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EFFECT OF BIOLOGICAL AND AGROTECHNICAL FACTORS ON THE CHEMICAL COMPOSITION OF DILL (*ANETHUM GRAVEOLENS* L.)

Waldemar Kmiecik, Zofia Lisiewska, Grażyna Jaworska

Department of Raw Materials and Processing of Fruit and Vegetables, Agricultural University of Cracow, Poland

ABSTRACT

The evaluation concerned usable parts of dill plants, cultivars Amat, Ambrozja, and Lukullus, grown in five cycles. The dill was sown on 10th April, 10th May, 10th June, 10th July, and 10th August. Harvesting was carried out when the plants were 25 cm in height, i.e. within 36-45 days of sowing. The basic discriminants of the chemical composition were determined in leaves of dill alone and in those with petioles. Leaves of dill when compared with leaves with petioles contained far greater amounts of dry matter, total sugars, dietary fibre, and total and protein nitrogen, smaller differences concerning ash, titration acidity, reducing sugars, and starch. For five growing periods the compared cultivars showed on the average small differences in the level of analysed discriminants, a slightly higher level, however, being noted in the case of titration acidity, sugars, and dietary fibre in the cultivar Lukullus and of ash and starch in Amat. The growing period significantly affected the chemical composition, this particularly concerning dry matter, ash, acids, sugars, and dietary fibre, and to a smaller degree total and protein nitrogen. The highest level of the investigated indices was found in the September and June harvests and decisively lower ones in the August and May crops.

Key words: dill, harvest time, leaves, leaves with petioles, chemical composition

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INTRODUCTION

The garden dill may be classed among plant species with a fairly wide scope of use. Young plants, and especially their leaves, are used for seasoning soups and dishes, cottage cheese, and salads. Also sauces and soups can be prepared on the basis of this vegetable. Mature plants with developed umbels are the basic spices in the production of pickled cucumbers while their extracts are used in the food industry, cosmetics, and medicine. The developing industry of food concentrates and frozen vegetables has increased the demand for this crop, particularly with regard to the Temperate Zone since, contrary to other spice plants, dill is characterized by a very short vegetation period, giving high yields even in the countries of Northern Europe [2, 6, 20].

The specific taste and smell of dill are due to the content of volatile oils, which stimulate and regulate the digestive processes. Apart from the oils, the content of vitamin C, chlorophylls, and carotenoids in dill is fairly large in comparison with other leafy vegetables [9, 12, 13, 16]. The literature data concerning the chemical composition of dill are sparse. The analogy with other crops suggests that the chemical composition of dill plants, significantly affecting both the fresh product and the quality of frozen and dried dill, depends on the cultivar and the conditions of growth [2, 6, 20, 9, 11, 12, 16, 19, 24].

The aim of this work was to determine the effect of the cultivar, kind of the usable part of young dill, and the growing period on the level of basic discriminants of the chemical composition.

MATERIALS AND METHODS

The experimental material consisted of two kinds of the usable parts of young dill plants: leaves alone or leaves with petioles. The vegetable was grown in five growing cycles conducted from spring to autumn. Three original cultivars of dill bred in Poland were used, i.e. Amat (bred in SPOJNIA HiNO Nochowo), and Ambrozja and Lukullus (bred in PLANTICO Gołębiew).

The dill was grown on an experimental field on the western outskirts of the city of Krakow, on brown soil developed from loess formations with the mechanical composition of silt loam. The soil, in a good horticultural state was characterized by a reaction approximating neutral - pH in H_2O 6.4-6.6. In the growing period the following soil fertility was determined: humus 1.49-1.60%, nitrogen $NO3^-$ 7-10 mg dm^{-3}, phosphorus 79-86 mg dm^{-3}, potassium 151-164 mg dm^{-3}, and calcium 1280-1360 mg dm^{-3}. The plantation was established in the second year after farmyard manure fertilization with pod plants as the fore-crop in all the growing periods. The soil fertility being very similar in the individual growing cycles, the fertilization was not differentiated. All the fertilizers were applied before sowing their level depending on the nutritional requirements of the crop and the content of macroelements in the soil. The following doses were applied: N - 30 kg/ha, P_2O_5 - 15 kg/ha, and K_2O - 30 kg/ha.

The dill was sown in rows 20 cm apart, at a density of 400 seeds/1 m calculated per 100% germination. In the plantation cultural practices included mechanical weed control, spraying with insecticides and if necessary with fungicides - the waiting periods being preserved - and the sprinkling irrigation when the soil humidity decreased to a degree that could endanger the height and quality of yields. The pattern of weather conditions in the vegetation period in the year 2000 is given in Figure 1. Total temperatures and total rainfall were recorded in the period of five days preceding the dill harvests (Table 1). Figure 1 also gives the dates of sowing and harvesting in the individual growing periods.

