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Original Research

Changes in the Pro-Health Potential of Pickled Stone Fruits - Pilot Studies

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Abstract

Freezing is the most commonly used method of preserving stone fruits. However, it is not the cheapest method. An alternative could be the pickling of fruits. Unfortunately, there is not much information in the literature on the effect of pickling on the health-promoting potential of stone fruits, including plums and cherries. This work focuses on assessing the impact of fruit pickling and storage on changes in the pro-health potential. Health-promoting properties were determined based on the content of anthocyanin dyes, vitamin C, total polyphenols, and the ability to inhibit free radicals. A substantial effect of pickling and storing pickled fruits on their health-promoting properties was observed. Pickling caused a decrease in the content of anthocyanins and vitamin C in the tested fruits. At the same time, the content of total polyphenols and the ability to reduce free radicals increased. It was also found that the content of bioactive compounds and the ability to reduce free radicals decreased during the storage of pickled cherries and plums. However, after 180 days of storage, pickled plums contained more polyphenols than fresh ones.

Keywords: pickling, pickled fruits, antioxidant properties, stone fruits

Introduction

Foods rich in antioxidant compounds are essential in preventing chronic non-communicable diseases. Therefore, selected components of the daily diet play an important role in shaping the total antioxidant potential of the human body. These ingredients are primarily fresh fruits, including stone fruits.

The antioxidant properties of stone fruits are determined by the content of antioxidant vitamins, such as A and C, and antioxidant substances, including flavonoids (natural dyes) and other phenolic compounds [1].

In addition to the seasonal supply, stone fruits are characterized by low shelf life, which makes them unsuitable for consumption long after harvest. For these reasons, preserving and storing them is necessary [2].

However, prolonged or improper fruit storage contributes to the rapid loss of health-promoting properties. Therefore, freezing or pickling is the safest food storage method [3].

Pickling is a biological preservation method based on the anaerobic process of lactic acid fermentation. The substrate of the reaction are sugars present in the raw material. In contrast, the product is stabilized by lactic acid bacteria produced by fermentation, which

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benefits the human body. In addition, the pH values decrease during pickling, thus increasing the health safety of food products [4].

In contrast to freezing, pickling and storage of pickled fruits is a process that requires lower financial outlays. In addition, pickling contributes to reducing the carbon footprint. In the case of freezing, creating and maintaining a low storage temperature is becoming increasingly expensive in the era of rising electricity prices. Nevertheless, freezing as a method of fruit preservation is more popular among the public than pickling.

Considering the above, it seems essential to popularize pickling to preserve fruits, including stone fruits.

In the literature, we can find many reports on the effect of pickling on the health-promoting properties of vegetables (cabbage, cucumbers). However, in the case of stone fruits and their storage in a pickled state, they are negligible.

The article aimed to present preliminary research results on assessing the impact of pickling and storage on the stability of the pro-health potential of stone fruits, on the example of cherries and plums.

Material and Methods

Chemicals and Equipment

Reagents and chemicals of analytical grade and redistilled water were used in the experiments. Potassium chloride, hydrochloric acid, sodium acetate, oxalic acid, glacial acetic acid, sodium acetate anhydrous, 2,6-dichlorophenolindophenol, xylene, Folin-Ciocalteu reagent, gallic acid, sodium carbonate, 2,2-diphenyl-1-picrylhydrazyl (DPPH) and ethanol were obtained from Sigma-Aldrich.

The absorbance of the samples was measured using a stationary VIS spectrophotometer SEMCO S/Ec (PZ EMCO, Warsaw, Poland) operating in manual mode, with a wavelength range of 330-1000 nm and repeatability of photometry measurement±0.001 A unit.

Research Material

The research material consisted of stone fruits: cherries of the Burtal variety and plums of the Crismo Glo variety, both fresh and pickled in home conditions.

The brine used for pickling fruit was prepared using 16 liters of water, 104 g of salt (14 tablespoons), 208 g of sugar (16 tablespoons), cloves, black peppercorns, and cherry leaves.

Water with salt and sugar was boiled and left to cool. Next, the fruits were washed and dried. Then the cherries were pitted, and the plums were cut and pitted. The fruits were placed in jars with a capacity of 315 mL, and cloves, black peppercorns, and cherry leaves were added. Next, the prepared fruits were poured with brine so the water completely covered them. Jars with fruits for pickling were covered with a cloth and left for four days at a temperature of 293,15 K. After this, jars were closed with scalded lids and stored for 180 days in a dry and cool room.

