Biochemical analysis of grape berries of varieties of different ecological and geographical origin after low-temperature storage

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Abstract. An assessment of the productive and economic properties of berries of 14 grape varieties was carried out. Grape varieties with economically useful traits that provide an increase in crop yield and productivity, as well as those with increased biological value and the ability for longer storage have been identified. The results of statistical data processing showed the absence of significant differences between the studied varieties. Correlation analysis between economically useful features of grapes was carried out. The correlation coefficient varied significantly in the range up to 0.888, which indicates a high correlation between the studied features. It has been established that varieties with larger berries are distinguished by a high content of chlorophyll a and b and a low content of carotenoids. An increase in the endogenous level of vitamin C provides an increase in the content of chlorophyll *a* and *b*. Since the photosensitive structure of chlorophyll consists of a large number of conjugated double bonds that can easily be destroyed by a free radical mechanism, an increase in the content of active antioxidant protects chlorophyll from destruction and ensures its accumulation in grapes.

1 Introduction

For climatic reasons, the cultivation of grapes is possible only on two narrow belts of the earth, a large belt lies in the northern hemisphere, there are large European vineyards, a smaller belt stretches like a thin ribbon of southern latitudes [1]. Recently, efforts have been made to spread the planting of grapes to the more northern regions of Russia and other countries. In this regard, there is a need to identify economically useful features of culture, which is the relevance of this work. To accomplish this task, biochemical studies of berry varieties were carried out according to various parameters, followed by the construction of correlation dependencies between them and the identification of the most significant indicators. Statistical processing of research results showed their reliability [2].

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2 Material and methods

14 varieties of grapes were used in the studies: The average weight of berries was taken into account, chlorophyll a and b, carotenoids, vitamin C, glucose, total sugars [3].

The average weight of berries was determined by determining the number of grapes in the average sample, which was at least 1 kg for each grape variety [3].

Chlorophyll a, b and carotenoids were determined by the spectrophotometric method with the determination of optical density at wavelengths of 440, 644, and 662 nm [3].

The dry matter content was determined by drying to constant weight at a temperature of 105°C [3].

Ascorbic acid was determined by titration with Tillmans' stain [3].

The content of glucose and total sugars was determined according to Bertrand and is based on the ability of reducing sugars to reduce oxide copper in an alkaline solution. Oligo-sugars, including sucrose, were subjected to hydrolysis during determination [3].

3 Results and discussion

Studies were carried out on grapes that have only a green color. Figure 1 shows data on the dependence of the average weight of berries on the content of chlorophyll *b* in them. It follows from the results that with an increase in the content of chlorophyll, the average weight of grapes also increases. Similar results were obtained for chlorophyll a, with an increase in the content of which the mass of berries also increases.

Transport of chlorophyll to berries occurs from the leaves, where it is synthesized. Obviously, the growth of larger berries in varieties Sukribe, Tayezhnyy izumrud, Korinka russkaya with a higher chlorophyll content is provided by the energy generated in the leaves and stored in the form of sucrose.

Due to the higher content of chlorophyll, photosynthesis proceeds more intensively, and therefore less photodamage is formed, developing according to the free radical mechanism in berries with a higher content of chlorophyll. Photodamage is possible in berries in case of photosensitization of chlorophyll present in berries. In this regard, the content of vitamin C in grapes was studied and correlations between the content of vitamin C and chlorophyll were obtained.

Figure 2 shows the effect of vitamin C on the content of chlorophyll b in grapes. An increase in the content of vitamin C provides an increase in the content of chlorophylls *b* and *a*, for which the same results were obtained. Since the photosensitive structure of chlorophyll consists of a large number of conjugated double bonds [4] that can be easily destroyed by a free radical mechanism, an increase in the content of active antioxidant protects chlorophyll from destruction and ensures its accumulation in grapes. Thus, vitamin C contributes to the accumulation of chlorophyll a and b in grapes, the content of which increases with an increase in the mass of berries.

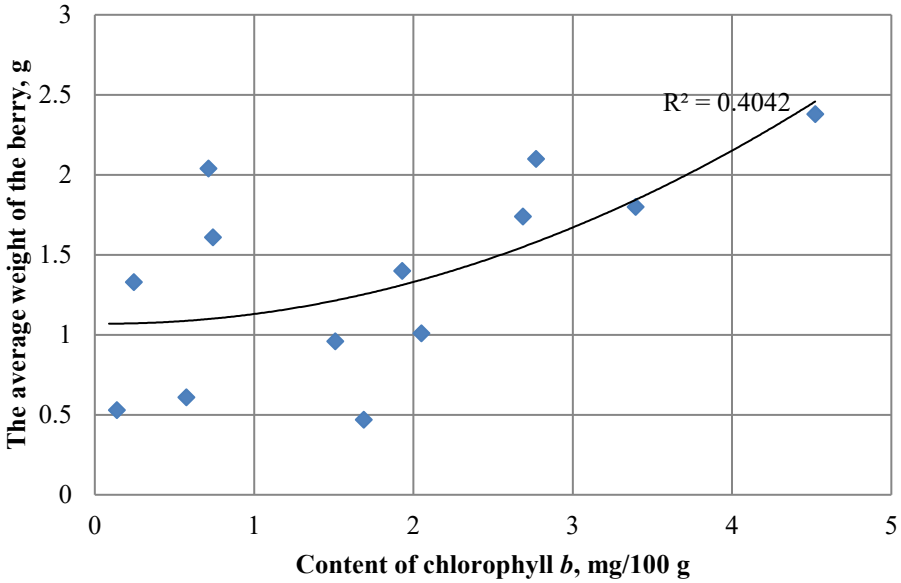

Fig. 1. Dependence of the average weight of berries on the content of chlorophyll b in grape berries.