Table 1. Sum of temperature and rainfall in the period of five days before harvest of dill

Cultivar	Sowing date									
	10.04		10.05		10.06		10.07		10.08	
	temp. °C	rainfall mm	temp. °C	rainfall mm	temp. °C	rainfall mm	temp. °C	rainfall mm	temp. °C	rainfall mm
Amat	75	45	90	0	76	60	121	1	90	0
Ambrozja	68	48	103	0	77	59	129	1	82	0
Lukullus	67	51	90	0	75	60	121	1	90	0

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The dill plants were harvested when they were about 25 cm in height. The plants were cut 1.5 - 2.0 cm above the ground. Directly after harvest the nonmarketable part of the crop was discarded, and the usable part subjected to evaluation. In the usable parts the level of physico-chemical discriminants was determined using analytical methods recommended by the following sources: AOAC (AOAC 1984) dry matter (32.019), total acids (32.047), ash (32.027), reducing sugars (32.040), total sugars (32.041), total nitrogen (2.057), and starch using Lintner method [4], dietary fibre [7], protein nitrogen using the method with trichloroacetic acid [1]. All determinations were conducted in four replications. The results were calculated per 100 g fresh matter and also, if necessary for correct interpretation, per 100 g dry matter. Two-factor analysis of variance was carried out to demonstrate differences in the content of the investigated components with respect to fresh matter.

RESULTS AND DISCUSSION

The chemical composition decides the nutritive value of the crops and the technological value of the raw material. Within a given species these values depend on the biological factors, such as the cultivar and on the agrotechnical conditions. In the presented work the position of the plantation, fertilization, and the number of seeds per area unit was identical for all the cultivars and growing periods. An attempt was also made to prevent water deficiency in the soil at any stage of plant growth. It may therefore be accepted that the differences in the content of physico-chemical constituents were associated with the cultivar, the variable weather conditions due to the harvest date, and the part of the plant accepted as the usable one.

The dill cultivars evaluated in the work were bred in Poland in the '90s of the last century. According to the breeders, the cultivars can be used for the fresh market and for preserves. The dill was grown in five cycles from spring to autumn in conditions typical of the temperate climate, i.e. with a fairly warm spring, hot and dry and alternately cool and rainy summer, and distinctly variable autumn weather. According to Pijanowski et al. [21], the variation in the chemical composition of crops due, among other factors, to the pattern of weather conditions, may reach - 50% and + 175% measured by the percentage deviation from the average content of components. Analyses of the chemical composition included the leafy part of the dill and the leaves with petioles. It was accepted that in some directions of usage and processing dill (pulp for soups and sauces, ground dry plants) whole young plants could be used, this considerably increasing the usable yield. It should be stressed that, depending on the cultivar and the season of the year, the petioles constitute up to 30-51% of the entire yield of leaves.

No complex data concerning the chemical composition of young dill leaves could be found in the literature. Neither the materials published by Souci et al. [22] nor the Polish tables of the nutritive value of crops [1] take dill into consideration. Thus, one may hope that complex data concerning the basic chemical components of young dill will be an important contribution to the knowledge of this vegetable-spice that is particularly valuable for the countries of the Temperate Zone.

Particular parts of plants are frequently characterized by considerable differences in their chemical composition. With respect to leafy vegetables this chiefly concerns differences between the leaves and petioles or stems [19, 24]. The above observation was confirmed in the case of most investigated components. Leaves alone contained on the average for all the factors more than leaves with petioles: dry matter by 23%, acids by 15%, ash by 6%, reducing sugars by 11%, total sugars by 24%, starch by 18%, dietary fibre by 26%, total nitrogen by 37%, and protein nitrogen by 39% (Tables 2-4). The above average data concern all the compared cultivars and five growing periods, the results being referred to fresh matter. When the results were referred to dry matter the values obtained were different. In dietary fibre, total nitrogen, and protein nitrogen the differences in favour of leaves reached only 2%, 11%, and 10%, respectively. With respect to the remaining indices, the content of acids in leaves was 7% lower, of ash 15%, of total sugars 2%, and of starch 5% lower than that in leaves with petioles. This finding should be taken into consideration when leaves with petioles are used in the production of the dried ground component of food concentrates.

