*Assiut J. Agric. Sci., (48) No. (1-1) 2017 (80-97)* *ISSN: 1110-0486*
*Website: http://www.aun.edu.eg/faculty_agriculture* *E-mail: ajas@aun.edu.eg*

# Effect of Gamma Irradiation on Quality and Composition of Sakkoty Date Fruits (*Phoenix dactylifera* L.*)* During Storage

**Ramadan, B.R.[1]; M.N.A. El-Rify[1]; A.A. Abd El-Hamied[2] and M.H. Abd El-Majeed[2]**

[1]Food Sci. and Tech. Dept., Faculty of Agric., Assiut Univ.

[2]Food Sci. and Tech. Dept., Faculty of Agric., Al-Azher Assiut Univ.

**Received on:** 6/11/2016 **Accepted for publication on:** 13/11/2016

## Abstract

This study was carried out to improve the quality and the shelf-life of Sakkoty date variety during storage period at room temperature using gamma irradiation doses of 0, 1, 2 and 4Kilo Gray (KGy). The effect of radiation treatments on the quality and composition of samples were evaluated at 0, 4, 8 and 12 months of storage. Results showed that the irradiated fruits with 4KGy are more effective for controlling the insect infestation (3.22%) followed by the irradiated date sample with 2KGy (6.00%) and 1KGy (6.45%). While, the control sample recorded 24.25% at the end of storage period. The moisture content of the control date sample decreased from 11.64 to 8.33% at the end of storage while it was decreased from 11.94 to 8.04%, from 11.89 to 8.35% and from 11.61 to 8.28% for the irradiated fruits by 1, 2 and 4KGy, respectively. However, the content of all sugars immediately decreased after irradiation, while it were increased gradually with increasing the storage time. Data revealed that the total bacterial counts immediately decreased after irradiation to a great extent, compared with the reduction in molds and yeasts. Beside, the microbial flora in all used doses were remained at a low count until the end of storage period. The irradiated sample with 4KGy had the lowest microbial counts, followed by the irradiated samples by 2 and 1KGy, respectively. The organoleptic evaluation showed that the panelists can not discriminate between the non-irradiated and irradiated date fruits. Furthermore, all the studied doses have no detectable adverse effect on the preference rating of the fruits. The irradiated sample with 1KGy was occupied the first rank in overall acceptability of sensory evaluation followed by the irradiated samples with 2KGy and with 4KGy. These results suggest that the packing irradiated fruits by 1, 2 and 4KGy of Sakkoty date fruit can be used as alternative method for improving the fruit quality, as well as prolonging its marketable period at room temperature for 12 months.

***Keywords:*** *Sakkoty date, Storage, Irradiation, Kilo Gray (KGy), Chemical composition, Physical characteristics, Microbial counts.*

## 1. Introduction

Date palm (*Phoenix dactylifera* L.) is marketed worldwide as an excellent source of sugars, minerals, salts and vitamins fruit crop (Abd El Bar *et al*., 2014). Many studies have revealed that dates have strong antioxidants, anticancer and antiviral activities (Al-Farsi *et al*., 2005).

The world production of dates increased considerably during the last 30 years. The Arab countries produce about 74.5% of global date production. Egypt considered as the first country of the top ten date producers

in world (1,501,799 tons), followed by Iran (1,083,720 tons) and Saudi Arabia (1,065,032 tons) (FAO, 2015).

Storage of dates at high temperature and high humidity renders them susceptible to insect infestation and microbiological harmful causing extensive losses in storage dates (Azelmat *et al*., 2006). Methyl bromide is the main fumigant used for the treatment of stored products still available. Due to its adverse effect on human health and environment, it has been identified as an ozone-depleting substance by the Montreal Protocol (UNEP, 1992). Its restricted use and anticipated phasing out by around 2010 (Patil *et al*., 2004) highlights the urgency for an alternative treatment (Ahmed, 2001). Currently, dates are preserved by many other methods. The other methods of preservation are too expensive and would need careful considerations (Navarro *et al*., 2000).

Irradiation is one of the safest and most economical ways of food preservation. Gamma radiation treatment has been approved by international bodies; FAO, IAEA and WHO in 1981, and most of the products irradiated with gamma rays at doses ranging from 1 to 10KGy. Losses of nutritional value are minimal as the irradiation treatment does not increase the temperature of the food than in canning, drying, pasteurization or sterilization (Joshi *et al*., 2011).

Radiation treatment established as safe process of food preservation was explored as a possible means to achieve microbial decontamination of the fresh as well as dried products without affecting the intrinsic physicochemical properties of the products (Diehl, 1995). Furthermore, irradiation is the possible alternative, to control insects in dates. Studies on use of irradiation to control insects in dates are enormous (Farkas *et al*., 1974; Zaklandnoi and Ratanova, 1978; El-Sayed and Baeshin, 1983 and Grecz *et al*., 1986). The choice of a suitable dose of irradiation is particularly important in determining the conditions for irradiation disinfestation of stored foods (Azelmat *et al*., 2006).

Knowledge of the qualitative and quantitative chemical composition of date fruit is of prime importance to the user of dates, in particular the packer, processor or trader, because it affects the possibilities and limitations of the raw material for the intended end-use. Before adopting radiation techniques for such purposes, the effect of radiation on the chemical composition of the date must be known, which also include the effect on the color chemistry of the product. The consumers interest was mainly focused on the nutritional properties of the product. To draw up a date quality profile will therefore involve an evaluation of moisture, protein, sugar and fat contents and the presence of microbial infestation. The quality and extending the shelf life of fresh dates can be improved by using irradiation technique. In this way we can contribute to improve economical status of this food material, thereby increasing the income and foreign exchange of the country (Ud Din *et al*., 2011).

Therefore, the main objective of this research is to investigate the effect of gamma irradiation doses of 1, 2 and 4KGy on the chemical compo-

sition, quality properties and the shelf life of Sakkoty date fruits during storage for twelve months at room temperature.

## 2. Materials and Methods

### Materials

Sakkoty date sample was obtained from the local market at Aswan governorate, Egypt during the 2014 season.

### Irradiation treatments

Irradiation process of date fruits was carried out in the National Center for Radiation Research and Technology (NCRRT), Cairo, Egypt using $Co_{60}$ facility "Indian Gamma cell" type Ge-4000A. The applied doses were 1, 2 and 4KGy delivered at a dose rate of 2.08KGy per hour at the time of experiments.

### Physical analysis

**Date fruit properties:** Sakkoty date fruits were evaluated for: fruits number per kg, mean weights of fruit, flesh, pit and calyx, flesh/pit ratio, percent of flesh and pits, percent of fruit insect infestation and fruit dimensions (length and width at maximum circumference).