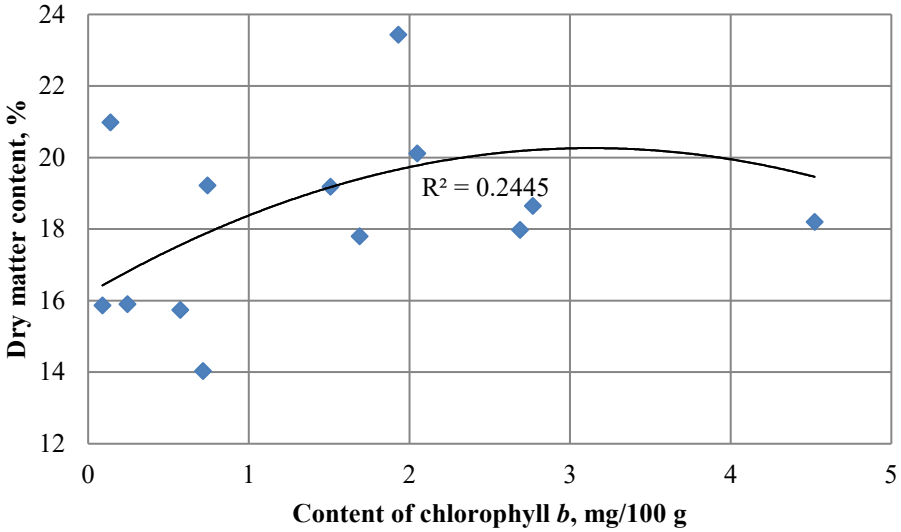

Fig. 2. Dependence of the content of chlorophyll *b* on the content of vitamin C in grapes.

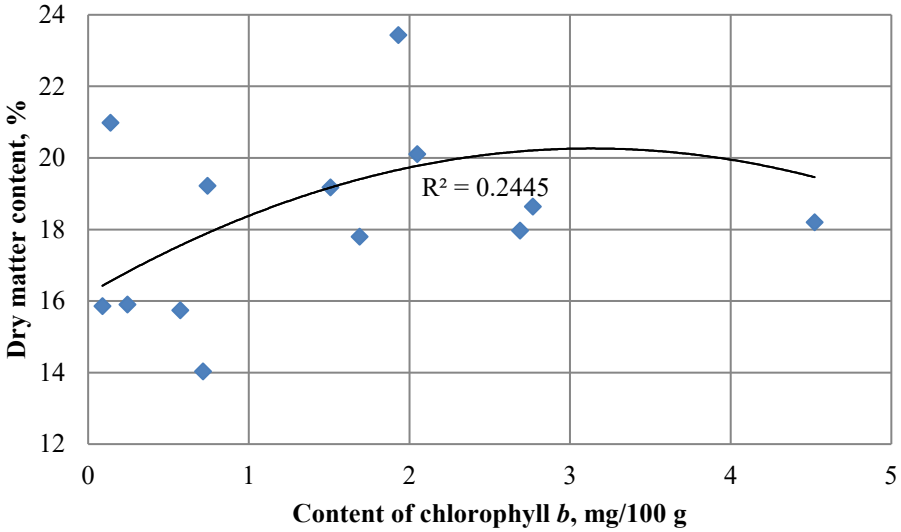

Fig. 3. Dependence of the amount of sugar content on chlorophyll *b* in grapes.

The content of dry matter, the amount of sugars and glucose in grapes is directly related to the content of chlorophyll and photosynthetic activity. On fig. Figure 3 shows the correlation between chlorophyll b content and dry matter content in green grapes. As follows from the given dependence, the growth of the chlorophyll content is accompanied by an increase in the dry matter content. The increase in solids is about 3%, judging by the equation corresponding to the trend line in Fig. 3. This is not a very significant increase in solids content. However, it cannot be significant, since water is always adjacent to dry substances, or rather its bound form, which is in a certain ratio with free water. An increase in the dry matter content implies an increase in the nutritional, biological and energy value of berries. These indicators are also related to the content of the sum of sugars and glucose in grapes, which are presented in fig. 4 and 5. As well as for dry substances, the content of glucose and the amount of sugars increase with an increase in the content of chlorophyll.

In the case of preserving grape berries, the more significant fact is that the content of chlorophyll and its destruction during storage is associated with a change in color, which will result in the appearance of carotenoids, which affects the ability of plant products to be stored. The same applies to other types of green plant products, such as green apples. The results of the study on the content of carotenoids in grapes are presented in fig. 6. According to the sum of chlorophylls a and b in connection with the content of carotenoids, identical results were obtained: an increase in the content of carotenoids in berries corresponds to a decrease in the content of chlorophyll and vice versa [5, 6, 7, 8, 9, 10].

