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EFFECT OF UV-C IRRADIATION ON THE PHYSICOCHEMICAL CHARACTERISTICS OF POTATO TUBERS DURING STORAGE

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ABSTRACT. *The effect of UV-C irradiation treatments on the physico-chemical characteristics of potato, as well as on weight loss during storage, was studied. For this purpose, potato tubers were subjected to a UV illumination treatment with a UV LED lamp for 30 minutes, equivalent to a dose of 2.0 kJ/m2, and then stored by refrigeration at 4°C and 85% relative air humidity. The changes during storage were compared with a control variant consisting of potato tubers refrigerated under the same conditions. A substantial impact of UV-C irradiation of potato tubers on individual potato tuber size and weight was observed. It was found that UV-C irradiation resulted in a significant reduction in weight loss. UV-C irradiation resulted in water retention in the cells and delayed the tubers' sprouting during storage. In UV-treated tubers, the total polyphenol content decreased during the first 30 days of storage (50.31 mg GAE/100 g fw) and steadily increased to 57.5 mg GAE/100 g fw at the end of storage. As for the effect of UV radiation on antioxidant activity, this led to a less pronounced decrease in antioxidant activity, which at the end of storage recorded values of 0.78 mM Trolox/100g fw, with significant differences from untreated tubers. UV-C irradiation can be applied to potato tubers before storage to delay germination and extend shelf life.*

KEYWORDS: *potato, UV radiation, storage, total phenols, antioxidant activity.*

INTRODUCTION

The efficiency of potato cultivation ensures high area utilization for food production, an important feature in a global scenario of constant population growth. Potato is the fourth most important horticultural crop and contains a wide variety of phytochemical compounds (Brown 2008, Marwaha et al. 2010, Ezekiel et al. 2013). The potato has been widely accepted worldwide as a staple food and is available in many forms, but many consumers are unaware of the healthy attributes of tubers. Potatoes have a higher amount of dry matter and protein per unit surface area compared to cereals (Bamberg and del Rio 2005). Despite this, consumers tend to believe that the potato is high in calories and fat compared to other carbohydrate sources such as rice or pasta; an incorrect assumption because the potato has negligible fat content and low energy value, similar to vegetables (Priestley 2006). Potatoes are usually eaten cooked and most often eaten boiled and uncooked in many regions of the world. Consumers prepare potatoes in an overwhelming variety of methods. Baking, boiling, dehydrating, and roasting are used as cooking methods worldwide. Processing methods are discussed in many scientific papers (Woolfe and Poats 1987, Lisinska and Leszczynski 1989, Gopal and Khurana 2006). Polyphenolic compounds represent a large part of the antioxidant activity of potatoes and their extracts by scavenging and neutralizing free radicals and breaking down lipid peroxides (Cao and Tibbits 1997). Although phenolic compounds are major contributors to total antioxidant activity in four Italian early potato cultivars, carotenoids and ascorbic acid were also important contributors (Leo et al. 2008). Differences in antioxidant content were found depending on variety and location of production. Potato cultivars with highly pigmented red or purple flesh contain significant amounts of anthocyanins (Brown 2005). Antioxidant capacity is in direct correlation with the anthocyanin content of the potato (Brown et al. 2003). The main compound of the dry substance in the potato is starch. Other polysaccharides are also important for health benefits - fiber, hemicellulose, pectin, and others. The most important carbohydrates are sucrose, glucose, and fructose (Barta and Bartova 2008).

Starch content varies between 10 and 25% in the fresh matter. The sugar content of potato tubers is influenced by the variety, the maturity of the tubers at harvest, the influence of the year, and the storage temperature, which are very important. The effect of temperature during storage is important, especially in affecting the content of reducing sugars, glucose, and fructose, which at higher values contribute significantly to the deterioration of processed potato products. After keeping the tubers at low temperatures (2-3°C), an increase in reducing sugar content is observed, which is seen until the end of the storage period. Tubers stored at a higher temperature (8-10°C) do not accumulate sugars. Reducing sugar levels are maintained at an acceptable level. Slow growth occurs at the end of the storage period due to the ageing of the tubers (Mareček et al. 2015). For these reasons, potato tubers are highly important for health and are a necessary food vegetable. Therefore, maintaining the quality of tubers for as long as possible by keeping them fresh and preventing eye swelling or sprouting of tubers during storage is a current issue.