Table 2. Content of dry matter, total acids and ash in dill depending on cultivar and growing period

Growing period	Amat		Ambrozja		Lukullus		Mean	
	Leaves	Leaves with petioles	Leaves	Leaves with petioles	Leaves	Leaves with petioles	Leaves	Leaves with petioles
Dry matter, g/100 g fresh matter								
I	12.87	9.96	13.21	10.22	13.03	9.78	13.04	9.99
II	15.95	13.97	16.32	13.22	16.22	13.63	16.16	13.61
III	13.78	10.76	13.39	10.95	14.35	10.76	13.84	10.82
IV	16.81	14.55	16.84	14.72	17.86	16.15	17.17	15.14
V	13.07	9.69	12.56	9.69	11.68	8.96	12.44	9.45
Mean	14.50	11.79	14.46	11.76	14.63	11.86	14.53	11.80
LSD p=0.01				Leaves			Leaves with petioles	
	For: cultivar			n.s			n.s.	
	growing period			0.423			0.413	
	interaction			0.733			0.715	
Total acids, cm^3 1M NaOH/100 g fresh matter								
I	1.76	1.60	2.10	1.58	1.82	1.46	1.89	1.55
II	1.98	1.88	2.32	1.86	2.28	2.06	2.19	1.93
III	1.55	1.31	1.86	1.58	2.09	1.72	1.83	1.54
IV	2.26	2.06	2.44	2.27	2.53	2.26	2.41	2.20
V	1.65	1.53	1.68	1.40	1.72	1.48	1.68	1.47
Mean	1.84	1.68	2.08	1.74	2.09	1.80	2.00	1.74
LSD p=0.01				Leaves			Leaves with petioles	
	For: cultivar			0.076			0.083	
	growing period			0.098			0.107	
	interaction			0.169			0.185	
Ash, g/100 g fresh matter								
I	1.83	1.73	1.67	1.54	1.57	1.48	1.69	1.58
II	2.21	2.07	2.23	2.02	2.12	2.03	2.19	2.04
III	2.12	2.02	1.80	1.70	1.88	1.78	1.93	1.83
IV	2.53	2.32	2.40	2.36	2.34	2.34	2.42	2.34
V	2.03	1.86	2.04	1.82	1.75	1.72	1.94	1.80
Mean	2.14	2.00	2.03	1.89	1.93	1.87	2.03	1.92
LSD p=0.01				Leaves			Leaves with petioles	
	For: cultivar			0.068			0.072	
	growing period			0.088			0.092	
	interaction			0.153			0.160	

Table 3. Content of sugars and starch in dill depending on cultivar and growing period

Growing period	Amat		Ambrozja		Lukullus		Mean	
	Leaves	Leaves with petioles	Leaves	Leaves with petioles	Leaves	Leaves with petioles	Leaves	Leaves with petioles
Reducing sugars, g/100 g fresh matter								
I	0.76	0.60	1.07	0.83	1.24	1.00	1.02	0.81
II	0.83	0.87	0.84	0.79	1.01	0.91	0.89	0.86
III	0.59	0.52	0.94	0.95	1.11	0.99	0.88	0.82
IV	1.41	1.34	1.24	1.20	1.62	1.58	1.42	1.37
V	0.99	0.78	0.69	0.56	0.63	0.51	0.77	0.62
Mean	0.92	0.82	0.96	0.87	1.12	1.00	1.00	0.90
LSD p=0.01				Leaves			Leaves with petioles	
	For: cultivar			0.060			0.060	
	growing period			0.078			0.077	
	interaction			0.135			0.133	
Total sugars, g/100 g fresh matter								
I	1.04	0.78	1.76	1.22	1.74	1.30	1.51	1.10
II	1.39	1.27	1.80	1.45	2.01	1.58	1.73	1.43
III	1.40	1.23	1.81	1.43	2.06	1.55	1.76	1.40
IV	2.62	2.24	2.63	2.36	3.38	2.98	2.88	2.53
V	1.48	1.00	0.99	0.79	1.16	0.90	1.21	0.90
Mean	1.59	1.30	1.80	1.45	2.07	1.66	1.82	1.47

Table 3 cont.