**Total soluble solids (TSS):** The TSS was estimated by the method described by Abdel-Hafiz *et al*. (1980).

**pH value**: The pH value was measured by using a Systronic 324-combination glass electrode pH meter at 25°C.

**Color:** Color was determined as the optical density (OD) of the diluted and centrifuged extract of fruit flesh (5% TSS) and the absorbance was measured at 400nm using Perkin Elmer Lambda, UV/VIS Spectrophotometer (Abd-Ellah, 2009).

### Chemical analysis

The moisture content was determined by drying the samples at 70°C. Sugars **(**reducing and total), crude fiber, crude protein, crude fat and ash were determined according to AOAC (2005) methods.

Acidity was determined as malic acid by titration, according to Dalaly and Al-Hakiem (1987). The minerals content of date fruits flesh was estimated according to AOAC (2005) methods. Potassium and sodium were determined using Flame photometric (410). Calcium, manganese, magnesium, copper, iron and zinc were determined using Perkin-Elmer Atomic Absorption Spectrophotometer 2380. Phosphorus was determined by Spectrophotometer Philips PV 8650.

Total phenolic compounds of date fruits were determined using Folin- ciocalteu reagent according to Velioglu *et al*. (1998). Total phenolic contents (mg/100g) were expressed as gallic acid equivalent (Asami *et al*., 2003).

Antioxidant capacity: Free radical scavenging activity of date fruits extract was determined using the 1, 1-diphenyl-2-picrylhydrazyl (DPPH) method (Ao *et al*., 2008).

$$\text{DPPH radical scavenging \%} = \frac{\text{OD control} - \text{OD sample}}{\text{OD control}} \times 100$$

The calorific value was calculated using the Alwater Factor (Joint FAO/WHO, 1973).

### Microbial evaluation

Total bacterial counts were determined using the plate counts technique on a nutrient agar medium according to A.P.H.A (1976) and Difco (1984) procedures. The plates were incubated at 37°C for 48 h. Yeast and mold counts were determined using

the plate counts technique on potato dextrose agar (PDA) according to A.P.H.A (1976) and Difco (1984) methods. The plates were kept between 3 and 5 days depending on the type of fungi at 25-28 ºC.

**Sensory evaluation**: Sakkoty date fruits and these irradiated samples were sensory evaluated. The quality attributes, including color, texture, taste, appearance and overall acceptability were evaluated by trained panelists according to Molander (1960).

**Statistical analysis**: The data obtained from three replicates were analyzed by ANOVA using the SPSS 20.0 software statistical package program, and differences among the means were compared using the Duncan's Multiple Range test (SPSS, 2011). A significance level of 0.05 was chosen and continuous variables described by mean and standard deviation (Mean, SD).

## 3. Results and Discussion

### Physical characteristics of date fruits

Sakkoty date fruits at Tamr stage were evaluated for their fruits number (154/ Kg), average weight of fruit (6.49g) and pit (0.94g), percentage of flesh (85.15%), total soluble solids (87.14%) and insect infestation percentage (4.54%) (Table, 1). Data of physical measurements are in the same ranges reported by other researchers (Ramadan, 1990 and 1995, Abd-Ellah, 2009 and Selim *et al*., 2012). Variation in the physical properties of the same date variety grown in different regions can be attributed to several factors such as soil, fertilization and other environmental conditions (Ramadan, 1995 and Selim *et al*., 2012).

**Table 1. Physical characteristics of Sakkoty date fruits:**

| Characteristics | |
|---|---|
| Fruits number/ Kg | 154±4 |
| Fruit weight | 6.49±0.25g |
| Flesh weight | 5.52±0.08g |
| Pit weight | 0.94±0.01g |
| Calyx weight | 0.03±0g |
| Flesh/pits ratio | 5.87±0.02 |
| Flesh | 85.15±0.17% |
| Pit | 14.51±0.62% |
| Calyx | 0.34±0% |
| Insect infestation | 4.54±0.13% |
| TSS | 87.14±0.15% |
| pH value | 6.06±0.05 |
| Color (at 400nm as OD) | 1.48±0.01 |

### Chemical composition

The results in Table (2) show the proximate analysis of Sakkoty date fruits at Tamr stage.

The moisture, sugars (total and reducing), crude protein, crude fiber, ash, crude fat and total acidity (as malic acid) contents were 11.64, (75.17 and 30.84), 3.69, 3.08, 2.67, 1.98 and 0.36%, respectively. These data are in good agreement with those reported by Ramadan (1995), Youssef *et al*. (1998), Fadhl *et al*., (1999), Al-Shahib and Marshall (2003), Abd-Elwahid (2007), Osman (2008), Abd-Ellah (2009) and Hasnaoui *et al*. (2010).. Besides, the results are in the trend with that recorded by Ba'abad (2000), Al-Hooti *et al*. (2002), Besbes *et al*. (2009) and Borchani *et al*. (2010).

Non-reducing sugars represented 58.97% of the total sugars at Tamr stage. Ramadan (1995) found that the total and reducing sugars in

five dry dates were 73.65-81.77% and 29.64-37.16%, respectively. Results in Table (2) illustrated that the calorific value of Sakkoty date fruits was 333.26 Cal./100g. These results are in the same trend with those recorded by Hussein *et al*. (1979), El-Shamery and El-Dien (1988) and Ramadan (1990 and 1995). Due to the notion that sugars were the predominat constituent of dates, there is a mutual relationship between calorific value and sugar content. This worth noting makes date to be a preferable main food-stuff for the mob especially during the holy fasting month (Ramadan) and those attaining hard works (Ramadan, 1995).

**Table 2. Chemical composition of Sakkoty date fruits *(% dry weight basis):**

| Components | % |
|---|---|
| Moisture** | 11.64±0.42 |
| Total solids | 88.36±0.42 |
| Total sugars | 75.17±0.06 |
| Reducing sugars | 30.84±0.08 |
| Non-reducing sugars | 44.33±0.02 |
| Crude protein | 3.69±0.10 |
| Crude fiber | 3.08±0.09 |
| Ash | 2.67±0.12 |
| Crude fat | 1.98±0.17 |
| Total acidity (% malic acid) | 0.36±0.03 |
| Calorific value (Cal/100g) | 333.26±1.51 |
| Total phenolics content (mg/100g) | 847.85±2.90 |
| Antioxidant activity** | 57.91±0.56 |

*Means of triplicates **On fresh weight basis

Data in Table (2) recorded that Sakkoty date flesh contained total phenolics (TP) 847.85 mg as gallic acid/100g on dry weight basis. This result is in accordance with those reported by Benmeddour *et al*. (2006). They reported that TP values were ranged from 226 to 955mg GAE/100g DW in ten Algerian date from Tolga (Biskra). The results also showed that antioxidant activity of Sakkoty date fruits was 57.91% (on fresh weight basis).

