RESULTS & DISCUSSION

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1 .Prevalence of *Salmonella* on quail carcasses :

Salmonella is the most common pathogenic bacteria causing food infection, it may be present in quail carcasses as natural flora on the skin or intestinal tract and also may reach to the carcasses during plucking, washing, processing, packaging and handling (***Niemand, et al. 1977; Cho, et al., 1985; Katta, et al., 1991 and Hoda 1994***).

One hundred of quail carcasses were examined for the presence of *Salmonella* and the obtained results are shown in Table (1) it could be noticed that *Salmonella* was detected in 70 carcasses. indicating that 70% of the examined quail carcasses were contaminated with *Salmonella*.

The presence of *Salmonella* in poultry carcasses were reported by many investigators (***Morris and Wells, 1970; Dougherty, 1974; Reusse et al., 1976; Thayer, 1991 and Hoda 1994***). They found that the percentage of *Salmonella* positive in duck carcasses ranged between 7 to 57% depending on the country, method of handling and processing. Moreover, ***Kampelmacher (1981)*** reported that 60-70% of poultry production is contaminated with *Salmonella*. (In 1983), a survey on the presence of *Salmonella* in chicken carcasses was examined in Cairo and they found that 25-46% of examined chicken carcasses were contaminated by *Salmonella* according to the season ***El-Fouly (1983)*** while ***Dubbert (1988)*** estimated that 35% of chicken carcasses in the United States are contaminated with *Salmonella*.

Table (1): Detection of *Salmonella* on quail carcasses

No. of Samples.	T.S.I	L .D.B	No. of Samples.	T.S.I	L .D.B	No. of Samples.	T.S.I	L.D.B
1	+	+	34	+	+	67	+	+
2	+	+	35	+	+	68	+	+
3	+	+	36	-	-	69	+	+
4	+	+	37	-	-	70	+	+
5	-	-	38	+	+	71	-	-
6	-	-	39	+	+	72	-	-
7			40	+	+	73		
8	+	+	41	+	+	74	+	+
9	+	+	42	+	+	75	+	+
10	-	-	43	+	+	76	-	-
11	-	-	44	-	-	77	+	+
12	-	-	45	-	-	78	-	-
13	+	+	46	+	+	79	+	+
14	+	+	47	+	+	80	+	+
15	+	+	48	+	+	81	+	+
16	-	-	49	-	-	82	+	+
17	-	-	50	+	+	83	+	+
18	+	+	51	+	+	84	+	+
19	-	-	52	-	-	85	-	-
20	+	+	53	+	+	86	+	+
21	+	+	54	-	-	87	+	+
22	-	-	55	+	+	88	-	-
23	-	-	56	+	+	89	-	-
24	-	-	57	+	+	90	-	-
25	+	+	58	-	-	91	+	+
26	+	+	59	+	+	92	+	+
27	-	-	60	+	+	93	-	-
28	+	+	61	+	+	94	+	+
29	+	+	62	+	+	95	+	+
30	+	+	63	+	+	96	+	+
31	+	+	64	+	+	97	+	+
32	-	-	65	+	+	98	+	+
33	+	+	66	+	+	99	+	+
						100	+	+

Percentage of *Salmonella* positive samples =70/100x100 =70%
TSI = Triple sugar iron
LDB = Lysine decarboxylase broth

2. Effects of gamma irradiation and soaking in STPP on the chemical composition of quail carcasses:

The effects of gamma irradiation and soaking in STPP on moisture, crude protein, total lipids, ash and total carbohydrates contents of quail carcasses are presented in Table (2).

From data in Table (2) it could be noticed that the moisture content was 72.10 %, while the percentages of crude protein, total lipids, ash and total carbohydrates contents were 59.28, 32.38, 4.44 and 3.90% for quail carcasses, respectively (on dry weight basis). These results are in agreement with those obtained by ***Tolokonnikov, et al., (1983), Bayoumy (1986), Shim and Lee (1988), Ayorinde (1994) and Singh, et al., (1999)*** who found that quail meat contained about 67.0 – 74.2% moisture, 53.93 – 77.59% protein, 17.27 – 32.66% fat, 4.08 - 12.33% ash and 1.64 - 6.36% total carbohydrates depending on the age, genotype and protein concentration on the diet.

It is evident from the same results in Table (2) that there were no real effects of the applied gamma irradiation doses on the chemical composition of quail carcasses under investigation. These results are in agreement with those obtained by ***Hegazy (1987), El-Mongy (1990) and Hoda (1994)*** who found that gamma irradiation had no effects on the chemical composition of poultry carcasses and their products. It is obvious also that, soaking in STPP had no detectable effects on the chemical composition of quail carcasses. These results are in agreement with those noticed by ***Pandey, et al., (1982) and Koushik, et al.,***

Table (2): Effects of gamma irradiation and soaking in STPP on the chemical composition of quail carcasses.

Components (%)	control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
Moisture	72.10	71.57	70.92	71.26	72.02	71.59
Total lipid *	32.38	32.64	33.03	32.94	32.45	33.25
Crude protein*	59.28	58.75	58.98	58.66	59.32	59.03
Total ash *	4.44	4.81	4.12	4.69	4.71	4.18
Total Carbohydrates**	3.90	3.80	3.87	3.71	3.52	3.54

STPP = Sodium tripolyphosphate
* = On dry weight basis
** = Calculated by differences

(1983) as they found that polyphosphate (PP) and (STPP) treatments had no real effect on the chemical composition of quail and ready-to-cook broiler carcasses.

Generally it could be concluded that, gamma irradiation doses and soaking in STPP treatments had no real effects on the chemical composition of quail carcasses.

3. Effects of gamma irradiation and soaking in STPP on the sensory properties of quail carcasses during cold storage (4 ± 1°C):

Physical and chemical analyses are useful as a wide indicator of food quality, but it can not be accurately used to predict its sensory quality. Moreover, sensory tests are the final guide to assure the product quality. `

All quail carcasses under investigation were submitted to panelists to evaluate the changes in the sensory properties i.e. appearance, odour, colour and over all acceptability percentages and the degree of panelists are recorded in Table (3-6). The results indicate that no changes in the sensory properties were observed by treated samples with either gamma irradiation doses or soaking in STPP treatments. This finding confirm that the irradiation of quail carcasses under frozen condition kept their sensory properties. Similar results were noticed by many investigators ***Grunewald (1975); Grozdanove, et al., (1990); Lescano, et al., (1991); Abou-Tarboush, et al., (1997) and Afifi and El-Nashaby (2000)*** as they found that no changes in the

Table (3) :Effects of gamma irradiation and soaking in STPP on the appearance of quail carcasses during cold storage at 4±1°C .

Storage period (days)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	8.9	8.9	8.9	8.9	8.9	8.9
1	8.9	8.9	8.9	8.9	8.9	8.9
2	8.8	8.7	8.8	8.8	8.8	8.8
3	8.2	8.6	8.8	8.8	8.8	8.7
4	8.0	8.3	8.7	8.7	8.7	8.5
5	7.0	8.0	8.6	8.7	8.7	8.5
6	6.0*	7.8	8.5	8.7	8.7	8.2
7		7.7	8.4	8.6	8.7	8.0
8		7.3	8.3	8.5	8.6	7.0
9		7.0	8.2	8.5	8.6	6.0*
10		6.9	8.0	8.5	8.6	
11		6.4	7.8	8.5	8.5	
12		6.0*	7.5	8.5	8.4	
13			7.2	8.0	8.3	
14			6.4	7.8	8.2	
15			6.0*	7.5	8.2	
16				7.3	8.0	
17				7.0	7.8	
18				6.8	7.5	
19				6.7	7.3	
20				6.3	7.0	
21				5.8*	6.4	
22					6.2	
23					6.2	
24					5.8*	

STPP = Sodium tripolyphosphate
* = Unacceptable organoleptically and rejected

Table (4) :Effects of gamma irradiation and soaking in STPP on the odour of quail carcasses during cold storage at 4±1 °C .

Storage period (days)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	8.9	8.8	8.8	8.8	8.8	8.9
1	8.7	8.8	8.8	8.8	8.8	8.8
2	8.0	8.5	8.7	8.7	8.7	8.5
3	7.0	8.5	8.7	8.7	8.7	8.0
4	6.0	8.0	8.6	8.6	8.6	8.0
5	5.0	7.8	8.5	8.6	8.6	7.8
6	3.0*	7.6	8.5	8.6	8.6	7.5
7		7.0	8.3	8.3	8.5	7.0
8		6.6	8.0	8.2	8.3	5.2
9		6.0	7.8	8.0	8.2	3.0*
10		5.8	7.5	7.8	8.1	
11		5.4	7.0	7.8	8.0	
12		3.0*	6.5	7.5	8.0	
13			5.8	7.0	7.9	
14			5.2	6.7	7.8	
15			3.0*	6.2	7.8	
16				6.2	7.7	
17				6.6	7.0	
18				5.8	6.5	
19				5.2	6.0	
20				3.1	5.8	
21					5.5	
22					5.3	
23					5.0	
24					3.1*	

STPP = Sodium tripolyphosphate
* = Unacceptable organoleptically and rejected

Table (5) :Effects of gamma irradiation and soaking in STPP on the colour of quail carcasses during cold storage at 4±1 °C .

Storage period (days)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	8.9	8.9	8.9	8.8	8.8	8.9
1	8.9	8.8	8.8	8.7	8.7	8.9
2	8.7	8.8	8.8	8.7	8.7	8.5
3	8.0	8.6	8.7	8.7	8.7	8.0
4	7.0	8.4	8.6	8.6	8.7	8.0
5	6.0	8.3	8.5	8.6	8.6	7.8
6	5.8*	8.0	8.5	8.6	8.6	7.5
7		7.6	8.4	8.6	8.5	7.0
8		7.2	8.2	8.5	8.5	6.0
9		6.8	8.0	8.4	8.4	5.9*
10		6.3	7.8	8.4	8.4	
11		6.0	6.9	8.3	8.3	
12		5.8*	6.5	8.2	8.2	
13			6.2	8.0	8.0	
14			6.0	7.5	7.9	
15			5.7*	7.0	7.5	
16				6.8	7.8	
17				6.5	7.0	
18				6.2	6.7	
19				6.0	6.5	
20				5.8	6.3	
21				5.6*	6.0	
22					6.0	
23					5.8	
24					5.5*	

STPP = Sodium tripolyphosphate
* = Unacceptable organoleptically and rejected

Table (6) :Effects of gamma irradiation and soaking in STPP on the over all acceptability % of quail carcasses during cold storage at 4±1 °C .

Storage period (days)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	89.0	88.6	88.3	88.0	88.0	89.0
1	88.3	88.3	88.3	88.0	88.0	88.6
2	85.0	86.0	87.3	87.3	87.3	87.0
3	77.3	85.6	87.3	87.3	87.3	86.0
4	70.0	82.3	86.3	86.3	86.6	81.6
5	60.0	80.3	85.3	86.3	86.3	79.6
6	49.3*	78.0	85.0	86.3	86.3	77.3
7		74.3	83.6	85.0	85.6	73.3
8		70.3	81.6	84.0	84.6	60.0
9		66.0	80.0	83.0	84.0	49.6*
10		63.3	77.6	82.3	83.6	
11		59.3	72.3	82.0	82.6	
12		49.3*	68.3	80.6	82.0	
13			61.0	76.6	80.6	
14			58.6	73.3	79.6	
15			49.0*	69.0	79.3	
16				67.6	77.3	
17				65.0	72.6	
18				63.3	69.0	
19				61.6	66.0	
20				57.6	63.6	
21				48.3*	59.6	
22					58.3	
23					56.6	
24					48.0*	

STPP = Sodium tripolyphosphate
* = Unacceptable organoleptically and rejected

organoleptic properties of irradiated poultry meat and their products.

The same Table (3-6) showed also that the control quail samples which stored at 4 ± 1°C remained fresh and acceptable during the first 5 days of storage, while the samples were rejected by the panelists after 6 days due to, off odour (putrid smell) and sign of spoilage evident. Moreover, irradiated quail samples at doses of 2,4,6 and 8 kGy were rejected after 12, 15, 21 and 24 days of cold storage, respectively. Obviously, an existed relationship between the increase in the sensory scores and those of the bacterial counts. Thus, it can be noticed that the delayed spoilage changes occurred in irradiated samples were mainly due to radiation survivors (mostly Gram positive organisms) which are not as active growers as radiation sensitive (Gram negative organisms) ***(Barnes, 1960)***.

On the other hand, the same data indicated that the sensory properties of samples treated with STPP declined during storage till samples were rejected by the panelists after 9 days of storage. Similar results were observed by ***Pandey and Mahapatra (1982); Vareltiz, et al., (1997)*** and ***Singh, et al., (1999)*** as they reported that chilled quail and chicken carcasses can safely be stored for 8 days under refrigeration without much loss to their quality attributes.

Generally, it could be concluded that application of gamma irradiation at doses of 2,4,6 and 8 kGy could be used to prolong the shelf- life of quail carcasses for 6,9,15 and 18 days, respectively .While soaked samples in STPP can be stored for at least 3 days more than the control sample.

4. Effects of gamma irradiation and soaking in STPP on the over all acceptability percentages of quail carcasses during frozen storage at-18°C:

Data given in Table (7) show that gamma irradiation at doses of 2,4,6 and 8 kGy had no real effects on the over all acceptability percentages of irradiated samples which had 88.6, 88.3, 88.0 and 88.0% as compared with 89.0% for control and soaked samples in STPP treatment.

