

# Effects of Low-Dose Irradiation on the Quality of Fresh Table Grapes

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# Phytosanitary Treatment

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- ▶ **Methyl Bromide**
  - ▶ Chemical fumigant
  - ▶ Highly effective
  - ▶ Being phased out – harmful to ozone layer



# Irradiation

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- ▶ Gaining use all over the world as a phytosanitary treatment (Hallman, 2011)
- ▶ Leaves no residues
- ▶ Irradiation breaks the bonds in DNA of pests
  - ▶ Death
  - ▶ Unable to develop further
  - ▶ Unable to reproduce



# Objective

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- ▶ Measure the effects of low-dose irradiation up to 800 Gy on physical and sensory quality of fresh table grapes (*Vitis vinifera*)



# Experimental Methods

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Grapes shipped to Sterigenics;  
Treated 10 days from harvest – 0, 400, 600, and 800 Gy

Grapes shipped to Chapman University; held in cold storage (3°C)

Grapes evaluated at **Day 7** and **Day 21** from treatment

## **Analytical Measurements**

Brix  
Titratable Acidity (TA)  
Texture – 2 different methods  
Color

## **Sensory Evaluation**

Trained Panel: Descriptive Testing  
Consumer Panel: Affective Testing

# Titratable Acidity & Brix

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- ▶ TA: 5 ml of fresh juice + 50 ml of CO<sub>2</sub> free water + indicator
  - ▶ Titrated with 0.1 N NaOH to end point of pH 8.2
  
- ▶ Brix: few drops of juice on a refractometer



# Texture – Firmtech 2

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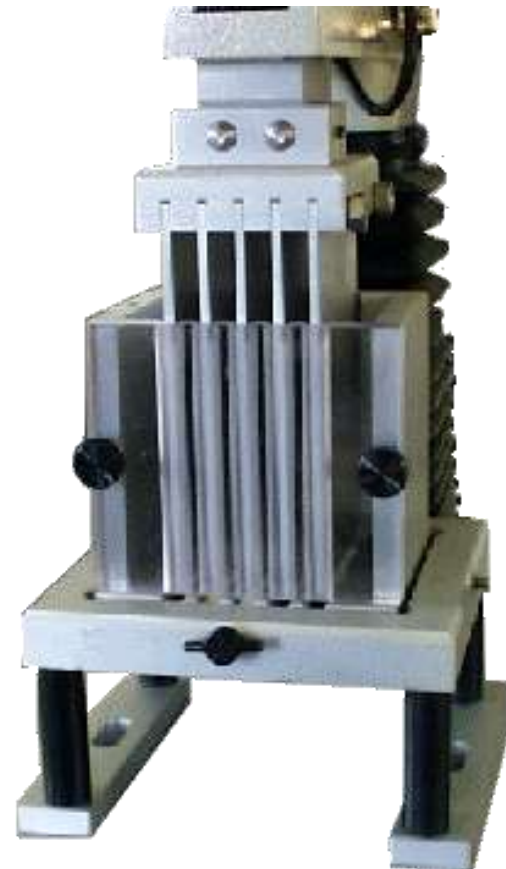
- ▶ Measures compression firmness
- ▶ Industry standard
- ▶ 200 grape berries per dose



# Texture – Shear force

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- ▶ TA-XTPlus Texture Analyzer with Kramer Shear (TA-91)
- ▶ 150g – 6 measurements per dose





# Color

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- ▶ Konica Minolta Spectrophotometer 2500d
- ▶ 50 berries, once on each side



