RESULTS AND DISCUSSION

4- RESULTS AND DISCUSION

4-1-Effects of gamma irradiation, microwave heating and soaking in boiling water on the chemical composition of olive fruits:-

The effect of gamma irradiation, microwave heating and soaking treatments on the chemical composition of Calamata olive fruits (moisture, protein, fat, total carbohydrates, and ash contents) were studied and the obtained results are presented in table (1)

4-1-1:Moisture content-:

Data in table (1) illustrate that the moisture content of Calamata olive fruits was 46.8% in the control sample. Dealing with moisture content of olive fruits under treatments, it can be noticed that gamma irradiation doses had no real effect on the moisture content in olive fruits where it was 46.9 and 47.00 for irradiation sample at doses of 1 and 3 kGy respectively . These results are in agreement with those obtained by ***Afifi (1985), Ismael (1999) and Ahamed (2000)*** who noticed that gamma irradiation had no real effect on moisture content of soybean and sesame seeds .

The same Table(1) indicates also that the microwave heating treatment induced a noticeable decrease in moisture content of olive fruits where it reached to 43.20 , 41.50 and 39.7 after the microwave treatments for 10,13 and 15 min. respectively .These decreases in moisture contents due to water evaporation during microwave heat treatments . These results are

in agreement with those obtained by ***Yoshida and Kajimota (1986), Conkerton, et al (1991), Yan Hwa Chu (1995) and Ismael (1999)*** who mentioned that the microwave heating caused a high decrease in moisture content of soybean and cotton seeds . On the other hand, a slight increase in moisture content of olive fruits samples were noticed after soaking olive fruits in boiling water and reaching to 47.80, 48.50 and 49.70 after 6, 9 and 12 min. in the same order . Similar results were reported by ***Basyony (1996)*** who found that soaking in boiling water caused a slight increase in moisture content of olive fruits.

4-1-2:Oil content:

Oil content of olive fruits in both control and treated samples under investigation are presented in Table (1).

It is clear that the oil contents in the olive fruits either in the control or in the different treatments showed about the same percentages with slight differences. Oil contents of all samples were ranged between 19 and 19.50%.

These results indicated that no detectable changes were observed in oil content of olive fruits after gamma irradiation, microwave heating and soaking treatments. These finding are in harmony with those obtained by ***Afifi (1985), Ismael (1999) and Ahamed (2000)*** who mentioned that gamma irradiation had no effect on the oil content of soy bean and sesame seeds . Also ***Conkerton, et al., (1991) and Ismael (1999)*** who noticed that the microwave heating treatment did not alter the oil content of soy bean seeds ***Basyony (1996)*** found that soaking in boiling

water and microwave heating treatments had no effect on the oil content of olive fruits .

4-1-3: Protein Content:

It could be noticed from data illustrated in Table (1) that the protein contents either in the control (untreated) or in treated olive fruits were ranging between 1.21 and 1.31% .These results indicated that gamma irradiation doses (1and 3 kGy), soaking (6, 9 and 12 min), and microwave heating (10, 13 and 15 min.,) induced no detectable effects on total crude protein of Calamata olive fruits. These results are in agreement with ***Hafez et al (1985a,b),Inayatullah and Zed (1987) and Ismael (1999)*** who noticed that gamma irradiation treatments had no real effect on protein of soybean ***Conkerton, et al., (1991) and Ismael (1999)*** who mentioned that microwave heating treatments did not alter in the total protein of soybean. ***Basyony (1996)*** noticed that treated olive fruits with soaking in boiling water and microwave heating had no real effect on the total protein.

4-1-4:Carbohydrate and ash contents

Carbohydrate and ash contents of olive fruits in both control and treated samples obtained under investigation are presented in Table (1).

It is clear that the total carbohydrates and ash contents of the olive fruits either in the control or in the treated samples showed about the same percentages with slight differences. Carbohydrate and ash contents of all samples ranged between 72.39 to 72.79% and 6.8 to 7.1% , respectively . These results indicated that no detectable changes were observed in total

carbohydrates content of olive fruits after gamma irradiation, microwave heating and soaking treatments. These finding are in harmony with those obtained by ***Inayatullah and Zed (1987) and Ismael (1999)*** who mentioned that the carbohydrates and ash contents in soybean seeds did alter by gamma irradiation . ***Conkerton et al., (1991), Basyony (1996) and Ismael (1999)*** mentioned that microwave heating treatment did not alter in the total carbohydrates and ash contents of soy bean and olive fruits. Similar observations were observed by ***Basyony (1996)*** who found that soaking in boiling water treatment had no real effect the total carbohydrates and ash contents of olive fruits .

irradiated samples with doses of 1 and 3 kGy where they prolonged the storagability of the olive fruits (without spoilage) to 30 and 35 days, respectively.

Generally, it could be concluded that gamma irradiation treatments was the best one of all treatments under investigation which had an extended shelf- life to 30 and 35 days for irradiated samples at 1 and 3 kGy where at ambient temperature. It could be also concluded that 3 kGy can be used for olive fruits after harvesting to prolong the shelf-life of fresh olive fruits and keeping their quality during storage and improve the properties of virgin oil .

All treated samples were sensory evaluated for appearance and freshness and the scores were obtained as described by ***D.L.G. (1973).*** The rejection of samples was based on appearing of molds growth on olive fruits.

Table (2) : Influence of gamma irradiation, soaking and microwave heating treatments on sensorial quality of olive fruits (points).

Storage period (days)	Control	Olive fruits treatments							
		Irradiation doses(kGy)		Hot water soaking time (min.)			Microwave heating time (min.)		
		1	3	6	9	12	10	13	15
0	90	90	90	75	70	70	80	80	80
5	85	85	90	60	55	55	70	65	65
10	70	80	80	39 ®	38 ®	35 ®	60	55	50
15	60	70	75	-	-	-	45 ®	45 ®	44 ®
20	45 ®	60	70	-	-	-	-	-	-
25	-	55	60	-	-	-	-	-	-
30	-	40 ®	55	-	-	-	-	-	-
35	-	-	45 ®	-	-	-	-	-	-

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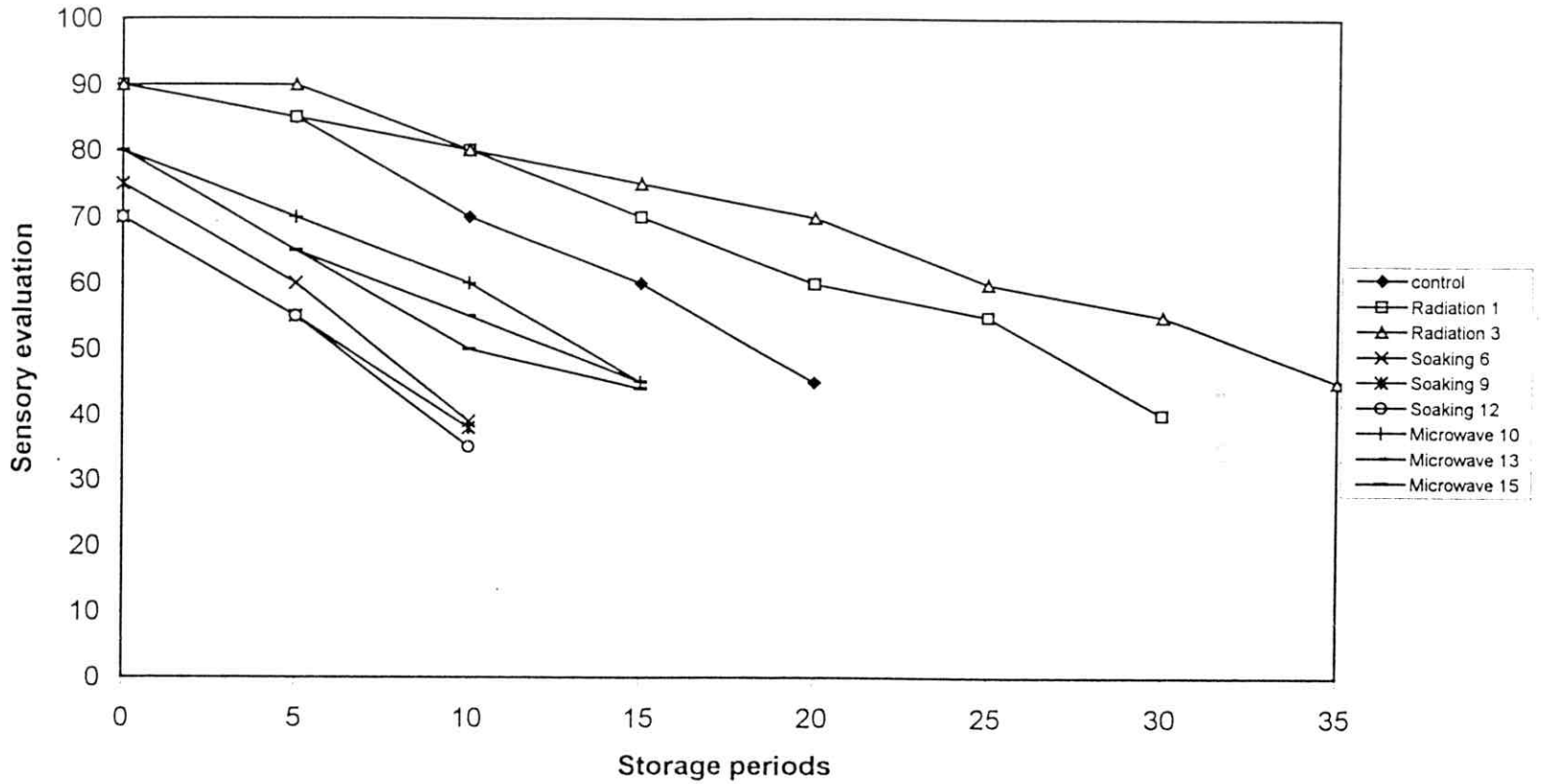

Fig (1) Infleuence of gamma rays , soacking and microwave heating treatments on Sensorial quality of olive fruits .

4-3-Microbiological evaluation

The total bacterial, moulds and yeasts counts of the stored olive fruits represent important factors for determining olive fruit shelf life.

Olive fruits samples were visually in spected daily for sign of moulds development and the rejection of samples was based on the visual observation of moulds and yeasts growth.

4-3-1 Total bacterial count:

The results in table (3) illustrate the bacterial load of olive fruits of control and different treatments. It can be observed that the total bacterial load of the olive fruits at the beginning (zero time) was 2..0 $x10^4$. These counts were gradually decreased to 1.0 $x10^2$ and 3.0 $x10^1$ after exposing olive fruits to doses of 1 and 3 kGy of gamma irradiation respectively .

Concerning soaking in boiling water for 6, 9 and 12 min., the total bacterial counts of the samples were decreased depending on the time of soaking reaching $5.0x10^3$, $3x10^2$ and $2.3x10^2$ cfu/g (at zero time), respectively.

The microwave treatment induced a noticeable reduction in the total bacterial counts. The thermal death point of bacteria depend on the time of the exposure under microwave heating treatment time (10, 13 and 15 min).

During storage of olive fruits at ambient temperature, (23 ± 2°C) the changes in the keeping quality (storag ability) depended on the development of bacterial count and other

Table (3) : Influence of gamma irradiation, soaking and microwave heating treatments on total bacterial counts of olive fruits.

Storage period (days)	Control	Olive fruits treatments							
		Irradiation doses(kGy)		Hot water soaking time (min.)			Microwave heating time (min.)		
		1	3	6	9	12	10	13	15
0	2×10^4	1×10^2	3×10^1	5×10^3	3×10^2	2.3×10^2	1.5×10^3	7×10^2	3×10^2
5	3.5×10^4	2.8×10^2	1.5×10^2	9.7×10^4	8.6×10^4	5.5×10^4	2.3×10^3	2.4×10^4	2.7×10^3
10	4.3×10^5	3.7×10^3	2.6×10^3	1.5×10^6 Ⓡ	5.6×10^5 Ⓡ	1.9×10^5 Ⓡ	3.7×10^4	5.4×10^4	3.7×10^4
15	2.6×10^6	4×10^4	2×10^4	-	-	-	8.4×10^5 Ⓡ	1.5×10^5 Ⓡ	1.4×10^5 Ⓡ
20	$.3 \times 10^7$ Ⓡ	5.9×10^5	6.3×10^4	-	-	-	-	-	-
25	-	7.9×10^5	3.5×10^5	-	-	-	-	-	-
30	-	1×10^6 Ⓡ	5×10^5	-	-	-	-	-	-
35	-	-		-	-	-	-	-	-

Table (4) : Influence of gamma irradiation, soaking and microwave heating treatments on total molds and yeasts counts of olive fruits.

Storage period (days)	Control	Olive fruits treatments							
		Irradiation doses(kGy)		Hot water soaking time (min.)			Microwave heating time (min.)		
		1	3	6	9	12	10	13	15
0	$4x10^3$	$3x10^1$	-	-	-	-	-	-	-
5	$3x10^4$	$5.5x10^2$	-	$3.5x10^3$	$4.5x10^3$	$2x10^2$	$4.5x10^2$	$1x10^2$	$2x10^2$
10	$4.5x10^4$	$4.5x10^3$	$2x10^1$	$6x10^5_R$	$2x10^5_R$	$5x10^4_R$	$5.5x10^4$	$2.5x10^3$	$1.5x10^3$
15	$3.6x10^5$	$1x10^4$	$1.5x10^2$	-	-	-	$7.8x10^5_R$	$3x10^4_R$	$2x10^4_R$
20	$6x10^5_R$	$1.5x10^4$	$3x10^2$	-	-	-	-	-	-
25	-	$3x10^4$	$2.7x10^3$	-	-	-	-	-	-
30	-	$8.5x10^4_R$	$4.3x10^3$	-	-	-	-	-	-
35	-	-	$2.4x10^4_R$	-	-	-	-	-	-

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4-4-Effect of gamma irradiation, soaking and microwave heating on the chemical properties of olive oil:

Chemical properties of oils extracted from untreated, irradiated at 1 and 3 kGy, treated by microwave heating for 10, 13, and 15 min. and soaking in boiling water for 6, 9 and 12 min. Calamata olive fruits were determined and the obtained results are tabulated in Tables (5), (6),(7) and (8) and illustrated in figures 2,3 and 4.

4-4-1- Acid value:

The acid values of olive oil extracted from the control (untreated) and treated Calamata olive fruits were determined and the obtained data are presented in Table (5) and illustrated in fig. (2).

At zero time the obtained results indicate that the acid value of the control and treated samples by irradiation ,soaking in boiling water and microwave heating of olive fruits were 0.27, 0.46, 0.81, 0.76, 2.48, 2.73, 0.37, 0.29, and 0.28 as oleic acid respectively. It is obvious from the same table that soaking olive fruits in boiling water caused a noticeable increase in acid value where reached 2.48.

On the other hand it could be noticed that the acid values of olive oil undertaken also increased by gamma irradiation doses (1 and 3 kGy) and microwave heating for 10, 13 and 15 min. treatments. However the rate of increase in acid values were much lower than that occurred by soaking in boiling water .

In respect of the effect of gamma irradiation on olive oil ***Kavalam and Nawra (1969) and Funes and Ernesto (1971)*** showed that as the irradiation dose increased it induced a marked increase in acidity of olive oil . Similar results were reported by ***Hammad et al,(1994),Hyun-jalee et al(1996) . and Ahamed(2000)*** on sesame oil and soybean oil.

During storage periods, it is obvious that acid values of oil extracted from control and treated Calamata olive fruits stored at ambient temperature ($23 \pm 2^{o}C$) were increased by prolonging the storage periods, reaching 5.13, 5.30, 7.81, 4.66, 4.79, 5.26, 5.41, 5.81 and 5.30 for control, soaking and microwave heating treatments at the time of rejection for each treatment.

It could be noticed that irradiated samples had an extended shelf- life of 30 and 35 day after treatment with 1 and 3 kGy respectively compared only with 20 days for control samples.

On the other hand, olive fruits samples treated by soaking for 6, 9 and 12 min. or by microwave heating for 10, 13 and 15 min. were rejected after 10, 15 days respectively.

The rejection of olive fruits according the standard properties of virgin oil (semi fine) depending on acid values as oleic acid, the rejection can be decided after reaching more than 5 as oleic acid. In the present study the acid value of virgin olive oil reached this value expect in the hot water soaking treatments.

Table (5) : Influence of gamma irradiation, soaking and microwave heating treatments on Acid value (as oleic acid)of olive oil .

Storage period (days)	Control	Olive fruits treatments							
		Irradiation doses(kGy)		Hot water soaking time (min.)			Microwave heating time (min.)		
		1	3	6	9	12	10	13	15
0	0.27	0.46	0.81	0.76	2.48	2.73	0.37	0.29	0.28
5	1.09	1.06	1.40	3.61	3.30	4.53	0.89	0.79	1.34
10	2.22	1.98	2.12	4.66R	4.79R	5.26R	4.47	4.90	4.13
15	5.00	3.02	3.46	-	-	-	5.41R	4.81R	5.3R
20	5.13R	4.09	4.15	-	-	-	-	-	-
25	-	4.80	4.77	-	-	-	-	-	-
30	-	5.3R	5.00	-	-	-	-	-	-
35	-	-	7.81R	-	-	-	-	-	-

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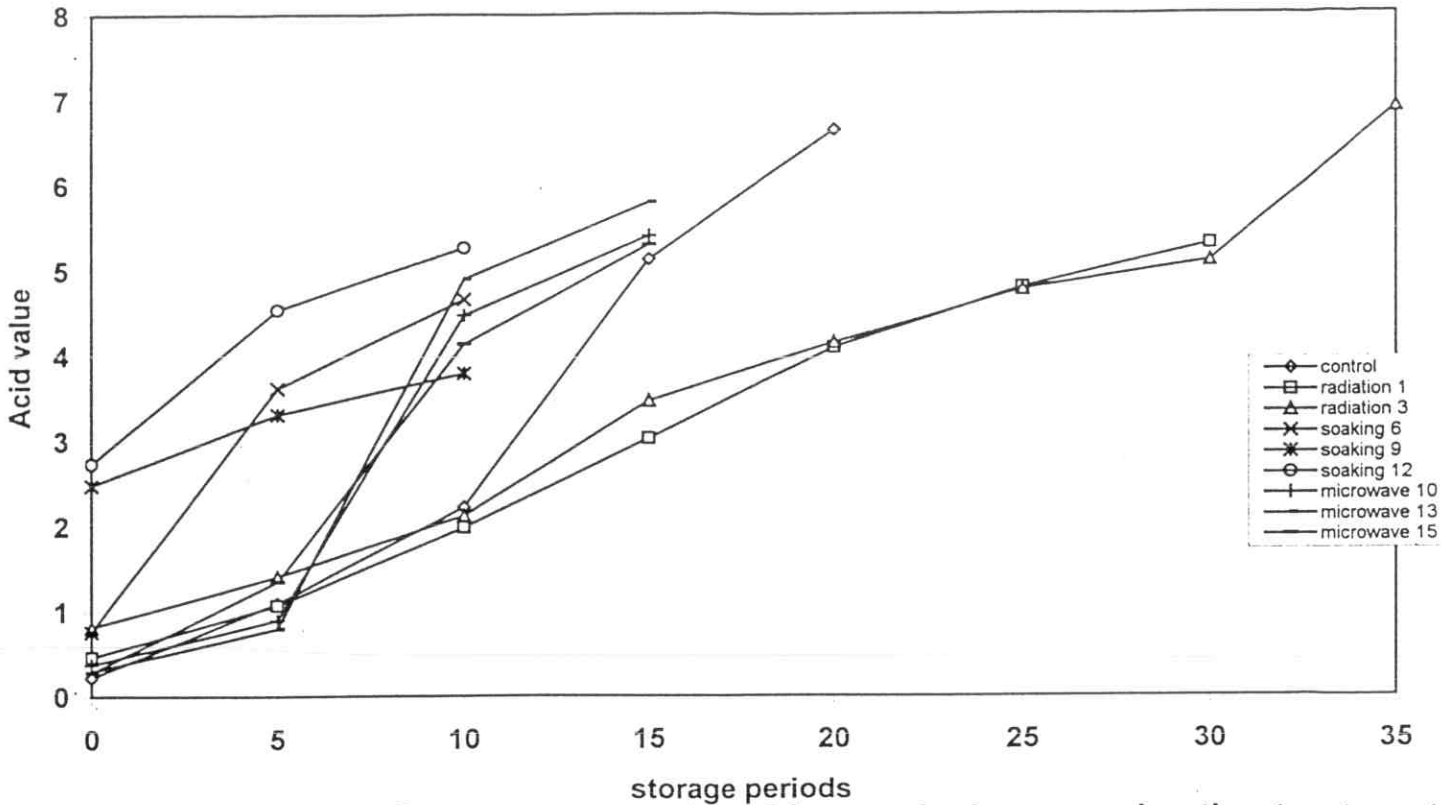

Fig (2):Influence of gamma rays and soaking and microwave heating treatments on acid value of olive oil .

4-4-2- Peroxide value

Peroxide value was determined to follow up the autoxidation of olive oil in the present study.

Data in Table (6) and fig. (3) indicate that peroxide value of oils extracted from control Calamata olive fruits was 3.95. These results are in agreement with those obtained by ***Ismael (1982) , Khalil (1987) and Rayn, et al., (1998)*** who noticed that the peroxide value of olive oil ranged from 1.30 to 25 meq/Kg depending on the varieties .

The same table clears that all treatments caused a noticeable increase in peroxide value reaching to 4.3 and 4.23 directly after gamma irradiation for 1 and 3 kGy .Similar results were reported by ***Nassar(1992), Hammad , et al,. (1994) , Ismael (1999) and Ahamed (2000)*** who reported that the treatment by gamma irradiation caused on increase in peroxide value of different oils (corn oil, soybean oil and sesame oil).Also peroxide value of olive fruits reached to 4.4 ,4.90 ,and 5.30 after soaking olive fruits samples in boiling water for 6,9 and 12 min. respectively. The microwave treatment of olive fruits (Calamata) revealed peroxide values of 5.30, 5.60 and 5.90 after treating the samples by microwave heating for 10 ,13 and 15 min. respectively . These results are in accordance with those obtained by ***Yan Hwo Chu (1995) and Ismael (1999)*** who found that the peroxide value in soybean oils increased with increasing microwave heating times .This increase in peroxide value could be attributed to the effects of different treatments and formation of peroxide compounds. The same result was emphasized by

Cossignani, et al,. (1998) where they found that the microwave heating treatment caused an increase in peroxide value of extra – virgin olive oil.