The same data in Table (7) show that the acceptability percentages of all samples under investigation were almost the same during the storage period which extended for about 6 months. At the end of storage period, all samples undertaken were found to be in excellent condition as expressed by the acceptability percentage given by the panelists.

It is obvious that appearance of deterioration during frozen storage was very slow and the rate of deterioration by time was too slow because of the stability of enzymatic reactions and microbiological spoilage under the solid state of freezing condition. These results are in agreement with those obtained by ***Singh and Panda (1987)*** who found that, sensory quality of quail meat gradually declined with increasing storage time but the meat remained sensory acceptable up to 6 months of frozen storage. Similar results were observed by ***Grozdanov, et al., (1990) and Hanan (1999)*** for broiler and minced meat.

Table (7):Effects of gamma irradiation and soaking in STPP on the over all acceptability (%) of quail carcasses during frozen storage at -18°C.

Storage period (month)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	89.0	88.6	88.3	88.0	88.0	89.0
1	88.8	88.3	88.3	88.0	88.0	89.0
2	88.5	88.0	88.0	87.8	87.8	88.8
3	88.0	87.8	87.8	87.5	87.5	88.3
4	87.8	87.5	87.5	87.3	87.0	88.0
5	87.3	87.0	87.0	87.0	86.8	87.8
6	87.0	87.0	86.8	86.5	86.3	87.3

STPP = Sodium tripolyphosphate

5. Effects of gamma irradiation and soaking in STPP on the microbial load of quail carcasses during cold storage:

5.1. Total bacterial count:

The total bacterial counts of control, irradiated and soaked quail carcasses under investigation were determined during cold storage (4 $\pm$ 1°C) and the results are tabulated in Table (8) and Fig. (1).

From these results it is clear that the mean of the initial total bacterial counts of the control sample was 1.5 x 10^5 cfu/g. ***Bayoumy (1991) and Reddy, et al., (1991)*** found that total bacterial counts of quail meat and quail carcasses were 1.4 x 10^5 cfu/g and 3.63 x $10^5/cm^2$, respectively. The high level of total bacterial in quail carcasses may be due to the various sources of contamination during manual plucking, eviscerating, washing and packaging of quail carcasses.

Subjecting quail carcasses samples to gamma irradiation caused a great reduction in total bacterial counts, and this reduction was proportional with irradiation dose. The total bacterial counts of irradiated quail carcasses at doses of 2 and 4 kGy was reduced by 97% and 99.9% as the counts reached 4.5 x 10^3 and 8.5x10 cfu/g, respectively. Moreover, no viable counts could be detected in samples irradiated at 6 and 8 kGy doses. The greatest reduction in the bacterial load is mainly due to the direct and indirect effects of gamma irradiation on the microorganisms as reported by ***Hegazy (1987); Lescano, et al.,***

Table (8):Effects of gamma irradiation and soaking in STPP on the total bacterial count of quail carcasses during cold storage at 4±1°C.

Storage period (days)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	$1.5x10^5$	$4.5x10^3$	$8.5x10$	Nil	Nil	$1.6x10^4$
3	$5.2x10^6$	$3x10^4$	$1.3x10^2$	Nil	Nil	$9.5x10^5$
6	$4.6x10^7$*	$8x10^4$	$15x10^2$	Nil	Nil	$8.6x10^6$
9		$6x10^5$	$7.5x10^4$	$6.5x10^2$	$5x10^2$	$1.9x10^7$*
12		$4x10^7$*	$12x10^5$	$9x10^3$	$7x10^3$	
15			$3.5x10^7$*	$31x10^4$	$2.5x10^4$	
18				$8.5x10^5$	$3x10^4$	
21				$2 x10^7$*	$2x10^5$	
24					$1 x10^7$*	

STPP = Sodium tripolyphosphate
* = Unacceptable organoleptically and rejected

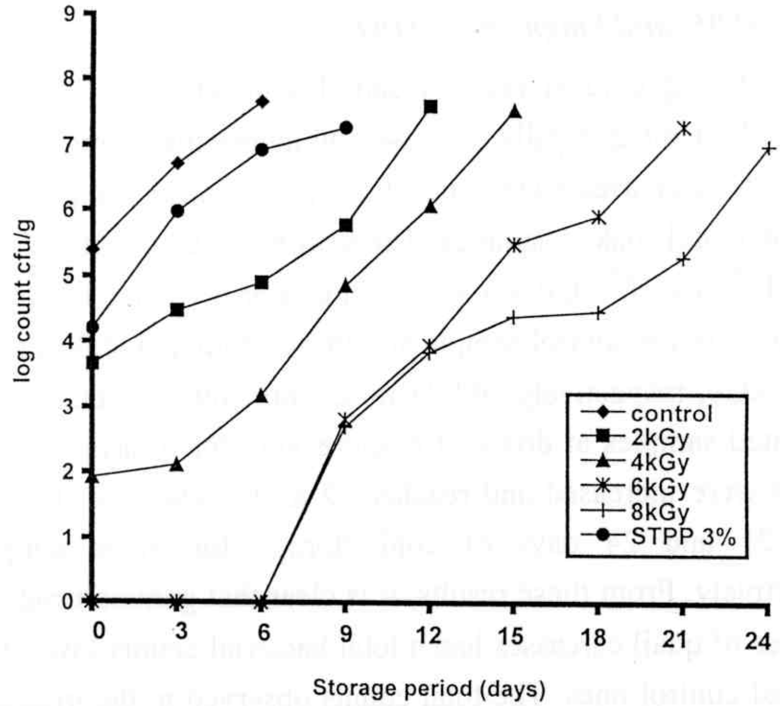

Fig.(1): Effects of gamma irradiation and soaking in STPP on the total bacterial count of quail carcasses during cold storage at 4± 1°C.

(1991); Kolsarica and Kirimica (1995) and Afifi and El-Nashaby (2000).

The same results reveal also that the total bacterial counts of soaked quail samples in STPP reduced by 89.3 % as the counts reached 1.6 x 10^4 cfu/g. Similar observations were obtained by ***Reddy, et al., (1991); Singh, et al., (1994). Panda, et al., (1995) and Singh, et al., (1999).***

During cold storage of samples under taken, the total bacterial counts generally increased by increasing storage period and these increases were much higher in control samples than irradiated and soaked samples. The total bacterial counts reached 4.6 x 10^7, 4 x 10^7 and 3.5 x 10^7 cfu/g after 6,12 and 15 days of cold storage for control sample and those irradiated at doses of 2 and 4 kGy, respectively. While no counts could be detected in irradiated samples at doses of 6 and 8 kGy for 6 days, then the counts were increased and reached 2 x 10^7 and 1 x 10^7 cfu/g after 21 and 24 days of cold storage for these samples, respectively. From these results, it is clear that gamma irradiated samples of quail carcasses had a total bacterial counts lower than those of control ones. The total counts observed in the irradiated samples may be due to the presence of a few members of aerobic bacterial cells and /or spores that could survive even upon exposure to the high doses used and grow at low temperatures (***Anderson, 1983***). These findings are in agreement with those obtained by ***El-Huseiny, et al., (1986 b); Lescano, et al., (1991) Kolsarica and Kirimica (1995); Badr (1998) and Afifi and El-Nashaby (2000).***

On the other hand, there was an increase in the total bacterial counts in treated samples with STPP and reached 1.9 x 10^7 after 9 days of cold storage, but the rate of increase was lower than the control ones. These results confirmed the findings obtained by ***Pandey and Mahapatra (1982); Reddy, et al., (1991); Panda, et al., (1995) and Singh, et al., (1999).*** However, the antibacterial property of STPP might be due to its ability to reduce the water activity (w_a) as well as to sequester metal ions which are essential factors for microorganisms ***(Ellinger, 1972 and Snyder and Maxcy, 1979).***

Generally, it could be concluded that the application of gamma irradiation treatments were more effective in reducing the total bacterial counts of quail carcasses samples under investigation as compared to soaked samples in STPP treatments.

5.2. Total psychrophilic bacteria:

The enumeration of psychrophilic microorganisms in foods that are to be stored at refrigeration temperature is important because their presence (particularly in large numbers) indicates a high potential for spoilage during cold storage. Raw foods held under refrigeration prior to processing, as well as non sterile heat processed foods that rely on refrigeration for shelf-life, are subjected to quality loss and possible spoilage by psychrophilic bacteria (***Gilliland et al., 1984***).

Table (9) and Fig.(2) show the effects of gamma irradiation and soaking in STPP treatments on the total psychrophilic bacteria in quail carcasses samples under investigation during cold storage (4 $\pm$ 1°C). These data reveal

Table (9): Effects of gamma irradiation and soaking in STPP on the total psychrophilic bacteria of quail carcasses during cold storage at 4±1°C.

Storage period (days)	control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	$14x10^4$	$2x10^2$	Nil	Nil	Nil	$25x10^3$
3	$5.5x10^5$	$7x10^3$	Nil	Nil	Nil	$3.5x10^4$
6	$38x10^6$*	$12x10^4$	$3.5x10^2$	Nil	Nil	$1.7x10^5$
9		$4.5x10^5$	$5x10^3$	Nil	Nil	$2.6x10^6$*
12		$6.5x10^6$*	$1.7x10^4$	$3.9x10^2$	$3.6x10^2$	
15			$9.8x10^5$*	$1.6x10^3$	$1.3x10^3$	
18				$2.5x10^4$	$1.2x10^4$	
21				$8.5x10^5$*	$2x10^5$	
24					$4.7x10^5$*	

STPP = Sodium tripolyphosphate
* = Unacceptable organoleptically and rejected

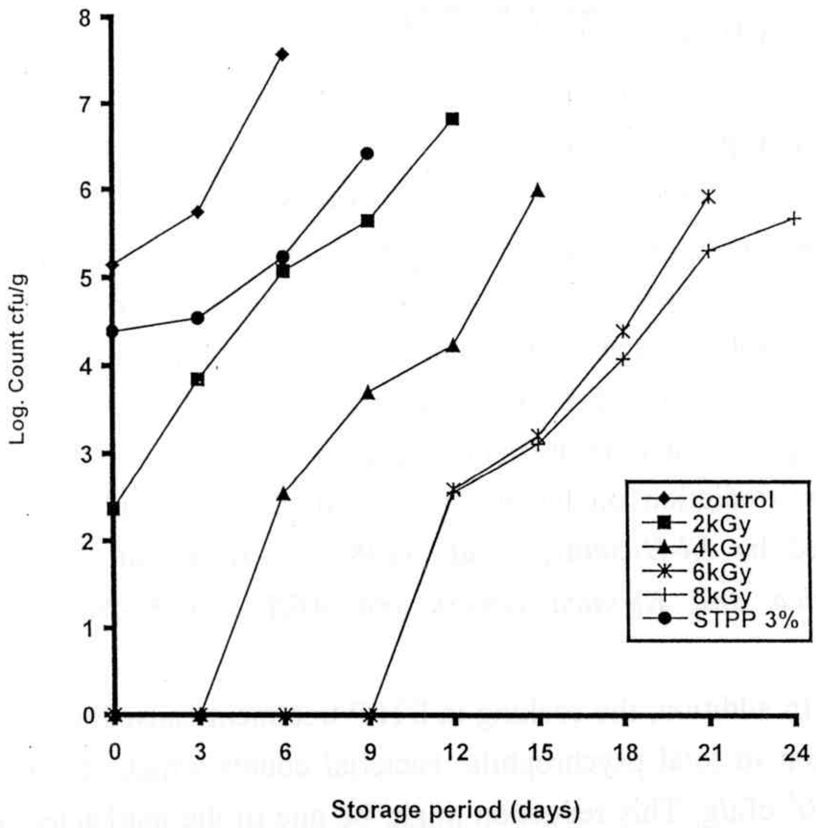

Fig.(2) : Effects of gamma irradiation and soaking in STPPon the total psychrophilic bacteria of quail carcasses during cold storage at 4±1°C.

that the initial count of total psychrophilic bacteria was 14×10^4 cfu/g in control sample of quail carcasses before storage. ***Bayoumy (1991) and Reddy, et al., (1991)*** found that psychrophilic bacterial counts of quail meat and quail carcasses were 2.4×10^5 cfu/g. and 1.16×10^4 /cm^2 , respectively.

It is evident from the obtained results that gamma irradiation greatly reduced the total psychrophilic bacterial counts presented in all quail carcasses samples under investigation, the counts reduced to 2×10^2 cfu/g. for samples received 2 kGy gamma irradiation dose. Meanwhile, the counts of psychrophilic bacteria were not detected in irradiated samples at doses of 4,6 and 8 kGy. This reduction in the counts of psychrophilic bacteria is mainly due to the direct effects of gamma irradiation on the microbial cell. Similar results were obtained by ***El-Huseiny, et al., (1986 b); Hammad (1994); Kolsarica and Kirimca (1995) and Afifi and El-Nashaby (2000).***

In addition, the soaking in STPP treatment caused a great reduction in total psychrophilic bacterial counts which reached 25×10^3 cfu/g. This reduction might be due to the antibacterial effects of STPP. These results confirmed the findings obtained by ***Reddy, et al., (1991).***

During cold storage (4 $\pm$ 1°C) of quail carcasses, the counts of total psychrophilic bacteria increased for all samples under investigation. The total psychrophilic bacteria reached 38×10^6 cfu/g. for control sample after 6 days of storage (rejection time) while, it reached 6.5×10^6 for samples irradiated at dose of 2 kGy after 12 days. Moreover, the psychrophilic bacteria were not also detected in irradiated samples at 4,6 and 8 kGy until 3,9 and 9 days of storage of these samples at 4 $\pm$ 1°C, then started to increase and reached 9.8 x 10^5, 8.5 x 10^5 and 4.7 x 10^5 cfu /g after 15, 21 and 24 days of storage for these samples, respectively.