**Minerals content**

Results of the average values of the macro-elements and micro-elements of Sakkoty date fruits are shown in Table (3). Potassium was the predominat element present of fruits (497.55 mg) followed by Ca (60.06 mg) and P (58.83 mg/100 g dry weight basis). The data are in the same line with those reported by Morton and Miami (1987), Al-Hooti *et al*. (1997), Youssef *et al*. (1998), Fadhl *et al*. (1999), Hassan (2000), Sahari *et al*. (2007) and El-Sohaimy and Hafez (2010). The same data revealed that Sakkoty flesh contained 56.19 mg Mg and 21.95 mg Na/100 g dry matter which are in accordance with that reported by Ahmed *et al*. (1995), Al-Hooti *et al*. (1995), Youssef *et al*. (1999), Hassan (2000) and Sahari *et al*. (2007).

Among the micro-elements (Table, 3) iron was the predominat element present in Sakkoty flesh (12.05 mg/100 g dwb). The levels of Cu, Zn and Mn were 1.21, 0.81 and 0.57 mg/100 g dwb of Sakkoty flesh, respectively. Data of micro-elements levels agree with those reported by Morton and Miami (1987), Ahmed *et al*. (1995), Al-Hooti *et al*. (1995), Youssef *et al*. (1998), Fadhl *et al*. (1999) and Hasnaoui *et al*. (2010).

**Table 3. Minerals content of the Sakkoty date fruits:**

| Element | | mg/100g (dwb) |
|---|---|---|
| Macro-elements | Potassium (K) | 497.55±2.27 |
| | Calcium (Ca) | 60.06±0.08 |
| | Phosphorus (P) | 58.83±1.12 |
| | Magnesium (Mg) | 56.19±1.07 |
| | Sodium (Na) | 21.95±1.17 |
| Micro-elements | Iron (Fe) | 12.05±0.16 |
| | Copper (Cu) | 1.21±0.04 |
| | Zinc (Zn) | 0.81±0.03 |
| | Manganese (Mn) | 0.57±0.02 |

**Effect of gamma irradiation on physical characteristics of Sakkoty fruits during storage:**

During the storage period (12 months) the pH value decreased from 6.06 to 5.36, from 6.04 to 5.41, from 6.03 to 5.39 and from 6.03 to 5.28 for the control and irradiated samples of 1, 2 and 4KGy, respectively (Table, 4). Benjamin *et al*. (1985) found that there was a relationship between the enzymes activity in date fruits and into pH value and color.

From the data in Table (4) it is clear that the infestation percentage in control sample was 4.54% at zero time and decreased up to zero% after storage for 8 months in both the irradiated fruits of 2 and 4KGy; and after 4 months in the irradiated date samples with 1KGy dose. Moreover, the results also showed that irradiation with 4KGy was more effective for controlling the insect infestation (3.22%) of stored dates for 12 month followed by the irradiation with 2KGy (6.00%) and with 1KGy (6.45%). While the control sample recorded 24.25% insect infestation at the same storage period (12 months). These results are in the same trend with those recorded by Emam *et al*. (1994) and Al-Kahtani *et al*. (1998).

**Table 4. Effect of gamma irradiation on physical characteristics of Sakkoty date fruits during storage at room temperature:**

| Treatment | Storage time (month) | physical characteristics | | |
|---|---|---|---|---|
| | | pH value | Infestation (%) | Color (OD) |
| Control | 0 | 6.06±0.05 | 4.54±0.13 | 1.48±0.01 |
| | 4 | 5.68±0.04$^{a}$ | 11.76±1.09$^{a}$ | 1.56±0.01 |
| | 8 | 5.47±0.04$^{a}$ | 12.54±1.27$^{a}$ | 1.70±0.01$^{ab}$ |
| | 12 | 5.36±0.04$^{a-c}$ | 24.25±3.36$^{a-c}$ | 1.81±0.01$^{a-c}$ |
| 1 KGy | 0 | 6.04±0.05 | 0±0$^{A}$ | 1.22±0.02$^{A}$ |
| | 4 | 5.62±0.04$^{a}$ | 0±0$^{Aa}$ | 1.40±0.01$^{Aa}$ |
| | 8 | 5.49±0.04$^{a}$ | 3.34±0.58$^{Aab}$ | 1.43±0.01$^{Aab}$ |
| | 12 | 5.41±0.04$^{a-c}$ | 6.45±0.18$^{ABa-c}$ | 1.60±0.01$^{Aa-c}$ |
| 2 KGy | 0 | 6.03±0.02 | 0±0$^{AB}$ | 1.24±0.03$^{A}$ |
| | 4 | 5.68±0.04$^{Ba}$ | 0±0$^{A}$ | 1.42±0.01$^{Aa}$ |
| | 8 | 5.48±0.04$^{ABab}$ | 0±0$^{AB}$ | 1.45±0.01$^{ABab}$ |
| | 12 | 5.39±0.04$^{ABac}$ | 6.00±0.58$^{ABa-c}$ | 1.64±0.01$^{ABa-c}$ |
| 4 KGy | 0 | 6.03±0.01 | 0±0$^{A}$ | 1.47±0.01$^{A-C}$ |
| | 4 | 5.70±0.04$^{ACa}$ | 0±0$^{A}$ | 1.55±0.01$^{A-Ca}$ |
| | 8 | 5.32±0.04$^{A-Cab}$ | 0±0$^{AB}$ | 1.59±0.01$^{A-Cab}$ |
| | 12 | 5.28±0.04$^{A-Ca}$ | 3.22±0.28$^{A-Ca-c}$ | 1.67±0.01$^{A-Ca-c}$ |

a: Significant difference in comparison with zero time A: Significant difference in comparison with control
b: Significant difference in comparison with 4 months B: Significant difference in comparison with 1KGY
c: Significant difference in comparison with 8 months C: Significant difference in comparison with 2KGY

Results in Table (4) also observed that there is an increase in color intensity (as OD) of the studied date samples during storage periods. However, the irradiation treatments recorded a good effect against fruit color darkening, especially the irradiated with 1KGy followed by the irradiated with 2KGy and with 4KGy samples during storage periods compared with the control sample. In general, the OD values were gradually increased during the storage for all studied samples. The increase in fruits color intensity during storage probably due to tannins oxidation as recorded by Mohamed (2000). The pigments degradation associated with postharvest physiological reactions also influence the color stability.