During storage periods of olive fruits undertaken, it can be noticed that the peroxide values of oil extracted from control were increased reaching 25.8 after 20 days at ambient temperature (23 ± 2°C) and 30.96, 37.6 for the two other treatments of irradiation after 30 and 35 days in the same order.

In respect of the oils obtained from soaking fruits in boiling water for different times (6, 9 and 12 min). the peroxide value were 20.93, 23.27 and 22.73 after 10 days then after that it was rejected. The olive oils obtained from the microwave heating treatments after different times indicated peroxide value of 17.45, 18.81 and 18.00 for samples under investigation at rejection time of each samples.

It is obvious that the rate of development of peroxide values was much lower comparing by the soaking treatment. This to indicate that the absorption of water during soaking enhanced the rate development of peroxide values.

The standard values of olive oil for peroxide value is about 20 meq/kg. All samples under investigation showed values more than 20 meq/kg. expect samples treated with microwave heating for 10,13 and 15 min. This may be due to the change of the peroxide compounds to organic acids or aldhyed or other compounds .

Table (6) : Influence of gamma irradiation, soaking and microwave heating treatments on Peroxide value(meq/Kg) of olive oil .

Storage period (days)	Control	Olive fruits treatments							
		Irradiation doses(kGy)		Hot water soaking time (min.)			Microwave heating time (min.)		
		1	3	6	9	12	10	13	15
0	3.95	4.30	4.23	4.4	4.90	5.30	6.30	5.60	5.90
5	10.20	8.30	12.40	16.20	18.10	17.69	9.80	10.41	10.92
10	16.76	14.21	19.34	20.93 R	23.27 R	22.73 R	14.75	12.30	11.73
15	21.85	18.91	21.34	-	-	-	17.45 R	18.81 R	21.20 R
20	25.80 R	23.23	25.89	-	-	-	-	-	-
25	-	28.79	29.32	-	-	-	-	-	-
30	-	30.96 R	32.88	-	-	-	-	-	-
35	-	-	37.60 R	-	-	-	-	-	-

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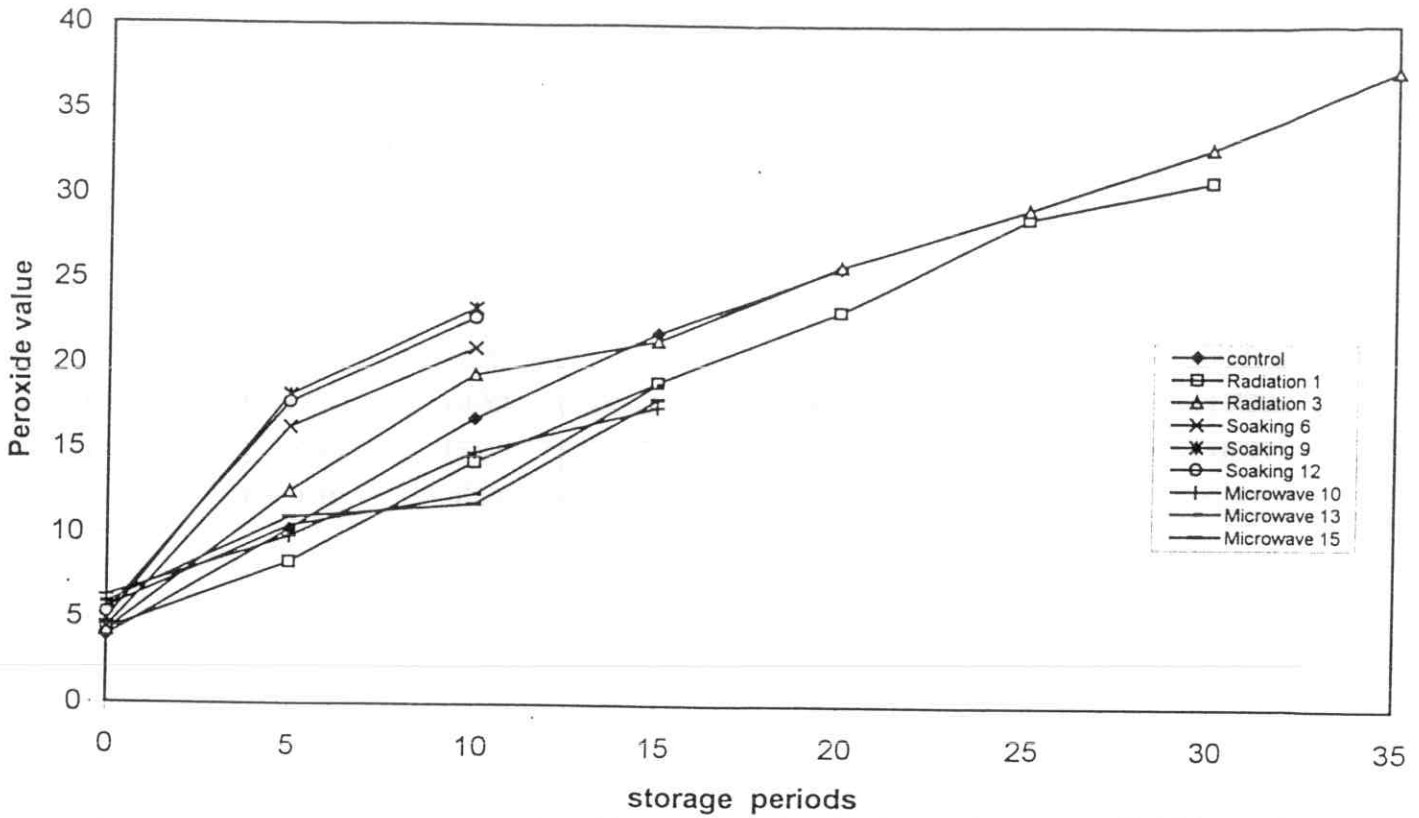

Fig (3) Influence of gammma ray ,soacking and microwave heating treatments on peroxide value of olive oil .

4-4-3-Thiobarbituric Acid (T.B.A) :-

Table (7) and Fig. (4) show that the T.B.A (absorbance O.D at 530 nm) control of sample was 0.06 for oil of Calamata olive fruits. The treatments of gamma irradiation, microwave heating and soaking in boiling water led to a slight gradual increase in T.B.A. (absorbance) of olive oils with increasing gamma irradiation doses, microwave heating and soaking times, as the values increased from 0.06 in control sample to 0.08 and 0.09 for oils of Calamata olive fruits treated with 1 and 3 kGy gamma rays .These results agreed with those obtained by ***Hammad, etal,. (1994) Afifi (1997)and Ismael (1999) and Ahamed (2000)*** where they found that T.B.A. value(absorbance) increased with increasing gamma irradiation doses of butter substitute, soybean and sesame oils. The increase of T.B.A. (absorbance) as a result of these treatments might be due to the formatiom of aldehydes. formed from the decomposition of lipid peroxides during treatment. In addition, the T.B.A of olive oil reached to 0.07 ,0.07, 0.08 ,0.08 ,0.09 and 0.1 after treated samples by soaking in boiling water for 6, 9 and 12 min. and microwave heating for 10 ,13 ,and 15 respectively. These results are in agreement with those obtained by ***Basyony (1996) and Ismael (1999)*** who noticed that T.B.A (absorbance) increase in olive oil and soybean oil samples exposed to microwave heating .But these results are not in agreement with those obtained by ***Yoshida, et al,. (1991)*** who observed that the T.B.A in coconut and palm oils decreased with increasing microwave heating times .

It is obvious from the same results that during storage periods the microwave heat treatment had more effects an increasing of T.B.A. (absorbance (of olive oils compared with gamma irradiation. Generally, during storage periods it can be noticed that the T.B.A. values of oil extracted from control were increased reaching 0.14 after 20 days. Further more there values increased to 0.14 and 0.35 for the two treatments of irradiation after 30 and 35 days in the same order. In respect of oils obtained from olive fruits soaked in boiling water for different times, the T.B.A. values were 0.12, 0.12 and 0.13 after only 10 days, after that it was rejected. The olive oils extracted from fruits treated with the microwave heating treatments for different times indicated that T.B.A. values were 0.13, 0.14 and 0.15 for these samples under investigation at the rejection time.

The unacceptable samples undertaken during storage at ambient temperature ($23 \pm 2^{\circ}C$) depended on olive fruit samples which were visually inspected daily for signs of moulds development. This rejection or unacceptance of samples were desired when heavy noticeable moulds growth on olive fruits surfaces .

Table (7) : Influence of gamma irradiation, soaking and microwave heating treatments on Thiobarbituric acid(O.D at 530 nm) of olive oil .

Storage period (days)	Control	Olive fruits treatments							
		Irradiation doses(kGy)		Hot water soaking time (min.)			Microwave heating time (min.)		
		1	3	6	9	12	10	13	15
0	0.06	0.08	0.09	0.07	0.07	0.08	0.08	0.09	0.1
5	0.07	0.09	0.10	0.09	0.09	0.11	0.11	0.12	0.12
10	0.09	0.09	0.12	0.12 R	0.12 R	013 R	0.12	0.13	0.13
15	0.13	0.11	0.15	-	-	-	0.13 R	0.14 R	0.15 R
20	R	0.12	0.17	-	-	-	-	-	-
25	-	0.13	0.23	-	-	-	-	-	-
30	-	0.14 R	0.31	-	-	-	-	-	-
35	-	-	0.35 R	-	-	-	-	-	-

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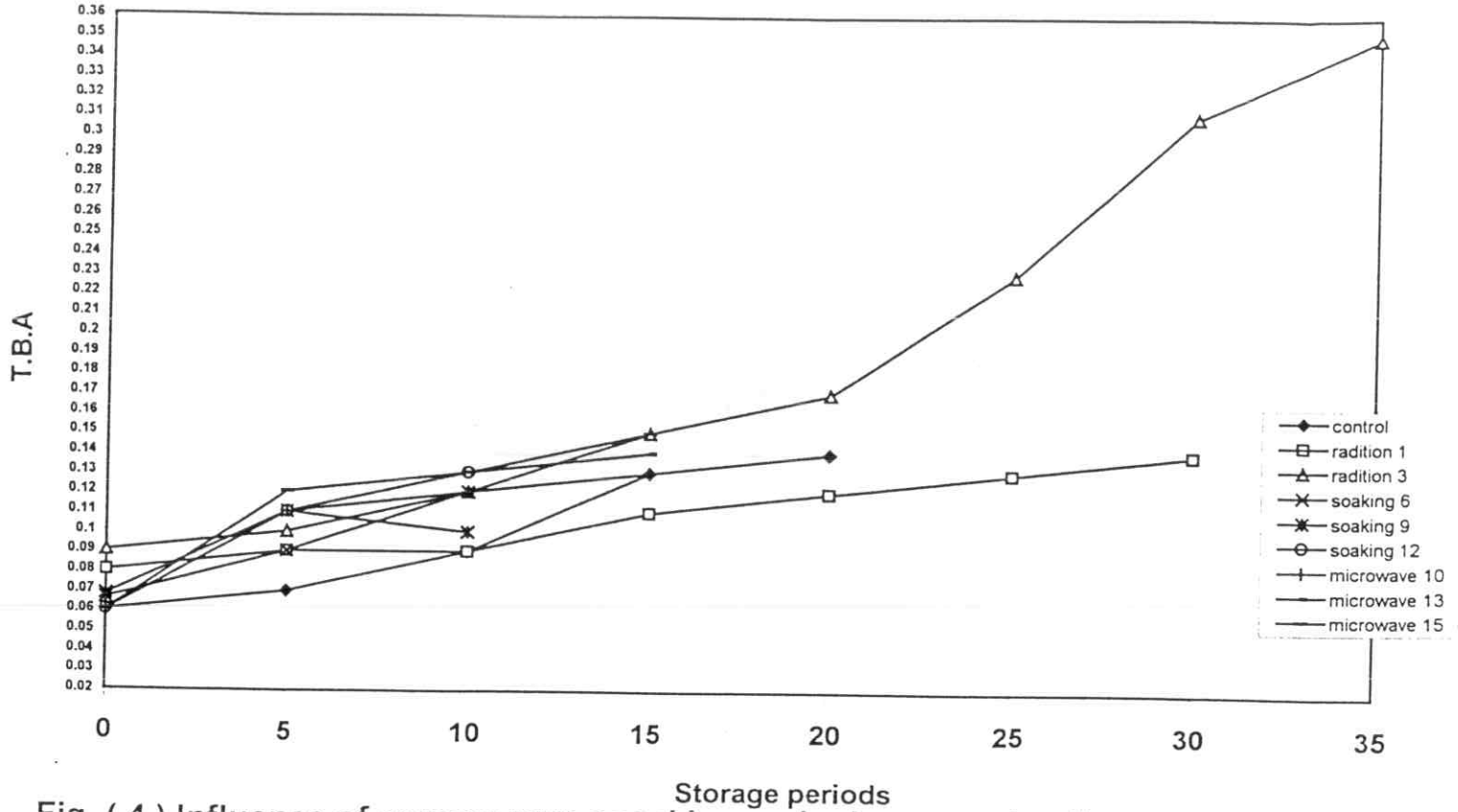

Fig. (4) Influence of gamma rays,soacking and microwave heating treatments on thiobarbituric acid of olive oil .

4-4-4- Iodine value

The iodine value is a measure of the amount of unsaturated (number of double bond) in any oil .

Date in Table (8) show that the iodine value of crude olive oil was 84.03 for control sample which agreed with that obtained by ***El-Agamy (1979), Ismeal (1982), Khalil, et al., (1983), Rahmani and Sarri Csallany (1991), Basyony (1996) and Ismael (1998),*** who mentioned that the iodine value of olive oil ranged from 73 to 94 depending on the varieties of olive fruits .

It is obvious from the some table that the iodine value of olive oil under investigation was slightly decreased by treating with gamma irradiation reaching 81.21 for 3kGy. These results are in agreement with those obtained by ***Afifi (1985), Ismael (1999) and Ahamed (2000).*** They found that the iodine values of different oils (soybean and sesame oil) were slightly decreased by treating with gamma irradiation .

The same table clears that the iodine values of olive oils under investigation did not alter by subjecting Calamata olive fruits either to microwave heating or soaking in boiling water treatments .The iodine values for oil samples from different treatment ranged from 83.10 to 84.30 . These results are in agreement with those obtained by ***Basyony (1996) and Ismael (1999)*** who noticed that microwave heating and soaking in boiling water treatments had no real effect on the iodine value of olive oil and soybean oil .

4-4-5- Saponifiction value

The saponification value is an index of the mean molecular weight of the glycerids comprising the oil or fat.

Data in Table (8) indicate that the saponification value of Calamata olive oil was 189 for the control samples. These results agreed with those obtained by ***Ismeal (1982), Khalil (1987), Rahmani and Sarri Csallany (1991) Basyony (1996) and Ismael_(1998)*** who found that the saponification value ranged from 182 to 200.08 depending on olive fruits varieties.

The same table indicates also that the saponification value of olive oils under investigation was not changed by either physical cold treatments (gamma irradiation) or hot treatment (microwave heating and soaking) ,as the saponification value of olive oils were almost constant (187-189) upon subjecting olive fruits to undertaken treatment for olive fruits. These results are in agreement with those obtained by ***Basyony (1996)*** who found that microwave heating and soaking in boiling water treatments did not alter the saponification number of olive oil , ***Ismael (1999) and Ahamed (2000)*** mentioned that the saponification number in soybean and sesame oil showed no changes after microwave heating treatments.

Table (8) : Influence of gamma irradiation, soaking and microwave heating treatments on Iodine value and saponification number of olive oil .

Storage period (days)	Control	Olive fruits treatments							
		Irradiation doses(kGy)		Hot water soaking time (min.)			Microwave heating time (min.)		
		1	3	6	9	12	10	13	15
Iodine value	84.03	84.07	81.21	84.01	84.3	48.3	82.2	83.16	83.75
Saponif. number	189	188	188	189	187	188	186	188	187

4-5- Effect of gamma rays, soaking and microwave heating on fatty Acid profiles of olive oil.

The results in Table (9) and figs (5,6,7,8,9,10,11,12and 13) show the fatty acids composition of olive oil extracted from irradiated, soaked and microwaved olive fruits. It is clear from the obtained results that olive oil extracted from control sample contained 17.71% saturated fatty acids SFA consisting of % myristic, %palmitic, %stearic and %arachidic acid. and 82.27% unsaturated fatty acids. Palmitic acid was the major saturated fatty acid and amounted to 14.78%. On the other hand, oleic acid was the predominant (USFA) and representing 66.37% of the total fatty acids while linoleic acid was the second major unsaturated fatty acid and amounted to 12.66% of the total fatty Acids. The obtained results are in agreement with those reported by ***Paganuzzi and Leoni (1979) , Yassa et al., (1990),Zeitoun et al., (1991) and Teresasatue et al., (1995)*** who found that oleic acid was the major fatty acid of olive oil and its level ranged from 66.4 to 78.3% followed by linoleic 6.1-13.3% and palmitic 8.8 to 15.2%. It is obvious from the same results in Table (9) that the applied doses (1 and 3 kGy) of gamma irradiation ,the times of soaking (6,9 and 12 min) and microwave heating (10, 13 and 15 min) of olive fruits under investigation had no detectable effects on total saturated or unsaturated fatty acids of olive oil. Several investigators. ***El–Sayed,etal., (1979), Basyony (1996), Ismael, et al,. (1996), Ismael (1999) and Ahamed (2000)*** found that gamma irradiation doses, heating time, autoclaving and soaking had no detectable effects on fatty Acid composition of olive oil and other different oil seeds.

Table (9) : Influence of gamma irradiation, soaking and microwave heating treatments on fatty acids composition of olive fruits.

Fatty acids (FA) composition	Control	Olive fruits treatments							
		irradiation doses(kGy)		Hot water soaking time (min.)			Microwave heating time(min.)		
		1 kGy	3 kGy	6	9	12	10	13	15
Myristic $C_{14:0}$	0.68	0.67	0.68	0.68	0.67	0.67	0.65	0.64	0.65
Palmitic $C_{16:0}$	14.78	14.89	14.85	14.86	14.70	14.47	14.72	14.51	14.52
Olic palmitic $C_{16:1}$	2.38	2.26	2.60	2.37	2.44	2.54	2.55	2.32	2.44
Stiaric $C_{18:0}$	1.88	1.58	1.65	1.94	1.95	1.84	1.82	1.72	1.87
Oleic $C_{18:1}$	66.37	67.36	66.79	67.39	66.74	66.40	66.33	66.70	67.30
Lenoleic $C_{18:2}$	12.66	11.97	12.09	11.46	12.22	12.67	12.76	12.80	11.92
Lenolenic $C_{18:3}$	0.86	0.88	0.92	0.89	0.87	0.91	0.78	0.88	0.87
Arachidic $C_{20:0}$	0.37	0.38	0.40	0.39	0.38	0.40	0.38	0.42	0.41
Saturated F.A.	17.71	17.52	17.58	17.87	17.70	17.38	17.57	17.29	17.45
Unsaturated F.A.	82.27	82.47	82.40	82.11	82.27	82.61	82.42	82.70	82.53

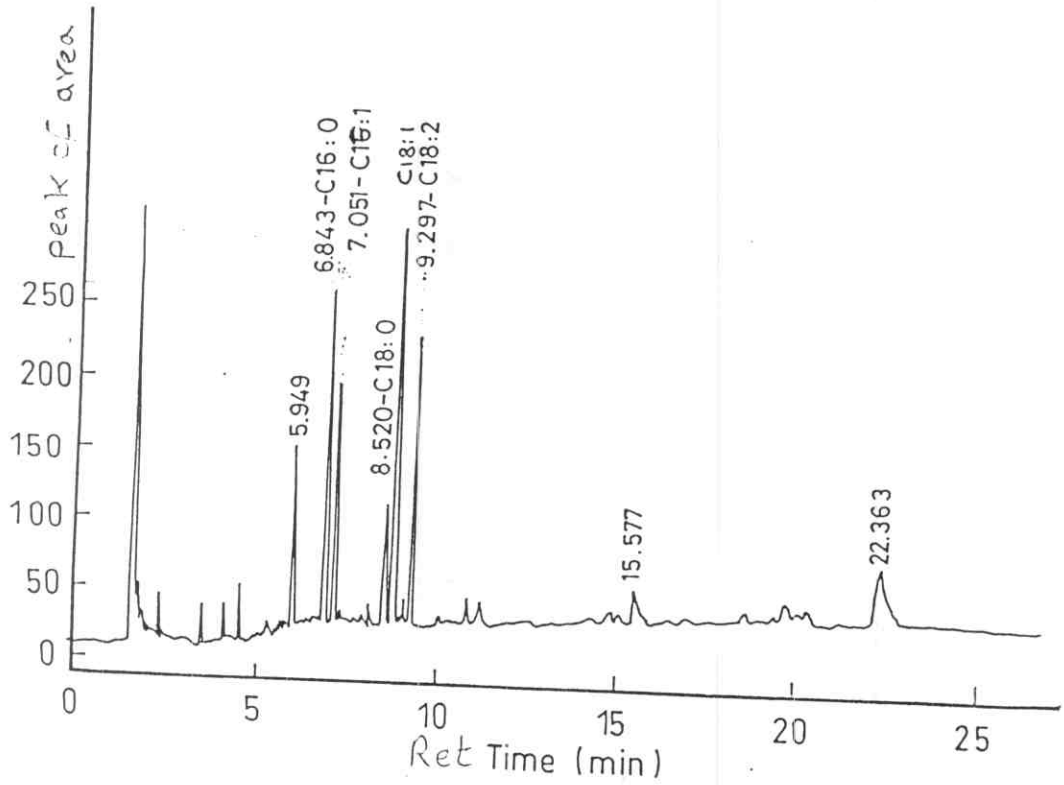

Fig.(5): Chromatographic analysis of fatty acids composition of olive fruit (olive oil).

