

Evaluation of Ethereal Extracts of Irradiated Garlic

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(Received: 22 December, 1983)

ABSTRACT

The present work describes the results of a comparative study on ethereal extracts of 'red' garlic bulbs, both in control samples and samples irradiated with 50 Gy of ^{60}Co gamma rays for sprout inhibition. The evaluations were carried out by both gas-liquid chromatography and visible and infra-red spectroscopy.

During 180 days' storage post-treatment in a commercial warehouse (Temperature: 6-32°C, RH: 58-86%) no appreciable changes were detected in gas-liquid chromatograms between control and irradiated samples. Neither were any differences in spectral character in the visible and infra-red ranges observed between the two types of samples maintained under similar storage conditions for 90 days after irradiation.

INTRODUCTION

Radiation has proved to be a potent tool for the extension of the shelf-life of certain fruits and vegetables. Many investigators have established the possibility of controlling sprouting in garlic by gamma-irradiation and have proved the usefulness of this technique (Baraldi, 1975; Khan and Wahid, 1978; Fernández and Arranz, 1979; Curzio *et al.*, 1982).

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Studies of flavor, odor, texture and pungency of garlic under gamma-irradiation after storage for 7 months were conducted by Mathur (1963). This author, using organoleptic panels, reported no changes in the above parameters. With regard to other quality changes, the effect of gamma-irradiation on carbohydrate content in garlic has been studied by Melitskii *et al.* (1967). They found that the carbohydrate content of irradiated garlic did not show significant changes when compared with non-irradiated controls.

Moreover, El-Warraki *et al.* (1978) have shown the behavior of 17 free amino acids throughout 180 days' storage after irradiation with gamma rays (dose lower than 250 Gy). The contents of lysine and arginine, methionine, phenylalanine, and norleucine were slightly increased by irradiation, especially at the highest doses, whereas the contents of other amino acids tended to be lowered.

Finally, Guo, An-Xi *et al.* (1981) have concluded that the contents and quality of soluble carbohydrates, lipids and proteins in garlic remain unchanged after ^{60}Co irradiation at dosages lower than 500 Gy and storage for periods longer than 8 months. A decrease of vitamin C content occurred immediately after 100–500 Gy ^{60}Co irradiation; however, the decrease in vitamin C during the remaining period of storage was much slower in the ^{60}Co irradiated samples than in non-irradiated controls.

Despite the existing reference data, no study of possible radio-induced changes in non-essential constituents of garlic bulbs has been carried out. In the present study, attempts have been made to compare ethereal extracts of a regional variety of garlic bulbs, both in control samples and samples irradiated for sprout inhibition. These extracts were evaluated by gas-liquid chromatography (GLC), visible spectroscopy (VS) and infrared spectrophotometry (IRS).

MATERIALS AND METHODS

Garlic bulbs of the 'red' variety, grown in the south-east of the Buenos Aires province and cured naturally in the field for about 10 days, were selected for this study.

Thirty days after harvest, the bulbs were packed in cartons (28 × 30 × 35 cm in size) and irradiated with a dose of 50 Gy of ^{60}Co gamma rays at the rate of 0.41 Gy/s and a dose uniformity ratio of 1.25. After treatment, the irradiated samples and the controls were stored in a

commercial warehouse, at temperatures ranging from 6 °C to 32 °C (RH: 58–86 %).

The peeled cloves were crushed and extracted in a Soxhlet apparatus using petroleum ether 60–80 °C as solvent. In order to determine the end of the extraction procedure, an aliquot of liquid present in the body of the Soxhlet was applied on Silica Gel G plates immediately after these plates were sprayed with a mixture of sulfuric acid–acetic acid (8:2 v/v) and dried for about 10 min in an oven at 100 °C. This process was carried out periodically until no spot was detected on the application point. The extract obtained was evaporated to dryness in a rotatory evaporator in vacuum at temperatures lower than 40 °C and dissolved in ethyl ether for analysis by GLC and VS.

