Experimental UV-C light apparatus built to saniteze food surfaces: a study on starwberries fruits.

POSTER
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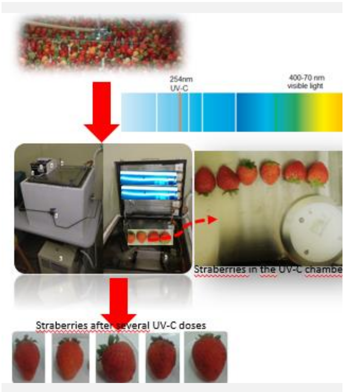

This work aimed to build and to evaluate the effect of the UV-C light to sanitize food surface using strawberries as model. Process parameters such as temperature increase and radiation doses to reduce the surface contamination without to affect the fruit structure were evaluated. Thus, physicochemical qualities parameters and fungal development on the surface were analyzed using several doses on strawberries, at 10 °C and 20 °C. After that, treated fruits were stored at 10 °C for five days. Qualities parameters such as color, firmness, pH and total soluble solids (TSS) of the strawberries submitted to UV-C treatment showed better results at 1.44 kJ.m^{-2} and 2.8 kJ.m^{-2} doses at 10 °C. The production of phenolic compounds and antioxidant activity was induced by UV-C light, mainly and doses of 1.44 kJ.m^{-2}. UV-C doses presented reductions of molds count at both temperatures when to compare the control sample. The UV-C radiation technology and the food irradiation system developed in the present work can be used successfully in prolonging the shelf life of fresh strawberries.
Keywords: UV-C radiation, Strawberry, Quality

Introduction

Ultraviolet radiation (UV) is a physical disinfection technique that comprises a wavelength range of 100 to 400 nanometers when UV-C it is between 200 – 280 nm, It is used for fresh foods and vegetable and also for water treatment. One of the advantages of this technology is that it does not alter the sensorial characteristics of the fruit and does not generate waste, therefore it can be used as sanitezing on fruits [1].The equipment to apply UV is generally low-cost, using low-pressure mercury germicidal lamps, operating in the 254 nm range, being effective in inactivating microorganisms . Because strawberries are a highly perishable fruit, with post-harvest losses of up to 40%, they were chosen as a model to validate the equipment developed in the present work due to their fragile physical characteristics and difficulty in handling [2].. Although UV-C light is a clean technology and capable of reducing losses due to microbial contamination, it is important to study the radiant dose so that physical characteristics and/or burning on the fruit surfaces do not occur. Thus, this study aimed to develop an experimental UV-C radiation apparatus to sanitize food products, using strawberries as a model system.

Material and Methods

UV-C iradiation chamber built is shown by Figure 1.
In order to avoid the influence of the environment, a reduced irradiation area was used and the sample distribuition inside the chamber was always the same position. Several UV-C doses test were perfomed to evalute the apparatus work using a radiometer.

UV-C assays

The strawberries (Fragaria x ananassa Duch) were purchased at the local market, in the city of Florianópolis – SC and kept refrigerated at 7-8 ºC until use. To apply UV-C, the fruits were placed in the chamber 10 cm from the lamps and at 10 and 20 ºC. During the experiments, the fruits were rotated to ensure uniform exposure to UV-C radiation. After the treatments, control samples (without tretaments and UV-C samples) were kept under refrigation conditions at 10 ºC and 90% RH, for 5 days. The quality control of fruits were performed by firmness, color, pH, TSS and visual fungal develpment.

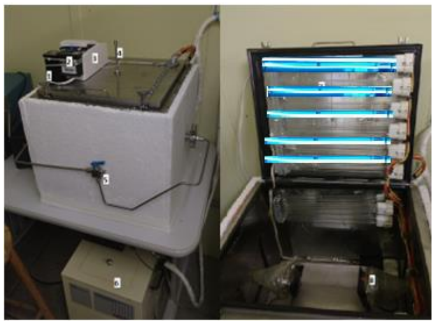

Figure 1: UV-C light chamber irradiation: 1) temperature display (Digimec – BTC 9090); 2) Microprocess (TT-34); 3) adjustors; 4) Termocouple-j; 5) Valve control (Hoke); 6) Thermobath); 7) UV-C-lamp ; 8) Cooler (Intel).

