Minia J. of Agric. Res. & Develop.
Vol. (٣١) No. ٢ pp ٢٣٣-٢٦٤,
٢٠١١

FACULTY OF AGRICULTURE

EFFECT OF IRRADIATION, FUMIGATION AND THERMAL TREATMENT ON CHEMICAL, ORGANOLEPTIC AND HISTOLOGICAL CHARACTERISTICS OF SIWI DATES DURING STORAGE.

M.N. Kenawi*; A.M. Hammam *; A.A. Dawood;**
A.M.Aly*; and B.A.G. Gado*** .**
Food Sci. Dept. Fac. of Agric. Minia Univ.*Fac. of Tourism & Hotels Minia Univ.**., Inst of Agric. Res. Center (ARC),*** Giza, Egypt.

Received ١٠ Oct. ٢٠١١ Accepted ٢٤ Oct. ٢٠١١

ABESTRACT

This investigation was conducted on semi-dry date fruits "Siwi variety" to study the quality characteristics of fruits during storage for ١٢ months at room temperature. Date samples were treated with fumigation (sulphar dioxide or methyl bromide (MB), low doses of gamma irradiation (١.٠, ٢.٠ and ٣.٠ KGy), thermal treatments (٥٠ ^{o}C /٢٤hr and ٥٠ ^{o}C /٤٨hr) and combined treatment (irradiation ١ KGy with thermal treatments ٥٠ ^{o}C /٢٤hr).Chemical and organoleptic characteristics and histological examination were made on treated dates samples . Total sugar values decreased during storage for all samples. Control sample had the lowest value of total sugar (٥٧.١٤٪) while thermal treatment recorded the highest value (٧٦.٤٣٪). The same trend was observed with other chemical characteristics: crude protein, crude fat, ash content, fiber content ,total sugar and minerals content. Methyl bromide (MB) or sulfur dioxide ($SO_٢$) residues after fumigation in dates was less than maximum residue limits (MRL). Panelists test gave preferability for the combination treatment at first rank, the thermal separately and other treatments, respectively. Histological examination, showed that

dates tissues contained exocarp, mezocarp and endocarp. Exocarp tissues have ٣-layers of similar small cutinized parenchymatou cells which filled in some cells with tannins. Whereas, the edible part as mezocarp tissues which has chloroplast tannins cells in groups , distributed in discontinuous bands. High doses of irradiations (٣.٠ kGy) or high temperatures (٥٠C°/٤٨ hrs) injured cell walls presented in shrinkage or collapsed cells. The proper treatment was heating at ٥٠ °C for ٢٤ hrs resulted in dates with less changes in studied characteristics without or with ١.٠ kGy.

It could be recommended that using thermal treatments are the suitable alternative for using chemicals or irradiation for improving quality of semi-dry date fruits. Irradiation and thermal treatment are beneficial methods to increase the storage quality of date.

INTRODUCTION

Date palm (*Phoenix dactylifera L.*) is an important agricultural crop in Egypt. High losses (about ٢٥٪) occur during post-harvest due to insect infestation and microorganisms contamination either during handling or storage under unsuitable conditions(FAO, ٢٠٠٧). During long storage at room temperature semi-dry date fruits such as Siwi variety suffer from insect and mold infestation with the consequent presence of aflatoxins (Emam et al. ١٩٩٤). The treatments usually use pesticides as fumigation with methyl bromide(MB) or phosphine. Methyl bromide (MB) is one of banned zone depleting substances of the Montereal Protocol besides its toxicity for human health (IARC, ١٩٨٦, EHC, ١٩٩٤). Therefore, the manufacture and exportation of MB will be prevented completely in ٢٠١٥ (Codex, ١٩٩٥). The irradiation of any food commodity up to an overall average dose of ١٠ kGy introduces no toxicological hazard, hence toxicological testing of food treated is no longer required" (FAO/IAEA, ١٩٩١). Egypt, is a commercial user of food irradiation and sterilization of dried food stuffs, herbs, and medical goods (Zaid et al. ٢٠٠٥). Methyl bromide (MB) is commercially available as a liquefied gas and used as fumigant for the control of nematodes, fungi and weeds.

Methyl bromide affects human health both directly and indirectly. It effects the nervous system and damages lungs, kidneys,

eyes and skin of workers involved in the manufacture as showed by Environmental Protection Agency (EPA), Baselt, (١٩٨٢), IARC (١٩٨٦) , FAO/WHO, (١٩٨٨) and EHC, (١٩٩٤). Sulfite as gas or salts has been used for long time as antimicrobial agents in food processing. The legal limit in the United Kingdom is ٤٥٠ µg/g as sulfur oxide in some processed food. It is used mainly to inhibit *Clostridium perfringeris* in fresh sausage (Dyett and Shelley, ١٩٦٦). Also, it can be used to prevent browning as antioxidant or as reducing agent (Roberts and Weeny, ١٩٧٢). The maximum acceptable daily intake of SO_2 for humans is about ٠.٧ mg/kg according to WHO (١٩٧٤). However, using sulfitation as anti-browning, antioxidant and anti-microbial treatment, some investigators proved toxicity of sulphite in food products (Mcweeny et al., ١٩٧٤).

Thermal treatment can be considered a suitable natural treatment in order to replace pesticides and fumigants to over-come residue regulation and increasing insect resistance towards these insecticides. Using gentle thermal treatment (٤٠-٦٠ºC) ,٧٠٪ Relative humidity) resulted in killing most of insects stages as shown by FAO (١٩٩٣ and ١٩٩٨).Also, using heat treatment (٤٥ºC, ٥٠ºC) combined vacuum packed dates resulted in high percentage of mortality for Ephestia sp. (FAO, ١٩٩٣, ١٩٩٨).

The objective of this investigation was to evaluate the effect of recommended doses of gamma irradiation, thermal treatments, sulfating, MB fumigation and combination treatments (thermal plus irradiation) on some chemical, histological and organoleptic properties of semi-dry Siwi date during ١٢ months of storage.

MATERIAL AND METHODS

Materials:

Date fruit "*Phoneix dactylifera*" c.v Siwi variety at tamer stage as semi-dry, were obtained from upper Egypt, New Valley Governorate during ٢٠٠٥ season.

Methods

Treatments.

Samples of date fruits were harvested free from any additional treatments, and packaged in polyethylene bags. Packaged dates were divided to nine groups for treating as control (untreated), irradiation with different doses (١.٠, ٢.٠ and ٣.٠ kGy), fumigation with methyl bromide(MB), sulfur dioxide($SO_٢$), thermal treatments at ٥٠°C for ٢٤ hrs, ٤٨hrs and combination treatments only irradiation with ١.٠ kGy plus ٥٠°C/٢٤ hr.

Irradiation process.

Packaged dates in polyethylene(١Kg) were exposed to gamma rays with different doses as ١.٠, ٢.٠ and ٣.٠ kGy at doses rates (٠.٩٠٣٨١ kGy.hr-١) using Gamma cell (Indian cell) at room temperature ٢٧°C. The irradiation process was carried out at National Center for Radiation Research& Technology, Nasr City, Cairo, Egypt.

Fumigation process.

Fumigation with methyle bromide gas was carried out with standard common commercial method at ١ lab/١٠٠٠ feet^٣ volume during ١٢ hr i.e. ١٥ gm gas/١ m^٣ at room temperature ٢٥°C, ٧٠-٧٥٪ RH. This process was performed at Food Technology Research Institute, Giza, Egypt, then all fumigated date samples were packaged directly after ١٢ hrs.

Sulphur dioxide treatment.

Date fruits were exposed to sulfur dioxide($SO_٢$) gas at ١٥٠٠ mg.Kg-١. All treated samples were packaged after treatment. This process were performed at date processing unite, Food Technology Research Institute, Giza, Egypt.

Thermal treatment.

Thermal treatment was made by using air circulation oven at ٥٠°C for two periods, the former one was at ٢٤ hrs whereas the last one at ٤٨ hrs. Date samples were spread on trays with moving fruits from time to time, then, packaged in polyehylen bags.

Combination treatment.

Packaged samples were heated at ٥٠°C/٢٤ hrs then irradiated with ١.٠ kGy.. All treated sample, (Table ١) were stored at room temperature (٢٥±٥°C), (٦٥ ±٥ RH%) for one year at laboratory of

Effect of some treatments on changes in siwi dates during storage.

Horticulture Crop Processing Research Department, Food Technology Research Institute, Giza.

Table ١: List of treatments of dates fruits

Number	Treatments
١	**Control (untreated dates)**
٢	**Gamma irradiation with ١.٠ kGy**
٣	**Gamma irradiation with ٢.٠ kGy**
٤	**Gamma irradiation with ٣.٠ kGy**
٥	**Fumigattion with Methyl bromide(MB)**
٦	**Sulfur dioxide gas.**
٧	**Thermal treatment at ٥٠°C/٢٤ hr.**
٨	**Thermal treatment at ٥٠°C/٤٨ hr.**
٩	**Combination treatment (٥٠°C/٢٤ hr + ١.٠ kGy)**

Chemical analysis

Total sugars were determined using the method described by Somogi, (١٩٥٢). Protein, lipids ,Fiber, Ash, Mineral contents were determined according to A.O.A.C. (٢٠٠٠).

Determination of methyl bromide and sulfur dioxide residues :

Preparation of samples, extraction and determination of bromide-containing fumigants as total inorganic bromide were performed according to Greve and Grevenstuk (١٩٧٦ & ١٩٧٩), Stijve (١٩٧٧& (١٩٨١) and Gad Alla et al., (٢٠٠٠). Total sulfur dioxide residue was determined in date samples using the method of Ranganna (١٩٧٩).

Organoleptic evaluation:

Treated date fruits samples were sensory evaluated for color, flavor, taste, texture and overall acceptability. Ten of Food Technology Research Institute staff members tested the treated samples after ١,٣,٦,٩ and ١٢ months. Each was presented nine samples and asked to evaluated the products for color, taste, texture and overall acceptability. Panel scores were based on a hedonic scale (١٠-١)with (٩-١٠) being the highly desirable and (٠-١) undesirable..

Histological examination:

Date fruits were prepared, preserved in formaline-aceto-alcohol (FAA.), embedded in paraffin wax, then sectioned at ١٠-١٥ µ according to the conventional method (Johansen, ١٩٤٠). Sections stained in saffraninen and light green, then slides were covered to

photo using scaled to ١٠٠ and ١٠٠ µm. in addition all the microphotographs presented as documentation. The number of cells and thickness area per each tissue was done using the micrometric slide. The magnification was ١٠ × ١٠ each value as expressed of average of ten sections. Thickness area value was expressed of area ٢٥µ × area per each tissue.

