.59	202.83	87.66	9.28	1.33	2.13	22.96	2.48	1.00	1.53	3.01	0.66	1.16	7.12	9.46	4.78	4.87	3.93	5.62
65	104.63	2.29	1.25	225.62	180.75	75.83	4.72	2.01	1.12	20.01	4.01	0.97	1.30	2.31	0.61	1.53	4.50	7.84	3.27	6.02	1.98	2.74
66	98.54	1.03	0.83	194.78	189.89	191.67	1.47	1.22	0.48	37.62	1.03	1.46	3.11	4.39	0.28	0.13	2.11	7.67	3.06	1.07	6.16	1.00
67	52.47	5.15	3.28	256.80	227.74	95.79	17.32	0.31	2.72	29.79	2.47	1.00	1.48	8.12	0.30	6.02	3.31	2.06	15.76	14.16	4.24	10.08
68	134.36	4.82	1.68	253.67	221.58	73.33	17.93	2.18	2.31	28.98	7.14	1.04	1.71	8.53	0.53	0.35	7.33	6.19	4.37	1.36	4.22	4.21

Table A3. Content of organic acids (g/kg dw) in 68 Norwegian plum cultivars from Njøs (42 samples) and NIBIO Ullensvang (8 samples) collected in 2019 and 2021 and from NMBU (18 samples) collected in 2019 and 2020.

No	Plum Cultivar	Citric	Maleic	Malic	Pyruvic	Shikimic	Lactic	Propionic	Butiric	Quinic	Oxalic	Fumaric
1	Admiral Rigny	0.87	1.33	27.30	0.90	0.18	0.14	0.002	0.36	8.74	0.13	0.24
2	Reine Claude d'Althanns	0.20	0.78	19.92	0.78	0.08	0.08	0.002	0.07	3.27	0.18	0.01
3	Anita	2.06	1.06	15.40	0.67	0.14	0.09	0.009	0.07	2.80	1.18	0.40
4	Avalon	1.13	1.52	26.90	1.53	0.12	0.13	0.003	0.10	2.90	1.11	0.65
5	Bleue de Belgique	1.78	1.16	29.63	1.16	0.15	0.10	0.001	0.09	4.51	0.05	0.38
6	Czar	0.40	0.86	21.93	0.86	0.09	0.08	0.001	0.08	3.81	0.25	0.05
7	Diana	1.12	1.09	28.00	1.09	0.16	0.10	0.001	0.10	3.74	0.83	0.41
8	Edda	0.76	0.68	17.45	0.68	0.08	0.08	0.001	0.07	3.13	0.18	0.06
9	Edwards	1.30	1.14	29.15	1.14	0.13	0.09	0.002	0.09	4.72	0.81	0.26
10	Excalibur	0.70	0.92	23.52	0.92	0.16	0.12	0.002	0.11	7.77	0.06	0.27
11	Frostaplomme	0.78	0.56	7.26	0.56	0.13	0.13	0.003	0.12	8.55	9.69	1.10
12	Grand Duke	0.95	1.03	26.63	0.99	0.18	0.13	0.004	0.24	9.06	0.11	0.30
13	Haganta	1.04	0.65	16.68	0.65	0.09	0.08	0.002	0.07	3.15	0.16	0.11
14	Helgøyplomme	1.03	2.33	31.59	1.99	0.37	0.24	0.004	0.26	5.33	1.65	0.25
15	Herman	0.13	1.64	14.06	1.64	0.14	0.10	0.001	0.10	2.35	5.25	2.25
16	Jefferson	0.79	1.13	23.65	1.86	0.24	0.19	0.003	0.15	4.26	1.15	0.27
17	Jubileum	1.30	0.68	17.36	0.68	0.11	0.10	0.003	0.09	3.85	0.99	0.13
18	Kirkes	1.36	1.63	31.26	1.11	0.20	0.14	0.002	0.14	4.22	1.11	0.65
19	Mallard	0.25	1.06	27.05	1.06	0.11	0.10	0.003	0.10	3.85	1.91	0.82
20	Mount Royal	1.19	0.94	24.17	0.94	0.17	0.10	0.001	0.10	4.31	0.12	0.44
21	Njøs II	1.27	0.69	17.70	0.69	0.09	0.08	0.002	0.08	2.62	0.09	0.10
22	Ontario	1.07	1.65	28.96	1.03	0.19	0.22	0.001	0.42	8.96	0.14	0.27
23	Opal	1.25	0.41	10.39	0.41	0.08	0.08	0.002	0.08	3.02	0.09	0.03
24	Reine Claude d'Oullins 'Henjum	1.00	1.56	26.90	2.63	0.26	0.22	0.002	0.17	5.00	1.13	0.13
25	Prosser 84	1.05	0.26	6.70	0.26	0.09	0.08	0.001	0.07	3.69	0.08	0.07
26	R5	0.71	0.41	10.41	0.41	0.11	0.10	0.003	0.10	6.85	10.19	1.16
27	Raud Eplevik	0.73	0.96	25.63	0.94	0.17	0.13	0.003	0.22	7.21	0.07	0.29
28	Reeves	1.47	0.70	17.84	0.70	0.11	0.09	0.002	0.09	2.61	1.13	0.14
29	Reine Claude Althanns	0.27	1.05	16.90	1.05	0.10	0.11	0.003	0.10	4.41	4.25	1.75
30	Reine Claude Noire	0.62	1.06	27.23	1.06	0.12	0.10	0.001	0.10	2.28	1.06	0.17
31	Reine Claude Souffriau	2.56	1.32	19.18	0.83	0.17	0.12	0.011	0.08	3.48	1.47	0.50
