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PHYSICOCHEMICAL PROPERTIES OF OIL, FLOUR AND TEHINA PRODUCED FROM IRRADIATED SESAME SEEDS.

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ABSTRACT : Sesame seeds ($Giza_{32}$ and sudany varieties) were gamma irradiated at 3,6,9 and 12 kGy and were used for producing tehina product, sesame flour and sesame oil. The effects of gamma rays on chemical composition of sesame seeds, stability of tehina product and some functional properties of sesame flour (foaming and emulsifying) were investigated. In addition the chemical properties, oxidative stability and fatty acids composition of sesame oil were studied. The results showed that the chemical composition of both varieties was close to each other and indicated also that gamma irradiation treatments had no effects on chemical composition of sesame seeds. On the other hand, the stability of tehina product was increased by ascending gamma irradiation doses, and retarded the oil separation in tehina product during storage at room temperature which reached 135 days for irradiated samples at dose of 12 kGy compared to only 45 days for control sample. Both foaming and emulsifying properties (capacity and stability) of sesame flour were gradually decreased by increasing gamma irradiation doses. A.V, P.V and TBA values were slightly increased while the oxidative stability at 120 °C of sesame oils was decreased by exposing seeds to gamma-irradiation treatment. Furthermore iodine value and saponification value as well as fatty acid composition were not alter by did not affect by the applied exposing sesame seeds to gamma rays.

INTRODUCTION

In the world, most of the sesame seeds are used for extraction of oil. The oil is used mainly for cooking purposes and a small percentage of oil is also used in pharmaceuticals, cosmetics and perfumery industries. Sesame seeds not only used as an important source of high quality oil, but also it self is used in manufacturing popular and nutritious food locally called "Tehina" and "Halawa tehinia" (Damir, 1984).

The main problem associated with tehina is its low stability during storage which characterized by the separation of its oil. Such a separation is in fact due to incomplete emulsification of the constituents of tehina. Several attempts, to improve the keeping quality of tehina were conducted for obtaining a relatively more stable emulsion during storage and generally, it has been concluded that the complete emulsification of tehina required the use of some edible emulsifying agents such as monoglycerides, polyvinyl pyroledone and sorbitol monostearate It is well known that diglycerides are one of compounds observed due to cleavage reaction of the triglyceride upon irradiation treatment (Anderson, 1983). Moreover, diglycerides are known to be among compounds that have an emulsifying effect (El–Taibany, 1970 and Sawaya *et al.*, 1985). Sesame seeds, like many other oil seeds and grains, are susceptible to attack by different species of fungi upon storage (causing undesirable changes in the quality of oil, germinability of seeds and the production of mycotoxins that are both toxic and carcinogenic to man and animals), sesame seeds may subjected to gamma irradiation treatment which recognized as a safe and effective methods in controling spoilage and mycotoxigenic fungi infecting different grains and oil seeds (Singh, 1987; Jonsyn, 1988, Chiou *et al.*, 1990 and Ragab *et al.*, 1994). The technical feasibility of food preservation by irradiation has now received wide scale acceptance and the production of certain irradiated food for human consumption has been approved in several countries, there are 44 countries, including Egypt, that approved the use of irradiated food and among them about 30 countries are applying irradiation commercially to food products (WHO, 1980, and IAEA, 1998). Therefore, the present study aims to investigate the possibility of improving the stability of sesame tehina through the treatment of sesame seeds by gamma irradiation and studying their effects on sesame oil properties and sesame functional properties of sesame flours.

MATERIALS AND METHODS

1. Materials

Sesame seeds [*Sesamum indicum*, L. Variety (G32)] were obtained form EGA seeds company, Giza, Egypt while sesame seeds [*Sesamum indicum*, L. variety sudany(s)] were obtained from manufactory Alsanhawy of popular confectionery, Benha, Kalubia Governorat , Egypt. The obtained seeds were carefully cleaned, and packed in polyethylene bags (each bag contain 1Kg) and the bags were tightly closed and divided into two groups. The first group was used for irradiation process while the second group was left as control sample.

2. Methods

2.1. Irradiation process

Eight bags (each bag contain 1Kg) from first group of G32 and S. varieties of sesame seeds were gamma irradiated at 3,6,9 and 12kGy doses using an Indian gamma chamber 4000 A (dose rate 2.3474 kGy/h) at National Center for Research and Radiation Technology, Nasr City, Cairo, Egypt.