Statistical analysis: The statistical analysis were performed according to Steel and Torrie (١٩٨٠).

RESULTS AND DISCUSSION

Chemical analysis:

Total sugar:

Results of Table ٢. show that total sugars content of control samples was ٧٩.٦٢٪. This was decreased gradually during storage at room temperature reaching ٥٧.١٤٪ after ١٢ months of storage. However, irradiation had high values of total sugar than control at the end period of storage. The total sugars content of irradiated samples after ١٢ months were ٧٦.٢٨, ٧٦.١٦ and ٧٥.٥٦٪ for ١.٠, ٢.٠ and ٣.٠ kGy, respectively. Whereas, thermal treatments recorded ٧٦.٤٣and ٥.٨٨٪ for ٥٠ºC/٢٤hrs and ٥٠ºC/٤٨hrs respectively at the end of period storage. These results are in accordance with the results of Kamel (١٩٦٧), Nezam El-Dine (١٩٨٨), Ramadan (١٩٩٠), Emam et al., (١٩٩٤), and Zaid *et al.*, (٢٠٠٥).

Fiber content (%):

It is commonly present as in soluble, non-nutritive portion of date fruits. According to the obtained results in Table (٣), Siwi dates had ١.٣٧٪ (at zero time of storage) then recorded a slight decrease (١.٣٢٪) after one year of storage. It is worthy to mention that low fiber character in Siwi dates is considered main factor in quality of Siwi as semi dry dates, when comparing with dry dates group which raise to more than ٤٪ (FAO, ١٩٩٤).

Most treatments, decreased fiber content during storage with negligible differences. The lowest value was observed with MB (١.٥٠٪) followed by sulfating treatments. Nearly same values were published by FAO (١٩٩٤), Abozaid, (٢٠٠٢) and El-Feky (٢٠٠٢).

Table ٢: Total sugars content of Treated Siwi date samples during storage at room temperature (dry weight basis)

Treatments	Storage period (month)				
	٠	٣	٦	٩	١٢
Untreated samples	٧٩.٦٢ ±٠.٨١	٧٧.٤٦ ±٠.٩٠	٧٦.٤٨ ±٠..٩٥	٦٣.٦٩ ±١.٠٠	٥٧.١٤ ±١.٠٠
Irradiation samples					
١kGy	٧٩.٨٠ ±١.١٠	٧٨.٩٧ ±١.١٠	٧٨.٠٦ ±٠.٩٥	٧٧.١١ ±١.٠٠	٧٦.٢٨ ±٠.٩٧
٢kGy	٧٨.٩١ ±١.٢٠	٧٧.٠٣ ±١.٠٠	٧٧.٠١ ±٠.٨٥	٧٦.٧٠ ±٠.٧٧	٧٦.١٦ ±٠.٧٩
٣kGy	٧٨.٣٣ ±٠.٩٥	٧٧.٥٥ ±١٠٠	٧٦.٩٩ ±٠.٩٨	٤٥.٧٢ ±٠.٩٤	٧٥.٥٦ ±٠.٩٧
Fumigation samples					
Methyl bromide(MB)	٧٧.٩١ ±١.١٠	٧٥.١٢ ±٠.٩١	٧٤.٦٧ ±٠.٩٨	٧٤.٥٣ ±٠.٨٥	٧٢.٧٣ ±٠.٩٦
Sulfating ($SO_٢$)	٧٦.٩٩ ±٠.٩٥	٧٥.٢٦ ±٠.٨٥	٧٤.٦٤ ±١.٠٠	٧٤.١١ ±١.٠٠	٧٣.٧٠ ±٠.٩٩**
Thermal treated					
٥٠°C/٢٤hrs	٧٩.٦٣ ±١.٠٠	٧٨.٧٣ ±٠.٨٥	٧٨.١٦ ±٠.٩٠	٧٧.١٨ ±٠.٧٥	٧٦.٤٣ ±٠.٨١
٥٠°C/٤٨hrs	٧٩.٤٠ ±١.٢٠	٧٨.١٢ ±١.٠٠	٧٧.١٥ ±٠.٩٥	٧٦.٥٤ ±٠.٩١	٧٥.٨٨ ±٠.٩٠
Combination treatment*					
(١.٠ kGy)+ (٥٠°C/٢٤hrs	٧٩.١٦ ±٠.٩٥	٧٥.٣٥ ±١.٠٠	٧٤.٦٦ ±٠.٨٠	٧٤.٥٣ ±٠.٩١	٧٤.١٦ ±٠.٩٠

*Combination treatment = irradiation (١.٠ kGy) +thermal process (٥٠°C/٢٤hrs)
**± = SD (Standard Deviation

Effect of some treatments on changes in siwi dates during storage.

Table ٣ : Fiber content (free pit) of treated Siwi date cultivar during storage periods (months) at room temperature (dry weight basis).

Treatments	Storage periods (month)				
	٠	٣	٦	٩	١٢
Untreated samples	١.٣٧ ±٠.٠٧	١.٣٦ ±٠.٠٦	١.٣٤ ±٠.١٤	١.٣٢ ±٠.١٦	١.٣٢ ±٠.٩٠
Irradiation samples					
١ kGy	١.٦٧ ±٠.١٢	١.٦٨ ±٠.١١	١.٦٦ ±٠.١٥	١.٦٦ ±٠.١٤	١.٦٥ ±٠.١٥
٢ kGy	١.٧٨ ±٠.١٠	١.٧٨ ±٠.١١	١.٧٦ ±٠.٠٨	١.٧٦ ±٠.٠٩	١.٧٥ ±٠.١٠
٣ kGy	١.٦٨ ±٠.١٩	١.٦٧ ±٠.١	١.٦٧ ±٠.١١	١.٦٦ ±٠.١٠	١.٦٦ ±٠.٠٩
Fumigation samples					
Methyl bromide (MB)	١.٥٢ ±٠.٢٧	١.٥١ ±٠.٢٨	١.٥١ ±٠.٣٠	١.٥٠ ±٠.٢٩	١.٥٠ ±٠.٢٨
Sulfating (SO_2)	١.٥٦ ±٠.١٤	١.٥٥ ±٠.١٥	١.٥٤ ±٠.١٤	١.٥٣ ±٠.١٨	١.٥٢ ±٠.١٩
Thermal treated					
٥٠°C/٢٤ hrs	١.٥٦٩٦ ±٠.١٦	١.٥٦٤٦ ±٠.١٧	١.٥٦ ±٠.١٥	١.٥٦١ ±٠.١٥	١.٥٥٢ ±٠.٢٣
٥٠°C/٤٨ hrs	١.٧١٥٤ ±٠.١٤	١.٧١٠٥ ±٠.١٣	١.٧٠١ ±٠.١٦	١.٧٠٠ ±٠.١٥	١.٧٠٠ ±٠.١٥
Combination treatment					
(١.٠ kGy)+ ٥٠°C/٢٤hrs)	١.٦٧١ ±٠.١٥	١.٦٧٠ ±٠.١٤	١.٦٦٩ ±٠.١٤	١.٦٦٠ ±٠.١٦	١.٦٤٩ ±٠.١٥

Ash content:

The determination of ash content (%) of semi-dry dates proved presence of(٢.٤٪) at zero time near some values as observed at end period of storage. In the same time, no effect was observed due to different treatments as shown in Table (٤). These results are in parallel with those obtained by different authors either for Siwi dates (Ramdan, ١٩٩٠; Khalil, ١٩٩٥; Ibrahim, ١٩٩٠; Assous, ١٩٩٩ and

Sahari et al., ٢٠٠٦) which ranged from ١.٨٪ to ٢.٣٪ or other varieties which obtained near ٢٪ (FAO, ١٩٨٣).

Table ٤ : Ash content of treated Siwi date samples during storage at room temperature (dry weight basis).

Treatments	Storage periods (month)				
	٠	٣	٦	٩	١٢
Untreated samples	**٢.٤٠ ±.٤٢**	**٢.٤٥ ±٠.٣٥**	**٢.٤٤ ±٠.٢٣**	**٢.٤٦ ±٠.٣٥**	**٢.٤٦ ±٠.٣٣**
Irradiation samples					
١ kGy	٢.٥٧ ±٠.٢٦	٢.٥٨ ±٠.٢٥	٢.٥٦ ±٠.٢٤	٢.٥٧ ±٠.٢٨	٢.٥٨ ±٠.٢٧
٢ kGy	٢.٤٠ ±٠.٤٠	٢.٤١ ±٠.٤٩	٢.٤٣ ±٠.٥٢	٢.٤٢ ±٠.٤١	٢.٤٣ ±٠.٤٢
٣ kGy	٢.٦٠ ±٠.٥٠	٢.٥٨ ±٠.٦٦	٢.٥٧ ±٠.٥١	٢.٥٧ ±٠.٥٢	٢.٦٠ ±٠.٥٨
Fumigation samples					
Methyl bromide(MB	٢.٦٧ ±٠.٣٢	٢.٦٤ ±٠.٣٥	٢.٦٥ ±٠.٣٧	٢.٦٦ ±٠.٤٠	٢.٦٧ ±٠.٣٨
(Sulfating $SO_٢$)	٢.٦٩ ±٠.٣٠	٢.٦٨ ±٠.٣١	٢.٦٦ ±٠.٣٥	٢.٦٤ ±٠.٣٢	٢.٦٠ ±٠.٣٠
Thermal treated					
٥٠°C/٢٤ hrs	٢.٦٥ ±٠.٥٣	٢.٦٦ ±٠.٧٧	٢.٦٧ ±٠.٧٠	٢.٦٧ ±٠.٦١	٢.٦٨ ±٠.٥٠
٥٠°C/٤٨ hrs	٢.٦٤ ±٠.٣٤	٢.٦٦ ±٠.٤٠	٢.٦٥ ±٠.٣٥	٢.٦٤ ±٠.٥٠	٢.٦٦ ±٠.٤١
Combination treatment					
(١.٠ kGy)+ ٥٠°C/٢٤hrs)	٢.٥٩ ±٠.٤٣	٢.٥٧ ±٠.٤١	٢.٥٨ ±٠.٣٥	٢.٥٨ ±٠.٤١	٢.٦٠ ±٠.٤٠

Minerals content:

Data considered a suitable source for health elements. Analysis of untreated samples only as shown in Table(٥). Mg content (mg/١٠٠gm on dry weight) ranged from ٣٥.١١ which increased gradually during storage to ٣٨.٧. Also, sodium content (Na) was ٦.١٣ mg which increased to ٧.٨ mg after nine months of storage. Same

trends were in Zn (١٣.٤ mg), Mn (٧.٤ mg), Fe (٩.١ mg), Ca (١٦.٢ mg), K (٤٨٠.٠ mg) and Cu (٣.٤ mg) which increased during storage ever end of storage to ١٨.٥ mg, ٨.٥ mg, ٩.٩ mg, ١٦.٨ mg, ٤٨٨.٦ mg and ٤.٢ mg/١٠٠ gm dry weight basis. The effect of storage caused increased elements contents may be due to decrease of moisture content. Same analysis of dates was observed by Sahari et al., (٢٠٠٦).