In fresh fruits, pickled after four days and stored after 30, 60, and 180 days, the content of anthocyanin pigments, vitamin C, polyphenols, and antioxidant activity were determined.

Anthocyanin Dyes Content

The content of anthocyanins was determined using the Fuleki and Francis method.

2 g of the product was weighed with an accuracy of 0.01 g and transferred to a 50 mL volumetric flask, supplemented with a buffer of pH = 1.0. Then, 10 g of the product was transferred to a 50 mL volumetric flask and supplemented with a buffer of pH = 4.5. The contents of the flasks were thoroughly mixed and left for two hours in a dark room at a temperature of 293.15 K. The solutions were filtered after the required time. The absorbance at λ = 510 nm was measured against the appropriate buffers as references.

The total content of anthocyanins was calculated using the formula:

$$TA_{cy} = \frac{500\left(5A_{pH=1,0} - A_{pH=4,5}\right)}{77,5}$$

Where $A_{pH=1.0}$ is the absorbance of the extract at pH = 1.0, and $A_{pH=4,5}$ is the absorbance at pH = 4.5. The results were expressed as mg/100 g fresh weight [5].

Vitamin C Content

The content of vitamin C was determined by the spectrophotometric method according to the PN-A-04019:1998 standard.

10 g of the laboratory sample of the research material was weighed and transferred quantitatively to a 100 mL volumetric flask using an extraction solution (2% oxalic acid). The contents of the flask were made up to the mark with the extraction solution, stirred, and filtered, discarding the first few milliliters of the filtrate.

5 mL of the prepared filtrate was transferred to a 50 mL Erlenmeyer flask, 5 mL of pH 4.0 buffer solution, 2 mL of 2,6-dichlorophenolindephenol solution, and stirred and 10 mL of xylene was added. The flask was then shaken for 10 seconds. After separating the layers, the xylene layer was collected into cuvettes, and the absorbance was measured. Excess dye was determined spectrophotometrically at a wavelength of λ = 500 nm.

The amount of mL of the 2,6-dichlorophenolindophenol solution that did not react was read from the calibration curve.

The content of vitamin C expressed in mg/100 g of fresh weight was calculated from the formula:

$$K = \frac{(V_0 - V_1) \cdot d}{m' \cdot V_2 \cdot m_0} \cdot 100$$

Where K is the content of vitamin C (mg/100 g), m_0 is the test material weight (g), m' is the titer of the dye solution (mL/1 mg of vitamin C), V_0 is the volume of 2,6-dichlorophenolindophenol solution added to the determination of the test sample (mL), V_1 is the volume of excess dye solution, corresponding to the measured absorbance of the sample, read from the calibration curve (mL), V_2 is the volume of the test sample filtrate taken for determination (mL), d is the volume of the volumetric flask (mL) [6].

Total Polyphenols Content

The total content of polyphenolic compounds was determined by the Folin-Ciocalteu method. It consists of measuring the absorbance of the complex formed due to the reduction of phosphotungstic salts of molybdic acid, the so-called Folin-Ciocalteu reagent. In an alkaline environment, phenolic compounds in the tested samples are oxidized. As a result, the salts of phosphomolybdic and phosphotungstic acids undergo reduction. In addition, this method uses the ability of polyphenols to react color with the Foliny-Ciocalteu reagent [7].

5 g of the test material was weighed and extracted with 30 mL of 80% ethanol alcohol for one hour at 293.15 K in a place protected from light. After the specified time, the mixture was centrifuged for 20 minutes at 1130 rpm. The centrifuged extract was transferred to a 50 mL volumetric flask and made up to the mark with 80% alcohol. The obtained extract was used to determine the content of polyphenolic compounds and their ability to reduce free radicals.

6 mL of distilled water, 0.5 mL of Folin-Ciocalteu reagent (2.0 mol/L), and 1.5 mL of saturated Na_2CO_3 solution were added to 0.1 mL of the ethanolic extract of the tested samples. The samples were incubated for 30 minutes at 313.15 K. Then their absorbance was measured at the wavelength of λ = 765 nm. The results of the determinations are presented as gallic acid equivalent per 100 g fresh weight (mg GAE/100 g) [8-9].