**Effect of gamma irradiation on chemical composition of Sakkoty fruits during storage:**

The consumer's interest was mainly focused on the nutritional properties of the product. To draw up a date quality profile will, an evaluation of gross chemical composition as well as total phenolic content and antioxidant activity were determined (Table, 5). The results indicated that the moisture content of all samples decreased during storage periods and the highest reduction was observed during the first 4 months of storage. The increase in dry matter content of both irradiated and non-irradiated dates may be due to the direct consequence of evaporation after storage for several months under ambient temperature (Azelmat *et al*., 2006).

The total and reducing sugars of the control and irradiated (1, 2 and 4KGy) date samples increased gradually with increasing the storage time (Table, 5). Total sugars increasing means that there was hydrolysis in the polysaccharides substances in date fruits during storage periods. The increase in storage time caused a decrease in starch contents in both irradiated and non-irradiated dates (Azelmat *et al*., 2006). Reducing sugars content recorded a gradually increase during storage periods in the same line of that total sugars content. The gradual increasing in the reducing sugars content was relevant with the hydrolysis of sucrose (Mikki *et al*, 1993). On contrary, the non-reducing sugars content was decreased in all the treatments during storage periods up to the end storage time, due to the invertase action on sucrose (Al-Kahtani *et al*., 1998).

The highest levels of sugars were obtained at the end of storage period in the control followed by the irradiated samples of doses 4, 2 and 1KGy. On the other hand, Thomas (1986) reported that radiolytic products of carbohydrates could be formed when foods treated with ionizing energy; such products include glucuronic, gluconic, and saccharic acid, glyoxal, arabinose, erythrose, formaldehyde, and dihydroxyacetone. These results also are in agreement with Al-Kahtani *et al*. (1998). They reported that irradiation at doses between 0.3 and 0.9 kGy, followed by 3 or 6 months storage at room temperature, significantly reduced fructose, glucose and total sugars content of dates (Khalas variety) immediately after irradiation.

The protein contents decreased from 3.69 to 2.81%, from 3.67 to 3.11%, from 3.61 to 3.20 and from 3.69 to 3.02% for the control and 1, 2 and 4KGy irradiated samples, respectively at the end of storage. The highest decrease was found in the control and irradiated samples with 4KGy dose. The results are in close agreement with those reported by Kenawi *et al*. (2011) and Selim *et al*. (2012).

Ihsanullah *et al*. (2005) reported that the irradiation up to 300Krads had no significant effect of the protein content of the irradiated date samples. Auda *et al*. (1977) reported that the protein content of three Iraqi date varieties was not affected by irradiation at 0.7–2.7 kGy.

Results in Table (5) also show that the fiber content of the studied date samples was reduced during storage up to 12 months at room temperature. Data are in agreement with those reported by Ihsanullah *et al*. (2005). Mohammadzai *et al*. (2010) investigated the influence of various doses of gamma irradiation up to 300Krads of date fruit and reported that the fiber levels gradually decrease in all samples in irregular pattern. The decreasing in crude fiber content of date fruits due to the effect of analytic enzymes on cellulose and hemicellulose as reported by Barreveld (1993), Ihsanullah *et al*. (2005), Kenawi *et al*. (2011) and Selim *et al*. (2012).

The ash content of the studied date samples showed an unnoticeable decrease during 12 months of storage, in the same time, no effect was observed due to the different treatments (Table, 5). Stewart (2001) reported

that irradiation dose not alter the elemental composition of food.

The crude fat content was reduced from 1.98 to 1.62, from 1.90 to 1.60, from 1.88 to 1.54 and from 1.87 to 1.55% in the control, 1, 2 and 4KGy irradiated samples, respectively from 0 to 12 months of storage. Many factors such as light, oxygen, heat and moisture, affect the quality of lipids during and after processing (Leo and Amer, 1983). Ihsanullah *et al*. (2005) studied the effect of various irradiation doses on fat content of Pakistani dates and found that fat levels were decreased in all treatments after 5 months of storage.

During the storage period (12 months); the acidity was increased from 0.36 to 0.55%, from 0.37 to 0.54%, from 0.36 to 0.54 and from 0.37 to 0.53% for the control, 1, 2 and 4KGy irradiated samples, respectively.

The total phenolics content increased up to 4 months of storage in all the studied samples except control sample. After this time, all stored samples seemed a gradually decrease in their phenolic content during storage periods up to 12 months. At the end of storage, the lowest phenolic content was recorded in the control sample (627.59 mg/100g dwb) while, the irradiated sample with 2KGy had the highest phenolic content (691.59 mg/100g dwb) compared with the other treatments. Bravo (1998) attributed the losses in phenolic content to binding of polyphenols with other organic substances such as carbohydrate or protein. The polyphenol oxidase enzyme may be activated, resulting in the degradation and consequent losses of polyphenols (Jood *et al*., 1998, Saxena *et al*., 2003 and Selim *et al*., 2012).

The data (Table, 5) also showed that there was a good correlation between the total phenolic content and antioxidant activity. This correlation indicated that phenolic compounds are the main micro constituents contributing to the antioxidant activity of date as reported by Kchaou *et al*. (2013).

**Effect of gamma irradiation on the total microbial counts of Sakkoty fruits during storage:**

Results presented in Table (6) showed that total bacterial counts were reduced immediately after irradiation to a greater extent, compared to the reduction in molds and yeasts. Since the laters are generally less sensitive to irradiation (Jay, 1986).

**Table 6. Effect of gamma irradiation on the total microbial count of Sakkoty fruits during storage at room temperature:**

| Treatment | Total microbial count | Storage time (month) (log cfu/gm) | | | |
|---|---|---|---|---|---|
| | | 0 | 4 | 8 | 12 |
| Control | Total bacterial counts | 4.48±0.03 | 3.46±0.01$^{a}$ | 2.95±0$^{ab}$ | 2.42±0.02$^{a-c}$ |
| | Molds + Yeast | 3.71±0.08 | 2.88±0.01$^{a}$ | 2.46±0.01$^{ab}$ | 2.04±0.04$^{a-c}$ |
| 1 KGy | Total bacterial counts | 3.16±0.01$^{A}$ | 2.64±0$^{Aa}$ | 2.38±0$^{Aab}$ | 2.11±0.1$^{Aa-c}$ |
| | Molds + Yeast | 2.51±0.03$^{A}$ | 1.88±0.01$^{Aa}$ | 1.26±0$^{Aab}$ | 0±0$^{Aa-c}$ |
| 2 KGy | Total bacterial counts | 2.89±0$^{AB}$ | 2.30±0$^{ABa}$ | 2.00±0.01$^{ABab}$ | 1.90±0.05$^{ABab}$ |
| | Molds + Yeast | 2.19±0.01$^{AB}$ | 1.49±0.01$^{ABa}$ | 0±0$^{ABab}$ | 0±0$^{Aac}$ |
| 4 KGy | Total bacterial counts | 2.63±0.01$^{A-C}$ | 2.13±0.01$^{A-Ca}$ | 1.92±0$^{A-Cab}$ | 1.69±0.09$^{BCa-c}$ |
| | Molds + Yeast | 1.97±0.01$^{A-C}$ | 1.31±0$^{A-Ca}$ | 0±0$^{A-Cab}$ | 0±0$^{BCac}$ |

- For the latters; a to c and A to C see footnote of Table (4).