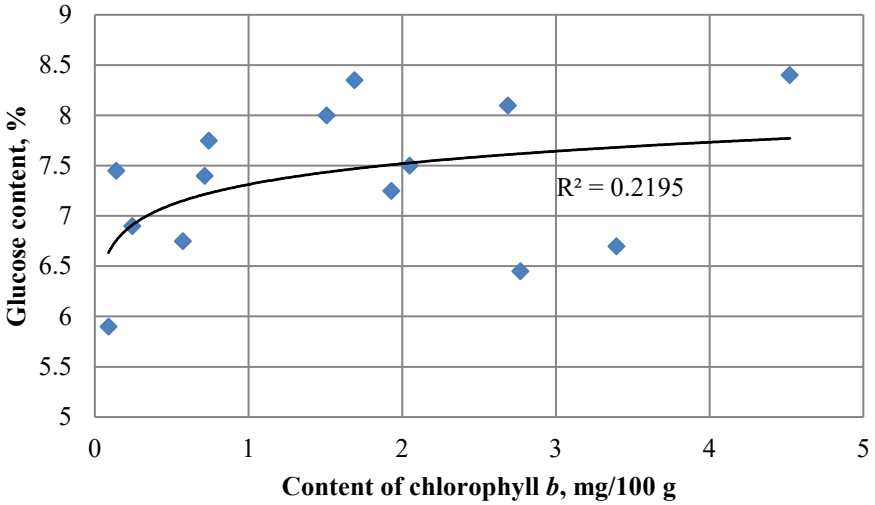

Fig. 4. Dependence of glucose content on chlorophyll *b* in grapes.

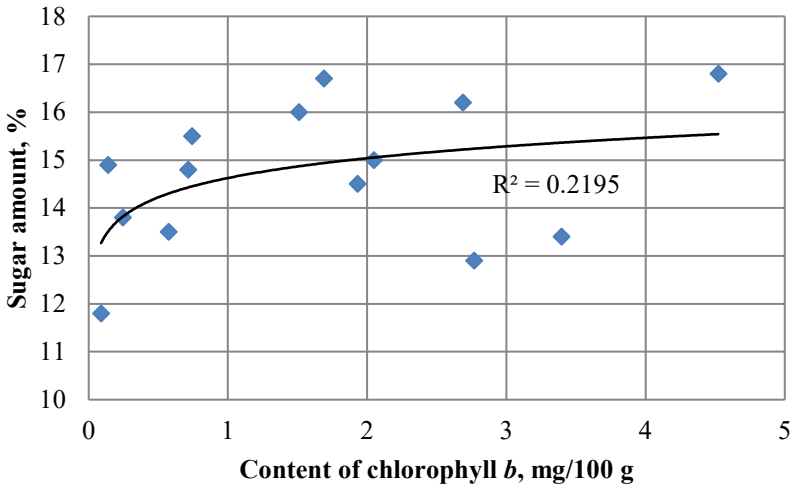

Fig. 5. Dependence of the total sugar content on chlorophyll *b* in grapes.

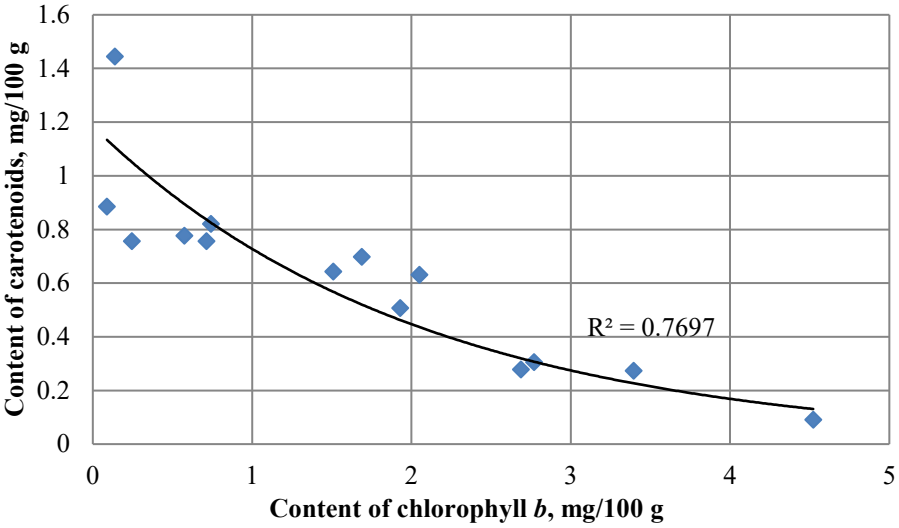

Fig. 6. Dependence of the content of carotenoids on chlorophyll *b* in grapes.

4 Conclusions

Based on the results obtained, grape varieties with economically useful traits have been identified, providing an increase in the yield and productivity of grapes, as well as having increased nutritional and energy value and the ability to store grapes for a longer time.

Acknowledgements

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