COMPARATIVE ESTIMATION OF BIOCHEMICAL COMPOSITION OF FRUITS OF *ERICACEAE* SPECIES UNDER CONDITIONS OF BELARUS

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Abstract

Thus, as a result of biochemical screening of 30 taxons of *Ericaceae* species taking into account 32 parameters in a long-term cycle of observation it has been established the different degree of dependence of variability level of biochemical structure components of fruits of alien crops on genotype and a hydrothermal mode of the period of their maturing has been revealed. The similarity of parameters of genotypic variability of some traits of all investigated *Ericaceae* species is also revealed: low one – for the general contents in fruits of soluble sugars, flavonols, of potassium, calcium, magnesium and high one – for the contents of anthocyanins, and also the ratio of fractions of pectinaceous substances and bioflavonoids.

Specific features of genetic determinacy of the analyzed traits, testifying the greatest degree of its displays of *V. corymbosum* for total accumulation of soluble sugars and bioflavonoids, flavonols contents, calcium and magnesium and by the lowest degree – for the contents of titratable acids, vitamin C, anthocyanins and values of a sugar-acid index were established. If to mention *V. vitis-idaea* L., the parameters of general accumulation in fruits of soluble sugars, dry substances and all major mineral elements were characterized by the greatest degree of genetic determinacy, whereas by the least degree – the contents of anthocyanins, catechines and tannins. If to mention *V. macrocarpon*, the parameters of accumulation in fruits of dry substances, nitrogen, potassium, calcium, phenol-carboxylic acids have been noted by the most expressed genetic determinacy, and by the least expressed – the contents of anthocyanins, sucrose and pectinaceous substances in fruits.

Keywords: lingonberry (*Vaccinium vitis-idaea* L.), highbush blueberry (*Vaccinium corymbosum* L.), large cranberry (*Vaccinium macrocarpon* Ait.), genotypic variability.

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1. Introduction

The major aspect of the introduction of researches connected with the in-depth study of berry plant species is the complex estimation of biochemical structure of fruits, which gives us the representation about the contents of a wide spectrum of useful substances in fruits. At the same time it is well-known, that accumulation parameters of the substances depend on genotype what determines distinctions of species of organoleptic properties of berry production. Last years the collection fund of Central Botanical Garden of the NAS of Belarus was replenished with new taxons of 3 *Ericaceae* species (*V. corymbosum* (a highbush blueberry), *V. vitis-idaea* (lingonberry) and *V. macrocarpon* (large cranberry)). It gives additional opportunities for the assortment expansion of the varieties offered for the division into districts and breeding on the basis of revealing most perspective of them not only according to plant and bioproductive characteristics, but also nutritious and vitamin value of berry production defined by its biochemical structure peculiarities. At the same time it is logical to assume the existence of genotypic distinctions of accumulation parameters in fruits of the separate chemical compounds specifying the degree of their genetic determinacy indirectly, allowing designate the characteristics possessing the highest and lowest stability at breeding new varieties.

The purpose of the given work is the establishment of intra-and inter-specific distinctions of the degree of genotype dependence of quantitative characteristics of biochemical structure of fruits of investigated *Ericaceae* species on the comparison basis of variability levels in cultivar rows in a long cycle of observation.

2. Materials and methods

Researches have been conducted during 2006–2008 years on the plant material received on Gantsevichi research station of Central Botanical Garden of the NAS of Belarus (the Brest region). Weather conditions during the most active maturing period of fruits of *Ericaceae* species in July-September differed within the observation by strongly expressed intra- and inter-seasonal contrasts what created the inadequate preconditions for the formation of biochemical structure of fruits. The lowest temperature background during the given period was noted in 2008, and the highest one – in 2006. Thus all of three seasons were characterized by plentiful atmospheric precipitations at the extremely uneven month distribution.

As the objects of researches the mature fruits of 16 cultivars of *V. corymbosum* (early-maturing: 'Bluetta', 'Northblue', 'Weymouth', 'Duke', 'Reka', 'Earliblue', 'Spartan', 'Puru', 'Nui'; mid-ripening: 'Bluecrop', 'Northland', 'Patriot', 'Toro', 'Jersey'; late-ripening: 'Elizabeth' and 'Coville'); 10 cultivars of *V. vitis-idaea* L. ('Koralle', 'Red Pearl', the 'Ruby', 'Erntedank', 'Erntesegen', 'Erntekrone', 'Ammerland', 'Masovia', 'Sanna', 'Sussi') and of 4 cultivars of *V. macrocarpon* ('Stevens', 'Ben Lear', 'McFarlin', 'Pilgrim') have been taken.