Regarding to the results in Table (6) it was observed that the microbial counts in all samples remained low until the end of storage period (12 months). The irradiated sample with 4KGy had the lowest microbial counts, followed by the irradiated with 2KGy and 1KGy. Moreover, it was clear that after 8 months of storage the fungus and yeasts were not detected in the samples with 2 and 4KGy doses. The low moisture content along with high sugar contents has made an increase the resistance of microbial deterioration where these conditions are unfavorable for the growth of microorganisms (Ahmed *et al*. 1995 and Al-Kahtani *et al*., 1998). This result indicates that the microbiological quality of dates can be substantially improved by irradiation by doses of 1, 2 and 4KGy.

Besides, data in Table (6) showed that the reduction in microbial counts decreased more and more with the increasing irradiation dose of date samples from 1 to 4 KGy as well as with the storage time progress. This is in agreement with that reported by Grecz *et al*. (1988) and Al-Kahtani *et al*. (1998).

**Effect of gamma irradiation on sensory evaluation of Sakkoty fruits during storage:**

Sensory evaluation is consider an important technique to determine product quality. Because of genetic differences variable and growth conditions, date show a wide variation in their final appearance and quality. With respect to consumers, important

quality criteria of the product and appearances including color, taste, flavor ….etc. (Wills *et al*., 1998).

The results of organoleptic evaluation (Table, 7) show that the panelists could not discriminate between the non-irradiated and the irradiated date fruits during storage periods. Furthermore, all treatments have no detectable adverse effect on the preference rating of the fruits by a taste panel.

The irradiated sample with of 2KGy followed by 1KGy had the best texture (6.14 and 6.00, respectively) in the end of storage at room temperature, while, the control sample recorded the lowest textures values. Regarding to appearance evaluation of the studied date samples it was evident that there are no significant differences among all treatments at zero time of storage. However, control sample contained the lowest values of appearance at the end of storage, while, the irradiated samples by 2 and 1KGy recorded the highest values, respectively. The color values of all samples recorded a gradually decrease during storage period, the control sample had the lowest color value followed by the 4, 2 and 1KGy irradiated samples at the end storage period. The taste value of control sample decreased to the lowest value (5.57) followed by the irradiated with 4KGy (5.71), 2KGy (6.00) and 1KGy (6.14) date samples. Finally, the irradiated with 1KGy samples were occupied the first rank in overall acceptability followed by the irradiated with 2KGy, 4KGy and control samples. These results are in the same trend with those recorded by Grecz *et al*. (1988), Al-Kahtani *et al*. (1998), Ismail *et al*. (2008), Kenawi *et al*. (2011) and Abd El-Bar *et al*. (2014).

**Table 7. Effect of gamma irradiation on sensory evaluation of Sakkoty fruits during storage at room temperature:**

| Treatment | Storage time month | Sensory evaluation | | | | |
|---|---|---|---|---|---|---|
| | | Color | Taste | Texture | Appearance | Overall acceptability |
| Control | 0 | 7.86±1.07 | 7.71±1.25 | 7.14±0.69 | 7.43±0.79 | 7.57±0.79 |
| | 4 | 6.71±0.76$^{a}$ | 6.86±1.07 | 6.29±1.50 | 7.14±1.07 | 7.00±0.82 |
| | 8 | 5.86±1.07$^{a}$ | 6.29±0.95$^{a}$ | 6.00±1.15 | 6.00±1.41$^{ab}$ | 6.14±1.35$^{ab}$ |
| | 12 | 5.29±1.38$^{a-c}$ | 5.57±0.98$^{a}$ | 5.14±1.35$^{ab}$ | 5.43±1.13$^{ab}$ | 5.86±1.77$^{ac}$ |
| 1 KGy | 0 | 7.86±0.69 | 7.43±0.98 | 7.00±1.29 | 7.43±0.98 | 7.57±0.98 |
| | 4 | 7.86±0.38$^{A}$ | 7.14±0.90 | 6.57±0.79 | 7.43±0.79 | 7.43±0.79 |
| | 8 | 7.29±0.49$^{Ab}$ | 6.57±0.79 | 6.57±0.53 | 6.71±1.11$^{b}$ | 6.86±0.90 |
| | 12 | 7.00±1.00$^{Ab}$ | 6.14±0.38$^{a}$ | 6.00±1.15 | 6.14±1.68 | 6.86±1.07 |
| 2 KGy | 0 | 7.43±0.79 | 7.29±0.95 | 6.86±1.07 | 7.57±1.13 | 7.43±1.27 |
| | 4 | 7.57±0.53 | 7.00±0.82 | 6.71±0.95 | 7.29±0.76 | 7.29±1.11 |
| | 8 | 7.00±0.82$^{Ab}$ | 6.43±0.53 | 6.57±1.13 | 6.71±1.11 | 6.71±1.25 |
| | 12 | 6.86±1.46 | 6.00±0.82$^{a}$ | 6.14±1.07 | 6.43±1.62 | 6.43±1.27 |
| 4 KGy | 0 | 7.29±1.11 | 7.00±1.15 | 6.71±1.11$^{C}$ | 7.43±1.13 | 7.29±0.95 |
| | 4 | 7.43±0.79 | 6.57±1.27 | 6.86±0.69 | 7.14±1.07 | 7.00±0.82 |
| | 8 | 6.86±1.07$^{B}$ | 6.29±0.95 | 6.71±1.11 | 6.57±0.79$^{a}$ | 6.29±1.11$^{a}$ |
| | 12 | 6.43±1.27$^{BC}$ | 5.71±0.95$^{a}$ | 5.86±1.07 | 6.00±1.41 | 6.14±1.07 |

- For the latters; a to c and A to C see footnote of Table (4).