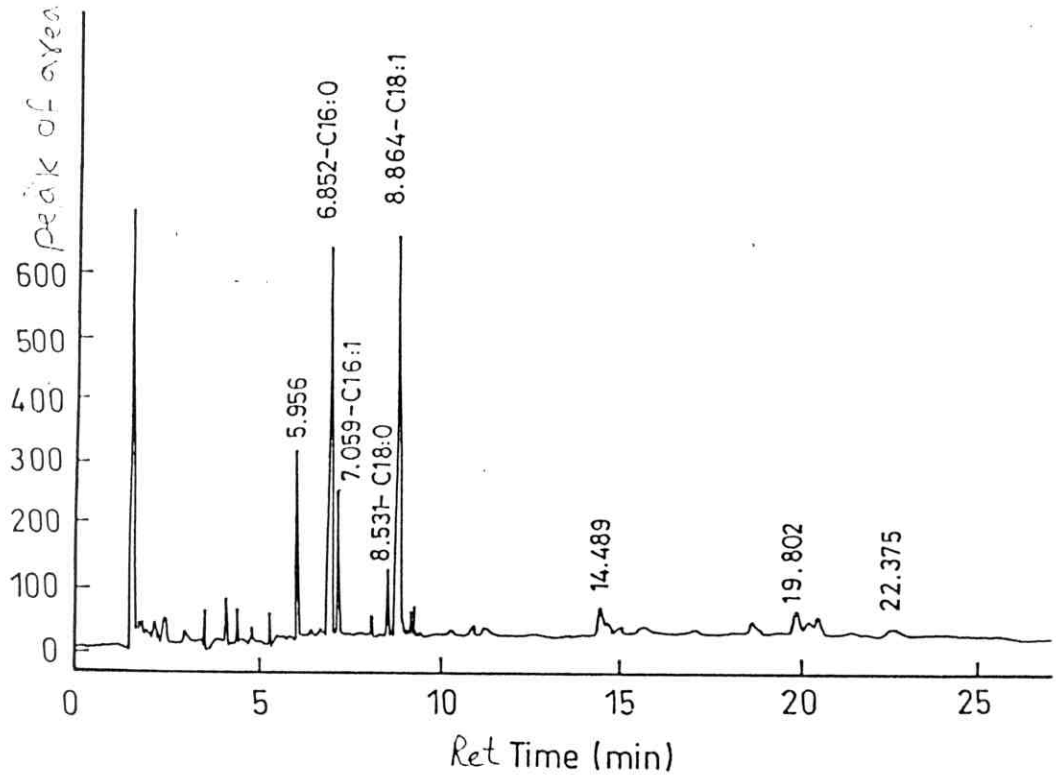

Fig.(6): Effect of 1.. .kGy of gamma irradiation dose on fatty acids composition of olive fruits (olive oil).

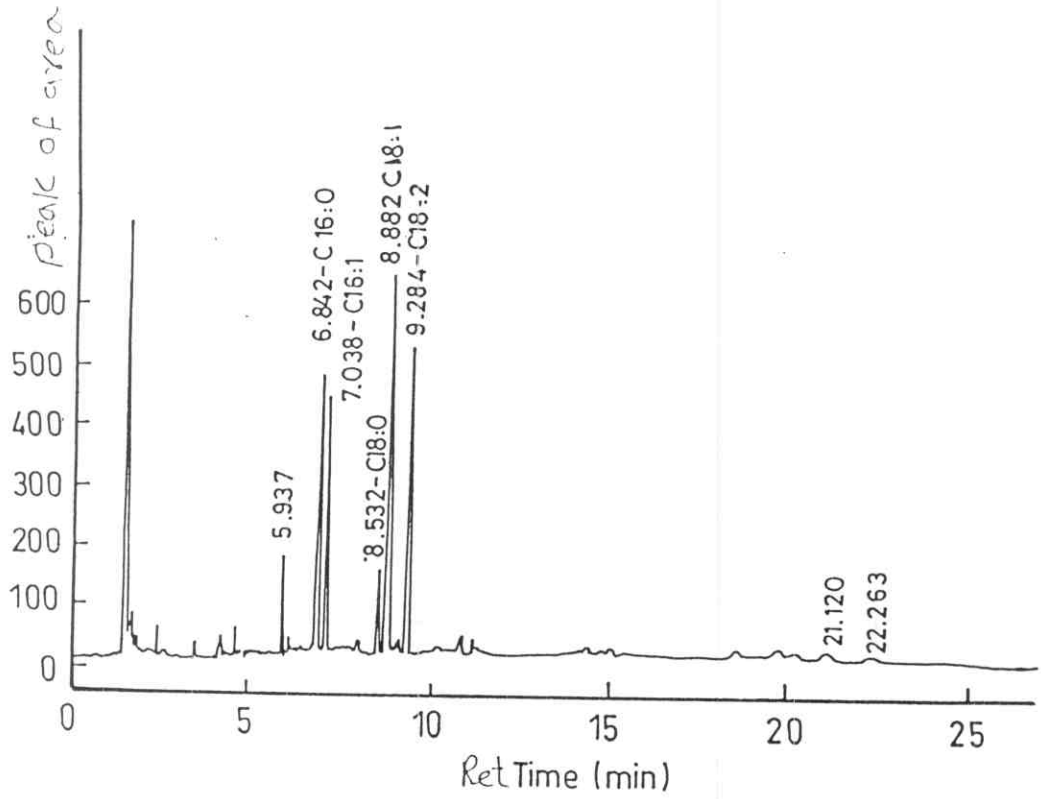

Fig. (7): Effect of 3 kGy of gamma irradiation dose on fatty acids composition of olive fruits (olive oil).

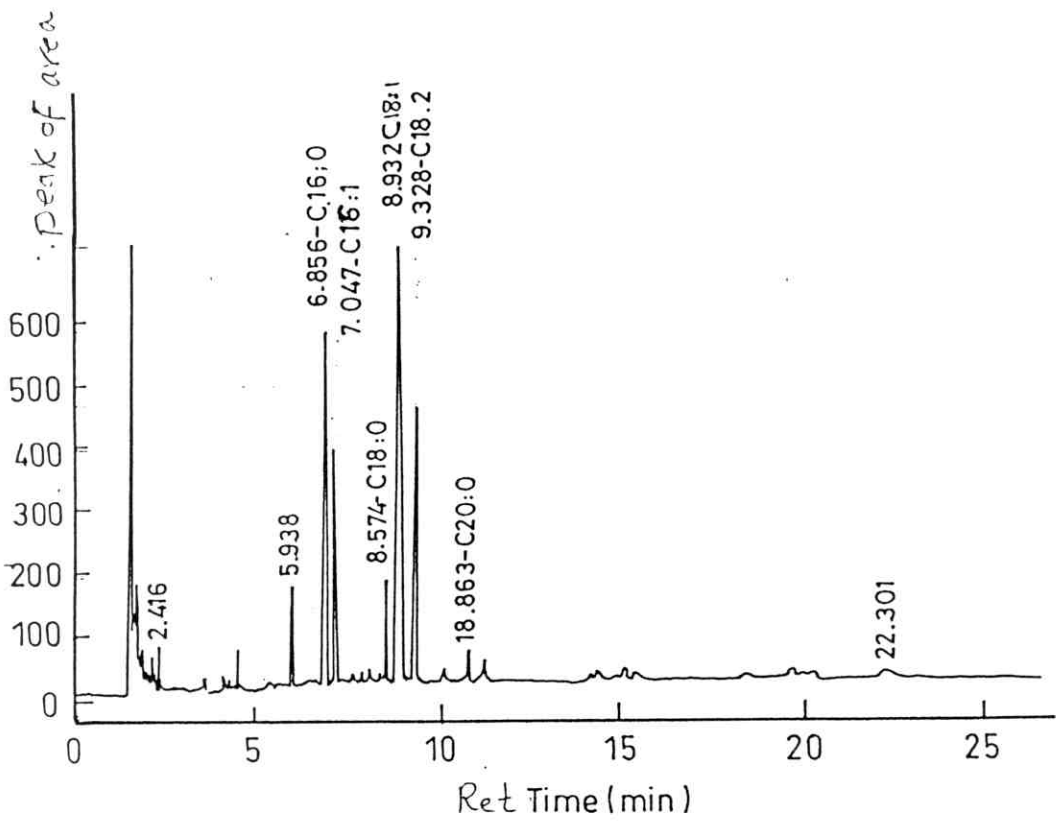

Fig.(8): Effect of 6 min of soaking in boiling water on fatty acids composition of olive fruits.

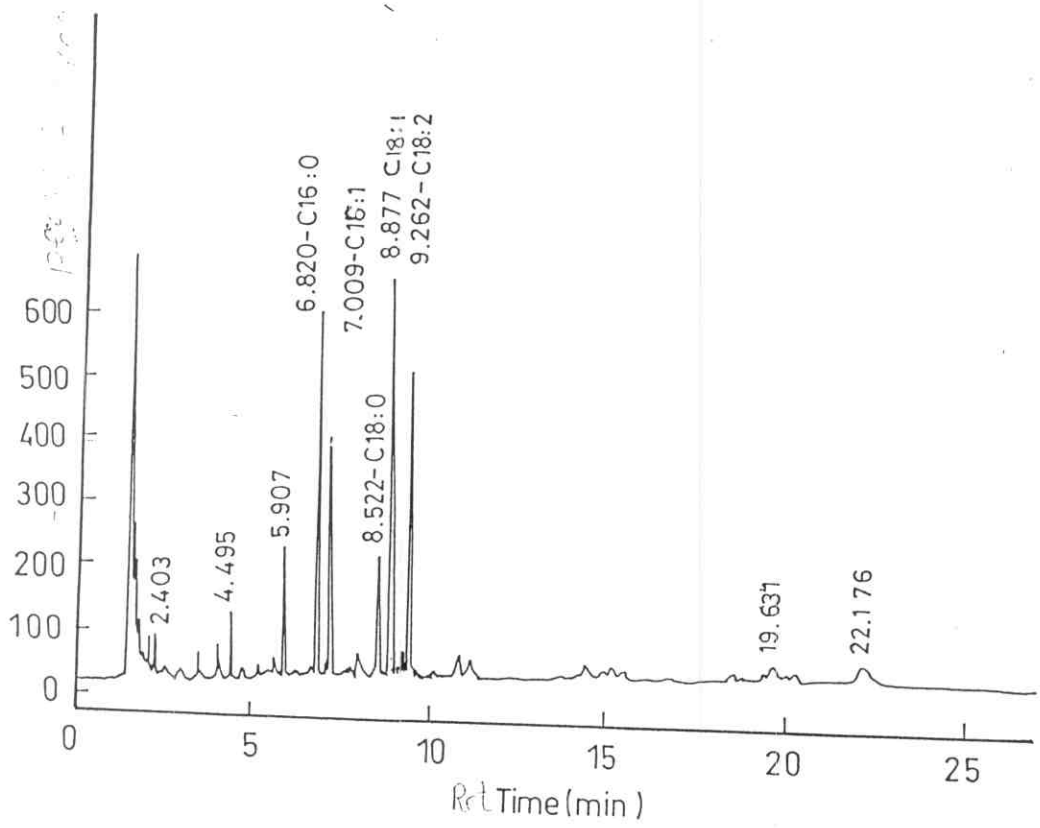

Fig. (9): Effect of 9 min soaking in boiling water on fatty acids composition of olive fruits.

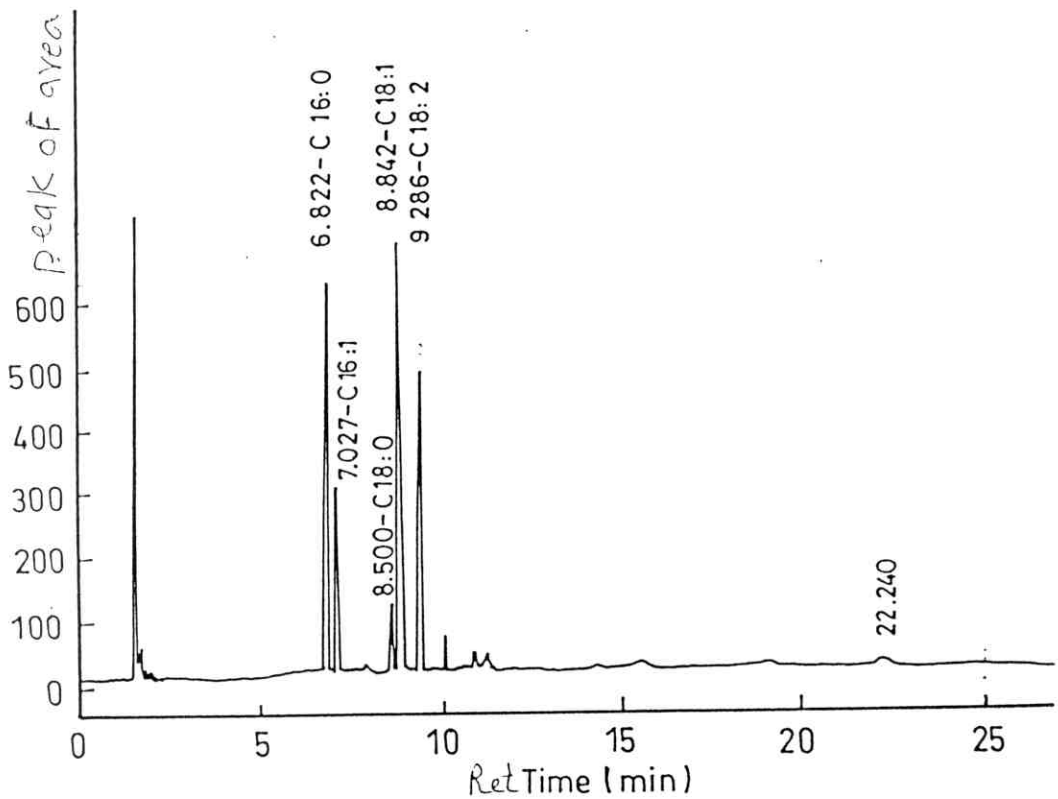

Fig. (10): Effect of 12 min. of soaking boiling water on fatty acids composition of olive fruits.

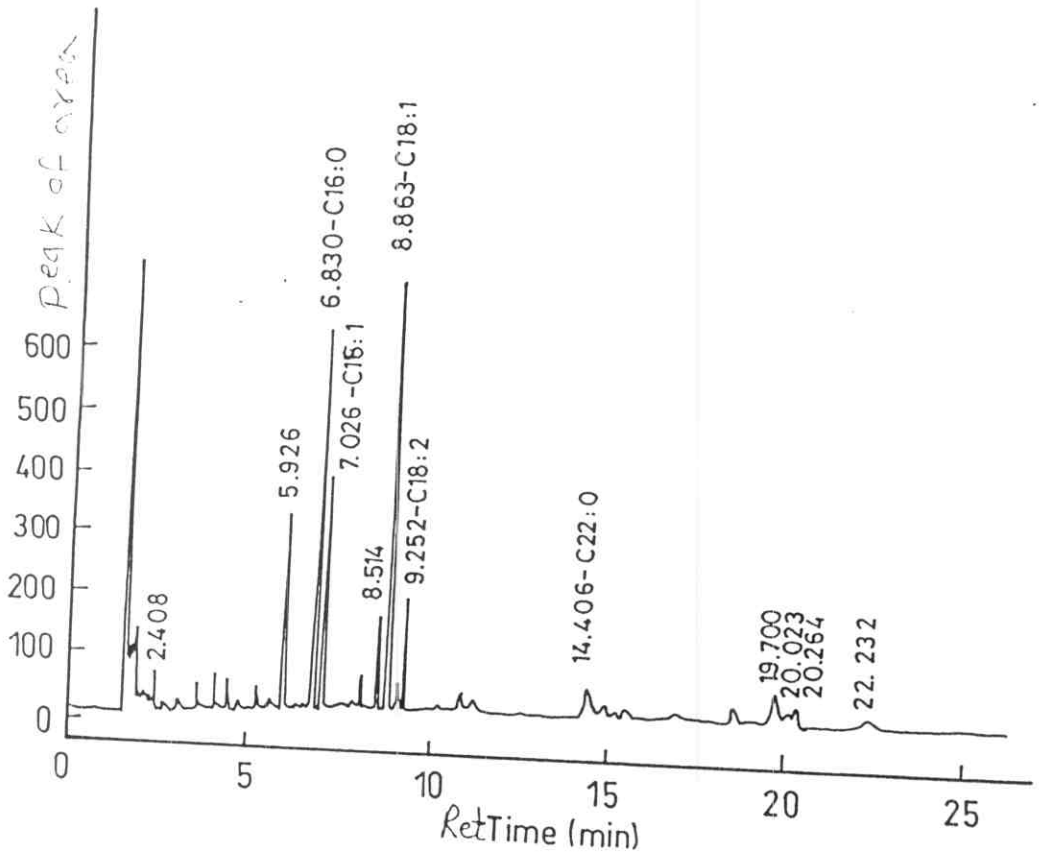

Fig. (11): Effect of 10 min of microwave heating on fatty acids composition of olive fruits.

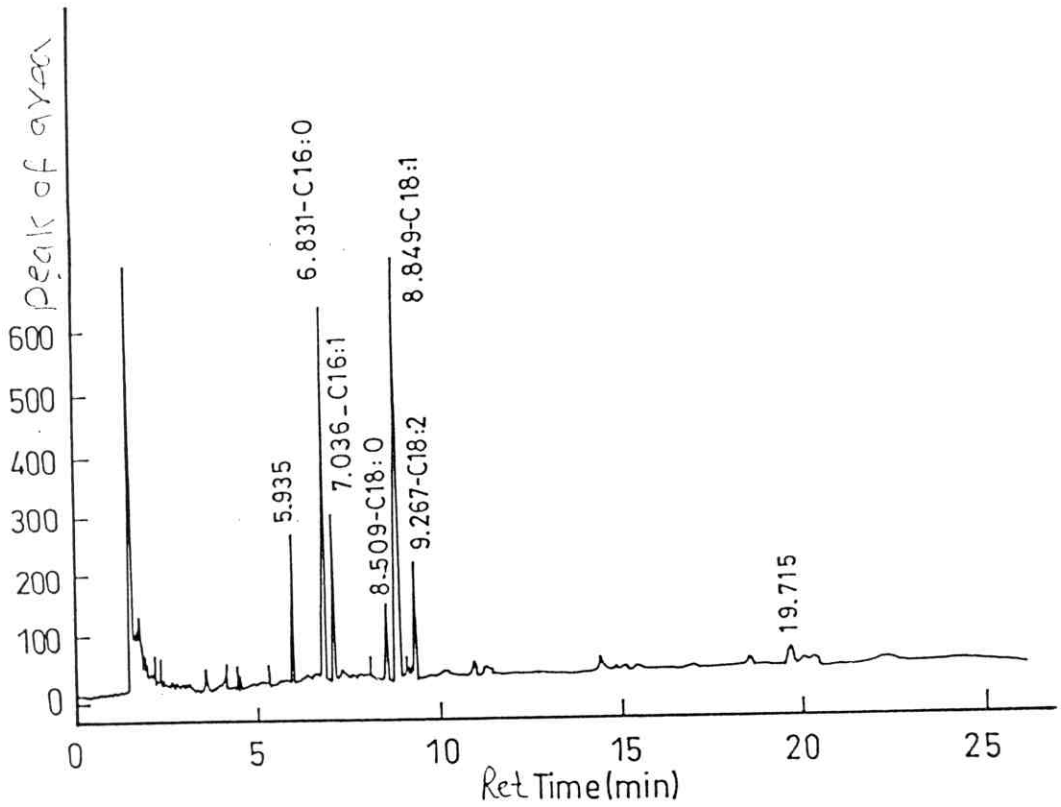

Fig. (12): Effect of 13 min of microwave heating on fatty acids composition of olive fruits.

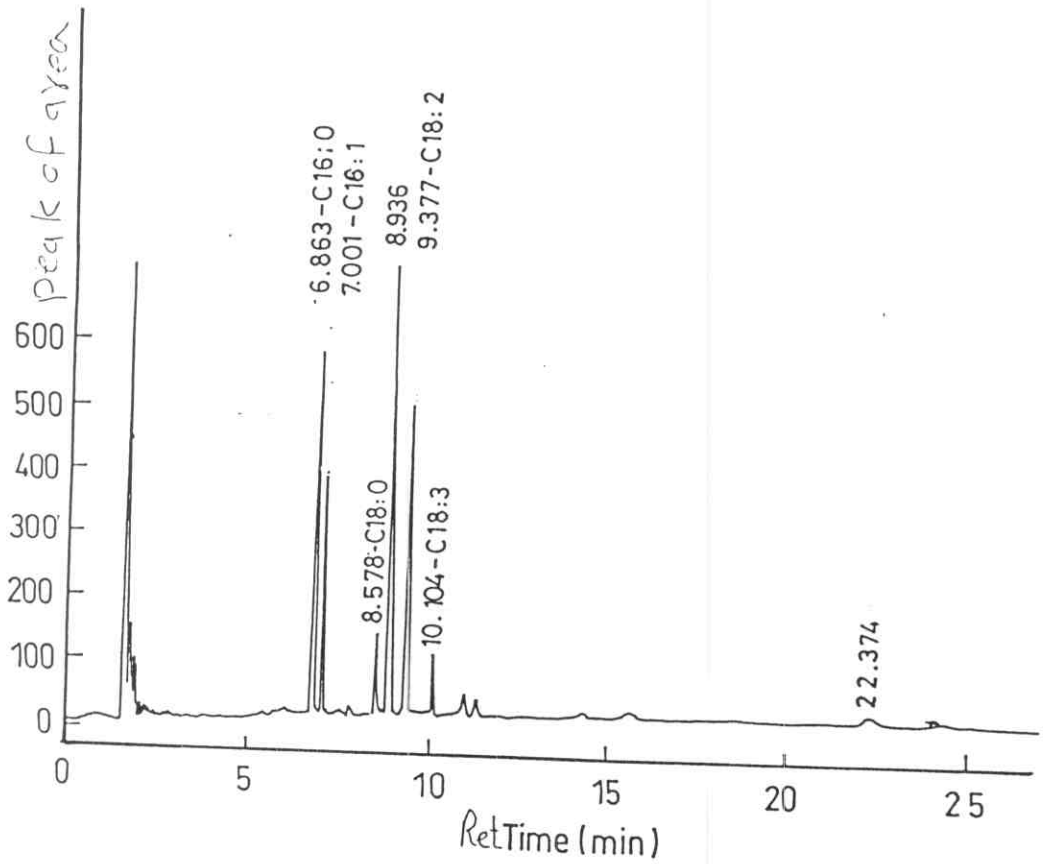

Fig. (13): Effect of 15 min of microwave heating on fatty acids composition of olive fruits.

4-6- Compositional quality and ripening changes of soft cheese containing olive oil.

Gross chemical composition of soft cheese.

The Chemical composition of soft cheese made from fresh mixed (buffaloe's and cow's) milk of 4% fat (as a control) or with 4% olive oil as a fat substitute were manufactured to soft cheese which are presented in the following tables (10-20). In addition two levels of sodium chloride (1% and 2%). Moreover some cheeses samples containing olive oil as fat substitute were exposed to gamma rays at a level of 1.5 and 2.5 kGy. All Cheese treatments were stored either in the refrigerator or at room temperature up to cheese deterioration as detected organoleplically by the growth of moulds and yeasts on cheese surfaces.