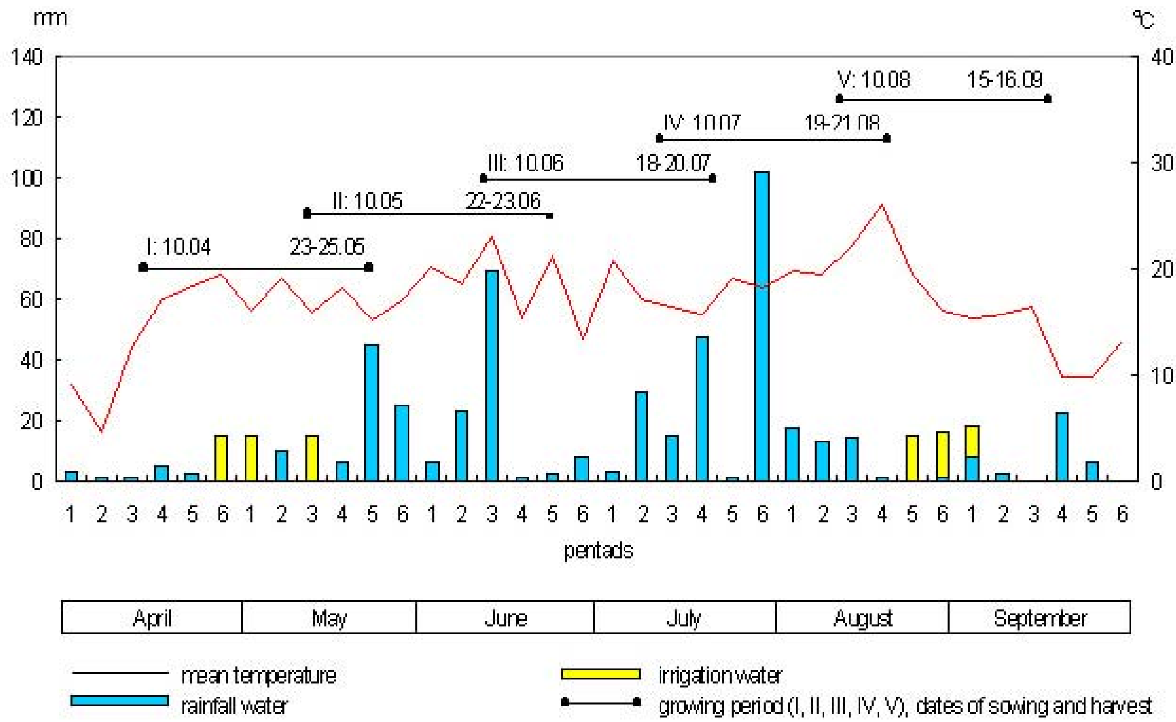
LSD p=0.01	For: cultivar growing period interaction			Leaves 0.116 0.149 0.259			Leaves with petioles 0.107 0.139 0.240	
Starch, g/100 g fresh matter								
I	0.71	0.64	0.70	0.63	0.63	0.59	0.68	0.62
II	0.88	0.76	0.73	0.61	0.69	0.61	0.77	0.66
III	0.84	0.77	0.82	0.69	0.77	0.63	0.81	0.70
IV	0.95	0.80	0.89	0.71	0.93	0.82	0.92	0.78
V	0.75	0.53	0.72	0.65	0.62	0.43	0.70	0.54
Mean	0.83	0.70	0.77	0.66	0.73	0.62	0.78	0.66
LSD p=0.01	For: cultivar growing period interaction			Leaves 0.031 0.040 0.070			Leaves with petioles 0.027 0.035 0.061	

Table 4. Content of dietary fibre and nitrogen in dill depending on cultivar and growing period

Growing period	Amat		Ambrozja		Lukullus		Mean	
	Leaves	Leaves with petioles	Leaves	Leaves with petioles	Leaves	Leaves with petioles	Leaves	Leaves with petioles
Dietary fiber, g/100 g fresh matter								
I	2.24	1.58	2.34	1.70	2.58	1.69	2.39	1.66
II	3.70	3.35	3.91	3.24	3.99	3.56	3.87	3.38
III	2.50	2.18	2.55	2.19	3.05	2.48	2.70	2.28
IV	3.44	2.60	3.80	2.82	3.30	2.49	3.51	2.64
V	2.15	1.63	1.74	1.45	2.14	1.59	2.01	1.56
Mean	2.81	2.27	2.87	2.28	3.01	2.36	2.90	2.30
LSD p=0.01	For: cultivar growing period interaction			Leaves 0.142 0.184 0.318			Leaves with petioles n.s 0.138 0.238	
Total nitrogen, g/100 g fresh matter								
I	0.72	0.50	0.67	0.45	0.65	0.45	0.68	0.47
II	0.89	0.74	0.89	0.64	0.83	0.63	0.87	0.67
III	0.70	0.59	0.63	0.48	0.72	0.53	0.68	0.53
IV	0.80	0.62	0.78	0.60	0.83	0.62	0.80	0.61
V	0.70	0.44	0.68	0.46	0.64	0.37	0.67	0.42
Mean	0.76	0.58	0.73	0.53	0.73	0.52	0.74	0.54
LSD p=0.01	For: cultivar growing period interaction			Leaves n.s. 0.043 0.074			Leaves with petioles 0.034 0.044 n.s.	
Protein nitrogen, g/100 g fresh matter								
I	0.63	0.43	0.58	0.39	0.59	0.38	0.60	0.40
II	0.75	0.60	0.75	0.55	0.74	0.55	0.75	0.57
III	0.61	0.48	0.58	0.43	0.64	0.46	0.61	0.46
IV	0.70	0.55	0.67	0.51	0.63	0.49	0.67	0.52
V	0.60	0.38	0.62	0.41	0.52	0.33	0.58	0.37
Mean	0.66	0.49	0.64	0.46	0.62	0.44	0.64	0.46
LSD p=0.01	For: cultivar growing period interaction			Leaves n.s. 0.039 0.067			Leaves with petioles 0.027 0.035 n.s.	