## 4. Conclusions

This study suggests that gamma irradiation treatment especially with doses of 1, 2 and 4KGy superior to untreatment and therefore could be used for improving the quality as well as prolonging the marketable shelf life of Sakkoty date fruits.

## 5. References

A.O.A.C. (2005): Official Methods of the Association of official Analytical Chemists 16th Ed. Washington, D.C., U.S.A.

A.P.H.A. (1976): American public Health Association of Methods for the Microbiological Examination of Foods. Speck, M. L. Ed., Washington, D.C., U.S.A.

Abd El-Bar, O. H.; Farag, S. A. and El-Magide, A. E. (2014): Effect of gamma irradiation on anatomical structure and quality attributes of some semi dry date palm fruits during storage. Horticu. Scie. and Ornamental Plants 6 (2): 100-108.

Abdel-Hafiz, M. J.; Shalabi, A. F. and AL-Akhal, I. A. (1980): Chemical composition of 15 varieties of dates grown in Saudi Arabia. Proc. Saudi Biol. Soc., 4: 181–194.

Abd-Ellah, A. E. I. (2009): Chemical and technological studies on some Sudanese date cultivars. Ph.D. Thesis, College., of Graduate Studies., Nile Valley Univ., Sudan.

Abd-Elwahid, A. A. (2007): Quality evaluation of some local date palm fruits under Rubatab Area. M.Sc. Thesis, Fac. of Agric., Nile Valley Univ., Atbara, Sudan.

Ahmed, I. A.; Ahmed, A. K. and Robinson, R. K. (1995): Chemical composition of date varieties as influenced by the stage of ripening. J. Food Chem., 54(3): 305-309.

Ahmed, M. (2001): Disinfestations of stored grains, pulses, dried fruits and nuts, and other dried foods. In: Molins, R.A. (Ed.), Food Irradiation: Principles and Applications. Wiley, New York, pp. 77–112.

Al-Farsi, M.; Alasalvar, C.; Morris, A.; Barron, M. and Shahidi, F. (2005): Comparison of anti-oxidant activity, anthocyanins, carotenoids, and phenolics of three native fresh and

sun-dried dates (*Phoenix dactylifera* L.). J. Agric. Food Chem., 53: 7592–7599.

Al-Hooti, S. N.; Sidhu, J. S.; Al-Saqer, J. M.; Al-Amiri, H. and Qabazard, H. (1997): Processing quality of important date cultivars grown in the United Arab Emirates for jam, butter and dates-in-syrup. J. Adv. Food Sci., 19(1/2): 35–40.

Al-Hooti, S.N.; Sidhu, J.S. and Qabajard, H. (1995): Studies on the physico-chemical characteristics of five UAE cultivars at different stages of maturity. Arab Gulf J. Sci. Res., 13(3): 553-569.

Al-Hooti, S.N.; Sidhy, J. S.; Al-Sager, J.M. and Al-Othman, A. (2002): Chemical composition and quality of date syrup as affected by pectinase/cellulose enzyme treatment. Food Chem., 79: 215-220.

Al-Kahtani, H. A.; Abu-Tarboush, H. M.; Al-Drhyim, Y. N.; Ahmad, M. A.; Bajaber, A. S.; Adam, E. E. and El-Mojaddidi, M. A. (1998): Irradiation of dates: insect disinfestation, microbial and chemical assessment, and use of thermoluminescence technique. Radiation Physics and Chem., 53:181-187.

Al-Shahib, W. and Marshall, R. J. (2003): The fruit of the date palm: it's possible use as the best food for the future. Int. J. of Food Sci. and Nutr., 54 (4): 247–259.

Ao, C.; Li, A.; Elzaawely, A. A.; Xuan, T. D. and Tawata, S. (2008): Evaluation of antioxidant and antibacterial activities of Fichus microcarpa L. fil. extract. Food Control, 19: 940–948.

Asami, D. K.; Hong, Y. J.; Barrett, D. M. and Mitchell, A. E. (2003): Comparison of the total phenolic and ascorbic acid content of freeze-dried and air-dried marionberry, strawberry, and corn grown using conventional, organic, and sustainable agricultural practices. J. Agric. Food Chem., 51: 1237-1241.

Auda, H.; Khalfa, Z. and Mirjan, J. (1977): Effect of gamma irradiation on the sugar and protein composition of Iraqi dates. Int. Atomic Energy Agency Report. SM 221/29a., 459-464.

Azelmat, K.; El-Garrouj, D.; Mouhib, M. and Sayah, F. (2006): Irradiation of 'Boufeggous' dates: effects on chemical composition during storage. Postharvest Biology and Tech., 39(2): 217-222.

Ba'abad, A. M. (2000): Chemical, nutritional and technological studies on some Yemeni dates. M. Sc. Thesis. Food Sci. and Tech. Dept., Fac. of Agric., Assiut Univ., Egypt.

Barreveld, W. H. (1993): Date palm products, FAO Agricultural Services Bulletin No 101. Food and Agric. organization of the united Nation, Rome.

Benjamin, N. D.; Al-Khalidi, M. S.; Shabana, H. R. and Moroki, A. S. (1985): The effect of cold storage conditions on the quality of six date fruit cultivars at Rutab stage. Agric. and Water Reso. Rese. Center, Fudailiya, Baghdad, Iraq. Date Palm J.,4(1): 1-18.

Benmeddour, Z.; Mehinagic, E.; Le M. D. and Louaileche, H. (2006): J. Funct. Foods, 5: 346.

Besbes, S.; Drira, L.; Blecker, C.; Deroanne, C. and Hamadi, A. (2009): Adding value to hard date (*Phoenix dactylifera* L.) compositional, functional and sensory characteristics of date jam. Chem., 112: 406-411.

Borchani, C.; Besbes, S.; Blecker, C.; Masmoudi, M.; Baati, R. and Attia, H. (2010): Chemical properties of 11 date cultivars and their corresponding fiber extracts. African J. of Biotechn., 9(26): 4096-4105.

Bravo, L. (1998): Polyphenols: chemistry, dietary sources, metabolism, and nutritional significance. Nutrition Reviews, 56(11):317-333.

Dalaly, B. K. and Al-Hakiem, S. H. (1987): Food analysis. Mosul University, Iraq.

Diehl, J. F. (1995): Safety of Irradiated Foods 2ed. Marcel Dekker, New York, 2ed. 310–454.

Difco-Manual, (1984): Dehydrated culture media and reagents microbiological and clinical laboratory procedures, Pub-Difco-Lab-Detroits Michigan, USA.