# Sensory Measurements

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## ▶ Trained Panel

### ▶ Descriptive Testing:

15-point unstructured scale from none-to-intense

▶ Focused on key attributes of grapes that might have changes

## ▶ Consumer Panel

### ▶ Affective Testing:

9 point hedonic scale

▶ Appearance

▶ Flavor

▶ Texture

▶ Juiciness

▶ Overall Liking

Like Extremely

Like Very Much

Like Moderately

Like Slightly

Neither Like nor Dislike

Dislike Slightly

Dislike Moderately

Dislike Very Much

Dislike Extremely

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# Results

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Day 7

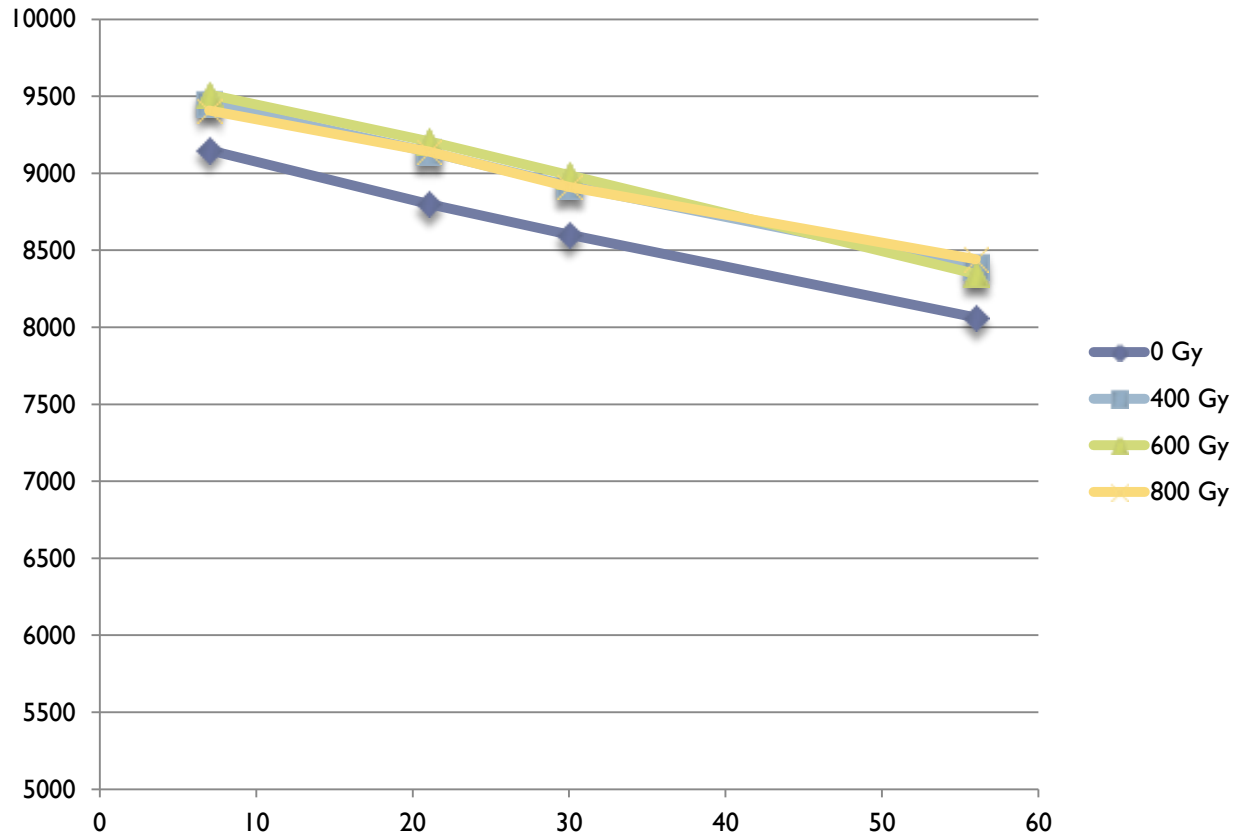


Day 21



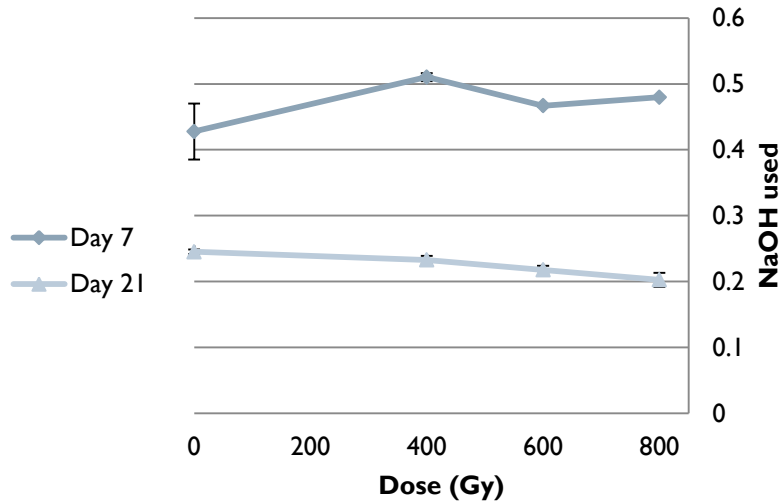
# Results – Weight Loss

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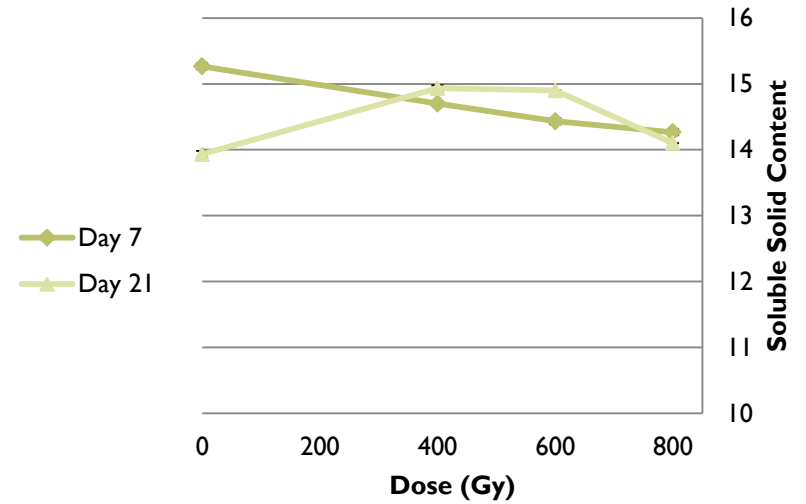


# Results

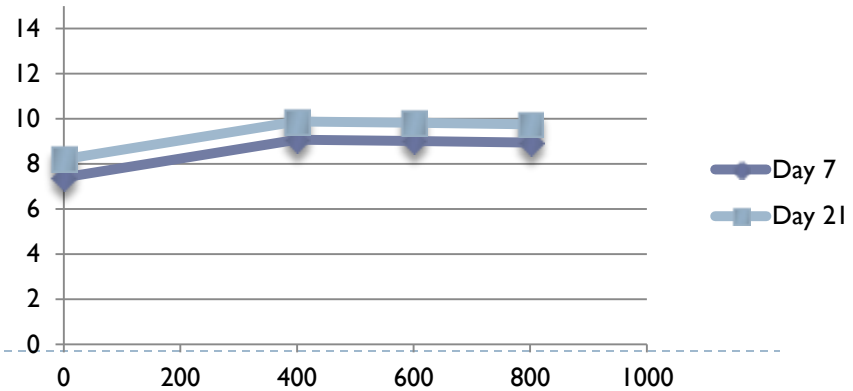
## T.A.