The dill contained considerable amounts of dry matter. Depending on the cultivar and the growing period, the content of dry matter ranged 11.68 - 17.86 g/100 g in leaves and 8.96 - 16.15 g in leaves with petioles. In general, the above values agree with the data found in the literature. Witkowska et al. [25] determined 8.07-14.09 g/100 g in fresh dill sampled in shops. Hälvä and Puukka [6] found 7.9-10.7 g/100 g in the case of varied fertilization and dill plants 30-35 cm in height. Pääkkőnen et al. [20] determined 14% before the formation of umbels, while a higher value (15.4%) was given by Ben-Amotz and Fishler [3]. Statistical analysis showed no differences between the cultivars in the level of dry matter. A distinct effect of the growing period and the interaction of the two factors was observed though (Table 2). A distinctly greater content was found in the June (the second growing period) and August (the fourth growing period) crops, with high temperatures and rain deficiency prevailing during the harvest time (Fig. 1, Table 1). In the remaining growing periods, especially in the last September harvest, the content of dry matter was distinctly lower. In relation to the average content in all the samples the greatest deviations in dry matter content were -20% to + 23% for leaves and -24% to +37% for leaves with petioles.

Fig.1. Mean air temperature and total rainfall during the vegetation season (in pentads) and growing period of dill



The acidity of dill has not yet been thoroughly discussed in the literature. Nor was it possible to find information concerning the kinds of acid in the usable parts of this plant. Hence the titratable acidity was given in cm^3 1 M NaOH. The content of acids in 100 g fresh matter ranged 1.55 - 2.53 cm^3 1 M NaOH in leaves and 1.31-2.27 cm^3 1 M NaOH in leaves with petioles (Table 1) depending on the cultivar and the growing period and pH ranging 5.41-5.98. In an investigation on dill storage Kmiecik et al. [13] determined the titratable acidity in the raw material at the level of 1.49-1.95 cm^3 1M NaOH/100 g and the pH of 5.89-5.92 depending on the analysed part of the plant. The following comparative values of titratable acidity may be quoted: 0.87-1.00 cm^3 in New Zealand spinach, 1.80-3.00 cm^3 1M NaOH/100 g in spinach [8], and 0.37-0.42 1M NaOH/100 g in parsley leaves [11]. Of the investigated cultivars higher acidity was found in Ambrozja and Lukullus and usually a lower one in Amat. As in the case of dry matter, comparison of the growing periods shows that more acids were found in the June and especially in the August harvests while in the remaining ones, particularly in the September one, their content was distinctly lower. In fresh matter of dill the maximum deviations from the average level of titratable acidity ranged -23% to +27% in leaves and -25% to +30% in leaves with petioles for all the combinations of the experiment. The respective values in dry matter were -19% to +15% and -18% to +11%.

The content of mineral constituents is fairly high in leafy vegetables, including those in dill. For example, parsley leaves contained 2.01-2.98 g/100g ash in fresh matter, depending on the type of vegetable and the time of harvest [11]. In spinach and New Zealand spinach from the spring and autumn growing periods the respective values were 1.86-1.88 g and 1.15- 1.42 g/100 g [8] and in dill 2.6-3.5 g/100 g [23]. In the discussed experiment dill leaves contained 1.57-2.53 g ash and leaves with the petiole 1.48-2.36 g in 100 g fresh matter (Table 2). When these values, were referred to 100 g dry matter, the average content reached 14.0 g in leaves and 16.5 g in leaves with petioles. The data given above show that mineral compounds are the basic constituents of dry matter in dill, being quantitatively inferior only to dietary fibre (Fig. 2-3). When the results were referred to fresh matter, the differentiation in ash content was significant both for cultivars and the growing periods. Moreover, an

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interaction of the two factors could be observed. Of the investigated cultivars a greater average content of ash was determined in Amat and the smallest in Lukullus, while the extreme differences did not exceed 10% and 7% in the separate usable parts of the dill. Distinctly greater differences were found between the growing periods and, as in the case of previously discussed indices, the greatest content of ash was determined in the crops from August and June and the smallest one in that from May. In fresh matter of dill the maximum deviations from the average level of ash content were -23% to +25% in leaves and -23% to +23% in leaves with petioles. Smaller deviations were found in dry matter, ranging -14% to +16% and -10% to +16%, respectively.