Antioxidant Activity Using DPPH Assay

The total antioxidant capacity was determined as the ability to quench the synthetic DPPH radical.

0.02 mL of an adequately prepared extract from the research material was added to 1.5 mL of the ethanolic DPPH solution. The samples were incubated at 303.15 K for 30 minutes. After the time had elapsed, the absorbance at λ = 517 nm was measured against ethanol as blank. The control sample was a mixture of 1.5 mL DPPH solution and 0.02 mL ethanol.

The ability to counteract the oxidation reaction, expressed as the percentage inhibition of the DPPH radical, was calculated based on the relationship:

$$\%\ \text{inhibition} = 100 \cdot \frac{(A_0 - A_{sr.})}{A_0}$$

Where $A_{sr.}$ is the average value of the absorbance of the test-containing solution antioxidant, and A_0 is the absorbance of the control sample [10].

Statistical Analysis

The results of the determinations are the arithmetic mean of six repetitions for each fruit. Multivariate analysis of variance (ANOVA) was used to determine the influence of the species, pickling, and fruit storage on the analyzed quality characteristics.

The normality of the distribution was checked with the Shapiro-Wilk test. The values of the p-statistic were higher than 0.05 ($p>0.05$), thus giving grounds for accepting the hypothesis of the normality of the distribution of the examined data.

The homogeneity of variance was checked with the Brown-Forstyhe test. It tests the null hypothesis of equality of variances. Since the significance values of the Brown-Forstyhe test were higher than 0.05 ($p>0.05$), there was no reason to reject the assumption of homogeneity of variance.

The significance of differences between the tested fruit samples was checked with the Tukey test. Relationships at the significance level of $p<0.05$ were considered statistically significant.

The obtained results of the statistical evaluation are presented in the table and the graphs with the indication of belonging to middle classes using letter classification.

Results and Discussion

Stone fruits, including cherries and plums, contain significant amounts of bioactive compounds such as phenolic acids, anthocyanins, carotenoids, vitamins, minerals, and pectins. For this reason, fruits are an essential component of the human diet regarding nutritional and dietary values. Consequently, they are an increasingly frequent subject of nutritional studies conducted on humans and animals, aiming to assess the impact of their consumption on the functioning of the body [11].

The initial content of bioactive components and the antioxidant activity of fresh stone fruits constituting the research material is presented in Table 1.

The obtained results of determination of the analyzed health quality indicators showed significant differences in the content of bioactive compounds and antioxidant activity depending on the fruit species. For example, fresh plums contained a significantly higher amount of anthocyanin pigments ($p<0.05$) and

Table 1. Content of selected bioactive ingredients and antioxidant activity of cherries and plums. Results are (means±SD) (n = 6). GAE (gallic acid equivalent).

Fresh fruit	Anthocyanin dyes [mg/100g]	Vitamin C [mg/100g]	Total polyphenols [mg GAE/100g]	Antioxidant activity [% inhibition]
Cherries	11.85±0.66a	8.31±0.31b	48.40±2.23a	14.63±0.80a
Plums	14.65±0.27b	6.57±0.20a	76.79±4.56b	21.03±1.19b

Mean values marked with different lowercase letters in the column differ significantly according to Tukey's test at $p<0.05$.
Source: own study.

total polyphenols ($p<0.05$) and were characterized by a significantly higher ability to reduce free radicals ($p<0.05$) than fresh cherries. On the other hand, cherries fruits, which constituted the research material, had a significantly higher concentration of L-ascorbic acid ($p<0.05$) than plum fruits.

The species, variety, and genetic factors largely determine the content of bioactive compounds in fruits and their antioxidant activity. However, these properties also depend on external factors, i.e., physical and chemical properties of the soil, weather conditions during the development, ripening, and harvesting of fruits, and how the plantation is managed (cultivation and pruning) [12-13].

Pickling stone fruits and their storage for 180 days caused changes in the content of bioactive compounds and the ability to inhibit free radicals. The direction and dynamics of the changes are presented in charts 1, 2, 3, and 4.

Anthocyanin Dyes Content

By analyzing the content of anthocyanins in pickled fruits, the content of these compounds was decreased. After four days of pickling, the range of anthocyanin pigments decreased significantly ($p<0.05$) by about 34%, from 11.86 mg to 7.86 mg/100g, in sweet cherry fruits and by about 13%, from 14.65 to 12.78 mg/100g in plum fruits (Fig. 1).