Regarding the quail carcasses treated with STPP, total psychrophilic bacteria gradually increased and reached 2.6 x 10^6 cfu/g. after 9 days of storage at 4 $\pm$ 1°C, but the rate of increase was lower in treated samples than the control ones under the same condition. Similar results were achieved by ***Panda (1980); Reddy and Varadarajulu (1989) and Reddy, et al., (1991)*** for broiler and quail carcasses.

Generally, it could be concluded that the applied of gamma irradiation doses were more effective in reducing the total psychrophilic bacterial counts of quail carcasses samples under investigation as compared to soaking in STPP treatment.

5.3. Total mold and yeast counts:

Data tabulated in Table (10) and Fig. (3) represent the total mold and yeast counts post irradiation and soaking in STPP treatments and as well as during cold storage (4 $\pm$ 1°C) of these samples undertaken.

From these data, it could be noticed that the counts of total mold and yeast were 17 x 10^3 cfu/g. in control samples of quail carcasses before storage. It is clear that 2 and 4 kGy gamma irradiation doses greatly reduced the initial total mold and yeast counts by 97.1% and 99.3% as the counts reached 4.9 x 10^2 and 1.1 x 10^2 cfu/g. While the mold and yeast counts were not detected in irradiated quail carcasses samples at 6 and 8 kGy

Table (10): Effects of gamma irradiation and soaking in STPP on the total mold and yeast counts of quail carcasses during cold storage at 4±1°C.

Storage period (days)	control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	$17x10^3$	$4.9x10^2$	$1.1x10^2$	Nil	Nil	$23x10^2$
3	$9x10^4$	$12x10^2$	$3.8x10^2$	Nil	Nil	$8.5x10^3$
6	$18x10^4$*	$26x10^2$	$7.1x10^2$	Nil	Nil	$12x10^3$
9		$3.5x10^3$	$8x10^2$	7.8x10	Nil	$3.5x10^4$*
12		$22x10^3$*	$14x10^2$	$2.3x10^2$	Nil	
15			$7x10^3$*	$3.4x10^2$	Nil	
18				$4x10^2$	Nil	
21				$6.5x10^2$*	Nil	
24					Nil *	

STPP = Sodium tripolyphosphate
* = Unacceptable organoleptically and rejected

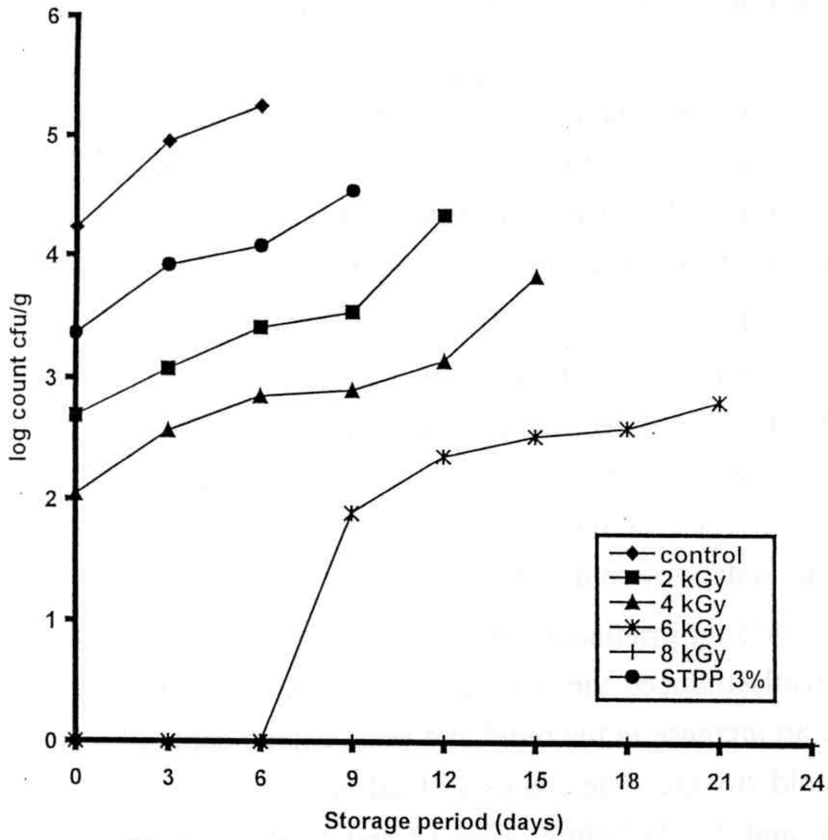

Fig. (3): Effects of gamma irradiation and soaking in STPP on the total mold and yeast counts of quail carcasses during cold storage at 4±1°C.

gamma irradiation doses. These results are in agreement with those obtained by ***El-Mongy (1990); Lescano, et al., (1991); Abou-Tarboush, et al., (1997) and Afifi and El-Nashaby (2000).***

On the other hand, soaking in STPP treatment decreased the total mold and yeast counts by 86.4% as the counts reached 23 x 10^2 cfu/g. for quail carcasses samples. ***Ellinger (1972)*** reported that medium-chain polyphosphates were inhibitors of fungal spoilage of meats, poultry and sea food.

The same results further show that the counts of total mold and yeast increased during cold storage (4 $\pm$ 1°C) in all samples under investigation but the increase was higher in control ones. The total mold and yeast counts reached 18 x 10^4 cfu/g. after 6 days of cold storage.

Regarding irradiated samples, although gamma irradiation could greatly reduced the mold and yeast counts or retarded its increase an increase in the mold and yeast counts could observed during cold storage. The counts of total mold and yeast reached 22 x 10^3 and 7 x 10^3 cfu/g. after 12 and 15 days for irradiated samples at doses of 2 and 4 kGy, respectively. While total molds and yeasts were not also detected in irradiated samples of quail carcasses at dose of 6 kGy until 6 days of storage for these samples at 4 $\pm$ 1°C, then the counts started to increase and reached 6.5 x 10^2 cfu/g after 21 days of storage, indicating the high radio-resistance of molds and yeasts present in samples. Molds and yeasts were not detected during cold storage of quail carcasses samples received 8 kGy gamma irradiation dose till the rejection time. These results are in agreement with those obtained by ***El-Mongy (1990); Abou-Tarboush, et al., (1997) Badr (1998) and Hanan (1999).***

Regarding the quail carcasses treated with STPP, total mold and yeast counts gradually increased and reached 3.5 x 10^4 cfu/g. after 9 days of storage at 4 $\pm$ 1°C, but the rate of increase was lower in soaked samples than the control ones. These results are in agreement with those obtained by ***Panda, et al., (1995).***

6.Effects of gamma irradiation and soaking in STPP on the pathogenic bacteria of quail carcasses during cold and frozen storage:

6.1. Cold storage (4 +1°C):

6.1.1.*Salmonella:*

The detection of *Salmonella* on quail carcasses has been undertaken immediately after irradiation and soaking in STPP treatments and periodically every three days during cold storage of samples (4 $\pm$ 1°C) and the obtained results are presented in Table (11).

From the tabulated results, it could be noticed that *Salmonella* was detected in control and soaked samples in STPP at zero time and during cold storage (4 $\pm$ 1°C) of samples under investigation, while it could not be detected in irradiated samples at doses of 2,4,6 and 8 kGy. These results indicated that gamma irradiation dose of 2 kGy was effective in complete destruction of *Salmonella* present in quail samples. This may be due to the sensitivity of *Salmonella* to the radiation treatment (***Licciardello, et al., 1968***). These results are in agreement with those obtained

Table (11):Effects of gamma irradiation and soaking in STPP on the presence of *Salmonella* of quail carcasses during cold storage at 4±1°C.

Storage period (days)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	+	-	-	-	-	+
3	+	-	-	-	-	+
6	+ *	-	-	-	-	+
9		-	-	-	-	+ *
12		- *	-	-	-	
15			- *	-	-	
18				-	-	
21				- *	-	
24					- *	

STPP = Sodium tripolyphosphate
+ = Positive
- = Negative
* = Unacceptable organoleptically and rejected

by ***Mulder, et al., (1977); El-Mongy (1990); Lescano, et al., (1991); Lamuka, et al., (1992) and Abou-Tarboush, et al., (1997)*** who reported that elimination of *Salmonella* from poultry and poultry meat required 2.5 kGy. While the inactivation of *Salmonella* on chilled or frozen chicken carcasses by using 0.25 and 0.5 kGy gamma irradiation doses has been proved by ***Kramomtong and El-Fouly (1981) and El-Mongy (1983).***

6.1.2. *Streptococcus faecalis:-*

Streptococcus faecalis is another means agent, but less acute, as food borne disease. Table (12) and Fig. (4) show the obtained results of *Streptococcus faecalis* counts in quail carcasses samples as affected by gamma irradiation and soaking in STPP treatments during cold storage (4 ± 1°C).

These data indicated that, the counts of *Streptococcus faecalis* in control sample was 9.5×10^4 cfu /g before storage. ***El-Mongy (1983)*** found that the *Streptococcus faecalis* counts in skin chicken carcasses ranged from 2.7×10^3 to more than 10^4 cfu/cm^2. The same results revealed also that the increase in exposure levels of quail samples to gamma irradiation caused a great reduction in the counts of *Streptococcus faecalis*.

The application of 2 kGy gamma irradiation dose was not sufficient for complete elimination of *Streptococcus faecalis*, however, greatly reduced its initial counts by 99.8% as the counts reached 1.8×10^2 cfu/g. in samples of quail carcasses. While increasing gamma irradiation dose to 4,6 and 8 kGy made

Table (12) :Effects of gamma irradiation and soaking in STPP on *Streptococcus faecalis* of quail carcasses during cold storage at 4±1°C.

Storage period (days)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	$9.5x10^4$	$1.8x10^2$	Nil	Nil	Nil	$12x10^3$
3	$14\ x10^4$	$2.5x10^2$	Nil	Nil	Nil	$22x10^3$
6	$7x10^5$ *	$3x10^3$	Nil	Nil	Nil	$3x10^4$
9		$1.5x10^4$	Nil	Nil	Nil	$1.5x10^5$*
12		$5x10^4$*	Nil	Nil	Nil	
15			Nil *	Nil	Nil	
18				Nil	Nil	
21				Nil *	Nil	
24					Nil *	

STPP = Sodium tripolyphosphate

* = Unacceptable organoleptically and rejected

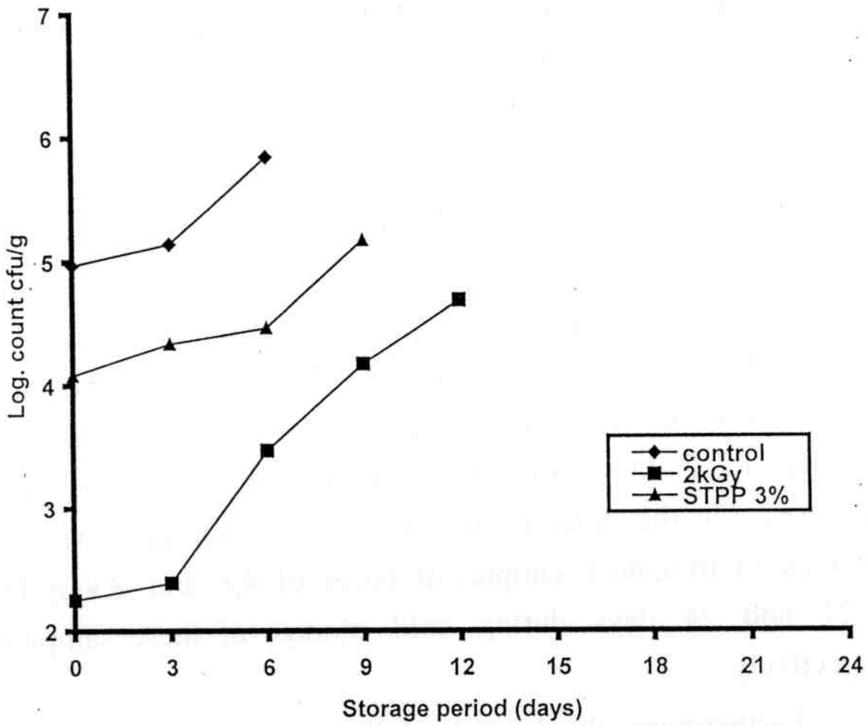

Fig.(4):Effects of gamma irradiation and soaking in STPP on *Streptococcus faecalis* of quail carcasses during cold storage at 4± 1°C.

the irradiated quail samples free from this food borne pathogen. These results are in agreement with those obtained by ***El-Huseiny, et al., (1986 a)*** and ***Hammad, et al., (1996)*** who found that no-growth of *Streptococcus faecalis* could be detected in chicken carcasses and fresh beef sausage irradiated with doses 3 and 4 kGy.

Meanwhile, soaking in STPP treatment caused a slight reduction in the counts of *Streptococcus faecalis*. The counts of this microorganism could be reduced by 87.3% as the counts reached 12 x 10^3 cfu/g in samples of quail carcasses.