## Brix



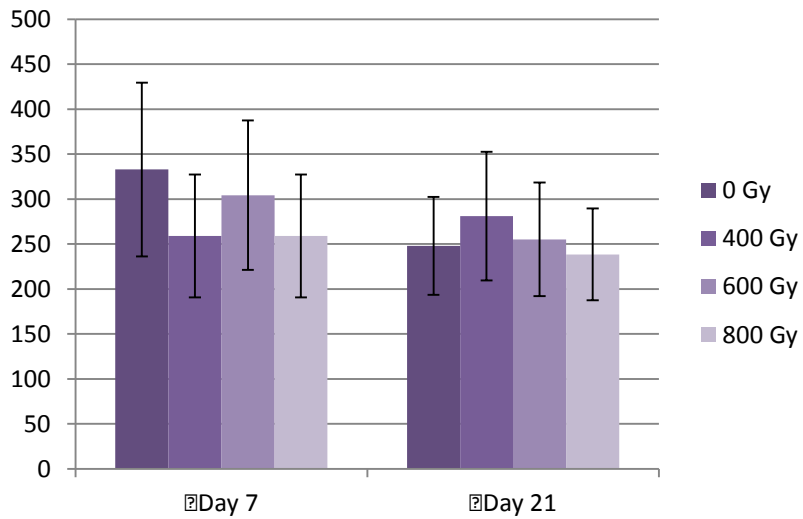
## Trained Panel Sweetness



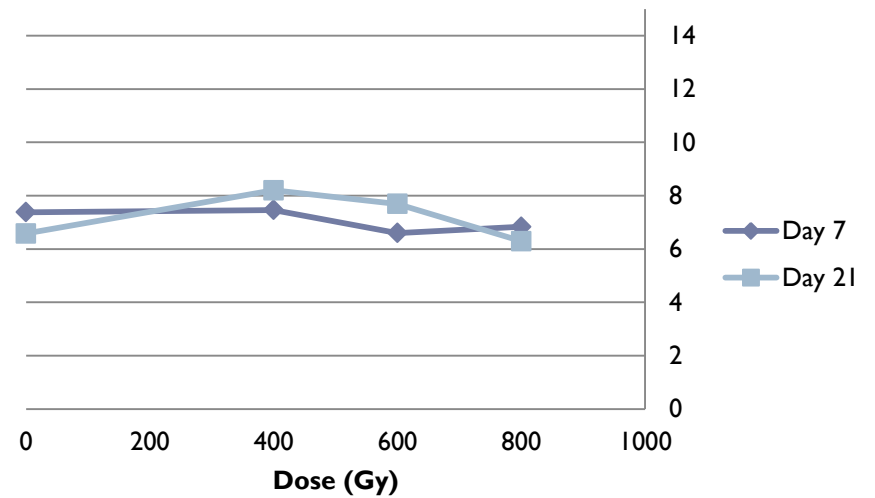
# Results

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## Firmtech Compression Firmness