32	Rives Early Prolific	1.25	1.16	24.22	1.21	0.13	0.11	0.001	0.09	5.36	0.21	0.20
33	Rød Victoria	0.53	0.59	15.03	0.59	0.09	0.08	0.002	0.07	5.14	0.09	0.11
34	Ruth Gerstetter	0.97	1.36	29.65	1.36	0.25	0.09	0.002	0.10	3.65	1.36	0.45

Table A3. *Cont.*

No	Plum Cultivar	Citric	Maleic	Malic	Pyruvic	Shikimic	Lactic	Propionic	Butiric	Quinic	Oxalic	Fumaric
35	Sanctus Hubertus	0.86	1.01	27.11	1.06	0.16	0.10	0.001	0.09	4.09	0.88	0.34
36	Sviske frå Tveit	0.89	1.44	18.95	1.44	0.27	0.10	0.001	0.10	6.93	0.11	1.07
37	Thames Cross	1.33	1.79	23.85	1.45	0.24	0.27	0.002	0.31	4.22	2.26	1.09
38	Valor	1.40	0.95	24.25	0.95	0.11	0.09	0.001	0.08	3.98	1.09	0.19
39	Victoria	1.69	0.91	23.38	0.91	0.14	0.10	0.001	0.09	4.22	0.56	0.29
40	Vinterplomme	0.73	0.73	9.67	0.73	0.10	0.10	0.003	0.09	6.77	10.17	0.63
41	Washington	0.85	1.59	19.54	1.24	0.24	0.22	0.001	0.10	5.24	1.00	0.54
42	Yakima	0.84	0.80	21.33	0.85	0.23	0.12	0.003	0.13	4.52	0.13	0.16
43	Edda	0.30	0.88	22.79	0.90	0.14	0.10	0.002	0.09	3.80	0.18	0.12
44	Jubileum	1.37	0.74	18.55	0.73	0.12	0.11	0.003	0.10	4.11	0.11	0.14
45	Čačanska lepotica	1.05	2.23	32.52	2.18	0.16	0.11	0.001	0.10	5.50	0.41	0.30
46	Mallard	0.24	0.89	23.69	0.92	0.30	0.08	0.002	0.08	3.38	0.17	0.07
47	Opal	0.16	0.83	23.78	0.85	0.11	0.09	0.001	0.08	4.00	0.28	0.12
48	Reeves	1.46	0.69	17.68	0.69	0.10	0.09	0.002	0.08	2.59	0.11	0.13
49	Valor	1.54	0.98	25.38	0.98	0.12	0.09	0.001	0.09	4.14	0.71	0.20
50	Victoria	1.78	1.03	24.90	1.10	0.14	0.11	0.002	0.10	4.60	1.92	0.32
51	Blue Rock	1.62	1.03	26.44	1.03	0.13	0.08	0.001	0.08	3.98	0.04	0.33
52	Czar	0.61	0.92	23.71	0.92	0.10	0.09	0.001	0.08	3.35	0.17	0.14
53	Diamond	1.21	0.88	22.53	0.88	0.15	0.08	0.001	0.07	3.70	0.08	0.46
54	Edwards	0.97	1.06	27.12	1.06	0.14	0.09	0.001	0.09	5.98	0.16	0.34
55	Emil	0.50	0.68	17.40	0.68	0.13	0.09	0.001	0.08	5.89	0.12	0.27
56	Excalibur	0.50	0.66	17.05	0.66	0.11	0.09	0.0005	0.08	5.52	0.04	0.20
57	Experimentalfältets sviskon	1.47	1.16	29.80	1.16	0.12	0.08	0.001	0.07	4.32	0.07	0.29
58	Herman	0.09	1.22	31.39	1.22	0.10	0.08	0.001	0.07	1.74	0.04	0.19
59	Ive	1.21	1.00	25.81	1.00	0.13	0.08	0.001	0.08	1.64	0.07	0.27
60	Mount Royal	0.99	0.79	20.08	0.79	0.14	0.08	0.0004	0.08	3.55	0.10	0.37
61	Reine Claude Noir	0.52	0.61	15.61	0.61	0.10	0.08	0.001	0.08	4.01	0.10	0.10
62	Reine Claude d'Oullins	0.98	0.24	19.67	0.24	0.08	0.07	0.0003	0.07	3.45	0.08	0.07
63	Reine Claude Souffriau	0.95	0.85	21.78	0.85	0.11	0.08	0.001	0.07	3.98	0.22	0.20
64	Rivers Early Prolific	0.79	1.19	30.36	1.19	0.11	0.09	0.001	0.08	5.97	0.22	0.20
65	Sinikka	0.68	0.94	24.16	0.94	0.14	0.09	0.001	0.08	6.17	0.20	0.37
66	Søgne	1.64	1.00	25.55	1.00	0.12	0.09	0.001	0.08	6.02	0.09	0.25
67	Sviske frå Tveit	0.80	1.18	30.21	1.18	0.20	0.10	0.001	0.09	5.04	0.18	0.66
68	Traneplommer	0.74	0.95	24.37	0.95	0.14	0.08	0.002	0.08	3.96	0.14	0.40

Table A4. Content of phenolic compounds (mg/kg), total phenolic content (TPC, g GAE/kg dw), and relative scavenging activity (RSA, mmol TE/kg dw) in 68 Norwegian plum cultivars from Njøs (42 samples) and NIBIO Ullensvang (8 samples) collected in 2019 and 2021, and from NMBU (18 samples) collected in 2019 and 2020.

