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SENSORY FEATURES OF DATE-FRUIT AS INFLUENCED BY GAMMA IRRADIATION

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Khudrawi and Zaidi varieties grown in the climatic conditions of Faisalabad were evaluated for determining their sensory features. Dates treated with three different doses of gamma irradiation were compared with non-irradiated control. It was found that the dose of 0.5 kGy proved the most effective in reducing deleterious biochemical changes than did the doses of 1.0 and 1.5 kGy. It thus helped in enhancing the shelf life of the date-fruits. Statistical analysis showed that the Khudrawi variety surpassed the Zaidi variety in softness, juiciness/pulpiness, taste, and weight loss, while the Zaidi was preferred by the panelists for its fruit colour, attractiveness, shiningness, and shrivelness/smoothness.

Key words: *Phoenix dactylifera*, Khalal stage, Gamma irradiation, Sensory features, biological changes.

Introduction

Date palm (*Phoenix dactylifera* L.) is believed to be the oldest fruit plant ever cultivated on the surface of the earth [1]. It grows well in hot dry climate. In Pakistan it is chiefly grown in the districts of Kharan, Makran, Muzaffargarh, Khairpur, Dera Ghazi Khan, Multan, Jhang and Bahawalpur [2]. It occupies an area of about 40,400 hectares with an annual production of 275,500 tonnes [3].

Date, like other fruits, is highly perishable under natural conditions. During ripening and storage it undergoes a number of physical and chemical changes, which have a direct influence on sensory attributes. Important changes take place in its colour and texture, which influence its quality and marketing [4]. The colour changes become more critical in the process of marketing.

Gamma irradiation has shown encouraging results in the process of increasing the shelf-life of many fruits [5]; but it can also be used to slow down the ripening process, if an appropriate dose is applied. Smith and Jansen [6] provided experimental evidence that, when avocados were irradiated with 0.4 and 0.7 kGy, the dose of 0.4 kGy delayed their ripening during storage at a room temperature of 35-38°. In the present study, two varieties of dates, namely, Khudrawi (V_1) and Zaidi (V_2), were exposed to 0.5, 1.0 and 1.5 kGy gamma irradiation to determine the effects on the sensory features of the fruits.

Materials and Methods

The study was conducted in the Department of Horticulture, University of Agriculture, Faisalabad, in collaboration with the Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad. Two date varieties having similar age and size were picked at "Doka", also called "Khalal", stage. The selected fruits were properly washed, carefully dried, cleaned, and were divided into four equal lots. Each lot

contained 50 fruits of equal size. The weight of one lot was 1 kg \pm 5 gm. Both the varieties were given similar treatments, except the irradiation doses in kGy (kiloGrey), as listed hereunder:

T_1 = Control (no use of gamma irradiation)

T_2 = Fruit exposed to 0.5 kGy gamma irradiation,

T_3 = Fruit exposed to 1.0 kGy gamma irradiation, and

T_4 = Fruit exposed to 1.5 kGy gamma irradiation.

Irradiation was carried out through the source of "Mark-IV Irradiator, Cobalt-60".

Free ventilation and temperature at $30 \pm 2^\circ$ were maintained throughout the experiment, and the data were taken after 12 days of storage for the following sensory features:

(1). Fruit colour, (2). Attractiveness and shiningness, (3). Shriveling/smoothness, (4). Softness, (5). Juiciness/pulpiness, (6). Taste of the fruit, and (7). Weight loss.

For the study of changes in colour of fruit, horticultural colour charts, Vol. I and II, were used. Colours were ranked from Greenish yellow to Dark Brown [1-7]. For grading the parameters numerically from No. 1 to 6, the 7-point Hedonic scale as described by Larmond [7] was used. To evaluate the treated products, a panel of ten judges consisting of senior professors, senior scientific officers and post-graduate students was formed. They scored the products for these parameters according to the following scheme:

(1). Extremely disliked/shriveled/juicy, (2). Very much disliked/shriveled/juicy, (3). Less disliked/shriveled/juicy, (4). Liked/shriveled/juicy, (5). Liked more/smooth/pulpy, (6). Very much liked/smooth/pulpy, and (7). Extremely liked/smooth/pulpy.

All the evaluations were carried out keeping in mind the instructions given by Larmond [7]. Every member was presented a set of three replicates for each treatment, and to compare one parameter all treatments were presented in a

single sitting. The weight loss, i.e., parameter No. 7, was determined by A.O.A.C. method [8].