Biochemical structure of fruits of above-mentioned taxons has been investigated according to 32 parameters. To get this result the contents of dry substances of fresh average samples of a plant vegetative material was defined – in accordance [1]; ascorbic acid (vitamin C) – by the standard indophenolic method [2]; titratable acids (of general acidity) – by the volumetric method [2]. The contents of chemical elements such as nitrogen, phosphorus, potassium have been determined in the average samples of fruits dried up at temperature 65 °C by the method of K. Fomenko and N. Nesterov [3]; calcium, magnesium – by the complexometric method [2]; glucose, fructose, sucrose – by resorcin and anilinphthalatic methods of paper chromatography of I. Zavadskaya et al. [3]; pectinaceous substances (water-soluble pectin and protopectin) – by carbazolic method [2]; the sums of anthocyanins – by the method of T. Swain and W. E. Hillis [5] with construction of a calibrating curve on crystal cyanidin, received from fruits of black chokeberry and defined by a technique of J. Skorikova and E. Shaftan [6] with the application in calculations formula of S. S. Tancheva [7]; anthocyanins – by the method of L. Shnajdman and V. Afanaseva [8]; the sums of flavonoids – by the method of L. Sarapuu and H. Mijdla [9]; the sums of catechines – by a photometric method with the use of a vanillin reactant [10]; phenol-carboxylic acids (in recalculation on chlorogenic one) – by the method of a descending chromatography on paper [11]; tannins – by titirimetric method of Levental [12]; lignins – by the modified method of Klason [2]; benzoic acid – by M. I. Kalebin and A. A. Kolesnik's method [13]; fat oils – by V. Sapunov and I. Fedunyak's method [14]; threeterpenic acids (in recalculation on ursolic acid) – by A. V. Simonyan's method [15]. All analytical definitions were made in triple-repeated biological repeatability by R. Rudakovskaya, N. Varavina, N. Krinitskaya, PhD V. Ignatenko (Laboratory of Plant Chemistry of Central Botanical Garden of the NAS of Belarus). The data are statistically processed with Excel program.

For the estimation of genotypic variability of accumulation parameters of the specified compounds in a spectrum of investigated taxons in a long-term cycle of observation we were guided by variation coefficient values (V) of the examined traits. Variation coefficient values have indicated the traits dependence on varietal belonging of plants. That is, the higher the variation coefficient is, the stronger this dependence is, and, hence, the lower level of genetic determinacy of a trait is.

By estimations of S. Sennov and V. Kovyasin [16], the row variability for biological objects is considered to be small if it is within the limits of 11–30 % and considered to be a big one if it exceeds 31 %. By consideration of the information presented in the given work, we should take into account active reaction of alien crops on the breeding process, allowing to a certain extend to resist it and regulate the biochemical structure of generative bodies within the limits of genetically determined variation ranges of each trait. It has given the basis to narrow specified above border of small row variability for examined parameters up to 10 %. Its average range was characterized by variability level within the limits of 11–20 %, and maximum – over 20 %. The accepted gradation of variability levels of analyzed traits coincides with the recommended for biological objects gradation by G. Zajtsev [17].

3. Results

As the definition of variation coefficient of analyzed traits is connected with the establishment of the average quantity parameters of biochemical structure of fruits for varietal rows, it has allowed point out boundary ranges of their changes in a long-term cycle of the observation, resulted in **Table 1**.