No	PA	5COA	pHBA	CA	R	pCA	Q3Og	I3Or	FA	I3Og	Q3Or	K7Og	Pz	Q	Pt	Ac	SA	Ae	K3Og	SUM	TPC	RSA
1	NF	8.87	NF	2.98	18.15	NF	7.66	NF	NF	NF	NF	NF	NF	6.50	NF	NF	NF	1.38	0.84	46.38	12.79	75.29
2	1.08	161.84	4.40	3.36	107.73	1.46	11.50	5.15	3.99	0.19	NF	0.99	0.95	1.99	0.18	0.17	NF	NF	NF	305.00	10.37	80.68
3	NF	2.22	NF	5.79	2.40	NF	3.09	NF	NF	NF	NF	NF	NF	6.67	NF	NF	NF	0.45	0.22	20.84	8.25	78.48
4	NF	0.57	NF	4.90	1.52	NF	0.86	NF	NF	NF	NF	NF	NF	7.22	NF	NF	NF	1.52	0.02	16.61	11.82	48.15
5	NF	15.08	NF	7.67	19.51	NF	7.61	NF	NF	NF	NF	NF	NF	8.64	NF	NF	NF	5.28	0.79	64.58	5.76	34.97
6	2.28	43.28	3.51	3.92	35.21	1.43	7.76	35.92	3.30	4.93	1.20	1.14	0.54	6.82	NF	0.25	NF	1.12	0.46	153.08	10.79	40.18
7	NF	0.55	NF	NF	1.54	NF	0.91	NF	NF	NF	NF	NF	NF	7.66	NF	NF	NF	0.76	0.14	11.56	8.81	32.78
8	2.07	118.94	2.85	3.52	122.38	0.24	20.02	3.75	2.72	0.13	0	1.04	0.96	3.10	0.30	0.15	NF	NF	NF	282.19	8.70	40.61
9	NF	2.42	NF	1.65	4.76	NF	2.57	NF	NF	NF	NF	NF	NF	8.04	NF	NF	NF	0.55	0.45	20.44	3.47	12.14
10	NF	1.11	NF	1.19	3.31	NF	4.77	NF	NF	NF	NF	NF	NF	5.70	NF	NF	NF	0.88	0.30	17.26	5.83	71.87
11	NF	0.19	NF	0.30	0.62	NF	2.52	NF	NF	NF	NF	NF	NF	7.15	NF	NF	NF	0.21	0.18	11.17	6.91	82.06
12	NF	NF	NF	0.69	0.66	NF	0.94	NF	NF	NF	NF	NF	NF	6.62	NF	NF	NF	0.48	0.21	9.60	6.16	21.15
13	1.67	90.94	4.18	6.62	60.48	2.18	13.81	3.83	2.67	0.31	0.21	0.91	0.90	2.66	0.23	NF	NF	NF	NF	191.60	7.92	30.53
14	NF	3.48	NF	2.45	9.76	NF	5.41	NF	NF	NF	NF	NF	NF	9.30	NF	NF	NF	1.68	1.21	33.29	6.06	16.27
15	NF	0.56	NF	0.81	0.83	NF	1.49	NF	NF	NF	NF	NF	NF	9.32	NF	NF	NF	0.20	0.33	13.54	6.77	27.13
16	NF	NF	NF	1.24	2.41	NF	0.62	NF	NF	NF	NF	NF	NF	7.36	NF	NF	NF	0.32	0.09	12.04	10.36	72.97
17	NF	2.67	NF	1.67	2.03	NF	0.97	NF	NF	NF	NF	NF	NF	7.41	NF	NF	NF	1.15	0.19	16.09	9.83	62.98
18	NF	NF	NF	1.10	2.91	NF	1.13	NF	NF	NF	NF	NF	NF	8.11	NF	NF	NF	0.35	0.07	13.67	8.60	30.52
19	NF	0.72	NF	2.28	2.59	NF	1.30	NF	NF	NF	NF	NF	NF	8.34	NF	NF	NF	1.51	0.11	16.85	6.71	37.41
20	NF	1.89	NF	2.40	4.15	NF	5.22	NF	NF	NF	NF	NF	NF	5.83	NF	NF	NF	1.29	0.35	21.13	11.75	23.88
21	1.27	129.12	2.67	3.73	42.95	1.21	3.89	2.04	1.60	0.16	0.16	0.43	0.59	2.12	0.47	0.91	NF	NF	NF	193.31	7.65	24.02
22	NF	0.18	NF	0.77	0.80	NF	0.54	NF	NF	NF	NF	NF	NF	5.90	NF	NF	NF	0.74	0.21	9.14	9.16	35.98
23	2.42	93.07	8.48	3.86	21.32	1.40	2.42	3.99	3.27	0.13	NF	0.52	0.52	1.89	0.25	0.28	NF	NF	NF	143.81	12.35	46.34
24	NF	0.74	NF	2.04	3.02	NF	1.45	NF	NF	NF	NF	NF	NF	6.66	NF	NF	NF	0.67	0.29	14.87	16.08	32.80
25	1.83	95.60	5.30	5.43	99.42	1.57	9.55	10.37	3.05	0.38	NF	0.58	1.13	2.65	NF	NF	NF	NF	NF	236.86	14.35	45.31
26	NF	0.18	NF	1.12	1.94	NF	1.98	NF	NF	NF	NF	NF	NF	7.98	NF	NF	NF	0.32	0.15	13.67	8.81	27.01
27	NF	2.61	NF	0.46	6.50	NF	2.45	NF	NF	NF	NF	NF	NF	6.71	NF	NF	NF	0.60	0.26	19.59	8.48	44.44
28	NF	1.37	NF	1.85	8.20	NF	1.49	NF	NF	NF	NF	NF	NF	8.37	NF	NF	NF	1.13	0.34	22.75	5.78	103.52
29	NF	1.59	NF	1.13	0.96	NF	0.73	NF	NF	NF	NF	NF	NF	6.08	NF	NF	NF	0.80	0.17	11.46	3.90	58.18
30	NF	0.81	NF	1.38	10.50	NF	7.12	NF	NF	NF	NF	NF	NF	7.83	NF	NF	NF	0.77	0.50	28.91	10.55	35.39
31	NF	0.78	NF	2.29	1.90	NF	2.17	NF	NF	NF	NF	NF	NF	7.31	NF	NF	NF	NF	0.09	14.54	7.96	47.36
32	12.82	44.16	NF	4.14	77.65	1.50	22.35	NF	NF	NF	NF	NF	NF	5.86	NF	NF	9.46	2.06	0.34	180.33	10.28	25.66
33	2.63	69.76	3.55	4.46	95.17	0.83	9.40	2.30	2.19	0.12	NF	0.48	0.38	2.10	0.21	0.24	NF	NF	NF	193.84	7.10	21.93
34	NF	NF	NF	0.48	0.57	NF	1.08	NF	NF	NF	NF	NF	NF	6.84	NF	NF	NF	0.22	0.28	9.47	6.99	57.39

Table A4. *Cont.*