. UV-C treatments on strawberries surface

UV-C experimental conditions for strawberries after the chamber test and works were: 1.44 and 2.80 kJ.m^{-2} doses at 10 °C and 20 °C, perfomed four tretaments

Results and Discussion

Physycal-chemical parmeters: Color, pH, TSS Statistically, there were no significant differences for parameters a* and b* between treatments with UV-C radiation ($p < 0.05$), and control after UV-C tretament and during the storage time, for both UV-C doses, at 10 ºC. However, there signficant diffence for samples at 20 ºC. Total soluble solids showed significance difference betwen the UV-C treatemnets and control samples, Table 2 shows the strawberries quality parameters, obtained for irradiated strawbweriies during the storage period

Strawberries with a pH lower than 3.5 are the most used industrially. and for fresh consumption, preference is given to low-acid fruits. Thus highlighting the advantages of using UV-C post-harvest.Throughout the storage period, treatments with higher doses of UVC (T2 and T4) did not show a significant difference ($p < 0.05$). A slight reduction in pH values from the third to the fifth of storage was also observed for all treatments except for T1.Figure 2 shows the influence of the UV-C light in the antioxidants compunds of the strawberries. Immediately after the application of UV-C light, the values for antioxidant activity in treated fruits are higher when compared to the control, mainly for T1 treatment. which showed around 80% DPPH inhibition. However, it is observed that there is no significant difference between the control and treatments with T2 and T3 ($p < 0.05$). At the end of five days of storage, all UV-C treatments showed values higher than the control being the best result obtained for T2 treatment. The control fruits showed a reduction in antioxidant activity over the days evaluated, resulting in the lowest values at the end of the experiment.

Phenolics compounds content increased after the radiation and during the storage. UV-C treatment stimulates defense mechanisms, promoting the development of various phenolic compounds such as flavonoids. Among its characteristics, it inhibits microbial development and stimulates the transcription of genes for the production of defense enzymes, such as the enzyme Phenylalanine Ammonialyase (PAL), with significant antifungal activity.

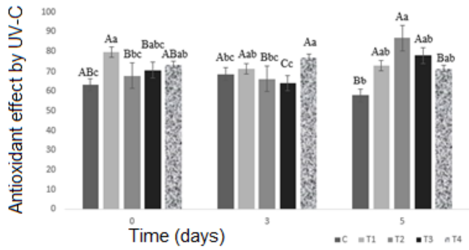

Figure 2: Atioxidant activit of the strawberries

Table 1: pH, total soluble solids (TSS) and of the strawberries treated by UV-C at 10 ºC and 20 ºC stored by 5 days.

		Storage conditions 10 ºC 90-95 %RH		
	Treatments	0 day	3 day	5 day
pH*	C	3.30±0.03^{Bb}	3.36±0.02^{Ab}	3.31±0.06^{Bbc}
	T1	3.37±0.07^{Bab}	3.36±0.04^{Bb}	3.49±0.18^{Aa}
	T2	3.38±0.02^{Aab}	3.41±0.10^{Aab}	3.40±0.07^{Aab}
	T3	3.55±0.25^{Aa}	3.51±0.20^{Aa}	3.28±0.08^{Bc}
	T4	3.38±0.12^{Aab}	3.38±0.02^{Ab}	3.35±0.02^{Abc}
TSS (ºBRIX)*	C	5.03±0.15^{Aa}	5.38±0.31^{Aa}	5.2±0.65^{Aa}
	T1	4.05±0.1^{Ab}	4.13±0.55^{Ab}	4.15±0.4^{Ab}
	T2	4.0±0.03^{Ab}	3.83±0.48^{Ab}	4.23±0.63^{Ab}
	T3	4.86±0.08^{Ba}	4.61±0.78^{Bab}	3.6±0.55^{Ab}
	T4	4.16±0.16^{Bb}	4.10±0.44^{Bb}	3.78±0.11^{Ab}
Phenolic compounds* (mg EAG/100 g of samples)	C	53.6±0^{ABb}	59.6±0.56^{Ab}	50.2±1.22^{Bb}
	T1	66.5±1.05^{Aa}	67.5±0.01^{Aa}	62.2±0.84^{Aa}
	T2	66.1±0.23^{Aa}	68.2±1.69^{Aa}	69.1±0.27^{Aa}
	T3	61.4±0.18^{Bab}	55.3±2.73^{Bb}	68.3±0.18^{Aa}
	T4	54.4±0.37^{Bb}	67.4±0.47^{Aa}	50.1±0.84^{Bb}

Means followed by the same capital letter in the line do not differ from each other for storage periods ($p < 0.05$). *Averages followed by the same lowercase letter in the column do not differ from each other for treatments ($p < 0.05$). T1/T2 (10°C), T3/T4 (20°C) both at 1.4/2.80 kJ.m^{-2},

Conclusions

The UV-C radiation on strawberries increased the phenolic content and antioxidant activities, showing a correlation between total phenolic and antioxidant activity. However, for fresh products some challenge such as temperature control and uniform treatment needs to be solved.

Acknowledgments: CNPq , Capes, PPGEAL-UFSC

References

[1] Li, M., Li, X., Han, C., Ji, N., Jin, P., Zheng, Y., *J. Agric. Food Chem,* 67, 4043, 2019.

[2] ERKAN, M., WANG, S. Y., WANG, C. Y. **Postharvest Biology and Technology**, 48, 163, 2008