During the storage of pickled fruits, the observed tendency was maintained. However, depending on the type of fruits, it occurred with different dynamics. For example, higher dynamics of this process were identified during the storage of plums (-2.6330) than in cherries (-2.0370). This proves the lower stability of anthocyanins during storage of plum fruits, which are the research material, than sweet cherry fruits. After 180 days of storage, a significant decrease in the content of anthocyanins in the tested fruits was found ($p<0.05$). In the case of sweet cherries, anthocyanin dye content decreased by about 69% compared to fresh fruit and by about 68% in plums. Cherries contained 3.66 mg/100 g of anthocyanins, while plums contained 4.64 mg/100g. This difference turned out to be statistically significant ($p<0.05$).

Wiczkowski, Szawara-Nowak, and Topolska [14] also found a decrease in the content of anthocyanins during the pickling and storage of red cabbage. According to the cited authors, the fermentation process caused the degradation of anthocyanins at the level of 24%, and after 180 days of storage, the content of dyes decreased by 58%. Whereas Di et al. [15], analyzing qualitative changes in the physicochemical properties of leaf mustard during fermentation, found an insignificant decrease in the content of anthocyanins.

The stability of anthocyanin dyes in fruits depends on many factors, including temperature, duration of the processing, oxygen content, sulfites, ascorbic acid, metal ions, exposure to light, the activity of tissue enzymes and microorganisms, and pH value [16-17].

During pickling, anthocyanin degradation could occur due to the temperature of 293.15 K prevailing throughout the fermentation process. The negative effect of such temperature on the concentration of dyes during food processing was also shown by Aaby et al. [18].

Fermentation microflora can also determine the content of anthocyanins in fruits. Research by Bisakowska, Atwala, Gardnery, and Champagne [19] on flavonoids in onions showed that lactic fermentation affects the content and composition of these compounds. In addition, during the preparation of the fruit for pickling, the cherries were pitted, the plums were cut into two halves, and the pits were removed.

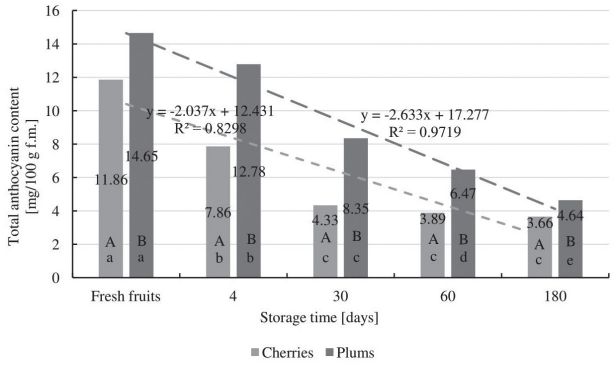

Fig. 1. Changes in the content of anthocyanin pigments during storage of pickled fruits.
Results are presented as mean, n = 6.
Mean values marked with different lowercase letters within the same product differ significantly by Tukey's test at $p<0.05$.
Mean values marked with different capital letters within the same time point differ significantly by Tukey's test at $p<0.05$.
Source: own study.

This could damage the cellular structure and increase the susceptibility of anthocyanins to enzymatic and non-enzymatic oxidation. The enzymes that degrade anthocyanin pigments may be native, present in plant tissue, or may be formed as a product of microbial contamination. Enzymes such as β-glucosidase, polyphenol oxidase, and peroxidase are mainly responsible for the decomposition of anthocyanins [17]. They can shape the content and composition of anthocyanins until they are deactivated by environmental factors of the fermentation process [20].

An important factor determining anthocyanins' stability is the process environment's pH. According to the literature, a pH below 4.0 favorably affects the stability of anthocyanins, while a pH close to neutral contributes to their degradation [14]. Unfortunately, the pH of the ensiling environment was not determined in the presented studies. However, this should be taken into account in further research.

The results of determinations of anthocyanin content (Fig. 1) allow us to conclude that the storage time significantly affected the level of these dyes, especially in the case of plums. Also, the reports of Khoo et al. [21] and Wiczkowski, Szawara-Nowak, and Topolska [14] indicated that the time and temperature of storage affect the kinetics of degradation of anthocyanin dyes.

In addition to storage time and temperature, the content of anthocyanins in pickled fruits during storage may also be influenced by other factors, such as the uncontrolled growth of microorganisms [14].