El-Sayed, S. A. and Baeshin, N. A., (1983): Feasibility of disinfestations of date fruits produced in Saudi Arabia by gamma irradiation. Proc. 1stSymp. On the date palm Saudi Arabia, K. F. Univ., Al-Hassa, Saudi Arabia, p. 342.

El-Shamery, G. and El-Dien, M. R. (1988): Microbiological studies on some foods. M. Sc. Thesis. Fac. of Agric., Moshtohor Zagazig Univ., Egypt.

El-Sohaimy, S. A. and Hafez, E. E. (2010): Biochemical and nutritional characterizations of date palm fruits (*Phoenix dactylifera* L.). J. of Applied Sci. Research, August: 1060-1067.

Emam, O. A.; Farag, S. E. A. and Hammad, A. I. (1994): Comparative studies between fumigation and irradiation of semi-dry date fruits. Food / Nahrung, 38: 612-620.

Fadhl, T. T.; Kassim, Y. A. and Ba-Faidh, S. (1999): The chemical analysis for some types of Shabowa dates. Univ. of Aden J. of Natural and Applied Sci., 3(1): 69-81.

FAO (2015): Statistical databases. http://faostat.fao.org.

FAO/WHO (1973): Energy and protein requirements. FAO Nutritional Meetings Report Series No. 52, WHO Technical Report Series No. 522, FAO, Rome.

Farkas, J.; Al-Charchafchy, F.; Al-Shaikhaly, M. H.; Mirjan, J. and Auda, H. (1974): Irradiation of dates. Acta Alimentaria, 3(2): 151-180.

Grecz, N.; AI-Harithy, R.; Jaw, R.; Al-Suwaine, A. R.; El-Mojaddidi, M. A. and Rahm, S. (1988): Radiation processing of dates grown in Saudi Arabia. Int. J. Radiat. Appl. Instrum, Part C. 31 (1-3):161-164.

Grecz, N.; Al-Harithy, R.; El-Mojaddidi, M. A. and Rahma, S. (1986): Radiation inactivation of microorganisms on dates from Riyadh and Al-Hassa area. 2ed Symp. on Date Palm: 155-164.

Hasnaoui, A.; El-Houmaizi, M. A.; Asehraou, A.; Sindic, M.; Deroanne, C. and Hakkou, A. (2010): Chemical composition and microbial quality of dates grown in Figuid of Morocco. Int. J. of Agric. and Biol., 12: 311-314.

Hassan, E. Y. A. (2000): Studies on extraction, concentration and storage stability of date syrup (Dibis). Ph.D. Thesis, Food Sci. and Tech. Dept., Fac. Of Agric., Cairo Univ., Egypt.

Hussein, F.; El-Kahtany, M. S. and Wally, Y. A. (1979): Date Palm Cultivation and Date Production in the Arabic and Islamic World. An-Shams Univ. Press, pp. 576 (in Arabic).

Ihsanullah, I.; Iqbal, Y. and Khattak, T. N. (2005): Effect of various irradiation doses on some nutrients of Pakistani date. J. of Radio Analytical and Nuclear Chem., 266: 2, 0236-5731 (Print), 1588-2780 (Online).

Ismail, B.; Haffar, L.; Baalbaki, R. and Henry, J. (2008): Physico-Chemical characteristics and sensory quality of two date varieties

under commercial and industrial storage conditions. J. of Food Quality and Preference, 12: 499-506.

Jay, J. M. (1986): Food preservation using irradiation. In: Modern Food Microbiology, 3rd ed. Van Nostr. and Reinhold, New York.

Jood, S.; Bishnoi, S. and Segal, S. (1998): Effect of processing on nutritional and anti- nutritional factors of moongbean cultivars. Food Biochem., 22: 245- 257.

Joshi, P.; Nathawat, N. S.; Chhipa, B. G.; Hajare, S. N. and Goyal, M. (2011): Irradiation of sangria (Prosopis cineraria): Effect on composition and microbial counts during storage. Rad. Physics and Chem., 80: 1242–1246.

Kchaou, W.; Abbès, F.; Blecker, B.; Attia, H. and Besbes, S. (2013): Effects of extraction solvents on phenolic contents and antioxidant activities of Tunisian date varieties (*Phoenix dactylifera L.*). Industrial Crops and Products,45: 262-269.

Kenawi, M. N.; Hammam, A. M.; Dawood, A. A.; Aly, A. M. and Gado, B. A. G. (2011): Effect of irradiation, fumigation and thermal treatment on chemical, organoleptic and histological characteristics of Siwy dates during storage. Minia J. of Agric. Res. and Develop., 31(2) 233-264.

Leo, D. A. and Amer, J. (1983): Oil Chem. Soc., 60: 301.

Mikki, M. S.; Al-Taisan, S. M. and Al-Oraifii, I. A. (1993): Effect of steam hydration on quality improvement of Biadh date cultivar grown at Najran Region. Proc. of 3rd symp. on date palm in S.A., K.F. Univ., Al-Hassa, Saudi Arabia, pp. 315-324.

Mohamed, A. A. (2000): Palm culture and production of dates In Sudan. A country report, Palm and Dates Research Centre, Sudan.

Mohammadzai, I. U.; Shah, Z.; Ihsanullah, I.; Khan, H.; Khan, H and Rashid, R. (2010): Effect of gamma irradiation, packaging and storage on the nutrients and shelf life of palm dates. J. of Food Processing and Preservation. 34: 622-638.

Molander, A. L. (1960): Discernment of primary test substances and probable ability to judge food. Iowa state Univ. Pub., Aimess, USA. C.F., Egypt Agric., Res., 77 (2): 873 - 889.

Morton, J. and Miami, F. L. (1987): Date In: Fruits of warm climates, pp. 5–11.

Navarro, S.; Donahaye, J. E. M.; Rindner, A. and Azrieli, (2000): Storage of dates under carbon dioxide atmosphere for quality preservation, in: Proc. Int. Conf. on controlled atmosphere and fumigation in stored products, Fresno, CA., USA, p. 231.

Osman, S. M. (2008): Fruit quality and general evaluation of Zaghloul and Samany date palm cultivars grown under condition of Aswan. American Eurasian, J. of Agric. and Environ. Sci., 4 (2): 230-236.

Patil, B. S.; Vanamala, J. and Hallman, G. (2004): Irradiation and storage in fluenceon bioactive components and quality of early and late season'Rio Red' grapefruit (Citrus paradisi Macf.). Postharvest Biol. Tech., 34: 53–64.

Ramadan, B. R. (1990): Chemical and technological studies on some New Valley dates. M. Sc. Thesis, Food Sci. and Tech. Dept., Fac. of Agric., Assiut., Egypt.