4-6-1: Moisture content of cheese

The results obtained in table (10) and illustrated in fig. (14) indicate that the use of 4% olive oil as fat substitute in the fresh soft cheese made by the traditional method from 1% and 2% salted milk, had a relatively higher moisture content (64.82%) as compared with the control sample (63.30%) which was made from mixed milk either with 1% or 2% salt (sodium chloride) and containing 4% fat.

During the storage periods under refrigeration for the cheese of the control and the irradiated and non irradiated cheese samples with 1% and 2% salt, it can be noticed that the moisture content of cheese samples showed a gradual decrease with

increasing storage period . The moisture content of the control cheese reached 58.62% after 18 days where the cheese samples were rejected depending on organoleptic test evaluation. In respect of non irradiated cheese made from salted milk with 1% sodium chloride the moisture content of cheese reached 59.1% after 18 days where the cheese samples were unaccepted organoleplically and were rejected.

Dealing with irradiated cheese at a doses of 1.5 and 2.5 kGy, the moisture content of cheese in the two treatments reached to 50. 13% and 49.0% respectively. At the end of the storage periods of 40 and 45 days which showed long shelf-life due to the preservative action of irradiation with gamma rays which may be due to the destructive effect against bacterial ount of cheese as mentioned by **EL Batawy et al, (1988)**

The moisture content of unirradiated cheese made from salted milk with 2% salt and contains 4% olive oil as fat substitute reached 58.6% at the end of the storage period of (21 days) where was rejected by sensory evaluation due to the unaccepted odor and flavour in addition to the growth of moulds and yeasts on the surface of the cheese samples.

The obtained results in concern of moisture content of soft cheese made from fresh skim milk with 4% olive oil and 1% or 2% salt are in agreement with those found by ***Iodin and Brelin(1959) and Foda et al(1976a,b)*** who stated that cheese made from maize oil homogenized into skimmilk tend to have a higher water content compared with soft cheese made from a mixture of fresh raw Buffaloe's and cow's milk containing 4% milk fat. The obtained results in the present study were

Table (10): The moisture content of irradiated and nonirradiated cheese manufactured by using Olive oil as fat substitute during storage

Storage period (days)	In refrigerator					At room temperature				
	control	Cheese from skimmilk containing 4% olive oil and 1%salt			Cheese from skimmilk containing 4% olive oil and 2%salt	Control	Cheese from skimmilkcontaining 4% olive oil and 1%salt			Cheese from skimmilk containing 4% olive oil and 2%salt
		Irradiation dose (kGy					Irradiation dose (kGy			
		0	1.5	2.5			0	1.5	2.5	
Fresh	63.30	64.82	64.84	64.84	64.30	63.30	64.82	64.84	64.84	64.30
3	62.10	63.21	63.00	63.99	63.20	61.51	62.30	62.70	62.51	64.10
6	61.00	62.80	62.70	63.07	61.80	59.92	60.10	59.81	60.00	62.90
9	59.30	61.00	62.31	62.23	59.10	57.65R	58.82R	56.90	57.29	60.20
12	59.00	60.31	61.72	61.82	58.70			53.42	55.00	57.2R
15	58.79	59.70	60.51	60.70	58.70			51R	52.99	
18	58.62R	59.1R	59.87	60.21	58.66				50R	
21			57.10	59.10	58.30R					
24			56.00	57.50						
27			55.80	56.30						
30			53.30	54.99						
33			51.10	53.00						
36			50.89	52.70						
40			50.13R	51.00						
45				48.12R						

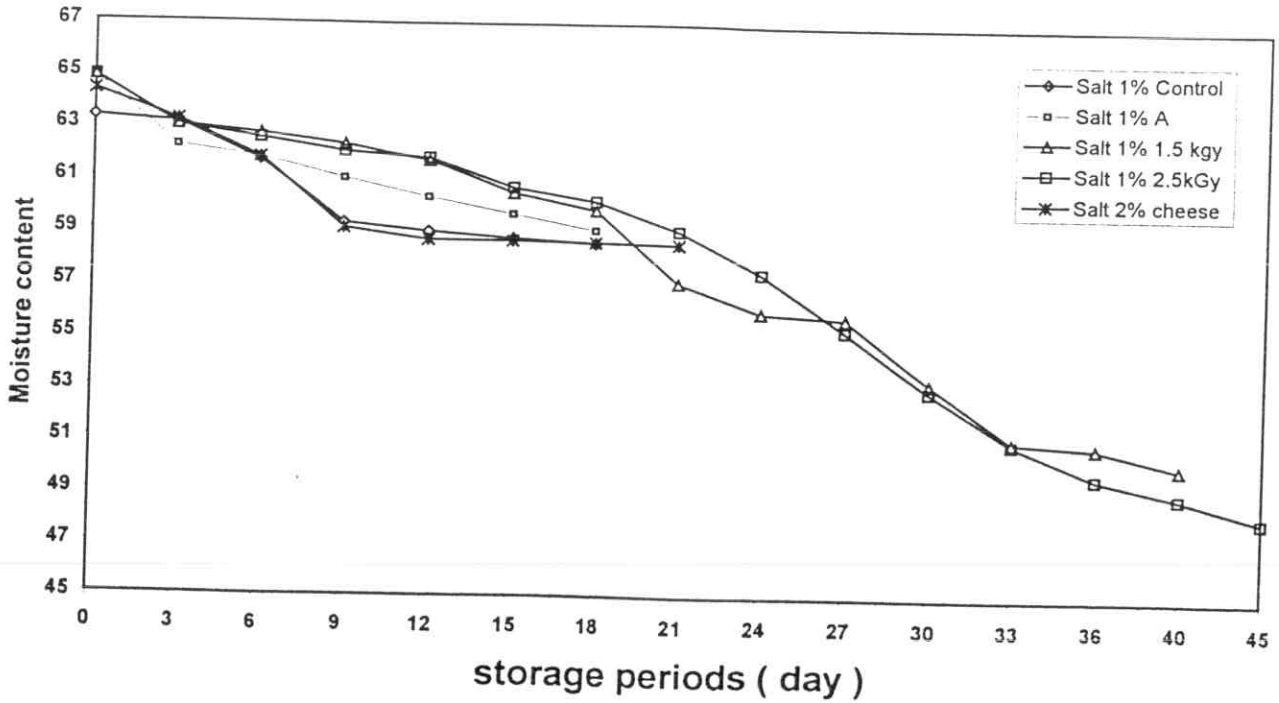

Fig. (14) Influence of different treatments and refrigerated storage on Moisture content of soft cheese manufactured by using olive oil as fat substitute

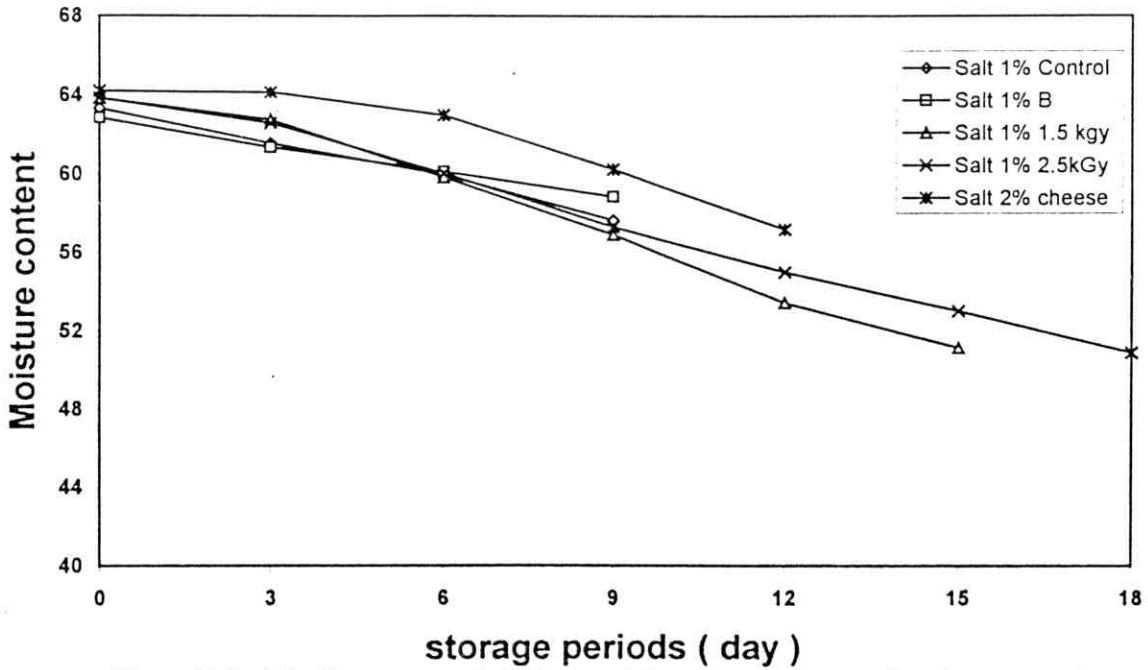

Fig. (15) Influence of different treatments and storage at room temperature on Moisture content of soft cheese manufactured by using olive oil as fat substitute

4-6-2-Titratable acidity (T.A).

Table (11) and Figs. (16&17) illustrate the acidity of soft cheeses from different treatment undertaken.

As presented in Table (11) and Fig (16 & 17) it could be noticed that the titratable acidity values were nearly the same in fresh soft cheeses in the control which contains 4% milk fat or in the different treatments, where olive oil of 4% was the replace of milk fat. The T. A. in the fresh control cheese and those in other treatments ranged from 0.37 – 0.38% .The obtained results are in agreement with ***Foda et al., (1976a)*** who used corn oil in soft cheese making and ***Badawy and kebary (1998)*** who studied the influence of fat replaces on the quality of low fat Tallage cheese and ***Ibrahim et al., (2000)*** on Domiati cheese.

A gradual increase in acidity was noticed during the storage period of soft cheese either in the control or those in other treatments stored in refrigerator or at room temperature where irradiated with different doses (1.5 and 2.5 kGy) or non irradiated cheese which contains 1% salt. The increase of total acidity of cheese differs from one treatment to another.

In regard to cheese of the control and the cheese made from mixed milk containing 1% salt and 4% olive oil as a fat substitute, the T. A reached 0.75% and 0.74% respectively after 18 days. It can be observed that the replacement of milk fat by olive oil did not affect the development of acidity in the cheeses. Similar results were reported by ***EL – Shibiny et al (1983) and Salem and A beid (1996)***

Concerning the effect of irradiation on the T. A. of soft cheese made from salted milk with 1% salt and containing 4% olive oil as fat substitute, it can be noticed that the acidity increased and reaching 1.25% and 1.30% at the end of the storage periods .The storage periods extended to 40 and 45 days for the first and the second doses of irradiation respectively. Also, it can be observed that slight differences in the rates of development of T. A. between the different two doses of irradiation for cheese stored under refrigeration which had an inhibitory effect against different microbial growth particularly moulds and yeasts and consequently led to prolong the shelf- life of cheese. In addition, the preservative action of irradiation which due to the destructive effect on the cheese microorganisms combined with refrigeration storage improving the keeping quality of irradiated cheese and extended its shelf-life, (40-45 days)although it contains low salt content (1 %).

Regarding the non irradiated cheese contained the same level of olive oil as fat substitute and made from milk with 2% salt and also stored in the refrigerator the rate of acid development differs than the irradiated cheese. The rate of acid development in this cheese was rapid giving 0.75% of control cheese, 0.74, 0.66, in the non irradiated cheese made from skim salted milk with 1% or 2% containing 4% olive oil and 0.60%, 0.53% for irradiated cheese with 1.5 and 2.5 kGy in the same order after 18 days of cold storage.

The obtained results are is accordance with ***Dawood (1964)*** and ***Foda et al (1976 a&b)*** who stated that the low

temperature retarted the growth and activity of acid producing organisms.

In concern of the effect of gamma irradiation on T.A of cheese, similar results were recorded by ***EL – Batawy et al (1988)*** who noticed a destructive effect against total bacterial count was induced as a result of exposing cheese to gamma rays which effect on the acid development of kariesh cheese during storage.

Results in Table (11) clears that the TA of cheese increased in higher rate reaching to 1.1% in nonirradiated cheese (1% salt) after 9 days of storage at room temperature, while that of 2%salt reached 1% after the same time of storage then increased to 1.5% after 12 days of storage at the same condition.

It is obvious from the presented data in Table(11) that irradiation has a noticeable effect on acid development of cheese containing 4% olive oil as fat substitute where it reached 1.8% and 1.75 % for cheese stored at room temperature compared with 0.55 and 0.49% for cheese stored at refrigerator after the same storage period of 15 days. The obtained results are in agreement with the results of ***EL – Batawy et al (1988)*** who recorded that inspite of irradiation; storing at room temperature led to activate the growth of moulds and yeasts and consequently rapid deterioration was occurred for cheese. The behavior of the T.A values of irradiated or non – irritated soft cheese as fresh or during storage are similar to the results of ***Ibrahim (1984)*** on Domiati cheese .

Table (11): The acidity content of irradiated and nonirradiated cheese manufactured by using Olive oil as fat substitute during storage

Storage period (days)	In refrigerator					At room temperature				
	control	Cheese from skimmilk containing 4% olive oil and 1%salt			Cheese from skimmilk containing 4% olive oil and 2%salt	Control	Cheese from skimmilk containing 4% olive oil and 1%salt			Cheese from skimmilk containing 4% olive oil and 2%salt
		Irradiation dose (kGy(					Irradiation dose (kGy(			
		0	1.5	2.5			0	1.5	2.5	
Fresh	0.38	0.37	0.37	0.38	0.37	0.38	0.37	0.37	0.38	0.37
3	0.38	0.38	0.37	0.38	0.38	0.50	0.52	0.45	0.42	0.49
6	0.46	0.43	0.42	0.40	0.42	0.87	0.76	0.70	0.68	0.75
9	0.50	0.49	0.46	0.45	0.48	1.02	1.10	0.88	0.85	1.00
12	0.55	0.55	0.49	0.46	0.53			1.38	1.30	1.50
15	0.63	0.64	0.55	0.49	0.60			1.80R	1.75	
18	0.75	0.74	0.60	0.53	0.66				1.90	
21			0.66	0.64	0.81					
24			0.73	0.70						
27			0.80	0.77						
30			0.88	0.83						
33			1.00	0.91						
36			1.12	1.01						
40			1.25R	1.14						
45				1.30						

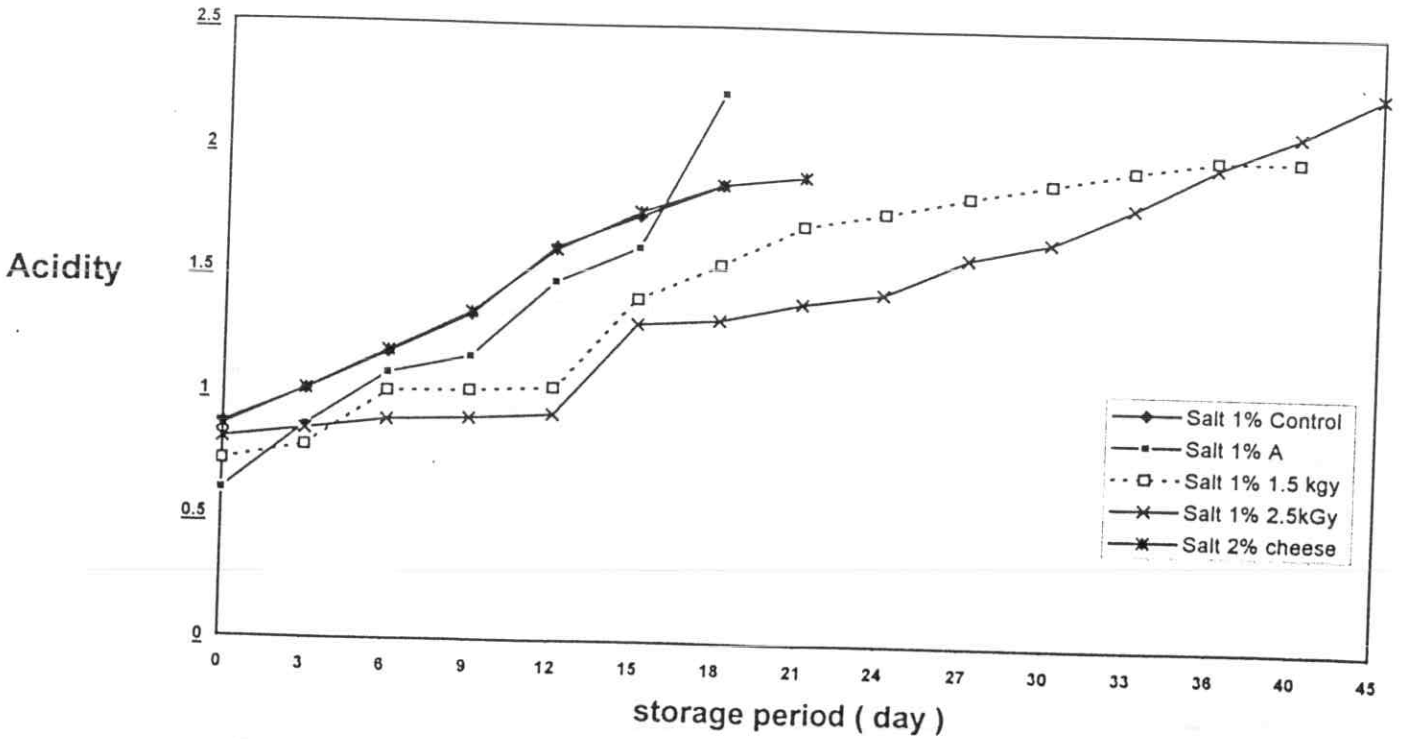

Fig (16) Effect of different teatments and refrigerated storage on the acidity of soft cheese manufactured by using olive oil as fat substitute .

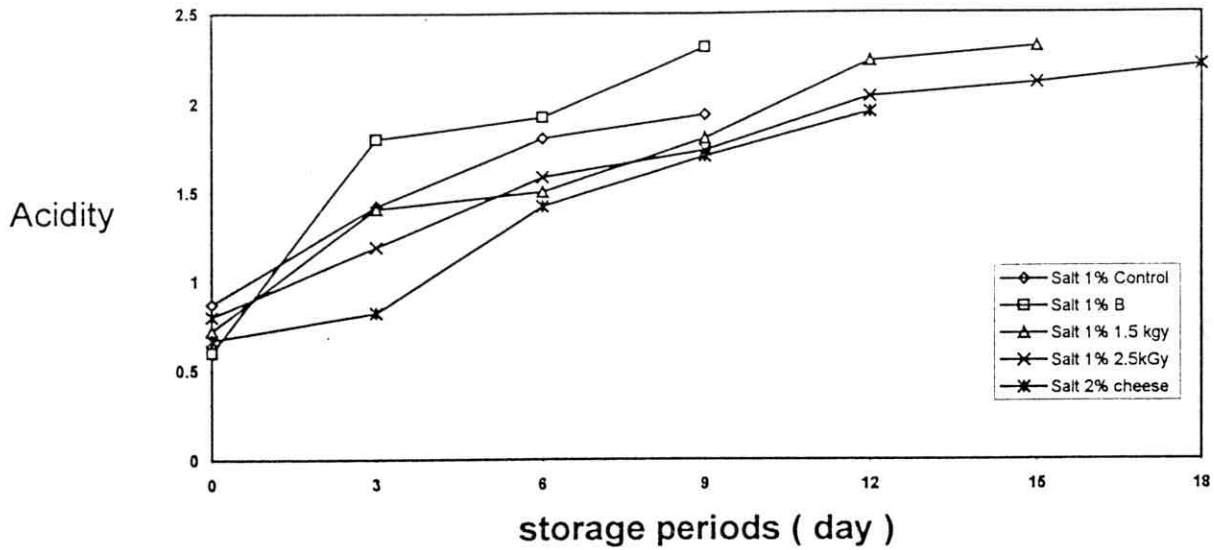

Fig (17) Effect of different teatments and storage at room temperature on the acidity of soft cheese manufactured by using olive oil as fat substitute .

4-6-3- The pH value:-

Table (12) and figs (18 &19) illustrate the pH values of soft cheese form different treatments. It is obvious that the pH values of the fresh cheese showed the same values ranging between pH 6.0 and 6.06.

The pH value of the control cheese decreased gradually and reached 5.2 after 18 days of cold storage. The same trend of pH values of cheese containing olive oil as fat substitute was noticed.

Regarding irradiated cheese the decrease of the pH values differs compared to the nonirradiated one reaching 4.5 and 4.46 after storing for 40 and 45 day for the two irradiation doses respectively.

Concerning cheese of 2% salt which stored in the refrigerator, the pH value of this treatment reached 5.17 after 21 day at cold storage. The obtained results agreed with the results of ***Badawi and Kebary (1998)*** on low fat Tallage cheese, ***Salem and Abeide(1996)*** for low sodium and cholesterol Domiati cheese. The same trend was mentioned by ***EL – Batawy et al(1988)*** on irradiated kareish cheese where they found that a slight effect on pH values in different treatments during storage period where the refrigerator temperature slightly decreased the pH value .

Dealing with cheese stored at room temp. it can be observed that the lowest pH value was noticed in the nonirradiated cheese stored at room temp. after 12 days which led to activate the growth of moulds and yeasts that induced

rapid deterioration of cheese. Therefore it can be concluded that the combined effect of gamma irradiation and cold storage had a remarkable effect on the keeping quality of soft cheese. This effect may by due to the inhibitory action against different microbial growth particularly moulds and yeasts and consequently led to prolong the shelf life of soft cheese.

The same findings were metioned by ***EL – Batawy et al (1988)*** on kareish cheese and ***Ibrahim (1984)*** on Domiati cheese.