No	PA	5COA	pHBA	CA	R	pCA	Q3Og	I3Or	FA	I3Og	Q3Or	K7Og	Pz	Q	Pt	Ac	SA	Ae	K3Og	SUM	TPC	RSA
35	7.15	82.85	NF	4.45	59.73	0.54	8.93	NF	NF	NF	NF	NF	NF	6.09	NF	NF	6.23	2.16	0.26	178.38	5.81	31.93
36	NF	1.16	NF	1.09	2.92	NF	3.90	NF	NF	NF	NF	NF	NF	6.88	NF	NF	NF	1.34	0.33	17.62	6.36	30.11
37	NF	NF	NF	1.03	2.05	NF	0.73	NF	NF	NF	NF	NF	NF	7.14	NF	NF	NF	0.89	0.13	11.97	9.55	41.57
38	NF	1.91	NF	1.59	5.81	NF	3.81	NF	NF	NF	NF	NF	NF	9.69	NF	NF	NF	1.57	0.30	24.68	7.50	24.29
39	0.79	57.14	7.46	4.13	42.47	1.70	3.17	4.64	2.32	0.02	NF	0.61	0.53	6.00	0.21	0.18	NF	2.38	0.59	134.34	7.80	27.86
40	NF	7.98	NF	3.68	7.17	NF	5.44	NF	NF	NF	NF	NF	NF	16.47	NF	NF	NF	1.99	1.05	43.78	7.84	24.01
41	NF	1.00	NF	1.50	0.88	NF	0.24	NF	NF	NF	NF	NF	NF	5.76	NF	NF	NF	0.47	0.14	9.99	17.09	45.98
42	NF	NF	NF	0.64	0.78	NF	0.33	NF	NF	NF	NF	NF	NF	6.00	NF	NF	NF	0.37	0.12	8.24	6.76	43.09
43	4.63	16.19	1.63	1.25	17.98	0.48	5.78	1.73	NF	NF	0.18	0.48	1.40	6.81	0.25	0.21	NF	0.53	0.58	60.11	6.82	30.01
44	2.75	22.49	3.05	1.65	14.89	4.72	1.13	27.68	NF	1.13	0.75	0.98	1.05	5.30	0.25	0.71	NF	0.65	0.03	89.22	20.59	36.66
45	26.69	16.35	3.17	1.24	18.77	4.03	3.23	11.84	NF	0.47	0.28	1.73	1.03	5.51	0.22	0.14	NF	0.41	0.14	95.26	6.49	18.11
46	8.46	13.50	5.47	1.07	7.37	1.10	0.58	1.08	NF	NF	0.14	0.16	0.75	4.59	0.25	0.29	NF	0.58	0.04	45.43	10.89	39.13
47	173.61	16.08	11.49	1.04	9.03	4.09	3.33	6.24	NF	0.35	0.26	0.71	0.74	6.50	NF	NF	NF	0.50	0.43	234.42	10.39	36.40
48	36.62	54.89	2.96	0.93	27.86	1.50	3.32	9.79	NF	0.32	0.47	0.64	1.25	4.54	0.24	NF	NF	0.30	0.06	145.69	6.49	25.49
49	1.40	14.15	2.13	1.36	9.25	1.13	2.02	1.97	NF	NF	0.18	0.36	0.72	5.98	0.22	0.61	NF	0.61	0.05	42.14	4.77	36.39
50	7.57	31.25	8.74	3.58	33.75	3.43	2.02	7.14	2.41	0.24	0.35	0.69	0.57	5.14	0.22	0.31	11.03	1.72	0.13	120.29	8.65	26.65
51	6.67	84.75	6.81	7.68	82.73	2.99	15.26	11.02	2.74	0.74	NF	0.70	0.46	3.56	NF	NF	9.40	6.16	NF	241.67	7.89	39.08
52	10.71	67.19	6.74	7.98	74.73	3.69	13.06	18.60	2.70	2.59	0.56	0.90	0.55	4.70	NF	0.23	14.81	5.88	NF	235.61	11.17	41.32
53	3.92	137.53	10.47	8.01	132.82	12.35	15.31	28.94	4.06	1.29	0.19	0.62	0.87	26.01	0.20	0.53	NF	NF	NF	383.11	6.46	47.61
54	8.61	42.88	20.77	5.76	80.88	6.50	7.05	3.65	2.92	NF	NF	1.13	0.59	4.01	0.19	0.28	12.62	3.67	NF	201.52	7.84	30.51
55	6.61	74.23	5.09	3.93	27.18	2.96	2.89	0.80	3.23	NF	0.23	0.33	2.42	3.11	0.23	0.27	6.32	2.89	NF	142.70	13.84	58.48
56	4.43	74.43	4.23	3.38	59.47	2.44	14.93	3.42	2.13	0.48	NF	0.78	0.52	2.72	NF	NF	6.25	0.94	NF	180.57	10.86	40.26
57	2.06	18.33	14.29	1.21	34.62	0.22	12.08	4.30	1.82	0.51	NF	0.46	0.29	3.38	0.19	0.25	NF	NF	NF	94.02	4.62	28.99
58	24.16	106.11	5.96	3.46	89.38	1.54	18.03	10.01	2.78	2.93	1.45	1.51	0.82	3.96	0.19	0.37	NF	NF	NF	272.65	10.73	54.49
59	2.80	56.65	4.60	5.37	28.98	2.34	6.34	11.03	4.30	2.43	NF	1.02	1.06	3.17	0.19	0.45	5.97	2.73	NF	139.43	4.86	42.70
60	5.79	106.21	6.98	4.20	74.01	2.73	20.99	3.44	3.71	0.50	0.15	1.11	0.93	2.75	0.19	NF	7.54	2.20	NF	243.43	7.15	35.19
61	5.35	32.75	1.66	2.29	48.32	0.86	7.82	3.72	0.79	0.28	NF	0.33	0.31	2.99	0.10	NF	7.13	0.89	NF	115.61	5.44	35.07
62	7.99	46.83	NF	6.84	19.20	2.34	2.11	NF	NF	NF	NF	NF	NF	1.97	NF	NF	8.07	2.54	NF	97.89	4.30	22.33
63	2.77	34.67	5.47	1.36	41.15	0.86	7.75	6.37	1.69	0.48	0.16	0.44	1.19	3.01	0.18	0.12	NF	NF	NF	107.69	7.59	32.50
64	11.95	51.32	9.38	2.51	36.06	1.69	11.61	6.65	2.39	1.63	NF	0.47	0.48	3.18	NF	NF	11.62	3.60	NF	154.54	6.35	25.84
65	7.72	77.38	6.75	13.13	79.10	17.56	11.89	9.71	4.89	3.27	7.62	0.71	1.53	13.71	0.19	0.55	11.20	7.48	NF	274.39	8.26	25.54