Table 1
Ranges of variation coefficients changes of averaged quantitative characteristics of biochemical structure of fruits (in dry substance) of Ericaceae varietal rows in a long-term cycle of supervision, %

Parameters (traits)	*V. corymbosum*	*V. vitis-idaea*	*V. macrocarpon*
Dry substances, %	13.9–14.1	14.9–16.9	10.3–12.5
Free organic acids, %	3.8–6.7	14.6–19.3	20.6–36.1
Ascorbic acid, mg of %	426.6–604.8	304.3–670.8	463.6–495.1
Glucose, %	4.49–5.34	5.65–5.95	5.18–6.96
Fructose, %	7.26–18.74	6.85–10.54	1.37–6.86
Sucrose, %	0.56–3.19	0.86–2.09	0.36–0.51
Total soluble sugars, %	12.79–27.25	14.72–18.27	6.91–12.69
Fructose/ Glucose ratio	1.7–3.6	1.2–1.9	0.3–1.3
Monose/Disaccharide ratio	7.9–22.7	6.5–17.4	24.6–28.1
Sugar-acid index	2.5–6.5	0.8–1.3	0.3–0.6
Hydropectin, %	1.98–2.37	2.56–3.03	2.22–2.54
Protopectin, %	2.60–3.45	3.45–3.84	3.56–5.40
Total pectins, %	4.77–5.71	6.01–6.73	6.10–7.65
Protopectin/Hydropectin ratio	1.2–1.8	1.3–1.5	1.4–2.5
Anthocyanins, mg of %	2.0–17.1	1.6–3.9	6.7–12.0
Leucoanthocyanins, mg of %	12.1–24.1	29.7–32.7	25.1–37.7
Total anthocyanic pigments, mg of %	14.1–41.2	32.8–36.6	34.8–49.7
Catechines, mg of %	570.1–984.3	710.0–1777.8	1067.1–1823.3
Flavonols, mg of %	1626.0–1890.6	1618.9–2227.5	1349.1–3112.9
Flavonols/Catechines ratio	1.9–3.4	1.1-3.7	1.4–3.0
Total bioflavonols, mg of %	2501.8–2776.0	2970.3–3719.8	2596.0–4227.0
Phenol-carboxylic acids, mg of %	781.4–800.3	484.9–838.1	486.8-700.5
Benzoic acid, %	1.11–1.18	1.14–1.65	1.12–1.49
Tannins, %	1.21–1.83	1.98–2.45	1.76–2.01
Lignins, %	11.3–11.7	10.7–11.9	10.0–13.2
Fat oils, %	3.17–3.61	5.16–6.09	4.43–5.35
Threeterpenic acids, %	2.49–3.22	2.58–3.41	2.09–3.44
Nitrogen, %	0.76–1.10	1.19–1.24	0.85–1.03
Phosphorus, %	0.14–0.17	0.14–0.18	0.13–0.16
Potassium, %	0.53–0.76	0.51–0.90	0.58–0.80
Calcium, %	0.31–0.42	0.32–0.39	0.24–0.30
Magnesium, %	0.08–0.11	0.08–0.11	0.08–0.10

The determination of the coefficients of variation of analyzed attributes is associated with the establishment of their average values for the variety series, it has allowed identify the boundaries of the range of variation of quantitative indicators of the biochemical composition of fruits of exotic species in the long-term observation series (**Table 1**) In accordance with the purpose of research, coefficients of variation of these parameters for the average high-grade series of Ericaceae have been identified and listed in **Table 2** In accordance with these data the position of each characteristic in the ranks of reduction of the level of their genetic determinism (**Table 3**).

Table 2
Averaged variation coefficients of quantitative characteristics of biochemical structure of fruits of Ericaceae varietal rows in a long-term cycle of supervision, %