Table ٥ : Minerals content(mg/١٠٠gm) of treated Siwi date samples during storage at room temperature(dry weight basis). .

Minerals	Storage periods (month)			
	٠	٣	٦	٩
Mg	٣٥١.٠٨٥	٣٥٦.٣١٠	٣٨٠.٩٤٠	٣٨٦.٦١٠
Na	٦.١٢٧	٦.٥٩٧	٧.٦٠٧	٧.٨٠١
Zn	١٣.٨٦٠	١٦.٣٩٧	١٧.٥٤٢	١٨.٤٩١
Mn	٧.٣٦٥	٨.٠٦٩٣	٨.١٩٨	٨.٤٩١
Fe	٩.١١٢	٩.١٩٢	٩.٣٠٣	٩.٩٥٩
Ca	١٦٢.٣١٢	١٦٤.٦٧٠	١٦٧.٠٢٩	١٦٨.٠٠٢
K	٤٨٠٣.٢٥٩	٤٨٤٣.٣٢١	٤٨٨٣.٠٢٦	٤٨٨٦.٠١٩
Cu	٣.٤٦٢	٣.٦٣٦	٤.١٢١	٤.٢١١

HPLC sugar analysis:

HPLC profile analysis of Siwi dates are shown in Table(٦). The results showed presence of major peaks as sucrose, glucose, fructose, xylose and mannose. Untreated dates contained high concentrations of sucrose (٠.١٤), glucose (٥٢.٦), fructose (٢٦.٩٤) and sorbitol (٠.٤٧) as mg/١٠٠ gm/D.W. These values slightly decreased with irradiation to (٠.١٦٥), (١.٠٨), (٠.٣٣٦) for ١.٠ kGy, ٢.٠ kGy and ٣.٠ kGy in respectively. Same trend by irradiation was clear even end of storage. Only MB and sulfiting treatment caused some increase as ٠.١٩٦ and ٠.٢٥٧ mg/١٠٠ gm/D.W. in respectively. But some increases were clear on thermal treated dates or with combination treatments which increased from ٠.٢٧٢ to ٠.٨٢ mg/١٠٠ gm/D.W. The reduction of sucrose after irradiation directly may be due to the effect of irradiation on glycosidic bond which can be broken easily in presence

of O٢ .The results were according with Al-Kahtani et al. (١٩٩٦), who showed that Khalas dates had some trend after irradiation directly or during storage period.

Table ٦ : Saccharides fraction of treated Siwi date samples during storage at room temperature(dry weight basis).

Treatments	Sucrose		Maltose		Glucose		Xylose		Mannose		Fructose		Sorbitol	
	A	b	a	b	a	b	a	b	a	b	a	b	a	b
Untreated samples	٠.١٣٦	---	---	---	٥٢.٥٩	---	---	---	---	---	٢٦.٩٤	---	٠.٤٧٢	---
Irradiation samples														
١ kGy	١٦٥	٠.٧٦	---	---	٥٦.٣٥	١٨.٤٤	٠.٠٦٦	---	٠.٣٥٩	---	٢٨.٥١	٢٠.٣٤	٠.٥٥	٠.١٤
٢ kGy	١.٠٨	٠.٦٣	---	---	٦٢.١٩٩	١٧.١٦	---	---	---	---	٢٨.٦٤	١٩.٠٧	٠.٨٩	٠.١٣
٣ kGy	٠.٣٣٦	١.١٧	---	---	٥٣.٣٢	٢٤.١٧	---	---	---	---	٢٧.١٦	٢٦.٩٢	٠.٨٣	٠.٢٢
Fumigation samples														
methyl bromide (MB)	٠.١٩٦	٠.٢٠	---	---	٥٢.٢٩	٩.٦١٧	---	---	٠.١١٥٦	---	٢٦.٤١	١٠.٩٧	٠.٠٩٦	٠.٠٦
Sulfating ($SO_٢$)	٠.٢٥٧	٠.٢٢	---	---	٤٧.٩٦	٨.٨٥	---	---	٠.٢٣٢	---	٣٠.٧١	١٠.٠٨	---	---
Thermal treated														
٥٠°C/٢٤hrs	٠.٣٠٧	٠.٤٤	---	---	٥٧.٠٦	١٥.٨٠	---	---	٠.١٣٢	---	٢٨.٠٠	١٧.٥٤	٠.١٤٥	٠.١٩
٥٠°C/٤٨hrs	٠.٣٠٨	٠.٨٦	---	---	٥٩.٠٣	٢١.٥٢	٠.٣٢	---	٠.١٦٩	---	٢٩.٣٣	٢٣.٩٣	٠.١٥٢	٠.١٤
Combination treatment														
(١ kGy/٥٠°C ٢٤hrs)	٠.٢٧٢	٠.٨٢	---	---	٥٤.٦٧	٢١.٨٨	٠.٢٦	---	٠.١٥٦	---	٢٦.٥٨	٢٤.٣٩	٠.٢٥	٠.١٥

a= At beginning of storage
b= At end of storage (١٢ months)
--- = Not detected

Crude protein:

The results of crude protein are tabulated in Table (٧). The protein content was ٢.٣٠٪ (mg/١٠٠gm on dry weight) in untreated samples at beginning of storage. This value was decreased gradually during long storage to ١.٣٠٪. The decrease in protein content due to transpiration consequently decomposition of some protein content especially at high temperature of storage at room temperature. All the tested treatments decreased level of protein content in all samples during long storage, but no big differences can be observed between the treated samples. The populated data proved that all used treatments can stabilize the crude protein content during long storage period. The

highest values were recorded with thermal treatment which reached ٢.٥٪ at end of storage. Same values were observed by Al Rawi et al., (١٩٦٧); FAO (١٩٨٣); Abd-Ellateaf, (١٩٩١); Khalil (١٩٩٥); Ramadan (١٩٩٥); Abozaid (٢٠٠٢) and Sahari et al., (٢٠٠٦)

Table ٧ : Protein content of treated Siwi date samples during storage at room temperature(gm/١٠٠gmdry weight basis).

Treatments	Storage periods (month)				
	٠	٣	٦	٩	١٢
Untreated samples	٢.٣٠ ±٠.٣	٢.١٠ ±٠.٣	١.٨٥ ±٠.٢٩	١.٤٥ ±٠.٣٥	١.٣٠ ±٠.٣٤
Irradiation samples					
١ kGy	٢.٣٥ ±٠.٢٤	٢.٣٣ ±٠.٢٥	٢.٣١ ±٠.٢٧	٢.٢٩ ±٠.٢٩	٢.٢٨ ±٠.٢٦
٢ kGy	٢.٣٦ ±٠.٢٥	٢.٣٥ ±٠.٢٧	٢.٣٣ ±٠.٢٦	٢.٣١ ±٠.٢٤	٢.٣٠ ±٠.٣١
٣ kGy	٢.٣٨ ±٠.١٧	٢.٣٦ ±٠.١٩	٢.٣٥ ±٠.٢٤	٢.٣٢ ±٠.٢٢	٢.٣٣ ±٠.١٩
Fumigation samples					
Methyl bromide (MB)	٢.٣٥ ±٠.٢٣	٢.٣٣ ±٠.٣٢	٢.٣٠ ±٠.٣١	٢.٣٠ ±٠.٣٥	٢.٢٨ ±٠.٢٩
Sulfating ($SO_٢$)	٢.٣٢ ±٠.٢٢	٢.٣٢ ±٠.٢١	٢.٢٩ ±٠.٣٠	٢.٢٥ ±٠.٢٤	٢.٢٥ ±٠.٢٦
Thermal treated					
٥٠°C/٢٤ hrs	٢.٤٩ ±٠.٣٩	٢.٤٨ ±٠.٣٧	٢.٤٦ ±٠.٣٨	٢.٤٧ ±٠.٣٥	٢.٤٥ ±٠.٤١
٥٠°C/٤٨ hrs	٢.٣٧ ±٠.٣٧	٢.٣٦ ±٠.٣٥	٢.٣٤ ±٠.٣٣	٢.٣٤ ±٠.٣٦	٢.٣١ ±٠.٣٥
Combination treatment					
(١ KGy/٥٠°C ٢٤hrs)	٢.٣٦ ±٠.٢٩	٢.٣٥ ±٠.٣٠	٢.٣٦ ±٠.٢٨	٢.٣٤ ±٠.٢٥	٢.٣٢ ±٠.٣٤

Crude fat:

The changes of lipids content after treating with different methods are shown in Table (٨) . The present date proved that some differences are noticed between dates after treatments. Only untreated samples recorded low levels of total lipids near ٣.١١٪ then increased to ٣.٢١٪ at end period of storage. Also, high temperature ٥٠° C/٤٨ hr, recorded high levels of crude fat (%) on dry weight basis. But, most the other treatments had negligible differences either at beginning or at end of storage period (١٢ months). Same obtained data were got Sawaya et al., (١٩٨٣); Youssef et al., (١٩٨٢); Ahmed et al., (١٩٨٥); Abozaid (٢٠٠٢) and Sahari et al., (٢٠٠٦) on Irani dates.

Table ٨ : Crude fat content of treated of Siwi date samples during storage at room temperature(dry weight basis).