Table (12): The pH content of irradiated and nonirradiated cheese manufactured by using Olive oil as fat substitute during storage

Storage period (days)	In refrigerator					At room temperature				
	Control	Cheese from skimmilk containing 4% olive oil and 1%salt			Cheese from skimmilk containing 4% olive oil and 2%salt	Control	Cheese from skimmilk containing 4% olive oil and 1%salt			Cheese from skimmilk containing 4% olive oil and 2%salt
		Irradiation dose (kGy)					Irradiation dose (kGy)			
		0	1.5	2.5			0	1.5	2.5	
Fresh	6.06	6.02	6.01	6.01	6.00	6.01	6.00	6.00	6.01	6.01
3	6.00	5.90	6.01	6.00	6.00	5.60	5.74	5.74	6.00	5.65
6	6.74	5.79	5.82	4.84	5.90	5.18	5.25	5.22	5.30	5.18
9	5.63	5.63	5.74	5.74	5.66	4.94	4.95	5.15	5.16	4.45
12	5.60	5.55	5.64	5.74	5.61			4.46	4.46	4.40
15	5.30	5.30	5.60	5.64	5.84			4.15	4.13	
18	5.20	5.18	5.48	5.61	5.25					
21			5.25	5.25	5.17					
24			5.20	5.22						
27			5.17	5.18						
30			5.15	5.16						
33			5.00	5.10						
36			5.94	5.00						
40			4.50	4.94						
45				4.46						

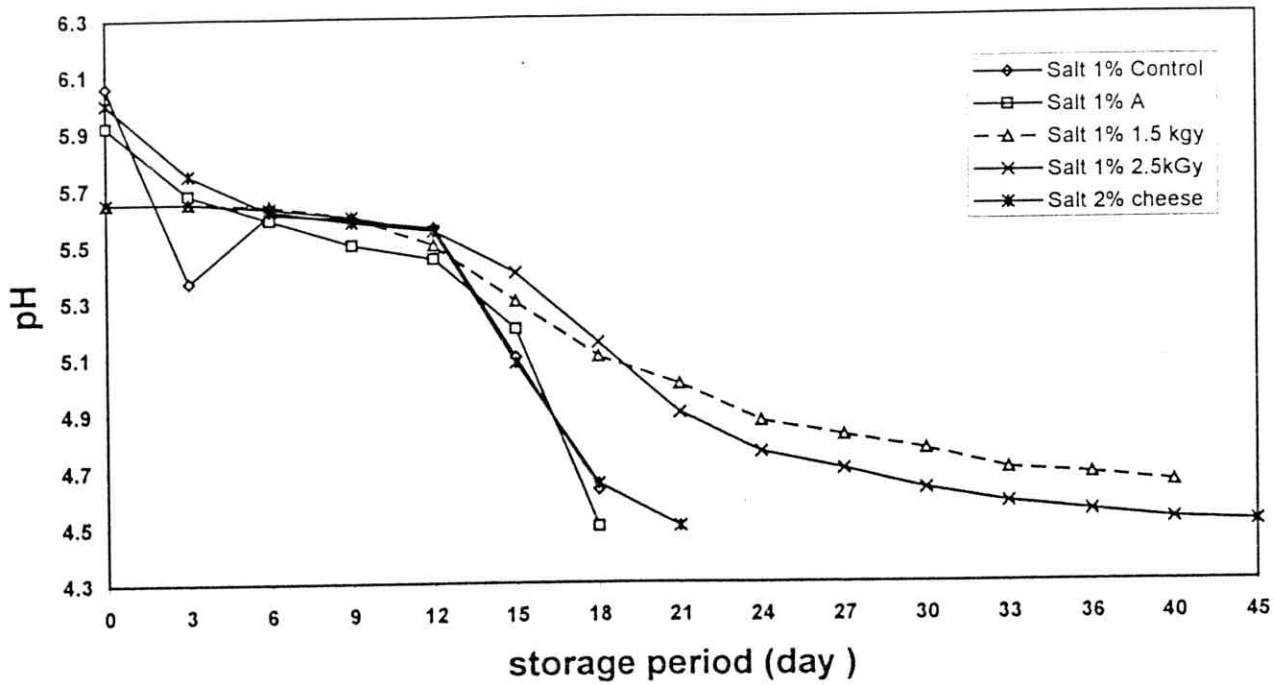

Fig. (18) Influence of different treatments and refrigerated storage on pH value of soft cheese manufactured by using olive oil as fat substitute

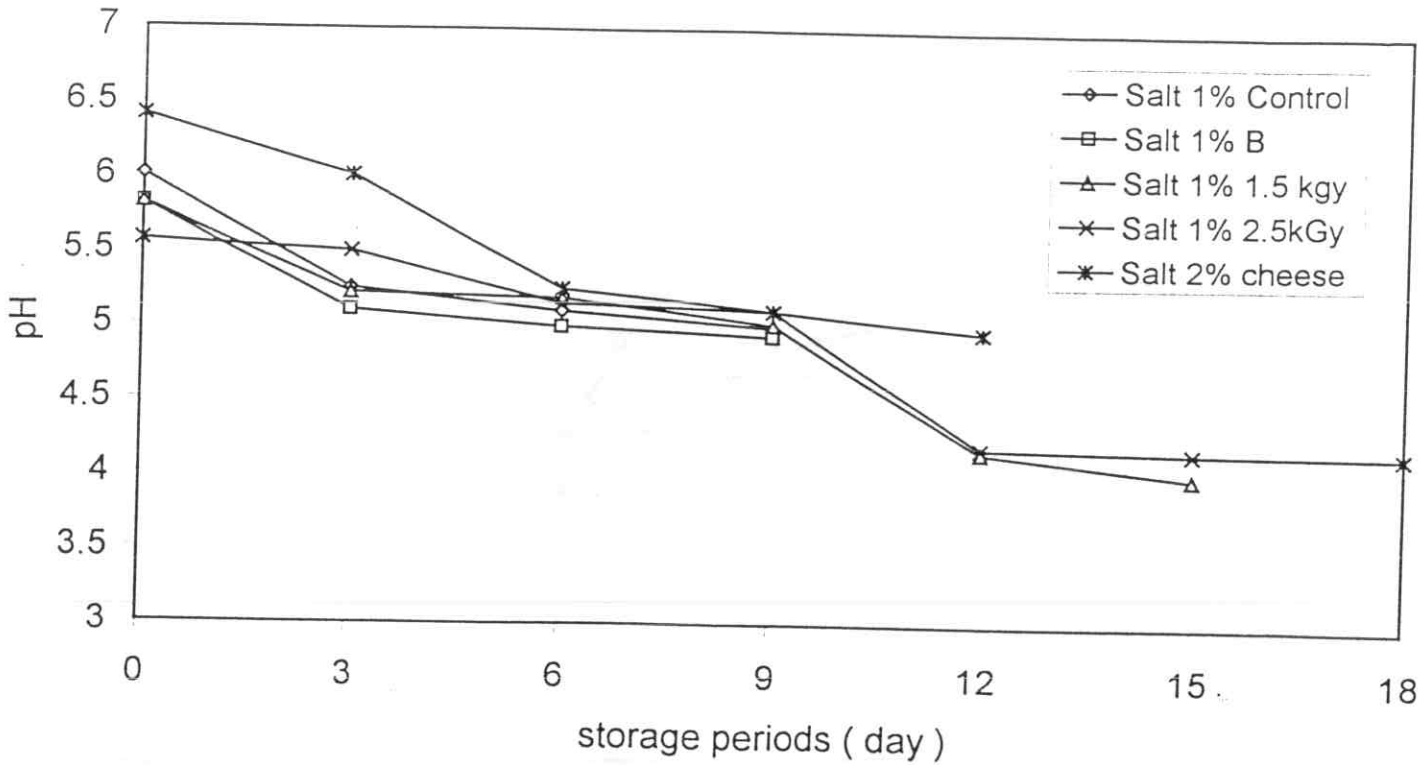

Fig (19) : Effect of different treatments and storage at room temprature on the PH value of soft cheese manufactured by using olive oil as a fat substitute .

4-6-4- Fat content of irradiated and non irradiated soft cheese stored under different conditions:

Effect of gamma irradiation and storage on fat contents of soft cheese are presented in table (13) and Fig (20).

The fat content in the fresh control cheese and those in other treatments were 18%.

A gradual increase in fat content was noticed with increasing storage period of soft cheese either in the control or other treatments stored in refrigerator or at room temperature.

The increase of fat content of cheese differs from one treatment to another and also there was a direct relationship between the fat content and total solid in all treatments when fresh and during storage.

The fat content of the control and cheese made from mixed milk containing 1% salt and 4% olive oil as fat substitute increased gradually reaching 20% and 19.5% after 18 days of cold storage respectively.

For irradiated cheese the increase of the fat content differs compared with non irradiated one reaching 23.3 and 22.8 after storing for 40 and 45 days for the two irradiation doses respectively.

Regarding cheese of 2% salt which stored in the refrigerator, the fat content of this treatment reached 19.80% after 21 days of cold storage. Similar results were stated by ***EL-Shibiny et al (1983), Badawi and Kebary (1998) and Salem and Abeid (1996).*** They found that the gradual increase of fat during

ripening could be attributed to the decrease in moisture and solids of non fat contents due to partial degradation of protein and fermentation of lactose.

The same Table indicates the changes in fat content of control cheese and of the other treatments stored at room temperature. The same phenomena was noticed for the control and different cheese treatments stored in refrigerator as fresh (zero time) and during storage. The only difference is noticed in the storage periods where irradiated samples had an extended shelf- life to 15 and 18 days for samples stored at room temperature compared with 40 and 45 days for those stored in refrigerator upon irradiated with 1.5 and 2.5 kGy respectively, against only 9 and 18 days of shelf life to cheese samples stored at room temperature and refrigerator for control respectivly. On the other hand samples made from salted milk by 1% and 2% salt where olive oil was used as fat substitute and stored at room temperature were unaccepted after 9 and 12 days compared with 18 and 21 days for cheese samples under cold storage.

The obtained results are in accordance with ***Foda et al (1976 a&b).***

The differences in fat content and (F/DM) in the fresh soft. cheese samples containing milk fat or olive oil either irradiated or not stored at refrigerator or at room temperature may be attributed to the degree of retention of fat in the prepared curd as well as the amount of whey exuded during the manufacturing process and the storage period of the obtained cheese from different treatments.

Similar trends for the obtained results were mentioned by ***Hefnawy et al (1992)and Foda et al (1976) .***

Table (13): The fat content of irradiated and nonirradiated cheese manufactured by using Olive oil as fat substitute during storage

Storage period (days)	In refrigerator										At room temperature									
	Control		Cheese from skimmilk containing 4% olive oil and 1%salt						Cheese from skimmilk containing 4% olive oil and 2%salt		Control		Cheese from skimmilk containing 4% olive oil and 1%salt				Cheese from skimmilk containing 4% olive oil and 2%salt	
			Irradiation dose (kGy)										Irradiation dose (kGy)					
			0		1.5		2.5						0		1.5		2.5			
	%	D.M	%	D.M	%	D.M	%	D.M	%	D.M	%	D.M	%	D.M	%	D.M	%	D.M	%	D.M
Fresh	18	49	18	51.16	18	51.16	18	51.16	18	50.42	18	49.04	18	51.16	18	51.16	18	51.16	18	50.42
3	18	47.49	18.2	49.46	18.1	50.51	18.1	50.26	18.1	49.18	18.3	47.54	18.3	48.54	18	48.25	18	48.01	18	50.13
6	18.5	47.43	18.5	49.73	18.5	49.59	18.4	49.83	18.7	48.95	18.5	46.15	18.5	46.36	18.5	46.03	18.5	46.25	18.1	48.78
9	19.2	47.17	19	48.71	18.8	49.88	18.8	49.77	19.5	47.67	19	44.86	19	46.13	18.8	43.61	19	44.49	18.5	46.48
12	19.2	46.82	19.0	47.99	19	49.63	19	49.76	19.6	47.45					20.1	43.15	20	44.44	19	44.39
15	19.6	46.55	19.3	47.89	19.2	48.61	19	48.34	19.6	47.45					21.1	43.06	20	42.55		
18	20	46.33	19.5	47.6	19.3	48.09	19	47.75	19.6	47.41							21	42		
21					19.7	45.92	19.3	47.18	19.80	47.26										
24					20.2	45.90	19.4	45.64												
27					20.2	45.70	20.2	45.19												
30					21.1	45.18	21	44.67												
33					22	44.98	21.8	44.48												
36					22	44.79	22.3	44.33												
40					22.3	44.71	2.5	44.11												
45							22.8	43.94												

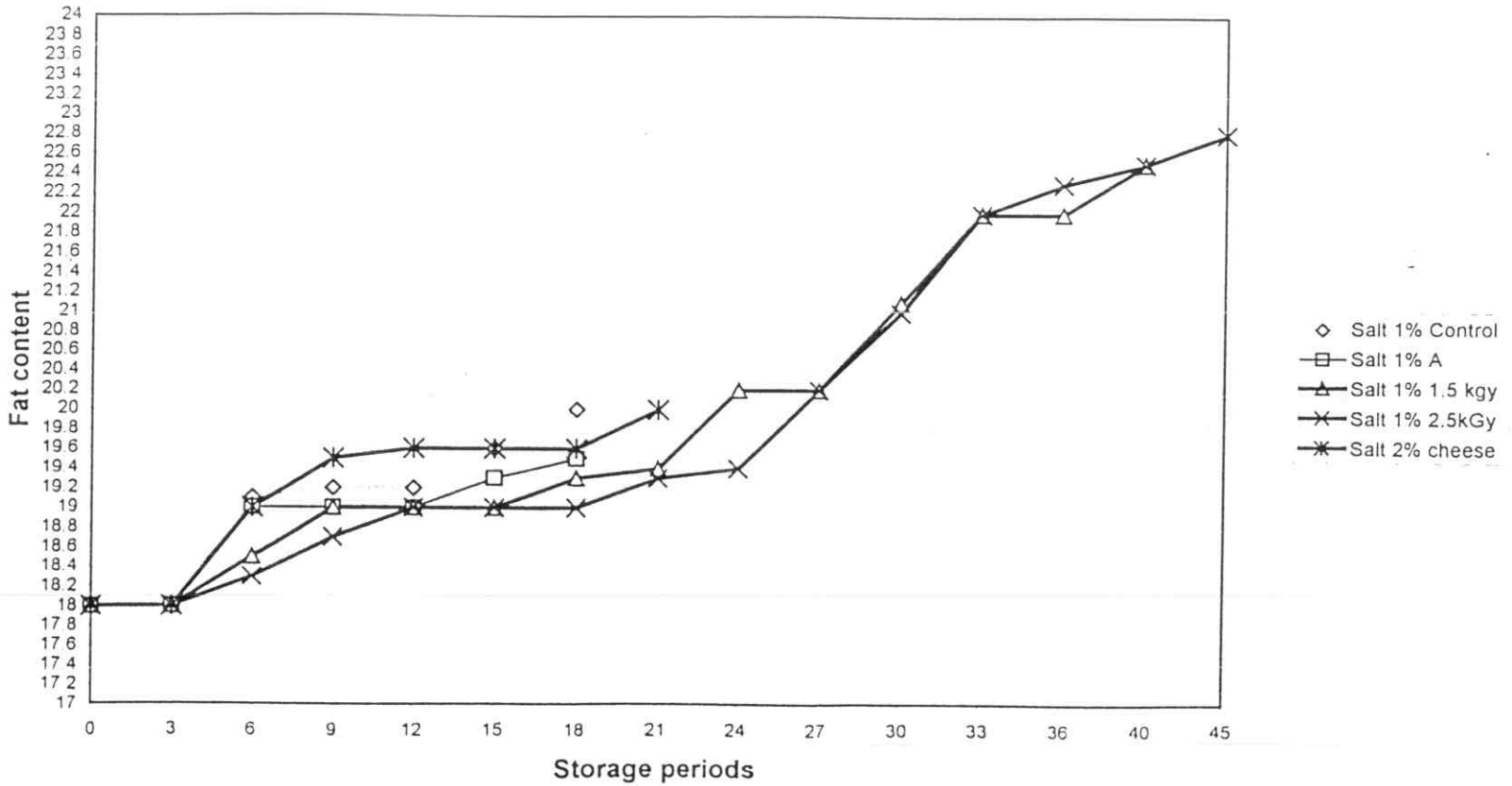

Fig (20) The fat content of irradiated and nonirradiated cheese manufactured by using olive oil as fat substitute during storage in refrigerator .

4-6-5- Ash content:-

Changes in ash content of soft cheese made from mixed milk (control) or from homogenized skim milk containing 4% olive oil and 1% and 2% salt are shown in Table (14)and Fig.(21)

Data presented in Table (14) indicate that ash content of soft cheese were 4.44, 4.48 ,4.48 and 4.49% for cheese made from salted milk (1%salt) and using olive oil as fat substitute, irradiated samples (1.5 and 2.5 kGy) and soft cheese made from salted milk (2% salt) and using olive oil as fat substitute samples respectively, while it was 4.51% for control sample. Generally, there was a decrease in ash content of cheese made from homogenized skim milk with 4% olive oil as fat substitute, as compared with the control sample. This decrease is probably due to the increase in moisture content of these samples. In this respect, ***Salem and Abeid (1996)*** found that the decrease in cheese ash content was accompanied with increasing percent of fat substitution.

During storage, the ash contents of control cheese and other treatments progressively increased as the time of storage increased. This was probably due to the progress decrease in moisture content of all samples during storage in refrigerator.

The above mentioned results are similar to those obtained by ***Badawi and Kebary (1998)*** who found that replacement of milk fat by fat replacers significantly increased ($P \leq 0.05$) the ash content of low fat Tallaga cheese.

It might be observed from Table (15) that the behavior of the ash contents of control and other treatments samples stored at room temperature were similar to those of samples stored in refrigerator at zero time and during storage periods.

Table (14): the Ash content of irradiated and nonirradiated cheese manufactured By using Olive oil as fat substitute during storage in refrigerator

Storage period (days)	Treatments				
	Control	Cheese from skimmilk containing 4% olive oil and 1%salt			Cheese from skimmilk containing 4% olive oil and 2%salt
		Irradiation dose(kGy)			
		0	1.5	2.5	
Fresh	4.51	4.44	4.48	4.48	4.49
6	4.60	4.6	4.58	4.53	4.58
12	4.75	4.72	4.71	4.58	4.67
18	4.91 R	4.83 R	4.87	4.63	4.76
21	-	-	4.87	4.66	4.76 R
27	-	-	5.33	5.31	-
30			5.55	5.46	
35			5.64	5.55	
40	-	-	5.85 R	5.73	-
45	-	-	-	5.88 R	-

® = Unacceptable organoleptically and Rejected.

Table (15) The ash content of irradiated and nonirradiated cheese manufactured by using Olive oil as fat substitute during storage at room temperature

Storage period (days)	Treatments				
	control	Cheese from skimmilk containing 4% olive oil and 1%salt			Cheese from skimmilk containing 4% olive oil and 2%salt
		Irradiation (kGy)			
		0	1.5	2.5	
0	4.51	4.46	4.48	4.48	4.49
6	4.75	4.60	4.62	4.61	4.6
9	4.88 R	4.75 R	4.78	4.76	4.78
12	-	-	5.41	5.30	5.33 R
15	-	-	5.70 R	5.65	-
18	-	-	-	5.80 R	-

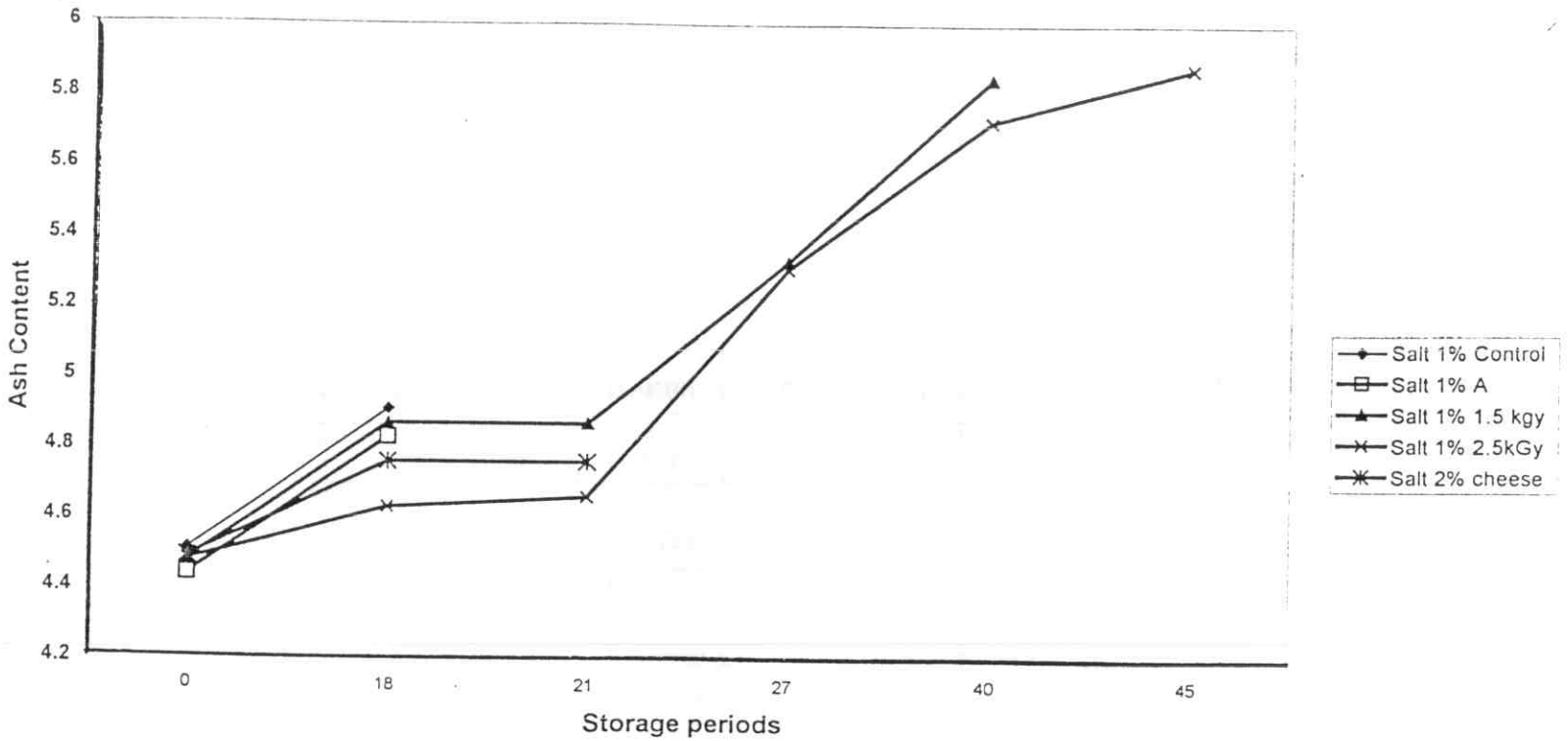

Fig (21) The ash content of irradiated and nonirradiated cheese manufactured by using olive oil as fat substitute during storage in refrigerator .

4-6-6-Total volatile fatty acids (TVFA):-

Changes in total volatile fatty acids of soft cheese made from mixed raw milk of 4% milk fat (control) or from homogenized skim milk where milk fat was replaced by 4% olive oil are shown in Table (16).