During cold storage (4 $\pm$ 1°C) of quail carcasses samples undertaken, another increase in the counts of *Streptococcus faecalis* were observed in both control and irradiated samples at 2 kGy dose. The counts reached 7 x 10^5 cfu/g. in control samples after 6 days, while it reached 5 x 10^4 cfu/g in samples exposed to 2 kGy after 12 days of cold storage for quail carcasses. On the other hand, *Streptococcus faecalis* was not detected in irradiated samples at doses of 4,6 and 8 kGy for 15,21 and 24 days during cold storage of these samples, respectively.

Furthermore, the increase in the counts of *Streptococcus faecalis* was observed in soaked samples in STPP of quail carcasses, the counts reached 1.5 x 10^5 in treated samples after 9 days of cold storage, but the rate of increase was lower than the control sample.

Generally, it could be concluded that application of gamma irradiation at dose of 4 kGy was enough and sufficient for complete destruction of this food borne pathogen.

6.2. Frozen storage (-18°C):

6.2.1. *Salmonella:*

The detection of *Salmonella* on quail carcasses has been examined post irradiation and soaking in STPP treatments and periodically every month during frozen storage for 6 months and the results are presented in Table (13).

From these results, it could be noticed that *Salmonella* was detected in control samples and those soaked in STPP, even after 6 months of frozen storage (Table, 13), indicating that neither freezing nor soaking in STPP treatments were effective for elimination of *Salmonella*. These results are in agreement with those reported by ***Brayn, et al., (1968) and Obafemi and Davies (1985)*** who found *Salmonella* on frozen poultry and reported that freezing process and frozen storage were insufficient to kill all *Salmonella* in poultry carcasses. Similar results were also obtained by ***Hoda (1994)*** for Pekin duck samples.

On the other hand, frozen quail carcasses samples exposed to 2,4,6 and 8 kGy gamma irradiation doses were found to be *Salmonella* free, indicating that these irradiation doses were destructed *Salmonella* of frozen quail samples post irradiation and during frozen storage period for 6 months at – 18°C.

From the above mentioned results it could be concluded that 2 kGy dose was sufficient for elimination of *Salmonella* naturally contaminated quail carcasses samples.

Table (13): Effects of gamma irradiation and soaking in STPP on the presence of *Salmonella* of quail carcasses during frozen storage at -18°C.

Storage period (month)	control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	+	-	-	-	-	+
1	+	-	-	-	-	+
2	+	-	-	-	-	+
3	+	-	-	-	-	+
4	+	-	-	-	-	+
5	+	-	-	-	-	+
6	+	-	-	-	-	+

STPP = Sodium tripolyphosphate
+ = Positive
- = Negative

6.2.2. *Streptococcus faecalis*:

Streptococcus faecalis is considered of faecal origin and its presence in food indicates that the food may have been exposed to contamination, either directly or indirectly.

Data in Table (14) show that the average of initial count of *Streptococcus faecalis* in control sample was 9.5 x 10^4 cfu/g before storage , this count was gradual decreased during frozen storage at -18°C and reached 2.5x10^2 cfu/g. after 6 months of storage. Meanwhile, the counts of *Streptococcus faecalis* were gradually decreased from 1.8 x 10^2 at zero time to 3.9x10 cfu/g in irradiated quail samples at 2 kGy dose and stored for the above mentioned storage period, indicating that this irradiation dose accompanied by frozen storage rendering quail samples safe. While increasing gamma irradiation dose to 4,6 and 8 kGy were completely destroyed the cells of *Streptococcus faecalis* and this pathogen did not appear in irradiated samples for 6 months during frozen storage. These results are in agreement with those obtained by ***El-Huseiny, et al., (1986 a)*** who found that *Streptococcus faecalis* could not be detected in irradiated chicken carcasses at dose of 3 or 5 kGy neither immediately after irradiation nor during the storage period at -18°C.

From the results in Table (14) it could be noticed that soaking treatment with STPP reduced the count of *Streptococcus faecalis* from 9.5 x 10^4 cfu/g for control samples to 12 x 10^3 for soaked samples in STPP. A gradual decrease in count of *Streptococcus faecalis* was observed during storage period at -18°C and reached 1.4 x 10^2 cfu/g after 6 month of frozen storage.

Table (14):Effects of gamma irradiation and soaking in STPP on *Streptococcus faecalis* of quail carcasses during frozen storage at -18°C.

Storage period (month)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	$9.5x10^4$	$1.8x10^2$	Nil	Nil	Nil	$12x10^3$
1	$23x10^3$	$1.2x10^2$	Nil	Nil	Nil	$85x10^2$
2	$18x10^3$	9x10	Nil	Nil	Nil	$51x10^2$
3	$5x10^3$	7.3x10	Nil	Nil	Nil	$19x10^2$
4	$7x10^2$	6.5x10	Nil	Nil	Nil	$5.5x10^2$
5	$4.5x10^2$	5.2x10	Nil	Nil	Nil	$3x10^2$
6	$2.5x10^2$	3.9x10	Nil	Nil	Nil	$1.4x10^2$

STPP = Sodium tripolyphosphate

7. Effects of gamma irradiation and soaking in STPP on the total volatile basic nitrogen (TVBNmg/100g) content of quail carcasses during cold and frozen storage:

7.1. Cold storage (4 ±1°C) :

The changes in the TVBN content is considered a chemical quality index of quail carcasses during cold storage (4 ±1°C) as affected by gamma irradiation and soaking in STPP treatments (Table 15 and Fig 5).

From the obtained results of Table (15) and Fig. (5) it could be observed that the content of TVBN in the control sample was 10.57 mg/ 100 g sample (on wet weight basis). These results , almost agreed with the findings obtained by ***Bayoumy (1986)*** Who indicated that TVBN of raw fresh quail meat was 11.20 mg /100g.

Data presented in Table (15) show also that gamma irradiation at different applied doses had no real changes in the TVBN values in the irradiated samples as compared to control one. These results are in agreement with those obtained by ***Badr (1998); El-Khawas, et al., (1999) and Afifi and El – Nashaby (2000)*** who reported that gamma irradiation had no real effect of the TVBN content on meat, minced fish and chicken meat products.

On the contrary, results also reveled that the TVBN decreased by soaking in STPP treatment it decreased from 10.57 to 9.48 mg /100 g sample. This decrease could be due to the ability of STPP to reduce microbial load ***(Tompkin, 1983 and***

Table (15): Effects of gamma irradiation and soaking in STPP on the total volatile basic nitrogen (TVBN mg/ 100g) content of quail carcasses during cold storage at 4±1°C.

Storage Period (days)	Control	Irradiation dose(kGy)				STPP 3%
		2	4	6	8	
0	10.57	10.56	10.58	10.62	10.65	9.48
3	18.25	14.92	13.89	12.38	11.56	15.60
6	26.54*	17.73	17.36	13.35	13.20	20.53
9		22.42	20.12	15.67	14.19	24.38*
12		26.36*	22.63	17.44	15.77	
15			26.24*	19.84	17.82	
18				22.50	20.36	
21				25.79*	22.18	
24					25.12*	

STPP = Sodium tripolyphosphate
* = Uunacceptable organoleptically and rejected

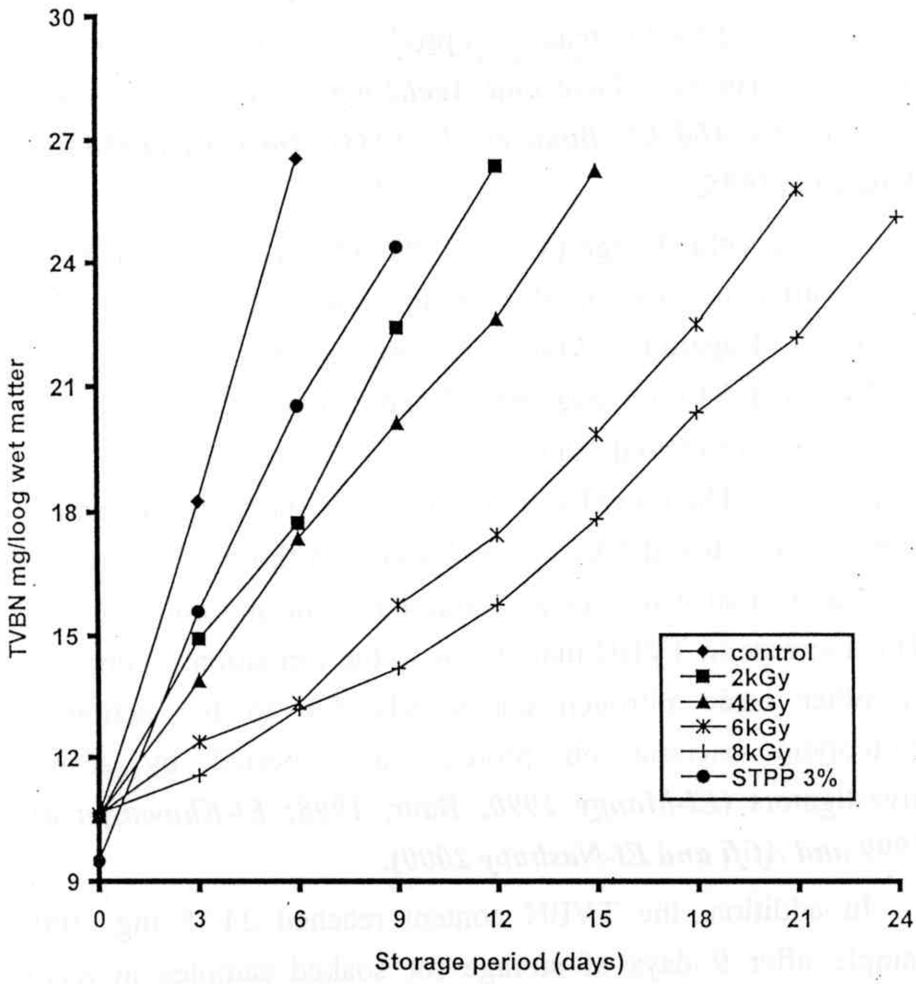

Fig.(5): Effects of gamma irradiation and soaking in STPP on the total volatile basic nitrogen (TVBN) content of quail carcasses during cold storage at 4± 1°C .

Molins, et al. 1985) and its react with meat protein producing a surface film on the treated samples, which may protect meat proteins from the actions of proteolytic enzymes and therefor could reduce protein breakdown products and volatile substances in treated samples (***Love and Abel,1966***). Similar results were obtained by ***Abd El- Baki, et al. (1983); Darwish (1986) and Moawad (1995).***

During cold storage (4 ±1°C), the TVBN reached 26.54 mg /100g after 6 days of storage for control sample of quail carcasses. Regarding, irradiated samples, the TVBN reached 26.36 and 26.24 mg /100g after 12 and 15 days of cold storage (4 ±1°C) for irradiated samples at doses of 2 and 4 kGy, respectively. The rate of increase in TVBN of irradiated samples at high level (6 and 8 kGy) was lower than those of control and irradiated quail carcasses at 2 and 4 kGy during cold storage . This increase in TVBN mainly due to the formation of ammonia or other basic nitrogen compounds due to the action of proteolytic bacteria on proteins as reported by several investigators (***El-Mongy 1990; Badr, 1998; El-Khawas,et al., 1999 and Afifi and El-Nashaby 2000***).

In addition, the TVBN content reached 24.38 mg /100g sample after 9 days of storage for soaked samples in STPP treatment.

Generally, it could be concluded that the all treatments under investigation increased the TVBN content of quail carcasses during cold storage (4 ±1°C). However, the rate of increase was lower in irradiated samples especially at higher doses than those of both control and soaked samples in STPP.

7.2. Frozen storage (–18°C):

It is known that TVBN could be used as an indication of protein breakdown during frozen storage ***(Khan, et al., 1963*** and ***Mohamed 1974).*** Table (16) and Fig. (6) represent the TVBN content of quail carcasses as affected by either gamma irradiation or soaking in STPP treatments during frozen storage at –18°C up to 6 months. As shown, the initial TVBN of control sample was 10.57 mg./100g (on wet weight basis). Gamma irradiation had no real effects on the TVBN content for irradiated samples, while it decreased by soaking in STPP treatment

It is obvious from the same Table that the TVBN content increased by increasing storage periods and reached 13.88, 13.92, 13.89, 13.90 and 13.90 mg./100g for control and irradiated samples at doses of 2,4,6 and 8 kGy after 6 months of storage at - 18°C, respectively. These results agreed with those obtained by ***Abd El-Wahed (1986); Bayoumy (1986); El-Mongy (1990) and Hanan (1999).*** However, the increase in the TVBN during freezing and frozen storage of quail carcasses samples, could be due to the breakdown of proteins by microbial activity and tissue enzymes **(*Pearson, 1968 and Shehata, 1974*).**

On the other hand, the lowest increase in TVBN during frozen storage was obtained by soaking samples in STPP as compared with the other treatments and reached 12.68 mg./100g after 6 months of frozen storage at - 18°C. These results indicated that the soaked samples showed slower breakdown of proteins than the other treatments. Similar results were reported by ***Abd El-Baki, et al., (1983); Darwish (1986) and Moawad***

Table (16): Effects of gamma irradiation and soaking in STPP on the total volatile basic nitrogen (TVBN mg/100g) content of quail carcasses during frozen storage at-18°C.