2.2 Oil extraction

Sesame seeds samples were ground using stainless steel mill. Soxhelt apparatus units (2 liters capacity) were used for oil extraction and the crude oil was dried over anhydrous sodium sulfate, filtered, packed in dark brown bottles without further purification and kept at −18°C till analysis.

2.3 Preparation of sesame seeds flours

Sesame seeds meals which remained after oil extraction from sesame seeds samples undertaken were dried in an oven at 65°C for 8h. and milled to pass through a 75 mesh screen, tightly packed in polyethylene bags and kept at room temperature (31+2°C) for further analysis. (Inyang and Ekanem, 1996).

2.4 Production of Tehina

The sesame seeds were dehulled by the wet method described by (Toma *et al.,* 1979).Seeds were soaked in tap water for 6-10 hours and washed and while being washed, they were rubbed by hand to decorticate them. The kernels were separated by soaking in brine solution (10% NaCl) and the separated kernels were washed to remove out the salt. After washing the kernels were roasted at 110-120°C for 100-120 minutes. The dehulled roasted kernels were cooled, sifted and ground in a coffee grinder for 10 second, followed by a quiescent period of 2 minutes. This process was repeated eight times for preparation of the paste, known as tehina, (Abd – Allah 1987).

2.5. Analytical methods

2.5.1Chemical analysis of sesame seeds:

Moisture, oil, protein and ash content were determined according to the methods described by the A. O. A. C. (1990).

2.5.2Calculation of total carbohydrates

The total carbohydrates were calculated by difference according to (Egan *et al.,* 1981) as follows :

Total carbohydrates% =100-(moisture% + crude protein % + total lipids% + ash %).

2.5.3 Analysis of sesame oil

2.5.3.1 Acid value, peroxide value, iodine number and saponification number were determined according to the method described by the A. O. C. S. (1989). While thiobarbitruic acid value (T. B. A.) was determined according to the method described by Sid well, *et al.*, (1954).

2.6 Fatty Acids composition

The methyl esters were prepared according to the method reported by Anon, (1966) and the fatty acid methyl esters were analyzed by gas chromatographic apparatus and identified by comparing their relative retention times with those of authentic fatty acid methyl esters. (USA).

2.7 Measurement of oil stability

The induction period of sesame oil samples was determined at 120°C using the 679 rancimat two and half grams sesame oil sample was weighted out in the reaction vessel which was then placed in heating block for 10 min. to preheat the sample. The air supply and the absorption vessels which contained deionized water (used as absorption solution for the conductivity measurements) were connected and the recording of the conductivity curves were started (Laeubli. and Bruttel, 1986).

2.8 Emulsifying and foaming properties of sesame flours

2.8.1 Emulsion capacity

One gram of each sample was mixed with 34 ml 3% Nacl solution in a warring micro-blender for 30 sec. While continuing blending, 50 ml vegetable oil (corn–oil) was added at a rate of 10 ml/ min. Blending was continued for an additional 30 sec. Each sample was transferred to 50 ml graduated centrifuge tube, kept in a water bath at 80°C for15 min., then centrifuged at 3,000 for 40 min. the volume of oil separated from each sample after centrifugation was read directly from the tube. Duplicate measurements were mad for each sample and averaged. Emulsion capacity was expressed as the amount of oil emulsified and held per gram of sample. (Okezie and Bello, 1988).

2.8.2 Emulsion stability

One half gram of each sample was dispersed in 12.5 ml distilled water, then 12.5 ml corn oil was added at a rate of 25 ml / min. while blending. Each sample was blended in a warring micro–blender at high speed for an additional 60 sec. and transferred into a 50 ml graduated cylinder. Volumetric changes in the foam, oil and aqueous layers were recorded after 30, 60, 90, 120, 150 and 180 min. Duplicate measurements were made and averaged. (Okezie and Bello, 1988).

2.8.3 Foam capacity

One half gram of each sample was blended with 40 ml distilled water at high speed in a warring micro – blender for 2 min. The process was repeated for each sample with blending for 6 min. after blending, each sample was transferred into a 100 ml graduated cylinder. The blender jar was washed with 10 ml distilled water which was then added gently to the graduated cylinder. For each sample, duplicate determinations were prepared and average values recorded. Volume were recorded before and after whipping and the percent volume increase due to whipping was calculated according to the method of Lawhon and Cater (1971).

$$\text{Foam capacity} = \frac{V_1 - V_2}{V_1} \times 100$$

Where :

V_1 = volume after whipping

V_2 = volume before whipping

2.8.4 Foam Stability

One half gram of each sample was blended for 1 min. with 40 ml distilled water at high speed in a warring micro - blender. The whipped mixture was transferred into a 100 ml graduated cylinder. The blender jar was rinsed with 10 ml distilled water which was then gently added to the graduated cylinder. Foam volume changes in the cylinder were recorded at intervals of 30, 60, 90 and 120 min. for each sample, duplicate measurements were made and the mean values recorded. (Okezie and Bello 1988).