Irradiation of vegetables is an important method to reduce the load of microorganisms on their surface and extend their shelf life (Cueva et al. 2010). UV radiation is electromagnetic radiation with a shorter wavelength than the light radiation perceived by the human eye (Zamanian and Hardiman 2005). The spectrum of UV radiation ranges from wavelengths of 10 - 380 nm (1 nanometre = 10^{-9} m). The UV radiation with a maximum germicidal effect is UV-C in the wavelength spectrum of 254 nm (the point at which the nucleic acids of microorganisms have maximum absorption) (Tran et al. 2022). This radiation is surface sterilant, affecting microorganisms, especially bacteria and viruses. UV-C radiation has a disinfectant effect because it affects the DNA structures of microorganisms, causing a photochemical effect on thymine (Kalisvaart 2004). It dimerizes, meaning two adjacent information carriers are improperly ligated (Schreier et al. 2007). This molecular change means that DNA can no longer be used for the essential processes of transcription (metabolism) and replication (cell division). As a result, the micro-organism is inactivated and then dies. Exposure to UV-C radiation has been used as a post-harvest treatment of fruits and vegetables and is useful to delay fruit senescence and reduce fruit rot (Wang et al. 2009). These alter the expression of genes involved in cell wall degradation, delaying fruit and vegetable softening (Pombo et al. 2011). Studies using UV-C illumination on fresh horticultural products have focused on selecting appropriate doses for different species. Still, less attention has been paid to the effect of radiation intensity (Khan et al. 2022). Previous studies have shown that UV-C illumination on horticultural products and fresh storage has resulted in extended shelf life (Cote et al. 2013). The duration of UV-C illumination varies, with previous research indicating 30 minutes (to achieve a dose of 2.0 kJ-m-2) (Nour et al. 2021).

In this paper, we aimed to study the effect of ultraviolet (UV) radiation on the main physicochemical properties of potato tubers, as well as their shelf life and sprouting phenomenon during storage.

MATERIALS AND METHODS

The effect of UV-C illumination treatments on the physicochemical characteristics of the potato, as well as on weight loss during long-term storage, was studied. Potato tubers purchased on the local market were sorted and packed in 15 kg plastic bags. Two variants were established, namely: the control variant (M) consisted of keeping potato tubers under refrigerated conditions: 4°C temperature and 85% relative air humidity and the second variant (V1) where the potato tubers were subjected to UV illumination treatment with a UV LED lamp for 30 minutes, equivalent to a dose of 2.0 kJ/m^2 measured with a handheld digital UVC radiometer (TN-2254, Taine Co., Ltd., Taiwan, China). The UV lamp was placed 30 cm away from the potatoes. To do this, the potato tubers were placed in an insulated single-layer enclosure, and after 15 minutes, they were turned over, and the treatment was continued for another 15 minutes. Afterward, they were packed and stored under the same temperature conditions (4°C) and relative humidity (85%). For each variant, the amount of potato studied was 75 kg (5 bags). During storage, samples were taken to highlight the changes in physicochemical properties and the effect of UV-C illumination. Tubers were stored for 4 months, the experiments were performed in five replicates, and the results were expressed as mean ± standard error of the mean of the replicates.

Analytical methods

Determining the total dry matter (DM) is based on removing water by evaporation from the average analytical sample by keeping it in an oven at 85-105°C. The results are expressed as a percentage of total dry matter.

The total soluble solids content (TSS%) was determined by the refractometric method using a digital refractometer (Hanna Instruments, Cluj, România).
The principle of the method is based on the measurement of the refractive index of light by substances dissolved in water in the products analyzed.