Storage period (month)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	10.57	10.56	10.58	10.62	10.65	9.48
1	11.71	12.25	12.34	12.67	12.71	10.07
2	12.09	12.32	12.80	12.86	13.10	10.67
3	12.38	12.50	13.02	13.32	13.42	11.14
4	13.49	13.67	13.79	13.80	13.87	11.48
5	13.65	13.79	13.85	13.92	13.98	11.89
6	13.88	13.92	13.89	13.90	13.90	12.68

STPP = Sodium tripolyphosphate

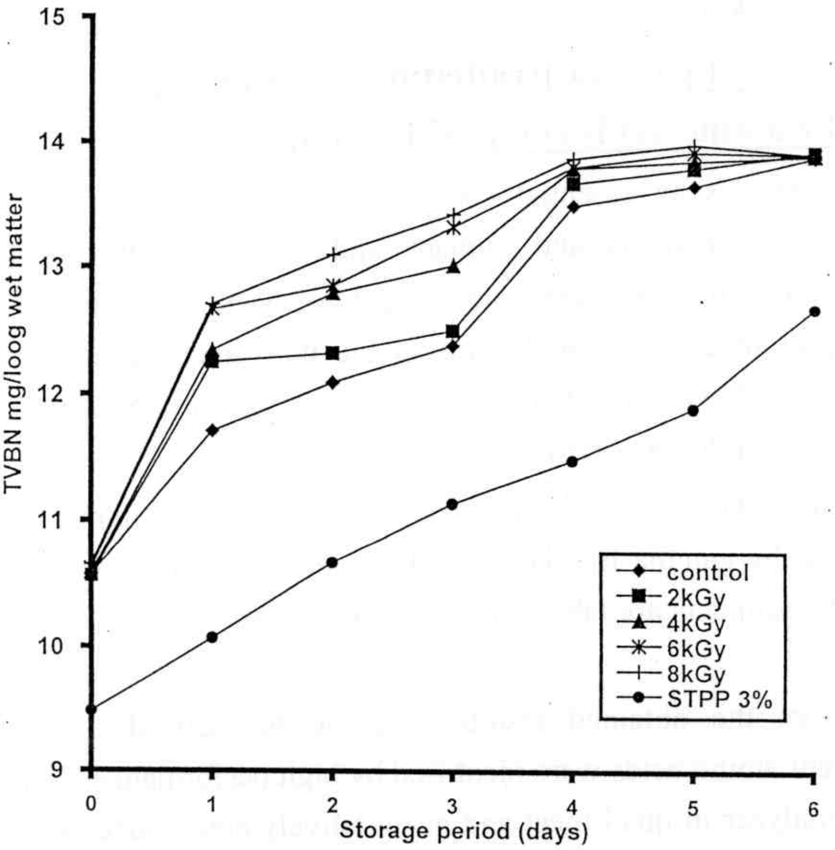

Fig (6): Effects of gamma irradiation and soaking in STPP on the total volatile basic nitrogen (TVBN) content of quail carcasses during frozen storage at-18°C.

(1995). The reduction in TVBN in treated samples could be due to as reported by (***Love and Abel, 1966; Tompkin, 1983 and Molins, 1985***).

8.Effects of gamma irradiation and soaking in STPP on the amino acids composition of quail carcasses:

Protein is an essential component of the diet needed for survival of animals and humans and its basic function in nutrition is to supply adequate amounts of needed amino acids. The protein quality also known as the nutritional or nutritive value of a food, depends on its amino acid content among other factors (***Friedman, 1996***).

The changes in the amino acids content of quail meat as affected by gamma irradiation at different doses and soaking in STPP treatments are tabulated in Table (17) and Figured in Fig. (7-12).

From the obtained results, it could be noticed that 17 different amino acids were identified by high performance amino acid analyzer in quail meat and quantitatively determined which presented a total amino acids content of 562,559,557,557,556 and 558 mg/g sample for control, irradiated at 2,4,6 and 8 kGy and soaked samples, respectively. Glutamic acid was the predominant amino acid (96 mg/g sample) followed by aspartic (58), leucine and lysine (48), arginine (36), alanine (35) and glycine (37 mg/g sample).

It is obvious from the above mentioned results that, gamma irradiation and soaking in STPP treatments had no detectable effects on the amino acids content of quail meat. Similar results

Table (17): Effects of gamma irradiation and soaking in STPP on the amino acids composition of quail carcasses .

Amino acids Composition	control	Irradiation dose(kGy)				STPP 3%
		2	4	6	8	
Aspartic	58	59	57	58	57	59
Threonine*	28	28	29	28	27	29
Serine	26	27	26	27	26	27
Glutamic	96	95	97	96	97	96
Proline	23	23	22	22	23	22
Glycine	33	33	33	32	33	32
Alanine	36	36	35	34	35	36
Cystine	6	7	5	5	5	5
Valine*	23	22	23	23	23	22
Methionine*	16	14	15	16	15	16
Isoleucine*	23	22	23	23	22	22
Leucine*	48	48	49	49	48	49
Turosine	19	18	19	18	18	19
Phenyalanine*	25	25	24	25	24	24
Histidine*	16	17	16	15	16	17
Lysine*	48	47	47	48	49	48
Arginine*	38	38	37	38	38	37
Total Amino Acid mg/g Samples	562	559	557	557	556	558

STPP = Sodium tripolyphosphate
* = essential amino acids .

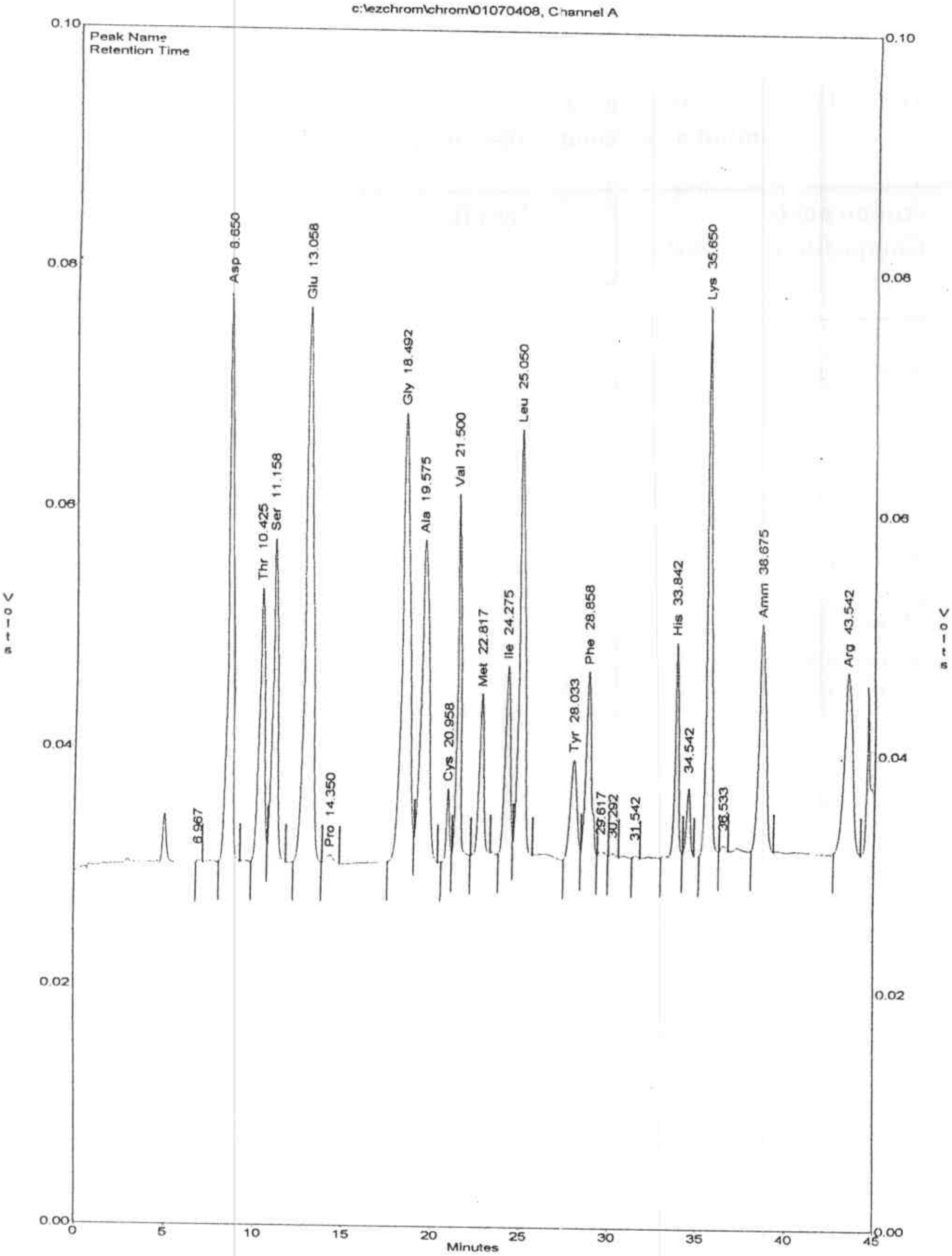

Fig. (7) : Chromatographic analysis of the amino acids components of quail carcasses.

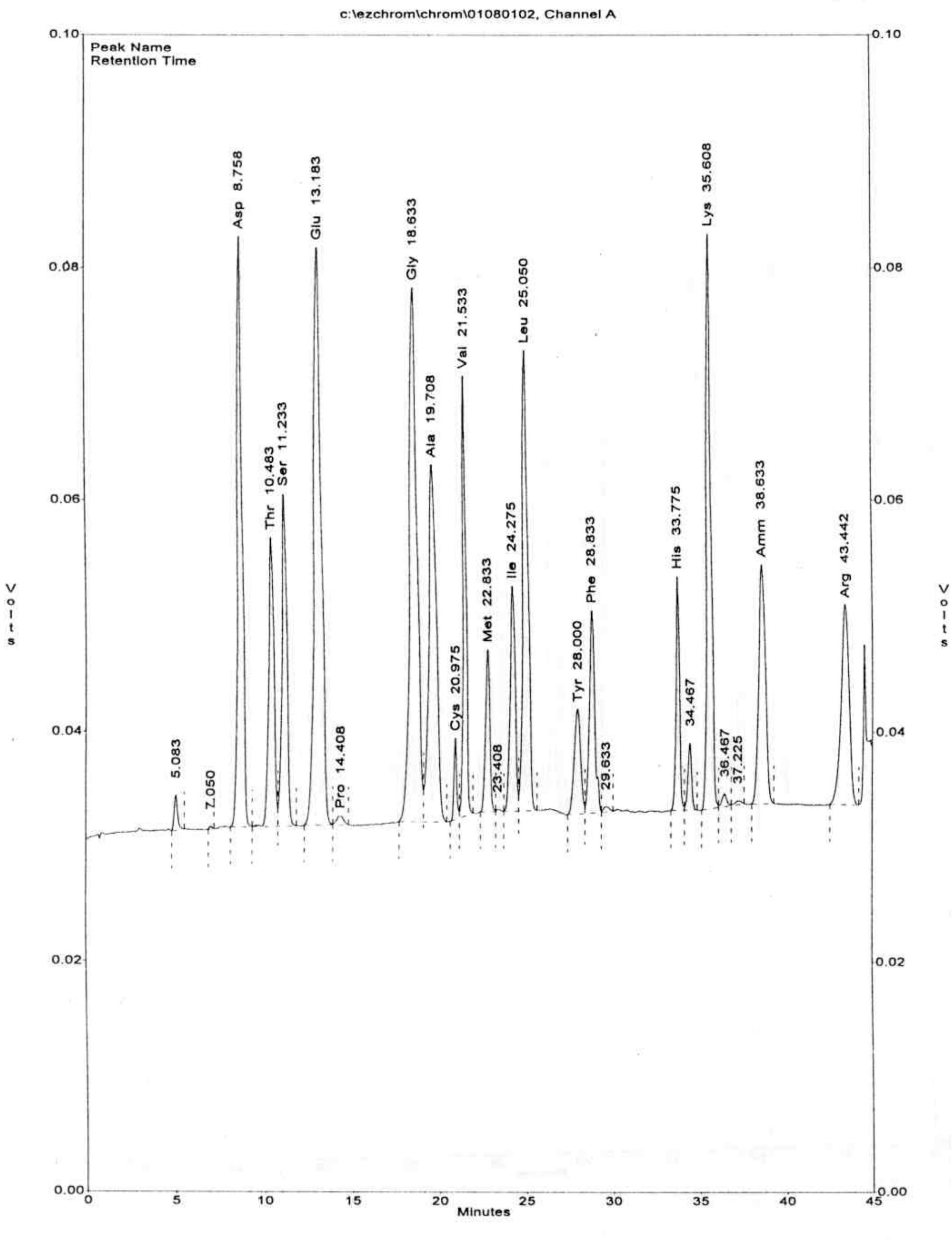

Fig. (8) : Effect of 2 kGy gamma irradiation dose on the amino acids composition of quail carcasses.