Vitamin C Content

The pickling of stone fruits also decreased vitamin C. After four days of pickling, the content of vitamin C reduced significantly ($p<0.05$), by about 23%, only in sweet cherries. In plums, however, this process caused an insignificant ($p>0.05$) reduction of this vitamin by about 10%. Pickled cherries contained 6.41 mg of vitamin C /100g, while plums contained 5.91 mg/100 g (Fig. 2). Tukey's test showed that the difference in the content of ascorbic acid between these fruits was not significant ($p>0.05$).

Storage of pickled fruit caused further degradation of L-ascorbic acid. In this case, however, more significant dynamics of unfavorable changes were identified during the storage of cherries (-0.9780) than plums (-0.7780) (Fig. 2). As in the case of anthocyanins, also after 180 days of storage, there was a significant decrease in the content of vitamin C in the analyzed fruits ($p<0.05$). In cherries, this vitamin was degraded at about 50%, and in plums at about 45% to the content in fresh fruits.

According to the literature, during lactic fermentation, vitamin C is synthesized by lactic acid bacteria, as a result of which pickled products should contain more of it than fresh ones. [22-23]. This can be confirmed by the research presented by Ipiroti [24], who

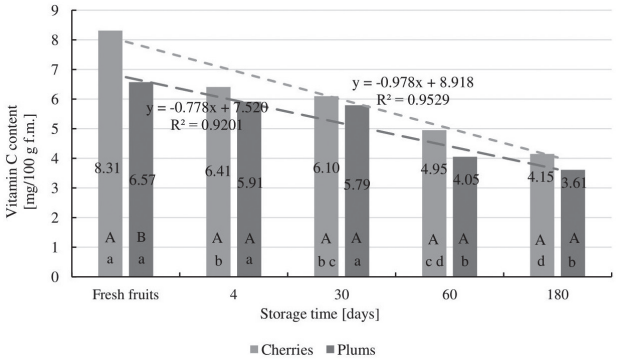

Fig. 2. Changes in vitamin C content during storage of pickled fruits.
Results are presented as mean, n = 6.
Mean values marked with different lowercase letters within the same product differ significantly by Tukey's test at $p<0.05$.
Mean values marked with different capital letters within the same time point differ significantly by Tukey's test at $p<0.05$.
Source: own study.

found a 2.5-fold increase in vitamin C content when pickling eggplants stuffed with cabbage and carrots compared to the product before pickling.

However, most researchers have found that this compound degrades during picking and storing plant-derived products. For example, Erdogan and Filiz [25], analyzing the effect of various pickling techniques on the antioxidant properties of fermented cabbage products, found a decrease in vitamin C content at 19% to 35%. Chun et al. [26], comparing the content of vitamin C in four varieties of fresh and sauerkraut, found a lower vitamin content in sauerkraut at the level of 42% to 66%. Di et al. [15], during the fermentation of leaf mustard, noted the degradation of L-ascorbic acid at 85%, while Ye et al. [27], during the production of *Paojiao* from chili peppers, did not find a significant decrease in the content of this vitamin. Ramli and Mohamad-Sadonn [28] also studied the effect of pickling fruits on their vitamin C content. They noted a significant reduction in ascorbic acid content during the guava pickling process.

Ascorbic acid is susceptible and unstable. Therefore, it is easily degraded to dehydroascorbic acid and then converted to 2,3-diketogulonic acid [27]. The intensity of this process is determined by many factors: alkaline or neutral pH, elevated temperature, presence of oxygen and metal ions. Enzymes also play an essential role in shaping the rate of vitamin C decomposition from the group of oxidases, especially ascorbate oxidase, which occur in plant tissues and are produced by microorganisms during fermentation. Their activity increases with the degree of damage to the tissues of the product of plant origin, which occurs during the processing or removal of seeds from fruits [3-27]. This would explain the decrease in vitamin C content in pickled and stored fruit.