The magnitude of the refractive index depends on the concentration of the substance being analyzed, the temperature, the thickness of the liquid layer, and the angle of incidence of light. The refractive index is determined at a temperature of 20°C. If the determination is carried out at another temperature, it is necessary to correct the results obtained. The results have been expressed in percent of TSS.

Titratable acidity was determined by extracting acids from products with water, boiling them, and neutralizing them with a strong base in the presence of phenolphthalein as an indicator. The results were expressed in g citric acid/100 g fm.

The total polyphenol content was determined by the Folin-Ciocalteu method described in a preceding study (Ionică et al. 2017). Folin-Ciocalteu reagent (2 N, Merck), gallic acid (99% purity, Sigma-Aldrich), and anhydrous sodium carbonate (99% Sigma-Aldrich) were used as reagents. One gram of potato homogenate was extracted with 15 ml of methanol in an ultrasonic bath for 60 minutes at room temperature. After extraction, samples were centrifuged for 5 min at 4200 rpm, and the supernatants were filtered through polyamide membranes with a pore diameter of 0.45 .mu.m and stored at -20°C. 100 µl of each methanolic extract was mixed with 5 ml of distilled water and 500 µl of Folin-Ciocalteu reagent. After 30 seconds to 8 minutes, 1.5 ml of sodium carbonate (20% v/v) is added. The mixture was diluted with distilled water to a final volume of 10 ml. Preparation of the standard solution of gallic acid followed the same procedure. Absorbance at each 765 nm was measured on a Varian Cary 50 UV spectrophotometer (Varian Co., USA) after a 30 min incubation at 40°C and the results were expressed as mg gallic acid (GAE)/100 g fresh substance. Antioxidant activity was measured in the methanolic extract using the DPPH (2,2-diphenyl-1-picrylhydrazyl) assay. Methanol (Merck, Germany), DPPH (2,2-diphenyl-1-picrylhydrazyl) (Sigma Aldrich, Germany), and Trolox (Merck, Germany) were used.

Sampling was performed according to the same protocol used for total polyphenol content. With some modifications, the free radical scavenging capacity of DPPH free radical extracts was determined, as described by Oliveira et al. (2008).

Each ethanolic potato extract (50 µl) was mixed with 3 ml of 0.004% (v/v) DPPH methanolic solution. The mixture was incubated for 30 min at room temperature in the dark, and the absorbance was measured at 517 nm on a Varian Cary 50 UV-VIS spectrophotometer.

DPPH free radical scavenging capacity was expressed as a ratio of Trolox (6-hydroxy2,3,7,8-tetramethylchroman-2-carboxylic acid), which was used as a standard reference to convert the scavenging capacity of each solution. A methanol/water control was used in each test.

Statistical analysis

All tests and analyses were performed in triplicate, and each sample's mean values were used for statistical analysis. To summarize the variability in the data sets, the standard deviation was used using Microsoft 365 Excel, and the data are presented as means ± SD.

A variance analysis was performed using the Polish median test to obtain more information than a simple p-value and to assess the interaction between the two factors (shelf life and UV-C irradiation) on weight loss and the chemical components. Statgraphics Centurion 18 software was used for this, and the results are presented in an adjacent table. These adjacent panels show the decomposition of each cell of the table (sweeping three times) into the following model: cell(i,j) = common + roweffect(i) + columneffect(j) + residual(i,j). It is similar to a two-way analysis of variance except that it bases the estimates of effects on medians rather than means.

RESULTS AND DISCUSSION

Determination of the physical properties of potatoes is necessary to analyze the heat and mass transfer during storage (Singh et al. 2006). Tuber size is also a varietal characteristic that gives clues to the cultivation technology implemented (Golmohammadi and Afkari-Sayyah 2013). The results on the evolution of the main physical properties of potato tubers during storage are presented in Tables 1, 2, and 3; the data presented in the tables represent the average of the repetitions carried out for each variant.

