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Sensory and bioactive quality indicators of fresh and dried blue honeysuckle fruits (*Lonícera caeruléa* L.)

Abstract. The relevance of the study is based on the special value of blue honeysuckle berries, since they contain a significant amount of biologically active substances that are endowed with antioxidant properties, but they have a short period of consumption. To extend it and provide the population with nutritional products, the goal was set to identify varieties whose fruits are the most suitable for processing by drying. Laboratory methods were used for the biochemical study

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of fruits and statistical methods (using the STATISTICA programme and Anova variance analysis, sensory indicators of the quality and content of phytosubstances, namely: vitamin C, polyphenols, flavonoids, anthocyanins and chalcones in fresh and dried fruits of the varieties `Boreal Blizzard`, `Boreal Beauty`, `Boreal Bist` and `Karina` were considered). As a result of the conducted research, varieties were identified that, in the process of heat treatment, preserved sensory and consumer quality indicators as much as possible in relation to the fresh analogue. The range of variation of polyphenolic substances was established, which was within the minimum of 7,370 (`Karina') and the maximum of 7,336 mg/100 g of dry weight (`Boreal Blizzard'), the percentage of their preservation in dried berries was the highest in the variety `Boreal Beauty`. The average content of flavonoids in fresh fruits of the studied varieties was 1,064 ± 240 mg/100 g, anthocyanins – 1,520 ± 289 mg/100 g of dry weight. Drying of berries contributed to an increase in the amount of these substances by 55-110% for flavonoids and by 48% for anthocyanins. It is proved that during the drying process, the fruits of blue honeysuckle lose vitamin C, losses depending on the variety are 65-72%. The findings will be useful in selecting parent forms for creating raw varieties and when choosing a variety for drying and making natural fruit powder concentrates with a high content of biologically active substances

Keywords: organoleptic analysis of fruits; drying; polyphenols; flavonoids; anthocyanins; chalcones

INTRODUCTION

Honeysuckle berries attract attention not only because of their attractive appearance and taste, but also because of their rich biocomponent composition. The fruits of berry crops are a useful food product due to the high content of biologically active substances, which are natural antioxidants (Sun *et al.*, 2019). One of which is ascorbic acid, also known as vitamin C. The fruit is rich in ascorbic acid and is the main source of human consumption (Zheng *et al.*, 2022). Vitamin C plays an important role as an antioxidant, counteracting harmful processes such as inflammation. Blue honeysuckle is considered one of the richest sources of ascorbic acid among all berries. Its content may vary depending on the climate and growing conditions, genotype, stage of ripeness, and time of harvesting. Another important phytoelement of blue honeysuckle fruits is polyphenolic substances. As stated by B. Sgorbini *et al.* (2019), it is these substances that can protect the human body from the effects of exogenous and endogenous free radicals. They are important components of the fruits of many fruit plants. These substances have antioxidant properties, help fight stress and prevent the development of a number of diseases.

Berries contain a significant amount of water in their composition, so during a short storage time, quality loss and deterioration of appearance are possible, which leads to a decrease in the economic efficiency of their production. E. Dermesonlouoglou *et al.* (2018) noted that its harvest seasons are short, and therefore, fruits are not available all year round, which limits their commercialisation and consumption. Therefore, drying processes occupy an important place in the food industry. Usually, heat treatment is used to reduce the harmful microbiological and chemical load, which worsens the quality of products. According to Y.V. Yevchuk *et al.* (2019), drying fruit is one of the easiest ways to extend the shelf life of fruit, especially berries.

Hot air drying is most commonly used for the production of dehydrated fruit and berry crops. The advantage of dried products over fresh ones is the possibility of their long-term storage. In addition, drying results in a significant reduction in volume, which facilitates transportation and storage (Shende *et al.* 2019). S. Alasalvar *et al.* (2020) claim that dried fruits contain a wide range of biologically active compounds, such as phenolic acids, flavonoids, anthocyanins, vitamin C, as well as proanthocyanidin and chalcones. It is these substances that, with their strong antioxidant activity, among other mechanisms, have a positive effect on human health. A serving (40 g or about a quarter cup) of dried fruit is a good balanced

dietary product, particularly in terms of fibre, water-soluble vitamins and minerals.