Parameters (traits)	*V. corymbosum*				*V. vitis-idaea*				*V. macrocarpon*			
	2006	2007	2008	average	2006	2007	2008	average	2006	2007	2008	average
Dry substances	12.8	10.1	12.1	11.7	11.7	5.4	4.1	7.1	7.4	9.4	2.1	6.3
Free organic acids	36.4	45.7	39.1	40.4	25.0	14.8	16.9	18.9	10.4	15.7	1.3	9.1
Ascorbic acid	20.3	26.3	30.3	25.6	36.4	17.7	8.4	20.8	15.7	16.1	5.5	12.4
Glucose	16.4	15.8	27.5	19.9	10.3	8.4	6.6	8.4	13.7	11.5	11.8	12.3
Fructose	2.9	3.9	22.3	9.7	10.3	10.2	10.2	10.2	30.2	11.8	7.3	16.4
Sucrose	19.8	20.2	22.1	20.7	10.8	17.6	20.1	16.2	55.3	20.4	26.6	34.1
Total soluble sugars	4.1	5.1	6.8	5.3	9.5	8.2	6.6	8.1	6.2	8.5	8.2	7.6
Fructose/ Glucose ratio	19.2	16.5	46.0	27.2	7.9	10.2	12.3	10.1	36.6	14.3	7.5	19.5
Monose/Disaccharide ratio	19.4	19.8	21.5	20.2	6.6	21.5	17.6	15.2	65.0	23.7	32.1	40.3
Sugar-acid index	31.2	39.5	75.9	48.9	25.7	17.4	13.0	18.7	18.2	15.3	13.3	15.6
Hydropectin	24.3	23.8	18.0	22.0	10.5	6.4	7.6	8.2	9.0	22.3	16.2	15.8
Protopectin	22.4	19.8	21.0	21.1	17.5	18.7	17.4	17.9	4.3	19.2	12.5	12.0
Total pectins	16.5	19.2	17.8	17.8	9.1	11.6	11.7	10.8	6.0	12.3	11.0	9.8
Protopectin/Hydropectin	33.8	22.9	17.1	24.6	25.7	18.6	16.1	20.1	6.7	37.6	16.8	20.4
Anthocyanins	45.1	91.5	35.5	57.4	37.0	136.1	48.6	73.9	17.1	43.6	51.5	37.4
Leucoanthocyanins	23.2	20.6	29.1	24.3	37.9	41.3	39.4	39.5	11.5	27.7	16.6	18.6
Total anthocyanic pigments	19.7	21.5	27.1	22.8	34.0	44.1	39.4	39.2	5.0	28.5	20.1	17.9
Catechines	20.2	27.6	15.4	21.1	25.2	57.6	50.0	44.3	3.8	25.7	16.9	15.5
Flavonols	5.5	11.0	12.2	9.6	10.0	8.1	10.2	9.4	6.0	18.9	3.4	9.4
Flavonols/Catechines	27.1	36.3	20.9	28.1	22.7	48.0	35.5	35.4	7.0	41.1	13.1	20.4
Total bioflavonols	6.9	11.7	9.2	9.3	15.0	29.9	15.1	20.0	3.5	16.1	6.1	8.6
Phenol-carboxylic acids	18.0	24.4	24.3	22.2	9.1	11.5	20.5	13.7	4.4	4.6	13.3	7.4
Benzoic acid	6.1	18.2	14.3	12.9	2.1	15.0	12.3	9.8	5.6	14.5	7.3	9.1
Tannins	19.5	23.2	16.3	19.7	28.6	24.4	49.8	34.3	7.1	16.1	6.4	9.9
Lignins	18.8	14.4	13.5	15.6	6.0	13.1	19.5	12.9	21.5	6.6	9.2	12.4
Fat oils	29.9	13.0	21.9	21.6	8.1	11.9	11.4	10.5	11.6	4.6	3.5	6.6
Threeterpenic acids	12.8	7.6	16.1	12.2	12.7	10.8	7.5	10.3	15.0	5.1	19.5	13.2
Nitrogen	15.1	16.2	10.3	13.9	8.3	8.0	4.8	7.0	6.7	2.4	8.9	6.0
Phosphorus	24.0	11.5	13.0	16.2	8.0	6.7	9.6	8.1	13.5	9.5	11.2	11.4
Potassium	10.0	8.7	11.3	10.0	9.1	4.4	9.2	7.6	5.8	4.3	5.4	5.2
Calcium	10.0	4.9	4.9	6.6	8.7	6.0	9.6	8.1	5.5	5.9	7.8	6.4
Magnesium	11.9	8.8	6.8	9.2	6.3	10.0	3.9	6.7	6.5	12.4	4.9	7.9

Table 3
Series of level decrease of genetic determinacy of averaged quantitative characteristics of biochemical structure of fruits of Ericaceae varietal rows in a long-term cycle of supervision

Parameters (traits)	*V. corymbosum*	*V. vitis-idaea*	*V. macrocarpon*
Dry substances	8	3	3
Free organic acids	30	23	10
Ascorbic acid	27	26	18
Glucose	16	9	17
Fructose	6	13	24
Sucrose	18	20	30
Total soluble sugars	1	5	7
Fructose/Glucose ratio	28	12	27
Monose/Disaccharide ratio	17	19	32
Sugar-acid index	31	22	22
Hydropectin	22	8	23
Protopectin	19	21	16
Total pectins	14	16	13
Protopectin/Hydropectin	26	25	28
Anthocyanins	32	32	31
Leucoanthocyanins	25	30	26
Total anthocyanic pigments	24	29	25
Catechines	20	31	21
Flavonols	5	10	12
Flavonols/Catechines	29	28	29
Total bioflavonols	4	24	9
Phenol-carboxylic acids	23	18	6
Benzoic acid	10	11	11
Tannins	15	27	14
Lignins	12	17	19
Fat oils	21	15	5
Threeterpenic acids	9	14	20
Nitrogen	11	2	2
Phosphorus	13	6	15
Potassium	7	4	1
Calcium	2	7	4
Magnesium	3	1	8