Table 1. Changes in the size of potato tubers of the studied variants during storage

Storage time (days)	Control			V1		
	D (mm)	D (mm)	H (mm)	D (mm)	D (mm)	H (mm)
0	58.2±3.06	47.8±2.65	79.1±3.93	58.2±2.8	47.8±2.65	79.1±3.90
30	55.1±3.02	45.0±2.38	75.3±3.87	57.1±2.81	45.9±2.40	77.9±3.84
60	54.2±2.98	43.7±2.16	75.2±4.11	55.3±2.95	44.2±2.48	76.6±3.85
90	52.3±2.93	41.6±2.18	73.9±4.07	53.6±2.68	41.7±2.19	76.2±4.05
120	50.9±2.54	39.2±2.06	72.6±3.67	52.4±2.58	39.1±2.23	75.1±3.91

At the beginning of the experiment, the average large tuber diameter was 58.2 mm, and the average small diameter was 47.8 mm. The average height of the potato tubers at the beginning of the experiment was 79.1 mm, with a size index of 61.77. The shape of the tubers was elongated ovate with a shape index of 1.36. During long-term storage, the size of the tubers decreased steadily in all of the tubers, both in the control and UV-treated varieties. This change in size, i.e., the size of the tubers during storage, is due to water loss from the tuber mass through evapotranspiration. However, the size of UV-treated tubers is relatively larger than that of untreated tubers at the end of storage. The change in the size of potato tubers can also be attributed to micro-mechanical changes in potato tuber tissues during storage (Nikara et al. 2020).

Table 2. Changes in size index (Im) and shape index (If) of potato tubers of the studied variants during storage

Storage time (days)	Control		V1	
	Size index	Shape index	Size index	Shape index
0	61.77±3.05	1.36±0.06	61.77±3.08	1.36±0.05
30	58.52±3.25	1.36±0.05	60.35±3.17	1.36±0.06
60	57.77±3.20	1.38±0.07	58.76±3.09	1.38±0.07
90	55.99±2.96	1.41±0.06	57.20±2.88	1.41±0.07
120	54.27±2.87	1.42±0.08	55.58±2.78	1.43±0.07

Changes in tuber size during storage result in altered size index (Table 2) and shape index. It is found that the size index decreased during storage, with significant differences from the beginning of the storage (Size index = 61.77 at the beginning of storage, respectively, Size index = 54.27÷55.58 after 120 days of storage). As in the case of dimensions, there are differences in the size index between the two variants, i.e., the UV-treated and the untreated variant (Size index =54.27 in the untreated variant, respectively Size index =55.58 in the UV-treated variant). However, it is observed that the shape index of the tubers increased throughout the storage of the tubers in both variants. Thus, it can be concluded that the dimensional changes of the tubers led to an elongation of the tubers during storage. There are no significant differences between the two variants studied.

As regards the variation of the individual weight of potato tubers during storage, it can be observed that it decreased continuously during the 120 days of storage (Table 3), with significant differences at the end of storage (96.8 g for the untreated variant, 104.8 g for the UV-treated variant) compared to the beginning of storage (136.7 g). The decrease in the individual weight of potatoes was higher in the first two months of storage, which is consistent with the data presented by Picha (1986). It can also be seen that the weight loss during storage is higher in untreated potatoes than in those treated with UV radiation, with significant differences between the two variants. The same pattern is observed for the individual volume of the tubers, while their specific weight did not vary significantly during the storage.

As to the weight losses registered during the storage of the potatoes, it can be observed that these losses increased during the 120 days of storage (Table 4).

Table 3. Changes in the individual weight, volume, and specific weight of potato tubers of the variants studied during storage

Storage time (days)	Control			V1		
	Weight (g)	Volume (cm^3)	Specific weight (g/cm^3)	Weight (g)	Volume (cm^3)	Specific weight (g/cm^3)
0	136.7±6.80	131.7±6.92	1.03±0.05	136.7±6.78	131.7±6.56	1.03±0.06
30	118.6±5.90	116.4±6.12	1.01±0.06	130.1±7.20	131.9±6.59	0.98±0.04
60	113.9±5.99	107±5.64	1.06±0.05	124.6±6.55	118.2±5.91	1.05±0.05
90	103.8±5.17	98.4±4.83	1.05±0.06	113.6±6.30	107.2±5.61	1.05±0.05
120	96.8±4.80	89.3±4.96	1.08±0.05	104.8±5.51	100.9±5.04	1.03±0.06

Table 4. Weight losses of potato tubers in the studied variants during storage (%) (* The effects of the storage period are in the right column. Effects of UV-C irradiation are in the bottom row. The global effect (UV-C irradiation + storage period) =7.19 is shown at the extreme end of the last row).