Fig. 2. Content of dry matter, total acids and ash in dill (mean for three cultivars and five growing periods)

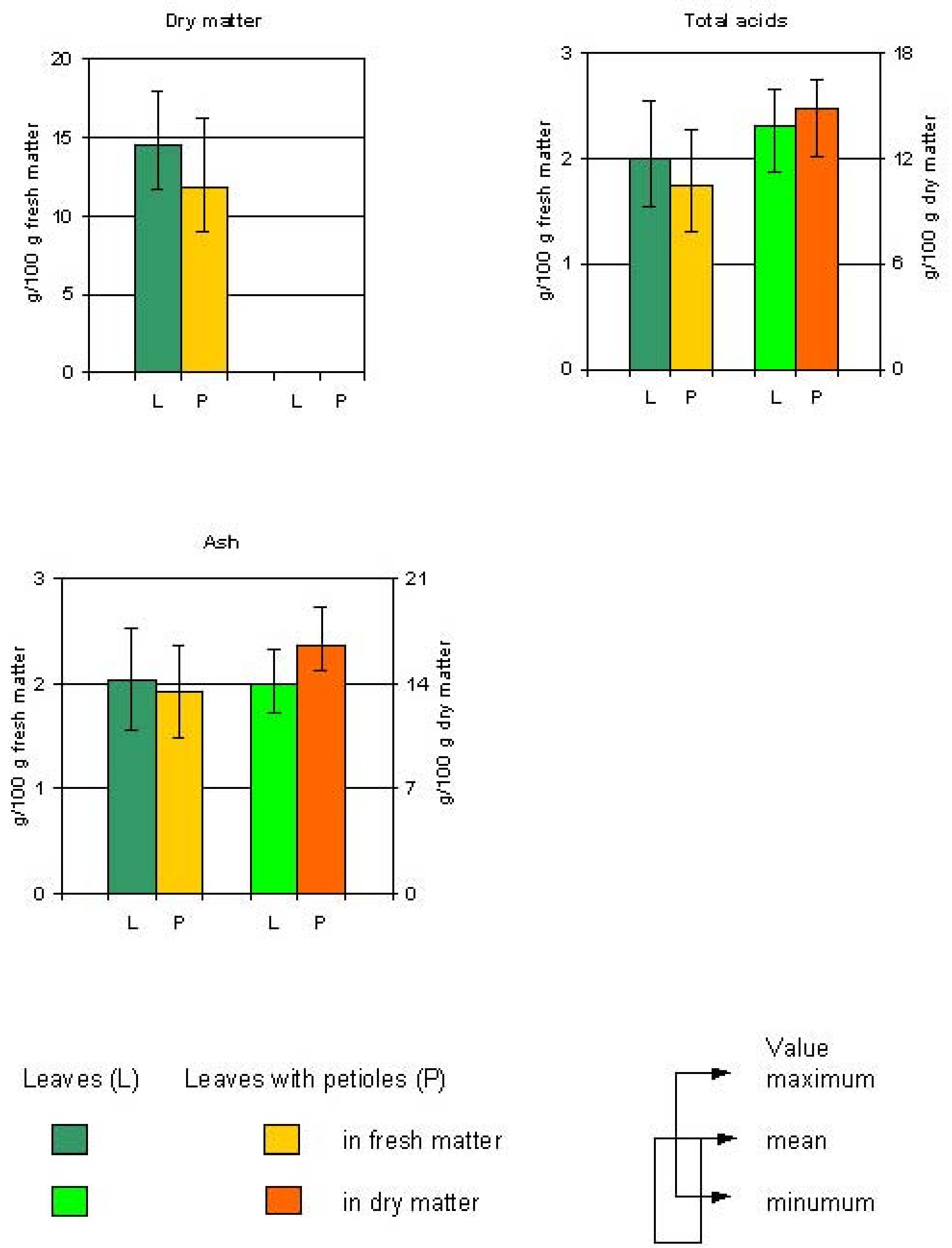
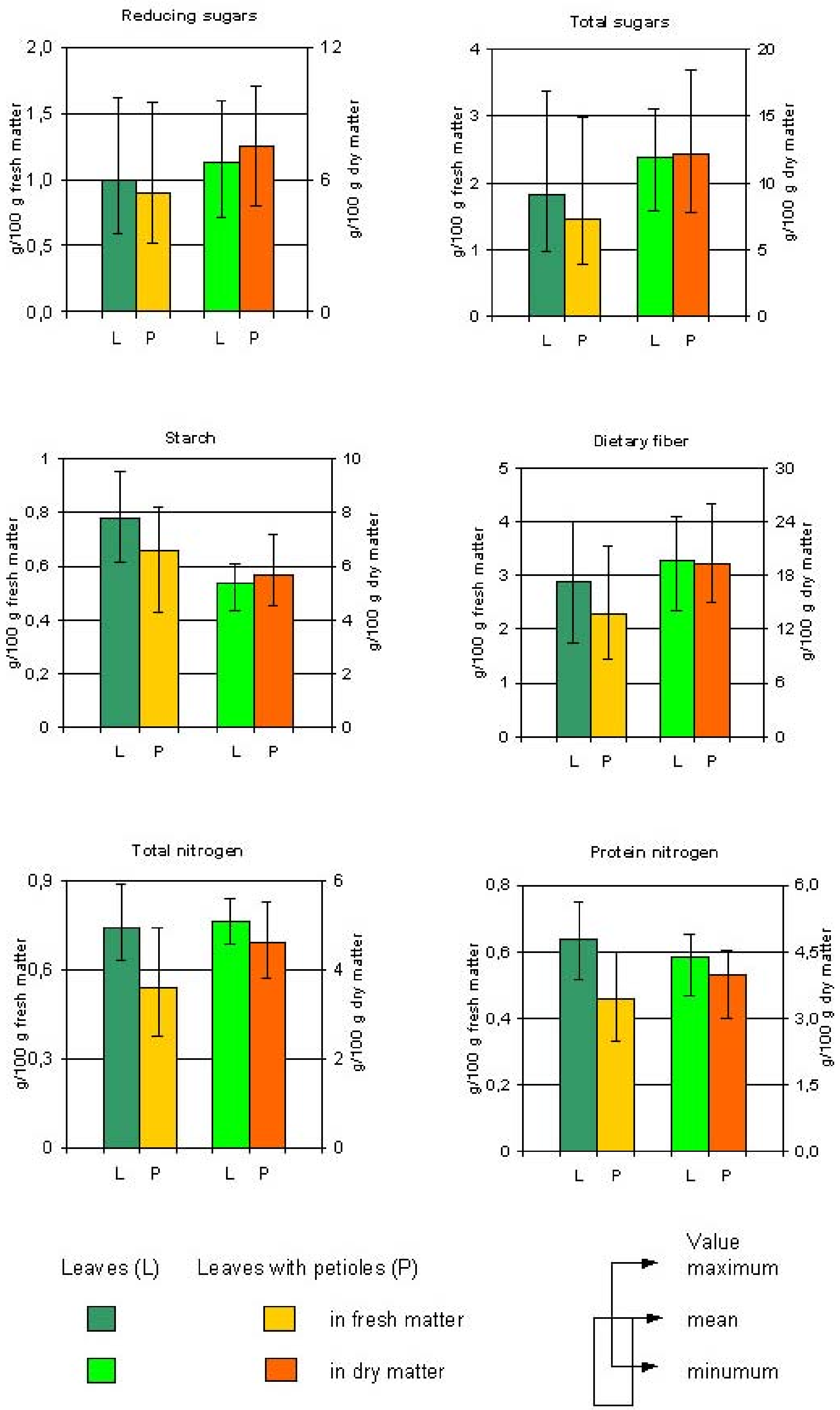