4. Discussion

Comparison of the given ranges of investigated species of alien crops has shown, that fruits of *V. corymbosum* as a whole differed by the greatest content of an ascorbic acid among *Ericaceae* species. It is comparable to those in fruits of *V. vitis-idaea* L. At the same time the content of phenol-carboxylic acids and the content of anthocyanins were comparable to those in fruits of *V. macrocarpon*, calcium, fructose and sucrose at the highest level of sugariness. But at the same time the fruits of *V. corymbosum* were characterized by the lowest accumulation of free organic and benzoic acids, glucose, pectinaceous substances, leucoanthocyanins, catechines, flavonols and

bioflavonoids, tannins, lignins, which were comparable to those in fruits of *V. vitis-idaea* L., fat oils, potassium and also nitrogen were comparable to those in fruits of *V. macrocarpon*.

The highest content of dry substances, vitamin C, hydropectin, leucoanthocyanins in fruits among investigated *Ericaceae* species for *V. vitis-idaea* L. has been shown, comparable to those in fruits of *V. macrocarpon*, as well as the highest content of benzoic acid, tannins, fat oils, nitrogen and potassium. At the same time the fruits of *V. vitis-idaea* L. were characterized by the lowest accumulation of anthocyanins.

Fruits of *V. macrocarpon* have appeared to be the richest ones in free organic acids, glucose, protopectin, all fractions of bioflavonoids at the greatest degree of tissues lignification. But at the same time the contents of dry substances, fructose, sucrose, calcium, ascorbic and phenol-carboxylic acids and sugar-acid index were the least among investigated *Ericaceae* species. For accumulation parameters in fruits of *Ericaceae* species of threeterpenic acids, phosphorus and magnesium the expressed interspecific distinctions have not been revealed.

The incommensurability of amplitudes of changes of analyzed traits in a long-term cycle of observation indicates different degree of their dependence on a hydrothermal mode during fruits maturing of the alien crops indirectly. Thus the greatest number of parameters with the maximum values, averaged for varietal rows of *Ericaceae* species has been established under the conditions of the hottest season in 2006, which stimulated accumulation of the majority of such useful substances as free organic acids, vitamin C, soluble sugars, bioflavonoids, pectin, terpenoids and compounds of phosphorus. The greatest number of parameters with minimum values has been for *V. corymbosum* in 2007, whereas for *V. vitis-idaea* L. and for *V. macrocarpon* – in 2008. The common for all investigated *Ericaceae* species was accumulation activation in fruits of benzoic and phenol-carboxylic acids at the maximum values a sugar-acid index in 2007, flavonols and major mineral elements – in 2008.

The analysis of the data resulted in **Table 2**, has revealed rather wide range of changes of variation coefficients of 32 quantitative characteristics of biochemical structure of the fruits, averaged for varietal rows of investigated *Ericaceae* species, both in several years, and for the period of observation as a whole. It showed the different level of their genetic determinacy and allowed to indicate the traits possessing the greatest and the lowest degree of intra- and inter-specific distinctions.

Within the years of observation the majority of parameters of biochemical structure of fruits of *V. corymbosum* had average (V=11–20 %) and high (V>20 %) levels of variability (accordingly 37–41 % and 37–47 % of parameters). Only for 15–22 % of them the levels of traits variability were low (V<10 %). The essential increase of a relative share of traits with low variability (in the first case up to 41–56 %, in the second – up to 31–59 %) in comparison with the previous species has been shown for fruits of *V. vitis-idaea* L. and especially of *V. macrocarpon*. It was mainly due to the decrease of shares of traits with its high level accordingly, up to 25–31 % and 12–28 %.