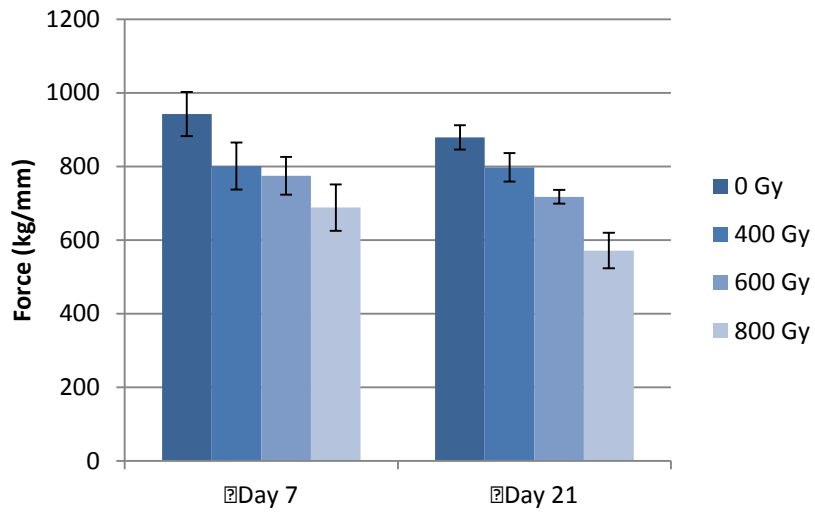
## Trained Panel Finger Firmness



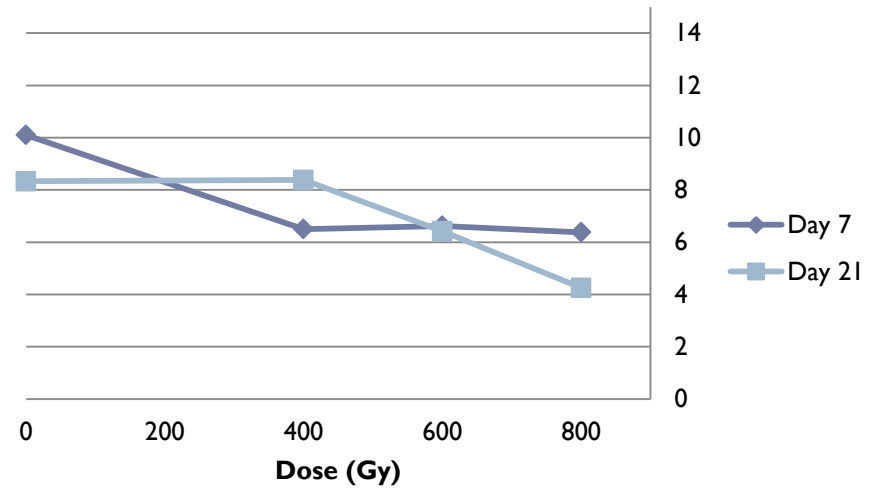
# Results

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## Kramer Shear Force

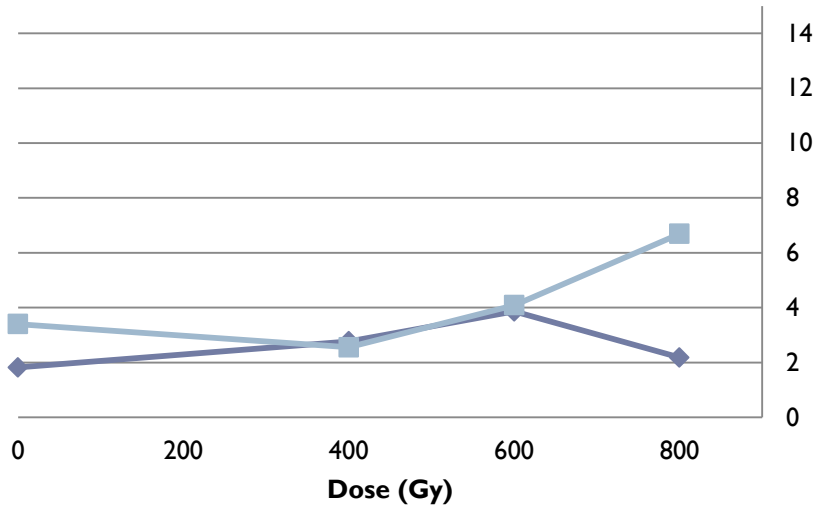


## Trained Panel Crispness

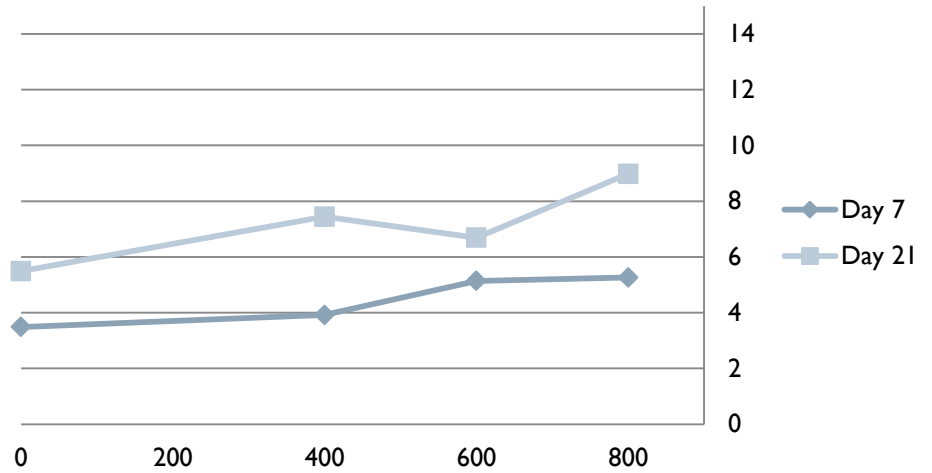


# Results

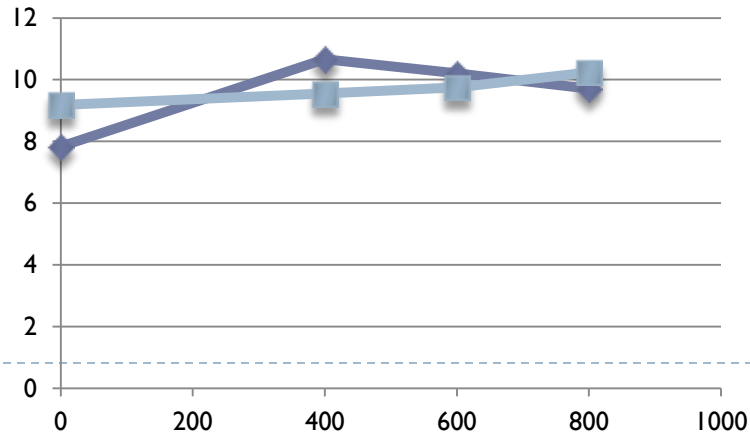
## Trained Panel Bloom



## Trained Panel Rachis



## Trained Panel Flavor

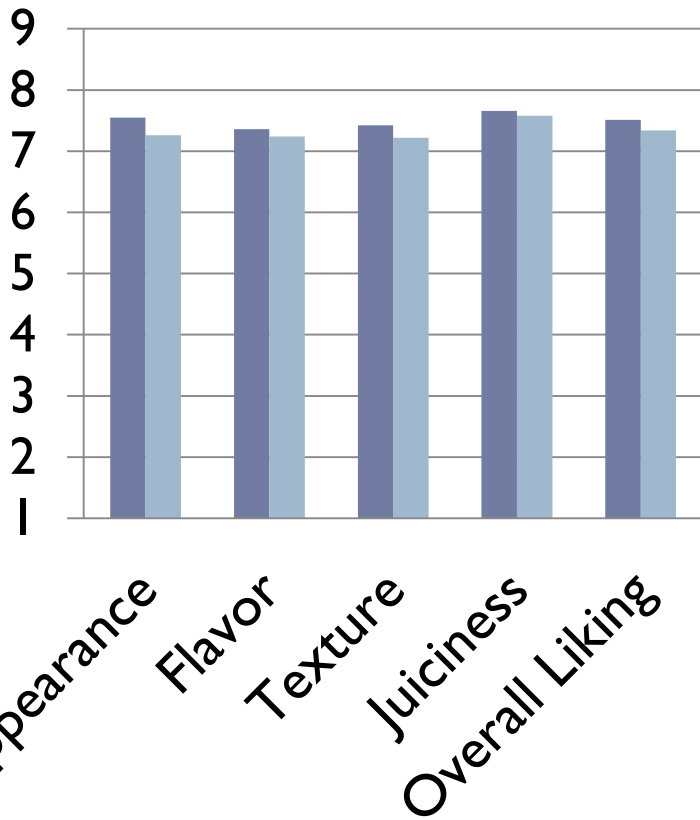




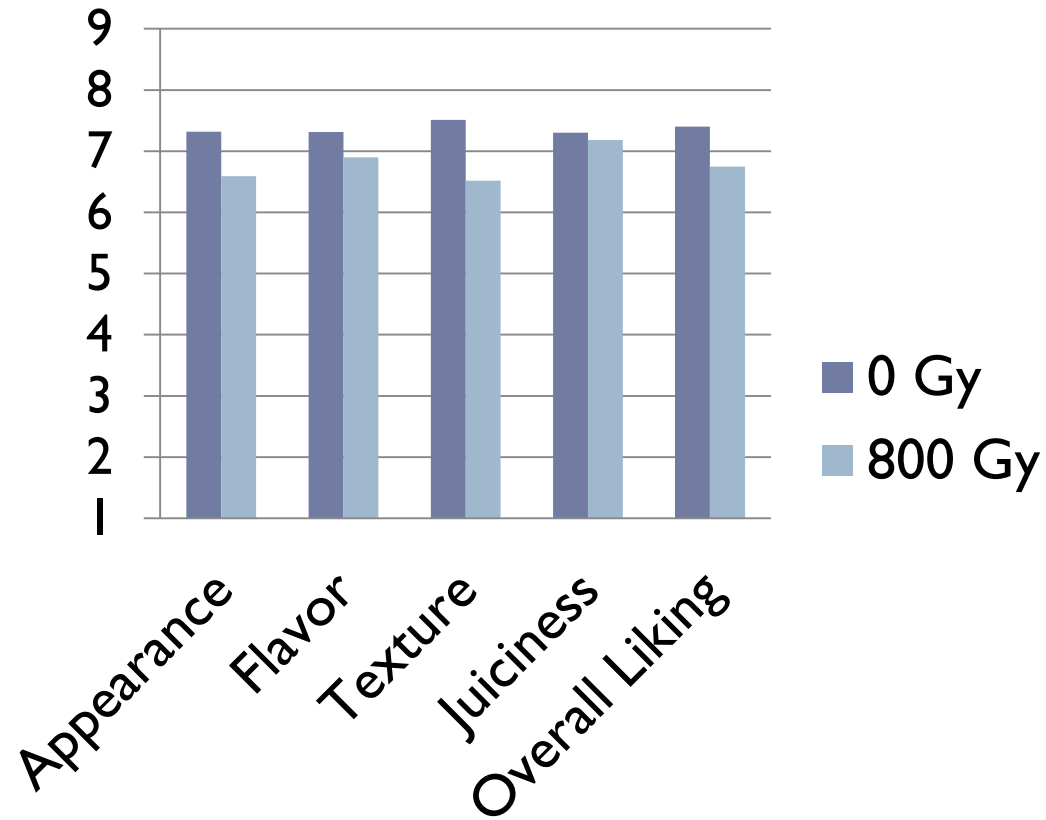
# Results – Consumer Panel

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## Day 7



## Day 21



# Discussion

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- ▶ Irradiation did not significantly affect Brix, TA, weight loss, and decay
- ▶ Irradiation significantly affected texture.
  - ▶ The crispness of grapes exhibited dose dependency

## Consumer Panel

On Day 7 - consumers rated the 800 Gy treated grapes similarly to control