One microlitre of the ethereal fraction was evaluated by GLC using a Varian 3700 gas chromatograph equipped with a flame ionization detector. The analysis was carried out on a 2 m × 1/8 in o.d. stainless steel column with 3 % OV-101 on Chromosorb WH-P 80–100 mesh (Varian Aerograph). The column temperature was programmed from 60 °C to 100 °C at 3 °C/min. The temperatures of the injection port and the detector were 220 °C and 310 °C, respectively. The carrier gas was nitrogen at a rate of 30 ml/min.

Spectrophotometric analysis of garlic extracts in the visible range was performed with the help of a double beam Beckman DB Spectrophotometer. Quartz cells with 1 cm light path were used.

Infra-red spectra were recorded by compensatory method in chloroform using a thin film of these solutions on a sodium chloride prism. A Perkin-Elmer Infracord spectrophotometer, Model 137, was employed.

RESULTS

Treated and untreated samples were evaluated by GLC at 90, 120, 150 and 180 days post-irradiation. Table 1 presents the ratio of the retention time of each peak to the retention time of the highest intensity peak at the above periods (T_r). Chromatograms obtained 180 days post-treatment are shown in Fig. 1.

A comparative visible spectrophotometric analysis of garlic extracts from control and irradiated samples, 90 days post-irradiation, is shown in Fig. 2. The spectra show λ_{\max} at 340 nm and 332 nm for control and irradiated samples, respectively. Figure 2 also shows the infra-red spectra of irradiated and non-irradiated garlic extracts 90 days post-treatment.

DISCUSSION

From results presented in Table 1 it can be concluded that no appreciable differences were detected in respect of T_r and the number of peaks between irradiated and non-irradiated bulbs during the 180 days of storage post-treatment.

Figure 2 indicates that there is no difference in spectral character between the two samples in the visible range. Moreover, the identical nature of the infra-red spectra of both samples indicates that there is no effect of irradiation on ether extractable components of red garlic at the dose employed in the present study.

Bandyopadhyay *et al.* (1970, 1973) have investigated ethereal extracts of onions by thin-layer chromatography and ultra-violet, visible and infra-red spectroscopy. They concluded that the irradiation at doses lower than 500 Gy did not induce noticeable qualitative changes on the components of these extracts.

In previous investigations carried out in our laboratory with the same

TABLE 1
 T_r Values for Ethereal Extract Components of Control and Irradiated Garlic, 90, 120, 150 and 160 Days Post-irradiation

Peak No.	T_r (min)							
	Non-irradiated				Irradiated			
	90 days	120 days	150 days	180 days	90 days	120 days	150 days	180 days
1	0.20	0.26	0.28	0.30	0.24	0.28	0.27	0.29
2	0.46	0.51	0.48	0.45	0.48	0.53	0.50	0.47
3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	1.07	1.09	1.12	1.12	1.10	1.07	1.08	1.11
5	1.20	1.22	1.25	1.24	1.21	1.24	1.22	1.20
6	1.70	1.66	1.68	1.70	1.68	1.69	1.68	1.67
7	1.74	1.79	1.77	1.81	1.80	1.75	1.76	1.80
8	1.95	1.97	1.98	1.98	1.94	1.97	1.96	1.99
9	2.17	2.20	2.25	2.23	2.20	2.22	2.23	2.25
10	2.53	2.49	2.51	2.52	2.49	2.50	2.51	2.50
11	2.70	2.68	2.72	2.66	2.65	2.73	2.69	2.70
12	3.00	2.98	3.01	2.97	3.02	3.03	2.98	2.98
13	3.55	3.50	3.51	3.56	3.57	3.50	3.53	3.55