RESULTS AND DISCUSSION

1 Effects of gamma irradiation on the chemical composition of sesame seeds

From data in Table (1) it could be noticed that the moisture, protein, oil, total carbohydrates and ash contents were (4.12, 4.19%); (21.07, 24.00%); (58. 92, 53.30%), (15.51, 17.93%) and (5.50, 4.77%) for Giza32 and Sudany sesame seeds varieties, respectively. These results are in agreement with those obtained by Azza, (1993) and Huang, (1994).

It is evident from the same table that chemical composition of two varieties of sesame seeds were not alter by gamma-irradiation treatments, similar results were obteined by (Azza, 1993; Hammad *et. al.*, 1994, and Choi and Hwang, 1997).

2. Effect of gamma irradiation on the chemical properties and stability of sesame seeds oils:

The chemical properties and stability of oils extracted from sesame seeds were determined and the obtained results are tabulated in Table (2). These data indicate that A.V showed a gradual increase with increase -irradiation dose for both seeds varities and reached 2.52 and 2.39 for oils of Giza32 and Sudany sesame seeds subjected to 12 kGy, respectively. These results agreed with those

Table 1. Effect of gamma irradiation on the chemical composition of sesame seeds) :

Varieties	Gamma irradiation doses kGy	Compnents % Moisture %	Protein	Oil	Carbohydrates	Ash
Giza 32	0	4.12	21.07	58.92	15.51	4.50
	3	4.21	21.35	59.01	15.39	4.25
	6	4.21	21.81	58.79	15.43	4.06
	9	4.02	22.01	58.33	15.41	4.25
	12	3.98	20.98	59.48	15.55	3.99
Sudany	0	4.19	24.00	53.30	17.93	4.77
	3	4.12	24.01	52.66	18.32	5.01
	6	3.89	23.98	52.70	18.33	4.59
	9	4.02	23.69	52.53	18.44	4.54
	12	4.03	23.98	53.09	17.94	4.99

Table 2. Effect of gamma irradiation doses on the chemical properties and stability of sesame oil extracted from sesame seeds:

Varieties	Gamma irradiation duses kGy	Acid value	Peroxide value (meq/ kg oil)	Thiobarbituric acid	Sapnifi -cation value	Iodine value	Stability Inductio time (hr)	Stability Decrease (%)
Giza 32	0	0.98	1.03	0.106	174.89	106.89	18.00	00.00
	3	1.11	2.69	0.155	172.03	105.06	14.00	22.22
	6	1.86	3.86	0.195	173.68	104.14	10.00	44.44
	9	2.01	3.98	0.220	173.98	104.00	8.47	52.44
	12	2.52	4.02	0.225	175.25	103.00	5.37	70.17
Sudany	0	1.00	1.01	0.110	173.68	106.99	-	-
	3	1.23	1.99	0.117	171.81	104.78	-	-
	6	1.59	3.52	0.227	172.32	103.03	-	-
	9	1.98	3.81	0.230	173.01	104.00	-	-
	12	2.39	4.11	0.245	175.02	103.00	-	-

obtained by Mohsen, (1996) and Mervat, (1999). Who found that the acid value gradually increased with increasing gamma irradiation doses. The same data in Table (2) indicate also that peroxide value and TBA were (1.03 and 1.01 meq/kg) and (0.106 and 0.110) for crude oils of two varieties undertaken, respectively. In addition The same phenomena was also observed for both peroxide value and T. B. A which, reached (4.02 and 4.11 meq/kg) and (0.225 and 0.245) for oils extracted from irradiated Giza 32 and sudany sesame seeds at 12 kGy, respectively.

These results are in agreement with those obtained by Hammad, *et. al.*, (1994); Afifi, (1997) and Mervat., (1999). Who found the peroxide value and T. B. A increased with increasing gamma irradiation doses. These increase in peroxide value and T.B.A value could attributed to the oxidation effects of gamma irradiation and formation of peroxide compounds and which decompose to aldhyde and increase TBA.