66	7.28	112.14	3.78	10.06	44.72	1.80	8.36	4.67	1.71	0.38	NF	0.61	0.52	2.92	0.21	NF	14.00	7.34	NF	220.50	12.36	33.28
67	4.30	21.08	17.38	2.24	15.39	4.27	2.41	8.88	1.77	0.64	NF	0.42	0.98	2.93	0.20	NF	5.55	1.38	NF	89.83	4.58	39.63
68	4.61	49.17	16.27	5.33	76.34	2.63	14.25	16.32	4.04	1.11	19.06	3.98	102.16	5.53	0.83	10.02	NF	NF	NF	331.65	5.52	23.81

PA—protocatechuic acid, 5OCA—5-*O*-caffeoylquinic acid, pHA—*p*-hydroxybenzoic acid, CA—caffeic acid, R—rutin, pCA—*p*-coumaric acid, Q3Og—quercetin 3-*O*-glucoside, I3Or—isorhamnetin 3-*O*-rutinoside, FA—ferulic acid, I3Og—isorhamnetin 3-*O*-glucoside, Q3Or—quercetin 3-*O*-rhamnoside, K7Og—kaempferol 7-*O*-glucoside, Pz—phlorizin, Q—quercetin, Pt—phloretin, Ac—acacetin, SA—syringic acid, Ae—aesculetin, K3Og—kaempferol 3-*O*-glucoside, TPC—total phenolic content, RSA—radical scavenging activity; NF—not found.

References

1. Potter, D.; Eriksson, T.; Evans, R.C.; Oh, S.; Smedmark, J.E.E.; Morgan, D.R.; Kerr, M.; Robertson, K.R.; Arsenault, M.; Dickinson, T.A.; et al. Phylogeny and classification of Rosaceae. *Plant Syst. Evol.* **2007**, *266*, 5–43. [CrossRef]
2. Milošević, T.; Milošević, N. Chapter 5: Plum (*Prunus* spp.) Breeding. In *Advances in Plant Breeding Strategies: Fruits*; Al-Khayri, J.M., Jain, S., Johanson, D., Eds.; Springer: Edinburgh, UK, 2018; pp. 165–215. [CrossRef]
3. Hartmann, W.; Neumüller, M. Plum breeding. In *Breeding Plantation Tree Crops: Temperate Species*, 1st ed.; Jain, S.M., Priyadarshan, P.M., Eds.; Springer Science Business Publishing: New York, NJ, USA, 2009; pp. 161–231.
4. Zohary, D.; Hopf, M.; Weiss, E. *Domestication of Plants in the Old World*, 4th ed.; Oxford University Press: Oxford, UK, 2012.
5. FAOStat. 2020. Available online: https://www.fao.org/faostat/en/#data/QCL (accessed on 26 November 2020).
6. Abanoz, Y.Y.; Okcu, Z. Biochemical content of cherry laurel (*Prunus laurocerasus* L.) fruits with edible coatings based on caseinat, Semperfresh and lecithin. *Turk. J. Agric. For.* **2022**, *46*, 908–918. [CrossRef]
7. Usenik, V.; Štampar, F.; Veberič, R. Anthocyanins and fruit colour in plums (*Prunus domestica* L.) during ripening. *Food Chem.* **2009**, *144*, 529–534. [CrossRef]
8. Gill, S.K.; Lever, E.; Emery, P.W.; Whelan, K. Nutrient, fibre, sorbitol and chlorogenic acid content of prunes (*Prunus domestica*): An updated analysis and comparison of different countries of origin and database values. *Int. J. Food Sci. Nutr.* **2019**, *70*, 924–931. [CrossRef]
9. Farcuh, M.; Bosheng, L.; Rivero, R.M.; Shlizerman, L.; Sadka, A.; Blumwald, E. Sugar metabolism reprogramming in a non-climacteric bud mutant of a climacteric plum fruit during development on the tree. *J. Exp. Bot.* **2017**, *68*, 5813–5828. [CrossRef]
10. Kim, H.Y.; Farcuh, M.; Cohen, Y.; Crisosto, C.; Sadka, A.; Blumwald, E. Non-climacteric ripening and sorbitol homeostasis in plum fruits. *Plant Sci.* **2015**, *231*, 30–39. [CrossRef] [PubMed]
11. Drkenda, P.; Music, O.; Oras, A.; Haracic, S.; Haseljic, S.; Blanke, M.; Hudina, M. Sugar, Acid and Phenols in Fruit of the Sharka-Tolerant Autochthonous Plum Genotype 'Mrkosljiva'. *Erwerbs-Obstbau* **2022**, *64*, 569–580. [CrossRef]
12. Walkowiak-Tomczak, J.; Reguła, J.; Łysiak, G. Physico-chemical properties and antioxidant activity of selected plum cultivars fruit. *Acta Sci. Pol. Technol. Aliment.* **2008**, *7*, 15–22.