Dried fruits can easily be stored for a long period of time due to their reduced water content, which can also help in the production of new functional foods. A. Pažereckaitė *et al.* (2020) suggest that they can be used in food formulations, and this approach is of great importance for consumers and the processing industry. Recently, the European Commission recognised blue honeysuckle (*Lonicera caerulea* L.) as a new food product on the European market. Berries of this crop due to their significant content of high-value secondary metabolites such as ascorbic acid, anthocyanins, phenolic acids, and fatty acids are endowed with a wide range of antioxidant properties (Martinez *et al.*, 2020). Blue honeysuckle is a new crop for the European and Ukrainian markets, so it requires a comprehensive study, including its suitability for various types of processing, one of which is drying by convection. According to R. Becker & A. Szakiel (2019), growing plants of the species *Lonicera caerela* L. is popular because of the early ripening of the fruit, the exceptional resistance of the plant to frost, pests and diseases, and because of its potential health and healing properties.

Researchers M. Senica *et al.* (2020) found that drying blue honeysuckle berries helped reduce the polyphenol content by more than 70% compared to fresh ones. As a result of the analysis of literature sources, it was found that there is a gap and a lack of data on the effect of heat treatment on the preservation of sensory and phytochemical indicators of the quality of blue honeysuckle fruits, namely the varieties `Boreal Blizzard`, `Boreal Beauty`, `Boreal Bist` and `Karina`, so the conducted research is relevant and necessary, both for scientists and producers of dried fruits. Since according to the data, drying of food products usually leads to deterioration of the product not only from a sensory standpoint, but also from a physico-chemical and nutritional standpoint, the purpose of the study was to investigate changes that occur in the fruits of blue honeysuckle during the drying process and to identify varieties whose fruits are an excellent raw material for this type of processing according to a complex of preserved quality indicators.

MATERIALS AND METHODS

The study was conducted during 2020-2021. The objects of research were the fruits of blue honeysuckle – varieties of Canadian selection 'Boreal Blizzard', 'Boreal Beauty', 'Boreal Bist', as well as Polish – 'Karina'. Fruits for laboratory tests were selected at experimental sites of the laboratory of selection and technology of growing berry crops of the Institute of Horticulture of the National Academy of Agrarian Sciences (NAAS) of Ukraine. Year of creation of plantings – 2016, planting scheme 1×3 m, the soil of the site is grey forest medium loamy. The system of soil retention in a row is mulching with sawdust, in the row spacing – sodification. The experiment was laid with irrigation, the care of plantings is recommended for the forest-steppe zone of Ukraine. The zone's climate is temperate continental. According to long-term data, the average air temperature was +9.7°C and the amount of precipitation for the year was 466.3 mm. The minimum average long-term temperature – negative 28.4°C (February), the maximum – 37.7°C (August).

Analytical studies were conducted in the laboratory of post-harvest quality of fruit and berry products of the Institute of Horticulture of the National Academy of Agrarian Sciences (NAAS) of Ukraine. The weight of one sample was one kilogramme (National Standard ISO 874-2002, 2003). On the day of fruit collection, the content of total polyphenols, anthocyanins, flavonoids, and chalcones was determined. Blue honeysuckle berries in a state of consumer ripeness with a characteristic shape and colour for each of the studied varieties were subject to laboratory tests according to the "Methodology for assessing the quality of fruit and berry products" (Kondratenko *et al*., 2008). For analytical studies of fruits, in particular, determination of the content of biologically active substances, samples were prepared using a laboratory homogeniser – Waring 800s (USA). The sample was weighed on an analytical scale – TVE-3-0,05-a (Ukraine) with an accuracy of up to the second sign.

Drying of blue honeysuckle berries was carried out in a drying cabinet "Sadochok 2M" (Ukraine) at a temperature of 65°C for 14 hours. The fruit was cut in half for drying and placed in a single layer on trays to be sent into the drying

oven. The drying process was considered complete when the final moisture content of the fruit was 18%. At this humidity, the product is suitable for long-term storage under certain conditions.

Before and after drying, organoleptic analysis of fruits was performed for the following sensory indicators: appearance, colour, taste, and the content of total polyphenols, flavonoids, anthocyanins, and chalcones were determined from biochemical indicators. For both fresh and dried fruits, the data obtained were expressed in mg/100 g of dry weight, and the results of the tasting assessment were expressed in points.