These data presented in Table (16) indicate that TVFA of fresh soft cheese were 7.2, 6.9, 7.0 ,6.9 and 7 equivalent to NaoH 0.1 N / 100g of control cheese made from salted milk with 1% and these containing olive oil as fat substitute, irradiated samples (1.5 and 2-5 kGy) with the same level of salt and cheese made from salted milk with 2% respectively. The control cheese shows slight higher content of TVFA compared with cheeses containing olive oil as fat milk substitute. Generally the TVFA of nonirradiated cheeses seems to be unaffected with the replacement of milk fat with olive oil which is in agreement of ***EL- Shibiny et al (1983).*** It can attribute the little decline of TVFA of cheese containing olive oil to the lower short chain fatty acids content of olive oil compared with milk fat .

These results are in agreement with those reported by ***Hefny (1975), Foda et al (1976 a&b), and Salem and Abeid (1996)*** where they found that the TVFA in control cheese was higher than cheese made using vegetable oil.

During storage, the TVFA of control and other treatments progressively increased reaching 20, 19.6 and 20.21 mL 0.1 NaOH/100g cheese after 18 day at cold storage for unirradiated cheese.

Dealing with the irradiated cheeses, the TVFA content of treated cheeses indicate different trend where the rate of increase of these components was slower within the first 3 weeks then gradually increased showing values of TVFA 28 and 40 for irradiated cheese with 1.5 kGy and 2.5 kGy after 40 and 45 days of storage at refrigerator. The same trend was mentioned by ***EL- Shibiny et al (1983) and Badawi and Kebary (1998)***.

In respect of the effect of irradiation on the TVFA the lower content of irradiated cheese in the first 3 weeks of storage compared with nonirradiated cheese might be due to the destruction of large number of bacteria and especially to the inhibitory effect of gamma radiation on milk lipase and lipolytic bacteria.

EL- Ghandour et al (1983) reported that with, progressive ripening, slight differences could by observed in TVFA of Ras cheese which may be due to the formation of TVFA from sources other than fat hydrolysis i.e lactose fermentation and amino acid metabolism. This also was stated by ***Abd- El- Baky (1973)*** who found that volatile fatty acids in control and cheeses made using vegetable oil and fat replacers progressively increased during storage periods. She also found that the fat content had a negligible effect on the TVFA content of " Domiati" cheese.

It is obvious from the results in table (16) that, the control sample and nonirradiated sample were unacceptable and rejected after 18 days of storage which, has bitter taste in addition to the appearance of micro-organisms growth on cheese surface, mean while cheese samples made from homogenized skim milk

Table (17) :The total volatile fatty acids (TVFA) of irradiated and nonirradiated Cheese manufactured by using Olive oil as fat substitute during storage at room temperature.

Storage period (days)	Treatments				
	Control	Cheese from skimmilk containing 4% olive oil and 1%salt			Cheese from skimmilk containing 4% olive oil and 2%salt
		Irradiation (kGy)			
		0	1.5	2.5	
0	7.5	6.9	7.0	6.9	7.0
6	18	19	9	8	19
9	29 R	28R	18	18	23
12	-	-	18	19	27 R
15	-	-	22 R	23	-
18	-	-	-	26 R	-

TVFA = NaOH 0.1 N / 100 g cheese

4-6-7-Total and soluble nitrogen in samples stored in refrigerator: -

Total itrogen (T.N)

From data given in Table (18) and illustrated in Fig (22) it can be observed that there was a direct relationship between the total nitrogen and the total solid in all treatments for fresh and during storage. This is may be due to the loss of moisture and the increase in total solid, Including the total nitrogen.

In regard to fresh cheese made from salted milk by 1% and 4% olive oil as fat substitute, irradiated samples with 1.5 and2.5 kGy and cheese made from milk with 2% salt and using 4% olive oil as fat substitute, they seem to show no effect on the total nitrogen content as compared to the control (fresh cheese made from salted milk with 1% salt and contained 4% milk fat.

The percentages of TN were 2.34, 2.33, 2.34, 2.34 and 2.35 respectively, these results are in agreement with those obtained by ***Ibrahim (1984)***.

In addition, a progressive slow increase occurred in the total nitrogen content during storage due to the loss of moisture of cheese.

The total nitrogen values for control ,cheese made from salted milk by 1% and using olive oil as fat substitute, irradiated samples at 1.5 and 2.5 kGy and the cheese made from salted milk by 2% and using olive oil as fat substitute were 2.48,

2.49, 2.58, 2.53 and 2.51 at the end of storage periods , respectively. Similar results were reported by ***El-Alfy 1988)*** who found that the increased in the total nitrogen related to increase in dry matter. The same trend was noticed by ***Foda, et al., (1976 a&b), Ibrahuim (1984), Mostafa et al., (1995), Badawi and Kebary (1998) and Ibrahium et al., (2000).***

In addition, ***Salem and Abeid (1996)*** concluded that replacing milk fat with vegetable oil at 1: 2 and 0.3 ratios led to an increase of total nitrogen content which due to the lower fat content of cheese obtained from these treatments.

Soluble nitrogen:-

Data presented in Table (18) and fig (23) show that the soluble nitrogen was 0.22% for fresh control cheese and cheese samples (non irradiated) made from homogenized skim milk containing 4% olive oil as fat substitute and 1% or 2% salt.

In irradiated samples (1.5 and 2.5 kGy the soluble nitrogen values were 0.22% and 0.23 respectively moreover, The soluble nitrogen of the control cheese and nonirradiated samples increased gradually throughout the storage periods. This might due to the protein degradation into water soluble nitrogenous compounds. Similar observation were mentioned by ***Hefny et al., (1975), EL- Alfy (1984) Frag et al (1988), Husein (1985) and Badawi and Kebary (1998).***

Dealing with irradiated (1.5 and 2.5 kGy) cheese containing olive oil as fat substitute, it can be observed a gradual increase in the soluble nitrogen content of cheese samples with increasing the cold storage period reaching 0.59% and 0.68% after 40 and 45 day in the same sequence .This might due to the effects of gamma irradiation and cold storage conditions than enhance the break dawn of insoluble protein into soluble nitrogen and the partially decrease of cheese moisture content. The obtained results are in agreement with ***Umemate et al., (1968)*** as mentioned that the increase of the soluble nitrogen during storage probable due to the degradation of protein by gamma irradiation and libration of tyrosine and nonprotein nitrogen.

Generally it can be observed that, irradiation of soft cheese containing olive oil as fat substitute made from skim milk containing 1% salt improved the keeping quality, prolonged the shelf- life and may enhance cheese ripening under storage conditions depending on SN content of cheese as repining factor.

Table (19) indicates the rate of proteolysis under cold storage condition (expressed as SN/TN%) of soft cheese samples. It can be noticed that the rate of proteolysis of control cheese gradually increasing during storage. The same trend was also observed for cheese containing olive oil as fat substitute either irradiated or not. The rate of proteolysis in the irradiated samples seems to be much higher during the storage period with noticeable differences between the two irradiation doses (1.5 and 2.5 kGy). In addition the replacement of olive oil insted of

milk fat seems to enhance the rate of proteolysis. The irradiated cheese samples containing olive oil as fat substitute contained higher moisture content show higher soluble nitrogen values than the control counterpart at any stage of storage. This might be due to the quicker proteolysis especially at the early stage of ripening. Similar trend of results were reported by ***Hefny (1975) EL- Ghandour et al., (1983) Foda et al., (1976 a&b) and Hefnawy et al., (1992).***

The effect of irradiation on increasing S.N of cheese content was mentioned by ***Ibrahim (1984)***He cleared that the increase of S.N. is probably due to the degradation of protein by gamma irradiation or production of proteolytic mutants of lactobacilli as suggested by ***Singh and Ranoanothan (1974).***

Table (18): The T.N and S.N of irradiated and nonirradiated Cheese manufactured by using Olive oil as fat substituted during storage in refrigerator

Storage period (days)	Total Nitrogen					Soluble Nitrogen				
	Control	Cheese from skimmilk contain 4% olive oil and 1%salt			Cheese from skimmilk contain 4% olive oil and 2%salt	control	Cheese from skimmilk contain 4% olive oil and 1%salt			Cheese from skimmilk contain 4% olive oil and 2%salt
		Irradiation dose					Irradiation dose			
		0	1.5	2.5			0	1.5	2.5	
0	2.34	2.33	2.34	2.34	2.35	0.22	0.22	0.22	0.23	0.22
9	2.40	2.41	2.40	2.41	2.47	0.30	0.33	0.33	0.34	0.32
18	2.48 R	2.49 R	2.44	2.46	2.49	0.35 R	0.36 R	0.38	0.40	0.36
21	-	-	2.46	2.48	2.51 R	-	-	0.40	0.42	0.37R
28	-	-	2.51	2.55	-	-	-	0.44	0.46	-
35			2.53	2.53		-	-	0.50	0.55	-
40	-	-	2.53 R	2.56	-	-	-	0.59 R	0.62	-
45	-	-	-	2.58 R	-	-	-	-	0.68 R	-

® = Unacceptable organoleptically and Reject

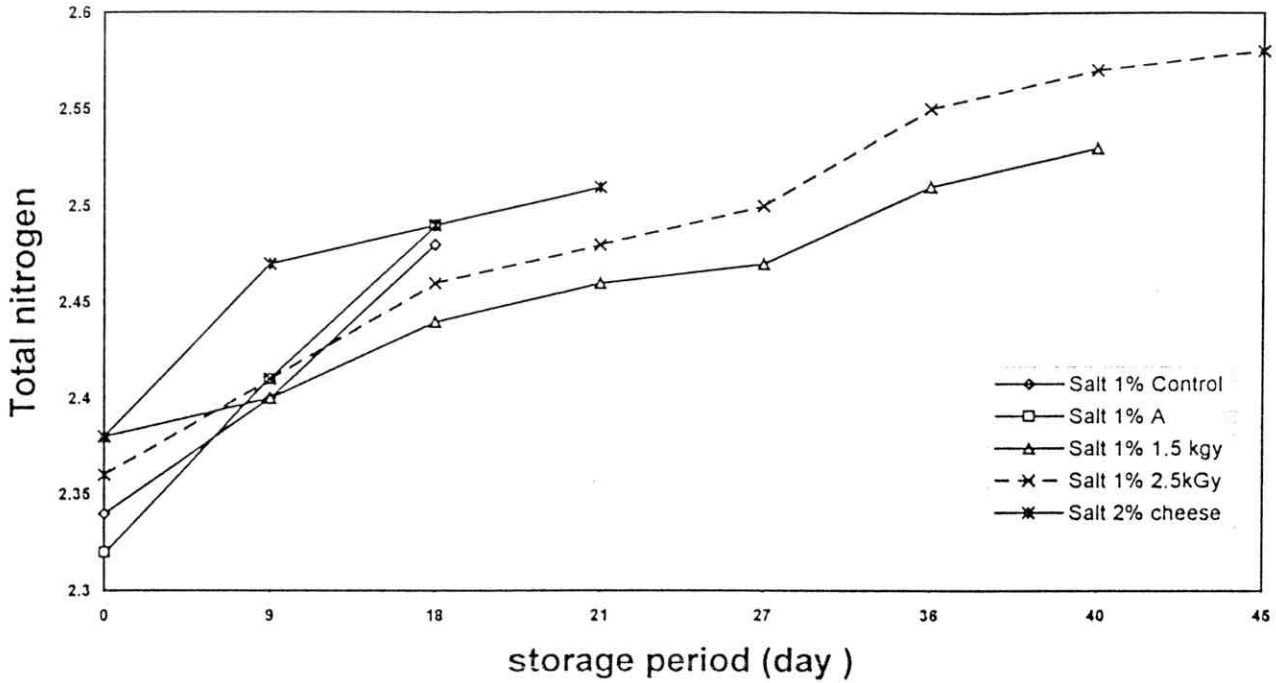

Fig. (22) Influence of different treatments and refrigerated storage onT,Ncontent of soft cheese manufactured by using olive oil as fat substitute

Table (19) the Soluble nitrogen /Total nitrogen content of irradiated and nonirradiated cheese manufactured using Olive oil as fat substitute during storage in refrigerator

Storage period ((days	Treatments				
	Control	Cheese from skimmilk containing 4% olive oil and 1%salt			Cheese from skimmilk containing 4% olive oil and 2%salt
		Irradiation dose(kGy)			
		0	1.5	2.5	
Fresh	9.40	9.40	10.69	11.11	9.36
9	12.5	13.69	13.75	14.10	13.22
18	14.11 R	14.06 R	15.57	16.26	14.45
21			16.26	16.93	14.75 R
28			17.52	18.03	
35			19.76	21.73	
40			23.32 R	24.21	
45				36.35 R	

® = Unacceptable organoleptically and Rejected.

Table (20) The TN, SN and SN / TN content of irradiated and nonirradiated Cheese manufactured by using Olive oil as fat substitute during storage at room temperature

Storage period (days)		T.N Storage period							S.N period Storage							S.N / T.N period Storage						
		0	3	6	9	12	15	18	0	3	6	9	12	15	18	0	3	6	9	12	15	18
1%salt	Control	2.35	2.37	2.40	2.43 R	--	--	--	0.22	0.27	0.38	0.40 R	--	--	--	9.4	11.39	15.83	R 16.16	--	--	--
	Cheese 4% olive oil	2.33	2.33	2.37	2.41 R	--	--	--	0.22	0.24	0.35	0.39 R	--	--	--	9.4	10.30	14.76	R 16.18	--	--	--
	1.5 kGy	2.34	2.35	2.38	2.41	2.45	2.50 R	--	0.22	0.28	0.38	0.47	0.52	0.55 R		9.4	11.91	15.96	19.50	21.22	22 R	--
	2.5 kGy	2.34	2.42	2.44	2.46	2.48	2.51	2.54 R	0.23	0.29	0.40	0.46	0.47	0.50	0.56 R	9.8	11.98	16.39	18.69	18.95	19.9 2	22.3 R
2%salt	Cheese 4% olive oil	2.35	2.40	2.40	2.43	2.47 R	--	--	0.22	0.30	0.38	0.40	4.5R	--	--	9.4	12.50	15.63	17.35	18.3 R	--	--

4-6-8-Total and soluble nitrogen in cheese stored at room temperature:

The behaviour of the control cheese and also all treatments undertaken of cheese samples stored at room temperature in table (20)were almost similar to those of the control and treated cheese samples stored at refrigerator, but the only difference was in the storage periods illustrated in Table (20) indicating that irradiated samples had an extended shelf-life to 15 and 18 days for 1.5 and 2.5 kGy respectively, against only 9 days for control samples. On the other hand, samples made from salted milk by 1% and 2%with using olive oil as fat substitute were unacceptable after 9 and 12 days depending on the sensory evaluation , respectively

Dealing with soluble nitrogen, the trends of all treatments and control were almost similar to the treatments and control stored at refrigerator. The only differences were observed from table (20) that the values of S.N which is lower than that found for cheese samples stored under cold storage .This may be related that cold storage conditions which enhance cheese ripening as measured by S.N content of cheese.

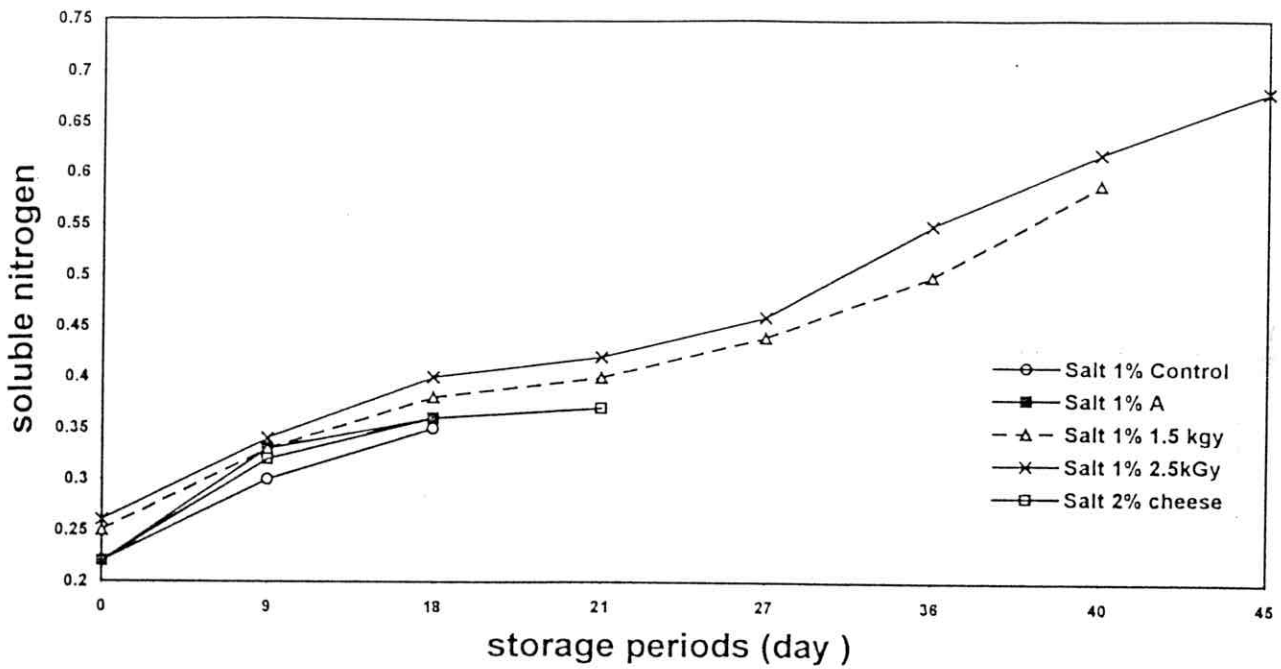

Fig. (23) Effect of different treatments and refrigerated storage on soluble nitrogen content of soft cheese manufactured by using olive oil as fat substitute

4-7-Microbiological evaluations of irradiated and nonirradiated soft cheese stored at different conditions:-

4-7-1: Total bacterial count (TPC) :-

Cold storage condition:-

It is clear from Table (21)and fig. (24) that the obtained soft cheese of the control and other treatments contain total bacterial counts (c.f.u) initially as fresh, $26x10^5$ and 25×10^5 and 21×10^5, for the control cheese made from raw mixed milk (buffaloe's and cow's) of 4% fat and 1% salt, soft cheese of homogenized skim milk of the same content of salt (1%) and 4% olive oil as milk fat substitute and soft cheese made from milk similar to the latter one only the salt content was increased to 2% respectively.

During the storage period which was ended after 18 days the log N of TPC of bacteria showed noticeable increase with increasing storage period . The rate of increase of the TPC, for the control cheese and those containing olive oil and the two different levels of salt showed the same trend with slight differences in cheese of 2% salt.

In regard to the irradiated soft cheese made of homogenized skim milk containing 4% olive oil) and 1% salt where stored under similar cold storage condition, it obvious that irradiation induced a great reduction in the TPC reaching $10x10^3$ and $3 x10^3$/g after applying the irradiation treatment. The rates of destruction due to radiation effect were 99.6% and 99.9% for

Table (21): The total bacterial count of irradiated and nonirradiated Cheese manufactured using Olive oil as fat substitute during storage refrigerator

Storage period (days)	Treatments									
	Control		Cheese from skimmilk contain 4% olive oil and 1%salt						Cheese from skimmilk contain 4% olive oil and 2%salt	
			Irradiation (kGy)							
			0		1.5		2.5			
	TBC	Log N	TBC	Log N	TBC	Log N	TBC	Log N	TBC	Log N
Fresh	$26x10^5$	6.4	$25x10^5$	6.4	$10x10^3$	4	$3x10^3$	3.5	$21x10^5$	6.3
3	$30x10^5$	6.5	$30x10^5$	6.48	$13x10^3$	4.11	$3x10^3$	3.5	$28x10^5$	6.5
6	$36x\ 10^5$	6.6	$35x10^5$	6.5	$15x10^3$	4.18	$4x10^3$	3.6	$33x10^5$	6.5
9	$43x\ 10^5$	6.63	$44x10^5$	6.6	$17x10^3$	4.23	$6x10^3$	3.8	$38x10^5$	6.6
12	$50x\ 10^5$	6.7	$51x10^5$	6.7	$20x10^3$	4.3	$10x10^3$	4	$42x10^5$	6.6
15	$55x10^5$	6.73	$54x10^5$	6.7	$24x10^3$	4.4	$14x10^3$	4.1	$48x10^5$	6.7
18	$60x10^5$	6.8	$58x10^5$	6.8	$29x10^3$	4.5	$17x10^3$	4.2	$50x10^5$	6.7
21					$34x10^3$	4.5	$23x10^3$	4.4	$51x10^5$	6.7
24					$3.8x10^4$	4.6	$2.9x10^4$	4.5		
27					$4.5x10^4$	4.7	$3.6x10^4$	4.6		
30					$5x10^4$	4.73	$4.2x10^4$	4.6		
33					$5.6x10^4$	4.8	$4.9x10^4$	4. 7		
37					$6.3x10^4$	4.8	$5.5x10^4$	4.7		
40					$7.1x10^4$	4.9	$6.3x10^4$	4.8		
45							$7.4x10^4$	4.9		

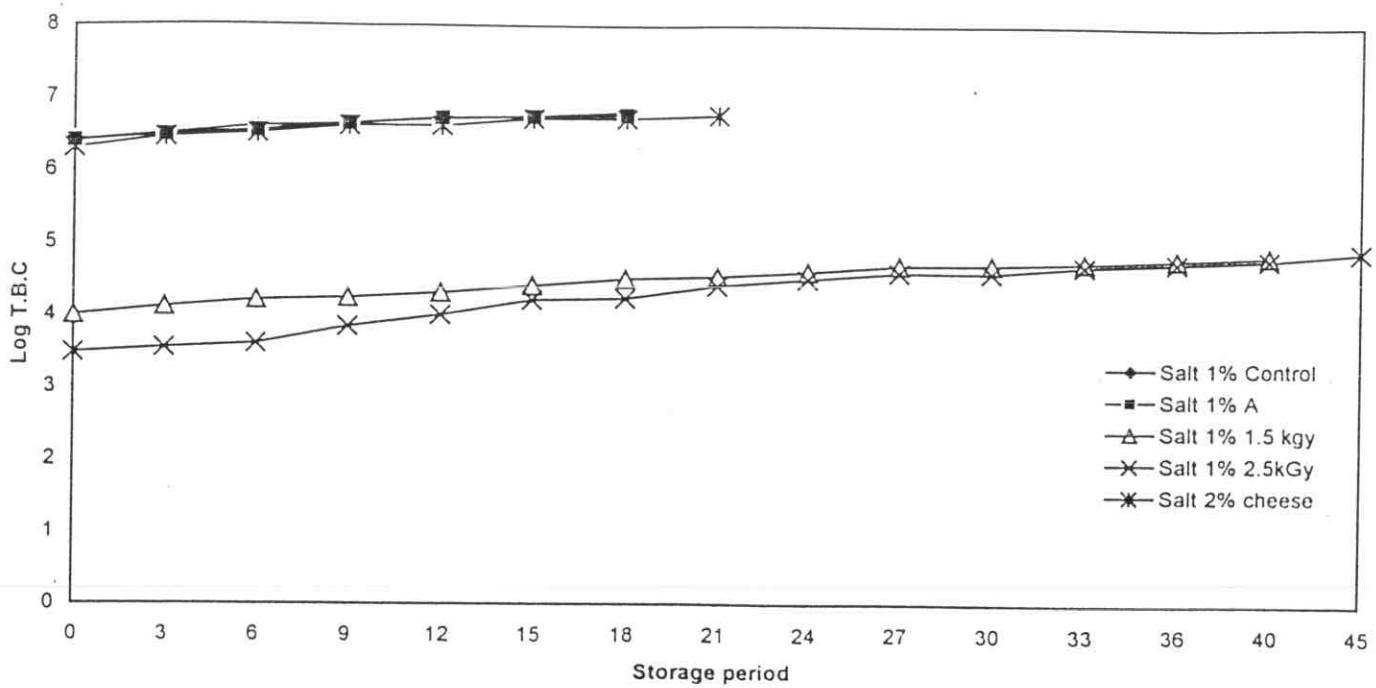

Fig (24) The total bacterial count of irradiated and nonirradiated cheese manufactured by using olive oil as fat substitute during storage in refrigerator .