Variant	After 30 storage days (%)	After 60 storage days (%)	After 90 storage days (%)	After 120 storage days (%)
Control	3.13±0.15	7.72±0.40	15.45±0.85	26.02±1.29
V1	2.21±0.12	6.66±0.33	13.13±0.63	19.7±1.02

Variant	After 30 storage days	After 60 storage days	After 90 storage days	After 120 storage days	After 30 storage days	***Storage time effect***
Control	-0.07	0.0	0.63	2.63	-0.07	0.53
V1	0.07	0.0	-0.63	-2.63	0.07	-0.53
UV_C Iradiation effect	-4.52	0.0	7.1	15.67	-4.52	7.19

The highest weight losses were recorded in the last 30 days of the storage period when the non-UV-treated version showed values above the limits allowed by the standards in application (26.02%). These are due to water loss through evapotranspiration but probably also to the swelling of the eyes on the surface of the tubers (sprouting). These data are consistent with data presented by Ezekiel et al. (2004) on some potato varieties grown in India and stored for 120 days. Regarding the influence of UV radiation treatment on the potato tubers, it was found that these treatments led to a significant reduction in weight loss, which was higher in the last part of the storage. The results of the experiment carried out, which showed a decrease in weight loss measured after three months of storage, are achieved by UV-C irradiation of potato tubers before storage and are similar to the results obtained for early and semi-early varieties (Vineta and Ditta) and described by Jakubowski (2018). The tests carried out in this study, and the results obtained allowed a decrease in weight loss and a delay in the swelling of the eyes and the start of their sprouting (Jakubowski and Królczyk 2020). The results of the variation in dry matter (DM %) content of the potato tubers during storage are shown in Table 5.

Table 5. Changes in dry matter (DM %) content of the potato tubers of the studied variants during storage (* The effects of the storage period are in the right column. Effects of UV-C irradiation are in the bottom row. The global effect (UV-C irradiation + storage period) =24.335 is shown at the extreme end of the last row).

Variant	0 storage days (%)	After 30 storage days (%)	After 60 storage days (%)	After 90 storage days (%)	After 120 storage days (%)
Control	25.11±1.33	22.82±1.42	24.85±1.30	25.22±1.40	28.67±1.56
V1	25.11±1.33	21.59±1.13	23.82±1.19	22.98±1.27	24.97±1.25

Variant	After 30 storage days	After 60 storage days	After 90 storage days	After 120 storage days	After 30 storage days	***Storage time effect***
Control	-0.615	0.0	-0.1	0.505	1.235	0.615
V1	0.615	0.0	0.1	-0.505	-1.235	-0.615
UV_C Iradiation effect	0.775	-2.13	0.0	-0.235	2.485	24.335

On introduction to storage, the total dry matter content of the tubers was 25.11%, values significantly higher than those presented by Cédric Camps and Norosoa Camps (2019) for the varieties *Innovator*, *Lady Claire,* and *Markies*. During storage, the total dry matter content increased up to 28.67%. From the collected data, it can be observed, for both variants, that during the first 90 days of storage, the total dry matter content remained almost constant or even decreased (UV-treated variant) and then increased slightly during the last 30 days of storage, which is in line with the data presented by Cédric Camps and Norosoa Camps (2019), who reported values higher than 37% for the *Innovator, Lady Claire* and *Markies* varieties. As regards the effect of UV radiation on the variation of the total dry matter content, from the data presented, it can be seen that the treatment applied resulted in the maintenance of the DM content at almost constant values during the 120 days of storage, correlated with the retention of water in the cells and the limitation of the water loss through evapotranspiration. The results concerning the total soluble solids content (TSS %) and titratable acidity of the potato tubers are shown in Tables 6 and 7.