Sensory analysis of dried samples was performed on a 9-point Hedonic Scale with the following levels of preference: 9 – Like Extremely, 8 – Like Very Much, 7 – Like Moderately, 6 – Like Slightly, 5 – Neither Like nor Dislike, 4 – Dislike Slightly, 3 – Dislike Moderately, 2 – Dislike Very Much, 1 – Dislike Extremely (Civille & Carr, 2015). For organoleptic analysis, a group of tasters of different ages was selected from fifteen researchers, six of whom were men, the rest were women. The tasting was conducted without specifying the name of the variety, each taster was presented with samples of fresh and dried fruits in the amount of 50 g on a separate tray. Each sample had a separate number. The results of organoleptic assessment of sensory traits, namely appearance, colour, taste, and the overall score, expressed in points, were mathematically processed and presented as an average.

Vitamin C content (ascorbic acid) was determined according to the method based on its extraction from berry samples with a mixture of 2% aqueous oxalic solution and 1% aqueous hydrochloric acid solution (80:20). 5 g of crushed fruit was ground using broken glass and transferred to a measuring flask with a capacity of 100 ml. The contents of the flask were brought to the mark with a mixture of 2% oxalic and 1% acetic acids (80:20) and left for extraction for 10 minutes. The resulting extract was filtered through a cotton wool filter into a 100 ml flat-bottomed flask. In a glass with a capacity of 50 ml, 10 ml of the extract was added and titrated from the microburette with a solution of 2.6 – dichlorophenol-indophenol with sodium salt (Tilmans paint) until a slightly pink colour appeared, which did not disappear for 1 min. The amount of paint that has been oxidised is used to determine the vitamin C content, and a mixture of oxalic and acetic acids is used as a control (Kondratenko *et al.*, 2008).

The content of total polyphenols was determined according to the method of P.V. Kondratenko *et al.* (2008), which is based on the extraction of phenolic substances from berry samples with ethyl alcohol. To do this, 5 g of crushed berry samples were added to a porcelain mortar, a small amount of ethyl alcohol was added and filtered under vacuum on a Buchner funnel through a blue ribbon paper filter into a Bunsen flask. The residue on the filter was washed with a small amount of ethyl alcohol until the sample was completely discoloured. The number of washes depended on the intensity of staining of the sample and was 3-5 times. The volume of alcohol used is recorded in ml. 7.9 ml of distilled water, 0.1 ml of extract, 1 ml of Folin-Denis reagent were added to the test tube, mixed and after 3 minutes 1 ml of saturated sodium carbonate solution was added and mixed again. For an hour, the optical density of the contents of test tubes was recorded on an ULAB 102UV (China) spectrophotometer at a wavelength of 640 Nm. For control, a mixture prepared from 8 ml of distilled water, 1 ml of Folin-Denis reagent and after 3 minutes, 1 ml of saturated sodium carbonate solution was added.

Total polyphenol content in the sample was calculated by equation (1):

$$X = (A \times V \times 100) \div (V_1 \times M), \quad (1)$$

where X – total polyphenol content in the sample, mg/100 g; A – amount of chlorogenic acid in the volume taken for spectrophotometric determination, found according to the calibration graph, mcg; V – total volume of the final extract of the sample, ml; V_1 – volume of aliquot of the final extract of the sample taken for analysis, ml; M – sample weight, g (Kondratenko *et al.,* 2008). The content of anthocyanins and chalcones was determined by spectrophotometric method (ULAB 102UV spectrophotometer). The absorption of extracts was determined at wavelengths of 530 and 364 Nm, respectively, using an alcohol extract from plant homogenate acidified with 3.5% hydrochloric acid (Kryventsov, 1982). Flavonoid

content was determined by absorption spectrophotometry by measuring the absorption of a flavonoid complex with a 3% aluminium chloride solution. An ULAB 102UV spectrophotometer with a wavelength of 410 Nm was used for the measurement (Vronska, 2018).

Statistical data processing was performed using the STATISTICA 13/1 software suite (StatSoft, Inc., USA). The results are presented as averages with their standard errors as the mean ± standard error (x ± SE). Differences between repetitions and relative to the average inter-varietal value were determined using ANOVA statistical model. The results of the research are presented at the level of reliability in $P < 0.05$. Univariate variance analysis of the materiality of the influence of the genotype of the variety on the content of biologically active substances in blue honeysuckle fruits and correlation analysis were performed in Excel, Data Analysis tab.

The research was conducted within the framework of scientific studies, the results of which comply with the norms of the Convention on Biological Diversity (1992) and the Convention on the Trade in Endangered Species of Wild Fauna and Flora (1973).