For statistical analysis the data obtained were analyzed by the two-factor factorial arrangement, and the means were compared by the Duncan's New Multiple Range Test [9].

Results and Discussion

Statistical analyses of the data reflected highly significant effects for each of the parameter. The results of the experiment are shown in Tables 1 and 2. A brief description of the results is presented below:

1. *Fruit colour*. The colour of a fruit is of prime importance for the evaluation of its quality as well as for its marketing. The judges noticed marked changes in both varieties (Table 1). The Zaidi variety scored a measure of superiority over the Khudrawi. The dose of 1.5 kGy (T_4) obtained the highest scores, followed by T_3 (1.0 kGy), showing that the higher dose of irradiation led to ripening. T_2 (0.5 kGy) reflected much less colour change, which showed that this dose helped in retaining the colour. Similar types of results were noticed for attractiveness and shiningness.

Trevelsen [10] administered gamma irradiation for different fruits and vegetables, and noticed that undesirable properties were induced by irradiation, such as change in colour. Rashid and Farooqi [11] reported that gamma irradiation (33Gy) and melecic hydrazide (1000, 1500, 2000 ppm), during storage (23-30°) of mango, had much influence on skin colour and delayed the ripening of hard green fruit. In the present experiment, the lower dose of 0.5 kGy delayed the ripening, and Rashid and Farooqi [11] also found such results by using a lower dose of 33 Gy in mango. Thus, it may be concluded that the use of gamma irradiation beyond 0.5 kGy is not desirable, if the aim is to delay the ripening of date- fruit.

2. *Attractiveness and shiningness*. Marked differences in attractiveness and shiningness were observed between the various doses of radiation. Table 1 shows that V_1 gave higher scores than V_2 . The scores for both these characteristics improved with higher dose of irradiation indicating that the judges ranked those treatments higher in which more gamma irradiation was administered, i.e., the matured fruits (brown in colour) rather than the immature or less mature.

3. *Shriveling/smoothness*. It is evident from Table 1 that Zaidi (V_2) was smoother than Khudrawi (V_1). With the increase in the dose of gamma irradiation shriveling also increased. Thus, T_4 caused shrivelage the most, T_1 ranked second, and T_3 came third. The dose of 0.5 kGy (T_2) was considered as the best, because the fruits were found to be the smoothest. The reason appears to be the same as for colour, i.e., the dose of 0.5 kGy inhibited the biochemical changes,

while the higher doses seemed to enhance the biochemical changes leading to quicker ripening.

4. *Softness*. Contrary to the above results in which Zaidi (V_2) was adjudged as superior for this parameter, Khudrawi (5.1) was found significantly softer than Zaidi (4.7). With the increase in the dose of gamma irradiation, the date-fruit became softer and softer. As softness is a desirable characteristic, the judges determined that Khudrawi was superior to the Zaidi (Table 1). Treatment T_2 (0.5 kGy) checked the biochemical changes and helped in the increase of shelf-life. Mahmood [12] conducted an experiment to see the effect of 0,1, and 3 kGy gamma irradiation on date cv. Hillawi and found that 1 kGy was the best treatment to delay the process of ripening while 3 kGy enhanced the ripening more than the all other treatments.

TABLE 1. AVERAGE SCORES FOR DIFFERENT SENSORY FEATURES (AVERAGES OF 10 JUDGES).

Attributes	Variety	T_1	T_2	T_3	T_4	Mean
Fruit colour	V_1	3.4c	1.8d	4.3b	5.7a	3.8
	V_2	3.9c	2.0d	5.2b	6.5a	4.4
	Mean	3.7c	1.9d	4.8b	6.1a	—
Attractiveness	V_1	2.6c	2.1d	3.4b	5.2a	3.3
	V_2	2.8c	2.4d	3.9b	6.2a	3.8
	Mean	2.7c	2.2d	3.7b	5.7a	—
Shiningness	V_1	2.9c	1.9d	4.1b	5.6a	3.6
	V_2	3.1c	2.6d	4.8b	6.1a	4.2
	Mean	3.0c	2.2d	4.4b	5.8a	—
Shriveliness	V_1	5.1a	3.3c	4.8b	2.1d	3.8
	V_2	5.6a	4.4c	5.0b	3.6d	4.7
	Mean	5.3a	3.8c	4.9b	3.8d	—
Softness	V_1	5.2c	2.7d	5.8b	6.6a	5.1
	V_2	5.0c	2.4d	5.4b	6.0a	4.7
	Mean	5.1c	2.5d	5.6b	6.3a	—
Juiciness/ pulpiness	V_1	4.8c	4.0d	5.1b	5.7a	4.9
	V_2	4.6c	3.4d	4.9b	5.4a	4.6
	Mean	4.7c	3.7d	5.0b	5.5a	—
Taste	V_1	4.7c	4.4d	5.0b	5.9a	5.0
	V_2	4.5c	4.2d	4.7b	5.5a	4.8
	Mean	4.6c	4.3d	4.8b	5.7a	—