From the above mentioned table, it could be noticed that the stability at 120°C the control oil sample extracted from Giza32 sesame seeds variety was 18.00 hours. These results are close to those obtained by Afaf and Lars – Ake, (1995) and Shahidi, *et. al.*, (1997) who found that the stability of crude sesame oil was 16.7 and 21.3 hours at 120°C.

It is obvious from the same results that gamma irradiation caused a gradual decrease in sesame oil stability with increasing the applied gamma rays dose the stability at 120°C decreased from 18.00 hours for control sample to 14.00; 10.10; 8.47 and 5.37 hours for oil extracted from irradiated samples at 3; 6; 9 and 12 kGy, respectively. This reduction in the stability of oils may be due to the decomposition of natural antioxidant substances (Tocopherols, Sesamin and Sesamol) in sesame seeds by gamma irradiation treatments. These results agreed with those obtained by Afifi, (1997) and Mervat, (1999). who reported that gamma irradiation reduced oil stability for different oils.

Moreover iodine value and saponification value of the extracted oils from Giza 32 and Sudany sesame seeds were (106.98 and 106.99) and (174.89 and 173.68), respectively. These values were not alter upon the exposure of sesame seeds to -irradiation doses similar observations were noticed by (Azza, 1993; Hammad *et. al.*, 1994 and Mervat, 1999).

3. Fatty acid composition of Giza 32 sesame seeds:

Table (3) shows that crude oil extracted from Giza sesame seeds contained 14.81% saturated fatty acids and palmitic acid was the major saturated fatty acids (8.70%) while, unsaturated fatty acids amounted to 85.18%, and oleic and lenoleic acids were the main unsaturated fatty acids in sesame oil and representing 43.14% and 42.03%, respectively. These results almost agreed with those obtained by (Salunkhe, *et. al.* 1991 and Abou – Gharbia, *et. al.* 1997). It is obvious from the same table that gamma irradiation doses had no detectable effects on both total saturated and unsaturated fatty acids and their individual acids of sesame oils. The same phenomena was also observed by (Afifi, 1997, and Mervat, 1999).

4. Effect of gamma irradiation and storage at room temperature (31+ 2°C) on the stability of tehina

Oil separation in tehina during storage is an indication of tehina stability, it was measured every 15 days till 190 days of storage at room temperature (31+ 2°C). From data in Table (4) it could be noticed that the oil separation occurred after 60 days of storage tehina that produced from two sesame varieties under investigation.. These results are in agreement with those obtained by El-Taibany, (1970) and Abd Allah, (1987) who found that the oil was separated from sesame tehina after 60 days of storage.

It was clear also that the amount of separated oil was gradually increased as the storage period increased and reached to the maximum at the end of storage period From the same Table (4) it is clear that gamma irradiation obviously retarded oil separation in tehina, it occurred after 90, 105, 120, 135 days for irradiated samples at 3, 6, 9 and 12 kGy, respectively, compared to 60 days for control sample. This retardation of oil separation in tehina produced from irradiated sesame seeds may be due to formation and splitting free radicals and rearrangment of oil molecules and formation of some free bonds that act as emulsifier (Gimarchi *et. al.*, 1991 and Choi and Hwung, 1997).

5.Effect of gamma irradiation on the emulsion capacity and stability of sesame flours :

The emulsion capacity and stability of sesame flours obtained from Giza 32 and Sudany varieties of sesame seeds were determined and the results are tabulated in Table (5). The results indicate that the emulsion capacity of sesame flours were 20.5 and 21.75 ml oil/g. for samples of Giza32 and Sudany varieties respectively, these results are in agreement with those obtained by (Inyang and Iduh, 1996 and Sung *et al.*, 1998).

It is obvious from the same table that the emulsion capacity of

Table 3. Effect of gamma irradiation on the fatty acid composition of oil extracted from Giza 32 sesame seeds.