RESULTS AND DISCUSSION

The appearance and colour of fresh fruits and products made from them play an important role in the consumer's choice. Secondary sensory experiences, such as taste and aroma, play a crucial role in the demand for products. Usually, when drying, organoleptic and consumer indicators of fruit quality change significantly and not for the better when compared with fresh analogues (Guiné, 2018). During the drying process, all fruits, without exception, undergo drastic changes, namely, as a result of biochemical transformations, the taste, aroma and colour change, the latter becomes less bright and acquires a brownish hue. Darkening of fruits can be caused by both enzymatic and non-enzymatic reactions.

As a result of drying, the berries of blue honeysuckle became wrinkled, lost their original shape and colour. The most drastic changes in appearance were made to the fruits of the 'Karina' variety, the tasting score of this sensory indicator was 5, while fresh berries had it at the level of 8. The appearance of fresh and dried fruits of the remaining varieties studied was rated one point higher, 9 and 6 points, respectively.

Fresh fruits of the studied varieties of blue honeysuckle were black in colour with a pronounced waxy coating. According to the results of the tasting, fresh fruits of the 'Boreal Bist' and 'Boreal Beauty' varieties had a one-dimensional colour, a tasting score of 9 points. 'Karina' and 'Boreal Blizzard' berries were rated at the level of 8 points for the specified sensory indicator. During the drying process, the wax coating of the berries degraded, they became black in colour with a pronounced gloss of varying intensity. As stated by A. Calín-Sánchez *et al.* (2020), changes in fruit colour during processing occur as a result of enzymatic darkening of the pulp. Namely, the oxidation of polyphenolic compounds by polyphenol oxidase takes place, which is accompanied by the formation of brown pigments (melanins), the so-called *o*-quinones.

The highest score, namely at the level of 8, was evaluated for this indicator in dried berries of the 'Boreal Bist' variety. A crucial role in the suitability of fruits for processing by drying is played by their ability to keep the taste as close as possible to the fresh analog. From the study group, these were berries of the 'Boreal Blizzard' variety. Tasters gave the fruits of this variety the maximum score of 8 points for taste (Fig. 1).

One of the most important components of berries is the amount of ascorbic acid. On average, it was 30.3 mg/100 g of dry matter (Krzykowski, *et al*., 2020). An unusually large amount of vitamin C was found in the varieties `Pereslenka` (100.5 mg/100 g of dry matter) and `Pavlivska` (70.6 mg/g of dry matter). The ascorbic acid content of honeysuckle berries grown in Switzerland was 10.78-40.21 mg/g of dry matter (Auzanneau *et al*. 2018), whereas those grown in Slovenia had 17.75-25.77 mg/100 g (Senica *et al*. 2019). Blue honeysuckle varieties 'Duet' and 'Karina' grown in Poland accumulated 44.4 and 62.6 mg/100 g of vitamin C in raw weight, (Gökçe *et al*., 2022). Berries grown in Ukraine contained vitamin C from 22.7 to 27.6 mg/100 g of raw weigh, which in terms of dry weight was 173 ('Karina') to 209 mg/100 g of dry matter ('Boreal Blizzard'). The coefficient of variation of the ascorbic acid content in the studied varieties was at a minimum level, and

amounted to 13.9 – 2020, 9.6 – in 2021. These indicators of vitamin C fixation indicate a small varietal difference in its content, in particular, in the study group of varieties.

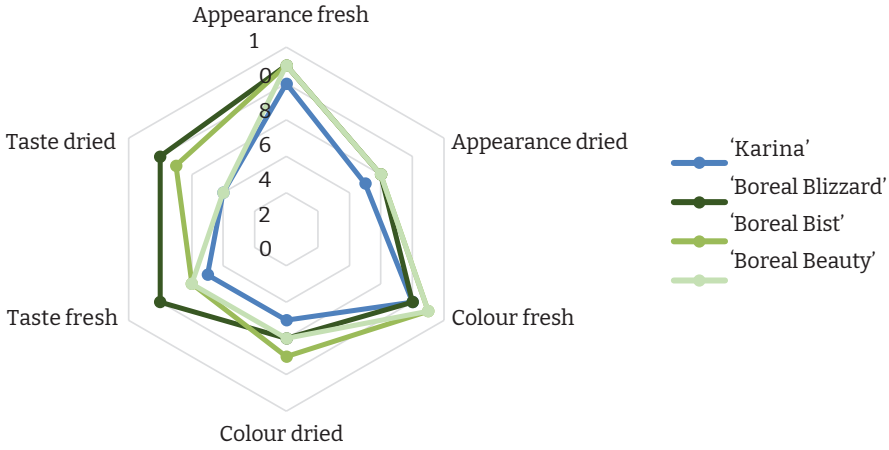

Figure 1. Sensory quality indicators of fresh and dried blue honeysuckle fruits
Source: compiled by the authors