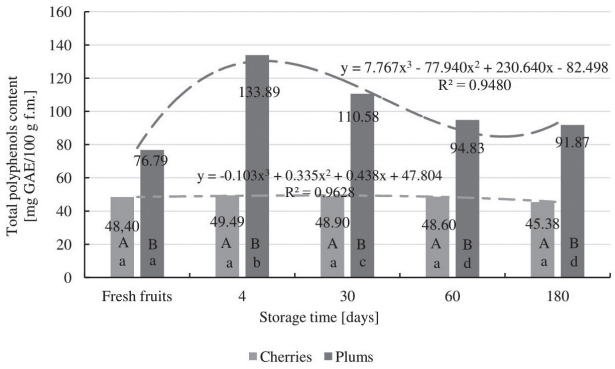

Fig. 3. Changes in the content of polyphenols during storage of pickled fruits.
Results are presented as mean, n = 6.
Mean values marked with different lowercase letters within the same product differ significantly by Tukey's test at $p<0.05$.
Mean values marked with different capital letters within the same time point differ significantly by Tukey's test at $p<0.05$.
Source: own study.

Total Polyphenols Content

The total polyphenols content also changed during the pickling and storage of stone fruits (Fig. 3). However, a different effect of pickling on changes in the content of these compounds was found than in the case of anthocyanin dyes and vitamin C.

The effect of four-day pickling was an increase in the content of polyphenols in both types of fruits. There was a slight ($p>0.05$) increase, by about 2%, from 48.40 mg GAE/100 g to 49.49 mg GAE/100g in cherries. In plums, however, this increase was significant ($p<0.05$) and amounted to about 74%, from 76.79 mg GAE/100 g in fresh fruits to 133.89 mg GAE/100g in pickled fruit (Fig. 3).

The polyphenols content gradually decreased during the storage of pickled cherries and plums. However, sweet cherries were characterized by lower dynamics of these changes. After 30 days of storage, the level of polyphenols decreased insignificantly ($p>0.05$) to 48.90 mg GAE/100g. A slight degradation of polyphenols occurred during further storage of the pickled cherries. After 180 days of storage, these fruits contained negligibly ($p>0.05$), by about 6%, less of these compounds than fresh cherries. A much higher dynamic of changes was noted in the case of plums. After 30 days, the gallic acid content decreased significantly ($p<0.05$) to 110.58 mg/100 g, and after 180 days, to 91.87 mg/100 g. However, it should be noted that after half a year of storage, pickled plums contained significantly more ($p<0.05$), by about 20%, total polyphenols than fresh fruit.

In their reports, other authors also showed an increase in the content of polyphenols in products of plant origin during pickling. For example, while pickling guava, Ramli and Mohamad-Sadonn [28] reported an almost 79% increase in polyphenolic compounds, with 760 mg GAE/100g d.m. up to 1360 mg GAE/100 g d.m.

Chan et al. [29], analyzing the effect of fermentation on the antioxidant properties and phenolic compounds of Bambangan (*Mangifera pajang*) fruit, also noticed a higher polyphenols content in pickled fruits. According to the cited authors, pickling resulted in a more than six-fold increase in the content of polyphenols. Fresh Bambangan fruits contained 7.06 mg GAE/g and pickled 44.69 mg GAE/g. Park et al. [30] reported that the content of polyphenols in mustard leaf kimchi increased during pickling from 474.8 mg GAE/g to 482.4 mg GAE/g. Still, after three months of storage, it decreased to 475.3 mg GAE/g, not showing a statistically significant difference compared to the product before pickling. Sayin and Alkan [31] also pointed to a decrease in polyphenol content during the storage of pickled vegetables. Assessing the effect of pickling on the total content of polyphenolic compounds in ten vegetables, they noted a decrease in the amount of polyphenols in pickled vegetables during 60-day storage. After this period, they found a significantly higher content of polyphenols in pickled vegetables than in fresh ones. A similar trend was also noted by Kapusta-Duch et al. [32], assessing the impact of the type of packaging on selected parameters of the nutritional quality of white sauerkraut. After three and four months of storage in refrigerated conditions, the authors noted a significant decrease in the content of polyphenols to the values determined before packaging.

One of the most important environmental factors determining polyphenols' amount and structural changes during lactic acid fermentation is pH. For example, fluctuations in pH between 2 and 7.5 significantly affect anthocyanin retention, with maximum stability around pH 1-2. Another phenol that is affected by pH is catechins. With an alkaline reaction, they are reduced by 70-80%. The amount and structure of the phenolic compounds may therefore change when the pH changes during fermentation [33]. The increase in the content of polyphenols during stone fruits pickling could also be caused by the release of polyphenols from the vacuole, in which they are mainly located, and from permanent connections with other food ingredients, which facilitated their extraction. Furthermore, the higher content of polyphenols in pickled fruits may also result from the enzymatic conversion of their glycosidic form to aglycone [23]. On the other hand, the decrease in the total amount of polyphenolic compounds during the storage of pickled products of plant origin could be caused by the degradation of phenolic compounds by the polyphenol oxidase produced [30].