Table 6. Changes in TSS content (%) of the potato tubers during storage (* The effects of the storage period are in the right column. Effects of UV-C irradiation are in the bottom row. The global effect (UV-C irradiation + storage period) =5.24 is shown at the extreme end of the last row)

Variant	0 storage days (%)	After 30 storage days (%)	After 60 storage days (%)	After 90 storage days (%)	After 120 storage days (%)
Control	5.24±0.25	4.72±0.24	5.24±0.23	6.1±0.32	6.32±0.30
V1	5.24±0.025	5.12±0.26	4.74±0.24	4.71±0.23	5.67±0.30

Variant	After 30 storage days	After 60 storage days	After 90 storage days	After 120 storage days	After 30 storage days	***Storage time effect***
Control	-0.25	-0.45	0.0	0.445	0.075	0.25
V1	0.25	0.45	0.0	-0.445	-0.075	-0.25
UV_C Iradiation effect	0.0	-0.32	-0.25	0.165	0.755	5.24

Table 7. Changes in Titratable acidity (g citric acid/100 g f.w.) of the potato tubers during storage (* The effects of the storage period are in the right column. Effects of UV-C irradiation are in the bottom row. The global effect (UV-C irradiation + storage period) =1.44 is shown at the extreme end of the last row)

Variant	0 storage days	After 30 storage days	After 60 storage days	After 90 storage days	After 120 storage days
Control	1.6±0.07	1.6±0.06	1.6±0.06	1.6±0.07	1.6±0.06
V1	1.6±0.07	1.6±0.08	0.9±0.05	1.2±0.06	1.2±0.06

Variant	After 30 storage days	After 60 storage days	After 90 storage days	After 120 storage days	After 30 storage days	***Storage time effect***
Control	-0.16	-0.16	0.16	0.0	0.0	0.16
V1	0.16	0.16	-0.16	0.0	0.0	-0.16
UV_C Iradiation effect	0.16	0.16	-0.16	0.0	0.0	1.44

At the beginning of the storage, the content of tubers in TSS was 5.24%. During the first 60 days of storage, the TSS content remained almost constant without significant differences, and then, during the last 30 days of storage, it increased sharply, reaching values of 6.32% in the untreated variant at the end of the storage. The data are consistent with those reported by Kirli et al. (2022), who reported values of 6.60% after 60 days of storage. Regarding the influence of UV radiation treatment, it was found that the treated tubers had a lower increase in TSS content than the untreated variant, with values of 5.67%. The increase in TSS content can also be attributed to the hydrolysis of the starch during the storage process, resulting in mono-glucids, which pass into the cell juice and are then used up by respiration. The titratable acidity (citric acid) level quantifies the concentration of organic acids present in food (De Oliveira et al. 2019). When potato tubers were placed in storage, they had a value of 1.6 g ac. citric/ 100 g f.w. This value remained constant during the 120 days of storage in the non-UV-treated variant. In the UV-treated variant, the titratable acidity decreased during the last 60 days of storage up to 1.28 g ac. citric/ 100 g f.w., the results being in agreement with those presented by Ierna et al. (2022). The results on the content of the potato tubers in total phenols (TP) and their antioxidant activity (AOA) are presented in Tables 8 and 9.