As noted by G. Akar *et al.* (2018), drying helps to reduce vitamin C, in particular, in rosehip fruits by 2.7 times, and in wild strawberry fruits when using the convector method at a temperature of 60°C by 77.6, at a temperature of 40°C – 66.8 and 25°C – 59.6% (Krzykowski *et al.*, 2020). With other types of processing, in particular, spreads and juices, the content of vitamin C in the finished product, on the contrary, increases compared to the content in fresh fruits (Senica *et al.*, 2019). Of the blue honeysuckle varieties studied, vitamin C losses during the drying process were at least 65% for the 'Boreal Beauty' variety and 72% for the 'Boreal Blizzard' variety, 69% for the 'Karina' variety and 71% for the 'Boreal Bist' variety (Table 1).

Table 1. Ascorbic acid content in fresh and dried blue honeysuckle fruits (average for 2020-2021), mg/100 g of dry weight

Varieties	2020		2021		Average for 2020-2021		% losses
	Fresh	Dried	Fresh	Dried	Fresh	Dried	
'Karina'	183 ± 0.05	57 ± 0.12	162 ± 0.08	52 ± 0.16	173 ± 0.06	54 ± 0.10	69
'Boreal Blizzard'	251 ± 0.03	70 ± 0.08	166 ± 0.08	47 ± 0.17	209 ± 0.18	59 ± 0.19	72
'Boreal Bist'	208 ± 0.03	56 ± 0.12	179 ± 0.04	55 ± 0.21	194 ± 0.07	55 ± 0.11	71
'Boreal Beauty'	197 ± 0.04	70 ± 0.07	200 ± 0.06	71 ± 0.06	199 ± 0.03	70 ± 0.04	65
Average	210 ± 0.02	63 ± 0.04	177 ± 0.04	56 ± 0.10	193 ± 0.09	60 ± 0.07	69
Variation coefficient, %	13.9	12.5	9.6	18.4	7.8	12.3	4.4
min	183	56	162	47	173	54	65
max	251	70	200	71	209	70	72

Source: compiled by the authors

According to researchers from Poland, blue honeysuckle has the highest content of total polyphenols among small fruits (Ponder *et al.*, 2022). Researchers from Croatia proved that the total content of polyphenols in fresh samples of blue honeysuckle was 6,209 mg/100 g of dry matter (Žlabur *et al.*, 2019). These findings is consistent

with the data obtained by researchers in the conditions of the forest-steppe of Ukraine, where blue honeysuckle berries accumulated 6,499 mg/100 g of dry weight, with a minimum value of 5,370 ('Karina' variety) and a maximum – 7,336 mg/100 g dry weight ('Boreal Blizzard' (Fig. 2), and this was significantly more than in berries grown in Poland, where the content of the above substances was 2,118.9 in organic berries and 27,263.97 mg/100 g of dry matter in berries grown using intensive technologies (Ponder *et al.*, 2022).

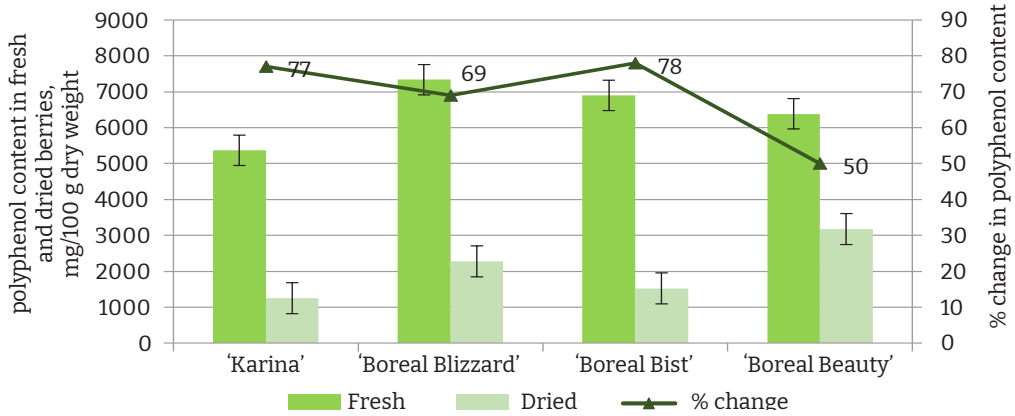

Figure 1. Content of polyphenolic substances in fresh and dried blue honeysuckle fruits (average for 2020 and 2021)

