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המכון הלאומי והאוניברסיטאי לחקלאות

Division of Fruit and Vegetable Storage
and Transportation

PRELIMINARY MEASUREMENTS OF THE EFFECT OF Co^{60} γ -RAYS ON
THE RESPIRATION RATE OF SHAMOUTI ORANGES AFTER HARVEST

By

R.S. Kahan, Y. Aharoni and S.F. Lattar

סקירה מוקדמת

המחלקה לפירסומים
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INTRODUCTION

Most measurements on the effect of radiation on fruits and vegetables^(1,2) have been of changes in structure and softening, in taste, odor and color, and in the constituents such as carbohydrates, proteins and vitamins. There have been very few reports of irradiation effect on the physiology of fruit.

The respiration rate is usually an efficient measure of the physiological state. Thus, at doses of 12 krad⁺⁺, the respiration rate of potato tubers, measured by carbon dioxide evolution, decreased immediately after irradiation, but increased a few hours later to 50% above that of non-irradiated controls⁽²⁾. Oxygen uptake increased immediately after irradiation and the increased rate continued for about 15 days, returning to that of non-irradiated controls only after several weeks. Doses of 50 krad or more caused the increased respiration rate to continue for even longer periods.

Radiation also affects the respiration rate of tomato fruit, the increase immediately following irradiation being proportional to the dose. With doses of 500 krad the rate decreased to that of the non-irradiated controls after 12 days⁽³⁾.

⁺ Israel Atomic Energy Commission.

⁺⁺ 1 Krad = 100 ergs of energy absorbed per gram of absorbing medium

It seemed of interest to test the effect of gamma ray doses that are insufficient to cause externally visible changes or changes in vitamin C content, on the respiration rate of Shamouti oranges.

Preliminary investigations, using segments of freshly picked Shamouti oranges irradiated with 150 krad, showed no changes in vitamin C content or in respiration rate using a Warburg apparatus⁺.

In the present work, a group of nine fruits, each irradiated with the same dose, was used as a unit for measuring the respiration rate in each experiment.

MATERIALS AND METHODS

Three experiments were carried out, each of which contained 3 units. Two units were irradiated with different doses but for the same period of time; the third, non-irradiated, unit served as control.

The fruit was picked shortly before irradiation towards the end of the Shamouti harvest in Feb/Mar. 1960 (Table I).

The irradiation of both units of each experiment was carried out simultaneously, using a 2300 curie cobalt-60 medical teletherapy unit⁺⁺. The fruits were individually wrapped in tissue paper and packed in a single layer of nine fruits in a carton, with the interstices filled with rice to obtain a more uniform absorbed dose. Two cartons were irradiated, one on top of the other, with a vertical beam from above; each carton was turned upside down halfway through the irradiation period, which enabled an almost uniform dose to be applied throughout the depth of the fruit.

⁺ Unpublished data (1960) R. Goren, S.P. Monselise and R.S. Kahan.

⁺⁺ By kind permission of Prof. A. Hochmann of the Hadassah Medical Organization, Jerusalem.

Table 1

Irradiation of Shamouti Oranges

Exp. No.	Unit No.	Absorbed dose (krad)	Source and handling of fruit	Date of irradiation	Total irradiation time (hr)
I	1	152	Fruit of unknown origin; unwashed and unwaxed	Feb. 12-17, 1960	68
	2	96			
II	3	176	Washed and waxed fruit from packing house	Feb. 28 - Mar. 5, 1960	99
	4	124			
III	5	184	Freshly picked fruit from known trees, unwashed and unwaxed	Mar. 6-10, 1960	69
	6	125			

The day after the end of irradiation, the fruits, together with controls, were transferred from Jerusalem to Rehovot for measurement of the respiration rate.

Each group of nine fruits, average weight about 1.5 kg, was placed in a glass container in a room kept at constant temperature (17°C), and a constant stream of 200 mls/hr of air of 90% relative humidity was passed through the container. The amount of oxygen absorbed by the fruit was determined using a Beckman oxygen analyzer.

The determinations were made daily for several days. The results, presented in Figure 1, are calculated in units of mg oxygen absorbed per kg of fresh fruit per hour.