Fig. 3. Content of carbohydrates and nitrogen in dill (mean for three cultivars and five growing periods)



The literature concerning the content of carbohydrates in dill is very small. Kunachowicz et al. [15] quote the amount of assimilable carbohydrates at the level of 6.1 g/100 g fresh matter, although the percentages of reducing sugars, total sugars, and starch are not specified. Bąkowski and Michalik [2] determined total sugars at the level of 3.3 g/100 g while Kmiecik et al. [13] give the figures 1.4-2.0 g/100 g, depending on separate usable parts of dill investigated as raw material for storage. In the discussed work a statistical dependence of the content of reducing sugars, total sugars, and starch on the cultivar and on the growing period was determined, the interaction of the factors analysed also being observed. Reducing sugars constituted on the average 55% of total sugars in leaves and 61% in leaves with petioles. If all the factors of the experiment were taken into consideration, the content of total sugars in fresh matter of leaves was 0.99 - 3.38 g/100 g. In leaves with petioles it ranged 0.79 - 2.98 g. The respective values for starch were 0.62-0.95 g and 0.43-0.82 g/100 g (Table 3). The greatest content of sugars was found in Lukullus and the smallest in Amat. Throughout the growing season total deviations, those maximum and minimum, were from the average content 27% for leaves and 25% for leaves with petioles. With respect to starch content the differentiation of cultivars was distinctly smaller than in the case of sugar, the total deviations not exceeding 12% for the two usable parts of dill. With respect to the level of this index, the order of cultivars was the opposite of that determined for sugars. The differences recorded between the growing periods considerably exceeded those found for cultivars, both in leaves and in leaves with petioles. The absolutely greatest contents of total sugars and starch were found in the August harvest. The smallest ones were noted in September or May. Of the discriminants analysed the extreme deviations were determined in the case of total sugars in relation to the average content found in cultivars and growing periods, ranging -46% to +86 for fresh matter of leaves and -46% to +103% for leaves with petioles. When the results were referred to dry matter the respective values were -34% to +31% and -36% to +53%. In the case of starch the discussed deviations reached values of -21% to +22% and -35% to +24% in fresh matter and -20% to +13% and -21% to +26% in dry matter.