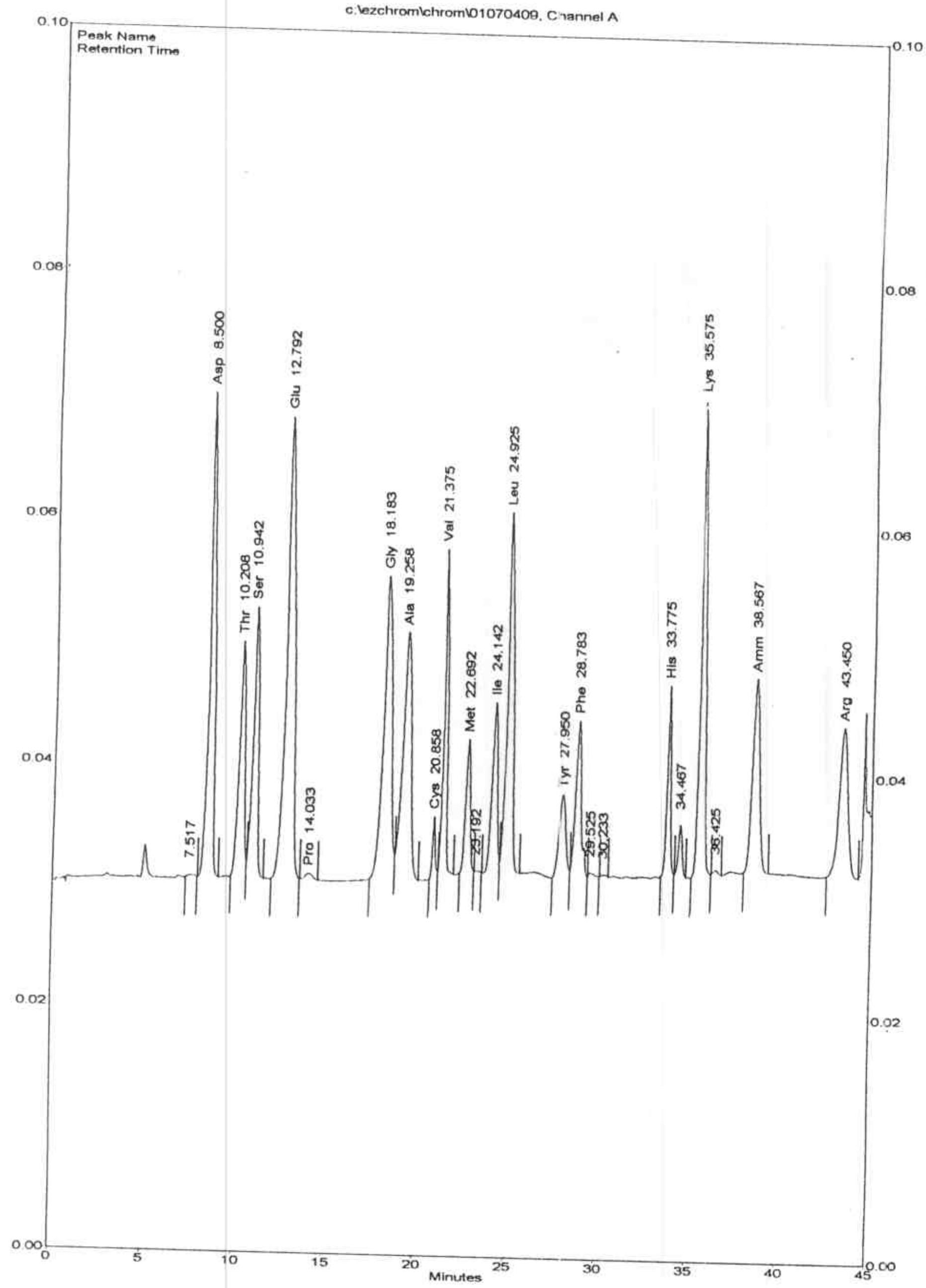

Fig. (9) : Effect of 4 kGy gamma irradiation dose on the amino acids composition of quail carcasses.

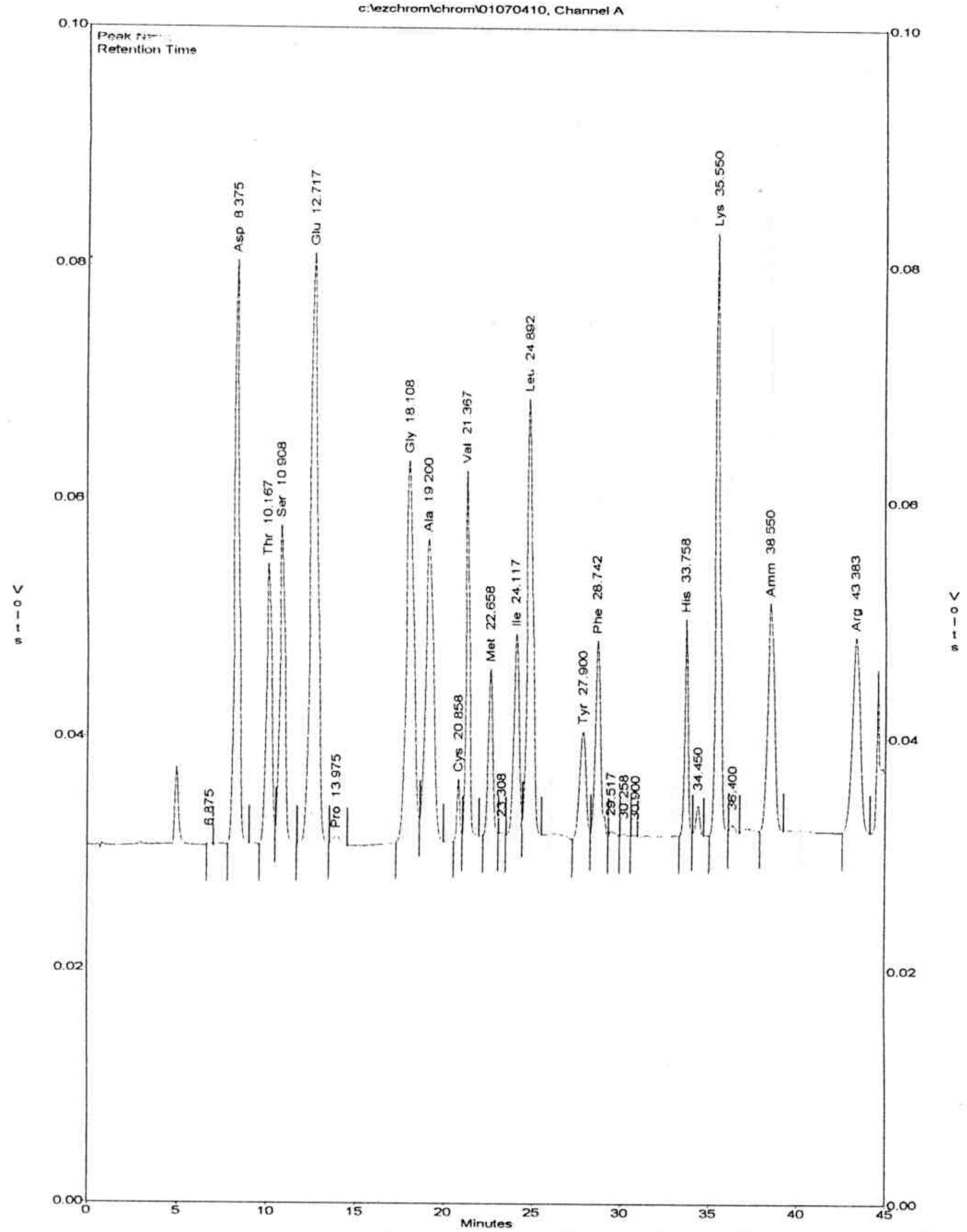

Fig. (10) : Effect of 6 kGy gamma irradiation dose on the amino acids composition of quail carcasses.

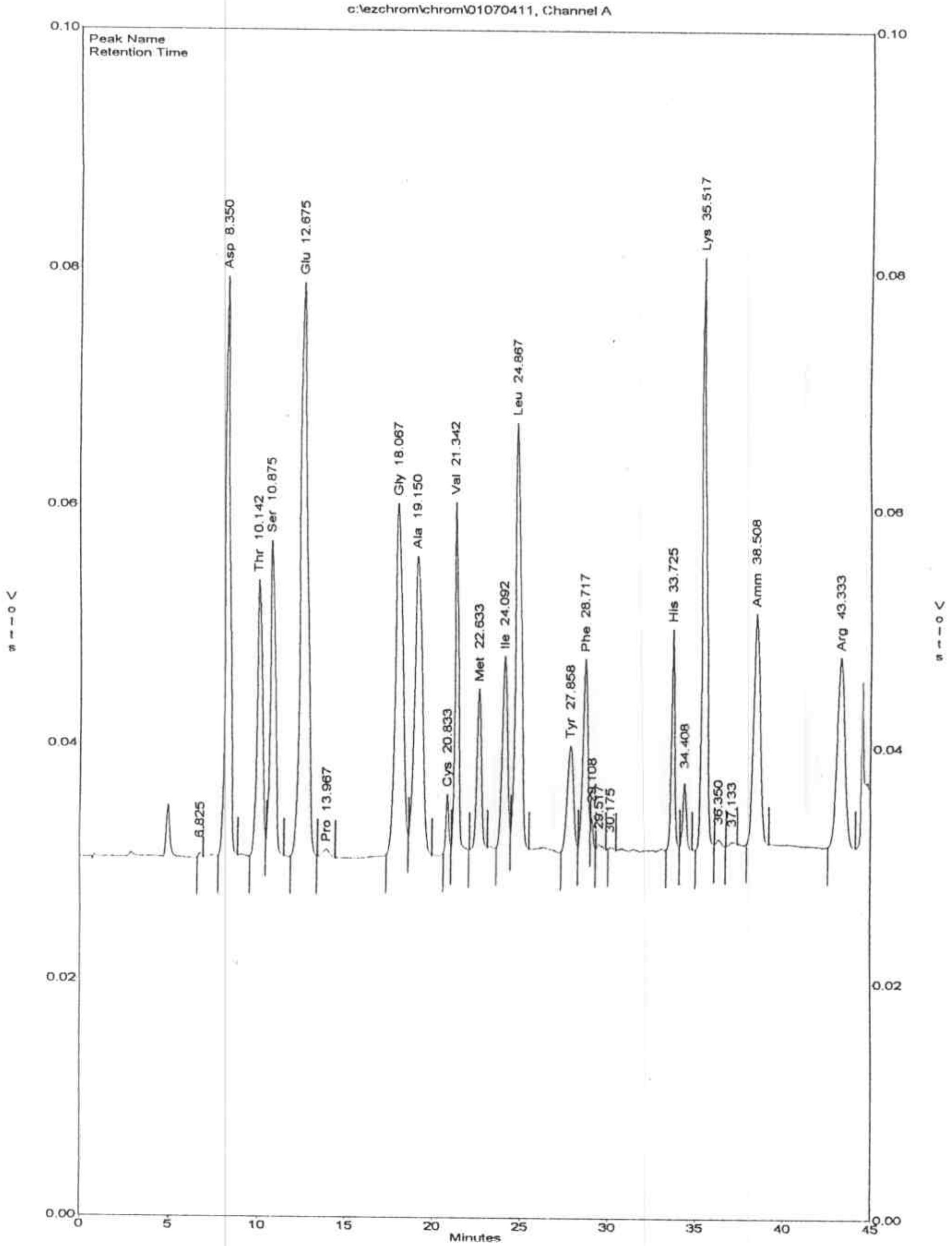

Fig. (11) : Effect of 8 kGy gamma irradiation dose on the amino acids composition of quail carcasses.

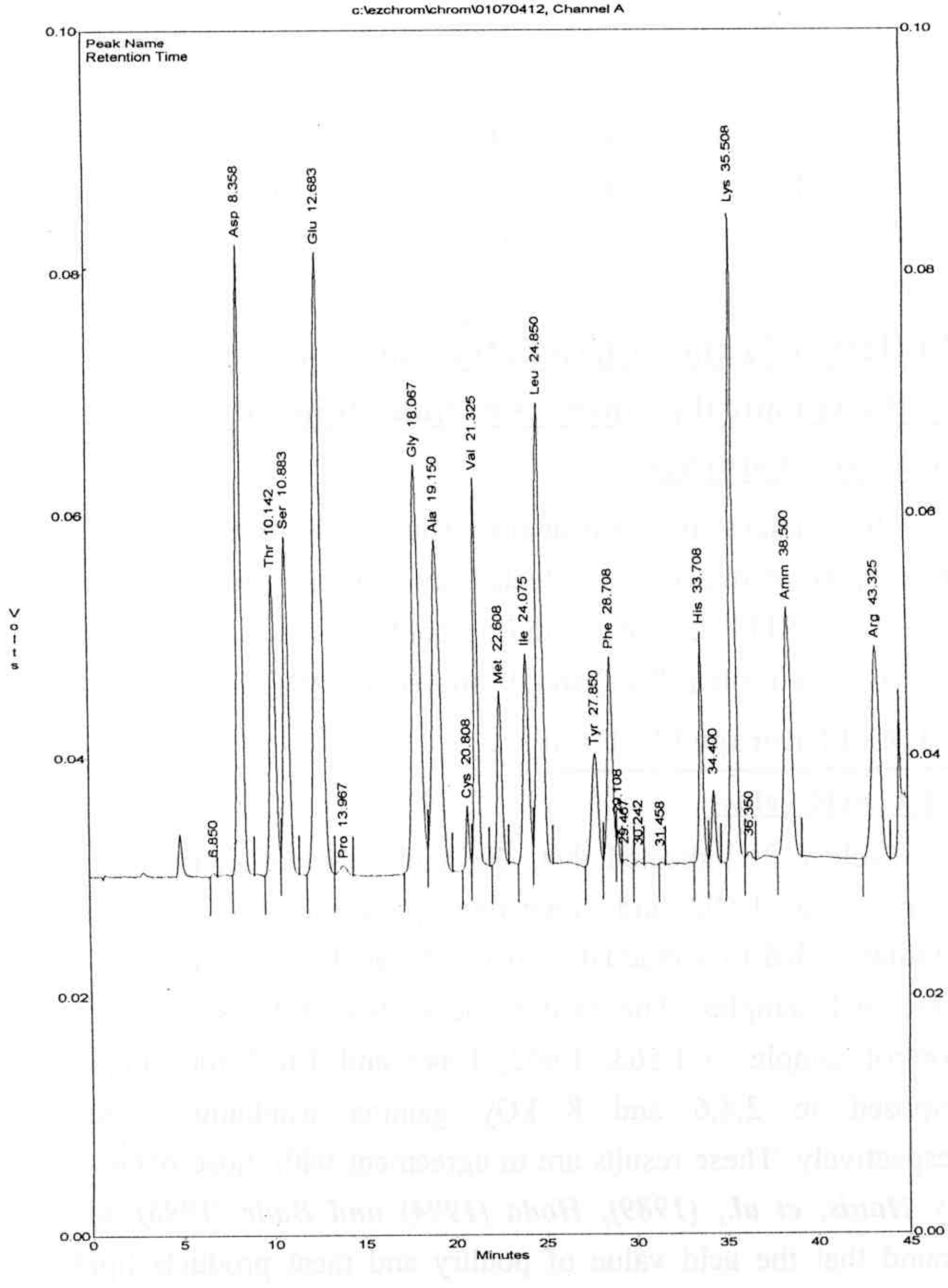

Fig. (12).: Effect of soaking in STPP on the amino acids composition of quail carcasses.

were obtained by ***Anon, (1989), Thayer, (1990) and Badr, (1998)*** as they found that, the amino acids of meat and poultry proteins were not alter by gamma irradiation even at sterilizing doses.