Table (22): The total bacterial count of irradiated and nonirradiated cheese manufactured by using Olive oil as fat substitute during storage at room temperature.

Storage period (days)	Treatments									
	Cheese from mixed milk contain 4% fat and 1%salt		Cheese from skimmilk containing 4% olive oil and 1%salt						Cheese from skimmilk containing 4% olive oil and 2%salt	
			Irradiation (kGy)							
			0		1.5		2.5			
	TBC	Log N	TBC	Log N	TBC	Log N	TBC	Log N	TBC	Log N
Fresh	$26x10^5$	6.4	$25x10^5$	6.3	$10x10^3$	4	$3x10^3$	3.5	$21x10^5$	6.3
3	$60x10^5$	6.8	$57x10^5$	6.8	$26x10^3$	4.4	$7x10^3$	3.8	$50x10^5$	6.7
6	$130x10^5$	7.1	$125x10^5$	7	$51x10^3$	4.7	$1x10^4$	4	$99x10^5$	7
9	$169x10^5$	7.2	$167x10^5$	7.2	$7.6x10^4$	4.9	$2.3x10^4$	4.3	$150x10^5$	7.2
12					$9.3x10^4$	5	$4.6x10^4$	4.7	$187x10^5$	7.3
15					$11x10^4$	5.1	$6.1x10^4$	4.8		
18							$7.8x10^4$	4.9		

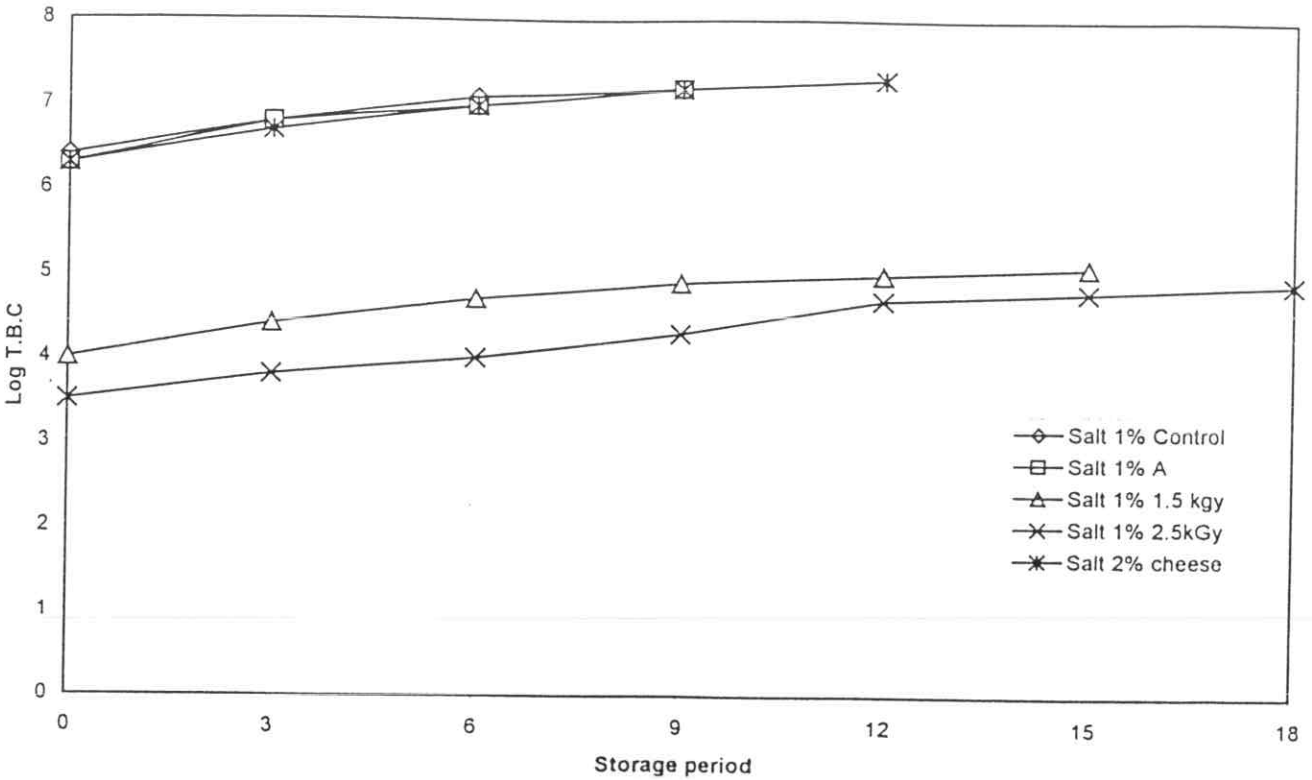

Fig (25) The total bacterial count of irradiated and nonirradiated cheese manufactured by using olive oil as fat substitute during storage at room temperature .

4-7-2-Moulds and yeasts of soft irradiated and non-irradiated cheeses stored at different conditions-:

At refrigerator

Data in Table(23)and Fig (26) indicate the numbers of moulds and yeasts of fresh control cheese made from mixed raw milk of 4% fat and 1% salt and that made from homogenized skim milk with 4% olive oil as a fat substitute and of the same level of salt. These numbers were 300/g where they were 250gm for cheese made from homogenized milk with the same level of olive oil as fat replacer and 2% salt. These moulds and yeasts being air contaminates for cheese during manufacturing and storage. Accordingly, they also recontaminate the irradiated cheese. In regards with the irradiated cheese, the moulds and yeasts were absent in the fresh cheese and after 3 and 6 days of examination after irradiation with 1.5 and 2.5 kGy respectively. The same trend was slated by ***Ibrahim (1984)*** on nonirradiated and irradiated Domaiti cheese.

The nonirradiated cheeses showed a gradual increase in moulds and yeasts with increasing cold storage period and reaching 5.1 $x10^4$, 5.3 $x10^4$ and 13.7 $x10^4$ to the end point of cheese spoilage after 18, 18 and 21 days for control cheese and the cheese of olive oil and 1% or 2% salt in the same order.

In respect of the behaviour of these organisms in irradiated cheese it can be noticed that moulds and yeasts were decreased within the first 6 days then rapidly increased reaching 11 $x10^4$ and 4 $x10^4$/g cheese exposed to 1.5 and 2.5 kGy gamma irradiation and sequently after cold storage for 40 and 45 days .

It is obvious that the shelf- life or the storagability of irradiated cheeses were extended to 40 and 45 days. This can be attributed to the destructive effect of gamma irradiation on the moulds and yeasts which are accounted as major factors in cheese spoilage even under cold storage conditions.

The obtained results agree with similar results recorded by ***EL- Shibiny et al (1983)Ibrahim (1984), and Soad et al (1990) .***

On the other hand the rapid deterioration of non-irradiated cheese may be due to the decrease in pH values of cheeses which was found to activate the growth of moulds and yeasts and consequently enhanced cheese spoilage. Therefore, it could be concluded that the combined effect of gamma irradiation and cold storage temperature had an inhibitory effects against different microbial growth particularly moulds and yeasts and therefore prolong the shelf-life of cheese .

The same explanation was mentioned by ***Foda et al., (1976 a,b), Krcal et al., (1978) and El-Batawy et al., (1988)*** on irradiated kareish cheese stored at refrigerator where its shelf-life was prolonged up to 4 weeks compared with three weeks for non- irradiated cheese stored at the same condition.

It can be noticed that the replacement of milk fat by olive oil has no effect on moulds and yeasts growth in all cheese samples when they were fresh or during storing.

At room temperature-:

Table (24) and Fig (27) illustrate the numbers and the log numbers of moulds and yeasts of non- irradiated and irradiated

cheese samples. It clear from the obtained results that they show gradual increase with increasing storage period as previously mentioned for the cheese stored at refrigerator. The main differences between the two different conditions of storage can be noticed in growth rate of moulds and yeasts during the storage period up to the spoilage of the cheeses. It obvious from the obtained data that the rate of growth for these organisms were much rapid and induced rapid deterioration of cheese samples after 9,9 and 12 days for nonirradiated cheese while reaching 15 and 18 days for irradiated ones by 1.5 and 2. 5kGy respectively.

The obtained results are in accordance with those reported by ***Foda et al., (1976a&b), Krcal et al (1978), Ibrahim (1984) and EL- Batawy et al., (1988) .***

Table (23): The moulds and yeasts count of irradiated and nonirradiated Cheese manufactured by using Olive oil as fat substitute during storage refrigerator

Storage period (days)	Treatments									
	Control		Cheese from skimmilk contain 4% olive oil and 1%salt						Cheese from skimmilk contain 4% olive oil and 2%salt	
			Irradiation (kGy)							
			0		1.5		2.5			
	T.M,Y	Log N	T.M,Y	Log N	T.M,Y	Log N	T.M,Y	Log N	T.M,Y	Log N
Fresh	$30x10^1$	2.47	$30x10^1$	2.5	-	-	-	-	$25x10^1$	2.4
3	$40x10^1$	2.6	$45x10^1$	2.6	-	-	-	-	$39x10^1$	2.6
6	$80x\ 10^1$	2.9	$78x10^1$	2.9	$12x10^1$	2.1	-	-	$76x10^1$	2.8
9	$21x\ 10^2$	3.3	$21x10^2$	3.3	$3x10^2$	2.5	$1x10^2$	2	$20x10^2$	3.3
12	$7x\ 10^3$	3.9	$7.2x10^3$	3.9	$1.5x10^3$	3.2	$0.8x10^3$	2.9	$6x10^3$	3.8
15	$22x10^3$	4.3	$22x10^3$	4.3	$8x10^3$	3.9	$2.5x10^3$	3.4	$40x10^3$	4.6
18	$5.1x10^4$	4.7	$5.3x10^4$	4.7	$12x10^3$	4.1	$4x10^3$	3.6	$4.2x10^4$	4.6
21					$15x10^3$	4.2	$5.3x10^3$	3.7	$13.7x10^4$	5.1
24					$23x10^3$	4.4	$6x10^3$	3.8		
27					$41x10^3$	4.6	$8x10^3$	3.9		
30					$6x10^4$	4.8	$9x10^3$	4		
33					$7x10^4$	4.9	$10.5x10^3$	4.11		
37					$10x10^4$	5	$15x10^3$	4.2		
40					$11x10^4$	5	$3x10^4$	4.5		
45							$4x10^4$	4.6		

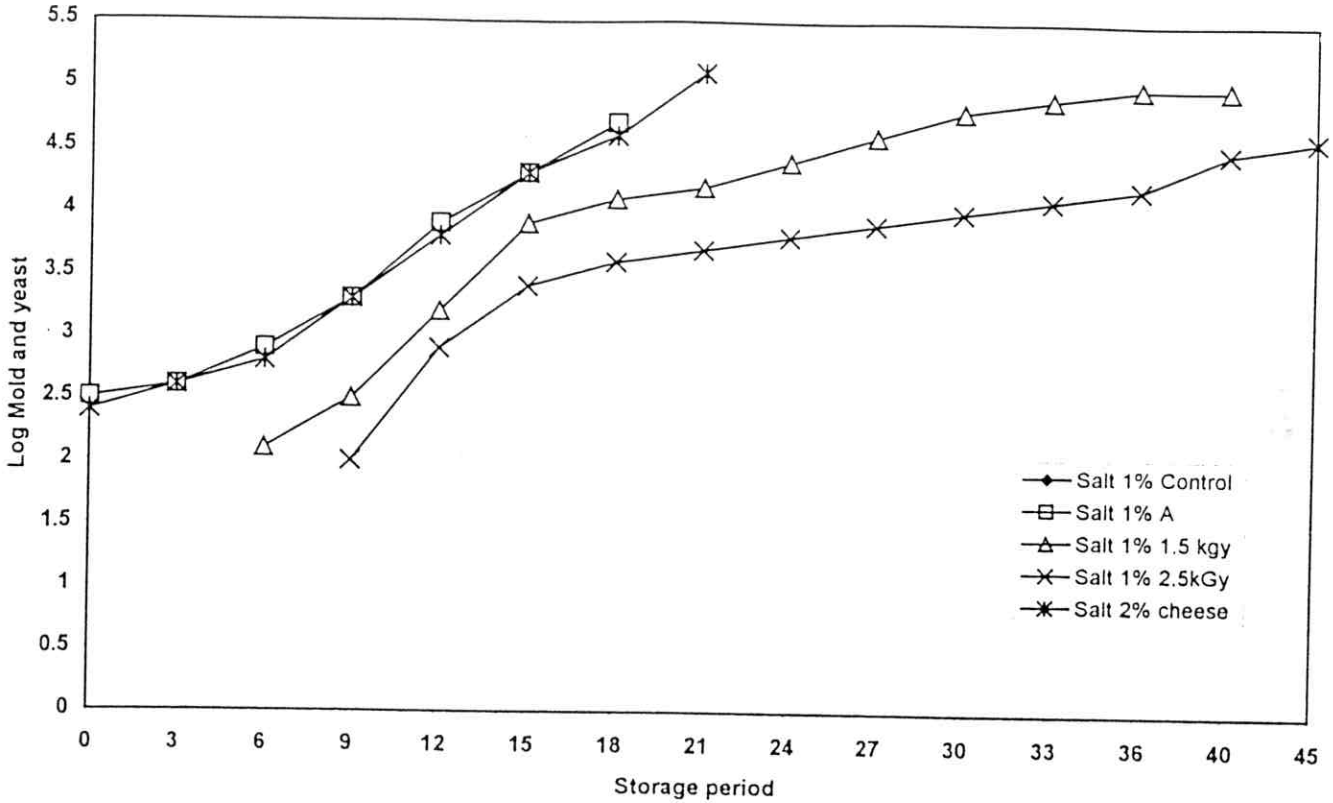

Fig (26) The M & Y count of irradiated and nonirradiated cheese manufactured by using olive oil as fat substitute during storage in refrigerator

Table (24): The molds and yeasts count of irradiated and nonirradiated Cheese manufactured by using Olive oil as fat substitute during storage at room temperature

Storage period (days)	Treatments									
	Control		Cheese from skimmilk containing 4% olive oil and 1%salt						Cheese from skimmilk containing 4% olive oil and 2%salt	
			Irradiation (kGy)							
			0		1.5		2.5			
	T.M,Y	Log N	T.M,Y	Log N	T.M,Y	Log N	T.M,Y	Log N	T.M,Y	Log N
Fresh	$30x10^1$	2.5	$31x10^1$	2.5	-	-	-		$25x10^1$	2.4
3	$36x10^3$	4.6	$39x10^3$	4.6	$10x10^3$	4	$3x10^2$	2.5	$30x10^3$	4.5
6	$8x10^4$	4.9	$9x10^4$	4.9	$2.1x10^4$	4.3	$2.2x10^3$	3.3	$7x10^4$	4.8
9	$20x10^4$	5.3	$20x10^4$	5.3	$5x10^4$	4.7	$1x10^4$	4	$17x10^4$	5.2
12	-	-	-	-	$67x10^4$	5.8	$55x10^4$	5.7	$10x10^5$	6
15	-	-	-	-	$80x10^5$	6.9	$40x10^5$	6.6	-	-
18	-	-	-	-	-	-	$83x10^5$	6.9	-	--

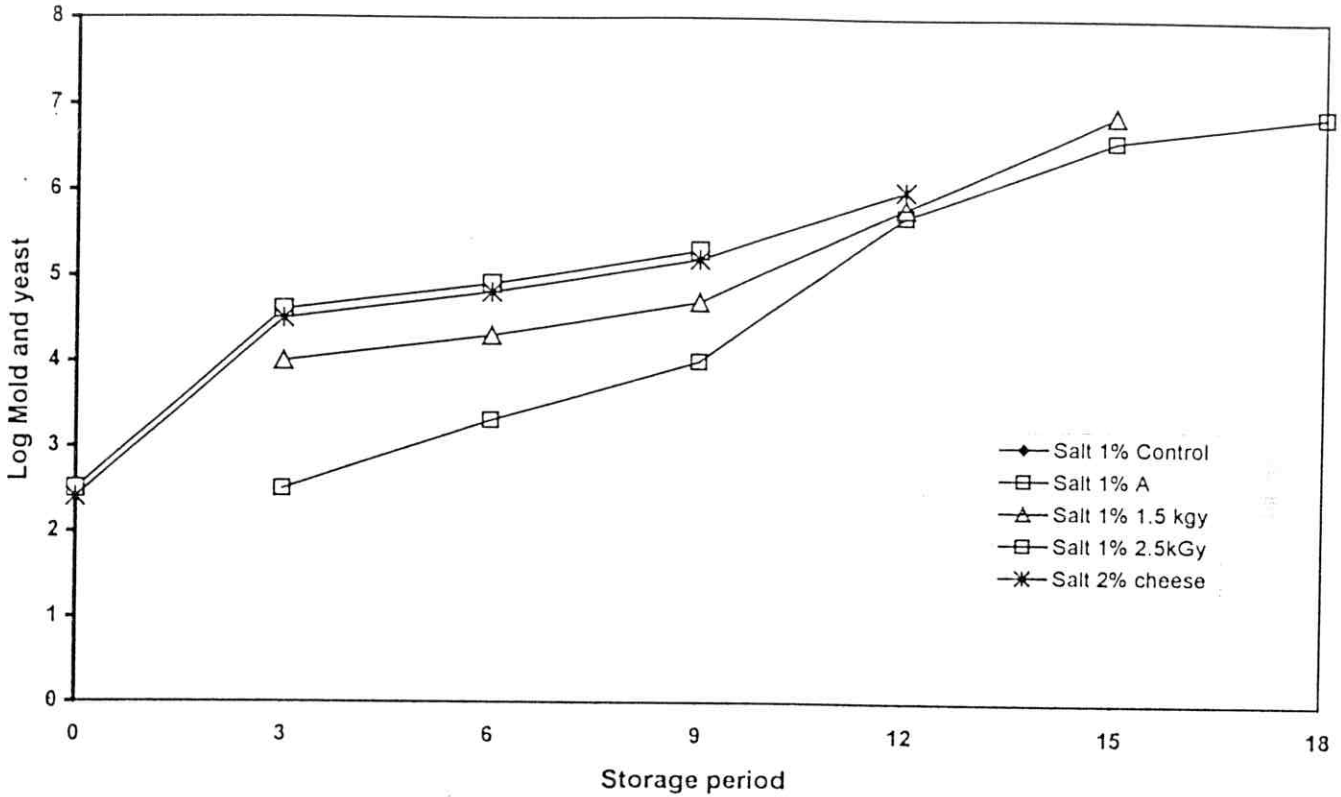

Fig (27) The M & Y count of irradiated and nonirradiated cheese manufactured by using olive oil as fat substitute during storage at room temperature .

4-8- Sensory evaluation:-

Stored at refrigeration:-

Sensory evaluation scores given in Table (25) showed that for the control soft cheese and that irradiated and nonirradiated cheese containing olive oil as fat substitute decreased with advancing storage time .As seen from Table (25) remarkable difference was observed in the appearance of the cheese among the treatments for the first week of storage periods for the control (cheese containing the milk fat) and other treatments that contained olive oil as fat substitute .A white colour was observed in the cheese containing olive oil . From the same table it can be seen that the body and texture of cheese containing olive oil and 1% or 2% salt obtained lower scoring compared with the control.

Dealing the flavour item the control cheese showed higher scoring points for flavour than the cheese of the treated samples due to the oily flavour of the latter ones. This oily flavour may be gradually improved as ripening advanced as reported by ***Davis (1965)*** who mentioned that flavour of corn oil becomes progressively more masked for cheddar cheese as the cheese ripens.This agrees with the trends given by ***Hassan et al., (1986) and EL- Deeb et al., (1987).*** The only exception was noticed after the 6^{th} day of storage for nonirradiated and irradiated cheese containing olive oil as fat substitute. This may be due to that these cheeses became smooth and more firmer due to the curd contraction and consequently the expulsion some of their moisture content. This result in accordance with ***Abdel-Kader (1971).***

The control cheese was ranked higher score as fresh compared with other treatments either irradiated or non irradiated containing olive oil as fat substitute. This may be due to the replacement of milk fat with olive oil induced an oily flavour which effected the acceptability of these cheese by the score panel testers.

The unirradiated cheese samples in the control or that containing olive oil showed rapid decrease in their quality after 6 days of cold storage showing slimy surface and yeasty flavour and became unacceptable with a slight bitter taste and were rejected after 18, 18 and 21 day for the control cheese and that containing olive oil and 1or 2% salt respectively. This is obviously due to the growth of the microorganisms contaminating the raw milk used in cheese manufacture in addition to the low salt content of the obtained cheese in these treatments.

The quick decrease in the scoring values of the previous mentioned cheese samples of the control and that containing olive oil as fat substitute could be related to the same reasons mentioned before .