The dill is a rich source of dietary fibre, its level being 1.74 and 3.99 g/100 g in leaves and 1.45-3.56 g in leaves with petioles. Kunachowicz et al. [15] and Witkowska et al. [25] determined the content of dietary fibre in dill at the level of 3.30 g and 3.99 g/100 g, respectively. These figures are in the upper range of values found in the present work. The above quoted authors, however, did not describe the conditions of dill cultivation, size of plants, or the kind of the analysed parts. The average content of dietary fibre did not differ to a great degree in the investigated cultivars, the differences concerning only leaves. Also in this case they did not exceed 7%. The greatest content was found in Lukullus. Distinctly greater differences concerned the time of harvest. The greatest content of dietary fibre in the two parts of dill analysed was recorded in the June harvest. It was followed by the August harvest while in September the smallest content of this component was determined. In relation to the May harvest, however, the difference was not significant in the case of leaves with petioles (Table 4). It is interesting that in the two analysed parts of dill plants the content of dietary fibre was above 19 g/100 g dry matter, i.e. it exceeded the total content of sugars and starch (Fig. 2). The greatest deviations of the extreme amounts of dietary fibre in fresh matter in relation to averages from all the samples were -40% to +38% in leaves and -37% to +55% in leaves with petioles. If the results were referred to dry matter the respective values were -29% to +25% and -22% to +35%.

Apart from nitrate and nitrite nitrogen, the content of nitrogen compounds in leafy vegetables has not yet been thoroughly investigated although in some of these vegetables, including dill, it is fairly high. Protein nitrogen constitutes a significant part of total nitrogen. In the present work protein nitrogen constituted on the average 86% of total nitrogen in leaves and 85% in leaves with petioles. Gasparyan [5] compared the content of nitrogen in spice plants, showing that protein nitrogen constituted 87-93% of total nitrogen. In the present work the extreme amounts of total nitrogen were from 0.63-0.89 g/100 g fresh matter of leaves and 0.37-0.74 g/100 g of leaves with petioles for all the analysed samples. Kirkham [10] and Varo et al. [23] recorded a still greater content of nitrogen in dill, quoting the interval of 0.67-0.95 g/100 g. The cultivars compared in the present work did not differ with respect to the level of nitrogen. The difference between the growing periods, though statistically significant, was smaller than that found for the previously discussed discriminants. The greatest content of total and protein nitrogen was determined in the June harvest (Table 4). The maximum deviations in total nitrogen content in relation to the average one calculated for the cultivars and growing periods were -15% to +20% in leaves and -31% to +37% in leaves with petioles. When referring the results to dry matter the respective values were -10% to +10%, and -17% to +20%. Interesting results are obtained when calculating the content of total and protein nitrogen in dill leaves into crude and true protein and referring these amounts to 100 g dry matter. If the average number of samples in the experiment (Fig. 2) is multiplied by 6.25 the obtained value for crude protein is 31.9 g and for true protein 27.5 g, this being comparable with pulse crops characterized by a high content of protein (1999).

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CONCLUSIONS

Leaves alone of dill when compared with leaves with petioles contained much greater amounts of dry matter, total sugars, dietary fibre, and total and protein nitrogen, smaller differences concerning ash, titratable acidity, reducing sugars, and starch. For five growing periods the compared cultivars showed on the average small differences in the level of analysed discriminants, a slightly higher level, however, being noted in the case of titratable acidity, sugars, and dietary fibre in the cultivar Lukullus and of ash and starch in Amat. The growing period significantly affected the chemical composition, this particularly concerning dry matter, ash, acids, sugars, and dietary fibre, and to a smaller degree total and protein nitrogen. The highest level of the investigated indices was found in the August and June harvests and decisively lower ones in the September and May crops. For three cultivars and five growing periods the maximum differentiation in the level of the indices analysed was distinctly greater when the results were referred to fresh matter than if expressed in dry matter. Moreover, in fresh matter of dill greater differences appeared in the analysed leaves with petioles than in leaves alone.

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Waldemar Kmiecik, Zofia Lisiewska, Grażyna Jaworska
Department of Raw Materials and Processing of Fruit and Vegetables
Agricultural University of Cracow, Poland
ul. Podłużna 3, 30-239 Cracow
tel. (+48 12) 425 28 06