

Xenon Corporation

Vitamin D Formation from Post-Harvest Pulsed Light Treatment of Mushrooms



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The objective of this research was to study the effects of high peak intensity pulsed light on the vitamin D formation in Portabella and White Whole mushrooms.

INTRODUCTION

Research shows that vitamin D enhances the absorption of calcium and magnesium – making it critical for healthy bones and teeth. New studies are reporting vitamin D will also reduce the risk of breast cancer, colon cancer, prostate cancer, autoimmune disease and cardiovascular disease. However, there is increasing concern that a critical deficiency of vitamin D exists in infants and adults. Adding to that concern are studies that suggest there is a need to increase the current Daily Value (DA).

MATERIALS AND METHODS

Portabella and Whole White Mushrooms were obtained from local food retailers and stored in refrigeration. Prior to testing, all mushrooms were taken out of refrigeration to bring them to room temperature ranging from 70°F to 79°F. The diameter of the Portabella mushrooms ranged from 4.79" to 5.26". The diameter of the Whole White Mushrooms ranged from 2.11" to 2.3". A total of 5 Portabella and 5 Whole White Mushrooms were treated.

EXPERIMENTAL DESIGN

For commercial-scale production, treatment times need to be as short as possible. Tests were conducted to investigate vitamin D formation with pulsed light applied in under 1 second. With a pulse rate of 3 pulses per second, exposures for different mushrooms were set at 0 (control mushroom), 1, 2 and 3 pulses. Further, two pulsed light lamps were used with different spectra. Type C lamp has a spectrum extending into the UVC region; Type B lamp has a spectrum which cuts off at the UVB region.

EXPOSURE TO PULSED LIGHT

Each mushroom was placed 1.25" below the lamp housing window at the center of a chamber containing a 16" flashlamp. A control until, containing power supply, pulse forming network and timing control, was set to individually expose mushrooms to 1, 2 or 3 pulses. Pulse rate was set at 3 pulses per second. Electrical configuration is shown in Table 1. Tests were first performed using a type C lamp with 1, 2, 3 pulses. Tests were then done using a Type B lamp and 2 pulses.

Sample #	Electrical Energy - Joules/pulse	Number of Pulses (1)	Lamp Type (2), (3)	BB Energy Read/Pulse J/cm ²	BB Energy Integrated J/cm ²	Act-5 Sed 240 Read/pulse J/cm ²	Act-5 Sed 240 Integrated J/cm ²
1-port-1C	505	1	C	1.12	1.12	0.0319	0.0319
2-port-2C	505	2	C	1.12	2.24	0.0319	0.0638
3-port-3C	505	3	C	1.12	3.36	0.0319	0.0957
4-port-2B	505	2	B	0.873	1.746	0.0343	0.0686
5-port-control	505	0	N/A	0	0	0	0
6-white-1C	505	1	C	1.12	1.12	0.0319	0.0319
7-white-2C	505	2	C	1.12	2.24	0.0319	0.0638
8-white-3C	505	3	C	1.12	3.36	0.0319	0.0957
9-white-2B	505	2	B	0.873	1.746	0.0343	0.0686
10-white-control	505	0	N/A	0	0	0	0

(1) Pulse rate set at 3 pulses/second

(2) Type "B" lamp does not produce ozone : part number 890-1958

(3) Type "C" lamp produces some ozone : part number 890-1957

Table 1 Pulsed Light System Settings

SYSTEM

Xenon Corporation model RC-847 Controller and 16" Linear Lamp Housing, model LH-840 were used in this study. Controller provides for manual selection of pulse number via a front panel setting. Internal power supply, pulse forming unit and pulse rate were factory set. The lamp housing was mounted in a stainless steel chamber to facilitate ease of placement of each mushroom on a removable tray, just below the lamp housing window.



VITAMIN D ANALYSIS

Following exposure, all mushrooms were shipped to Medallion Laboratories (Minneapolis, MN) for vitamin D analysis. Test results were expressed as Vitamin D Total, IU (international units) per 100 grams. Depending upon the number of pulses, total vitamin D in each mushroom ranged from 71% to 181% DV (Daily Value*) for Portabella mushrooms and 183% to 538% for White Whole mushrooms (Table 1).

* DV = 400 IU

Control	Lamp	IU	% DV
<i>Portabella control</i>	<i>N/A</i>	<i>30</i>	<i>8%</i>
<i>Sliced White Whole control</i>	<i>N/A</i>	<i>20</i>	<i>5%</i>
Portabella			
<i>1-pulse</i>	<i>C</i>	<i>285</i>	<i>71%</i>
<i>2-pulses</i>	<i>C</i>	<i>554</i>	<i>139%</i>
<i>2-pulses</i>	<i>B</i>	<i>724</i>	<i>181%</i>
<i>3-pulses</i>	<i>C</i>	<i>456</i>	<i>114%</i>
Sliced White Whole			
<i>1-pulse</i>	<i>C</i>	<i>734</i>	<i>183%</i>
<i>2-pulses</i>	<i>C</i>	<i>2106</i>	<i>526%</i>
<i>2-pulses</i>	<i>B</i>	<i>1541</i>	<i>385%</i>
<i>3-pulses</i>	<i>C</i>	<i>2151</i>	<i>538%</i>

Table 2 Vitamin D Content in Fresh Mushrooms Exposed to Pulsed Light

CONCLUSIONS

Results of this study indicate that mushrooms exposed to pulsed light for under 1 second produce vitamin D in amounts greater than 100% Daily Value.

Research continues at Pennsylvania State University to investigate the effectiveness of pulsed light on other mushrooms varieties.