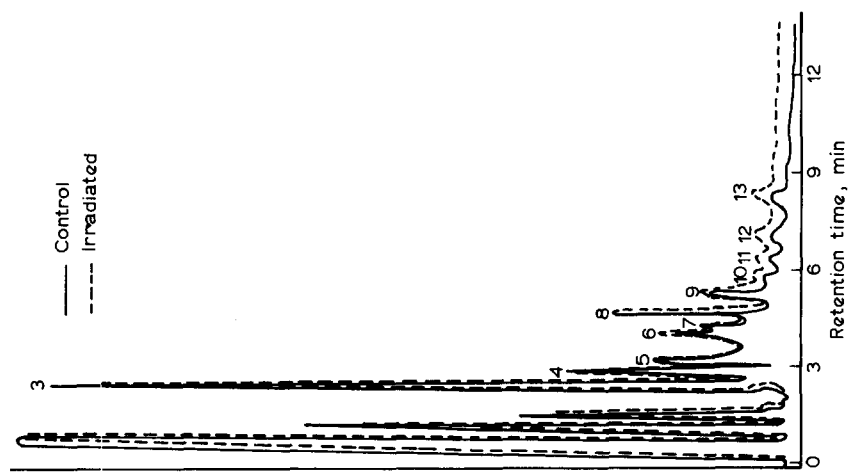


Fig. 1. Gas-liquid chromatograms of ethereal extracts of control and irradiated garlic 180 days post-treatment.

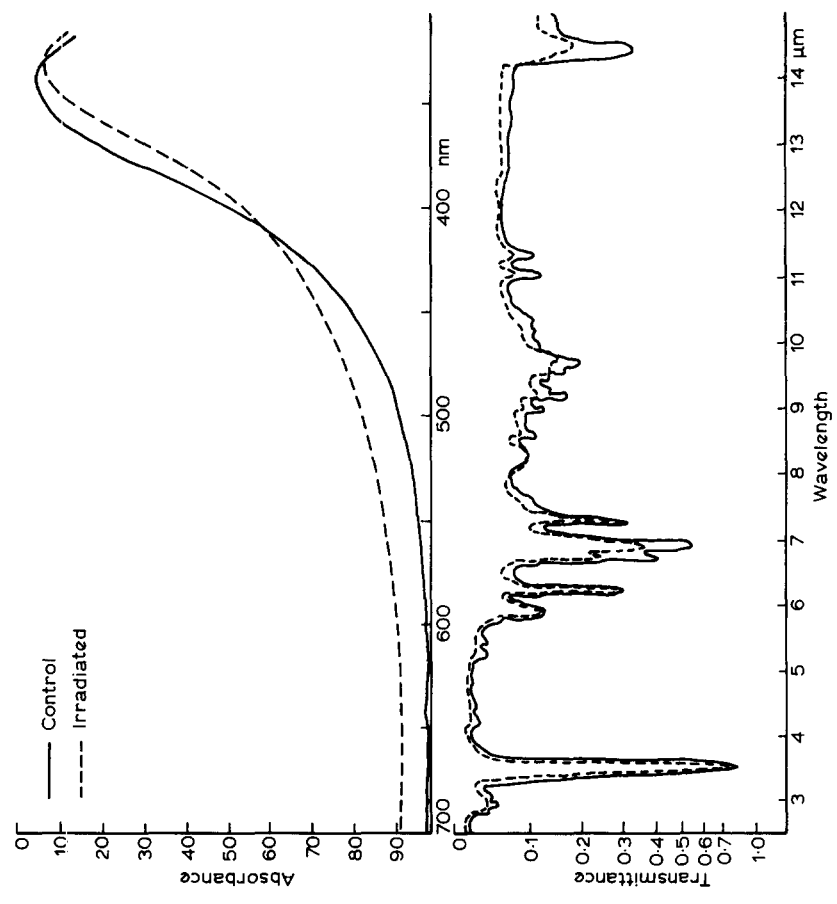


Fig. 2. Visible and infra-red spectra of ethereal extracts of control and irradiated garlic 90 days post-irradiation.

local cultivars, irradiation proved to be effective in reducing weight loss and spoilage percentage of the bulbs. After 10 months of storage the weight loss was observed to be reduced by 37% in irradiated garlic (30 Gy) (Curzio & Croci, 1982, Curzio *et al.*, 1982).

Therefore, it can be concluded that irradiation not only was effective for sprouting inhibition but also produced no detectable qualitative alterations in ethereal extracts of the regional variety used in this study. On the other hand, the observations in onions of Bandyopadhyay *et al.* (1970, 1973) can be extended to garlic irradiated with a sprouting inhibition dose.

ACKNOWLEDGEMENTS

Thanks are given to the Comisión Nacional de Energía Atómica for making their irradiation facilities available. This work was supported, in part, by the Comisión de Investigaciones Científicas de la Provincia de Buenos Aires and the Subsecretaría de Ciencia y Técnica.

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