Treatment	Storage periods (month)				
	٠	٣	٦	٩	١٢
Untreated samples	٣.١١ ±٠.٤٢	٣.٠٢ ±٠.٣٥	٣.١٦ ±٠.٢٩	٣.٢١ ±٠.٣١	---
Irradiation samples					
١ kGy	٣.٦٤ ±٠.٥٣	٣.٦٥ ±٠.٤٠	٣.٦٣ ±٠.٣٦	٣.٦١ ±٠.٤٨	٣.٦٥ ±٠.٥١
٢ kGy	٣.٤٩ ±٠.٣٩	٣.٤٧ ±٠.٤٠	٣.٥٠ ±٠.٣٥	٣.٤٨ ±٠.٣٧	٣.٥٠ ±٠.٤٢
٣ kGy	٣.٧٠ ±٠.٤٠	٣.٧٣ ±٠.٣٥	٣.٧١ ±٠.٣٨	٣.٦٨ ±٠.٤٢	٣.٦٩ ±٠.٤٣
Fumigation samples					
Methyl bromide(MB)	٣.٣٩ ±٠.٤٨	٣.٣٩٥ ±٠.٣٩	٣.٤٢ ±٠.٤٠	٣.٤١ ±٠.٣٧	٣.٤٤ ±٠.٤٥
Sulfating (SO_2)	٣.٩٢ ±٠.٥١	٣.٩٤ ±٠.٤٨	٣.٩٠ ±٠.٤٠	٣.٩٤ ±٠.٥٠	٣.٩٥ ±٠.٤٧
Thermal treated					
٥٠°C/٢٤ hrs	٣.٩٦ ±٠.٢٥	٣.٩٥ ±٠.٢٩	٣.٩٧ ±٠.٣٥	٣.٩٦ ±٠.٢٧	٣.٩٨ ±٠.٢٦
٥٠°C/٤٨ hrs	٤.٠٦ ±٠.٣٥	٤.٠٦٧ ±٠.٢٨	٤.١٠ ±٠.٤١	٤.١٨ ±٠.٣٥	٤.١٩ ±٠.٢٧
Combination treatment*					
(١ KGy/٥٠°C ٢٤hrs)	٣.٦٦ ±٠.٤٣	٣.٦٥ ±٠.٣٨	٣.٦٨ ±٠.٤١	٣.٦٧ ±٠.٣٥	٣.٧١ ±٠.٢٩

Effect of some treatments on changes in siwi dates during storage.

Methyl bromide (MB) and sulfur dioxide (SO_2) residues:

Determination of residues of methyl bromide (MB) using analysis by Gas chromatograph in date samples proved that fumigated fruits with methyl bromide contained less than ٠.٠١ ppm. That is less than maximum residue limits as shown by Codex Alimentarius Commission (FAO/ WHO, ١٩٨٨).

Also, sulfur dioxide (SO_2) residual was determined in dates. The obtained results showed that SO_2 residue in sulfated dates were less than ١٥٠٠ ppm. These results are paralleled with E.O.S.Q.C (١٩٨٦**).**

Panelist evaluation:

It was considered to take the panelist opinions for tested treatments of date fruits. The results are shown in Tables (٩, ١٠, ١١ and ١٢). The available data of dates texture proved that all tested samples were near in value of texture evaluation even ٦ months. But at the end period of storage, the values of texture of untreated samples decreased gradually especially even ١٢ months. At the end period of storage, the lowest value of texture decrease was recorded with combination treatment (٨.٧٢ ١), then follow by the thermal treatments separately, sulfating and (MB) treatments.

Whereas, the irradiated samples were occupied the second rank near ٧٠٪. Same trends were resulted with color and taste results, after ١٢ months the highest values recorded with thermal treatments separately or with irradiation besides fumigation (MB) and sulfating. Whereas irradiated dates occupied the second rank. The overall acceptability degrees were introduced. The prefer ability of thermal treatments with or without irradiation. In addition, fumigation and sulfating had near degrees. Whereas, irradiated dates values were in second rank after ١٢ months, as shown in Tables (٩, ١٠, ١١ and ١٢). The organoleptic evaluation of dates samples produced by the thermal treatments either with or without irradiation introduced the prefer ability of using a cheap and applicable treatments, as alternative for using chemicals as (MB), sulfating or irradiation . The same results were obtained by El-Salhy, ١٩٩٧.

Table ٩ : Effect of irradiation, , fumigation, thermal treatment and combination (irradiation + thermal) on color of Siwi date samples during storage at room temperature.

Treatment	Storage periods (month)				
	١	٣	٦	٩	١٢
Untreated samples	٧.٥٦ ±٠.٥١	٧.٥٤ ±١.٥	٥.٨١ ±٠.٧٣	٥.١٧ ±٠.٢٩	١.٠٦ ±١.٠٠
Irradiation samples					
١ kGy	٨.٤٧ ±٠.٥٠	٨.٢٨ ±٠.٦٢	٨.٢٦ ±٠.٦٤	٧.٥ ±٠.٧١	٦.٤ ±٠.٧٥
٢ kGy	٨.٥٧ ±٠.٥١	٨.٠٢ ±١.٠٠	٨.١٤ ±٠.٣١	٧.٣٩ ±٠.٥٤	٦.٣٣ ±٠.٥٨
٣ kGy	٨.٠٠ ±١.٠٠	٧.٦ ±١.٥١	٧.٣٦ ±٠.٥٦	٧.٠٠ ±١.٠٠	٥.٢ ±٠.٣٥
Fumigation samples					
Methyl bromide(MB	٨.٠٠ ±٠.٠٠	٧.٩٣ ±٠.١٢	٨.٢٣ ±٠.٦٨	٨.٢١ ±٠.٧٠	٧.٥٥ ±٠.٥١
Sulfating (SO_2)	٩.١٣ ±١.٠٢	٨.٩٥ ±١.٠٠	٨.٥٦ ±٠.٥١	٨.٥ ±٠.٥٠	٧.٦ ±٠.٥٣
Thermal treated					
٥٠°C/٢٤ hrs	٨.٥٧ ±٠.٥١	٨.٨١ ±٠.٣٢	٨.١٣ ±٠.٢٣	٨.٣ ±١.٥٧	٨.٣٣ ±٠.٤٧
٥٠°C/٤٨ hrs	٨.٦٠ ±٠.٥٣	٨.٧٠ ±٠.٥٨	٧.٢٢ ±٠.٦٢	٧.٥٤ ±٠.٥١	٨.٣٠ ±٠.٨٢
Combination treatment*					
(١ KGy/٥٠°C ٢٤hrs)	٨.٤٤ ±٠.٧٧	٧.٩٥ ±١.٠٠	٨.١٧ ±١.٠٤	٨.٦٢ ±٠.٤٨	٧.٩٣ ±٠.١٢

*Combination treatments = (irradiation/kGy) + thermal process (٥٠°C/٢٤hrs)

Effect of some treatments on changes in siwi dates during storage.

Table ١٠ : Effect of irradiation, , fumigation, thermal treatment and combination (irradiation + thermal) on texture of Siwi date samples during storage at room temperature.

Treatment	Storage periods (month)				
	١	٣	٦	٩	١٢
Untreated samples	٨.٨٨ ±٠.٢١	٨.٨٧ ±٠.٢٣	٧.٠٢ ±٠.٠٣	٥.٠٥ ±٠.٠٧	٠.٣٥ ±٠.٢٠
Irradiation samples					
١ kGy	٨.٢١ ±٠.٢٦	٨.٢٨ ±٠.٦٢	٧.٨٦ ±١.٠٣	٧.٤٤ ±٠.٥١	٥.٦ ±٠.١٧
٢ kGy	٨.٧٨ ±٠.٠٣	٨.٢ ±٠.٣٥	٨.٣١ ±٠.٦٠	٧.٤٤ ±٠.٥١	٥.٨ ±٠.١١
٣ kGy	٨.٤٨ ±٠.٥٠	٧.٩٣ ±١.٠٠	٧.١١ ±٠.١٨	٦.٦٩ ±٠.٣٥	٥.٨٧ ±٠.٢٣
Fumigation samples					
Methyl bromide(MB)	٨.٧٩ ±٠.٣٧	٨.٤ ±٠.٥٣	٧.٨٨ ±٠.٢١	٧.١٣ ±٠.٢٣	٧.٨٣ ±١.٠٨
Sulfating (SO_2)	٨.٦٧ ±٠.٥٨	٨.٨١ ±٠.٣٣	٨.٤٣ ±٠.٥١	٧.٦٧ ±٠.٥٨	٧.٢٧ ±٠.٦٤
Thermal treated					
٥٠ ^{o}C/٢٤ hrs	٨.٩٣ ±٠.١٢	٨.٥٣ ±٠.٥٠	٨.٥٢ ±٠.٥٠	٨.٨٣ ±٠.٢٩	٨.٧٢ ±٠.٤٨
٥٠ ^{o}C/٤٨ hrs	٨.٨٣ ±٠.٢٩	٨.٤ ±٠.٥٣	٨.٠٦ ±٠.١٢	٨.٣٣ ±٠.٥٨	٧.٩ ±١.٠٣
Combination treatment*					
(١ KGy/٥٠ ^{o}C ٢٤hrs)	٨.٧٧ ±٠.٢٥	٨.٥٣ ±٠.٥٠	٨.٥٢ ±٠.٥٠	٨.٨٣ ±٠.٢٩	٨.٧٢ ±٠.٤٨

Table ١١: Effect of irradiation, , fumigation, thermal treatment and combination (irradiation + thermal)) on taste of Siwi date samples during storage at room temperature.

Treatment	Storage periods (month)				
	١	٣	٦	٩	١٢
Untreated samples	٨.٨٧ ±٠.٨٥	٨.٢٨ ±٠.٤٨	٨.٢٨ ±٠.٣٩	٤.٧٨ ±٠.٦٩	٠.٩ ±٠.٨٤
Irradiation samples					
١ kGy	٩.٣٣ ±٠.٥٨	٨.٥٢ ±٠.٥٠	٧.٦٩ ±٠.٦٠	٧.٣٣ ±٠.٥٨	٦.٠٠ ±١.٠٠
٢ kGy	٨.٢٥ ±١.٢٧	٧.٧٩ ±١.٥٥	٧.٩٢ ±١.١	٧.٢٩ ±١.٢٥	٦.٠٠ ±٠.٨١
٣ kGy	٨.٦٥ ±١.٥٢	٨.٠١ ±٠.٨٢	٧.٨٩ ±٠.٨٤	٧.٥٨ ±١.٢٦	٥.٥ ±٠.٦٠
Fumigation samples					
Methyl bromide (MB)	٨.٨٧ ±١.٠٣	٨.٥ ±٠.٥٠	٨.٠٥ ±١.٠٠	٨.٢٧ ±٠.٦٣	٧.٤٠ ±٠.٥٣
Sulfating (SO_2)	٨.٥ ±١.٥	٨.٠٠ ±١.٠٠	٨.٢٩ ±٠.٦٢	٧.٦١ ±٠.٥٤	٦.٥٣ ±٠.٥٠
Thermal treated					
٥٠°C/٢٤ hrs	٩.٤ ±٠.٥٣	٩.٢ ±٠.٦٢	٨.٨١ ±١.٠٥	٨.٤٤ ±٠.٥١	٨.٤ ±٠.٥٣
٥٠°C/٤٨ hrs	٩.٤ ±٠.٥٤	٨.٠٦ ±١.٠٨	٨.٥٧ ±٠.٥١	٨.٥٠ ±٠.٥٠	٨.١٠ ±١.٠١
Combination treatment					
(١ KGy/٥٠°C ٢٤hrs)	٩.٣٢ ±٠.٦٢	٨.٤٣ ±٠.٥١	٨.٠٣ ±٠.٥٨	٧.٦٣ ±٠.٥٥	٧.٩٤ ±١.٠٠

Effect of some treatments on changes in siwi dates during storage.