13. Rampáčková, E.; Göttingerová, M.; Kiss, T.; Ondrášek, I.; Venuta, R.; Wolf, J.; Nečas, T.; Ercisli, S. CIELAB analysis and quantitative correlation of total anthocyanin content in European and Asian plums. *Eur. J. Hortic. Sci.* **2021**, *86*, 453–460. [CrossRef]
14. Sahamishirazi, S.; Moehring, J.; Claupein, W.; Graeff-Hoenninger, S. Quality assessment of 178 cultivars of plum regarding phenolic, anthocyanin and sugar content. *Food Chem.* **2017**, *214*, 694–701. [CrossRef] [PubMed]
15. Ismail, H.M.; Williams, A.A. The flavour of plums (*Prunus domestica* L.). An examination of the aroma components of plum juice from the cultivar victoria. *J. Agric. Food Chem.* **1981**, *32*, 613–619. [CrossRef]
16. Lenchyk, L.V. Determination of content of flavonoids, hydroxycinnamic acids and volatile compounds in plum leaves. *Int. J. Adv. Pharm. Biol. Chem.* **2016**, *5*, 131–136.
17. Radulović, N.S.; Đorđević, A.S.; Zlatković, B.K.; Palić, R.M. GC–MS analyses of flower ether extracts of *Prunus domestica* L. and *Prunus padus* L. (Rosaceae). *Chem. Pap.* **2009**, *63*, 377–384. [CrossRef]
18. Groh, B.; Bauer, H.; Treutter, D. Chemotaxonomical investigations of *Prunus domestica* by isoenzyme markers and phenolic compounds. *Sci. Hort.* **1994**, *58*, 41–55. [CrossRef]
19. Parmar, V.S.; Vardhan, A.; Nagarajan, G.R.; Jain, R. Dihydroflavonols from Prunus domestica. *Phytochemistry* **1992**, *31*, 2185–2186. [CrossRef]
20. Ortega-Vidal, J.; Cobo, A.; Ortega-Morente, E.; Gálvez, A.; Martínez-Bailén, M.; Salido, S.; Altarejos, J. Antimicrobial activity of phenolics isolated from the pruning wood residue of European plum (*Prunus domestica* L.). *Ind. Crops Prod.* **2022**, *176*, 114296. [CrossRef]
21. Islam, N.U.; Amin, R.; Shahid, M.; Amin, M.; Zaib, S.; Iqbal, J. A multi-target therapeutic potential of *Prunus domestica* gum stabilized nanoparticles exhibited prospective anticancer, antibacterial, urease-inhibition, anti-inflammatory and analgesic properties. *BMC Complement. Altern. Med.* **2017**, *17*, 276. [CrossRef]
22. Fotirić Akšić, M.; Mesarović, J.; Gašić, U.; Trifković, J.; Milatović, D.; Meland, M. Determination of phenolic profile in kernels of different plum cultivars. *Acta Hortic.* **2019**, *1260*, 229–234. [CrossRef]
23. Slimestad, R.; Vangal, E.; Brede, C. Analysis of Phenolic Compounds in Six Norwegian Plum Cultivars (*Prunus domestica* L.). *J. Agric. Food Chem.* **2009**, *57*, 11370–11375. [CrossRef] [PubMed]
24. Fanning, K.J.; Topp, B.; Russell, D.; Stanley, R.; Netzel, M. Japanese plums (*Prunus salicina* Lindl.) and phytochemi.cals–breeding, horticultural practice, postharvest storage, processing and bioactivity. *J. Sci. Food Agric.* **2014**, *94*, 2137–2147. [CrossRef]
25. Munekata, P.E.S.; Yilmaz, B.; Pateiro, M.; Kumar, M.; Domínguez, M.A.S.; Hano, C.; Lorenzo, J.M. Valorization of by-products from *Prunus* genus fruit processing: Opportunities and applications. *Crit. Rev. Food Sci. Nutr.* 2022; 1–16, *Online ahead of print*. [CrossRef]
26. Birwal, P.; Deshmukh, G.; Saurabh, S.P.; Pragati, S. Plums: A Brief Introduction. *J. Food Nutr. Popul. Health* **2017**, *1*, 1–5.