Antioxidant Activity Using DPPH Assay

Along with changes in the content of bioactive compounds in the assessed fruits, their ability to reduce free radicals changed. A similar effect of pickling on the

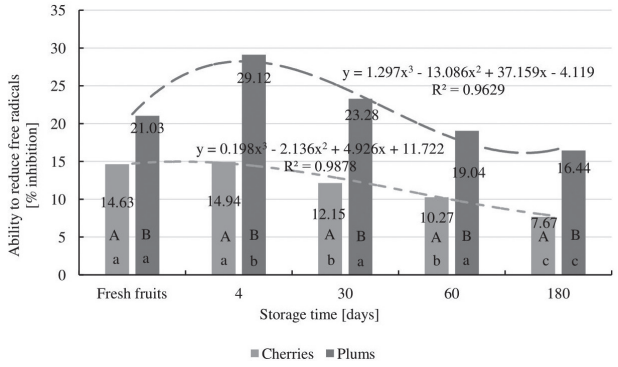

Fig. 4. Changes in antioxidant activity during storage of pickled fruits.
Results are presented as mean, n = 6.
Mean values marked with different lowercase letters within the same product differ significantly by Tukey's test at $p<0.05$.
Mean values marked with different capital letters within the same time point differ significantly by Tukey's test at $p<0.05$.
Source: own study.

ability to reduce free radicals was found, as in the case of the impact on polyphenols (Fig. 4).

Four-day pickling caused an insignificant ($p>0.05$), about 2%, increase in the antioxidant activity of sweet cherry fruit and a significant, almost 39%, increase in plum fruit ($p<0.05$).

During the storage of pickled fruits, the ability to absorb free radicals by them gradually decreased. After 180 days of storage, the tested fruits found a significantly ($p<0.05$) lower ability to reduce free radicals. For example, the ability of cherries to inhibit radicals decreased by about 48%, and of plums by about 22%, compared to fresh fruit after 180 days of storage (Fig. 4). The presented trends of changes in antioxidant activity expressed by the ability to absorb free radicals are consistent with the data presented in the literature on the subject. Park et al. [30] showed an increase in antioxidant activity during mustard leaf kimchi pickling, followed by a decrease. Studies conducted on pickled products of plant origin showed that fermentation increased the antioxidant activity of blueberries, mulberries, and apple pomace [31]. Kapusta-Duch et al. [32] found a decrease in the ability to absorb free radicals during the 4-month storage of sauerkraut.

The release of simple phenolic compounds may cause changes in the ability to absorb free radicals by pickled stone fruits due to acidic and enzymatic hydrolysis of polymerized phenolic compounds. In addition, lactic acid bacteria possess enzymatic and non-enzymatic antioxidant mechanisms and minimize the production of reactive oxygen species to levels that are harmless to the cell [31].

Such factors can also determine the level of antioxidant activity of fruits subjected to lactic fermentation as pH, temperature, solvent, fermentation time, and aerobic environment [30].

Conclusions

This article presents a pilot study on the effect of pickling and pickles storage on the stability of the pro-health potential of selected stone fruits. The results indicated a destructive impact of pickling on the content of anthocyanin pigments and vitamin C in fruits. On the other hand, pickling increased the content of polyphenols in preserved fruits and their ability to reduce free radicals. Storage of pickled cherries and plums resulted in a decrease in the content of bioactive compounds and the reduction potential towards free radicals. However, it was proved that after 180 days of storage, pickled plums were characterized by a significantly higher polyphenolic compound content than fresh fruit. However, in the case of cherries, there was a statistically insignificant decrease in the content of these compounds in relation to fresh fruit. Therefore, pickling stone fruits probably has a more beneficial effect on the stability of their health-promoting potential than other preservation methods, including freezing.

However, further research is needed to identify the impact of pickling and storage of pickled stone fruits on their health-promoting potential, taking into account other factors (environmental pH, extended storage time, and other stone fruits). Furthermore, the effect of pickling on the stability of health-promoting properties should also be compared with the impact of different preservation methods, e.g., freezing. In addition, a critical study that should still be carried out is the verification of the acceptability of pickled stone fruits by consumers.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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