Fatty acids composition		Gamma irradiation doses (kGy)				
		Control	3	6	9	12
Palmitic	C16: 0	8.709	8.351	9.001	8.622	8.899
Stearic	C18:0	5.574	6.016	5.498	6.180	5.989
Oleic	C18:1	43.036	43.712	42.999	43.240	43.003
Linoleic	C18:2	42.036	41.379	41.991	41.409	41.500
Arachidic	C 20:0	0.527	0.533	0.501	0.539	0.599
Totoal saturated		14.810	14.900	15.000	15.341	15.487
Total unsanurated		85.180	85.091	84.990	84.649	84.503

Table 4. Effect of gamma irradiation doses and storage at room temperature (31± 2°C) on the stability of Tehina*:

Storage peridos (days)	Giza 32					Sudany				
	Gamma irradiation doses (KGy)					Gamma irradiation doses (KGy)				
	0	3	6	9	12	0	3	6	9	12
0	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-
60	+	-	-	-	-	+	-	-	-	-
75	+	-	-	-	-	+	-	-	-	-
90	++	+	-	-	-	++	+	-	-	-
105	++	+	-	-	-	++	+	-	-	-
120	++	+	-	-	-	++	+	-	-	-
135	++	++	+	+	-	++	++	+	+	-
150	+++	++	++	+	+	+++	++	++	+	+
165	+++	+++	++	+	+	+++	+++	++	+	+
190	+++	+++	++	+	+	+++	+++	++	+	+

* Tehina produced from sesame seeds
- No separation of oil occurred.
+ Separation of oil occurred.

sesame flours slightly reduced by exposing sesame seeds to 3,6, 9 and 12 kGy gamma irradiation doses.

The same table indicate also that the emulsion stability of sesame flour increased by increasing the time of leaving stable, it increased from 0 to, 3.5, 4.4, 4.8, 5.5 and 5 ml. H2o after 30, 60, 90, 120, 150 and 180 min., for control samples of Giza32 sesame flours respectively, Moreover the applied doses of gamma irradiation caused a slight increase in the quantity of the separated water, where it reached to 3.8, 4, 4.3 and 4.5 ml. H2o for irradiated samples at doses 3,6,9 and 12 kGy respectively. It is known that the stability of the emulsion took opposite direction with quantity of the separated water from the emulsion, therefor it could be concluded that both emulsion capacity and stability of sesame flours decreased by increasing gamma irradiation doses, and this decrease might be due to gamma irradiation doses that caused weakness in protein molecules structure (aggregation and precipitation). As a result of the weakness of the protein molecules that being unable to bound, hold and absorb the water molecules, so, its emulsion capacity and stability were decreased by increasing gamma irradiation doses (Diehl, 1990).

6.Effect of gamma irradiation on the foam capacity and stability of sesame flours

The results in Table (6) show that the foam capacity percentages of sesame flours prepared from Giza32 and Sudany sesame seed were 23% and 24%, respectively. This results are in agreement with those obtained by Inyang and Nawdimkpa, (1992); Inyang and Iduh, (1996) and Sung *et al.*, (1998) who noticed that the foam capacity percentage of sesame flour ranged from 9.0 to 48.5%.

It is obvious from the same table that foam capacity slightly reduced by exposing sesame seeds to gamma irradiation doses, it decreased from 23% in control sample to 21.5; 20.5; 19.0 and 18% for flours of Giza32 sesame seeds subjected to 3,6,9 and 12 kGy gamma irradiation doses, respectively. The same table reveled also, that the foam stability decreased by increasing leaving stable times, it decreased from 61.5 and 62 ml at zero time to 55.5 and 56.5 ml after 120 min. for flours of Giza 32 and Sudany sesame seeds respectively. On the other hand, the foam stability slightly decreased by increasing gamma irradiation doses, it reached to 53.0 and 54.0 ml. after 120 min. for flours of irradiated Giza32 and Sudany sesame seeds at 12 kGy of gamma irradiation dose, respectively.

Table 5. Effect of gamma irradiation doses on the emulsion capacity and stability of sesame flour (two varieties):

Varieties	Gamma irradiation doses kGy	Emulsion capacity		Emulsion stability (ml.H_2O separated)						
		Amoun*	%	0	30	60	90	120	90	120
Giza 32	0	20.50	41.0	0.0	3.5	4.4	4.8	5.0	5.0	5.0
	3	20.25	40.5	0.0	3.8	4.7	5.1	5.3	5.3	5.3
	6	19.75	39.5	0.0	4.0	4.9	5.3	5.5	5.5	5.5
	9	19.25	38.5	0.0	4.3	5.2	5.6	5.8	5.8	5.8
	12	18.75	37.5	0.0	4.5	5.5	5.8	6.0	6.0	6.0
Sudany	0	21.75	43.5	0.0	3.0	3.9	4.3	4.5	4.5	4.5
	3	21.25	42.5	0.0	3.3	4.1	4.6	4.8	4.8	4.8
	6	20.75	41.5	0.0	3.5	4.4	4.8	5.0	5.0	5.0
	9	20.0	40.00	0.0	3.8	4.7	5.1	5.3	5.3	5.3
	12	19.25	38.50	0.0	4.0	4.9	5.5	5.8	5.8	5.8

* ml. Oil / g sample

Table 6. Effect of gamma irradiation on the foam capacity and stability of sesame flours.