Note: In a row means followed by the same letter do not differ significantly at $p = 0.05$ according to DMR test.

TABLE 2. EFFECT OF GAMMA IRRADIATION ON WEIGHT LOSS (AVERAGE OF 3 REPS).

Attributes	Variety	T_1	T_2	T_3	T_4	Mean
Weight loss(%)	V_1	16.6a	12.8c	13.3b	10.2d	13.2
	V_2	12.3a	9.5b	7.0d	8.2c	9.3
	Mean	14.4	11.1	10.1	9.2	

Note: In a row means followed by the same letter do not differ significantly at $p = 0.05$ according to DMR test., V_1 = Khudrawi; V_2 = Zaidi; T_1 = No irradiation (Control); T_2 = 0.5 kGy Gamma irradiation; T_3 = 1.0 kGy Gamma irradiation; T_4 = 1.5 kGy Gamma irradiation.

5. *Juiciness/pulpiness*. Khudrawi (V₁) was found to be pulpy, while the Zaidi (V₂) was juicy. As pulpiness is desirable, the judges ranked Khudrawi (4.9) higher than Zaidi (4.6). With the increase in the dose of gamma irradiation, the pulpiness increased. It is known that the pulp is developed when the fruit matures, and increases when it ripens. The data recorded for colour and softness also support this finding. The dose of 0.5 kGy proved to be the best for enhancing ripening.

6. *Taste of the fruit*. Taste develops with ripening of the fruit. Therefore, a ripe fruit can naturally provide better taste, flavour and aroma. Any factor contributing to the early ripening of the fruit should improve the taste. Judges liked the Khudrawi (5.0) more than the Zaidi (4.8), probably due to its greater sweetness. But the Zaidi also obtained scores quite close to those of the Khudrawi. The data regarding juiciness/pulpiness also supports this varietal trend. It shows that due to earlier ripening of the Khudrawi variety, the judges gave it higher scores than to the Zaidi (Table I). As the earlier findings revealed that 1.5 kGy dose enhanced the process of ripening, the judges recorded higher scores for taste to T₄, followed by T₃, T₁ and T₂. The minimum marks to T₂ indicated that this dose checked the ripening changes. Wahid et al [13] compared date-fruit treated with 1.0 kGy gamma irradiation with the untreated one, and observed that irradiated samples resulted in higher organoleptic scores, indicating improved quality.

7. *Weight loss*. All the treatments were found significantly different from each other, statistically. Control showed the maximum weight loss %age (14.4). While it decreased with the increase in the dose of gamma irradiation, i.e., from 11.1% to 9.2%. The Zaidi variety retained the more moisture than the Khudrawi variety. Mathur and Lewis [14] assessed that when Alphonso mangoes were treated with 1.2 kGy gamma irradiation, losses in weight were less in irradiated material as compared to control.

Conclusion

Each variety of a species is known for its certain characteristics. Similarly, it became evident from the present study that the variety Khudrawi (V₁) was found superior to the Zaidi (V₂) in softness, juiciness/pulpiness, taste and weight loss, while the judges ranked Zaidi higher than Khudrawi for the fruit colour, attractiveness, shiningness and shriveiness/smoothness parameters. It was also concluded that the dose of 0.5 kGy proved to be effective in enhancing the shelf-life of dates, while the use of higher doses of gamma irradiation seemed to enhance the bio-chemical changes leading to quicker ripening. Cooper and Salunkhe [15] recommended the use of an optimum dose of 0.25 kGy gamma irradiation for enhancing the shelf-life of strawberries and sweet cherries by 15 days.

The use of doses lower than 0.5 kGy gamma irradiation is suggested for ascertaining their effect on the quality and shelf-life of date- fruits.

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