27. Tomić, J.; Štampar, F.; Glišić, I.; Jakopič, J. Phytochemical assessment of plum (*Prunus domestica* L.) cultivars selected in Serbia. *Food Chem.* **2019**, *299*, 125113. [CrossRef] [PubMed]
28. Murcia, M.A.; Jiménez, A.M.; Martínez-Tomé, M. Evaluation of the antioxidant properties of Mediterranean and tropical fruits compared with common food additives. *J. Food Protect.* **2001**, *64*, 2037–2046. [CrossRef] [PubMed]

29. Bennett, L.E.; Singh, D.P.; Clingeleffer, P.R. Micronutrient mineral and folate content of Australian and imported dried fruit products. *Crit. Rev. Food Sci. Nutr.* **2010**, *51*, 38–49. [CrossRef]
30. Karasawa, K.; Miyashita, R.; Otani, H. Anti-allergic properties of a fruit extract of prune (*Prunus domestica* L.) in mite-sensitized BALB/c mice. *Food Sci. Technol. Res.* **2012**, *18*, 755–760. [CrossRef]
31. Igwe, E.; Charlton, K. A systematic review on the health effects of plums (*Prunus domestica* and *Prunus salicina*). *Phytother. Res.* **2016**, *30*, 701–731. [CrossRef]
32. Arion, C.M.; Tabart, J.; Kevers, C.; Niculaua, M.; Filimon, R.; Beceanu, D.; Dommes, J. Antioxidant potential of different plum cultivars during storage. *Food Chem.* **2014**, *146*, 485–491. [CrossRef]
33. Murathan, Z.T.; Arslan, M.; Erbil, N. Analyzing Biological Properties of Some Plum Genotypes Grown in Turkey. *Int. J. Fruit Sci.* **2020**, *20* (Suppl. S3), S1729–S1740. [CrossRef]
34. El-Beltagi, H.S.; El-Ansary, A.E.; Mostafa, M.A.; Kamel, T.A.; Safwat, G. Evaluation of the fitochemical, antioxidant, antibacterial and anticancer activity of *Prunus domestica* fruit. *Not. Bot. Horti. Agrobo.* **2019**, *47*, 395–404. [CrossRef]
35. Belhadj, F.; Marzouki, M.N. Antioxidant, antihemolitic and antibacterial effects of dried and fresh *Prunus domestica* L. *Int. J. Pharm. Res. Bio. Sci.* **2014**, *3*, 191–207.
36. Miljić, U.; Puškaš, V.; Cvetković, D.; Velićanski, A.; Vujić, J. Chemical composition and in vitro antimicrobial and cytotoxic activities of plum (*Prunus domestica* L.) wine. *J. Inst. Brew.* **2016**, *122*, 342–349. [CrossRef]
37. Fotirić Akšić, M.; Nešović, M.; Ćirić, I.; Tešić, Ž.; Pezo, L.; Tosti, T.; Gašić, U.; Dojčinović, B.; Lončar, B.; Meland, M. Polyphenolics and Chemical Profiles of Domestic Norwegian Apple (*Malus* × *domestica* Borkh.) Cultivars. *Front. Nutr.* **2022**, *9*, 1–20. [CrossRef] [PubMed]
38. Fotirić Akšić, M.; Nešović, M.; Ćirić, I.; Tešić, Ž.; Pezo, L.; Tosti, T.; Gašić, U.; Dojčinović, B.; Lončar, B.; Meland, M. Chemical composition of different domestic raspberries from Norway. *Horticulturae* **2022**, *8*, 765. [CrossRef]
39. Milošević, T.; Milošević, N. Factors influencing mineral composition of plum fruits. *J. Elem.* **2012**, *17*, 453–464. [CrossRef]
40. Çalişir, S.; Hacýseferoðullarý, H.; Özcan, M.; Arslan, D. Some nutritional and technological properties of wild plum (*Prunus* spp.) fruits in Turkey. *J. Food Eng.* **2005**, *66*, 233–237. [CrossRef]
41. Motyleva, S.; Upadysheva, G.; Tumaeva, T. Influence of rootstocks on the productivity and chemical composition of *Prunus domestica* L. fruits. *Potr. S. J. F. Sci.* **2021**, *15*, 1029–1038. [CrossRef] [PubMed]
42. Jaroszewska, A. Quality of fruit cherry, peach and plum cultivated under different water and fertilization regimes. *J. Elementol.* **2011**, *16*, 51–58.
43. Nergiz, C.; Yildiz, H. Research on chemical composition of some varieties of European plums (*Prunus domestica*) adapted to the Aegean district of Turkey. *J. Agr. Food Chem.* **1997**, *45*, 2820–2823. [CrossRef]
44. Stacewicz–Sapuntzakis, M.; Bowen, P.E.; Hussain, E.A.; Damayanti-Wood, B.I.; Farnsworth, N.R. Chemical composition and potential health effects of prunes: A functional food? *Crit. Rev. Food Sci. Nutr.* **2001**, *41*, 251–286. [CrossRef]
45. Rato, E.A.; Agulheiro, C.A.; Barroso, M.J.; Riquelme, F. Soil and rootstock influence on fruit quality of plums (*Prunus domestica* L.). *Sci. Hort.* **2008**, *118*, 218–222. [CrossRef]
46. Kabata-Pendias, A.; Mukherjee, A.B. *Trace Elements from Soil to Human*; Springer: Berlin/Heidelberg, Germany, 2007. [CrossRef]
47. Lever, E.; Scott, S.M.; Louis, P.; Emery, P.W.; Whelan, K. The effects of prunes on stool output, gut transit time and gastrointestinal microbiota: A randomized controlled trial. *Clin. Nutr.* **2019**, *38*, 165–173. [CrossRef]
48. Sheet, B.S.; Artik, N.; Ayed, M.; Fawzi, O.A. Some Alternative Sweeteners (Xylitol, Sorbitol, Sucralose and Stevia): Review. *Karaelmas Sci. Eng. J.* **2014**, *4*, 63–70. [CrossRef]
49. Durán-Soria, S.; Pott, D.M.; Osorio, S.; Vallarino, J.G. Sugar signaling during fruit ripening. *Front. Plant Sci.* **2020**, *11*, 564917. [CrossRef]
50. Woznicki, T.L.; Heide, O.M.; Sønsteby, A.; Måge, F.; Remberg, S.F. Climate warming enhances flower formation, earliness of blooming and fruit size in plum (*Prunus domestica* L.) in the cool Nordic environment. *Sci. Hortic.* **2019**, *257*, 108750. [CrossRef]
51. Kang, H.K.; Kang, H.R.; Lee, Y.S.; Song, H.S. Characteristics of organic acid contents and fermentation solution of Prunus mume in South Korea. *Korean J. Plant Res.* **2020**, *33*, 194–199. [CrossRef]
52. Mertoğglu, K.; Gülbandilar, A.; Bulduk, İ. Growing conditions effect on fruit phytochemical composition and anti-microbial activity of plum (cv. Black Diamond). *Int. J. Agric. For. Life Sci.* **2020**, *4*, 56–61.