Source: compiled by the authors

The content of polyphenolic substances in fresh blue honeysuckle fruits ranged from 5,370 mg/100 g of dry matter ('Karina' variety) to 7,336 mg/100 g of dry matter ('Boreal Blizzard'). According to L. Shevchuk *et al.* (2022), the variation in the content of polyphenolic substances in blue honeysuckle is quite high, with a coefficient of variation of 22%, as also evidenced by studies by M. Senica *et al.* (2020). At the level of 6,900 and 6,387 mg/100 g of dry matter, they were accumulated by the fruits of 'Boreal Bist' and 'Boreal Beauty', respectively. Previously, the high content of polyphenolic substances in the fruits of blue honeysuckle was reported by Polish researchers. E. Hallmann *et al.* (2020) noted that the genetic characteristics of varieties of this crop have a significant impact on the chemical composition of fruits. A. Grobelna *et al.* (2020) found that berries, due to the presence of active antioxidants and anti-inflammatory compounds, help reduce the harmful effects of free radicals. They are rich sources of vitamin C, contain polyphenols, and are widely used in dietary supplements and medications. Since they have a high nutritional value, growing these berries is of great importance. Their resistance to low temperatures and early maturation make them a valuable raw material.

The most significant losses of polyphenolic compounds during the drying process were observed in the varieties 'Karina' and 'Boreal Bist' – 77 and 78%, respectively, while the best content of polyphenols was preserved in berries of 'Boreal Beauty' variety (50%). For example, pear fruits lost 30% of these substances during the drying process for 10 hours, according to A. Wilkowska *et al.* (2016). As noted by X. Li *et al.* (2019), the loss of polyphenolic substances significantly depends on their quantitative and qualitative composition. They investigated the relationship between the accumulation of polyphenols and the process of darkening apple slices during hot air drying (65°C, air velocity 2 m/s). The composition of polyphenols was determined for different varieties of apples, and among them chlorogenic acid and epicatechin were the most common, accounting for 44.47-75.45 g/100 g and 30.31-35.16 g/100 g of the total amount of polyphenols in the apple pulp, respectively. According to K.M. Moon *et al.* (2020), the decrease

in total polyphenols in dried berries can be explained by the fact that the biological processes of berries are destroyed by the degradation of specific compounds due to the natural activity of the enzyme polyphenol oxidase, which induces the enzymatic browning process as soon as the berry tissue is damaged.

It is worth noting that the varietal variation of the polyphenolic component in the studied varieties was strong, as indicated by the corresponding coefficient – 43%. The conducted studies show that the flavonoid content in fresh blue honeysuckle fruits was 1,064 ± 240 mg/100 g of dry weight, significantly less than the average value of them contained berries of the varieties 'Karina' (812 ± 23 mg/100 g) and 'Boreal Bist' (961 ± 29 mg/100 g) (Table 2).

Table 2. Content of flavonoids, anthocyanins, and chalcones in fresh and dried blue honeysuckle berries (average for 2020-2021), mg/100 g of dry weight

Varieties	Flavonoids		Anthocyanins		Chalcones	
	Fresh	Dried	Fresh	Dried	Fresh	Dried
'Karina'	812 ± 23	1,708 ± 180	1,108 ± 60	1,724 ± 133	337 ± 16	977 ± 19
'Boreal Blizzard'	1,108 ± 39	1,977 ± 22	1,699 ± 100	2,325 ± 144	292 ± 18	1,268 ± 21
'Boreal Bist'	961 ± 29	2,418 ± 146	1,531 ± 91	2,440 ± 80	313 ± 22	1,140 ± 75
'Boreal Beauty'	1,376 ± 39	2,130 ± 57	1,741 ± 25	2,420 ± 90	367 ± 16	1,182 ± 123
Average	1,064 ± 240	2,058 ± 296	1,520 ± 289	2,227 ± 339	327 ± 32	1,142 ± 122
Variation coefficient, %	23	14	19	15	10	11
min	812	1,708	1,108	1,724	292	977
max	1,376	2,418	1,741	2,440	367	1,268