Table ١٢ : Effect (irradiation, fumigation thermal treatment and combination (irradiation + thermal)) on overall acceptability of Siwi date samples during storage at room temperature.

Treatment	Storage periods (month)				
	١	٣	٦	٩	١٢
Untreated samples	٨.٥ ±٠.٩١	٨.٣٣ ±٠.٥٠	٦.٠٠ ±١.٠٠	٤.٦٧ ±١.٥٢	٠.٠٠ ±٠.٠٠
Irradiation					
١ kGy	٨.٧٣ ±٠.٤٦	٨.٣٨ ±٠.٥٤	٨.٣١ ±٠.٦٠	٧.٥٠ ±٠.٥٠	٦.٢٣ ±٠.٣٦
٢ kGy	٨.٥٢ ±٠.٥٠	٨.٥٣ ±٠.٤٥	٨.٣٦ ±٠.٥٥	٧.٧٢ ±٠.٦٣	٥.٧ ±٠.٥٨
٣ kGy	٨.٤٧ ±٠.٥٠	٨.٨٧ ±٠.٧١	٧.٩٠ ±١.٠١	٧.٥ ±٠.٥٠	٥.٦ ±٠.٥٣
Fumigation samples					
Methyl bromide(MB	٨.٨٣ ±٠.٢٩	٨.٣٣ ±٠.٥٨	٨.٢٣ ±٠.٧	٨.١٧ ±٠.٧٦	٧.٦ ±٠.٧٩
Sulfating ($SO_٢$)	٩.٠٢ ±٠.٨٢	٩.٢٦ ±٠.٤٢	٨.٩٢ ±١.١١	٧.٨٩ ±٠.١٩	٨.٠٠ ±٠.٥٠
Thermal treated					
٥٠°C/٢٤ hrs	٩.٤٧ ±٠.٦٩	٨.٩٠ ±٠.١٧	٨.٨٨ ±٠.٢١	٨.٣٩ ±٠.٥٤	٨.١٩ ±٠.٧٣
٥٠°C/٤٨ hrs	٨.٥٣ ±٠.٥٠	٨.٨٣ ±٠.٢٩	٨.٦٩ ±٠.٥٣	٧.٩٤ ±٠.٠٧	٧.٢٩ ±١.٨٠
Combination treatment					
(١ KGy/٥٠°C ٢٤hrs)	٨.٩٣ ±١.٠١	٨.٨٣ ±٠.٢٩	٨.٨١ ±٠.٣٣	٨.٢٠ ±٠.٢٦	٧.٩٤ ±٠.٤٤

Histological studies:

Exocarp tissues :

Exocarp tissue was shown in different layers between ٣ to ٥ layers (tables ١٣, ١٤and ١٥), the first layer usually is the epidermis cells. The second layers are the outer hypodermal cells . The third layers are the inner hypodermal cells (stone cells). Such results are in good accordance with data were obtained by Hamdy (١٩٨٢).

during storage at room temperature:

Mesocarp tissues were recognized to in three zones (tables ١٣, ١٤ and ١٥), the first one is the outer mesocarp zone. The second zone contains tannins cells in differs groups and distribute around the inside surface of mesocarp in red-brown colored in two rows with discontinuous band. in the outer mesocarp zone. The third layer is the parenchymatous cells of inner mesocarp. The vascular system of the pericarp consisted of several collateral bundles, distributed in all zones of the mesocarp.

Endocarp tissues:

Endocarp tissues was arranged in two rows around seed cavity (Tables ١٣, ١٤ and ١٥). It contains vascular system besides collateral cells.

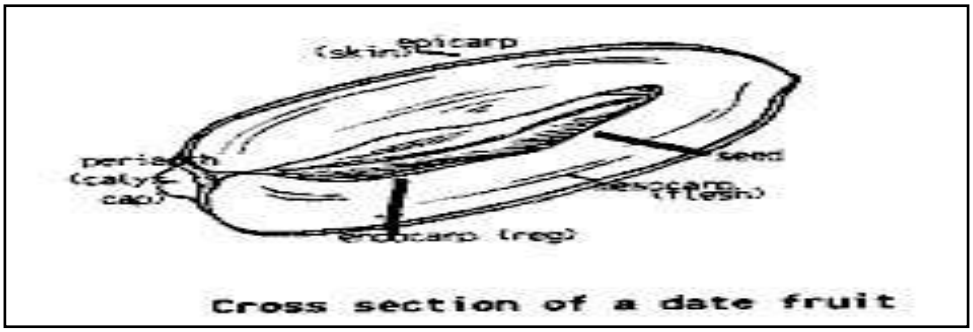

Fig. ١: Light microscope micrographs of cross-section of untreated samples of semi-dry date fruits "Siwi variety"

Effect of used treatment in the histological characters of dates:

Effect on number of raw cells:

Using micrometric slide for counting the number of cells per each tissue proved some changes in each treated date sample. As shown in Fig. (١) and Table (١٣), the cell number of rows per each treated dates as endocarp, mesocarp and endocarp of fruits. The edible part mainly mesocarp occupied more than ٧٠.٠٪ of date cells, while. Exocarp which can remove or separate during process occupy less than ٢٠٪ and the remain part was endocarp cells. The percentage of

date tissues were more affected by treatments. All treatments reduced exocarp cells from (٢٥.٣١٪) in untreated samples (control) to (١٦.٩٢٪) in irradiated dates at ١.٠ kGy, (٢٢.٨٥٪) at ٢.٠ kGy and (١٨.٠٧٪) at ٣.٠ kGy. Whereas, some changes were observed with fumigation or sulfitation. More reduction was clear by thermal treatments viz., ١١.٨٦٪ (٥٠°C/٢٤ hrs), ١٦.٦٦٪ (٥٠°C/٤٨ hrs) and ١٢.٧٣٪ (٥٠°C/٢٤ hrs plus ١.٠ kGy). Mesocarp and endocarp tissues usually eat as edible portion of dates for tenthly these parts were less affected with tested treatments as shown in Table (١٣) .

Effect on layer thickness area:

The effect of used treatments on layer thickness area as expressed as (%) area per each tissues are shown in Tables ١٤ and ١٥) and Fig. (٣). The main edible portion as mesocarp, in untreated occupied (٩١.٧٦٪) which decreased by irradiation doses (١.٠, ٢.٠ and ٣.٠ kGy) to ٨٦.٥٤٪, ٧٨.٢٦٪ and ٨٩.٢١٪ on respectively. While fumigation with (MB) or sulfating decreased it to ٨٢.٣٥٪ and ٨٥.٧١٪ on respectively. Only gentle treatment (٥٠°C/٢٤ hrs) separately or with ١.٠ kGy resulted values near control treatments as (٩٢.٥٥٪ and ٩٠.٥٢٪) in respectively. While, thermal treatments at ٥٠°C/٤٨ hrs reduced it to ٨٥.٩١٪, these data proved the permeability of gentle thermal treatments either separately or with irradiation dose (١.٠ kGy) effect of treatments on histological characters of date fruits. As shown in Fig. (٧) irradiation at low dose caused collapsed parenchyamtous and shrinkage tissues in mesocarp tissue .With some damage of tannins as storage tannin cells. Whereas, high doses (٣.٠ kGy) caused more damage in tannin cells even its become empty cells as shown in Fig. (٤). Also, injured cells and shrinkage cells of mesocarp tissues.

The relationship between the histological results and the panel test.

Concerning, the relationship between the histological results and the panel test, it is clear that decreasing values of texture in irradiated samples can explain through effect of irradiation as proved in injured, collapse, the parenchymatouse cells besides dissolving tannin cells consequently decreasing he texture o irradiated dates. Whereas, that phenomena not present in he other treatments.

Table ١٣ : Effect treatments for Siwi dates on row number cells

Treatments	Row number cells			Total row number cells
	Exocarp	Mesocarp	Endocarp	
Untreated	٢٠ ٢٥.٣١٪	٥٧ ٧٢.١٥٪	٢ ٢.٥٣٪	٧٩
Irradiation samples				
١ kGy	١١ ١٦.٩٢٪	٥٢ ٨٠٪	٢ ٣.٠٧٪	٦٥
٢ kGy	١٦ ٢٢.٨٥٪	٥٠ ٧١.٤٣٪	٤ ٥.٧١	٧٠
٣ kGy	١٥ ١٨.٠٧٪	٦٦ ٧٩.٥٢٪	٢ ٢.٤١٪	٨٣
Fumigation samples				
Methyl bromide(MB)	١٩ ٢٥.٦٧%	٥٢ ٧٠.٢٧٪	٣ ٤.٠٥٪	٧٤
Sulfating ($SO_٢$)	١٠ ٢٠٪	٣٨ ٧٦٪	٢ ٤٪	٥٠
Thermal treated				
٥٠ ^{o}C /٢٤hrs	٧ ١١.٨٦٪	٥٠ ٨٧.٧٥٪	٢ ٣.٣٩٪	٥٩
٥٠ ^{o}C /٤٨hrs	١٤ ١٦.٦٦٪	٦٨ ٨٠.٩٥٪	٢ ٢.٣٨٪	٨٤
Combination treatment				
(irrad. + thermal) (١ KGy/٥٠^{o}C ٢٤hrs)	٧ ١٢.٧٣%	٤٥ ٨١.٨٢٪	٣ ٥.٤٥٪	٥٥

Effect of some treatments on changes in siwi dates during storage.

Table ١٤ : Layer thickness area and number of row cells for Exocarp, Mesocarp and Endocarp for Siwi date fruits treat.