9.Effects of gamma irradiation and soaking in STPP on the chemical properties of quail lipids during cold and frozen storage.

The changes in chemical properties of the extracted lipids from quail carcasses as affected by gamma irradiation and soaking in STPP treatments during cold storage at 4 $\pm$ 1°C are presented in Table (18-21) and illustrated in Fig. (13-16).

9.1. Cold storage (4 $\pm$1°C):

9.1.1. Acid value:

Table (18) indicated that, the acid value of control quail sample was 1.502 and subjecting quail samples to gamma irradiation led to a gradual increase the acid value for lipids of irradiated samples. The acid value increased from 1.502 for control sample to 1.563, 1.602, 1.645 and 1.672 for samples exposed to 2,4,6 and 8 kGy gamma irradiation doses, respectively. These results are in agreement with those obtained by ***Hanis, et al., (1989), Hoda (1994) and Badr (1998)*** who found that the acid value of poultry and meat products lipids increased with increasing gamma irradiation doses. This increase due to the effects of gamma irradiation on the ester bonds and liberation of free fatty acids (***IAEA, 1982 and Rady and Schwartz, 1991***)

Table (18): Effects of gamma irradiation and soaking in STPP on the acid value of the extractable lipids of quail carcasses during cold storage at 4±1°C.

Storage period (days)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	1.502	1.563	1.602	1.645	1.672	1.360
3	2.920	2.782	2.621	2.405	2.232	1.980
6	4.843*	3.570	3.175	2.982	2.730	2.533
9		3.912	3.642	3.100	2.460	3.920*
12		4.780*	3.800	3.450	3.321	
15			4.702*	3.647	3.576	
18				3.980	3.820	
21				4.623*	4.047	
24					4.470*	

STPP = Sodium tripolyphosphate
* = Unacceptable organoleptically and rejected

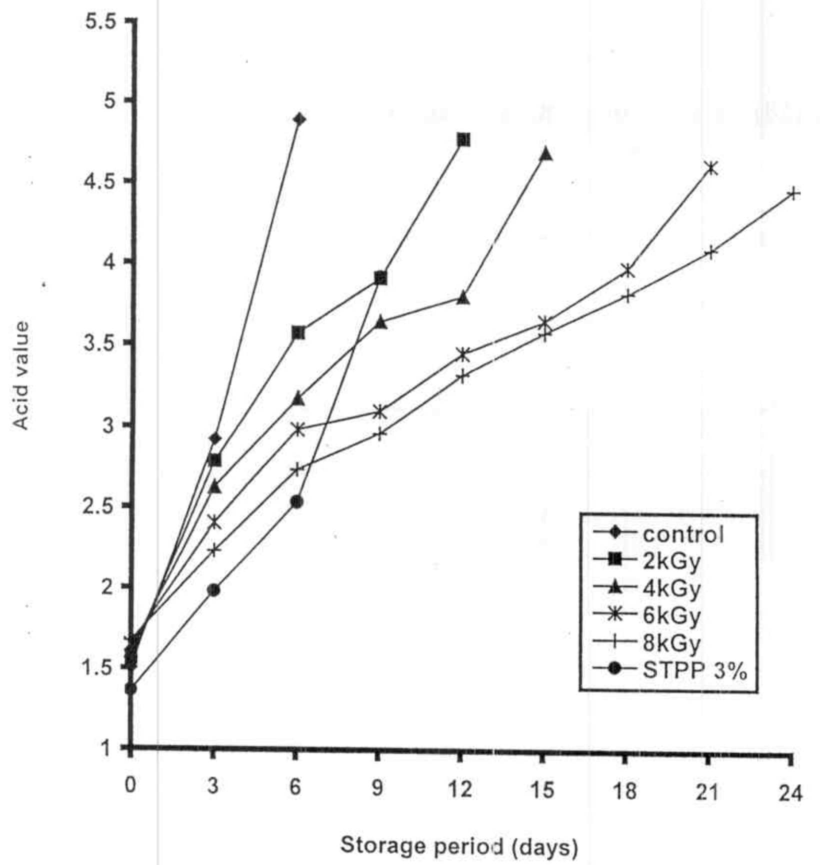

Fig.(13) : Effects of gamma irradiation and soaking in STPP on the acid value of the extractable lipids of quail carcasses during cold storage at 4±1°C.

Meanwhile, soaking samples in STPP treatment caused a slight decrease in the acid value of extracted lipids from treated samples than the control one. This is due to the antimicrobial effects of sodium tripolyphosphate, which contributed to the ability of polyphosphate to chelate divalent metal cations producing complex prooxidont metal ions ***(Trout and Schmidt, 1983; Younathan, 1985; and Sofos, 1986).***

Cold storage of quail samples led to gradual increase in the acid value of lipids but the rate of increase was higher in the control samples, it increased from 1.502 to 4.893 after 6 days of cold storage. The acid value reached 4.780, 4.702, 4.623 and 4.470 after 12,15,21 and 24 days of cold storage (4 ± 1°C) for samples exposed to 2,4,6 and 8 kGy gamma irradiation doses, respectively.

The same phenomena was also observed upon soaking quail samples in STPP treatment, as acid value increased to 3.920 after 9 days of cold storage (4 ± 1°C) and the rate of increase was lower in treated samples than the control one.

The increase in the acid value may be due to microbial lipases activity during cold storage, while in samples which had a microbial count of less than the detectable levels the observed increase in the acid value may be due to microbial lipases initially produced. Similar observations were reported by several investigators (***Emam, 1990; Lefebvre, et al., 1994 and Badr, 1998***).

9.1.2.Peroxide value:

The peroxide value is the most commonly used assay of fat oxidation (***Chan, 1987***). The results summarized in Table (19) and Fig. (14) show the changes in the peroxide value of extracted lipids from quail carcasses as affected by gamma irradiation and soaking in STPP treatments during cold storage (4 ± 1°C).

The peroxide value of control sample was 0.786 meq/kg lipid. The results showed that gamma irradiation gradually increased the peroxide value with increasing the applied dose. It increased from 0.786 to 0.835, 0.967, 1.263 and 1.489 meq/kg for irradiated samples at doses of 2,4,6 and 8 kGy, respectively.

These results agreed with those obtained by ***Hegazy (1987); Hoda (1994); Badr (1998) and Kareima (1998)*** who noticed that gamma irradiation increased the peroxide value of poultry and meat products lipids. This increase in peroxide value could be attributed to the oxidation effects of gamma irradiation and formation of peroxide compounds ***(Keskinel, et al., 1964).***

Concerning extracted quail lipid from soaked sample in STPP showed a lower peroxide value compared to control one, as peroxide value decreased to 0.589 meq/kg lipid. This is due to the antioxidant effect of sodium tripolyphosphate ***(Trout and Schmidt, 1983; Younathan, 1985 and Sofos, 1986).***

During cold storage (4 ± 1°C) of quail samples, further gradual increase in the peroxide value was observed for extracted lipids from all samples of quail carcasses undertaken. The peroxide value increased to 5.221, 5.672, 6.060, 7.470 and 8.542 meq/kg lipid after 6,12,15,21 and 24 days of cold storage

Table (19): Effects of gamma irradiation and soaking in STPP on the peroxide value of the extractable lipids of quail carcasses during cold storage at 4±1°C.

Storage period (days)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	0.786	0.835	0.967	1.263	1.489	0.598
3	1.980	2.053	2.095	2.120	2.329	1.725
6	5.221*	2.146	2.187	2.223	2.970	3.786
9		3.452	3.563	3.884	4.026	5.090*
12		5.672*	5.706	5.670	5.920	
15			6.060*	6.030	6.460	
18				6.592	6.892	
21				7.470*	7.973	
24					8.542*	

STPP = Sodium tripolyphosphate
* = Unacceptable organoleptically and rejected

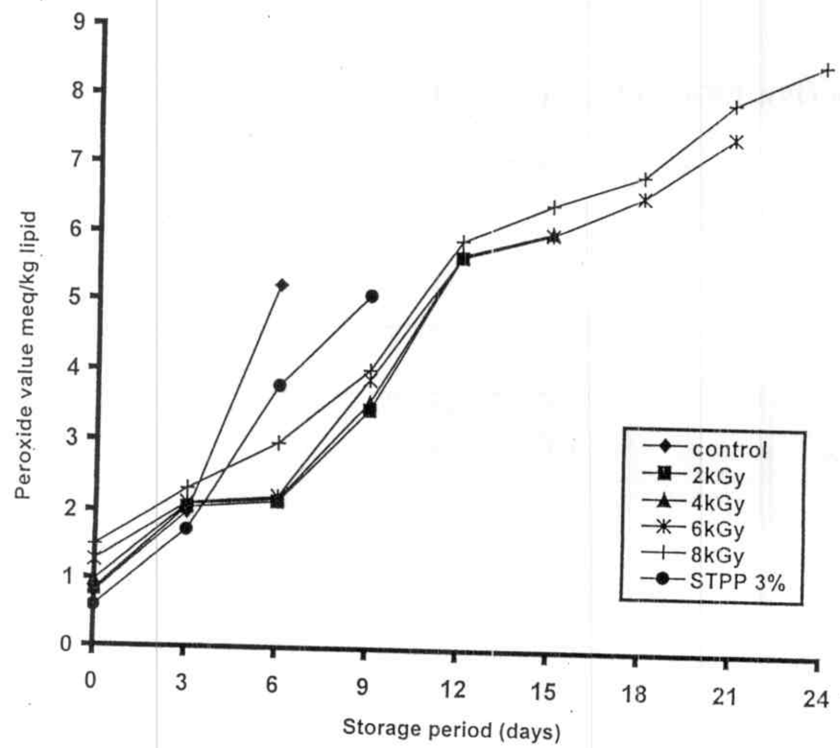

Fig.(14): Effects of gamma irradiation and soaking in STPP on the peroxide value of the extractable lipids of quail carcasses during cold storage at 4± 1°C.

($4 \pm 1°C$) for control samples and those exposed to 2,4,6 and 8 kGy gamma irradiation doses, respectively, similar results were found by ***Hegazy (1987); Emam (1990) and Lefebvre, et al., (1994)*** who observed an increase in the peroxide value of extracted lipids from irradiated and non irradiated chicken meat and meat products during cold storage.

Regarding soaking in STPP treatment, the peroxide value increased to 5.090 after 9 days of cold storage ($4 \pm 1°C$) but the rate of increase in peroxide value was lower than the control one.

9.1.3.Thiobarbituric acid (T.B.A).

Table (20) and fig. (15) illustrate another parameter (TBA) for the autoxidation of lipids in quail carcasses under investigation due to gamma irradiation and soaking in STPP treatments during cold storage ($4 \pm 1°C$).

It could be clearly noticed that the TBA value of extracted lipid from control quail sample was 0.050. The application of gamma irradiation led to a slight gradual increase in TBA of quail lipids with increasing gamma irradiation doses, it reached 0.073, 0.079, 0.086 and 0.090 for irradiated samples at doses of 2,4, 6 and 8 kGy, respectively. These results agreed with those obtained by ***Hegazy (1987); El- Mongy (1990); Hoda (1994); Badr (1998), Kareima (1998) and Min, et al., (1998)*** who found that TBA values of poultry and meat products lipids increased with increasing gamma irradiation doses. The increase of TBA as results of these treatments might be due to the increase of aldehydes formed from the decomposition of lipid peroxides during treatments. Meanwhile, TBA value of quail lipids decreased from 0.050 in control sample to 0.039 due to

Table (20) : Effects of gamma irradiation and soaking in STPP on the thiobarbituric acid value of the extractable lipids of quail carcasses during cold storage at 4±1°C.