Source: compiled by the authors

Unlike fruits, the total flavanoid content of blue honeysuckle leaves varies from 37.21 to 20.61 mg/100 g, according to J. Xie *et al.* (2019). This difference may be related to the morphology of various plant organs and varietal characteristics, location and growing conditions, etc. Drying at 65°C for 14 hours contributed to an increase in the flavonoid content from 55 to 110%. On average, the content of the above substances in dried blue honeysuckle berries was 2,058 ± 296 mg/100 g dry weight, and the fruits of the 'Boreal Bist' variety contained more than the average value (2,418 ± 146 mg/100 g).

Blue honeysuckle fruits under growing conditions in the forest-steppe of Ukraine accumulate 1,520 ± 289 mg/100 g of dry anthocyanin weight, their maximum amount of 1,741 ± 25 and 1,699 ± 100 mg/100 g of dry weight contained varieties 'Boreal Beauty' and 'Boreal Blizzard', respectively. The data obtained are consistent with studies conducted in Slovakia, according to researcher T. Jurikova *et al.* (2012), berries *Lonicera caerulea* L. contain 1,470 mg/100 g of anthocyanins. Moreover, the above-mentioned scientists noted that the content of anthocyanins significantly depends on the type and conditions of cultivation, the limit of variation of the content is 400-1,500 mg/100 g.

The results of research have established that the fruits of varieties of Canadian selection – 'Boreal Blizzard', 'Boreal Bist', 'Boreal Beauty', in the drying process are enriched with anthocyanin content, and their amount in the finished product is – 2,350; 2,440; 2,420 mg/100 g of dry weight, respectively. Significantly higher amounts of anthocyanins in dried samples of 'Indigo Gem' blue honeysuckle (4,223.25 ± 120.10 mg/100 g of dry weight) were found by P.Y. Gökçe *et al.* (2022). R. Khattab *et al.* (2016) also noted a significant anthocyanin content in this variety – 4,033 mg/100 g of dry weight. In the 'Aurora' variety, the content of the above compounds was at the level of the data obtained in this study.

Drying at 65°C contributed to an increase in the anthocyanin content in blue honeysuckle berries by an average of 48%. J. Stojanovic & J.L. Silva (2007), W. Yuan *et al.* (2011), who studied another berry crop such as blueberries, noted

a decrease in anthocyanin content. J. Stojanovic & J.L. Silva (2007) proved that the amount of anthocyanins in the berries of the above crop decreased by almost 60% compared to fresh, A. Wilkowska *et al.* (2016) reported a decrease in anthocyanin content in *Vaccinium myrtillus* berries by 57%, W. Yuan *et al.* (2011) also confirmed this claim that the anthocyanin content of eight different blueberry varieties also decreased by 60% after hot air drying. They evaluated the antioxidant activity and content of total phenols and anthocyanins in both fruits and leaves of 19 genotypes. Antioxidant activity, total phenols, and anthocyanin content remained virtually unchanged when stored at 4°C or -20°C for two weeks, but significantly decreased when the berries were oven-dried at 65°C for 48 hours.

Studies have shown that the amount of chalcones in fresh and dried blue honeysuckle fruits was stable. It was noted that the proportion of these substances in fresh blue honeysuckle fruits averaged 327 ± 32 mg/100 g of dry weight, in dried fruits – 1,142 ± 122 mg/100 g. As a result of the study, it was proved that the drying process contributed to an increase in the content of chalcones in blue honeysuckle berries by 190-335%. The highest amount of chalcones in both fresh and dried fruits was noted in the 'Boreal Beauty' variety – 367 ± 16 and 1,182 ± 123 mg/100 g of dry weight, respectively.

The conducted studies of the content of phytosubstances in fresh fruits of 4 varieties of blue honeysuckle and their changes during drying do not give a complete understanding of the effect of heat treatment on the preservation of ascorbic acid and polyphenolic components in them. Therefore, it will be advisable to conduct further research with other varieties of this crop.