Thus the relative share of traits with average variability of both these species was comparable to those of *V. corymbosum* under conditions of 2007 and 2008 whereas in 2006 it was noticeably lower, especially of red whortleberry 12.5 % and 25.0 %, accordingly. All of this data testify the greatest expressiveness of cultivar distinctions of quantitative characteristics of biochemical structure of fruits of *V. corymbosum* in comparison with those of *V. vitis-idaea* L. and *V. macrocarpon*.

It is stipulated for the reason that the majority of North American cultivars of blueberry, unlike cranberry and lingonberry are interspecific hybrids of high-bush species – *V. corymbosum* L. and *V. australe* Small, as well as of lowbush *V. angustifolium* Ait. and of some other species [18]. The use method of the remote hybridization in breeding process on the basis of attraction of genomes with a different set of chromosomes has predetermined, in our opinion, such an expressed genotypic variability of biochemical structure of fruits of *V. corymbosum* under introduction to Belarus. At the same time the conformity of a variability level of a certain trait of this or that area of the accepted gradation of genotypic variability of investigated species was kept not in all cases during 3 year period of observation.

For example, in fruits of *V. corymbosum* the similar stability of a low level of variability was in accumulation parameters of calcium and the total soluble sugars; an average level of variability was in total amount of pectinaceous substances and a degree of tissue lignification; a high level

of variability was in the contents of titratable and ascorbic acids, anthocyanins, a ratio of bioflavonoids fractions, and also the values of a sugar-acid index (**Table 2**). Accumulation parameters of glucose, fructose, the Total soluble sugars, flavonols and all major mineral elements in fruits of *V. vitis-idaea* L. were characterized by the relative stability of a low level of genotypic variability within observation; the content of hydropectin – an average level; the contents of anthocyanins, catechines, tannins, and also a ratio of bioflavonoids fractions – high level of genotypic variability. By the most expressed stability of a low level of genotypic variability within observation in fruits of *V. macrocarpon* were characterized accumulation parameters of dry substances, total amount of soluble sugars like two previous *Ericaceae* species, as well as compounds of nitrogen, potassium and calcium; the contents of glucose and value of a sugar-acid index – average level; accumulation parameters of sucrose and a ratio of monose to disaccharide – high level.

In other cases the conformity of the level of genotypic variability of parameters of biochemical structure of fruits of investigated *Ericaceae* species to certain area of the accepted gradation was traced only during 1–2 seasons. Moreover, even within the limits of this or that area of variability of analyzed traits the essential inter-seasonal distinctions of levels of their variability have been established, what unequivocally specifies their expressed dependence on a hydrothermal mode of the period of fruit maturing; the content of hydropectin – an average level; the contents of anthocyanins, catechines, tannins, and also a ratio of bioflavonoids fractions – high level of genotypic variability. By the most expressed stability of a low level of genotypic variability within observation in fruits of *V. macrocarpon* were characterized accumulation parameters of dry substances, total amount of soluble sugars like two previous *Ericaceae* species, as well as compounds of nitrogen, potassium and calcium; the contents of glucose and value of a sugar-acid index – average level; accumulation parameters of sucrose and a ratio of monose to disaccharide – high level.

In our opinion, the most objective representation about a degree of variability of quantity traits of biochemical structure of fruits in varietal rows of investigated *Ericaceae* species can give the value of variation coefficient averaged in a 3-year cycle of observation. In this case it is possible to divide the analyzed traits into 3 groups, according to the level of genotypic variability:

1 – with low variability (V=5.3–10.0 % for blueberry; V=6.7–10.5 % for lingonberry; V=5.2–9.9 % for cranberry);

2 – with average variability (V=12.2–19.9 % for blueberry; V=12.9–20.0 % for lingonberry; V=11.4–19.5 % for cranberry);

3 – with high variability (V=20.9–75.9 % for blueberry; V=20.1–48.6 % for lingonberry; V=20.4–40.3 % for cranberry).