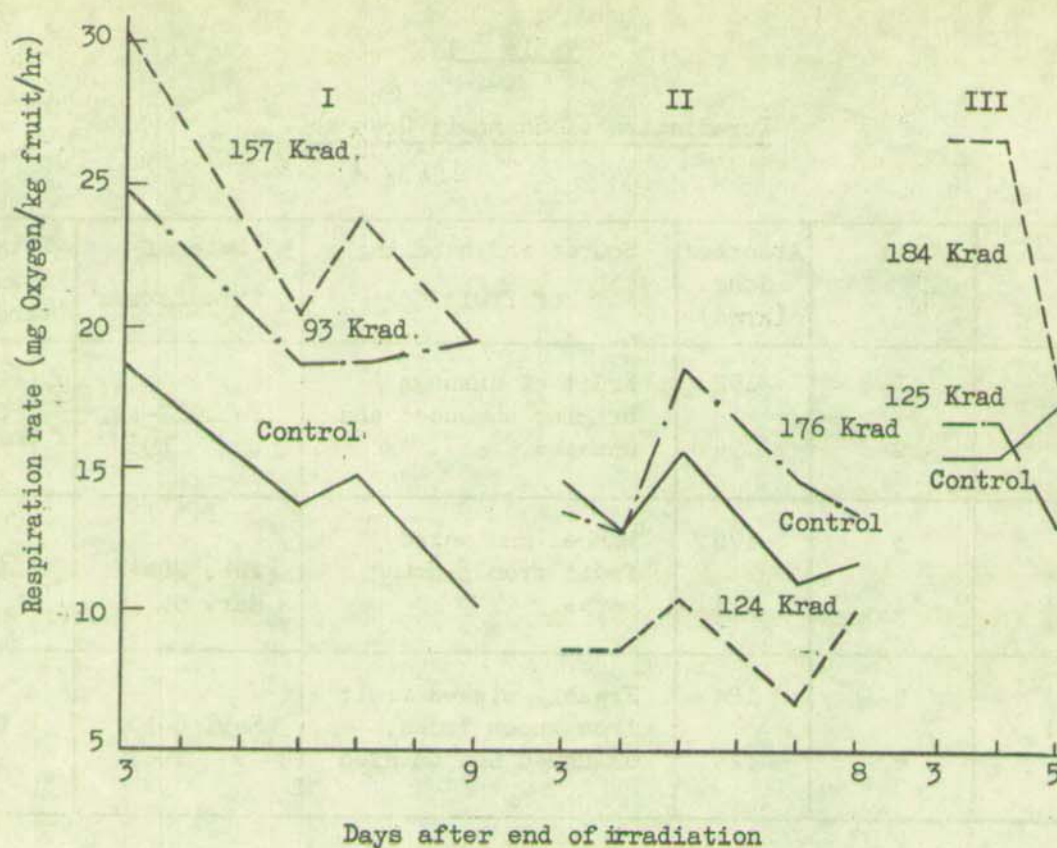


Fig. 1 : Respiration curves of Shamouti oranges after irradiation

RESULTS AND DISCUSSION

Doses of 124-125 krad (unit 4 and 6) did not increase the respiration rate of freshly picked fruit, while doses of 176-184 krad caused higher rates than in the control. With fruit of unknown origin that did not appear to be very fresh, doses of both 96 and 157 krad increased the respiration rate, the increase being larger at the higher dose.

The results show that radiation may increase the respiration rate, but in all cases the caused effect tends to decrease some days after the irradiation and the respiration rate then approximates that of the non-irradiated control.

More precise experiments are necessary to determine whether there is a threshold radiation dose causing changes in respiration rate, and to confirm the magnitude of the effect of different doses.

ACKNOWLEDGMENTS

We wish to thank the Israel Atomic Energy Commission for a grant, and the Hadassah Medical Organization for agreeing to the modification of the unit for continuous operation.

We gratefully record our thanks to the staff of the Radium Institute of the Hadassah Hospital, Jerusalem, for their cooperation during the irradiations, and to the Israel A.E.C. for permission to publish this paper.

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ח ק צ י ר

מאת

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הנשימה משמשת בדרך-כלל קנה-מידה יעיל לבחינת מצבו הפיסיולוגי של הפרי. נערכו שלושה ניסויים בחודשים פברואר-מארס 1960 כדי לבדוק את השפעת ההקרנה בקרני גאמא של קובאלט 60 על נשימת פירות שאמוטי לאחר הקטיף. כל ניסוי כלל 3 קבוצות (9 פירות בכל קבוצה), אשר שתיים מהן הוקרנו במנות-קרינה שונות אך במשך אותה תקופת זמן, ואילו הקבוצה השלישית לא קיבלה כל טיפול ושימשה לביקורת. לאחר ההקרנה (שנעשתה בבית החולים של "הדסה" בירושלים) הועברו הפירות למיכלי זכוכית, שהושמו בחדר, בסמפראטורה של 17 מ"צ; כמות החמצן, אשר קלטה כל קבוצת-פרי, נמדדה פעם ביום במשך ימים אחדים בעזרת מכשיר בקמאן לבדיקת חמצן.

החוצאות הראו, שמנות-קרינה מסויימות העלו את עוצמת נשימת-הפרי, אולם ההשפעה הלכה וקטנה לאחר ימים אחדים וערכי נשימת הפירות המוקרנים התקרבו לאלה של הפירות שלא הוקרנו.

דרושים ניסויים נוספים כדי לקבוע אם ישנה השפעה מובהקת של ההקרנה על ערכי נשימת הפירות וכך כדי לבחון מהי מידת-ההשפעה של מנות קרינה שונות.

* הוועדה הישראלית לאנרגיה אטומית

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המכון הלאומי והאוניברסיטאי לחקלאות

המחלקה לאיחסון פירות וירקות

ניסויים מוקדמים לבדיקת השפעת הקרנה בקרני גאמא של קובאלט 60 על נשימת תפוזי-שאמוסי לאחר הקסיף

מאת

ר"ס קהן, י' אהרובי, ש"פ למר

סקירה מוקדמת

המחלקה לסירטומים

תשרי תשכ"ג, ספטמבר 1962 - רחובות