Storage period (days)	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
0	0.050	0.073	0.079	0.086	0.090	0.039
3	0.180	0.184	0.188	0.209	0.275	0.095
6	0.295*	0.310	0.320	0.347	0.388	0.135
9		0.362	0.406	0.432	0.502	0.230*
12		0.436*	0.482	0.512	0.529	
15			0.533*	0.566	0.630	
18				0.645	0.705	
21				0.720*	0.810	
24					0.946*	

STPP = Sodium tripolyphosphate
* = Unacceptable organoleptically and rejected

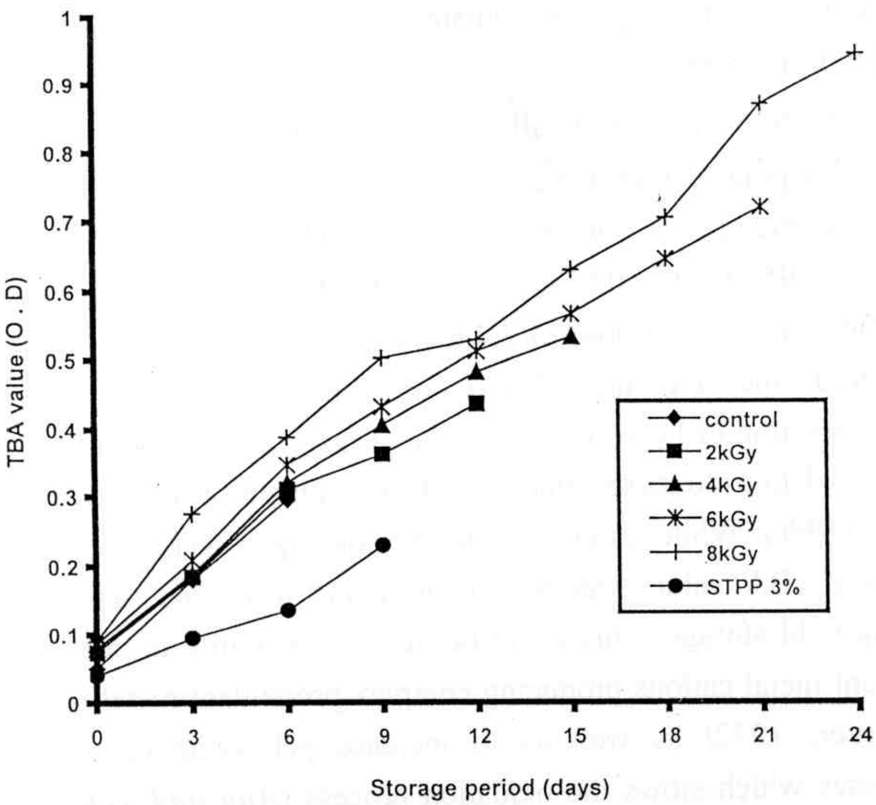

Fig. (15): Effects of gamma irradiation and soaking in STPP on the thiobarbituric acid (TBA) of the extractable lipids of quail carcasses during cold storage at 4± 1°C

soaking in STPP treatment. These results are in accordance to the findings obtained by ***Abd El- Baki, et al., (1983); Ang and young (1987); Lai, et al., (1991); Choi, et al., (1992); Singh, et al., (1994); Moawad (1995) and Singh, et al., (1999).*** Their results indicated that polyphosphate have been shown to protect poultry lipid from oxidation.

Moreover, TBA of all samples under investigation also showed a gradual increase during cold storage (4± 1°C). At the end of storage period for each sample, the TBA value was found to be 0.295, 0.436, 0.533, 0.720 and 0.946 for control and irradiated samples at dose of 2,4,6 and 8 kGy, respectively. The observed increase in TBA value may be due to the decomposition of hydroperoxides (the primary initial products of lipid oxidation) to its secondary products as mentioned by ***Gray, et al., (1996).*** While samples treated by soaking in STPP showed a lower TBA value than both control and irradiated samples during cold storage. This could be due to it's ability to chelate divalent metal cations producing complex prooxidant metal ions ***(Ellinger, 1972)*** as well as to increase pH value of quail carcasses which slows the oxidation process ***(Ang and Young. 1989)***.

9.2. Frozen storage (– 18°C).

The changes in acid value, peroxide value and thiobarbituric acid value of treated quail carcasses with gamma irradiation and STPP during frozen storage at -18°C were illustrated in Table (21).

9.2.1.Acid value:

Table (21) shows that the acid value of extracted lipids from all samples under investigation increased during frozen storage and reached 4.843, 4.780, 4.702, 4.623, 4.470 and 3.920 for control, irradiated at doses of 2,4,6 and 8 kGy and soaked samples in STPP treatment, respectively. These results are in agreement with those obtained by ***Bayoumy (1986); Singh and Panda (1987); Hoda (1994) and Kareima (1998)*** who found that the acid value of extracted lipids from unirradiated and irradiated poultry carcasses increased during frozen storage. The observed increase in the acid value may be due to microbial lipases activity initially produced and could remain active after irradiation.

It is obvious from the same results that the acid value of extracted lipid from soaked samples of quail carcasses in STPP was lower than both control and irradiated samples during frozen storage.

9.2.2.Peroxide value:

Table (21) indicates that, gamma irradiation induced a gradual increase in the peroxide value of quail lipids with increasing gamma ray doses. While it decreased by soaking in STPP treatment as compared to control sample. It was also noticed that peroxide value of extracted lipid from control sample increased during frozen storage at – 18°C and reached 3.205 meq/kg lipid after 6 months of storage. The same results

Table (21): Effects of gamma irradiation and soaking in STPP on the chemical properties of the extractable lipids of quail carcasses during frozen storage at –18°C.

Chemical properties	Storage period (month)	Control	Irradiation dose (kGy)				STPP 3%
			2	4	6	8	
Acid value	0	1.502	1.563	1.602	1.645	1.672	1.360
	2	2.030	1.942	1.807	1.764	1.701	1.571
	4	2.683	2.635	2.503	2.398	2.252	2.030
	6	3.030	2.870	2.781	2.614	2.403	2.376
Peroxide value (meq/kg lipid)	0	0.783	0.835	0.967	1.263	1.489	0.598
	2	1.956	2.083	2.380	2.645	2.970	1.662
	4	2.870	2.950	3.261	3.590	3.885	2.153
	6	3.205	3.232	3.593	3.872	4.220	2.810
Thiobarbituric acid value (absorbance at 530 nm)	0	0.050	0.073	0.079	0.086	0.090	0.039
	2	0.135	0.182	0.218	0.280	0.337	0.126
	4	0.208	0.268	0.340	0.395	0.574	0.197
	6	0.239	0.392	0.512	0.602	0.718	0.210

STPP = Sodium tripolyphosphate

were obtained by ***Bayoumy (1986) and Singh and Panda (1987)*** for quail carcasses.

Meanwhile, it increased to 3.232, 3.593, 3.872 and 4.220 for irradiated samples at doses of 2,4,6 and 8 kGy during frozen storage, respectively. These results are in accordance to the findings obtained by ***Hoda (1994) and Kareima (1998)*** who observed an increase in the peroxide value of extracted lipids from irradiated and non- irradiated poultry meat during frozen storage.

On the other hand, the peroxide value of soaked samples in STPP treatment increased during frozen storage and the rate of increase was lower in treated sample compared to control and other treatment ones.

9.2.3.Thiobarbituric acid (T.B.A):

From Table (21) it could be noticed that, the changes in TBA value were similar to that obtained for the acid value and peroxide value, as TBA showed a gradual increase with increasing frozen storage period. It reached 0.239, 0.392, 0.512, 0.602, 0.718 and 0.210 after 6 months of frozen storage at- 18^{o}C for control, irradiated samples at doses of 2,4,6 and 8 kGy and soaked samples in STPP treatment, respectively. These results are in agreement with those obtained by ***Fouda (1981); Bayoumy (1986); Singh and Panda (1987) and Hoda (1994)*** who found that the TBA value increased with increasing frozen storage time for extracted lipids from unirradiated and irradiated poultry meat.

However, the increase in TBA values during freezing and frozen storage could be due to oxidation of unsaturated fatty acids as well as to lypolysis ***(Davidkova and Khan, 1967)***.

From the obtained results of Table (21) it could be observed that the TBA value showed also a slight increase by soaking in STPP during frozen storage at -18°C for 6 months and the rate of increase was lower in treated samples than the control one. These results are in agreement with the findings reported by ***Abd El- Baki (1983) Lai, et al., (1991) and Moawad (1995)*** who indicated that polyphosphate have been shown to protect chicken lipids from oxidation. However, the antioxidant effect of polyphosphate could be due to its ability to interacted with meat proteins producing surface protein layer, which could act as a barrier to oxygen, resulting in a reduction of lipid oxidation during prolonged frozen storage ***(Nikkila, et al., 1967).***

10. Effects of gamma irradiation and soaking in STPP on the physicochemical properties of quail lipids.

Physical and chemical properties of the extracted lipids from quail carcasses as affected by either (2,4,6 and 8 kGy) gamma irradiation doses or soaking in STPP treatment are presented in Table (22).

10.1.Physical properties :

10.1.1.Refractive index :

Data in Table (22) shows that the refractive index of the extracted lipid from control sample was 1.4660. While ***Bayoumy (1986)*** found that refractive index of quail lipid was 1.4677.

From the same Table, it is clear that gamma irradiation and soaking in STPP treatments did not alter the refractive index of quail lipids. Similarly, ***Hoda (1994)*** found that gamma rays up to 6 kGy did not alter the refractive index of Pekin duck lipids.

10.1.2.Colour :

The results in Table (22) show that the absorbance of quail lipids at 460 nm (as an index of colour change). It is seen that, the absorbance of quail lipids showed an increase by increasing gamma ray doses or by soaking in STPP treatments, it increased from 0.077 of control sample to 0.082, 0.163 , 0.197, 0.209 and 0.096 for irradiated samples at used doses and soaked samples in STPP, respectively. It is evident that, the increase percentage of absorbance at 460 nm was 6, 111.6, 155.8, 171.4 and 24.6 for samples under investigation, indicating that gamma irradiation was most effective treatments on the absorbance of quail lipids compared to other treatment. Similar observations were obtained by ***Rady, (1992) and Hoda, (1994)*** who found that gamma irradiation increased the absorbance (at 460 nm) of fish and Pekin duck lipids.

10.2.Chemical properties :

10.2.1.Iodine value :

Data presented in Table (22) indicate that the iodine value of control sample was 66.66 and it showed no real changes by subjecting quail carcasses to applied doses and soaking in STPP treatments. These results are in agreement with those obtained by ***Hoda (1994) and Kareima (1998)*** who found that gamma irradiation did not alter the iodine value of pekin duck and chicken carcasses lipids.

Table (22): Effects of gamma irradiation and soaking in STPP on the physicochemical properties of the extractable lipids of quail carcasses.

Constituentse	Control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
Refractive index	1.4660	1.4660	1.4661	1.4660	1.4661	1.4660
Colour	0.077	0.082	0.163	0.197	0.209	0.096
Iodine value	66.663	66.630	65.718	65.836	65.698	66.590
Saponification value	180.47	180.30	180.22	180.53	180.61	180.25
Unsaponifiable matter (%)	1.479	1.452	1.420	1.369	1.356	1.473

STPP = Sodium tripolyphosphate

10.2.2.Saponification value :

Results in Table (22) indicate that the saponification value of control sample was 180.47. Moreover, gamma irradiation or soaking in STPP treatments did not affect the saponification value of quail lipids. This means that gamma irradiation doses and soaking in STPP treatments did not show detectable change on the molecular weight of fatty acid of quail lipids. Similar results were also obtained by ***Hoda (1994)***

10.2.3.Unsaponifiable matter content:

The above mentioned results present in Table (22) indicate that gamma irradiation caused a slight decrease in percentage of unsaponifiable matter separated from quail lipids. It decrease from 1.479 in control sample to 1.452, 1.420, 1.369 and 1.356 for irradiated quail samples at doses of 2,4,6 and 8 kGy, respectively. These results agreed with those obtained by ***Hoda (1994)*** for Pekin duck lipids. While soaking in STPP treatment induced no change in the unsaponifiable matter content.

11.Effects of gamma irradiation and soaking in STPP on the fatty acids composition of quail lipids:

The fatty acids composition of the extracted quail lipids from control, irradiated and soaked samples of quail carcasses were analyzed by gas liquid chromatographic technique and the obtained results are presented in Table (23).

It is clear from the obtained results that, quail lipid of control sample contained 27.82% saturated fatty acids (SFA) and plamitic acid was the major SFA (21.06%), followed by stearic

Table (23): Effects of gamma irradiation and soaking in STPP on fatty acids composition of quail lipid.

Fatty acids Composition	control	Irradiation dose (kGy)				STPP 3%
		2	4	6	8	
Myristic $C_{14:0}$	1.612	1.799	1.487	1.540	1.582	1.672
Palmitic $C_{16:0}$	21.060	20.932	20.620	20.749	21.070	20.478
Palmitoleic $C_{16:1}$	5.065	5.205	5.039	4.958	5.141	5.297
Stearic $C_{18:0}$	5.154	4.983	5.730	5.434	5.261	5.709
Oleic $C_{18:1}$	30.818	30.959	31.249	31.378	31.072	31.105
Linoleic $C_{18:2}$	36.288	36.046	35.878	35.938	35.881	35.747
Total saturated	**27.826**	**27.714**	**27.837**	**27.723**	**27.913**	27.859
Total unsaturated	**72.171**	**72.210**	**72.166**	**72.274**	**72.094**	72.149

STPP = Sodium tripolyphosphate