Treatments	Layer thickness area			Number of row cells		
	Exocarp	Mesocarp	Endocarp	Exocarp	Mesocarp	Endocarp
Untreated samples	٤٠×٢٥	٤٩٠×٢٥	٤×٢٥	٢٠	٥٧	٢
Irradiation samples						
١ kGy	٦٠×٢٥	٤٥٠×٢٥	١٠×٢٥	١١	٥٢	٢
٢ kGy	١٠٥×٢٥	٤٥٠×٢٥	١٠×٢٥	١٦	٥٠	٤
٣ kGy	٥٠×٢٥	٤٣٠×٢٥	٢×٢٥	١٥	٦٦	٢
Fumigation samples						
Methyl bromide MB	٨٠×٢٥	٤٢٠×٢٥	١٠×٢٥	١٩	٥٢	٣
Sulfating ($SO_٢$)	٥٠×٢٥	٣٣٠×٢٥	٥×٢٥	١٠	٣٨	٢
Thermal treated						
٥٠°C/٢٤ hrs	٣٠×٢٥	٤١٠×٢٥	٣×٢٥	٧	٥٠	٢
٥٠°C/٤٨ hrs	٨٠×٢٥	٥٠٠×٢٥	٢×٢٥	١٤	٦٨	٢
Combination treatment						
(١ KGy/٥٠°C ٢٤hrs)	٣٥×٢٥	٤٣٠×٢٥	١٠×٢٥	٧	٤٥	٣

Table ١٥ : Effect treatments for Siwi date (on layer thickness area

Treatments	Layer thickness area			Total of area
	Exocarp	Mesocarp	Endocarp	
Untreated	٤٠ × ٢٥ ٧.٤٩٪	٤٩٠ × ٢٥ ٩١.٧٦٪	٤ × ٢٥ ٠.٧٤٩٪	٥٣٤ × ٢٥ ١٣٣٥٠
Irradiation samples				
١ kGy	٦٠ × ٢٥ ١١.٥٣٪	٤٥٠ × ٢٥ ٨٧.٥٤٪	١٠ × ٢٥ ١.٩٢٪	٥٢٠ × ٢٥ ١٣٠٠٠
٢ kGy	١٠٥ × ٢٥ ١٨.٢٦٪	٤٥٠ × ٢٥ ٧٨.٢٦٪	١٠ × ٢٥ ١.٧٤٪	٥٧٥ × ٢٥ ١٤٣٧٥
٣ kGy	٥٠ × ٢٥ ١٠.٣٧٪	٤٣٠ × ٢٥ ٨٩.٢١٪	٢ × ٢٥ ٠.٤٢٪	٤٨٢ × ٢٥ ١٢٠٥٠
Fumigation samples				
methyl bromide (MB)	٨٠ × ٢٥ ١٥.٦٨٪	٤٢٠ × ٢٥ ٨٢.٣٥٪	١٠ × ٢٥ ١.٩٦٪	٥١٠ × ٢٥ ١٢٧٥٠
Sulfating (SO_2)	٥٠ × ٢٥ ١٢.٩٨٪	٣٣٠ × ٢٥ ٨٥.٧١٪	٥ × ٢٥ ١.٣٠٪	٣٨٥ × ٢٥ ٩٦٢٥
Thermal treated				
٥٠°C/٢٤hrs	٣٠ × ٢٥ ٦.٧٧٪	٤١٠ × ٢٥ ٩٢.٥٥٪	٣ × ٢٥ ٠.٦٨٪	٤٤٣ × ٢٥ ١١٠٧٥
٥٠°C/٤٨hrs	٨٠ × ٢٥ ١٣.٧٥٪	٥٠٠ × ٢٥ ٨٥.٩١٪	٢ × ٢٥ ٠.٣٤٪	٥٨٢ × ٢٥ ١٤٥٥٠
Combination treatment*				
(irrad. + thermal) (١ kGy/٥٠°C ٢٤hrs)*	٣٥ × ٢٥ ٧.٣٧٪	٤٣٠ × ٢٥ ٩٠.٥٢٪	١٠ × ٢٥ ٢.١١٪	٤٧٥ × ٢٥ ١١٨٧٥

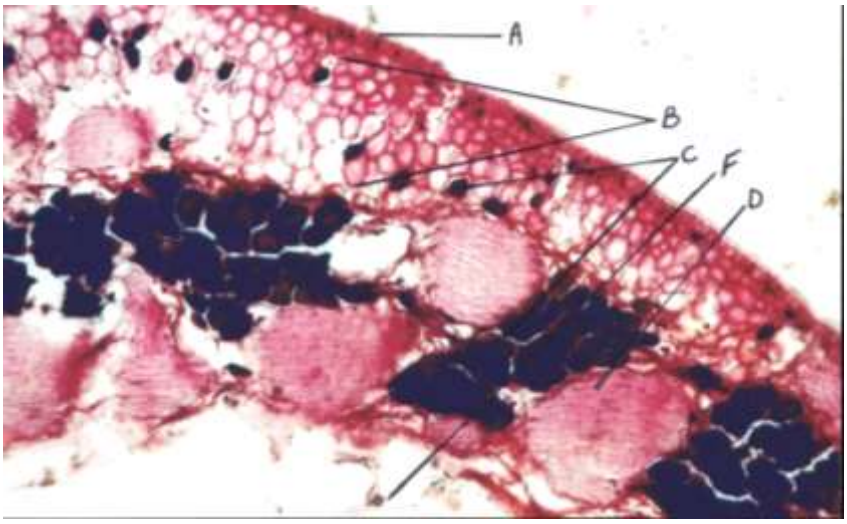

Fig. ٢ : Cross – Section of untreated date fruits – Siwi variety.

A- Epidermal cells. B- Outer hypodermal cells.
C- Outer hypodermal cells. D- Tannin cells.
E- Stone cells. F- Inner hypodermal cells.

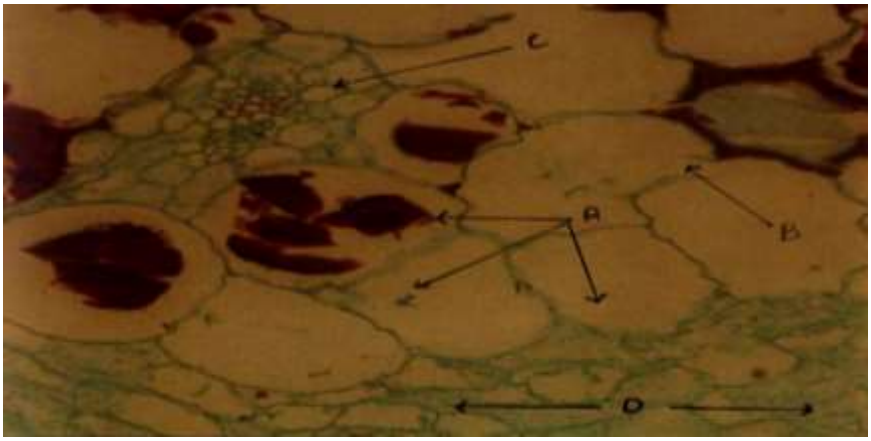

Fig. ٣ : cross-section of date fruits – Siwi – variety after irradiated ٣.٠kGy, (١٢.٥x).

A- Tannin cells (damaged free injured cells). B- Broken cells.
C- Vascular system. D- Shrinkage outer hypodermal cells.

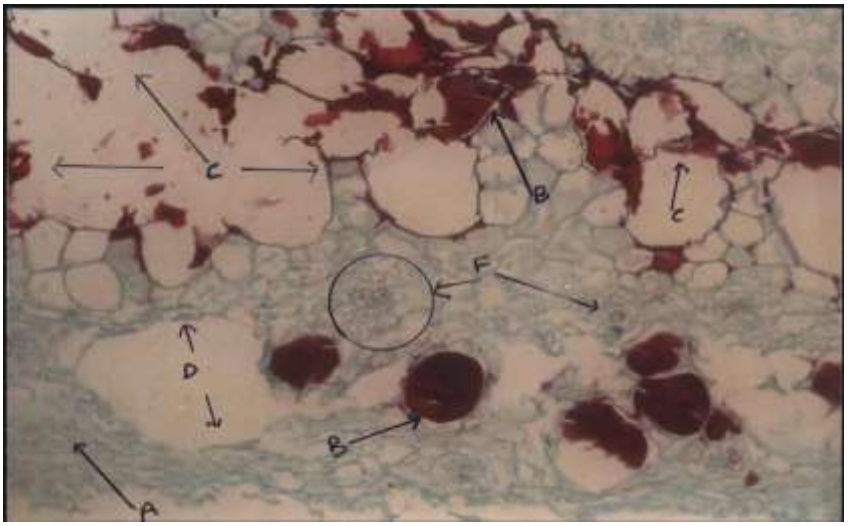

Fig. ٤: Cross -Section of dates Siwi variety after combination treatments Thermal ٥٠c° / ٢٤hr plus irradiation ١.٠ kGy (١٢.٥x).

A-Outer hypodermal cells. B-Tannin cells.
C- Rupture cells. D- Empty cells.
F-Vascular system.

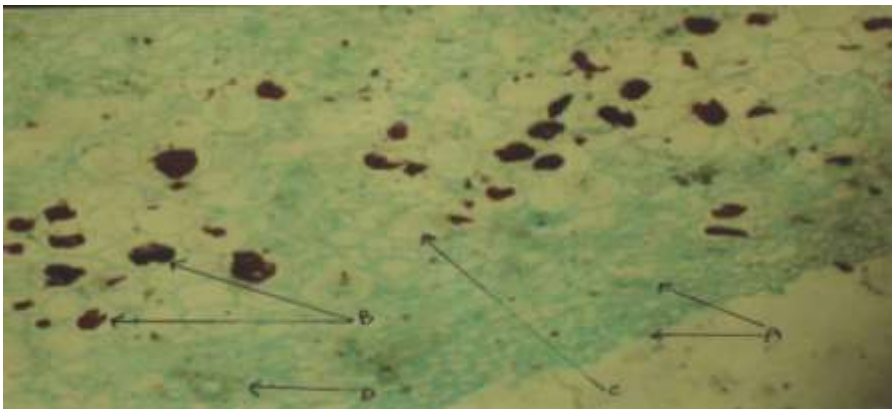

Fig. ٥: cross – section of treated dates Siwi variety after sulfiting treatments (٣.٢x).