CONCLUSIONS

As a result of the conducted studies, the materiality of degradation of bioactive substances (polyphenols, flavonoids, anthocyanins and chalcones) and the materiality of changes in sensory quality indicators (general appearance, circles and taste) in the fruits of blue Honeysuckle varieties 'Boreal Blizzard', 'Boreal Beauty', 'Boreal Bist' and 'Karina' during drying were established. The greatest amount of vitamin C was accumulated by the fruits of the varieties 'Boreal Blizzard' and 'Boreal Bist', polyphenolic substances – 'Boreal Blizzard', flavonoids – 'Boreal Beauty', anthocyanins – 'Boreal Bist'. The highest percentage of ascorbic acid retention (35%) was found in the 'Boreal Beauty' variety, and total polyphenols at the level of 50% were found in dried berries of the 'Boreal Beauty' variety. The amount of flavonoids up to more than 2,000 mg/100 g and anthocyanins up to more than 2,400 mg/100 g of dry weight during drying increased in the fruits of the mentioned variety and the 'Boreal Bist' variety.

It is established that during the drying process, the fruits of blue honeysuckle lose their attractiveness and their taste qualities deteriorate. In particular, dried berries of the 'Karina' variety were the least attractive in terms of appearance and colour. Best of all, according to the definition of tasters, the score is 8 points, the taste during drying was preserved by the fruits of the variety 'Boreal Blizzard'. Considering the data obtained, namely the assessment of the preservation of sensory indicators of quality and biological activity, the most suitable for processing by drying method are fruits of Canadian selection, 'Boreal Blizzard', 'Boreal Beauty', and 'Borial Bist'.

The obtained data will be useful for further scientific research on the creation of new varieties with a high content of phytosubstances. The varieties 'Boreal Blizzard' and 'Boreal Beauty' will be involved in hybridisation, since the first of these varieties, when grown in the forest-steppe of Ukraine, accumulates the most total polyphenols, and the second anthocyanins. The next research will be to expand knowledge about the impact of blue honeysuckle consumption on human health, and to create new products and technologies to maximise the use of blue honeysuckle fruits in various industries and medicine. In the future, it is possible to study the possibilities of using blue honeysuckle fruits in various industries, including the food and pharmaceutical industries. This may include creating new products, supplements, or pharmaceuticals based on this plant, determining the content of vitamins (such as vitamin C, vitamin E), minerals (such as potassium, magnesium), and antioxidants (such as flavonoids, anthocyanins) in different parts of the fruit and their changes during drying.

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CONFLICT OF INTEREST

None.

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Сенсорні та біоактивні показники якості свіжих та сушених плодів жимолості голубої (*Lonícera caeruléa* L.)

Анотація. Актуальність досліджень базується на особливій цінності ягід жимолості голубої, оскільки вони містять значну кількість біологічно активних речовин, котрі наділені антиоксидантними властивостями. але мають нетривалий період споживання.

Для його подовження та забезпечення населення нутрієнтноцінною продукцією було поставлено мету виділити сорти, плоди яких є найбільш придатними для перероблення способом сушіння. Було використано лабораторні методи для біохімічного дослідження плодів та статистичні методи (з допомогою програми STATISTICA та дисперсійного аналізу ANOVA розглядалися сенсорні показники якості та вміст фіторечовин, а саме: вітаміну С, поліфенолів, флавоноїдів, антоціанів і халконів у свіжих та сушених плодах сортів 'Boreal Blizzard', 'Boreal Beauty', 'Boreal Bist' і 'Каріна'). В результаті проведених досліджень було виділено сорти, котрі в процесі термічної обробки максимально, по відношенню до свіжого аналогу, зберегли сенсорні та споживчі показники якості. Встановлено діапазон варіювання поліфенольних речовин, який знаходився в межах мінімуму 7370 ('Каріна') та максимуму 7336 мг/100 г сухої маси ('Boreal Blizzard'), відсоток їх збереження у сушених ягодах найвищий був у сорту 'Boreal Beauty'. Середній вміст флавоноїдів у свіжих плодах досліджуваних сортів становив 1064 ± 240 мг/100 г, антоціанів – 1520 ± 289 мг/100 г сухої маси. Сушіння ягід сприяло збільшенню кількості даних речовин на 55-110 % – флавоноїдів та на 48 % – антоціанів. Доведено, що в процесі сушіння плоди жимолості голубої втрачають вітамін С, втрати залежно від сорту становлять 65-72%. Результати досліджень стануть корисними при підборі батьківських форм для створення сировинних сортів та при виборі сорту для сушіння і виготовлення натуральних плодових порошкових концентратів з підвищеним вмістом біологічно активних речовин

Ключові слова: органолептичний аналіз плодів; сушіння; поліфеноли; флавоноїди; антоціани; халкони