Table 8. Changes in total phenolic content (TP) of the potato tubers of the studied variants during storage (* The effects of the storage period are in the right column. Effects of UV-C irradiation are in the bottom row. The global effect (UV-C irradiation + storage period) =55.31 is shown at the extreme end of the last row)

Variant	0 storage days	After 30 storage days	After 60 storage days	After 90 storage days	After 120 storage days
Control	56.56±2.80	56.25±2.78	55.62±2.95	54.37±2.86	53.12±2.77
V1	56.56±2.80	50.31±2.64	54.06±2.85	56.25±3.12	57.50±3.19

Variant	After 30 storage days	After 60 storage days	After 90 storage days	After 120 storage days	After 30 storage days	***Storage time effect***
Control	0.0	2.97	0.78	-0.94	-2.19	0.0
V1	0.0	-2.97	-0.78	0.94	2.19	0.0
UV_C Iradiation effect	1.25	-2.03	-0.47	0.0	0.0	55.31

At the beginning of storage, the total phenolic content of potato tubers was 56.56 mg GAE/100 g fw. It remained almost constant during the first 30 days of storage, after which it decreased slightly in the untreated variant, reaching values of 53.12 mg GAE/100 g fw, at the end of the storage. In the UV-treated variant, immediately after the treatment, the total polyphenol content decreased during the first 30 days of storage (50.31 mg GAE/100 g fw.) and then steadily increased to 57.5 mg GAE/100 g fw, at the end of storage. The decrease in total phenolic content in the first 30 days of storage is probably due to the effect of UV radiation on the tubers. Kirli et al. (2022) mention that the total value of phenolic compounds decreased with increasing storage time. They found that untreated tubers lost more total phenolic compounds than the tubers treated by spraying with chitosan before introduction to the storage. It is thus found that UV treatment of the potato tubers before storage keeps their total phenolic content almost constant, even leading to a slight increase at the end of storage.

Table 9. Changes in the antioxidant activity (AOA) of the potato tubers of the studied variants during storage (* The effects of the storage period are in the right column. Effects of UV-C irradiation are in the bottom row. The global effect (UV-C irradiation + storage period) =0.77 is shown at the extreme end of the last row)

Variant	0 storage days	After 30 storage days	After 60 storage days	After 90 storage days	After 120 storage days
Control	0.87±0.04	0.76±0.05	0.68±0.03	0.52±0.02	0.50±0.02
V1	0.87±0.04	0.91±0.04	0.86±0.04	0.81±0.04	0.78±0.03

Variant	After 30 storage days	After 60 storage days	After 90 storage days	After 120 storage days	After 30 storage days	***Storage time effect***
Control	0.09	0.015	0.0	-0.055	-0.05	-0.09
V1	-0.09	-0.015	0.0	0.055	0.05	0.09
UV_C Iradiation effect	0.1	0.065	0.0	-0.105	-0.13	0.77

In correlation with the potato's phenolic compounds, the focus has been on the antioxidant capacity (Kammoun et al. 2022, Brown 2005). It is known that the antioxidant activity of the potato decreases with increasing storage time, as is the case for the total phenolic compounds (Kirli et al. 2022). The same can be seen from the results presented for both experimental variants. At the beginning of the storage, the antioxidant activity of potato tubers was 0.87 mM Trolox/100 g fw, reaching, after 120 days of storage, the value of 0.50 mM Trolox/100g fw in the control variant. As regards the effect of UV radiation on potato tubers, it can be observed that it led to a less pronounced decrease in antioxidant activity, which at the end of storage recorded values of 0.78 mM Trolox/100g fw with significant differences compared to untreated tubers. It was also found that UV radiation had an increasing effect on the antioxidant activity of the tubers immediately after the treatment and the first 30 days of storage, after which it resumed its characteristic decreasing pattern.

CONCLUSIONS

A significant impact of UV-C irradiation of the potato tubers on the dimensions and individual weights of the potato tubers was observed, the change being less abrupt compared to the untreated variant. A reduction in weight loss of potato tubers due to transpiration and respiration compared to the non-UV treated sample was shown. UV-C radiation resulted in delayed tuber germination during storage. The UV-C treatment favored the maintenance of water in the cells and the total dry matter and soluble dry matter content at optimal values. UV-C radiation helped to maintain total phenolic and antioxidant activity in potato tubers, with less loss of these bioactive principles during storage. The result of the experiment indicates that the proposed physical UV-C method can be applied in practice and can be used as a way to reduce natural defects in stored potato tubers and even as a method to extend the shelf life of potato tubers.

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