A- Outer hypodermal cells. B- Tannin cells.
C- Mesocarp cells. D- Vascular system.

Effect of some treatments on changes in siwi dates during storage.

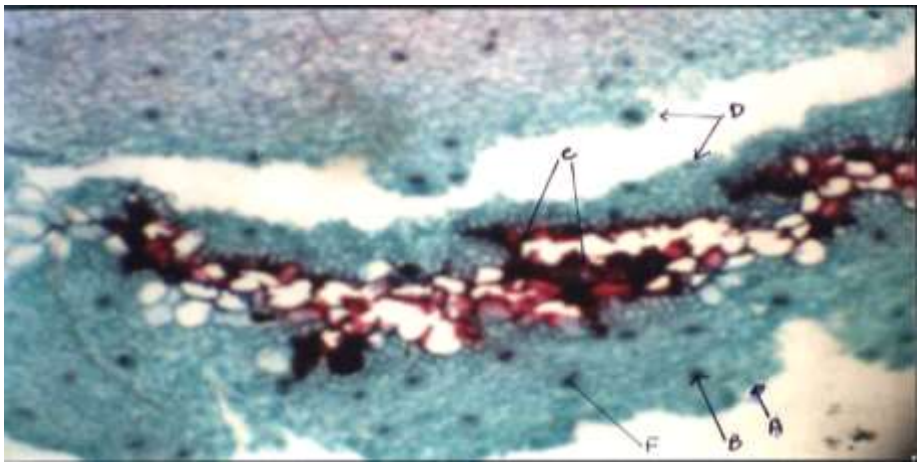

Fig. ٦: cross-section of date fruits – Siwi – variety after fumigation with Methyl Bromide (١٢.٥x).

A- Mesocarp cells (hypodermal cells). B, F – Stone cells.
C- Tannin cells. D- Inner hypodermal cells.

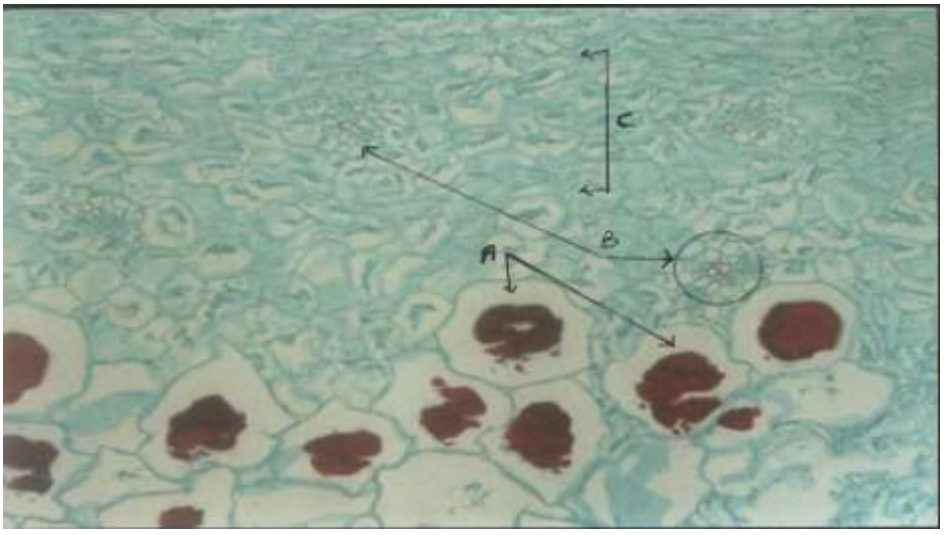

Fig. ٧: cross-section of date fruits – Siwi – variety after irradiated ١.٠kGy, (١٢.٥x).

A- Tannin cells (damaged small size). B- Vascular system.
C- Shrinkage outer hypodermal cells.

REFERENCES

Abd- Ellateaf, A.M. (١٩٩١). Effect of dehydration technique on dates and apricot sheets. M.Sc. Thesis, Food Sci., Tech. Dept., Fac. of Agric. El Fayoum, Cairo Univ.

Abozaid, M.S.M.A. (٢٠٠٢). Chemical and technological studies on using some date varieties for producing some balanced foods. M.Sc. Thesis, Fac of Agric., Al-Azhar Univ .

Ahmed, M.S.H.; Hameed, A.A.; Kadhum, A.A. and Ali, S.R. (١٩٨٥). Comparative evaluation of trial shipments of fumigated and radiation disinfected dates from Iraq. Acta Aliment. ١٤ : ٣٥٥-٣٦٦.

Al-Kahtani, H.A.; Abu-Tarboush, H.M.; Al-Dryhine, Y.N.; Adnan, M.A.A.; El-Shami, B. and El-Magaddidi, M.A. (١٩٩٦). Irradiation of dates. Insect disinfestations microbial and chemical assessments, and use of thermoluminescence technique. Plant Production Department, College of Agriculture, King Saud Univ..

Al-Rawi, N.; Markakis, P. and Bauer, D.H. (١٩٦٧). Amino acid composition of Iraqi dates. J. Sci. Food Agric. ١٨, ١-٢.

AOAC (٢٠٠٠). Official Methods of Analysis of the Association of Official Analytical Chemists International. Published by the Association of Official Analytical Chemist's International. Maryland ٢٠٨٧٧-٢٤١٧. USA

Assous, M.T.M. (١٩٩٩). Production and evaluation of Siwi date syrup (Dibis). M.Sc. Tesis, Fac. of Agric., Cairo Univ.

Baselt, R. (١٩٨٢). Disposition of toxic Drugs and chemicals in ٢nd Ed. Biochemical publications, Davis, California pp. ٥١٦-٥١٧.

Codex(١٩٩٥). Alternative to methyl bromide,: Research needs for California. The department of pesticide regulation and the California Department of Food and Agriculture, September,١٩٩٥.

Dyett, E.J. and Shelley, D. (١٩٦٦). The effects of sulphite preservative in British fresh sausages. J. Appl. Bacteriol. ٢٩ : ٤٣٩-٤٤٦.

EHC, (١٩٩٤). Environmental Health Criteria (EHC) for methyl bromide, draft for Editor, IPCS/UNEP/ILO/WHO.

Effect of some treatments on changes in siwi dates during storage.

E.O.S.Q.C. (١٩٨٦). Egyptian Organization for Standardization and Quality Control. ES : ١٢٩-٩ UDC ٦٦٤-٨٥, Fruit Preserves, Ministry of Industry, Cairo, Egypt.

El-Feky, M.S.H.M. (٢٠٠٢). Chemical and microbiological quality of some foods. Ph.D. Thesis. Fac. Agric. Moshtohor, Zagazig Univ., (Benha Branch), Egypt.

El-Salhy, F.T.A. (١٩٩٧). Effect of gamma rays on fruit storage of some date palm cultivars. MSc. Thesis Fac. Agric. Moshtohor, Zagazig Univ., Egypt.

Emam, O.A., Farag, S.A. and Hammad, A.T. (١٩٩٤). Comparative studies between fumigation and irradiation of semi-dry date fruits. Die Nahrung vol. ٣٨ N. ٦ pp. ٦١٢-٦٢٠.

FAO (١٩٨٣). Composition of foods. FUM/RS Rev. ١, Rome

FAO(١٩٩٣). Coporate Document Repository. Date palm products-M-١٧. ISBN ٩٢-٥-١٠٣٢٥١-٣.

FAO (١٩٩٤). Food and Agriculture Organization of the united nations. Date Palm Products, Agricultural services Bulletin ١٠١.

FAO (١٩٩٨). Food quality and safety systems. A training manual on food hygiene and hazard analysis and critical control point HACCP system, Food and Agriculture Organization of the United Nations, Rome.

FAO (٢٠٠٧). Statistics of World date production.

FAO/IAEA (١٩٩١). Analytical detection methods of irradiated foods International Atomic Energy Agency IAEA, P.٧

FAO/WHO (١٩٨٨). Pesticide residues in food. Report of the Jaint meeting of the FAO panel experts on pesticide residues in food and the environment and WHO expert group on pesticide residues. FAO plant production and production paper ٩٢.

Gad Alla , , A. Sohair.; A. M. El-Marasafy.; E. Y. Salama; M.M. Ayoub and Salwa, M. Dogheim (٢٠٠٠). Monitoring of methyl bromide residues as bromide ion some cereals and herbs collected from Egyptian Governorates. ٨th of Agric. Dev. Res., Fac. Agric., Ain Shams Univ., , November ٢٠-٢٢. ٢٠٠٠.

Greve, P.A. and W.B.F. Grevenstuk, (١٩٧٦). Optimization studies on the determination of bromide residues in lettuce, Meded. Fac. Landbouww. Rijksuniv. Gent, ٤١ : ١٣٧١-١٣٨١.

Greve, P.A. and W.B.F. Grevenstuk, (١٩٧٩). Gas-Liquid chromatographic determination of bromide ion in lettuce inter laboratory studies, JAOAC, ٦٢ : ١١٥٥-١١٥٩.

Hamdy, Z ., M. (١٩٨٢). Studies on date pollen characters of some date varieties and their effect on fruit anatomy of Amhat dates. Agric. Res. Rev., ٦٠ (٣) : ١-٢٢.

IARC (١٩٨٦). Monographs on the evaluation of the carcinogenic risk of chemicals to humans: some halogenated hydrocarbons and pesticide exposure vol. ٤١, pp ١٨٧-٢١٢.

Ibrahim, H.I.K. (١٩٩٠). Solar energy dehydration of fruits and vegetables and its effects on enzymatic activities of the process. M.Sc. Thesis, Fac. of Agric., Ain Shams Univ., Egypt.

Johansen, D.A. (١٩٤٠). Plant micro technique. New York Company, pp.٥٢٣.

Kamel, S.I. (١٩٦٧). Factors influencing the quality of dehydrated dates. Ph.D. Thesis, Fac. of Agric., Cairo University.

Khalil, S.A.A. (١٩٩٥). Chemical and Technological studies on some date products. M.Sc. Thesis Fac. of Agric. Moshtohor, Zagazig Univ., Banha Branch, Egypt.

Mcweeny, D.J.; M.E. Knowles and J.F. Hearne (١٩٧٤). The chemistry of non-enzymatic browning in foods and its control by sulphites. J. Sci. Food Agric. ٢٥ : ٧٣٥-٧٤٦.

Nezam El-Din, A.M.M. (١٩٨٨). Studies on harmful substances in some foods Ph.D. Thesis, Fac. of Agric. Moshtohor, Zagazig Univ., Egypt.