On Day 21 - consumers rated flavor and juiciness of 800 Gy and control similarly.

Appearance, texture, and overall liking were significantly ( $p \leq 0.05$ ) lower for irradiated grapes.

## Trained Panel

The sweetness and flavor significantly ( $p \leq 0.05$ ) increased in a similar amount for each irradiated dose level.

- ▶ Irradiation had a significant affect on the following visual and sensory attributes: color, bloom, rachis, firmness, crispness
- ▶ Irradiation did not affect the following visual and sensory attributes: blemish,
- ▶ stem quality, detachment force, sourness, off flavor, astringency.

# Conclusions

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- ▶ Age (or storage time) had a greater effect on the quality of the grapes than irradiation.
- ▶ Irradiation did not affect the shelf-life of grapes, positively or negatively.
- ▶ Consumers gave high overall liking scores to control and irradiated grapes
  - ▶ Consumers rated 800 Gy lower on Day 21 but the difference between the 800 Gy and 0 Gy was only 0.59 points
  - ▶ The 800 Gy sample received a score of 6.75 on a 9 point scale which indicates an above average consumer liking.



# Future Research

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- ▶ Red Crimson Seedless grapes (*Vitis labrusca* )
- ▶ Transport simulations
  - ▶ Sea transport ( 20 days in 3°C + 2 days in 35°C )
  - ▶ Land transport ( 4 days in 3°C + 2 days in 35°C )
- ▶ Comparing Irradiation with other treatments
  - ▶ No treatment
  - ▶ Irradiation only
  - ▶ Sulfur Dioxide only
  - ▶ Methyl Bromide only
  - ▶ Irradiation + Methyl Bromide



# Acknowledgements

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- ▶ USDA-FAS for the research grant
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# Thank You

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