Ramadan, B. R. (1995): Biochemical, nutritional and technological studies on dates. Ph.D. Thesis, Food

Sci. and Tech. Dept., Fac., of Agric., Assiut Univ., Egypt.

Sahari, M. A.; Barzegar, M. and Radfar, R. (2007): Effect of varieties on the composition of dates (*Phoenix dactylifera* L.). J. Food Sci. and Tech. Inter., 13(4): 269-275.

Saxena, A. K.; Chadha, M. and Sharma, S. (2003): Nutrients and antinutrients in chickpea (Cicer arietinum L.) cultivars after soaking and pressure cooking. J. Food Sci. and Tech., 40(5): 493- 497.

Selim, K.; Abdel-Bary, M. and Ismaael, O. (2012): Effect of irradiation and heat treatments on the quality characteristics of Siwy date fruit (*Phoenis dactylifera* L.). AgroLife Scientific J., 1: 103-111.

SPSS, (2011): SPSS for windows. Release, 20.0., Standard Version, Armonk, NY: IBM Corp.

Stewart, E. M. (2001): Food irradiation chemistry In: Food Irradiation Principles and Applications, R. A.Molins (ed.), Wiley Inter. Sci., New York, USA.

Thomas, M. H. (1986): Use of ionizing radiation to preserve foods. In: Nutritional Evaluation of Food Processing, E. Kramas and R. S. Harris, (Eds.), 3rd ed. AVI Puplishing, Westport, CT.

Ud Din, Z.; Ullah Shah, H.; Ihsanullah.; Zubair, A. and Khan, S. A. (2011): Estimation of physic-chemicals and microbiological levels during storage of irradiated fresh date sample. Int. J. of Sci. and Nature, 2(1): 16-21.

United Nations Environmental Programme (UNEP), (1992): Proceedings of the Fourth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, Copenhagen, UNEP, Nairobi, Kenya, pp. 23–25.

Velioglu, Y.S.; Mazza, G.; Gao, L. and Oomah, B. D. (1998): Antioxidant activity and total phenolics in selected fruits, vegetables, and grain products. J. Agric. Food Chem., 46: 4113–4117.

Wills, R.; Glasson, M. C.; Graham, B. and Toyce, D. (1998): Postharvest. An introduction on the physiology and handling of fruit, vegetables and ornamentals. Adel Aide, UNSW press. 4ed, pp: 262.

Youssef, M. K. E.; Abou El-Hawa, S. H.; Seleim, M. A. and Ramadan, B. R. (1998): Evaluation of chemical composition of various types of Upper Egypt dates. Assiut J. of Agric. Sci., 29(3): 33-52.

Youssef, M. K. E.; El-Rify, M. N.; El-Geddawy, M. A. H. and Ramadan, B. R. (1999): Nutrient elements and vitamins content of some New Valley dates and certain date products. Proc. of the Int. Conf. on Date Palm. Assiut Univ., Center for Environmental Studies, Egypt, pp. 201-210.

Zaklandnoi, G. A. and Ratanova, V. F. (1978): Stored-grain Pests and their Control. Oxonian Press, New Delhi.

# تأثير التشعيع الجامى على جودة وتركيب ثمار البلح السكوتى أثناء التخزين

**بلبل رمضان رمضان[١]، محمد نجيب أحمد الريفى[١]، عادل أحمد عبدالحميد[٢]، محمود حسين عبدالمجيد[٢]**

[١]قسم علوم وتكنولوجيا الأغذية كلية الزراعة جامعة أسيوط

[٢]قسم علوم وتكنولوجيا الأغذية كلية الزراعة جامعة الأزهر بأسيوط

**الملخص**

اجريت هذه الدراسة لتحسين جودة وفترة صلاحية ثمار البلح السكوتى خلال فترة التخزين على درجة حرارة الغرفة باستخدام التشعيع الجامى بجرعات صفر ، ١ ، ٢ و ٤كيلو جراى. وتم دراسة تأثير المعاملات بالإشعاع على جودة وتركيب العينات بعد فترات صفر ، ٤ ، ٨ و١٢ شهر من التخزين. وأظهرت النتائج أن التشعيع بجرعة ٤كيلو جراى أكثر فاعلية للسيطرة على الأصابة الحشرية (٣،٢٢%) تليها العينة المشععة بجرعة ٢كيلو جراى (٦%) ثم المشععة بجرعة ١كيلو جراى (٦،٤٥%) فى حين سجلت العينة الكنترول ٢٤،٢٥% عند نهاية فترة التخزين لمدة ١٢شهر. وأن محتوى الرطوبة فى العينة الكنترول انخفض من ١١،٦٤ الى ٨،٣٣% فى نهاية فترة التخزين وانخفض من ١١،٩٤ الى ٨،٠٤% ، من ١١،٨٩ الى ٨،٣٥% ومن ١١،٦١ الى ٨،٢٨% لكل من العينات المشععة بجرعات ١ ، ٢ و ٤كيلو جراى على التوالى. ومع ذلك ، فإن محتوى جميع السكريات انخفض مباشرة بعد التشعيع ، فى حين انها زادت تدريجياً مع زيادة فترة التخزين. وقد تبين أن العدد الكلى للبكتيريا انخفض مباشرةً بعد التشعيع الى حد كبير مقارنة بالانخفاض فى الخمائر والفطريات. اضافة الى بقاء العدد الميكروبى منخفضاً فى كل الجرعات حتى نهاية فترة التخزين ، واحتوت العينة المشععة بجرعة ٤كيلو جراى على أقل محتوى ميكروبى تلتها المشععة بجرعة ٢ و١كيلو جراى على التوالى. ومن نتائج التقييم العضوى الحسى لم يظهر أى تمييز بين عينات التمور المشععة وغير المشععة. وقد تبين كذلك أن جميع المعاملات ليس لها أى تاثير سلبى على درجة تقبل الثمار، وقد احتلت العينة المشععة بجرعة ١كيلو جراى المرتبة الأولى فى درجة التقبل العام تلتها العينة المشععة بجرعة ٢كيلو جراى ثم العينة المشععة بجرعة ٤كيلو جراى. وتشير هذه النتائج الى أن التشعيع بجرعات ١ ، ٢ و ٤ كيلو جراى يمكن أن تستخدم كوسيلة بديلة لتحسين جودة ثمار البلح السكوتى فضلاً عن اطالة فترة تسويقها على درجة حرارة الغرفة لمدة ١٢شهر.

***الكلمات الدالة:*** *البلح السكوتى، التخزين، التشعيع ، كيلو جراى ،التركيب الكيميائى ، الخصائص الفيزيائية ، العد الميكروبى.*