Ramadan, B.R. (١٩٩٠). Chemical and technological studies on some New Valley dates. M.Sc. Tesis, Food Sci. Tec. Dep., Fac of Agric., Assiut Univ., Egypt.

Ramadan, B.R. (١٩٩٥). Biochemical nutritional and technological studies on dates. Ph.D. Thesis, Fac of Agric., Assiut Univ., Egypt.

Ranganna, S. (١٩٧٧). Manual of analysis of fruit and vegetable products. Tata McGraw-Hill Publishing Company Limited, New Delhi.

Ranganna, S. (١٩٧٩). "Manual of Analysis of fruit and vegetable products." Tata McGraw Hill Publishing Co. Limited, New Delhi.

Roberts, A.C. and Mc Weeny, D.J. (١٩٧٢). The uses of sulfur dioxide in the food industry. J. Fd. Technol., ٧ : ٢٢١-٢٣٨.

Sahari, M.A.; Barzegar, M. and Rodfar, R. (٢٠٠٦). Effect of varieties on the composition of dates (Phoneix dactylifera L.) note. Food Sci. tech. Int. ١-٧.

Sawaya, W.; Khalil, J.; Safi, W. and Al-Shalhate, A. (١٩٨٣). Physical and chemical characterization of three Saudi date cultivars at various stage of development. Canadian Inst. Food Sci. and Tech. j. ١٦ (٢) ٨٧-٩٢.

Somogi, M. (١٩٥٢). Notes on sugar determination. J. Biol. Chem., ١٩٥ : ١٩-٢٣.

Steel, R.G.D. and Torrie, J.H. (١٩٨٠). Principle and procedures of statistics. A biometerical approach, Mc Graw Hill Co., New York.

Stijve, T. (١٩٧٧). Improved method for the gas chromatographic determination of inorganic bromide in food stuffs fumigated with methyl bromide. Deutsche Lebensm. Rundsch, ٧٣ : ٣٢١-٣٢٥.

Stijve, T. (١٩٨١). Gas chromatographic determination of inorganic bromide residues – a simplified procedure, Deutsch lebensm-Rundsch ٧٧, ٩٩.

Youssef, A.K.; Benjamine, W.D.; Kads, A.; Mehislldin, S. and Ali, S.M. (١٩٨٢). Chemical composition of four Iraqi date cultivars. Date Polin. J. ١ (٢): ٢٨٥-٢٩٤.

WHO (١٩٧٤). Toxicological evaluation of some food additives including anticaking agents, antimicrobials, antioxidants, emulsifiers and thickening agents. World Health Organization

Zaid, S.F.; El-Salhy, F.T.; Nassef, A.E.; El-Beltagy, A. and Mohrame, H. (٢٠٠٥). Physicochemical studies for detection of irradiated dried date fruits. Isotope & Rad. Res., ٣٧, ٦, ١٥٧٥-١٥٨٦.

تأثير التشعيع والتبخير والمعاملة الحرارية على الخواص الكيمائية والحسية والهستولوجية للبلح السيوى أثناء التخزين.

محمد نجيب قناوي* – أحمد محمود همام* – عبد البارى داوود **
محمد على*** – جادو بكر جادو***
* قسم علوم الأغذية – كلية الزراعة –جامعة المنيا
** كلية السياحة والفنادق – جامعة المنيا
*** مركز البحوث الزراعية – الجيزة – مصر

أجريت هذه الدارسة علي ثمار البلح النصف جاف" صنف سيوي " بهدف تحسين صفات جودة الثمار علي درجة حرارة الغرفة. وتضمنت الدارسة استخدام الإشعاع الجامي بجرعات منخفضة (١، ٢، ٣ كيلو جراي) ومعاملات حرارية (٥٠°م / ٢٤ ساعة ،٥٠°م / ٤٨ ساعة) و معاملات مزدوجة (٥٠° م /لمدة ٢٤ ساعة مع التشعيع بجرعة إشعاعية ١كليو جراي) لإحلالها محل التبخير ببروميد المثيل و الكبر ته بثاني أكسيد الكبريت والتخزين مدة١٢ شهر (سنة كاملة).. وتم اجراء التحاليل لبعض الصفات الكيماوية (السكريت الكلية والألياف والبروتين الخام والدهن الخام والرماد ونوعيةالسكريات وقيم الأملاح المعدنية)للثمار والإختبارات الحسية وكذلك الدارسة التشريحية للثمار.ولوحظ من النتائج انخفاض قيم السكريات الكلية فى جميع العينات أثناء مدة التخزين ،وكانت قيمة للسكريات الكلية فى عينة الكنترول أقل قيمة (٥٧.١٤%)فى نهاية التخزين بينما سجلت أعلى قيمة للسكريات الكلية(٧٦.٤٣%) فى المعاملة الحرارية ٥٠م°/٤٨ساعة فى نهاية مدة التخزين . كما تبين من التحليل بـ HPLC للسكريات الموجودة في عينات التمور (المعاملات) والغير معاملة للصنف (سيوي) احتواء العينات علي سكريات أساسية هي الجلوكوز، الفركتوز، السكروز ،وسكريات أخري بكميات أقل مثل الزيلوز– المالتوز – المانوز – السوريبتول ،ووجود نسب قليلة جدا من سكريات غير معروفة ، وتراوحت قيم السكروز والجلوكوز والفركتوز في العينات الغير معاملة ٠.١٣٦% ، ٥٢.٥٩%،٢٦.٩٤% علي الترتيب، كما تبين ان قيم السكريات الأساسيةازدادت بالمعاملات عن العينات الغير معاملة ولكن انخفضت بزيادة مدة التخزين (١٢ شهر). تبين من نتائج دراسة متبقيات المبيدات الحشرية أن جميع عينات الكنترول الغير معاملة خالية نهائيا من أي مبيدات حشرية ، بينما كانت العينات المعاملة ببروميد الميثيل أقل من الحدود القصوى ٠.٠١ جزء/ المليون فى متبقيات بروميد الميثيل ، كما وجدت أن العينات المعاملة بالكبرتة تحتوىعلى متبقيات عملية الكبر ته أقل من ١٥٠٠ جزء/ المليون. أوضحت النتائج أن ثمار التمور فقيرة فى محتواها من البروتين الخام والدهن الخام (٢.٣٠– ٢.٣٨ %) ، ٣.١١– ٣.٩٦%)، يعكس الرماد المرآة الحقيقية للمحتوي المعدني للعناصر في ثمار التمور السيوي وأوضحت النتائج

Effect of some treatments on changes in siwi dates during storage.

عدم وجود تغير ملموس بسبب المعاملات المستخدمة وتراوحت القيم في العينات الكنترول الغير معاملة والمعاملة من (٢.٤٠- ٢.٦٨) % خلال مدة الخزن ١٢ شهرا. وتراوحت قيم العناصر المعدنية في ثمار التمور المدروسة كالآتى: المغنسيوم (٣٥.١١ – ٣٨.٦٦) ، صوديوم (٦.١٣- ٧.٨) ، زنك (١٣.٤- ١٨.٤٩) المنجنيز (٧.٣٦- ٨.٤٩) ، الحديد (٩.١١- ٩.٩٥) الكالسيوم (١٦.٢٣- ١٦.٨) البوتاسيوم (٤٨.٠٣- ٤٨.٨٦) النحاس(٣.٤٦- ٤.٢١) ملليجرام لكل ١٠٠ جرام مادة جافة خلال مدة الخزن،كما أظهرت النتائج انخفاض قيم الألياف الخام تدريجيا من بداية الخزن حتى نهاية الفترة ١٢ شهرا من ١.٣٧% إلي ١.٣٢% فيكل من العينات الغير معاملة (كنترول)و العينات المعاملة،وبينت نتائج دراسة الخواص الحسية أن قيم اللون للمعاملات الآمنة سجلت درجات مقبولة وهي معاملات الإشعاع ١ ، ٢ ، ٣ كليو جراي كذلك المعاملات الحرارية ٥٠مه /٢٤ساعة ، ٥٠o م /٤٨ساعة والمعاملة المزدوجة (حرارة + إشعاع). بينما سجلت قيم الطعم والقوام أيضا درجات عالية في المعاملات الآمنة كالسابق ولكن كانت أقل درجة في القوام للمعاملة بالإشعاع عند ٣ كيلو جراي. ولكن كانت اعلي درجة للطعم والقوام عند المعاملة بالحرارة ٥٠o م /٢٤ساعة .أما بالنسبة للقبول العام للثمار المدروسة احتلت المعاملة الحرارية ٥٠o م /٢٤ساعة ٩.٤٧ درجة في بداية الخزن – ٨.١٩ في نهاية فترة الخزن ١٢ شهر.

أظهرت الدراسات التشريحية للثمرة وجود ثلاثة طبقات أساسية هي كالآتي :أنسجة طبقة الغلاف الخارجي (Exocarp) والتى تتكون من ثلاث إلي خمسة مناطق ، وأنسجة الطبقة الوسطى (Mesocarp) وتتميز هده الأنسجة إلي ثلاث مناطق، أنسجة الطبقة الداخلية (Endocarp) والتى تترتب في صفين ، وقد اثبتت النتائج التشريحية أن الأفضلية للمعاملة الحرارية ٥٠°م لمدة ٢٤ ساعة سواء منفردة أو مشتركة مع الإشعاع ، بينما أدى الإشعاع بجرعة ١ كيلوجراي إلي إحداث تغيرات كبيرة واضحة حيث حدثت كرمشة لأنسجة الـ Mesocarp وانضغاط للخلايا البرانشيمية فيه ، بينما أحدثت الجرعات العالية ٣ كيلوجراي تكسير في خلايا التانينات حيث أصبح بعضها فارغآ تمامآ منها بجانب الضرر في خلايا الـ Mesocarp. وتبين من الدارسة استبعاد معاملتي التبخير ببروميد الميثيل والكبريت لحظر تداول الأول حسب الاتفاقات الدولية ووجود متبقيات من كب أ٢ في المعاملة الثانية، بينما حازت باقي المعاملات الإشعاع ١ ، ٢ ، ٣ كيلو جراي و كذلك المعاملات الحرارية ٥٠°م /٢٤ساعة ، ٥٠°م /٤٨ساعة و المعاملة المزدوجة الرضا من النتائج المتحصل عليها في الدارسة. ويعتبر الإشعاع والمعاملة الحرارية من أفضل الطرق الآمنة والصالحة لزيادة جودة التخزين لثمار البلح ..