Dealing with the irradiated cheese with 1.5 and 2.5 k Gy ,it can be observed that applying 2.5 kGy of gamma radiation gave the best result of scoring All the irradiated cheese samples obtained higher scoring points during the storage periods under refrigeration and remained in acceptable conditions (60 points) for 30 and 36 days for irradiation doses of 1.5 and 2.5 kGy respectively. It can be observed that as the storage period advanced the irradiated cheese remained in acceptable condition

and the cheese flavour was improved where the olive oily flavour becomes progressively more masked. This may be due to the combined effect of cold storage condition and the destructive effect of irradiation on the micro-organisms of the obtained cheese particularly moulds and yeasts and consequently led to prolonging the shelf life of obtained cheese .These results are in agreement with similar results found by ***Ibrahim (1984) and El-Batawy et al (1988).***

From the previously mentioned results it can be concluded that a safe and good quality soft cheese can be made from homogenized milk containing 4 % olive oil as milk fat substitute (containing a higher percentage of long chain unsaturated fatty acids) and salted with 1 % salt .

This cheese is more suitable as a higher nutrient food stuff for people suffering from blood hepertension , high blood cholesterol ,liver and heart diseases, as olive oil is a source of significant nutritional value in human health and a preventive factor in many dietrelated illness.

olive oil relieved abdominal pain and lessened indigestion after a meal , a gentle laxative effect which aids in relieving mild chronic constipation,a relaxing positive effect on gall bladder contractions because it activates the hormone cholecystokinin , enhanced the detoxicative properties of the liver ***Ricci, (1969), , Charbonnier (1985) and Viola and Audisio, (1987),***

In addition olive oil as a nutritionally balanced diet is essential in the proper growth and development of young children, it is equally important in maintaining the health and

well being of elderly people, intake reduced arterial blood pressure, source of dietary lipids:- olive oil has a high content of biologically active α- tocopherol hence its enhanced antioxidative stability , the rapeutic effects on peptic ulcers since a decline in stomach ulcers occurred when olive oil was substituted for saturated animal fats in the diet and revealed that MUFA diets produed equal reductions in LDL cholesterol. In addition, excessive carbohydrate in take decreased glycemic control and raised triglycerid levels ***Taita, (1966), Grundy, (1986) and Viola and Audisio, (1987).***

These studies demonstrated that the monounsaturated diet improved glucose tolerance and had a positive effect on HDL, LDL, and triglyceride levels. ***Grundy, (1986), and Glauber et al.,(1988).***

In regarding to, when saturated fats are replaced by a monounsaturated fat such as olive oil the effect plasma total cholesterol was equal to results obtained when saturated fats are reduced. on agree with recommendation of the American heart association in reducing milk fat intake to lower blood cholesterol which presumaly reduces risk of strockers and heart attacks ***christensen ,(1982) .***

Stored of room temperature:-

Table (26) illustrates the scoring values of soft cheeses of the control and those made from homogenized skim milk containing 4% olive oil as fat substitute and 1% or 2% salt where some of the obtained cheese was subjected to gamma radiation with 1.5 kGy or 2.5 kGy. It is clear that all fresh cheese samples

obtained higher score values ranging from 95 to 80 points .The control cheese was ranked the higher score compared with the other treatments of cheese where olive oil replaced the milk fat. The slight difference may be related to replacing milk fat with olive oil imparted oily flavour with fresh cheeses.

This result in accordance with the results of ***Salem and Abeid (1996)*** who noticed that replacing milk fat with 3% sun flour oil induced an oily flavour with Domiati fresh cheeses. This flavour disappeared during the ripening periods of the cheese.

The nonirradiated and irradiated cheese stored at room temperature were ranked less scores reaching the point of rejection. The storagability of the cheeses from the control and other treatment showed different periods. The keeping quality of the obtained cheese was about 6 days for the control and non-irradiated cheese samples.

In regards of irradiated cheese stored at room temperature, the shelf- life was extended to 15 and 18 days for the cheese treated with 1.5 and 2.5kGy respectively. The trend of the obtained results agree with similar results stated by ***Ibrahim (1984) and EL- Batawy et al., (1988) on Domaiti and Kareish cheese.***

The rapid spoilage of the obtained cheese stored at room temperature 23+2 C could be due to the lower salt content , higher moisture content and the high rate increase of microorganisms in cheese stored under room temperature conditions.

4-9- Manufacturing o yoghurt with different level of olive oil:

Chemical compositions of yoghurt made from mixed buffaloe's and cow's milk of 4 % milk fat and from different percentage of olive oil as fat substitute.

4-9-1:Total Solids:-

It can be observed from Table (27) that total solid in yoghurt samples made from mixed buffaloe's and cow's milk (the control) and that with different substitutions of milk fat by 25%, 50% and 75% olive oil were 13.60, 13.50, 13.48 and 13.17 respectively.

The same table (27) clears that the total solid in control and other treatments showed about the same percentage with slight differences. Total solid of all samples were ranged between 13.17 and 13.50.

During storage it is obvious that total solid of control and yoghurt samples with different substitutions of milk fat by 25%, 50% and 75% olive oil during storage at refrigerator 6 $\pm 2^{o}$C decreased by increasing the storage periods, reaching 12.60, 12.50, 12.48 and 12.39% for samples under investigation at the end of storage period of 8 days.

The slight decrease in total solid of all treatments can be attributed to lactose fermentation, protein and fat hydrolysis producing volatile substances, in additions to lactic acid, acetaldehyde and acetone. Similar results were reported by ***El - Shibiny et al., (1979), Abd- El -Salam, et al., (1996), Abd- El***

Aty et al., (1998) and Kebary and Hussen (1999) who found that the average total solids of yoghurt gradually decreased during storage periods.

It can be noticed that , using olive oil at different levels as milk fat substitute in yoghurt manufacturing has slight effect on the total solids of produced yoghurt from different treatments.

4-9-2:Fat content:-

It is evident from Table (27) that the average fat content of fresh yoghurt samples made from mixed milk (control) and in the other treatments with different substitution for milk fat by 25%, 50% and 75% olive oil was 4% in all fresh yoghurt either made from fresh mixed milk or by different substitutions for milk fat using olive oil.

During storage, it can be noticed that the average fat content decreased during storage periods to 3.9, 3.7, 3.7 and 3.6 for the control and samples from different treatments with substituting milk fat by 25%, 50% and 75% olive oil respectively.

The slight decrease in the fat content of Yoghurt during storage may be due to the slight hydrolysis of fat. These results are in accordance with those reported by ***EL- Shibiny et al., (1979), Abd -EL- Salam, et al., (1996), Abd EL-Aty et al., (1998) and Kebary and Hussien (1999)*** who found that the statistical analysis of averages yoghurt fat contents of different treatments were not significant in zero time however storage had a significant effects on yoghurt fat from different treatments during storage.

Table (27) : Total solid, total nitrogen and fat content of yoghurt from different treatments during storage

Treatments	Total solid %		Total nitrogen %		Fat content %	
	Storage period		Storage period		Storage period	
	fresh	8 days	fresh	8 days	fresh	8 days
Control of 4% milk fat	13.60	12.60	0.679	0.675	4	3.9
25% olive oil replacement of milk fat	13.50	12.50	0.673	0.670	4	3.7
50% olive oil replacement of milk fat	13.48	12.48	0.674	0.669	4	3.7
75%olive oil replacement of milk fat	13.17	12.39	0.673	0.665	4	3.6

4-9-3:**Titratable Acidity (T.A)**

Table (28) and fig (28) illustrate the determined total acidity (T.A.) for yoghurt made from mixed milk (control) and those from different treatments.

It can be noticed that, T.A in fresh samples were 0.85, 0.82, 0.83 and 0.85 respectively. These results are in agreement with ***Abd- El Salam et al., (1996) and Abd EL -Aty et al., (1998)*** who made yoghurt with different stabilizers and with some vegetable oil in yoghurt manufacture.

During storage periods, it is obvious that T.A. increased in all samples with slight differences between the treatments and the control. These results agreed with those reported by ***Mehanna et al., (1988) Abd EL Aty et al., (1998) and Kebary and Hussien (1999)*** as they found that acidity slightly increased during the first 6 days of storage, then gradually increased up to the end of storage period of yoghurt.

It can be concluded that ,using olive oil at 25%, 50% and 75% as fat substitute has no noticeable effects on total acidity for fresh yoghurt or after 8 days of storage.

4-9-4: pH Values

Table (28) and fig. (29) indicate that the pH value of control and yoghurt samples made with substituting milk fat by 25%, 50 and 75% olive oil were 4.70, 4.71, 4.71 and 4.70 as fresh respectively .Also it is clear that there is not any change after using olive oil as fat substitute. These results are in accordance with ***EL- Shibiny et al., (1979), Mehanna et al.,***

(1988), Abd EL- Salam et al., (1996) and Kebary and Hussien (1999).

During storage, a gradual decrease in the pH values was observed up to the end of storage period reaching to 4.12, 3.97, 3.89 and 3.86 for the control samples and the three different treatments, respectively. It is due to the development of lactic acid by lactose fermentation.

Moreover, it can be observed that no noticeable effects were present between yoghurt in the control and other treatments with different levels of olive oil as fat substitute in respect pH values of the obtained yoghurt as fresh or after storage for 8 days.

In respect of the effect of storage on the acidity and pH of zabadi ***EL- Shibiny et al., (1979)*** found that it was not significant.

Table (28)Effect of different treatments and storage on the acidity and pH values of yoghurt made by using olive oil as fat substitute .

Storage period (days)	Acidity				PH			
	Control 4%fat	Percentage of olive oil replacement fat			Control 4%fat	Percentage of olive oil replacement fat		
		25	50	75		25	50	75
fresh	0.85	0.82	0.83	0.85	4.70	4.71	4.71	4.70
2	0.90	0.90	0.89	0.92	4.62	4.63	4.62	4.60
3	0.94	0.95	0.96	0.99	4.58	4.55	4.51	4.48
4	0.99	1.02	1.01	1.02	4.46	4.38	4.35	4.44
5	1.05	1.06	1.07	1.08	4.40	4.31	4.27	4.25
6	1.11	1.14	1.16	1.18	4.35	4.22	4.19	4.12
7	1.17	1.19	1.20	1.25	4.26	4.12	4.06	3.97
8	1.18	1.25	1.32	1.32	4.12	3.97	3.89	3.86

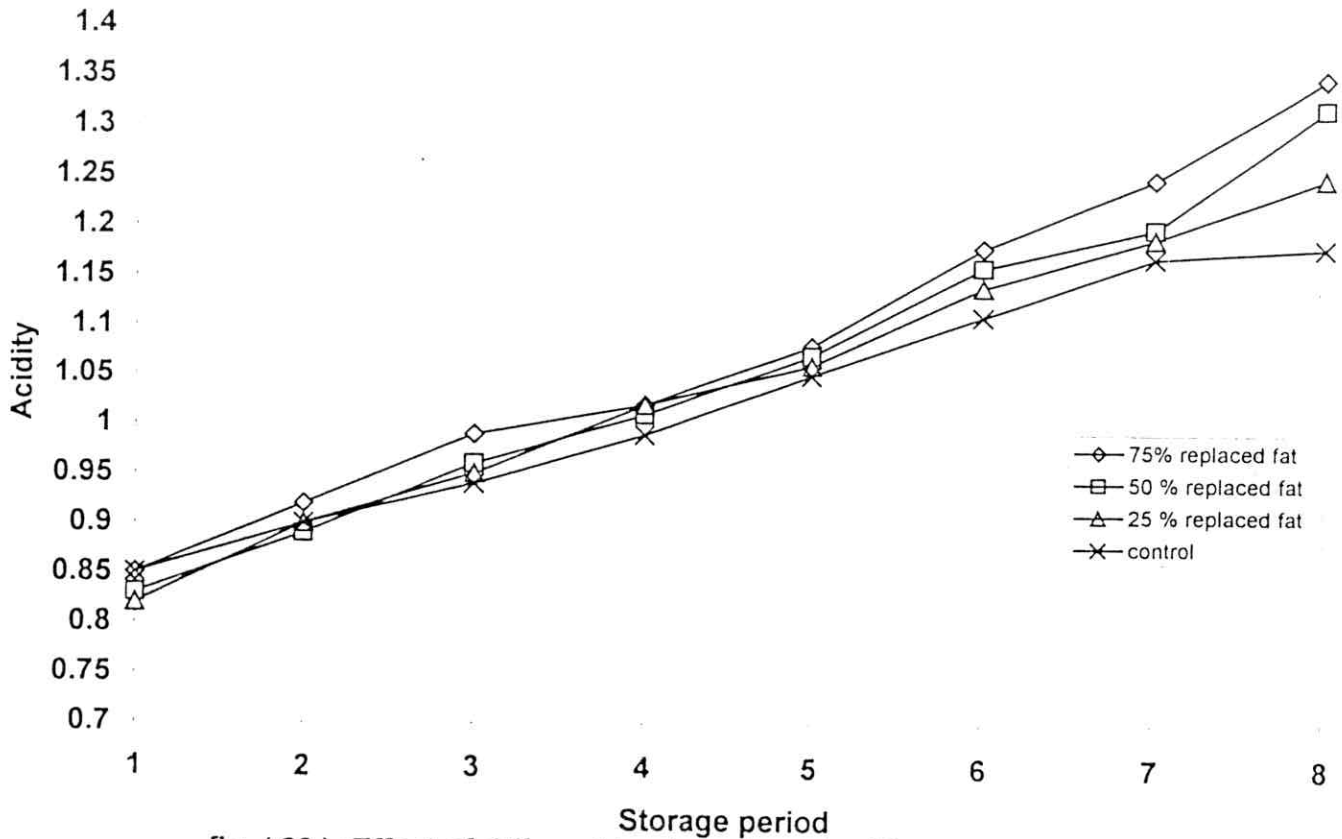

fig. (28) :Effect of different treatments and refrigerated storage on the acidity of yogurt manufacture using olive oil as fat substitut.

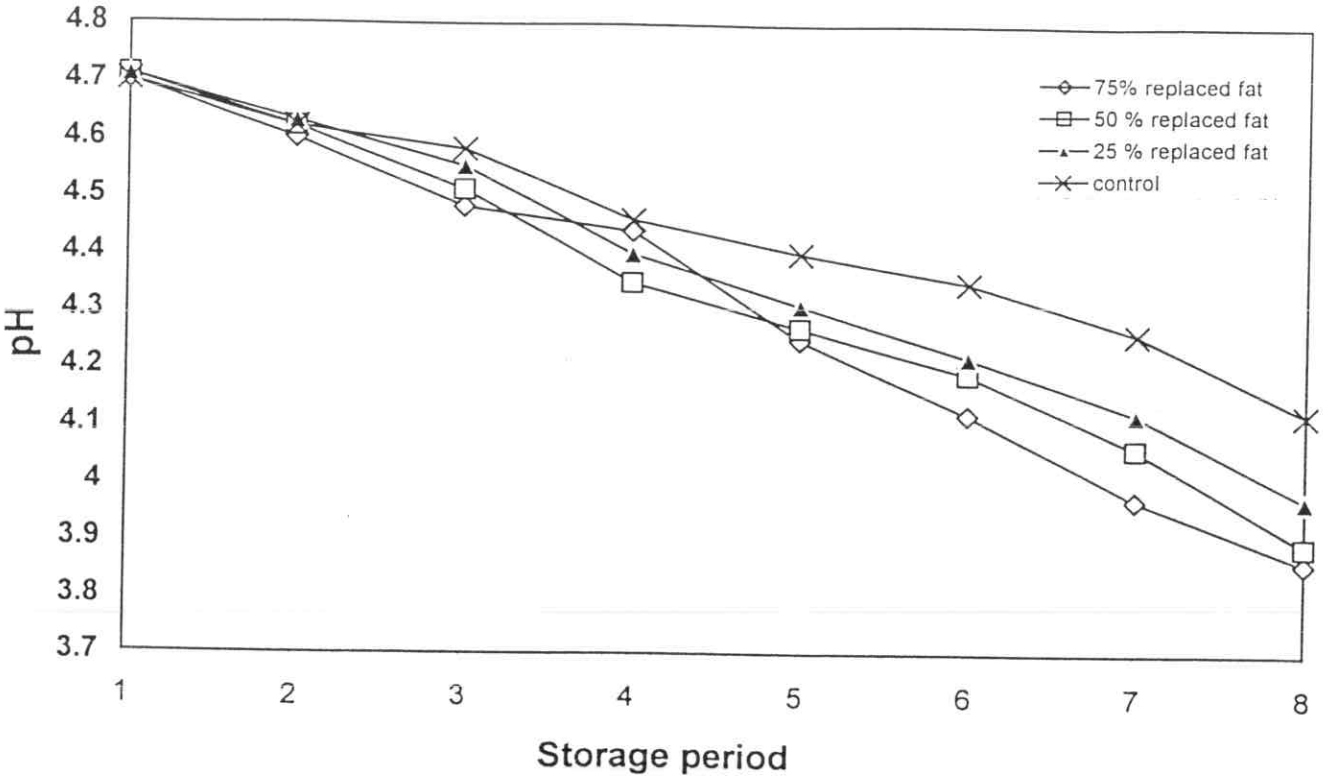

fig. (29) :Effect of different treatments and storage on the pH of yogurt made by using olive oil as fat substitut.

4-9-5:Total volatile fatty acids(TVFA):-

Values of T.V.F.A of yoghurt samples made from mixed milk and those made by using olive oil as fat substitute under investigation are presented in Table (29).

It is clear from this date that T.V.F.A values in the control samples were equivalent to 6.80 ml 0.1 N NaoH. in fresh samples, 6.8, 6.5 and 6.7 in yoghurt samples containing 25,50, and 75% of olive oil as a replacer of milk fat respectively. these results are in agreement with ***EL- Shibiny et al., (1979).***

During storage the T.V.F.A gradually increased reaching 11.14, 10.1, 9.5 and 9.36 mL equivalent to 0.1 N NaoH / 100 gm yoghurt after 8 days. These results are in agreement with ***Mehanna et al (1988).***

The increase of milk fat replacement with olive oil as fat substitute induced a noticeable reduction in total volatile fatty acids

This can be attributed to the lower content of olive oil from short chain fatty acids compared with milk fat.The obtained results are in accordance with ***EL- Shibiny et al (1979) and Mehanna et al., (1988***) where they found that storage period had significant effect on increasing T.V.F.A in stored yoghurt.

Table (29): Effect of different treatment on the total volatile fatty acid (T.V.FA)of manufactured yoghurt by using olive oil as fat substitute .

Storage period (days)	Control 100%fat	Percentage of olive oil replacement fat		
		25	50	75
Fresh	6.8	6.8	6.5	6.7
3	7.62	7.31	7.31	7.32
6	8.91	8.00	7.91	7.83
8	11.41	10.1	9.50	9.36

T.V.FA = ml.0.1 N NaOH/100 g. yoghurt

4-10- Sensory evaluation:-

Scores of organoleptic properties of yoghurt (appearance, flavour body and texture and total scores) as affected by the replacement of milk fat with olive oil and storage period. are shown in table (30). Adding olive oil to substitute of milk fat at a level of 25% decreased scores of the produced fresh yoghurt for flavour and body and texture compared with the control fresh yoghurt samples (made from mixed milk of 4% milk fat).

During the storage periods of 8 days ,it was noticed that increasing added olive oil to 50 % and 75 % as milk fat substitute minimized the flavour score of yoghurt which was accompanied by a noticeable decrease in body , texture than of the control one .This could be attributed to the distinct difference in the flavour of yoghurt containing olive oil which the mixed milk fat and may be due to the inhibitory effect of olive oil on volatile component produced by starter bacteria .

Moreover, the replacement of olive oil at difference percentages caused a noticeable effect on the total score and overall quality of fresh yoghurt and during the storage period of 8 day . This may be due to the superior flavour of milk fat and its physical properties which cause important contribution to platability as it acts as acarier and source of flavour components, and mouth feel of dairy emulsions ***Norris,(1990***).

These observations were also reported by **Al-*Saleh and Hammed (1992)*** on yoghurt made form camel butter oil , cow butter oil ,corn oil and sunflower oil with substitution of 50,75

and 100% of previous mentioned animal milk fats and different vegetable oils . All yoghurt samples showed similar trends.

Increasing the replacement level of milk fat substitute to 50% and 75% olive oil induced a noticeable decrease in the organoleptic properties of yoghurt samples.

On the other hand ,increasing cold storage period up to 8 days had obvious decrease of the total scores of yoghurt samples from different treatments.

All yoghurt samples were organoleplically accepted up to the end of storage period of 8 days receiving 82, 73, 64 and 55 points.

It is clear that ,olive oil had pronoumced effect on the all Organoleptic parameters that affect the acceptable quality of produced yoghurt from different treatments.

It can be concluded that, olive oil can be used as milk fat substitute at a level of 25% and 50% according to its nutritional point of view where it contained a high percent of long chain of unsaturated fatty acids (83%)compared with milk fat (50 %).

The produced yoghurt of low milk fat by replacing olive oil by 25% or 50% of milk fat avoid health problems associated with milk fat such as diobetes, hyper temsion galblondder disease and heart disease. These results were emphasized by many researchers as ***Ricci, (1969), Harman (1978) ,Turchetto and Mancini et al (1985), Charbonnier (1985), Grundy (1986), Viola and Audisio, (1987), Glauber et al.,(1988) and Kiritsakis, (1990).***

As the produced yoghurt with 25% and 50% olive oil as milk fat substitute seamed to be which of weak body and texture it can be mixed well before consumption and can be considered as a fermented drink milk product.

The obtained results dealing with the effect of substituting milk fat with different levels of olive oil on the organoleptic properties of yoghurt are in accordance with **Al-*Saleh and Hammed(1992)*** who studied the effect of substituting cows milk fat by different fats and oils on the yoghurt quality.They found highly significant correlation between the flavour and body and texture and score values of yoghurt samples obtained from different substitutions of milk fat with other fats and vegetable oils. This can be due to the yoghurt gel formation and the distinctive nutty taste and aromatic flavour of the produced products from mixed milk containing only milk fat. This findings were also mentioned by ***Tamime and Robinson,(1985)***

Table (30): Effect of substituting milk fat with different level of olive oil on the organoleptic properties of yoghurt

Treatments / Storage period		control	%replaced fat 25	%replaced fat 50	%replaced fat 75
Fresh	Appearance	9	9	9	9
	Body &Texture	59	55	58	55
	Flavour	30	26	23	20
	Total	98	90	90	84
3	Appearance	8	8	8	8
	Body &Texture	55	52	50	44
	Flavour	28	25	23	21
	Total	91	85	81	73
6	Appearance	8	6	6	6
	Body &Texture	52	50	44	40
	Flavour	28	23	22	10
	Total	88	79	72	65
8	Appearance	7	6	5	5
	Body &Texture	50	45	40	35
	Flavour	25	22	19	15
	Total	82	73	64	55