53. Berüter, J. Carbohydrate metabolism in two apple genotypes that differ in malate accumulation. *J. Plant Physiol.* **2004**, *161*, 1011–1029. [CrossRef]
54. Vangdal, E.; Flatland, S.; Nordbø, R. Fruit quality changes during marketing of new plum cultivars (*Prunus domestica* L.). *Hort. Sci.* **2007**, *34*, 91–95. [CrossRef]
55. Liaudanskas, M.; Okulevičiūtė, R.; Lanauskas, J.; Kviklys, D.; Zymonė, K.; Rendyuk, T.; Žvikas, V.; Uselis, N.; Janulis, V. Variability in the content of phenolic compounds in plum fruit. *Plants* **2020**, *9*, 1611. [CrossRef]
56. Navarro, M.; Moreira, I.; Arnaez, E.; Quesada, S.; Azofeifa, G.; Vargas, F.; Alvarado, D.; Chen, P. Polyphenolic characterization and antioxidant activity of *Malus domestica* and *Prunus domestica* cultivars from Costa Rica. *Foods* **2018**, *7*, 15. [CrossRef]
57. Aitchison, J. Principal component analysis of compositional data. *Biometrika* **1983**, *1*, 57–65. [CrossRef]
58. Aitchison, J. Reducing the dimensionality of compositional data sets. *Math. Geol.* **1984**, *16*, 617–635. [CrossRef]

59. Reig, G.; Font i Forcada, C.; Mestre, L.; Jiménez, S.; Betrán, J.A.; Moreno, M.Á. Horticultural, leaf mineral and fruit quality traits of two 'Greengage' plum cultivars budded on plum based rootstocks in Mediterranean conditions. *Scientia Horticulturae* **2018**, *232*, 84–91. [CrossRef]
60. Dugalic, K.; Sudar, R.; Viljevac, M.; Josipovic, M.; Cupic, T. Sorbitol and Sugar Composition in Plum Fruits Influenced by Climatic Conditions. *J. Agric. Sci. Tech.* **2014**, *16*, 1145–1155.
61. Yu, X.M.; Rizwan, H.M.; Li, P.; Luo, S.X.; Sherameti, I.; Wu, W.F.; Lin, J.; Zheng, S.X.; Oelmüller, R.; Chen, F.X. Comparative studies on the physiochemical properties, phenolic compounds and antioxidant activities in 13 japanese plum cultivars grown in the subtropical region of China. *Appl. Ecol. Environ. Res.* **2020**, *18*, 3147–3159. [CrossRef]
62. Moriguchi, T.; Ishizawa, Y.; Sanada, T. Differences in Sugar the Classification Composition by the Princi in pal Prunus persica Fruit and Component Analysis. *J. Japan Soc. Hort. Sci.* **1990**, *59*, 307–312. [CrossRef]
63. Bae, H.; Yun, S.K.; Jun, J.H.; Yoon, I.K.; Nam, E.Y.; Kwon, J.H. Assessment of organic acid and sugar composition in apricot, plumcot, plum, and peach during fruit development. *J. Appl. Bot. Food Qual.* **2014**, *87*, 24–29. [CrossRef]
64. Trendafilova, A.; Ivanova, V.; Trusheva, B.; Kamenova-Nacheva, M.; Tabakov, S.; Simova, S. Chemical Composition and Antioxidant Capacity of the Fruits of European Plum Cultivar "Čačanska Lepotica" Influenced by Different Rootstocks. *Foods* **2022**, *11*, 2844. [CrossRef]
65. Celik, F.; Gundogdu, M.; Alp, S.; Muradoglu, F.; Ercişli, S.; Gecer, K.M.; Canan, I. Determination of Phenolic Compounds, Antioxidant Capacity and Organic Acids Contents of *Prunus domestica* L., *Prunus cerasifera* Ehrh. and *Prunus spinosa* L. Fruits by HPLC. *Acta Chromatogr.* **2017**, *29*, 507–510. [CrossRef]
66. Stojanov, D.; Milošević, T.; Mašković, P.; Milošević, N. Impact of fertilization on the antioxidant activity and mineral composition of red raspberry berries of cv. 'Meeker'. *Mitt. Klosterneubg. Rebe Und Wein Obstbau Und Früchteverwertung* **2019**, *69*, 184–195.
67. de Souza, V.R.; Pereira, P.A.P.; da Silva, T.L.T.; de Oliveira Lima, L.C.; Pio, R.; Queiroz, F. Determination of the bioactive compounds, antioxidant activity and chemical composition of Brazilian blackberry, red raspberry, strawberry, blueberry and sweet cherry fruits. *Food Chem.* **2014**, *156*, 362–368. [CrossRef] [PubMed]
68. Nile, S.H.; Park, S.W. Edible berries: Bioactive components and their effect on human health. *Nutrition* **2014**, *30*, 134–144. [CrossRef] [PubMed]
69. Fotirić Akšić, M.; Tosti, T.; Nedić, N.; Marković, M.; Ličina, V.; Milojković Opsenica, D.; Tešić, Ž. Influence of frost damage on the sugars and sugar alcohol composition in quince (*Cydonia oblonga* Mill) Floral nectar. *Acta Physiol. Plant* **2015**, *37*, 1701. [CrossRef]
70. Carbone, K.; Giannini, B.; Picchi, V.; Lo Scalzo, R.; Cecchini, F. Phenolic composition and free radical scavenging activity of different apple varieties in relation to the cultivar, tissue type and storage. *Food Chem.* **2011**, *127*, 493–500. [CrossRef]