Varieties	Gamma irradiation doses kGy	Foam capacity (F. C)			Foam stability [Vol. (ml) at room temperature after time (min.)]				
		A	B	F.C %	0	30	60	90	120
Giza 32	0	50	61.50	23.0	61.50	57.50	56.00	55.50	55.50
	3	50	60.75	21.5	60.75	57.00	55.50	55.00	55.00
	6	50	60.25	20.5	60.25	56.50	55.25	54.00	54.00
	9	50	59.50	19.00	59.50	55.00	54.50	53.25	53.25
	12	50	59.00	18.00	59.00	54.00	53.75	53.00	53.00
Sudany	0	50	62.00	24.0	62.00	58.00	57.00	56.50	56.50
	3	50	61.50	23.0	61.50	57.50	56.00	56.00	56.00
	6	50	61.00	22.0	61.00	57.00	56.00	55.50	55.50
	9	50	60.50	21.0	60.50	56.00	55.50	55.00	55.00
	12	50	60.00	20.0	60.00	55.00	54.50	54.00	54.00

A= Volme before whipping B= Volume after whipping

Generally it could be concluded that the decrease in the foam capacity and stability of sesame flours by increasing gamma irradiation doses might be due to the effect of gamma irradiation on the protein molecules, that resulted in the unfolding of the molecules, hence, the protein after irradiated became weaker than before irradiation, so its foam capacity and stability become less than the control samples (Diehl, 1990).

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الخواص الطبيعية والكيماوية لكل من الزيت والدقيق والطحينة المنتجة من بذور السمسم المعاملة بأشعة جاما

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تم معاملة بذور السمسم لصنفى (جيزة ٣٢ ،السودانى المستورد) بالجرعات الإشعاعية ٣، ٦ ، ٩ ، ١٢ كيلو جراى واستخدامها فى إنتاج الطحينة وإلدقيق السميسم واستخلاص الزيت منها ، وذلك لدراسة تأثير أشعة جاما على التركيب الكيماوى للبذور وثبات الطحينة المنتجة أثناء تخزينها على درجة حرارة الغرفة وبعض الخواص الطبيعية لبروتينات دقيق السمسم (الاستحلاب والرغوة) بالاضافة إلى زلك تم دراسة الخواص الكيماوية وثبات الزيت وتركيب الأحماض الدهنية للزيوت المستخلصة من البذور المعاملة . وأوضحت الدراسة أن الركيب الكيماوى لبذور الصنفين متقارب وأن أشعة جاما لم يؤثر على التركيب الكيماوى لكل الصنفين ، لوحظ زيادة فى ثبات الطحينة بزيادة الجرعة الإشعاعية المستخدمة فى معاملة البذور ، حيث لوحظ أنفصال الزيت من الطحينة المصنعة من بذور السمسم المعاملة بالجرعة ١٢ كيلوجراى ، حيث أنفصلت بعد ١٣٥ يوم مقارنة بالعينة المقارنة التى أنفصلت بعد ٤٥ يوم . كما لوحظ أنخفاض تدريجى فى خواص الاستحلاب والرغوة لدقيق السمسم وذلك بزيادة الجرعة الإشعاعية المستخدمة فى معاملة البذور بالاضافة لذلك لوحظ زيادة طفيفة فى رقم الحموضة ورقم البيروكسيد والـ T.B.A. للزيوت المستخلصة من بذور السمسم المعاملة وذلك بزيادة الجرعة الإشعاعية المستخدمة كذلك انخفاض الثبات الحرارى للزيت بزيادة الجرعة الإشعاعية المستخدمة . أما الرقم اليودى ورقم التصبن للزيوت المستخلصة فلم وتؤثر أشعه جاما على كل منهما كذلك لم يكن هناك تأثير ملحوظاً لاى من المعاملة بأشعة جاما على تركيب الأحماض الدهنية المستخلصة من بذور السمسم.