The analysis of data in **Table 2** allowed in some cases reveal the similarity of variability parameters of analyzed traits in cultivar rows of all investigated *Ericaceae* species. So, genotypic, and, hence, cultivar distinctions in the common contents in fruits of soluble sugars, flavonols, potassium, calcium and magnesium; blueberry and lingonberry – of fructose; blueberry and cranberry – of the general accumulation of bioflavonoids; lingonberry and cranberry – of the contents of dry and pectinaceous substances, benzoic acid, fat oils and nitrogen happened to be the least expressive. Other parameters of biochemical structure of fruits of *Ericaceae* were characterized by an average and high degree of variability in cultivar rows. Thus the most essential genotypic distinctions of all investigated species have been established for accumulation parameters in fruits of anthocyanins, catechines, flavonols and also for the ratio of proto- to hydropectin; blueberry and lingonberry – to the content of vitamin C, anthocyanins, catechines; blueberry and cranberry – for the content of sucrose and the ratio of sucrose to monose.

At the same time specific features of genotypic variability of quantitative characteristics of biochemical structure of fruits even within the limits of certain area of variability were inherent to each *Ericaceae* species. For revealing the sequence of analyzed traits by decreasing the level of their genetic determinacy specifying amplification of cultivar distinctions, the positions of each of them according to increase in values of variation coefficient presented in **Table 3** have been determined.

It follows from the table data, that the least expressed cultivar distinctions of *V. corymbosum* have been established for the total contents in fruits of soluble sugars, total amount of bioflavonoids, flavonols, calcium and the magnesium, the most expressed – for the content in fruit of titratable

acids, vitamin C, anthocyanins, of the monose to disaccharide ratio and fractions of bioflavonoids, and also of sugar-acid index values. The least expressed cultivar distinctions of *V. vitis-idaea L.* have been established for the content of dry substances, all major mineral elements, and also total amount of soluble sugars in fruits, whereas the most expressed cultivar distinctions – for the content of anthocyanins, catechines, and tannins in fruits. The least expressed cultivar distinctions of *V. macrocarpon* have been established for the contents of dry substances, nitrogen, potassium, calcium and phenol-carboxylic acids in fruits; the most expressed cultivar distinctions – for the content of anthocyanins, sucrose, total amount of pectinaceous substances and ratio of carbohydrates fractions.

Unfortunately, we could not compare the results of our research on the genotypic variability of the biochemical composition of fruits of *Ericaceae* with the results of other authors, because such information is not available in the scientific literature.

The downside of our work is that for the calculation of *Ericaceae* anthocyanin pigments content in the fruits we used the formula of S. S. Tancheva [14] that significantly underestimates the results. However, this did not affect the variability of this trait. In further studies, we have eliminated this shortcoming by using newer methods of quantitative determination of these compounds [19, 20].

5. Conclusions

1. Thus, as a result of biochemical screening of 30 taxons of *Ericaceae* species taking into account 32 parameters in a long-term cycle of observation it has been established that the leading position in accumulation in fruits of vitamin C, phenol-carboxylic acids, anthocyanins, calcium, fructose and sucrose at the highest values of sugar-acid index belongs to *V. corymbosum*; in accumulation of hydropectin, leucoanthocyanins, benzoic acid, tannins, fat oils, nitrogen and potassium – to *V. vitis-idaea* L.; in accumulation of free organic acids, glucose, protopectin, bioflavonoids and lignines – to *V. macrocarpon*.

2. The different degree of dependence of variability level of biochemical structure components of fruits of alien crops from a genotype and a hydrothermal mode of the period of their maturing have been revealed. The similarity of parameters of genotypic variability of some traits of all investigated *Ericaceae* species is also revealed: low one - for the general contents in fruits of soluble sugars, flavonols, of potassium, calcium, magnesium and high one – for the contents of anthocyanins, and also the ratio of fractions of pectinaceous substances and bioflavonoids.

3. Specific features of genetic determinacy of the analyzed traits, testifying the greatest degree of its displays of *V. corymbosum* for total accumulation in fruits of soluble sugars and bioflavonoids, flavonols contents, calcium and magnesium and by the lowest degree – for the contents of titratable acids, vitamin C, anthocyanins and values of a sugar-acid index were established. If to mention *V. vitis-idaea* L., the parameters of general accumulation in fruits of soluble sugars, dry substances and all major mineral elements were characterized by the greatest degree of genetic determinacy, whereas by the least degree – the contents of anthocyanins, catechines and tannins. If to mention *V. macrocarpon*, the parameters of accumulation in fruits of dry substances, nitrogen, potassium, calcium, phenol-carboxylic acids have been noted by the most expressed genetic determinacy, and by the least expressed – the contents of anthocyanins, sucrose and pectinaceous substances in fruits.

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